City of Homer

Road Assessment Report

Summer 2020

City of Homer Public Works Department
7-20-2020

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Executive Summary

Data collection and record keeping are necessary for producing and maintaining organized and efficient work processes. A data-driven and systematic process for identifying road deficiencies will help the City of Homer identify and achieve short and long term maintenance goals by generating evidenced-based action plans for prioritizing tasks and guiding budgeting decisions. Additionally, having quantifiable data regarding the City's infrastructure will help educate, demonstrate accountability to, and build credibility with the City's executive leadership, elected officials and the public.

This Report describes the road assessment process developed by the City of Homer Public Works Department in the summer of 2020. The process included the following steps:

a. Researching best practices related to road assessment models;
b. Adapting a selected model to Homer conditions;
c. Conducting a field review of actual road conditions;
d. Compiling the data into an assessment report, complete with findings and ratings of Homer's road conditions;
e. Integrating the ratings into the City's existing GIS maps;
f. Preparing this Road Assessment Study; and
g. Using the Study to program road maintenance tasks.

A result of the process is a system of methods and standards, which can be used to regularly assess road conditions. This system can be used as a tool to plan and explain road maintenance work.

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Introduction

The City of Homer's crew of heavy equipment operators maintain fifty miles of roads within the City of Homer. Of that total, 29 miles are gravel roads and 21 miles are paved roads. Regular road maintenance duties include (a) snow removal and sanding in the winter; and (b) ditch clearing, corridor brushing, crack sealing, patching, grading and dust control in the summer and shoulder seasons. Maintenance procedures and requirements differ, depending on road type – gravel or paved. For example, crack sealing is a paved road repair, while grading is a routine maintenance duty for the City's gravel roads.

As winter road maintenance is devoted to snow removal and sanding, maintenance that directly affects road structural conditions occurs in the summer and shoulder seasons. For example, grading and dust control of gravel roads takes place in early summer, just after the ground has thawed. Crack sealing of paved roads takes place in mid-summer, when it's dry. Brush cutting and ditch cleaning of all roads takes place in late summer, because these activities are less weather dependent. The record of what maintenance activities are conducted on what roads is largely anecdotal, rather than documented.

An annual or biannual road condition inventory, based on a systematic road assessment strategy, with detailed spatial information will provide a documented record of deficiencies, repairs, and progress. This will enable road maintenance activities to be budgeted for and planned with greater efficiency. It will also allow crews to conduct training and preparedness activities more mindfully in the event of employee turnover.

The road condition assessment data was largely collected by and integrated with the City's web-based, GPS-enabled Geographic Information System (GIS) by the City's GIS Technician, Aaron Yeaton. In the future, updates to the road condition assessment survey will be made by the road maintenance crews utilizing the same system. This will allow for mobile and spatially accurate data gathering that can be updated with real time immediacy. When needed, this information could be disseminated in maps and tables to other Public Works and City of Homer employees. Having evidenced- based information in this format will also allow the City to engage in more proactive public outreach – to educate the community about road maintenance activities.

Methodology

Two methods were used in the assessment process. Method 1 utilized GPS and a Geographic Information System (GIS) to thoroughly map road deficiencies, to documented observations about road conditions while walking along the roads. This data was later analyzed to evaluate and rate overall road condition. Initially, the goal was to walk all fifty miles of Homer's roads throughout the summer for a close, highly detailed evaluation of the City's roads. While this method did create detailed data, it was time-consuming. Further, the data indicated that many of Homer's roads had similar problems, so the high level of detail was not the most efficient use of time. To expedite the process, Method 2, where the roads were evaluated from a vehicle, was used.

Method 2 involved a "pencil and clipboard" assessment while driving along the roads with a member of the City's road maintenance crew. It was accomplished much more quickly and with the added assistance of an experienced road maintenance expert, it generated a detailed and accurate summation of road conditions.

Both methods relied on the criteria set forth in the Pavement Surface Evaluation and Rating (PASER) model developed by the Transportation Information Center, University of Wisconsin – Madison.[1] There is a separate PASER manual for paved roads and for gravel roads. The PASER manuals guided the quantification of road conditions and provided important insights into the process of (a) conducting objective road assessment data and (b) documenting ratings of road conditions.

The PASER model doesn't specifically address brush and tree obstructions, which are important issues in the City of Homer. The criteria in the PASER model were augmented to include vegetation as an element of road corridor conditions. Yet, to maintain fidelity with PASER's quantification methods, which mostly focuses on road surface conditions, the assessment of vegetation and corridor conditions did not overly impact the final road condition ratings.

Method 1

Gravel roads were first assessed. This choice was made so that springtime breakup conditions endemic to many of Homer's gravel roads, could be evaluated prior to grader maintenance. Ninety-six roads totaling 21 miles were inventoried using a web-interfaced Trimble R2 GPS device and associated base station. With 3-inch accuracy, affording detailed assessment and mapping of road deficiencies, two-thirds of the gravel roads were walked and inventoried in GIS – Method 1. The remaining third of the gravel roads was mapped using GPS and GIS but while driving – Method 2. Time was of the essence because of the need to record gravel road conditions ahead of advancing grader maintenance. This quicker assessment undoubtedly left out some deficiency details, particularly regarding culverts, but the overall condition of roads was nevertheless mapped adequately.

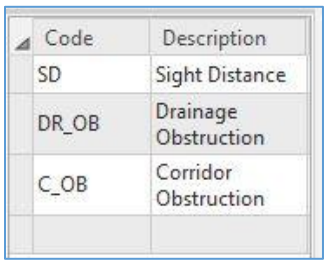
Generally, gravel road conditions can change rapidly due to environmental factors and recent maintenance activities. Because of this, the PASER model recommends that gravel road assessment be based on major factors rather than detailed surface conditions. The five main surface conditions and defects for gravel roads are:

1. crown condition,
2. drainage,
3. gravel layer,
4. surface deformation, and
5. surface defects.

[1] The City of Soldotna uses the PACER Model for its Road Maintenance Plan.

These categories provide the basis for quantifying overall road condition. Spring breakup conditions, as a seasonal inevitability, were included in the "surface deformation" category. According to the PASER model, "surface deformations" are limited to washboarding, potholes and ruts, but not the kind of seasonal frost-heaving some Alaskan roads experience. This is probably because the original Pacer criteria were developed in Wisconsin where it is unlikely the ground shifts as dynamically as it does in Alaska.

Prior to field work, a series of GIS feature classes applicable to PASER's road deficiency categories were created in a Geodatabase to be used for mapping road conditions. For example, polygon features were made to represent breakup conditions, polyline features to represent sub-standard ditches, and point features to represent vegetation obstructions. These features were given added specificity by applying "domains", or coded descriptions, within their attribute tables. For example, for vegetation obstructions, a domain was created to describe the nature of the obstruction in the form of a drop down menu, as shown in the figure below.



Code	Description
SD	Sight Distance
DR_OB	Drainage Obstruction
C_OB	Corridor Obstruction

Figure 1: Domains assigned to vegetation obstruction feature

Having such fields in the Attribute Tables facilitated data gathering in the field. A "Notes" field was also added to the Attribute Table to further augment basic attribute information. For instance, a "features condition" could be rated with considerable detail by added notes such as severe, moderate, etc. This gave us the opportunity to add historic notes about a particular road – for example, whether it was built to City standards or not.

When taking measurements, the GPS device interfaces with the GIS "Collector" App, which is a cloud-based platform that hosts editable maps used for taking field measurements. The Collector App records location, counts, lengths, areas, dates, as well as any notes and posts them to the City's GIS organizational account in real time. Once features are collected the maps were uploaded locally onto a desktop to ArcGIS Pro for further analysis and editing of symbology.

Figure 2: Gravel rood deficiencies mapped in a GIS. Different symbology represent different deficiencies: i.e. breakup, potholes, and shallow ditches.

Analysis of mapped features in ArcGIS Pro allowed close evaluation of the counts, lengths and areas of road deficiencies. This information was compared to individual road length, thereby providing close approximation of overall road condition for rating purposes. Each deficiency category (surface conditions, and defects listed by PASER) was then given an averaged value ranging from poor to excellent. The values were weighted based on comparisons of road condition segments. For example if a small length of a long road was experiencing severe breakup, but the remainder of the road was in fair condition, the overall value for surface deformation was ranked from "fair to moderate".

PASER ratings for gravel roads range from 1 – 5; with "1" being a road in failed condition, "5" being excellent. Ultimately, the ratings are prescriptive in nature; meaning each rating corresponds to the level of maintenance the road needs. If a rating of "5" is given, the road has been recently constructed and needs no maintenance, whereas a road with a rating of "1" requires complete reconstruction. To produce a final rating for a particular road, the scores in the individual deficiency categories were averaged to produce an overall rating. The final ratings were exported from ArcGIS attribute tables into Excel formats to produce finished tables.

Method 2

The City's paved roads were assessed using Method 2, the drive-along method. The roads were evaluated by directly applying the PASER model's paved roads criteria. Before the field survey began, the criteria were inserted into an Excel table. These categories involved assessment of the following conditions:

1. surface defects,
2. surface deformation,
3. cracks,
4. patches, and
5. potholes.

Since drainage isn't as crucial a factor to paved road surfaces as it is for gravel roads, the PASER model does not use it as a standalone category. To maintain as comprehensive a survey as possible, a drainage category was added to the PASER model. As with the gravel road assessments, we added a vegetation category, which, as with

the gravel road assessments, did not overly effect the final road rating so as to maintain the integrity of the PASER model's quantification methods.

Over the course of several days, the team, including the City's GIS Technician and an experienced road maintenance operator, drove along the City's paved roads to observe, evaluate and rate them. They routinely stopped to more closely examine defects and deformities. Adding the expertise of a seasoned road maintenance operator proved invaluable in making comprehensive assessments more quickly.

Because paved roads are not typically subject to the same type of rapid changes that gravel roads are, the ratings for paved roads tend to be more nuanced. Condition categories have more variables to consider. For example, the category of "surface deformation" includes rutting, distortion – rippling and shoving, settling, and frost heave. The condition of "cracking" includes there are longitudinal, transverse, slippage, reflection, block and alligator cracking. Final road conditions ranged from 1 to 10, with "1" meaning "failed" and "10" meaning "excellent". The ratings encompassed varying degrees of poor, fair, good and excellent. Like the gravel road assessments, final paved road ratings were based on averaging the values of the condition categories. And, as with the gravel road assessments, ratings are based on road maintenance needs.

Results

Gravel Roads

The majority of gravel roads fall into the "Fair" category (rating – 3), with the next numerous being "Good" (rating 4). A considerable number of roads fall into the "Poor" category (rating – 2). The "fair" and "poor" rated roads mostly comprise those of the annexation area. These roads were not constructed to City standards and inherently have structural issues and alignment problems. The "excellent" ratings are roads that have been constructed within the last year. A "failed" rating was applied to Crossman Ridge Road, due to severe breakup issues. The major deficiencies contributing to a less than good rating were poor gravel layer and breakup issues.

Table 1

	GRAVEL				
Rating	1	2	3	4	5
Descrp.	**Failed**	**Poor**	**Fair**	**Good**	**Excellent**
# Roads	1	35	60	50	3

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 5 Newly constructed road. Excellent crown and drainage. No maintenance required.

Rating 4 Good crown and drainage. Routine maintenance.

Rating 3 Roadway shows traffic effects. Needs regrading, minor ditch maintenance, and spot gravel application.

Rating 2 Road needs additional aggregate layer, major drainage improvements.

Rating 1 Travel is difficult. Complete rebuilding required.

Table 2: PASER rating descriptions for gravel roads

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Figure 3: Severe Breakup area on Sprucewood Dr.

Figure 4: Extensive Breakup down the length of Eagle Pl.

As stated previously, local road condition issues, particularly breakup-related subsidence and boiling, are not reflected in PASER's rating criteria. Interpolation of PASER criteria were made to suit local conditions. Therefore springtime breakup was a major factor in evaluating gravel road surface deformities. Even though these inferences were made, the basic evaluation process outlined by PASER was valuable and applicable for rating Homer's gravel roads.

Paved Roads

Overall, Homer's paved roads are in better condition than the gravel roads. The majority of paved roads fell into the lower "Good" category (Rating 6), followed by the upper "Good" category (Rating 7) and then "Fair" (Ratings 4 & 5). Of the Hundred plus paved roads in the community, only 8 rated in the two "Poor" categories.

	PAVED									
Rating	1	2	3	4	5	6	7	8	9	10
Descrp.	Failed	Very Poor	Poor	Fair	Fair	Good	Good	Very Good	Excellent	Excellent
# Roads	0	4	4	3	7	44	33	9	1	4

Table 3

Surface rating	*Visible distress**	*General condition/ treatment measures*
10 Excellent	None.	New construction.
9 Excellent	None.	Recent overlay. Like new.
8 Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than ¼").	Recent sealcoat or new cold mix. Little or no maintenance required.
7 Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open ¼") due to reflection or paving joints. Transverse cracks (open ¼") spaced 10' or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.	First signs of aging. Maintain with routine crack filling.
6 Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open ¼"–½"), some spaced less than 10'. First sign of block cracking. Sight to moderate flushing or polishing. Occasional patching in good condition.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat.
5 Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open ½") show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.	Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2")
4 Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½" deep or less).	Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2" or more).
3 Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (1" or 2" deep). Occasional potholes.	Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
2 Very Poor	Alligator cracking (over 25% of surface). Severe distortions (over 2" deep) Extensive patching in poor condition. Potholes.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective.
1 Failed	Severe distress with extensive loss of surface integrity.	Failed. Needs total reconstruction.

Table 4: PASER rating description for paved roads

Figure 5: Extensive Alligator cracking and Rutting on Ohlsen Ln.

