Parlin Field Runway Assessment
and
Improvement Plan

Introduction

This document is intended to serve two purposes: One is to be a part of the Airport Master Plan that is in development to comprehensively address the long term needs of the airport. The other purpose is to provide a stand-alone document to support the current activities to improve the airport main runway.

In recent years it has become apparent that the condition of the main runway (18-36) has become unacceptable for many aircraft and was in a state of accelerating decay. It is now felt that unless corrective action is taken in the near future that the condition will degenerate to the point where aircraft could be damaged and the utility of the airport put in jeopardy.

In order to address this problem an assessment of the condition of the runway has been undertaken and study of alternative corrective actions has been done. As a result of these activities a recommendation has been developed that reflects both the technical consensus of those studying the problem and the meets the constraints of the available funding. While the funding issues will not be addressed in this document, they did play a significant roll in developing the corrective action plan as they by necessity forced us to focus on the best value for the dollar associated with any recommendation.

It should also be noted that at this time this plan addresses in detail only the original 2850' runway. In 1992 the south end of the runway was extended by 600'. This addition was constructed on the Sugar River floodplain approximately 7 feet lower in elevation than the original the runway, resulting in significant problems, including flooding, frost heaving and pavement breakup not relevant to the original runway. Some of the planning for the eventual improvement of this section and a discussion of it's impact on the improvement plan will be discussed later in Section IV (recommendations).

Assessment of Current Runway Condition

Methodology

It is difficult to provide an objective assessment of the condition of a runway. It is very much like a road: Some may say that it is “fair”, others “poor” depending upon their vehicle or their tolerance for the conditions. Therefor this type of evaluation is by nature very subjective. Even the state Division of Aeronautics uses a scale of Poor, Fair, Good and Excellent that is based upon the judgment of the individual inspector. On this scale, Parlin field has been rated “Fair” (see Appendix B). Were the assessment to get to “Poor”, the airport could loose it's state approval as a public use airport.

However it is desirable for the assessment to be as objective as possible. To that end, the condition of the Parlin Field main runway (18-36) has been evaluated in accordance with the criteria provided in the Pavement Surface Evaluation and Rating (PASER) Manual produced for the Federal Aviation Administration (FAA) by the University of Wisconsin-Madison College of Engineering. PASER uses a 5 level scale to evaluate pavement: 5-Excellent, 4-Good, 3-Fair, 2-Poor and 1-Failed.

PASER uses visual inspection to evaluate pavement surface conditions. The inspection will identify, categorize and rate defects in the pavement. These defects are the result of deterioration over time resulting from two general causes: Environmental due to weathering and aging, and structural caused by repeated traffic loadings.

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 heaving

Cracks

Thermal, reflection, slippage, joint/edge, block, and alligator cracks

Patches and potholes

The PASER manual provides descriptions (including pictures) and potential causes for these defects and enables a metric of severity (rating) to be applied to each one. Once the defects have been inventoried, then the following table (from the PASER Manual) is used to establish an overall rating for the runway. The table also identifies treatment methods that can be used to address the defects.

Surface Rating	**Visible Distress**	**General Conditions/ Treatment Methods**
5 - Excellent	None, or initial thermal cracks, all narrow (less than 1/8”)	New pavement less than 5 years old. Now maintenance or isolated crack sealing required.
4 - Good	Additional Thermal Cracking. Cracks generally generally spaced more that 50' apart. Less than 10% of cracks and joints need sealing. Minimal or slight raveling. No distortion. Patches in good condition.	Recent sealcoat or pavement over 5 years old
3 - Fair	Moderate raveling. Thermal crack and joints generally spaced less than 50' apart. Crack sealing or repair of sealant needed on 10-25% of cracks or joints. Edge cracks along 10% or less of pavement sedges. Block crack pattern with cracks 6'-10' apart. Isolated alligator cracking and poor patches. Minor distortion or crack settlement less than 1”.	Seal open cracks and joints. Replace failed sealant. Apply new surface treatment or thin overlay. Minor patching and joint repair.
4 - Poor	Frequent thermal cracks. Wide cracks and joints with raveling in cracks. Deterioration along more than 25% of cracks. Edge cracks on up to 25% of pavement edges. Block cracks spaced 5' apart or less. Alligator cracking or poor patches cover up to 20% of surface areas. Distortion or settlement 1”- 2”.	Needs significant crack sealing plus patching and repair on up to 25% of pavement surface. Overlay entire area with structural overlay.
5 - Failed	Widespread, severe cracking with raveling and deterioration. Alligator cracking and potholes over 20% of the area. Distortion over 2”.	Condition may be limiting service. Needs reconstruction.