Figure 6: Longitudinal cracking at shoulder indicative of failing subgrade. Tulin Terrace

The vast majority of paved roads have minor to moderate longitudinal and lateral cracking that is maintainable with annual crack sealing. Most roads have minor surface defects, most notably ravelling, which is a condition where pavement material deteriorates exposing the aggregate. Among the roads meriting reconstruction are Ohlson Lane, Tulin Terrace Blvd. and Woodside Ave. These roads have extensive alligator cracking, rutting and potholes; deformities that indicate the road structure itself, not just the pavement surface, is failing. Many roads have minor rutting. Although the PASER model considers rutting to be a surface deformity caused by sub-surface settling, in the case of Homer, rutting is mostly due to studded tire use. Nevertheless, as rutting compromises sheeting of water from crown to shoulder, it was a contributing factor in road rating.

Vegetation

A significant aspect of this assesment outside the PASER criteria involved inventorying vegetation obstructions. As the road crew annually brushes out road corridors to an extent reasonable for proper maintenance, the areas of alder, perennial grasses, etc. within the corridor were generally disregarded during this assessment. Exceptions were made when these obstructions impeded sight distance or the establishment of drainage ditches. These situations often occur in cases where the road is not aligned with the right-of-way. In some cases, the road is so far off center, the edge of the road practically grazes the outer boundary of the right-of-way. In such cases, the road crew does its best to maintain a reasonably brush-free corridor to enable snow plowing, ditching and other essential maintenance activities. However, this is not always possible.

Corridor obstructions, such as large spruce, located inside the right-of-way were mapped in Method 1 or made note of in Method 2. These obstructions often impede operator maintenance during snow removal and ditching. Roads that have notable vegetation impediments are Easy Street, Mountain Park Street, and Race Road. Vegetation ratings are available in the master spreadsheets located in the Appendices. Landowner concern for the vegetation fronting their property, often makes problem tree removal a sensitive issue.

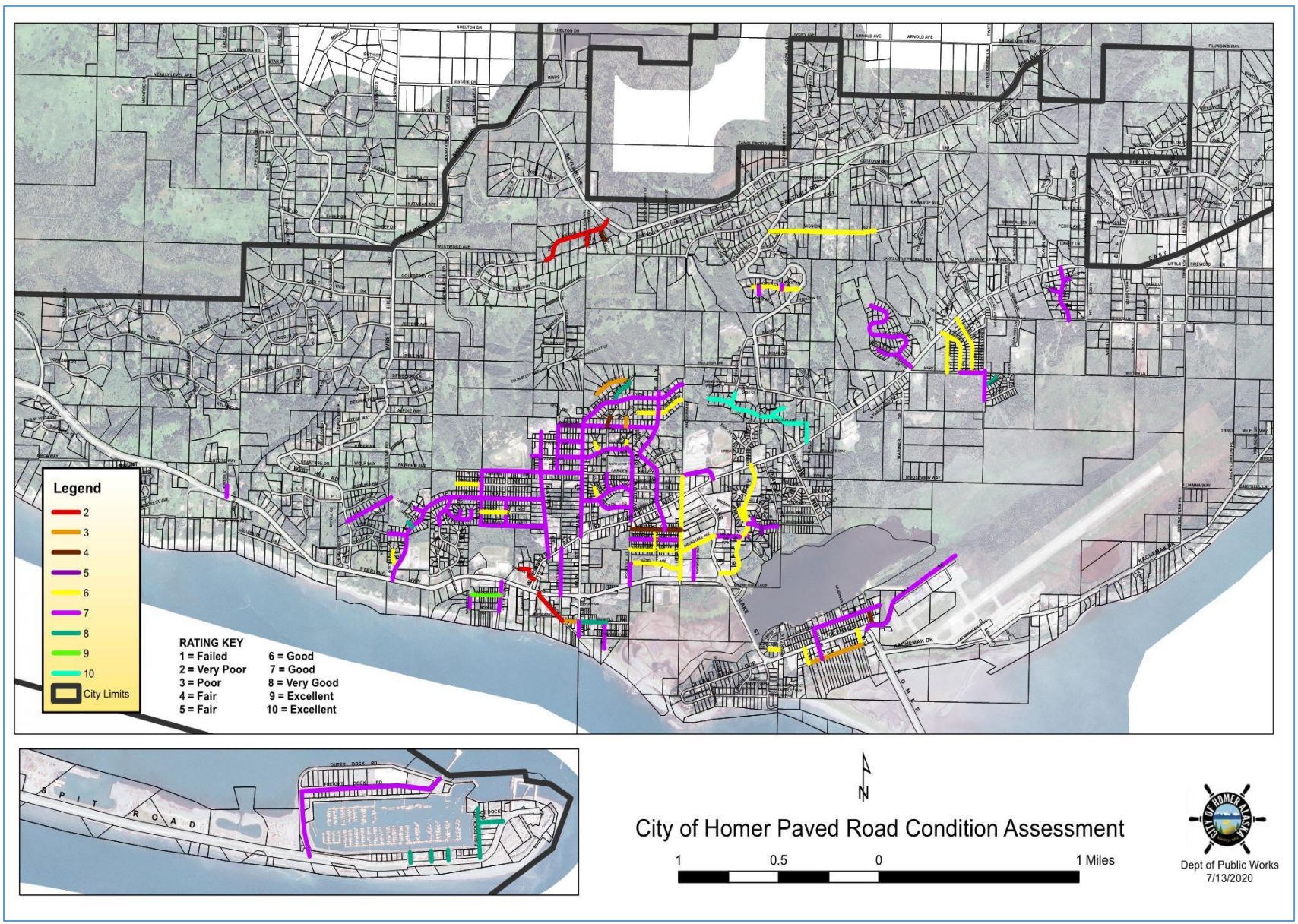
Figure 7: Tree, well inside right of way, scarred from grader during snow removal

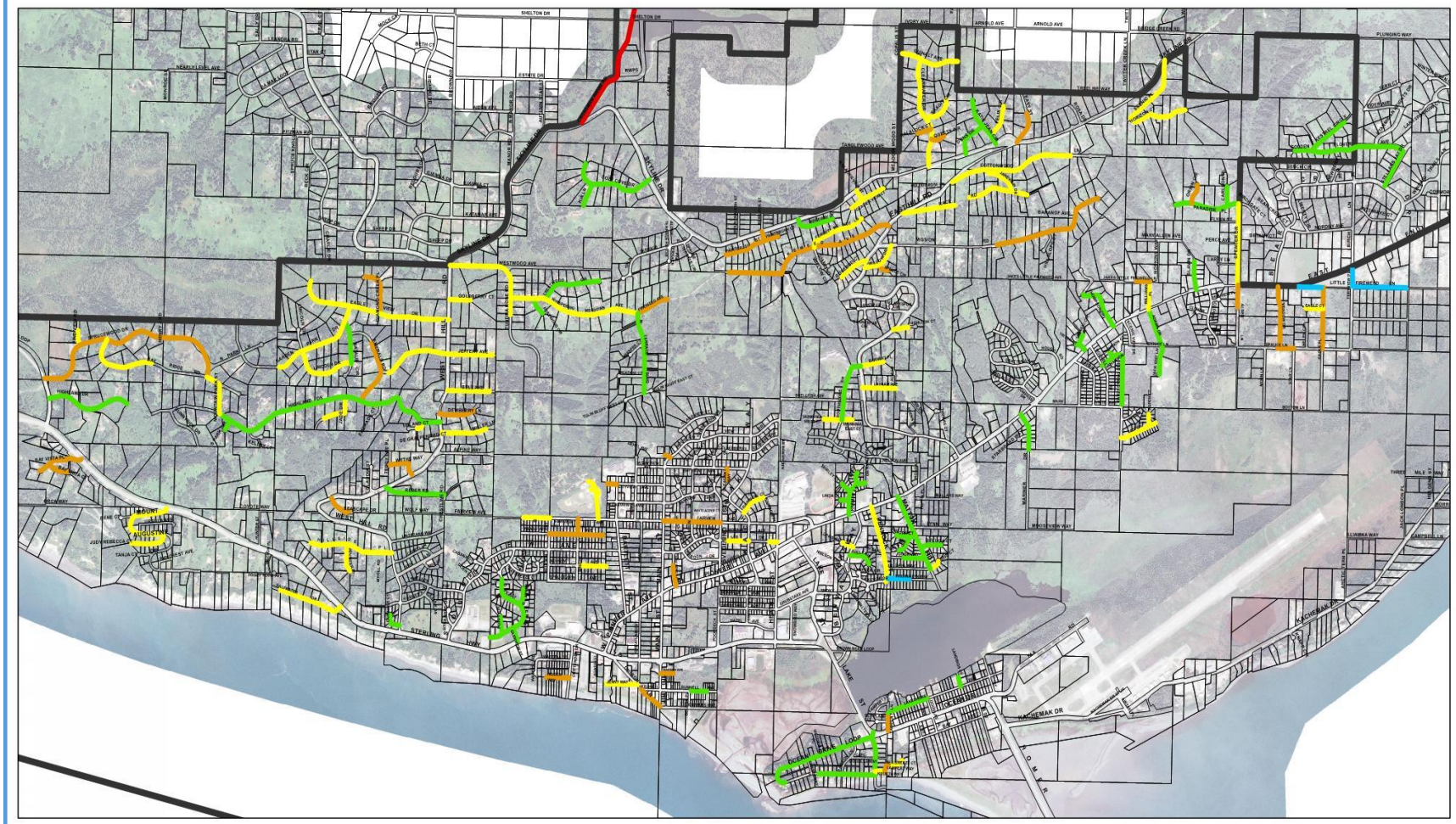
Figure 8: Tree limbs within roadway

Figure 9: Alder, routinely hedged, yet impeding ditch establishment due to road misalignment

Figure 10: Spruce trees in corridor preventing proper ditch establishment

Appendix A - Maps


Legend
2
3
4
5
6
7
8
9
10
City Limits
RATING KEY
1 = Failed
2 = Very Poor
3 = Poor
4 = Fair
5 = Fair
6 = Good
7 = Good
8 = Very Good
9 = Excellent
10 = Excellent
SPIT ROAD
OUTER DOCK RD
FREIGHT DOCK RD
N
City of Homer Paved Road Condition Assessment
1
0.5
0
1 Miles
Dept of Public Works
7/13/2020


Legend
Rating
1
2
3
4
5
City_Limits
KEY TO RATING
1 = Failed
2 = Poor
3 = Fair
4 = Good
5 = Excellent
N
City of Homer Gravel Road Condition Assessment
1
0.5
0
1 Miles
Dept of Public Works
7/13/2020

Appendix B – Paved Road Assessment Tables

PAVED ROAD INFO			ROAD SURFACE CONDITION					VEG	RATING
STREET	TYPE	ANNEXED	SURFACE DEFECTS	SURFACE DEFORMATION	CRACKS	PATCHES & POTHOLES	DRAINAGE	VEGETATION	1:FAILED 2:VERY POOR 3:POOR 4:FAIR 5:FAIR 6:GOOD 7:GOOD 8:VERY GOOD 9:EXCELLENT 10:EXCELLENT
A St.	Paved		Minor	Minor	Severe	Minor	4	Moderate	4
B St.	Paved		Minor	Minor	Moderate	Minor	6	Moderate	6
Bay Ave.	Paved		Moderate	Moderate	Severe	Moderate	3	Minor	3
W. Bayview Ave.	Paved		Minor	Minor	Severe	Moderate	5	None	5
E. Bayview Ave.	Paved		Minor	Minor	Moderate	None	6	Moderate	7
Bayview Ct.	Paved		Minor	Severe	Severe	Minor	3	None	3
Beluga Pl.	Paved		Minor	Minor	Minor	None	7	None	7
Ben Walters Ct.	Paved		Minor	Minor	Minor	Minor	7	None	7
Ben Walters Ln.	Paved		Minor	Minor	Moderate	None	6	None	6
Bonanza Ave.	Paved		Minor	Minor	Minor	Minor	5	None	7
W. Bunnell Ave.	Paved		Moderate	Moderate	Severe	Moderate	3	None	3
Calhoun Ct.	Paved		Minor	Moderate	Moderate	Minor	4	Minor	4
Crittenden Dr.	Paved		Minor	Minor	Minor	Minor	7	None	7
Nielson Cir.	Paved		Moderate	Minor	Moderate	Minor	6	Minor	6
Clover Pl.	Paved		Minor	None	Minor	None	7	None	7
Clover Ln.	Paved		Minor	Minor	Minor	None	7	Minor	7
East Hill Rd.	Paved		Minor	None	Minor	None	7	Minor	7
Ice Dock Rd.	Paved		None	None	None	None	8	None	8
FAA Rd.	Paved		Minor	Minor	Moderate	Minor	6	None	7
E st.	Paved		Minor	Minor	Moderate	Moderate	6	None	6
Grubstake Ave. East	Paved		Minor	Minor	Minor	None	7	None	10
Daybreeze Ct.	Paved		Minor	Minor	Minor	None	7	None	7
Calamari Ct.	Paved		Minor	Minor	Minor	None	7	None	7
Sea Plane Ct.	Paved		Minor	Minor	Minor	Minor	6	None	6
El Sario Ct.	Paved		Minor	Minor	Moderate	None	6	None	6
Elderberry Ct.	Paved		Minor	Minor	Moderate	None	6	None	6
Elderberry Dr.	Paved		Minor	Minor	Moderate	None	6	None	6
W. Fairview Ave.	Paved		Minor	None	Minor	None	7	None	7
Freight Dock Rd.	Paved		Minor	None	None	None	7	None	7
Frisbee Ct.	Paved		None	None	None	None	8	None	8

PAVED ROAD INFO			ROAD SURFACE CONDITION					VEG	RATING
STREET	TYPE	ANNEXED	SURFACE DEFECTS	SURFACE DEFORMATION	CRACKS	PATCHES & POTHOLES	DRAINAGE	VEGETATION	1:FAILED 2:VERY POOR 3:POOR 4:FAIR 5:FAIR 6:GOOD 7:GOOD 8:VERY GOOD 9:EXCELLENT 10:EXCELLENT
Gavin Ct.	Paved		Minor	Minor	Moderate	None	6	None	6
Hazel Ave	Paved		Minor	Minor	Moderate	Minor	6	None	6
Herdon Dr.	Paved		Minor	Minor	Moderate	None	6	Minor	7
Hillview Pl.	Paved		Minor	Minor	Minor	None	7	Moderate	7
E. Danview Ave.	Paved		Minor	Minor	Moderate	None	5	None	7
Larkspur Ct.	Paved		Minor	Minor	Moderate	None	6	Moderate	6
N. Larkspur Cir.	Paved		Minor	Minor	Minor	None	7	Moderate	7
S. Larkspur Cir.	Paved		Minor	Minor	Minor	None	7	Moderate	7
Lakeside Ct.	Paved		Minor	Minor	Minor	None	7	None	7
Lakeside Dr.	Paved		Minor	Minor	Minor	None	7	None	7
Lakeside Cir.	Paved		Moderate	Minor	Minor	None	5	None	5
Pine Terrace Cir.	Paved	YES	Moderate	Moderate	Severe	None	2	Minor	2
Smoky Bay Way	Paved		Minor	Minor	Moderate	None	6	None	7
Rochelle Rd.	Paved		Minor	Minor	Minor	Minor	6	None	6
Sabrina Rd.	Paved		Minor	Minor	Minor	Minor	6	None	6
Sitka Rose Cir	Paved		Minor	Minor	Minor	Minor	6	None	6
Spruce Terrace Cir.	Paved	YES	Moderate	Moderate	Moderate	None	4	None	4
Svedlund Cir	Paved		Minor	Minor	Moderate	Moderate	6	None	6
Svedlund St.	Paved		Minor	Minor	Moderate	Minor	6	None	7
Tamara St.	Paved		Minor	Minor	Moderate	Minor	6	Minor	6
Towne Heights Ln.	Paved		None	None	None	None	8	None	8
Tulin Terrace Blvd.	Paved	YES	Moderate	Moderate	Severe	Moderate	2	Moderate	2
Waddell St.	Paved		None	None	Minor	None	9	None	9
Woodside Ave.	Paved		Moderate	Severe	Severe	Moderate	2	None	2
Freight Dock Rd.	Paved		Minor	None	Minor	None	7	None	7
Harbor Entrance Roads	Paved		Minor	None	None	None	8	None	8
Harbor Entrance Roads	Paved		Moderate	None	None	Moderate	7	None	7
Harbor Entrance Roads	Paved		Moderate	None	None	Minor	7	None	7
Fish Dock Rd.	Paved		None	None	None	None	8	None	8
Lakeshore Dr.	Paved		Minor	Minor	Moderate	Minor	6	None	7
Douglas Pl.	Paved		Minor	None	Minor	None	6	None	7
Douglas Pl.	Paved		Minor	None	Minor	None	6	None	7
Forest Glenn Dr.	Paved		Minor	Minor	Minor	Minor	7	None	7

PAVED ROAD INFO			ROAD SURFACE CONDITION					VEG	RATING
STREET	TYPE	ANNEXED	SURFACE DEFECTS	SURFACE DEFORMATION	CRACKS	PATCHES & POTHOLES	DRAINAGE	VEGETATION	1:FAILED 2:VERY POOR 3:POOR 4:FAIR 5:FAIR 6:GOOD 7:GOOD 8:VERY GOOD 9:EXCELLENT 10:EXCELLENT
W. Danview Ave.	Paved		Minor	None	Moderate	None	6	None	7
W. Danview Ave.	Paved		Minor	None	Moderate	None	6	None	7
Rangeview Ave.	Paved		Minor	Minor	Moderate	None	6	None	6
Calhoun St.	Paved		Minor	Minor	Moderate	None	6	None	7
Lee Dr.	Paved		Minor	Minor	Moderate	None	6	None	7
Mark White Ave.	Paved		Minor	Minor	Minor	None	6	None	7
Mission Rd.	Paved		Minor	Minor	Moderate	None	6	Minor	6
Fairview Ave.	Paved		Minor	Minor	Minor	Minor	6	None	7
E. Bunnell Ave.	Paved		Minor	None	None	None	8	None	8
Main St.	Paved		Minor	Minor	Minor	None	6	None	7
Heath St.	Paved		Minor	Minor	Moderate	Minor	5	None	6
Heath St.	Paved		Minor	Minor	Moderate	Minor	5	None	6
Mountain View Dr.	Paved		Minor	Minor	Moderate	None	6	None	7
Klondike Ave.	Paved		Moderate	Moderate	Moderate	Moderate	4	None	4
Kachemak Way	Paved		Minor	Minor	Minor	None	7	None	7
Soundview Ave.	Paved		Minor	Minor	Moderate	None	6	None	7
Barlett St.	Paved		Minor	Minor	Minor	None	6	None	7
Spruceview Ave.	Paved		Minor	None	Moderate	Minor	6	None	7
Mulliken St.	Paved		Minor	Minor	Minor	None	7	None	7
Shelly Ave.	Paved		Minor	Minor	Minor	None	7	None	7
Tajen Ln.	Paved		Minor	None	None	None	8	None	8
Cabana Ct.	Paved		Minor	Minor	Minor	None	6	None	7
Compass Dr.	Paved		Minor	Minor	Minor	None	7	None	7
Candlelight Ct.	Paved		Minor	Minor	Minor	Minor	7	None	7
Craftsman Rd.	Paved		Minor	Minor	Minor	Minor	7	None	7
Kachemak Way	Paved		Minor	Minor	Minor	None	7	None	7
Hunter St.	Paved		Minor	Minor	Minor	Minor	7	None	7
Early Spring St.	Paved		Minor	Minor	Minor	Minor	7	None	7
Snowbird St.	Paved		Minor	None	Minor	None	7	None	7
Grubstake Ave.	Paved		Minor	Minor	Moderate	None	5	None	6
Main St.	Paved		Minor	Minor	Minor	Minor	6	None	7
Eric Ln.	Paved		Minor	Minor	Minor	None	8	None	7
Craftsman Rd.	Paved		Minor	Minor	Minor	None	7	None	7

PAVED ROAD INFO			ROAD SURFACE CONDITION					VEG	RATING
STREET	TYPE	ANNEXED	SURFACE DEFECTS	SURFACE DEFORMATION	CRACKS	PATCHES & POTHOLES	DRAINAGE	VEGETATION	1:FAILED 2:VERY POOR 3:POOR 4:FAIR 5:FAIR 6:GOOD 7:GOOD 8:VERY GOOD 9:EXCELLENT 10:EXCELLENT
Greatland St.	Paved		Minor	None	Minor	Minor	8	None	7
Lucky Shot St.	Paved		Minor	Minor	Minor	Minor	6	Minor	6
Noview	Paved		Minor	Minor	Minor	Minor	7	None	7
Ronda S.	Paved		None	None	None	None	10	None	10
Nelson Ave.	Paved		None	None	None	None	10	None	10
South Slope Dr.	Paved		None	None	None	None	10	None	10
Father Dean Ct.	Paved		None	None	None	None	10	None	10
Wright St.	Paved		Minor	Minor	Moderate	None	6	None	7
Noview Ave.	Paved		Minor	Minor	Minor	Minor	6	None	6
Island View Ct.	Paved		Minor	Moderate	Severe	None	3	None	3
Hohe St.	Paved		Minor	Minor	Moderate	None	6	None	7
Poopdeck St.	Paved		Minor	Minor	Moderate	None	7	None	7

Appendix C – Gravel Road Assessment Tables

GRAVEL ROAD			ROAD SURFACE CONDTIONS					VEGETATION CONDITIONS		RATING
STREET	TYPE	ANNEX	CROWN	DRAIN AGE	GRAVEL LAYER	SURFACE DEFORMATION	SURFACE DEFECTS	VEG	VEGETATION NOTES	1:FAILED 2:POOR 3:FAIR 4:GOOD 5:EXCELLENT
Adams Dr.	Gravel		Good	Good	Good	None	None	None		4
Alder Ln.	Gravel		Poor	Fair	Poor	Moderate	None	None		2
Aprill Pl.	Gravel		Good	Good	Good	None	None	None		4
Aspen Ct.	Gravel		Fair	Fair	Fair	Minor	None	Minor	Routine Brushing	3
Aspen Ln.	Gravel		Fair	Fair	Fair	Minor	None	Minor	Ditch Obst	3
Aurora Ct.	Gravel		Good	Good	Good	None	None	None		4
Barnett Pl.	Gravel		Good	Fair	Fair	None	None	None		3
Bay Ridge Rd.	Gravel	YES	Fair	Good	Fair	Minor	None	None		3
Bay Vista Ct.	Gravel		Fair	Poor	Poor	Moderate	Moderate	None		2
Bay Vista Pl.	Gravel		Fair	Poor	Poor	Minor	None	None		2
Bell Ave.	Gravel	YES	Fair	Fair	Fair	Minor	None	None		3
Beluga Cir.	Gravel		Good	Good	Good	None	None	None		4
Beluga Ct.	Gravel		Good	Good	Good	None	None	None		4
Campground Rd.	Gravel		Fair	Fair	Fair	None	None	None		3
Carlson Pl.	Gravel	YES	Good	Good	Good	None	None	None		4
Carriage Ct.	Gravel		Good	Good	Good	None	None	None		4
Clearwater Dr.	Gravel	YES	Good	Fair	Good	Minor	None	None		3
Cook Way	Gravel		Good	Good	Good	None	None	None		4
Cottonwood Ln.	Gravel	YES	Fair	Good	Poor	Moderate	Minor	None		3
Cozy Cove Dr.	Gravel		Good	Good	Good	None	None	None		4
Crestwood Cir.	Gravel	YES	Good	Good	Good	Minor	None	None		4
Crossman Ridge Rd.	Gravel	YES	Poor	Poor	Poor	Severe	None	None		1
Dehel Ave.	Gravel		Poor	Poor	Fair	Minor	None	None		2
Dewberry Ln.	Gravel		Poor	Fair	Poor	Minor	None	None		2
Diamond Creek Pl.	Gravel	YES	Fair	Fair	Poor	Moderate	None	None		2
Dons Dr.	Gravel	YES	Good	Fair	Good	None	None	None		4
E. Bunnell Ave.	Gravel		Good	Good	Good	None	None	None		4
E. Fairview Ave.	Gravel		Poor	Poor	Poor	Severe	None	None		2
E. Jeffery Ave.	Gravel	YES	Fair	Fair	Good	Moderate	None	None		3
Eagle Court	Gravel		Fair	Fair	Fair	Minor	Minor	None		3
Eagle Pl.	Gravel		Poor	Poor	Poor	Severe	None	Moderate		2

STREET	TYPE	ANNEX	CROWN	DRAIN AGE	GRAVEL LAYER	SURFACE DEFORMATION	SURFACE DEFECTS	VEG	VEGETATION NOTES	1:FAILED 2:POOR 3:FAIR 4:GOOD 5:EXCELLENT
Eagle View Dr.	Gravel	YES	Good	Good	Poor	Moderate	None	Minor	Routine Brushing/1 spruce	3
Easy St.	Gravel	YES	Fair	Poor	Fair	Minor	None	Severe	Spruce within entire maintenance corridor	2
Emerald Rd.	Gravel	YES	Fair	Poor	Poor	Severe	None	None		2
Felix Cir.	Gravel	YES	Good	Fair	Good	None	None	Moderate	Spruce Obst	3
Fireweed Ave.	Gravel	YES	Fair	Fair	Poor	Severe	None	None	Bad Breakup	2
Forest Glenn Dr.	Gravel		Good	Good	Good	None	None	None		4
Forget Me Not Ln.	Gravel	YES	Good	Fair	Good	Minor	None	None		3
Garden Park Dr.	Gravel	YES	Good	Fair	Fair	Moderate	None	None		3
Glacier View Ct.	Gravel	YES	Good	Poor	Good	Minor	None	None		3
Glenview St.	Gravel		Good	Good	Good	None	None	None		4
Goldberry Ct.	Gravel	YES	Fair	Fair	Fair	None	None	None		3
Golden Plover Ave.	Gravel		Good	Good	Good	None	None	None		4
Hanson Ave.	Gravel		Poor	Poor	Poor	Minor	None	Minor		2
Heidi Ct.	Gravel		Good	Good	Good	Minor	Minor	None		4
Hidden Way	Gravel		Poor	Poor	Poor	Moderate	Moderate	Moderate		2
Highland Dr.	Gravel		Good	Good	Good	Minor	None	None		4
Highland Dr.	Gravel		Fair	Fair	Fair	Moderate	None	None		3
Highlook Ct.	Gravel		Good	Fair	Good	None	None	None		3
Hillfair Ct.	Gravel		Good	Good	Good	None	None	None		4
Hillside Pl.	Gravel		Fair	Fair	Fair	Minor	None	None		3
Horizon Ct.	Gravel		Fair	Poor	Fair	Minor	None	Moderate	Row Misaligned crowding road	3
Hornaday Parking Are	Gravel		Fair	Fair	Fair	None	None	None		3
Iris Ct.	Gravel		Good	Poor	Good	None	None	None	No Draingage at CuldeSac	3
Jack Gist Ln.	Gravel		Good	Good	Good	None	None	None		4
Jade Dr.	Gravel		Fair	Fair	Poor	Moderate	None	None		3
Jakes Little Fireweed I	Gravel	YES	Good	Poor	Good	None	None	Severe	alders prevent ditch establishment	2
Janeview Dr.	Gravel	YES	Good	Fair	Good	Minor	None	Minor	SD Obst's	3
Jennifer Pl.	Gravel		Good	Good	Good	Minor	Minor	None		3