Parlin Field Conditions

At Parlin Field we inventoried the defects identified along the entire length of the runway in accordance with the PASER Manual. As would be expected, we found that many, but not all of the potential defects that can affect asphalt were present. Because of the relatively light traffic at Parlin (compared to roads or large commercial airports), most of the damage seen reflects environmental stress (mostly temperature and moisture) accumulated over time. These effects were aggravated by poor maintenance practices over the years – primarily the lack of timely crack sealing that resulted in moisture penetrating the surface layer of asphalt resulting in accelerated cracking and distortion with seasonal temperature changes. There is also evidence of a previous overlay that was improperly applied, resulting in slippage between layers and resultant cracking of the surface layer.

Specifically, we found that the following conditions are most prevalent at the airport:

Cracking

Cracking is the most prevalent and serious condition present in the runway. Parlin evidences significant thermal, reflective, block and alligator cracking. Cracks can range from hairline to several inches in width and have length ranging from inches to hundreds of feet. All cracks will start small, and grow at varying rates with time. A brief description of each of these types of cracking follows – a more detailed description, along with pictures can be found in the PASER manual. Note that many of the cracks have been filled with either a rubberized sealant or asphalt mix. Unfortunately a high percentage of the repairs have failed over time due to continued shrinkage and movement of the asphalt.

- *Thermal Cracking*. These cracks are caused by movement due to temperature changes and hardening of the asphalt with aging and are the most prevalent type of crack at Parlin. They are typically transverse (across the runway) and can have various degrees of raveling, distortion and additional cracking along their edges.
- *Reflective Cracking*. Reflective cracks look similar to thermal cracks but result from movement of underlying pavement with temperature changes. Since the Parlin runway was overlaid in the past (the specific date is unknown, but believed to be in the early 80's) it is likely that a significant percentage of the cracks are due to this mechanism.
- *Block Cracking*. This cracking is characterized by interconnected cracks, usually at right angle, that form large blocks that range from a few feet to more that 10' across. They can form between thermal and reflective cracks, or between these and joint cracks. Better than 50% of cracks at Parlin are now joined to form blocks.
- *Joint Cracking*. These result along the joints where the pavement was laid down and are mostly longitudinal. They can also reflect the joint cracks of underlying pavement.
- *Edge Cracking*. Runway edge cracks are primarily due to insufficient shoulder support and are a significant issue at Parlin, existing along over 80% of the runway.
- *Alligator Cracking*. These are interconnected cracks forming small pieces ranging in size from about 1” to 6”. They are usually due to inadequate base or subgrade support. Parlin evidences alligator cracking in several locations, primarily in areas of settling – both in areas where subgrade problems have been identified and along settled sections of some of the larger cracks. These cracks then form in clusters that can cover significant areas. If left unattended the surface then breaks up forming potholes. These

areas identified at Parlin will need to be repaired prior to any resurfacing.

Patches and Potholes

Parlin has a large number (33) of transverse cutout patches that were done to repair cracks in accordance with FAA specifications. The repair process involved cutting out 24" sections of pavement centered over the crack and then filling and compacting with asphalt mix. Over time, the settling and shrinking of both the old and the new pavement has caused the edges of the patches to form cracks that range from hairline to about 1.5". In addition, the surface of the patches has in most cases settled below the surrounding pavement resulting in a pronounced "thump" when traversed with an aircraft (or a car for that matter!).

The Parlin runway has many areas where broken up pavement has been patched with asphalt mix. While this type of repair (common to pothole repair of roads) is a satisfactory temporary repair, it again results in an uneven surface that is hard on landing and departing aircraft. Many of these patches have also formed cracks at their boundary due to shrinkage.

Surface Deformation - Settling

Deformation on the Parlin runway surface show up as settling in areas of inadequate base or subgrade support. These are primarily manifested by alligator cracking and settling along cracks. The larger of these will require excavating to repair the base followed by patching with asphalt mix. There are three areas that have been identified for cut, excavation and fill. The smaller distortions, primarily along cracks can be addressed by shimming prior to resurfacing.