STREET	TYPE	ANNEX	CROWN	DRAIN AGE	GRAVEL LAYER	SURFACE DEFORMATION	SURFACE DEFECTS	VEG	VEGETATION NOTES	1:FAILED 2:POOR 3:FAIR 4:GOOD 5:EXCELLENT
Jenny Way	Gravel		Good	Fair	Fair	None	None	None		3
Judy Rebecca Ct.	Gravel		Fair	Fair	Fair	Minor	None	None		3
Kalalock Ct.	Gravel	YES	Poor	Fair	Poor	Moderate	None	Moderate	Spruce/Alder	2
Kestrel Circle	Gravel		Good	Good	Good	None	None	None		4
Kia Ln.	Gravel		Good	Good	Good	None	None	Minor	SD Obst	4
Kramer Ln.	Gravel		Good	Good	Good	Minor	None	None		4
Krueth Way	Gravel		Good	Poor	Good	None	None	None		3
Lake St.	Gravel		Good	Good	Good	None	None	None		4
Lakeshore Dr. (W)	Gravel		Good	Good	Good	None	None	Minor		4
Lampert Ln.	Gravel		Good	Poor	Good	Severe	None	None		2
Lampert Ln.	Gravel		Good	Good	Good	Minor	None	None		4
Landing St.	Gravel		Good	Good	Good	None	None	None		4
Latham Ave.	Gravel		Fair	Good	Poor	Moderate	None	None		3
Lee Dr.	Gravel		Poor	Fair	Poor	None	None	Minor		3
Lincoln Dr.	Gravel	YES	Good	Good	Fair	None	None	None		3
Linda Ct.	Gravel		Good	Good	Good	Minor	None	None		4
Little Fireweed Ln.	Gravel		Excellent	Excellen	Excellent	None	None	None		5
Little Fireweed Ln.	Gravel		Good	Good	Good	None	None	None		4
Lupine Ct.	Gravel		Good	Fair	Good	Minor	None	None		3
Mariner Dr.	Gravel		Fair	Good	Good	Good	None	None		4
Mariner Dr.	Gravel		Fair	Fair	Fair	Minor	None	None		3
Mattox Rd.	Gravel		Good	Good	Good	Minor	None	None		4
Meadow Dr.	Gravel		Poor	Poor	Fair	Moderate	None	None		2
Miller Ln.	Gravel		Fair	Fair	Fair	Moderate	None	None		3
Mission Rd.	Gravel	YES	Fair	Poor	Poor	Moderate	None	Minor	Routine Brushing	2
Mount Augustin Dr.	Gravel		Fair	Fair	Poor	Moderate	None	Minor	Routine Brushing	3
Mountain Park Street	Gravel		Good	Fair	Good	Minor	None	Moderate	Spruce well within corridor	3
N. Glacier View Ct.	Gravel	YES	Good	Fair	Good	None	None	None		3
Natilie Cir.	Gravel	YES	Good	Fair	Good	None	None	None		4
Noview Ave.	Gravel		Fair	Poor	Good	None	None	None		3
Ocean Drive Lp.	Gravel		Good	Fair	Good	None	None	Minor	Spruce	4
Ohlson Ln.	Gravel		Poor	Poor	Poor	Moderate	None	None		2
Orion Cir.	Gravel	YES	Poor	Good	Poor	Minor	Minor	None		2
Paintbrush Ct.	Gravel	YES	Fair	Poor	Fair	Severe	None	Moderate	Spruce&SD Obst	2

STREET	TYPE	ANNEX	CROWN	DRAINAGE	GRAVEL LAYER	SURFACE DEFORMATION	SURFACE DEFECTS	VEG	VEGETATION NOTES	1:FAILED 2:POOR 3:FAIR 4:GOOD 5:EXCELLENT
Paintbrush St.	Gravel	YES	Poor	Poor	Poor	Moderate	None	Moderate	Spruce obst	2
Paradise Pl.	Gravel	YES	Good	Good	Good	Minor	None	None		4
Pennock St.	Gravel		Good	Fair	Good	Minor	None	Moderate		3
Pine View Rd.	Gravel	YES	Fair	Fair	Fair	None	None	None		3
Pleasant Way	Gravel		Poor	Poor	Poor	None	None	Moderate		2
Poppy Cir.	Gravel		Good	Good	Good	None	None	None		4
Queets Cir.	Gravel	YES	Fair	Good	Poor	Moderate	None	None		2
Quinalt Ave.	Gravel	YES	Good	Fair	Fair	None	None	Minor	Spruce Obst/SD Obst	3
Race Rd.	Gravel	YES	Good	Good	Poor	Moderate	None	None		3
Race Rd.	Gravel	YES	Good	Good	Poor	Moderate	None	None		3
Rainbow Ct.	Gravel		Fair	Poor	Poor	Minor	None	Severe		3
Rainbow Pl.	Gravel		Poor	Poor	Poor	Moderate	None	None		2
Rangeview Ave.	Gravel		Fair	Good	Poor	Severe	None	Severe		2
Rangeview Ave.	Gravel		Fair	Fair	Poor	Severe	None	None		2
Reber Rd.	Gravel		Good	Fair	Good	None	None	None		4
Ridgeway Ct.	Gravel	YES	Good	Fair	Good	None	None	Moderate	Ditch Obst	4
Rosebud Ct.	Gravel	YES	Fair	Poor	Fair	Moderate	None	None		3
Rosewood Cir.	Gravel	YES	Good	Good	Good	Minor	None	Minor	SD Obst	4
S. Park Cir.	Gravel	YES	Good	Good	Good	Minor	None	None		4
Saltwater Dr.	Gravel		Fair	Good	Poor	Moderate	None	Minor		3
Scenic Pl.	Gravel	YES	Fair	Fair	Fair	Minor	None	None		3
Sea Breeze Ct.	Gravel		Good	Poor	Good	None	None	Moderate		3
Seascape Dr.	Gravel		Fair	Poor	Fair	None	None	None	Severe ROW Misalignment	2
Shannon Ct.	Gravel		Good	Good	Good	None	None	None		4
Shannon Ln.	Gravel		Good	Good	Good	None	None	None		4
Shelford St.	Gravel		Poor	Poor	Poor	Poor	None	Moderate		2
Shirley Ct.	Gravel		Good	Good	Good	Minor	None	None		4
Skagit Cir.	Gravel		Fair	Fair	Fair	Fair	None	None		3
Slavin Dr.	Gravel	YES	Good	Fair	Good	None	None	None		4
South Slope Dr.	Gravel		Good	Good	Good	None	None	Minor	Routine Brushing	4
Spencer Dr.	Gravel	YES	Good	Poor	Good	None	None	Severe	Row Misaligned crowding road	3
Spruce Cir.	Gravel	YES	Fair	Poor	Poor	Moderate	None	None		2
Spruce Ln.	Gravel		Poor	Poor	Poor	Moderate	None	None		2

STREET	TYPE	ANNEX	CROWN	DRAINAGE	GRAVEL LAYER	SURFACE DEFORMATION	SURFACE DEFECTS	VEG	VEGETATION NOTES	1:FAILED 2:POOR 3:FAIR 4:GOOD 5:EXCELLENT
Sprucewood Dr.	Gravel	YES	Good	Poor	Poor	Severe	None	None		2
Stellars Jay	Gravel		Good	Good	Good	Minor	None	None		4
Tasmania East	Gravel		Good	Good	Poor	None	None	Minor	Routine Brushing	3
Tasmania West	Gravel		Good	Fair	Poor	None	None	Minor	Routine Brushing	3
Ternview Pl.	Gravel		Excellent	Excellen	Excellent	None	None	None		5
Thompson Dr.	Gravel		Good	Fair	Good	None	None	Minor	Brush in Travelway	4
Triton Ct.	Gravel		Good	Good	Good	None	None	None		4
Tundra Rose Rd.	Gravel	YES	Good	Fair	Good	Moderate	None	Minor	Routine Brushing	3
Uminski Ct.	Gravel		Good	Fair	Good	None	None	Minor		4
Upland Ct.	Gravel		Good	Fair	Poor	None	None	None		3
Virginialyn Way	Gravel		Excellent	Excellen	Excellent	None	None	None		5
W. Cityview Ave.	Gravel		Fair	Poor	Poor	Moderate	None	None		2
W. Fairview Ave.	Gravel		Fair	Fair	Fair	Minor	None	None		3
W. Jeffery Ave.	Gravel	YES	Fair	Poor	Fair	Moderate	None	Minor		3
West Terrace Blvd.	Gravel		Good	Good	Good	None	None	None		4
Westwood Ave.	Gravel	YES	Good	Fair	Good	Minor	None	None		3
Whispering Meadow A	Gravel	YES	Good	Good	Poor	Moderate	None	None		3
Williams Pl.	Gravel		Good	Fair	Good	None	None	None		3
Willow Dr.	Gravel	YES	Good	Fair	Good	Minor	None	None		3
Wright St.	Gravel		Poor	Poor	Poor	Severe	None	Moderate		2
Wythe Way	Gravel		Poor	Poor	Poor	Minor	None	None		2

Appendix D – Manuals for the PASER Road Assessment Model

Pavement Surface Evaluation and Rating

PASER Manual

Gravel Roads

RATING 5

RATING 3

Transportation Information Center
University of Wisconsin–Madison

RATING

1

Contents

This manual is intended to assist local officials in understanding and rating the surface condition of gravel roads. It describes types and causes of distress and provides a simple system to visually rate the road segment's condition. The rating procedure can be used as condition data for the Wisconsin DOT local road inventory and as part of a computerized pavement management system like PASERWARE.

Produced by the T.I.C. with support from the Federal Highway Administration, the Wisconsin Department of Transportation, and the University of Wisconsin-Extension. The T.I.C., part of the nationwide Local Technical Assistance Program (LTAP), is a Center of the College of Engineering, Department of Engineering Professional Development, University of Wisconsin-Madison.

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Pavement Surface Evaluation and Rating

PASER Manual

Gravel Roads

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Transportation Information Center
University of Wisconsin–Madison

Pavement Surface Evaluation and Rating

Gravel PASER Manual

There are many miles of unsurfaced roads in this country. Wisconsin alone has over 22,000 miles of gravel roads under the jurisdiction of local governments. Maintaining and improving these roads is a major responsibility for local governments.

Gravel roads may service very remote areas and very few vehicles. On the other hand it is common to have gravel roads providing service to agricultural, logging, and recreational areas with fairly high traffic volumes. Many urban areas also have some gravel roads. Heavy trucks and residential traffic can combine to make very heavy demands on these unsurfaced roads.

This manual is intended to help you plan the maintenance and overall management of gravel roads. It discusses common problems and typical repairs. A simple system for evaluating conditions and rating roads is included.

The Wisconsin Transportation Information Center also has PASER manuals for other pavement types (see inside back cover). The rating systems are similar and compatible so that local road agencies can work with a comprehensive condition rating method. The rating procedure can be used as condition data for the Wisconsin DOT local road inventory (WISLR) and as part of a computerized pavement management system like PASERWARE.

Taking an organized approach to roadway management has many benefits. By documenting the actual conditions of roads you can set realistic budgets, make timely repairs, and set up cost effective maintenance procedures. Developing an overall plan for the roadway system lets local agencies develop budgets and plan for future needs. When detailed information is available, local officials can respond more effectively to questions from the public. A planned approach is easier to explain and receives greater public support.

Several key steps are necessary to develop a meaningful roadway management plan. First, you must inventory the existing condition. This is normally done by dividing the roadway into segments with similar conditions. During the inventory you collect information on construction history, roadway width, etc. Then you need some method for assessing the condition of the existing roadway. This Gravel PASER Manual uses a visual approach. Other information from material sampling, testing, and traffic counts can be useful for a more detailed system plan.

Another necessary step is setting priorities for roadway improvements. You can use roadway condition and the local importance of these roads to assign priorities. Then budgets can be developed based on cost estimates for the projected improvements. Since not all improvements can be made in one year, you can set up a multi-year budget plan. You can make a capital improvement plan for three to five years. Normally this is updated annually.

Gravel road evaluation

Evaluating and rating gravel roads requires a different perspective than similar evaluations of asphalt or concrete pavements. This is due to the nature of gravel roads and their variability. Surface conditions on gravel roads can change literally overnight. Heavy rains and local heavy traffic can dramatically change the surface characteristics of gravel roads from one day to the next. In addition, routine maintenance activities, such as one pass of a motor grader, could improve the surface conditions of a gravel road significantly.

Since the evaluation or rating of a road could vary depending on recent weather conditions or recent maintenance activities, it should be based on major factors. Detailed surface conditions should be secondary.

The most important factors in evaluating a gravel road are the road cross section, drainage, and adequacy of the gravel layer. The gravel road cross section must contain adequate crown and good lateral drainage systems. The crown should be approximately 6", the adjacent ditches should be deep enough to contain surface water, and the culvert systems should be clean and sized to prevent any serious impoundment of water against the roadway.

The depth of the gravel layer will obviously depend on the existing soils and the amount of heavy traffic. For most conditions, a minimum gravel thickness of 6" is required. Heavier layers are necessary for very poor soils and/or very heavy traffic loads. Using geotextiles in very poor subgrade soil conditions can also significantly improve the performance of a gravel road.

Surface distress, such as ruts and potholes, indicates a lack of strength. This could be caused by improper drainage, by lack of adequate gravel cover, or possibly both. Therefore, surface distress becomes an important indicator of the primary concern for drainage and adequate gravel. The level of service that a gravel road provides to the driver also depends on smooth ride and dust control. Therefore distress such as washboarding, loose rock, and dust are important in the overall service of the road. However, these conditions are secondary since they can change quickly due to weather and maintenance activities. They should not influence the primary evaluation of the roadway.

It may be difficult to distinguish between a poorly maintained gravel road and an unimproved (dirt) road. The local road agency must first decide if they plan to maintain the road with a gravel surface or as an unimproved road. A minimum of 1½"– 2" of gravel surfacing is generally necessary to be considered a gravel road. More gravel is needed to provide a good level of service.

Surface conditions and defects

The *Gravel PASER Manual* presents a method for visually assessing and rating the conditions of existing roadways. It is based on understanding the conditions and defects common on gravel roads. To set a rating you assess both the extent of problems on the road and the appropriate repairs or reconstruction needed.

It is helpful to separate the various conditions common to gravel roads. Five road conditions can be used to evaluate and rate gravel roads.

Crown
The height and condition of crown, and an unrestricted slope of roadway from the center across the shoulders to the ditches.

Drainage
The ability of roadside ditches and under-road culverts to carry water away from the road.

Gravel layer
Adequate thickness and quality of gravel to carry the traffic loads.

Surface deformation
Washboarding, potholes and ruts.

Surface defects
Dust and loose aggregate.

Each of these is described in some detail in this manual. Assessing the condition of an actual roadway usually involves looking for different combinations of conditions.

In reviewing different conditions and defects, it is important to consider their severity and extent. Generally problems begin slowly and progressively become more serious. Slight defects will grow into moderate and then severe conditions. At first, defects may be found in only a few isolated places. As the condition worsens, more defects will show up on the surface. Examples in this manual will help you identify conditions and determine both how bad they are and how extensive they are.

CROWN

An unsurfaced road must be built so water drains quickly off the roadway. If it is not, water stays in ponds or puddles, soaks into the roadbed, and softens it. Building a crown into the road—making the center of the road higher than the shoulder—enhances drainage. Normally, a gravel road will have 4"– 6" of crown, or fall, from its center to the edge.

A roadway that has no crown will pond water. A windrow of soil or a high shoulder may also trap water on the roadway and impede drainage. In severe cases the crown is reversed—lower than the edges—so that the road is in a bowl shape. Naturally, this traps water and rapidly deteriorates the roadway, especially under traffic.

Inadequate crown can be restored by regrading with a motor patrol grader. Light blading will restore minor irregularities. Restoring crown to a flat roadway may require complete reworking. This involves scarifying, or cutting loose, 3"– 4" of gravel and reshaping the crown. It is helpful to apply water and use compaction to establish the crown.

If the surface gravel on the roadway is inadequate you may need to add gravel to construct a road with proper crown. Use good quality aggregate. Hard and sound aggregate will prevent the breakdown of large aggregate into small particles under traffic. A proper mixture of aggregate sizes (gradation) is also important. You need an adequate amount of fines to bind the gravel together on the road. See Wisconsin Transportation Bulletins No. 4, *Road Drainage* and No. 5, *Gravel Roads* for more information.

When you do routine maintenance grading, take care to grade the roads to allow free drainage from the center of the road to the shoulder and into the ditch. Improper grading can create a secondary ditch.

► **Excellent crown. No restriction to water flow from centerline to ditch.**

Flat crown with poor grading has created secondary ditch preventing free drainage into

▼ **roadside ditch.**

Poorly graded crown traps water causing it to run down center of road.

DRAINAGE

Roadside ditches and culverts must be able to handle surface water flow. Without adequate ditches, water will pond on the roadway and soften the road base. The ditch must be wide and deep enough to accommodate all the surface water. It must slope so water drains and doesn't form local ponds. A ditch bottom which is several feet below the top of the road is best. This will provide thorough drainage of the roadbed and prevent flooding. Deeper and wider ditches may be necessary to accommodate very heavy surface water flow. Ditches must be maintained to prevent erosion or the buildup of debris.

Drainage across roadways is handled with culverts or bridges. These drainage structures must be maintained to prevent ponding and water backup. Culvert headwalls and riprap are very helpful in directing water flow and preventing erosion of the roadbed.

Ditch cleaning is a routine maintenance procedure necessary to keep water flowing properly. Spoil material from a ditch may be used along the roadway if there is room. Major ditch cleaning may require loading and hauling excess material. Take care to maintain uniform ditch slopes. Seed the soil or install additional erosion control after major ditching repairs.

Roadway culverts tend to fill with debris and silt. They must be cleaned routinely to maintain their water carrying capacity. Replacing headwalls and riprap is also necessary to prevent erosion. Collapsed or damaged culverts must be replaced.

◄ **Excellent drainage with wide deep ditches.**

Partial drainage. Ditch and new culvert being added on left. Little or no drainage on right. ▼

▲ **Good ditches.**

DRAINAGE

Continued

► **Poor drainage due to little or no ditch, no driveway culverts.**

Shallow, narrow ditch cannot carry surface water causing ditch erosion and temporary roadway flooding.

▼

◄ **Shallow ditch and partially filled culvert. Ditch needs cleaning and culvert should be lowered to allow a minimum of 12” of aggregate cover.**

► **No ditch. Road is actually trenched into roadside forcing water onto surface.**

GRAVEL LAYER

Traffic loads require an adequate layer of gravel to carry and distribute the loads to the subsoils. The thickness needed will vary with the amount of heavy traffic and the stability of the subsoils. A minimum layer of 6" is normally required. Heavier layers, up to 10" or more, are sometimes used for heavy loads or poor soil conditions.

The gravel must be of good quality to provide long term service. The gradation and durability of the gravel (measured by hardness and soundness testing) are important. A proper gradation contains a mixture of larger aggregate (1"), sand-sized aggregate, and fines. More fines (8%–15%) are recommended for surfacing gravel than are normally used in base gravel. See Transportation Information Bulletin No. 5, *Gravel Roads,* for more information.

► **Excellent gravel layer.**

◄ **Adequate gravel layer. No ruts or potholes.**

◄ **Little or no gravel layer.**

SURFACE DEFORMATION

Washboard

Traffic action can dislodge aggregate and create a washboard effect on the surface. This washboarding or corrugation develops across the road, perpendicular to the direction of traffic. It is more prevalent under heavy traffic and under loose aggregate conditions. It may also tend to develop on hills or curves, near intersections, or in areas where traffic is accelerating or decelerating. Soft roadbeds and improper grader operation can also cause washboards.

Light washboarding can be removed with routine grading. Washboarding that is moderate or severe often requires scarification, cutting down 3”-4”, and regrading. If there is insufficient material, new gravel will be required. Select an aggregate with sufficient fines to resist future washboarding.

Since washboarding may be concentrated at specific locations, spot regrading is often required. Take care to blend the regraded sections into the adjoining roadway. Since moisture is needed for compaction, correcting washboarding after a rain is more effective. Maintain the crown, and super-elevation, and match bridges and intersections when repairing spot corrugations.

Operating a motor patrol grader at a high rate of speed can actually create corrugations during routine maintenance. Speeds below 10 mph are recommended. Proper blade angle and pitch, and proper tire inflation, are also essential.

▼ **Moderate washboarding in center of road.**

► **Severe washboarding traps water.**

Potholes

Potholes and depressions can develop in the gravel or surface. They're caused when surface material is worn away or soft spots develop in underlying soils. They may fill with water and are accelerated in roads without adequate crown. Isolated potholes may be repaired by hand. This can involve putting granular material into the holes and compacting it.

◄ **Small, isolated potholes. Routine regrading should eliminate them.**

▲ **Series of moderate potholes require scarification and regrading.**

▲ **Potholes at bridge may require scarification and hand patching. Gravel and debris should be cleaned off bridge deck.**

◄ **Severe potholes covering most of road need additional gravel and regrading.**

Extensive potholes require reworking and major regrading. It is usually necessary to add granular material to repair them. Scarify the area prior to repair to insure a good blend. You may need to reshape the road to restore a crown and make drainage improvements to restore surface stability and prevent future potholes.

Ruts

Traffic can create a surface depression or rut over a portion of a gravel road. The ruts may be caused by dislodging some of the surface gravel. Loose unstable gravel may be displaced by traffic causing minor surface ruts. Severe rutting (over 3") may be caused by weak underlying soils. Poor crown and drainage conditions weaken the base and accelerate rutting.

Slight rutting can be removed by blading and restoring the crown. Severe rutting caused by unstable subsurface soils will require improvements in drainage and addition of aggregate.

▲ **Rut in wheel path needs regrading to eliminate ponding and prevent further road deterioration.**

Numerous ruts and very poor drainage create soft roadbed conditions and need major

▼ **regrading and new aggregate.**

SURFACE DEFECTS

Dust

Traffic on dry gravel roads can generate dust. Good quality gravel used in the construction of gravel roads has a combination of large aggregate, sand, and fine material or binder. These fines can be picked up under the action of traffic and become airborne.

Dust on gravel roads creates several problems. Visibility can be severely restricted under heavy dust conditions, creating traffic safety hazards. Dust is a form of air pollution and can be very objectionable to nearby property owners. The loss of the fine material from a well-graded gravel surface can eventually lead to a loss of stability. Without the fine binder material, the larger particles become unstable and are dislodged by traffic.

Rolling and compacting a new gravel surface will help maintain a tight and impervious surface or crust. Under traffic and during extended dry periods this crust may be disturbed and heavy dust conditions result. Controlling dust with liquid calcium chloride or other surface treatment agents can be very helpful.

It is essential to replace the fines in the gravel mix to maintain the road and keep it stable under traffic. Fines can often be reclaimed from the shoulder edge and regraded and mixed with existing gravel. This should be done as routine maintenance while restoring and maintaining the crown.

◄ **Heavy dust obscures vision and causes loss of roadway fine material. A dust control chemical may be advisable in areas of heavy traffic.**

Loose aggregate

Loose aggregate or unstable surface gravel conditions can develop from loss of fines through heavy dust action or from erosion due to an improper gradation mix of the original aggregate. Vehicles can move loose or unstable aggregate forming ridges or windrows in the direction of traffic. Generally gravel will be moved from the wheel path and form ridges at the center of lanes and at roadway edges. Loose aggregate can also accumulate at places where vehicles frequently turn or stop.

Loose aggregate may be temporarily bladed to the shoulder although you have to be careful not to restrict drainage. By remixing loose aggregate with fines from the road edge it may be possible to produce a well graded mix. However, a severe accumulation of loose aggregate usually requires mixing with additional well graded surface gravel.

▲ **Loose aggregate over most of road. Light grading and compaction during wet weather would improve stability and develop a surface crust.**

► **Heavy accumulation of loose aggregate on outside of roadway.**

Regrading and possibly new aggregate are needed.

Rating road surface condition

A simplified rating system has been developed to help manage gravel roads. It uses a scale of 1 to 5—5 is excellent condition and 1 is failed. In a normal progression the road will start out in excellent condition and gradually deteriorate under the effects of traffic and weather. Routine grading and minor patching may be sufficient to restore the road to excellent condition. As conditions worsen, more extensive maintenance may be required; complete rebuilding may eventually be necessary.

To select a rating first assess the crown, drainage, and gravel layer. Then review the individual defects and select the type of maintenance or rehabilitation necessary. The rating should reflect the condition and type of maintenance or repairs required. Look at the photographs in this section to become more familiar with the ratings and conditions.

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 5 Newly constructed road. Excellent crown and drainage. No maintenance required.

Rating 4 Good crown and drainage. Routine maintenance.

Rating 3 Roadway shows traffic effects. Needs regrading, minor ditch maintenance, and spot gravel application.

Rating 2 Road needs additional aggregate layer, major drainage improvements.

Rating 1 Travel is difficult. Complete rebuilding required.

Surface rating	*Visible distress**	*General condition/ treatment measures*
5 Excellent	No distress. Dust controlled. Excellent surface condition and ride.	New construction—or total reconstruction. Excellent drainage. Little or no maintenance needed.
4 Good	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	Recently regraded. Good crown and drainage throughout. Adequate gravel for traffic. Routine grading and dust control may be needed.
3 Fair	Good crown (3”-6”). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate but additional aggregate may be needed in some locations to correct washboarding or isolated potholes and ruts. Some culvert cleaning needed. Moderate washboarding (1”-2” deep) over 10%-25% of the area. Moderate dust, partial obstruction of vision. None or slight rutting (less than 1” deep). An occasional small pothole (less than 2” deep). Some loose aggregate (2” deep).	Shows traffic effects. Regrading (reworking) necessary to maintain. Needs some ditch improvement and culvert maintenance. Some areas may need additional gravel.
2 Poor	Little or no roadway crown (less than 3”). Adequate ditches on less than 50% of roadway. Portions of the ditches may be filled, overgrown and/or show erosion. Some areas (25%) with little or no aggregate. Culverts partially full of debris. Moderate to severe washboarding (over 3” deep) over 25% of area. Moderate rutting (1”-3”), over 10%-25% of area. Moderate potholes (2”-4”) over 10%-25% of area. Severe loose aggregate (over 4”).	Travel at slow speeds (less than 25 mph) is required. Needs additional new aggregate. Major ditch construction and culvert maintenance also required.
1 Failed	No roadway crown or road is bowl shaped with extensive ponding. Little if any ditching. Filled or damaged culverts. Severe rutting (over 3” deep), over 25% of the area. Severe potholes (over 4” deep), over 25% of area. Many areas (over 25%) with little or no aggregate.	Travel is difficult and road may be closed at times. Needs complete rebuilding and/or new culverts.

** Individual road sections will not have all of the types of distress listed for any particular rating. They may have only one or two types.*

RATING 5

EXCELLENT — Little or no maintenance required

New construction with excellent crown, drainage and gravel layer. Little or no distress.

► **Newly constructed road with excellent crown, drainage and gravel layer.**

► **Road has excellent crown. Gravel has been stabilized for dust control. Very good drainage.**

RATING 4

GOOD — Routine maintenance may be required

Good crown, drainage and gravel layer. Distress limited to traffic effects such as dust, loose aggregate, and slight washboarding.

◄
Good crown, ditches, and gravel layer.

Slight traffic effects, washboarding, and loose gravel.

◄
Good crown and gravel, ditch appears good throughout.

Occasional routine grading for traffic effects.

◄
Plenty of crown and excellent ditch. Needs routine grading to eliminate slight secondary ditch and loose gravel.

RATING 3

FAIR — Regrading and drainage improvement, spot gravel application needed

Adequate drainage and crown on more than 50% of roadway. Gravel layer is adequate with only need for spot replacement. Regrading needed to improve crown and repair wash-boarding and slight ruts or potholes.