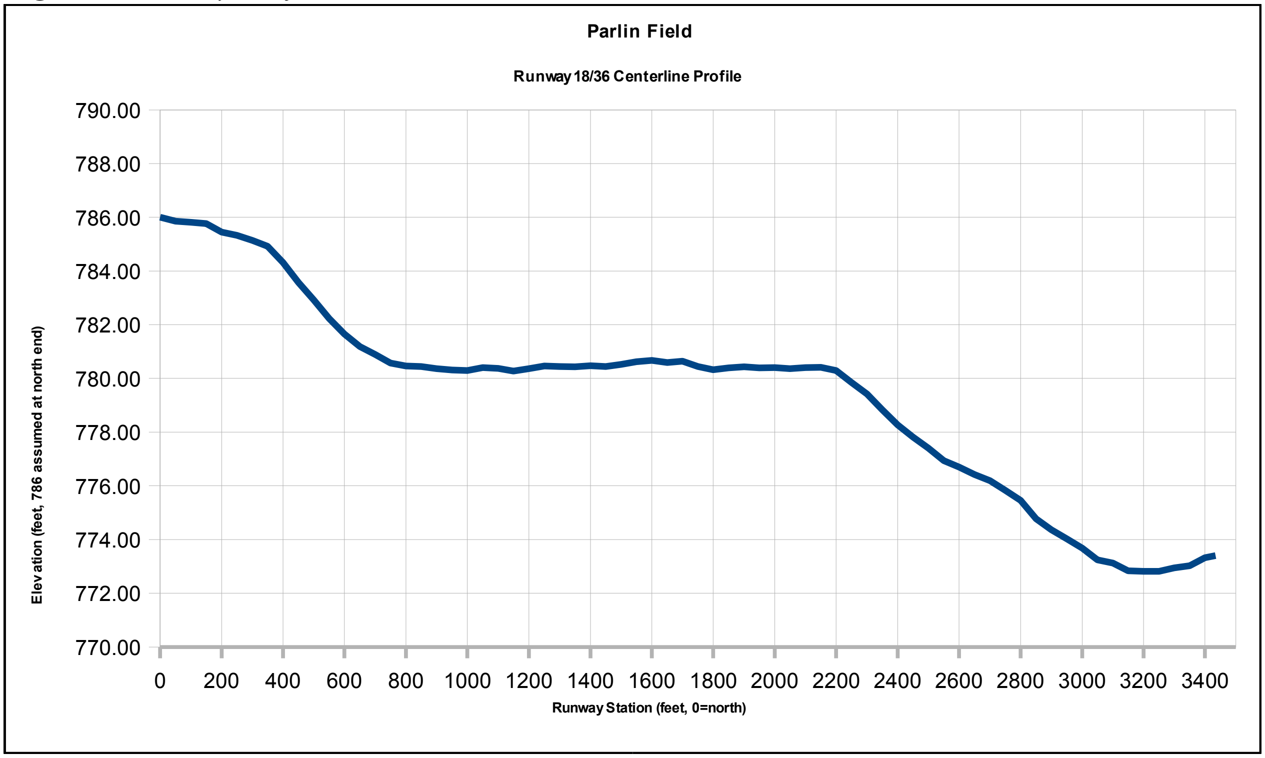
Surface Defects - Raveling

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 in the mix. All of these causes may be relevant at Parlin, but whatever the cause, raveling is apparent over most of the surface of the runway, with the worst conditions along the joint cracking at the centerline. When in an advance state, raveling can speed breakup of the pavement and create debris that can damage aircraft.

Runway Profile

While it is not a characteristic of the of the runway surface (and therefore is not addressed by the PASER manual), the runway profile – or the change in elevation along the runway from north the south – is a feature of the runway that we did investigate and quantify. The fact the the runway slopes from the north to the south is well known by local pilots and does play a role in determining how to best use the runway under some circumstances. There is also a known issue in landing from the south (Runway 36) whereby landing in a certain area can result in a bounce. This area is termed the "ski jump" (station 2200 in the centerline profile). As a part of the runway assessment, the runway profile was surveyed and the results are shown in *Figure 1*, below. The survey showed that the overall slope of the runway was approximately 0.4% – a low figure with no operational implications and well within FAA specifications. However, the "ski jump" has a vertical curvature that is too short to meet FAA standards and does have operational implications.