► **Good gravel and crown but ditch partially blocked. Needs cleaning or additional culvert.**

► **Heavy accumulation of loose gravel.**

Requires regrading. Ditch cleaning needed on right side.

► **Fair crown and good gravel layer. Shallow ditch needs improvement.**

RATING 3

FAIR — *(continued)*
Regrading and drainage improvement, spot gravel application needed

◄
Fair crown and gravel layer.

Needs ditching on right and more crown.

◄
Adequate drainage and fair crown. A few small potholes indicate need for regrading and additional gravel.

RATING 2

POOR — More gravel and major drainage improvements required

Travel at slow speeds (25 mph) may be necessary. Additional gravel layer needed to carry traffic. Little or no crown. Ditching is inadequate on more than 50% of roadway.

► **Some gravel and crown but almost no ditch. Driveway culvert required.**

▲ **Little gravel and almost no ditches or crown.**

No crown, poor drainage, and needs gravel. ▼

▲ **Lack of ditch on right causes ruts. Needs gravel.**

Numerous potholes indicate additional gravel most likely required to restore crown. Needs extensive reworking. ►

RATING 1

Failed — Reconstruction required

Needs complete rebuilding. Travel is difficult; road may be closed at times.

◄ **Ruts. No ditch or aggregate.**

▲ **Deep ruts and potholes. No drainage. Travel is difficult.**

▲ **Complete failure. Restricted travel.**

Practical advice on rating roads

Inventory and field inspection

Most agencies routinely observe roadway conditions as a part of their normal work and travel. However, an actual inspection means looking at the entire roadway system and preparing a written summary of conditions. This inspection has many benefits over casual observations. Useful comparisons between segments can be made and more dependable decisions are likely because the entire roadway system is considered.

An inspection also encourages a review of specific conditions important in roadway maintenance—drainage and adequate strength, for example.

A simple written inventory is useful in making decisions where other people are involved. You do not have to trust your memory, and you can usually answer questions in more detail. Having a written record also improves your credibility with the public.

Finally, a written inventory is very useful in documenting the changing roadway conditions. Without records extending over several years, it is impossible to know if your road conditions are improving, holding their own, or declining.

Annual budgets and long range planning are best done when based on actual needs as documented with a written inventory.

The Wisconsin DOT local road inventory (WISLR) is a valuable resource for managing your local roads. Adding PASER surface condition ratings is an important improvement.

Averaging and comparing sections

For evaluation, divide the local road system into individual segments which are similar in construction and condition. Rural segments may vary from ½ mile to a mile long, while some sections in urban areas will likely be 1-4 blocks long or more. If you are starting with the WISLR inventory, the segments have already been established. You may want to review them for consistent road conditions. Obviously no roadway segment has entirely consistent conditions. Some "averaging" will be necessary. Also, individual road segments will not have all of the types of distress listed for any particular rating; they may have only one or two. The objective is to rate the condition that represents the majority of the roadway. Small or isolated conditions should not influence the rating. It is useful to note these special conditions on the inventory form so this information can be used in project design. For example, some spot repairs may be required.

Occasionally pavement conditions vary significantly. For example, short sections of good condition may be followed by sections of poor pavement conditions. In these cases it is best to rate the pavement according to the worst conditions and note the variation on the form.

The overall purpose of condition rating is to provide a relative comparison of the condition of all your pavement segments. Therefore, comparing any two pavement segments would show the better pavement having a higher rating. Within a given rating, say 3, not all pavements will be exactly the same. However, they should all be considered to be in better condition than those with lower ratings, say 2. Sometimes it is helpful in rating a difficult segment to compare it to other previously rated segments. For example, if it is better than one you rated 2, and worse than a typical 4, then a rating of 3 is appropriate. Having all road segments rated in the proper relative order is most important and useful.

Separating road function from conditions

Gravel roads often are found in very low volume applications. This sometimes is confusing. People rating roads are more willing to accept poor condition on a road if it is little used. In higher traffic situations, they expect a road in better condition.

Therefore, there may be a tendency in evaluating the condition of a road to evaluate the condition more harshly in higher traffic volume situations and to be more lenient in evaluating little-used roads. This tendency should be avoided. The evaluation of the actual roadway condition must be objective.

You will also consider the road's function or importance but this must be done separately. Roads can be categorized by their use or their function. In selecting project improvements, you will likely consider both the road condition and the road's importance to select the most needed projects.

Planning maintenance and repair

We have found that relating a normal maintenance or rehabilitation procedure to the surface rating scheme helps local officials use the rating system. However, an individual surface rating should not automatically dictate the final maintenance or rehabilitation technique. You should consider safety, future traffic projections, original construction, and roadway strength since these may dictate a more comprehensive rehabilitation than the rating suggests.

Summary

Using local road funds most efficiently requires good planning and accurate identification of appropriate rehabilitation projects. Assessing roadway conditions is an essential first step in this process. The PASER evaluation procedure has proven effective in improving decision making and using highway funds more efficiently. It can be used directly by local officials and staff. It may be combined with additional testing and data collection in a more comprehensive pavement management system. For additional training and information, contact the Wisconsin Transportation Information Center.

Transportation Information Center Publications

Pavement Surface Evaluation and Rating (PASER) Manuals

Asphalt PASER Manual, 2002, 28 pp.

Brick and Block PASER Manual, 2001, 8 pp.

Concrete PASER Manual, 2002, 28 pp.

Gravel PASER Manual, 2002, 20 pp.

Sealcoat PASER Manual, 2000, 16 pp.

Unimproved Roads PASER Manual, 2001, 12 pp.

Drainage Manual
Local Road Assessment and Improvement, 2000, 16 pp.

SAFER Manual
Safety Evaluation for Roadways, 1996, 40 pp.

Flagger's Handbook (pocket-sized guide), 1998, 22 pp.

Work Zone Safety, Guidelines for Construction, Maintenance, and Utility Operations, (pocket-sized guide), 2002, 58 pp.

Wisconsin Transportation Bulletins

#1 Understanding and Using Asphalt

#2 How Vehicle Loads Affect Pavement Performance #3 LCC—Life Cycle Cost Analysis

#4 Road Drainage

#5 Gravel Roads

#6 Using Salt and Sand for Winter Road Maintenance #7 Signing for Local Roads

#8 Using Weight Limits to Protect Local Roads #9 Pavement Markings

#10 Seal Coating and Other Asphalt Surface Treatments #11 Compaction Improves Pavement Performance

#12 Roadway Safety and Guardrail

#13 Dust Control on Unpaved Roads

#14 Mailbox Safety

#15 Culverts-Proper Use and Installation

#16 Geotextiles in Road Construction/Maintenance and Erosion Control #17 Managing Utility Cuts

#18 Roadway Management and Tort Liability in Wisconsin #19 The Basics of a Good Road

#20 Using Recovered Materials in Highway Construction #21 Setting Speed Limits on Local Roads

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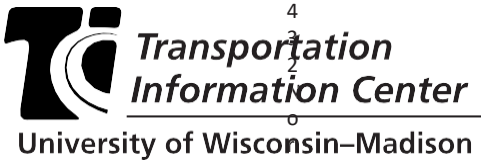

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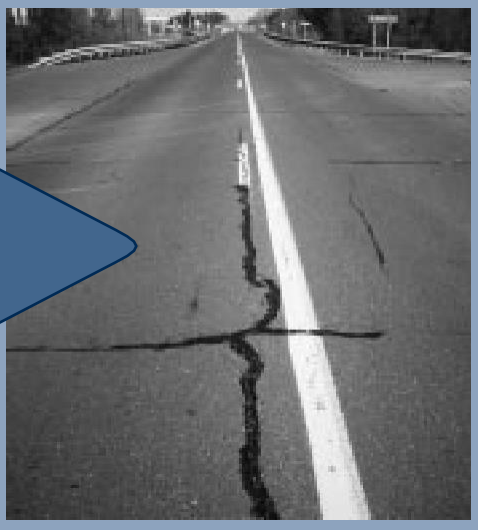
Gravel Roads

Pavement Surface Evaluation and Rating

PASER Manual

Asphalt Roads



Transportation Information Center
University of Wisconsin–Madison

Contents

Department of Engineering Professional Development,
University of Wisconsin–Madison.

This manual is intended to assist local officials in understanding and rating the surface condition of asphalt pavement. It describes types of defects and provides a simple system to visually rate pavement condition. The rating procedure can be used as condition data for the Wisconsin DOT local road inventory and as part of a computerized pavement management system like PASERWARE.

The PASER system described here and in other T.I.C. publications is based in part on a roadway management system originally developed by Phil Scherer, transportation planner, Northwest Wisconsin Regional Planning Commission.

Produced by the T.I.C. with support from the Federal Highway Administration, the Wisconsin Department of Transportation, and the University of Wisconsin-Extension. The T.I.C., part of the nationwide Local Technical Assistance Program (LTAP), is a Center of the College of Engineering,

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Pavement Surface Evaluation and Rating

PASER Manual

Asphalt Roads

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Lynn Entine, Entine & Associates, ***editor***
Susan Kummer, Artifax, ***designer***

Transportation Information Center
University of Wisconsin–Madison

Pavement Surface Evaluation and Rating

Asphalt PASER Manual

A local highway agency's major goal is to use public funds to provide a comfortable, safe and economical road surface—no simple task. It requires balancing priorities and making difficult decisions in order to manage pavements. Local rural and small city pavements are often managed informally, based on the staff's judgment and experience. While this process is both important and functional, using a slightly more formalized technique can make it easier to manage pavements effectively.

Experience has shown that there are three especially useful steps in managing local roads:

1. Inventory all local roads and streets.
2. Periodically evaluate the condition of all pavements.
3. Use the condition evaluations to set priorities for projects and select alternative treatments.

A comprehensive pavement management system involves collecting data and assessing several road characteristics: roughness (ride), surface distress (condition), surface skid characteristics, and structure (pavement strength and deflection). Planners can combine this condition data with economic analysis to develop short-range and long-range plans for a variety of budget levels. However, many local agencies lack the resources for such a full-scale system.

Since surface condition is the most vital element in any pavement management system, local agencies can use the simplified rating system presented in this *Asphalt PASER Manual* to evaluate their roads. The PASER ratings combined with other inventory data (width, length, shoulder, pavement type, etc.) from the WisDOT local roads inventory (WISLR) can be very helpful in planning future budgets and priorities.

WISLR inventory information and PASER ratings can be used in a computerized pavement management system, PASERWARE, developed by the T.I.C and WisDOT. Local officials can use PASERWARE to evaluate whether their annual road budgets are adequate to maintain or improve current road conditions and to select the most cost-effective strategies and priorities for annual projects.

PASER Manuals for gravel, concrete, and other road surfaces, with compatible rating systems are also available (page 29). Together they make a comprehensive condition rating method for all road types. PASER ratings are accepted for WISLR condition data.

Asphalt pavement distress

PASER uses visual inspection to evaluate pavement surface conditions. The key to a useful evaluation is identifying different types of pavement distress and linking them to a cause. Understanding the cause for current conditions is extremely important in selecting an appropriate maintenance or rehabilitation technique.

There are four major categories of common asphalt pavement surface distress:

Surface defects
Raveling, flushing, polishing.

Surface deformation
Rutting, distortion—rippling and shoving, settling, frost heave.

Cracks
Transverse, reflection, slippage, longitudinal, block, and alligator cracks.

Patches and potholes

Deterioration has two general causes: environmental due to weathering and aging, and structural caused by repeated traffic loadings.

Obviously, most pavement deterioration results from both environmental and structural causes. However, it is important to try to distinguish between the two in order to select the most effective rehabilitation techniques.

The rate at which pavement deteriorates depends on its environment, traffic loading conditions, original construction quality, and interim maintenance procedures. Poor quality materials or poor construction procedures can significantly reduce the life of a pavement. As a result, two pavements constructed at the same time may have significantly different lives, or certain portions of a pavement may deteriorate more rapidly than others. On the other hand, timely and effective maintenance can extend a pavement's life. Crack sealing and seal coating can reduce the effect of moisture in aging of asphalt pavement.

With all of these variables, it is easy to see why pavements deteriorate at various rates and why we find them in various stages of disrepair. Recognizing defects and understanding their causes helps us rate pavement condition and select cost-effective repairs. The pavement defects shown on the following pages provide a background for this process.

Periodic inspection is necessary to provide current and useful evaluation data. It is recommended that PASER ratings be updated every two years, and an annual update is even better.

SURFACE DEFECTS

Raveling

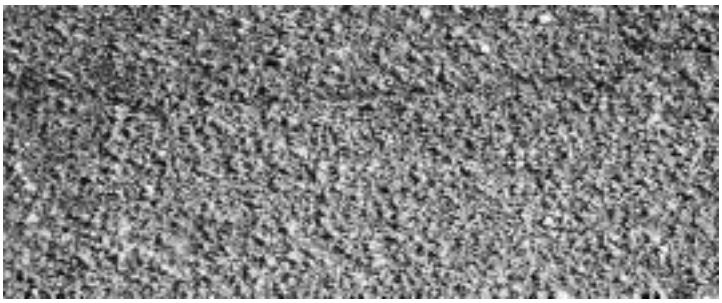
Raveling is progressive loss of pavement material from the surface downward, caused by: stripping of the bituminous film from the aggregate, asphalt hardening due to aging, poor compaction especially in cold weather construction, or insufficient asphalt content. Slight to moderate raveling has loss of fines. Severe raveling has loss of coarse aggregate. Raveling in the wheelpaths can be accelerated by traffic. Protect pavement surfaces from the environment with a sealcoat or a thin overlay if additional strength is required.