Figure 1. Runway Profile



Quantifying the Assessment

The overall assessment of the runway quality was based upon the following metrics derived from the examination of the conditions outlined in B above and evaluated in accordance with the criteria provided in the PASER manual (reproduced in the table in IIA above):

1. Edge cracking and deterioration on over 80% of runway edge (exceeds PASER POOR criteria)
2. 33 Transverse repair cutouts with edge cracking from .25” to 1.5” (see Appendix D for table of details).
3. 72 transverse and 56 longitudinal cracks (see Appendix D for details by section).
4. Counting the transverse cracking associated with 2 and 3 above there is on the average a crack every 20', significantly worse than the 50' specification for PASER FAIR criteria.
5. There is blocking meeting the PASER POOR criteria on 6 of 12 runway sections (defined by runway light separation) and meeting the PASER FAIR criteria on 10 of 12 sections (See Appendix D for table by section).
6. There is sufficient raveling and alligator cracking to meet the PASER FAIR criteria.
7. Edge deterioration on more than 25% of cracks, meeting the PASER POOR criteria
8. There are numerous settled areas along cracks meeting the PASER POOR criteria.

Overall the condition of the runway in accordance with PASER would be between FAIR and POOR.

Runway Improvement Alternatives

Introduction

All of the individual runway defects discussed in the previous section have mitigation and/or repair techniques that can and in many cases have been used at Parlin; cracks can be filled and holes can be patched. There and even surface treatments (sealing) that could be considered to try and extend the usable life of the pavement. The matrix below attempts to show where these techniques are applicable and what improvements could be expected by their use. However the implication of overall runway assessment is clear: The time has long past when a satisfactory result can be had just by continuing to band aid new defects every time they pop up. For this reason, the search for improvement alternatives has focused on those approaches that have the potential to both return the surface to a good condition and significantly extend the useful life of the runway.

Constraints

One of the considerations when addressing the runway repairs is the extent to which federal regulations governing airports constrain the approaches that can be taken. The bottom line is that Parlin Field, because it does not receive federal funding, is not obligated to adhere to FAA regulations governing airports – including those covering the construction and repair of runways. There are also no state regulations that we are required to meet. Having said that, it is and has always been our intent to adhere as closely as possible to the spirit if not always the letter of the regulations. We also do not want to jeopardize future improvements where FAA regulations may apply – one of these is the possibility of an instrument approach for Parlin Field. At this time we are not aware of any areas where our proposed runway improvements would conflict with FAA requirements. The FAA Advisory Circulars themselves simplify the selection of asphalt overlays and topcoats in that they allow the use of state highway standards for use on small airport runways (reference Advisory Circular AC 150/5320-6E Section 503a.).

Alternatives

As is shown by the matrix below, any fix that either replaces or overlays the existing runway surface will, for a time, return the runway to good condition; it will "fix" the problems. Any action that just addresses individual problems will not. The real issue is how long a particular technique will last and how much it will cost. The ratio of longevity to cost is therefore a key metric in deciding what is the best solution. The definition of longevity is also pertinent to enabling an apples to apples comparison of approaches. For the purpose of this report, we say that a surface is "lasting" as long as it is in as good or better condition than it is now. The estimates for longevity given in the matrix are those provided by the contractors.

Reconstruction

As stated above, there are two categories of resurfacing that can be considered: Overlaying or complete reconstruction (this includes Reclamation). The most comprehensive fix is unquestionably a complete rebuild (a full depth reconstruction). This would involve removing all of the existing asphalt and possibly the base beneath it and rebuilding everything from the bottom up, including sub-base, base and topcoats. This would provide the longest lasting surface, but would be prohibitively expensive.

A more cost effective way of resurfacing at Parlin would be via a reclamation, whereby the existing base is retained, but the asphalt surface is ground up in place and re-compacted as a new base. This would be viable because all indications are that the base below the asphalt on the old section (original 2850') of runway has been stable over the years. We have good reason to believe this is the case due to the lack of frost heaving and major settlement. While this approach is more cost effective than a complete reconstruction, it is still very expensive and would be beyond our current means to finance.

Overlay

From the cost perspective, a more attractive alternative would be to do an overlay of the existing runway. This approach is particularly attractive at Parlin because, as mentioned above, it is believed that the base beneath the existing pavement is very stable. If this were not so, then an overlay would be a waste of money, since it would soon break up due to frost heaving and thermal movement in the base. This is exactly the problem in the south 600' section of the runway (which was recently overlayed with a 1" asphalt mix) and is the primary reason for that section not being included in the current repair plan.

There are a number of questions to resolve in considering an overlay:

1. How thick should it be?
2. What is the Job Mix?
3. How should it be applied?
4. How should the surface be prepared?

The most basic overlay is a single coat of asphalt mix from 1" to 2" thick. The thicker it is, the longer it will "last". The primary failure mechanism will be the appearance of reflective cracks, which will inevitably appear – perhaps within a year. The appearance of reflective cracking however does not define the end of the overlay's useful life. If the surface is maintained properly by sealing cracks yearly as they appear, the life of the overlay can be significantly extended.