Flushing

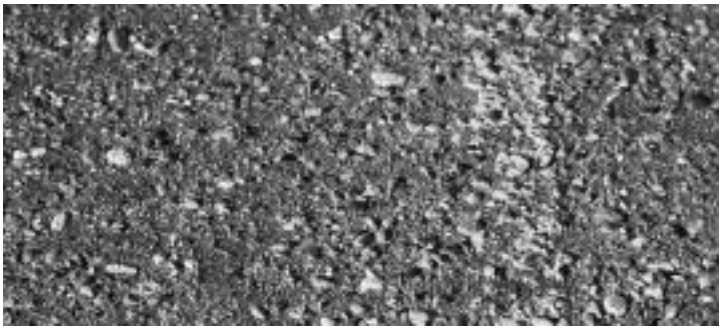
Flushing is excess asphalt on the surface caused by a poor initial asphalt mix design or by paving or sealcoating over a flushed surface. Repair by blotting with sand or by overlaying with properly designed asphalt mix.

Polishing

Polishing is a smooth slippery surface caused by traffic wearing off sharp edges of aggregates. Repair with sealcoat or thin bituminous overlay using skid-resistant aggregate.



◄ **Slight raveling. Small aggregate particles have worn away exposing tops of large aggregate.**

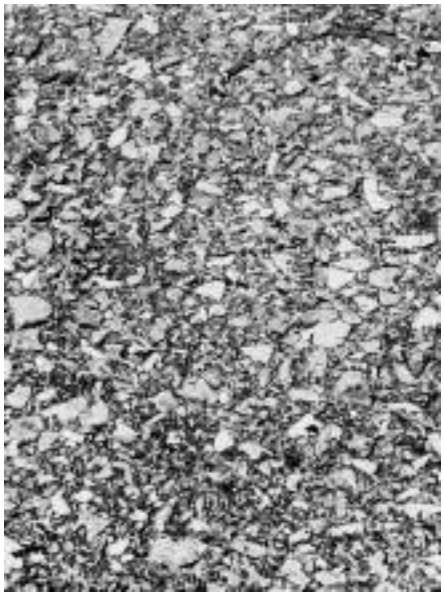


◄ **Moderate to severe raveling. Erosion further exposes large aggregate.**

◄ **Severe raveling and loss of surface material.**

Polished, worn aggregate needs repair. ▼

► **Flushing. Dark patches show where asphalt has worked to surface.**



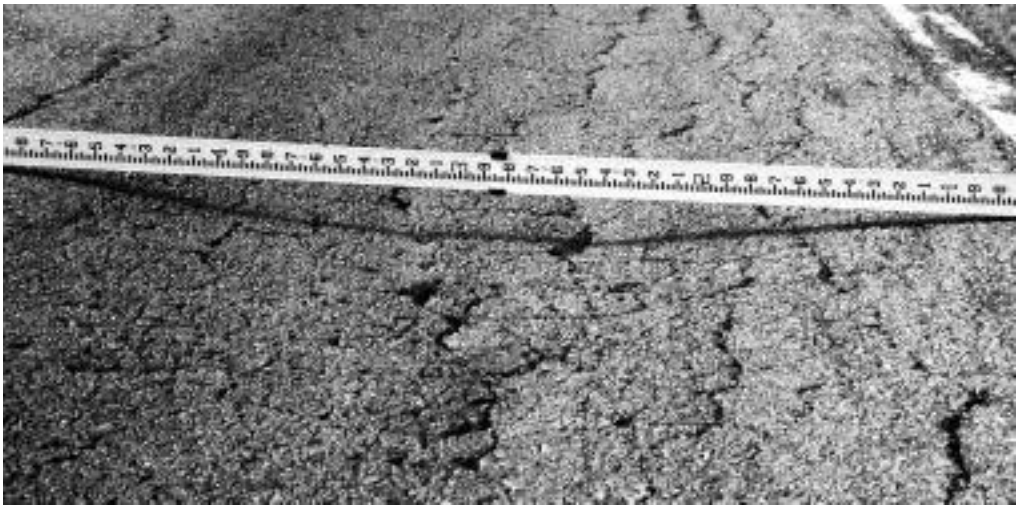
SURFACE DEFORMATION

Rutting

Rutting is displacement of material, creating channels in wheelpaths. It is caused by traffic compaction or displacement of unstable material. Severe rutting (over 2") may be caused by base or subgrade consolidation. Repair minor rutting with overlays. Severe rutting requires milling the old surface or reconstructing the roadbed before resurfacing.

◄ **Even slight rutting is evident after a rain.**

◄ **Severe rutting over 2" caused by poor mix design.**



◄ **Severe rutting caused by poor base or subgrade.**

EVALUATION — Surface Deformation 6

Distortion

Shoving or rippling is surfacing material displaced crossways to the direction of traffic. It can develop into washboarding when the asphalt mixture is unstable because of poor quality aggregate or improper mix design. Repair by milling smooth and overlaying with stable asphalt mix.

Other pavement distortions may be caused by settling, frost heave, etc. Patching may provide temporary repair. Permanent correction usually involves removal of unsuitable subgrade material and reconstruction.

▼ Heavy traffic has shoved pavement into washboard ripples and bumps.

► Severe settling from utility trench.

► Frost heave damage from spring break-up.

▼ Widely spaced, well-sealed cracks.

CRACKS

Transverse cracks

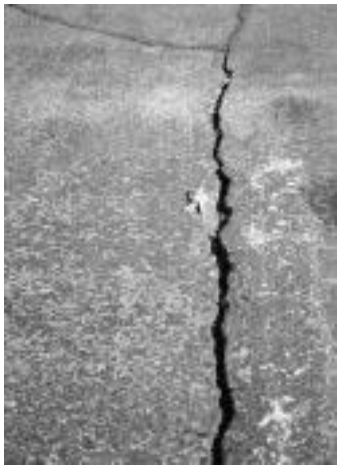
A crack at approximately right angles to the center line is a transverse crack. They are often regularly spaced. The cause is movement due to temperature changes and hardening of the asphalt with aging.

Transverse cracks will initially be widely spaced (over 50'). Additional cracking will occur with aging until they are closely spaced (within several feet). These usually begin as hairline or very narrow cracks; with aging they widen. If not properly sealed and maintained, secondary or multiple cracks develop parallel to the initial crack. The crack edges can further deteriorate by raveling and eroding the adjacent pavement.

Prevent water intrusion and damage by sealing cracks which are more than ¼" wide.

◄ **Sealed cracks, a few feet apart.**

▲ **Tight cracks less than ¼" in width.**



▲ **Open crack – ½" or more in width.**

▲ **Water enters unsealed cracks softening pavement and causing secondary cracks.**

▲ **Pavement ravels and erodes along open cracks causing deterioration.**

Reflection cracks

Cracks in overlays reflect the crack pattern in the pavement underneath. They are difficult to prevent and correct. Thick overlays or reconstruction is usually required.

► **Concrete joints reflected through bituminous overlay.**

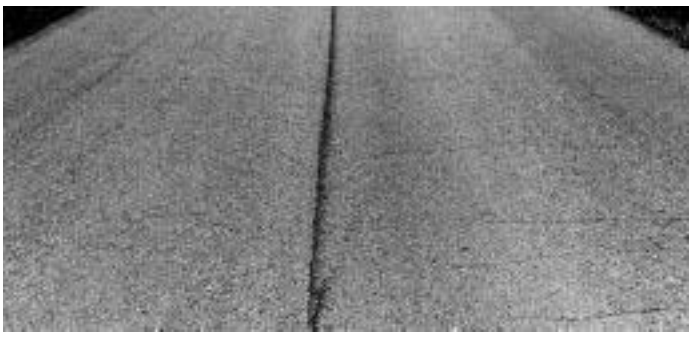
Slippage cracks

Crescent or rounded cracks in the direction of traffic, caused by slippage between an overlay and an underlying pavement. Slippage is most likely to occur at intersections where traffic is stopping and starting. Repair by removing the top surface and resurfacing using a tack coat.

► **Crescent-shaped cracks characteristic of slippage.**

► **Loss of bond between pavement layers allows traffic to break loose pieces of surface.**

Centerline crack (still tight). ►



Edge cracking from weakened subbase and traffic loads. ▼

►

First stage of wheelpath cracking caused by heavy traffic loads.

Longitudinal cracks

Cracks running in the direction of traffic are longitudinal cracks. Center line or lane cracks are caused by inadequate bonding during construction or reflect cracks in underlying pavement. Longitudinal cracks in the wheel path indicate fatigue failure from heavy vehicle loads. Cracks within one foot of the edge are caused by insufficient shoulder support, poor drainage, or frost action. Cracks usually start as hairline or vary narrow and widen and erode with age. Without crack filling, they can ravel, develop multiple cracks, and become wide enough to require patching.

Filling and sealing cracks will reduce moisture penetration and prevent further subgrade weakening. Multiple longitudinal cracks in the wheel path or pavement edge indicate a need for strengthening with an overlay or reconstruction.

.

▼

Multiple open cracks at center line, wheelpaths and lane center. ▼

Block cracks

Block cracking is interconnected cracks forming large blocks. Cracks usually intersect at nearly right angles. Blocks may range from one foot to approximately 10' or more across. The closer spacing indicates more advanced aging caused by shrinking and hardening of the asphalt over time. Repair with sealcoating during early stages to reduce weathering of the asphalt. Overlay or reconstruction required in the advanced stages.

► **Large blocks, approximately 10' across.**

► **Intermediate-size block cracking, 1'-5' across with open cracks.**

▲ **Extensive block cracking in an irregular pattern.**

► **Severe block cracking –1' or smaller blocks. Tight cracks with no raveling.**

Alligator cracks

Interconnected cracks forming small pieces ranging in size from about 1” to 6”. This is caused by failure of the surfacing due to traffic loading (fatigue) and very often also due to inadequate base or subgrade support. Repair by excavating localized areas and replacing base and surface. Large areas require reconstruction. Improvements in drainage may often be required.

◄
Alligator crack pattern. Tight cracks and one patch.

◄
Characteristic “chicken wire” crack pattern shows smaller pavement pieces and patching.

◄
Open raveled alligator cracking with settlement along lane edge most likely due to very soft subgrade.

PATCHES AND POTHOLES

Patches

Original surface repaired with new asphalt patch material. This indicates a pavement defect or utility excavation which has been repaired. Patches with cracking, settlement or distortions indicate underlying causes still remain. Recycling or reconstruction are required when extensive patching shows distress.

► **Typical repair of utility excavation. Patch in fair to good condition.**

► **Edge wedging. Pavement edges strengthened with wedges of asphalt. Patch is in very good condition.**

► **Extensive patching in very poor condition.**

Potholes

Holes and loss of pavement material caused by traffic loading, fatigue and inadequate strength. Often combined with poor drainage. Repair by excavating or rebuilding localized potholes. Reconstruction required for extensive defects.

◄
Small pothole where top course has broken away.

◄
Multiple potholes show pavement failure, probably due to poor subgrade soils, frost heave, and bad drainage.

◄
Large, isolated pothole, extends through base.

Note adjacent alligator cracks which commonly deteriorate into potholes.

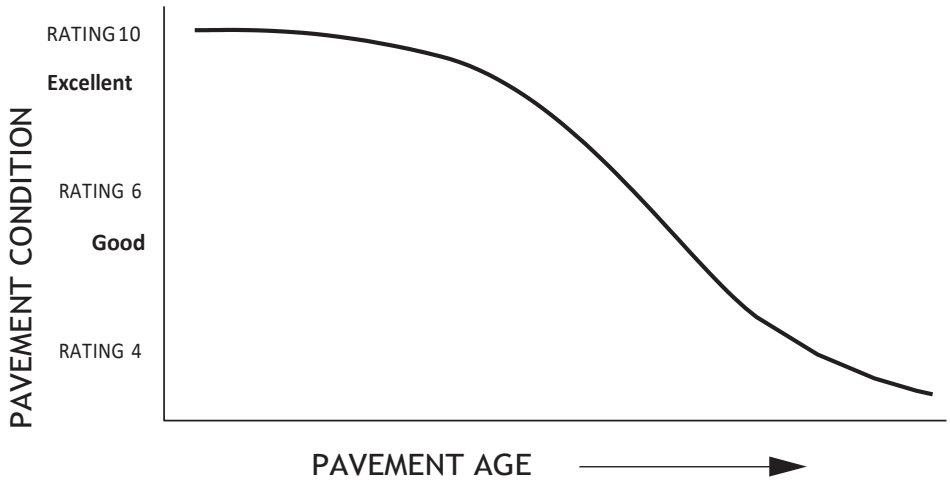
Rating pavement surface condition

With an understanding of surface distress, you can evaluate and rate asphalt pavement surfaces. The rating scale ranges from 10 - excellent condition to 1- failed. Most pavements will deteriorate through the phases listed in the rating scale. The time it takes to go from excellent condition (10) to complete failure (1) depends largely on the quality of the original construction and the amount of heavy traffic loading.

Once significant deterioration begins, it is common to see pavement decline rapidly. This is usually due to a combination of loading and the effects of additional moisture. As a pavement ages and additional cracking develops, more moisture can enter the pavement and accelerate the rate of deterioration.

Look at the photographs in this section to become familiar with the descriptions of the individual rating categories. To evaluate an individual pavement segment, first determine its general condition. Is it relatively new, toward the top end of the scale? In very poor condition and at the bottom of the scale? Or somewhere in between? Next, think generally about the appropriate maintenance method. Use the rating categories outlined below.

Finally, review the individual pavement distress and select the appropriate surface rating. Individual pavements will ***not*** have all of the types of distress listed for any particular rating. They may have only one or two types.



In addition to indicating the surface condition of a road, a given rating also includes a recommendation for needed maintenance or repair. This feature of the rating system facilitates its use and enhances its value as a tool in ongoing road maintenance.