The composition of the overlay material is referred to as the Job Mix. This is a combination of an asphalt binder and stone aggregate. The aggregate is a graded mix of different size rock particles designed to meet specific performance parameters. While the selection of a Job Mix is in itself a complex science, the bottom line is that all of the contractors consulted on the project recommended using the New Hampshire DOT job mix used on the public roads for this application. This is also consistent with FAA recommendations which allow the use of state specifications for runways designed for aircraft weighing 12,500 lbs or less. The state specifications also define the application methodology.

A more substantial overlay approach, and the one recommended by most of the contractors would be to first prepare the existing surface by filling cracks, digging up and patching failed sections. Then apply a tack coat of asphalt to bind the overlay to the surface. Next apply an average ½' shim layer to level the surface. The final coat would be a 1 1/2" overlay using ½' Superpave Aggregate. The term Superpave refers to a specific aggregate specification defined by the Superpave design method, which is the asphalt mix design method that has been adopted by most states.

Mill and Overlay

In this approach the surface is mechanically ground to remove some surface imperfections followed by an overlay of 1" to 2". This option is not applicable because the existing pavement surface is too thin in some places to sustain milling. Moreover, this is an expensive process and would not provide any better longevity than the basic overlay approach.

Table 1: Runway Repair Matrix

Problem/Concern	crack fill	crack/hole repair	Thin overlay	fill/repair and overlay	mill and overlay	partial depth reconstruction	full depth reconstruct ion
Problem 1 – large cracks throughout surface are hazardous to tailwheel and other aircraft.	partial fix	fix	fix	fix	fix	fix	fix
Problem 2 – uneven surface transmits shock through landing gear to aircraft.	no fix	partial fix	fix	fix	fix	fix	fix
Problem 3 – raveling and breakup along cracks and runway edges leave FOD on runway.	partial fix	partial fix	fix	fix	fix	fix	fix
Problem 4 – Failed pavement areas may leave hazardous holes in pavement and cause FOD on runway.	no fix	fix	fix	fix	fix	fix	fix
Problem 5 – Change in runway profile at south 1/3 of runway contributes to hard/bounced landings.	no fix	no fix	no fix	no fix	no fix	fix	fix
Problem 6 – Pavement condition discourages local and transient use of airport.	no fix	partial fix	fix	fix	fix	fix	fix
Expected longevity with no maintenance	1-4 yrs	3-6 yrs	2-3 yrs	6-8 yrs	2-3 yrs	15-20 yrs	20+ yrs
Expected longevity with annual maintenance	1-4 yrs	4-7 yrs	4-7 yrs	8-12 yrs	4-7 yrs	20+ yrs	20+ yrs
Approximate cost		7k+	95k	150k	?	330k	NA
General Assessment	inadequate	inadequate	Not long lasting	most cost effective for condition	Expensive for results	Good but expensive	not needed

Recommendation and Conclusion

As can be seen from the table the most cost effective approach is the contractor recommended overlay discussed in the last section. There are of course disadvantages with an overlay vs. a reconstruction. The primary consideration is that reflective cracking will inevitably occur earlier than thermal cracks would appear in a reconstruction and the vertical curvature at the "ski jump" will not be corrected. However as previously stated, these facts do not limit the useful lifetime of the surface. The history of the present surface also lends confidence that this approach is viable: The present surface is also an overlay (and not a particularly well done one) of the original asphalt that as best we can determine was done over 25 years ago. And even though there was little maintenance done to preserve it, the surface was quite acceptable until about 3 years ago. If a new overlay can perform anywhere near as well, we can all be well satisfied!

Appendix A
Applicable Documents

Advisory Circular AC150-5300-13, Airport Design. Federal Aviation Administration.

Advisory Circular AC150-5370-10e, Standards for Specifying Construction of Airports. Federal Aviation Administration.

Advisory Circular AC150-5380-6b, Guidelines and Procedures for Maintenance of Airport Pavements. Federal Aviation Administration.

Pavement Surface Evaluation and Rating (PASER) Manual. University of Wisconsin-Madison College of Engineering.

Appendix B
State Airport Inspection Report

(attached on following pages)

Appendix C
Photographs of Runway Conditions

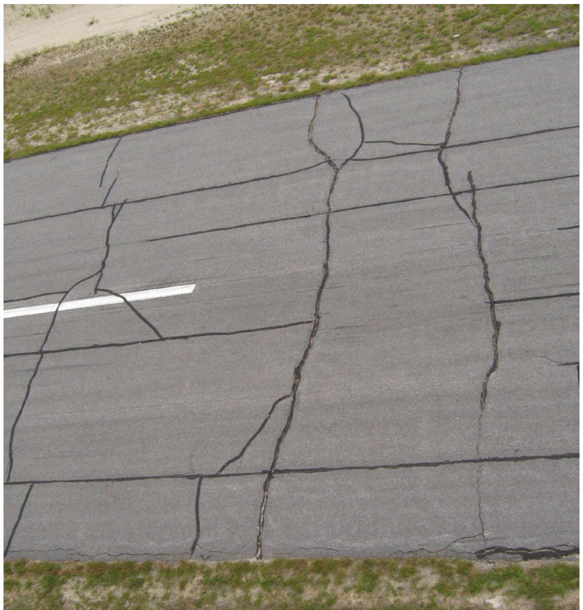


Illustration 1: Pavement rating FAIR. Thermal cracks less than 50 feet apart with minor deterioration along cracks. Block cracks 6 to 10 feet apart.

Illustration 2: Pavement rating POOR, wide cracks less than 50 feet apart with significant deterioration, settling, and deformation along crack edges.

Illustration 3: Pavement rating POOR. Extensive alligator cracking over less than 20% of area, settling of 1 to 2 inches, and deformation.

Illustration 4: Pavement rating POOR. Wide cracks with deterioration along crack edges and minor settling.

Appendix D
Runway Existing Repair Inventory

Existing Repairs on Runway 18/36		
Repair Number	Width of Cracks on Either Side of Repair (inches)	Notes
1	0.75	northern most repair
2	0.50	
3	0.50	
4	0.50	edge breakdown
5	0.50	
6	0.50	
7	0.25	
8	0.25	near rwy 18 threshold
9	0.50	
10	0.25	
11	0.25	
12	0.50	half way across runway
13	0.25	10 feet needs treatment
14	0.50	
15	0.50	
16	0.50	
17	1.00	
18	0.50	
19	1.00	
20	1.00	
21	1.00	
22	1.50	
23	0.50	
24	0.50	
25	1.00	
26	0.50	
27	0.75	
28	0.75	
29	1.50	
30	1.50	
31	0.25	
32	0.50	
33	1.00	southern most repair

Appendix E
Runway Section Inventory

Section by Section Evaluation
Runway 18/36 – August 2010

Section Number	Section Description	Transverse Cracks	Longitudinal Cracks	General Condition	PASER Rating
1	northern end of runway, north of red/clear runway light	7	5	blocks, all sizes, some 5 ft by 10 ft.	FAIR
2	between red/clear and threshold lights	10	5	blocks 5 ft to 20 ft and larger, extensive raveling at south end of section	FAIR
3		6	5	blocks 5 ft to 20 ft by 10 ft to 40 ft.	FAIR
4		5	5	1 ft by 30 ft area of alligator cracking along a longitudinal crack, 7 blocks 5 ft by 20 ft	POOR
5		5	4	one area (1 ft by 30 ft) settling and alligator cracking along centerline; one area (5 ft by 40 ft) incipient alligator cracking on west side; one area (8 ft by 30 ft) alligator cracking on west side; blocks 5 ft by 20 ft.	POOR
6		2	4	no comments	GOOD
7		6	4	20% of section has blocks smaller than 5 ft; other blocks are 10 ft or greater	POOR
8		1	4	large blocks	FAIR
9		3	3	settled and alligator cracking in longitudinal areas 1 ft by 60 ft and 2 ft by 4 ft; large blocks less than 50 ft.	POOR
10		3	3	one area (15 ft by 40 ft) settled with alligator cracks; one area (1 ft by 15 ft) raveled, settled, with alligator cracks; one 1 ft by 20 ft settled crack; on 2 ft by 10 ft settled crack; blocks 5 ft to 20 ft.	POOR
11		6	3	raveled surface, most blocks 5 ft to 10 ft; settling and alligator cracking on on large transverse crack	POOR
12		11	5	blocks 10 ft by 30 ft, variable, some 5 ft or less, raveling on filled cracks	FAIR
13	north of the south 600	7	6	blocks 5 ft by 12 ft, some less than 5 ft	FAIR