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 9 & 10	No maintenance required
Rating 8	Little or no maintenance
Rating 7	Routine maintenance, crack sealing and minor patching
Rating 5 & 6	Preservative treatments (sealcoating)
Rating 3 & 4	Structural improvement and leveling (overlay or recycling)
Rating 1 & 2	Reconstruction

Rating system

Surface rating	*Visible distress**	*General condition/ treatment measures*
10 Excellent	None.	New construction.
9 Excellent	None.	Recent overlay. Like new.
8 Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than ¼").	Recent sealcoat or new cold mix. Little or no maintenance required.
7 Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open ¼") due to reflection or paving joints. Transverse cracks (open ¼") spaced 10' or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.	First signs of aging. Maintain with routine crack filling.
6 Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open ¼"– ½"), some spaced less than 10'. First sign of block cracking. Sight to moderate flushing or polishing. Occasional patching in good condition.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat.
5 Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open ½") show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.	Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2")
4 Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½" deep or less).	Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2" or more).
3 Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (1" or 2" deep). Occasional potholes.	Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
2 Very Poor	Alligator cracking (over 25% of surface). Severe distortions (over 2" deep) Extensive patching in poor condition. Potholes.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective.
1 Failed	Severe distress with extensive loss of surface integrity.	Failed. Needs total reconstruction.

** Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.*

RATING 10 & 9

EXCELLENT —

No maintenance required

Newly constructed or recently overlaid roads are in excellent condition and require no maintenance.

► **RATING 10**

New construction.

► **RATING 9**

Recent overlay, rural.

► **RATING 9**
Recent overlay, urban.

RATING 8

VERY GOOD —

Little or no maintenance required

This category includes roads which have been recently sealcoated or overlaid with new cold mix. It also includes recently constructed or overlaid roads which may show longitudinal or transverse cracks. All cracks are tight or sealed.

◄ **Recent chip seal.**

◄ **Recent slurry seal.**

▼ **Widely spaced, sealed cracks.**

▲ **New cold mix surface.**

RATING 7

GOOD —

Routine sealing recommended

Roads show first signs of aging, and they may have very slight raveling. Any longitudinal cracks are along paving joint. Transverse cracks may be approximately 10‘ or more apart. All cracks are ¼” or less, with little or no crack erosion. Few if any patches, all in very good condition. Maintain a crack sealing program.

► **Tight and sealed transverse and longitudinal cracks. Maintain crack sealing program.**

► **Tight and sealed transverse and longitudinal cracks.**

► **Transverse cracks about 10’ or more apart. Maintain crack sealing program.**

RATING 6

GOOD —

Consider preservative treatment

Roads are in sound structural condition but show definite signs of aging. Seal-coating could extend their useful life. There may be slight surface raveling. Transverse cracks can be frequent, less than 10‘ apart. Cracks may be ¼–½”and sealed or open. Pavement is generally sound adjacent to cracks. First signs of block cracking may be evident. May have slight or moderate bleeding or polishing. Patches are in good condition.

◄
Slight surface raveling with tight cracks, less than 10’ apart.

◄
Transverse cracking less than 10’ apart; cracks well-sealed.

▼ Large blocks, early signs of raveling and block cracking.

▼ Open crack, 1/2" wide; adjoining pavement sound.

▼ Moderate flushing.

RATING 5

▼ Block cracking with open cracks.

FAIR –

Preservative maintenance treatment required

Roads are still in good structural condition but clearly need sealcoating or overlay. They may have moderate to severe surface raveling with significant loss of aggregate. First signs of longitudinal cracks near the edge. First signs of raveling along cracks. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Any patches or edge wedges are in good condition.

► Moderate to severe raveling in wheel paths.

▼ Severe flushing.

Wedges and patches extensive but in good condition.

▲

RATING 4

FAIR –

Structural improvement required

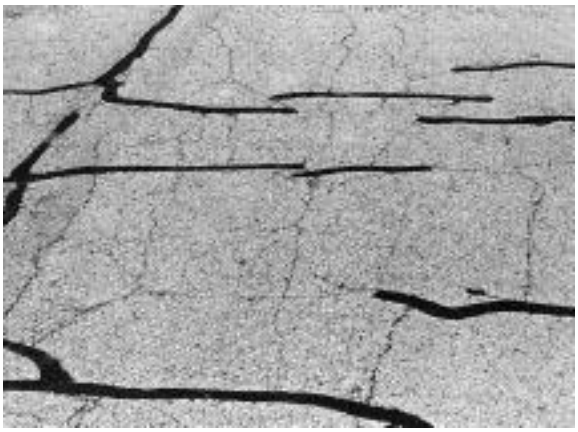
Roads show first signs of needing strengthening by overlay. They have very severe surface raveling which should no longer be sealed. First longitudinal cracking in wheel path. Many transverse cracks and some may be raveling slightly. Over 50% of the surface may have block cracking. Patches are in fair condition. They may have rutting less than ½" deep or slight distortion.

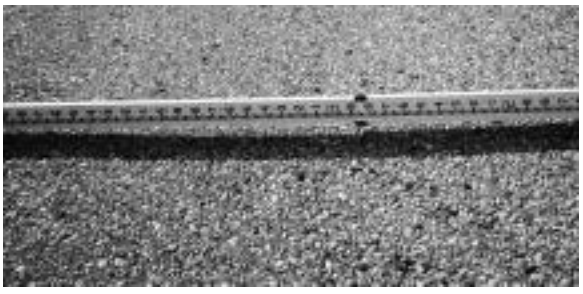
▼ Severe raveling with extreme loss of aggregate.

▼ Load cracking and slight rutting in wheel path.

◄ Longitudinal cracking; early load-related distress in wheel path. Strengthening needed.

▼ Slight rutting; patch in good condition.





◄ Extensive block cracking. Blocks tight and sound. Slight rutting in wheel path.

RATING 3

POOR–

Structural improvement required

Roads must be strengthened with a structural overlay (2“ or more). Will benefit from milling and very likely will require pavement patching and repair beforehand. Cracking will likely be extensive. Raveling and erosion in cracks may be common. Surface may have severe block cracking and show first signs of alligator cracking. Patches are in fair to poor condition. There is moderate distortion or rutting (1-2”) and occasional potholes.

► **Many wide and raveled cracks indicate need for milling and overlay.**

► **2” ruts need mill and overlay.**

► **Open and raveled block cracks.**

RATING 3

POOR — (continued)

Structural improvement required

◄ **Alligator cracking. Edge needs repair and drainage needs improvement prior to rehabilitation.**

▼ **Distortion with patches in poor condition. Repair and overlay.**

RATING 2

VERY POOR—
Reconstruction required

Roads are severely deteriorated and need reconstruction. Surface pulverization and additional base may be cost-effective. These roads have more than 25% alligator cracking, severe distortion or rutting, as well as potholes or extensive patches in poor condition.

► **Extensive alligator cracking. Pulverize and rebuild.**

▲ **Severe rutting. Strengthen base and reconstruct.**

▲ **Patches in poor condition, wheelpath rutting. Pulverize, strengthen and reconstruct.**

► **Severe frost damage. Reconstruct.**

RATING 1

FAILED —

Reconstruction required

Roads have failed, showing severe distress and extensive loss of surface integrity.

◄ **Potholes from frost damage. Reconstruct.**

◄ **Potholes and severe alligator cracking. Failed pavement. Reconstruct.**

Ext

◄ **Extensive loss of surface material: Rebuild**

Practical advice on rating roads

Inventory and field inspection

Most agencies routinely observe roadway conditions as a part of their normal work and travel. However, an actual inspection means looking at the entire roadway system as a whole and preparing a written summary of conditions. This inspection has many benefits over casual observations. It can be helpful to compare segments, and ratings decisions are likely to be more consistent because the roadway system is considered as a whole within a relatively short time.

An inspection also encourages a review of specific conditions important in roadway maintenance, such as drainage, adequate strength, and safety.

A simple written inventory is useful in making decisions where other people are involved. You do not have to trust your memory, and you can usually answer questions in more detail. Having a written record and objective information also improves your credibility with the public.

Finally, a written inventory is very useful in documenting changing roadway conditions. Without records over several years it is impossible to know if road conditions are improving, holding their own, or declining.

Annual budgets and long range planning are best done when based on actual needs as documented with a written inventory.

The Wisconsin DOT local road inventory (WISLR) is a valuable resource for managing your local roads. Adding PASER surface condition ratings is an important improvement.

Averaging and comparing sections

For evaluation, divide the local road system into individual segments which are similar in construction and condition. Rural segments may vary from ½ mile to a mile long, while sections in urban areas will likely be 1-4 blocks long or more. If you are starting with the WISLR Inventory, the segments have already been established. You may want to review them for consistent road conditions.

Obviously, no roadway segment is entirely consistent. Also, surfaces in one section will not have all of the types of distress listed for any particular rating. They may have only one or two types. Therefore, some averaging is necessary.

The objective is to rate the condition that represents the majority of the roadway. Small or isolated conditions should not influence the rating. It is useful to note these special conditions on the inventory form so this information can be used in planning specific improvement projects. For example, some spot repairs may be required.

Occasionally surface conditions vary significantly within a segment. For example, short sections of good condition may be followed by sections of poor surface conditions. In these cases, it is best to rate the segment according to the worst conditions and note the variation on the form.

The overall purpose of condition rating is to be able to compare each segment relative to all the other segments in your roadway system. On completion you should be able to look at any two pavement segments and find that the better surface has a higher rating.

Within a given rating, say 6, not all pavements will be exactly the same. However, they should all be considered to be in better condition than those with lower ratings, say 5. Sometimes it is helpful in rating a difficult segment to compare it to other previously rated segments. For example, if it is better than one you rated 5 and worse than a typical 7, then a rating of 6 is appropriate. Having all pavement segments rated in the proper relative order is most important and useful.

Assessing drainage conditions

Moisture and poor pavement drainage are significant factors in pavement deterioration. Some assessment of drainage conditions during pavement rating is highly recommended. While you should review drainage in detail at the project level, at this stage simply include an overview drainage evaluation at the same time as you evaluate surface condition.

Urban drainage.

RATING:

Excellent

Good rural ditch and driveway culvert. Culvert end needs cleaning.
RATING: Good

High shoulder and no ditch lead to pavement damage. Needs major ditch improvement for a short distance.
RATING: Fair

No drainage leads to failed pavement.

RATING: Poor

Consider both pavement surface drainage and lateral drainage (ditches or storm sewers). Pavement should be able to quickly shed water off the surface into the lateral ditches. Ditches should be large and deep enough to drain the pavement and remove the surface water efficiently into adjacent waterways.

Look at the roadway crown and check for low surface areas that permit ponding. Paved surfaces should have approximately a 2% cross slope or crown across the roadway. This will provide approximately 3“ of fall on a 12‘ traffic lane. Shoulders should have a greater slope to improve surface drainage.

A pavement’s ability to carry heavy traffic loads depends on both the pavement materials (asphalt surfacing and granular base) and the strength of the underlying soils. Most soils lose strength when they are very wet. Therefore, it is important to provide drainage to the top layer of the subgrade supporting the pavement structure.

In rural areas, drainage is provided most economically by open ditches that allow soil moisture to drain laterally. As a rule of thumb, the bottom of the ditch ought to be at least one foot below the base course of the pavement in order to drain the soils. This means that minimum ditch depth should be about 2‘ below the center of the pavement. Deeper ditches, of course, are required to accommodate roadway culverts and maintain the flow line to adjacent drainage channels or streams.

You should also check culverts and storm drain systems. Storm drainage systems that are silted in, have a large accumulation of debris, or are in poor structural condition will also degrade pavement performance.

The T.I.C. publication, *Drainage Manual: Local Road Assessment and Improvement*, describes the elements of drainage systems, depicts them in detailed photographs, and explains how to rate their condition. Copies are available from the Transportation Information Center.

Planning annual maintenance and repair budgets

We have found that relating a normal maintenance or rehabilitation procedure to the surface rating scheme helps local officials use the rating system. However, an individual surface rating should not automatically dictate the final maintenance or rehabilitation technique.

You should consider future traffic projections, original construction, and pavement strength since these may dictate a more comprehensive rehabilitation than the rating suggests. On the other hand, it may be appropriate under special conditions to do nothing and let the pavement fully deteriorate, then rebuild when funds are available.

Summary

Using local road funds most efficiently requires good planning and accurate identification of appropriate rehabilitation projects. Assessing roadway conditions is an essential first step in this process. This asphalt pavement surface condition rating procedure has proved effective in improving decision making and using highway funds more efficiently. It can be used directly by local officials and staff. It may be combined with additional testing and data collection in a more comprehensive pavement management system.

Transportation Info

Center Publications

Pavement Surface Evaluation and Rating (PASER) Manuals

Asphalt PASER Manual, 2002, 28 pp.

Brick and Block PASER Manual, 2001, 8 pp.

Concrete PASER Manual, 2002, 28 pp.

Gravel PASER Manual, 2002, 20 pp.

Sealcoat PASER Manual, 2000, 16 pp.

Unimproved Roads PASER Manual, 2001, 12 pp.

Drainage Manual

Local Road Assessment and Improvement, 2000, 16 pp.

SAFER Manual

Safety Evaluation for Roadways, 1996, 40 pp.

Flagger's Handbook (pocket-sized guide), 1998, 22 pp.

Work Zone Safety, Guidelines for Construction, Maintenance, and Utility Operations, (pocket-sized guide), 1999, 55 pp.

Wisconsin Transportation Bulletins

#1 Understanding and Using Asphalt

#2 How Vehicle Loads Affect Pavement Performance #3 LCC—Life Cycle Cost Analysis

#4 Road Drainage

#5 Gravel Roads

#6 Using Salt and Sand for Winter Road Maintenance #7 Signing for Local Roads

#8 Using Weight Limits to Protect Local Roads #9 Pavement Markings

#10 Seal Coating and Other Asphalt Surface Treatments #11 Compaction Improves Pavement Performance

#12 Roadway Safety and Guardrail

#13 Dust Control on Unpaved Roads

#14 Mailbox Safety

#15 Culverts-Proper Use and Installation

#16 Geotextiles in Road Construction/Maintenance and Erosion Control #17 Managing Utility Cuts

#18 Roadway Management and Tort Liability in Wisconsin #19 The Basics of a Good Road

#20 Using Recovered Materials in Highway Construction #21 Setting Speed Limits on Local Roads

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