Moriarty Municipal Airport (0E0) Pavement Condition and Analysis

Submitted to:

Jane M. Lucero, AICP
Airport Development Administrator
New Mexico Aviation Division
P.O. Box 9830
Albuquerque, NM 87119
tel: 505-244-1788 ext. 111
e-mail: Jane.Lucero@state.nm.us

Prepared by:

Dr. Mark P. Cal, P.E.
Professor and Chair
Department of Civil & Environmental Engineering
801 Leroy Place, Jones Annex
Socorro, NM 87801
tel: (575) 835-5059
e-mail: mcal@nmt.edu

May 18, 2010 (FINAL)

Contents

1. Conditions at Moriarty Airport (0E0) 4

Figure 1. Geographic Location of Moriarty Airport (0E0)..4

Table 1. Moriarty Airport (0E0) Aircraft Operations (2007-2008)..5

Table 2. Moriarty Airport (0E0) Predicted Aircraft Operations 2007-2027 6

Figure 2. Moriarty Airport (0E0) PCI Branch Map, April 28, 2007...7

Figure 3. Moriarty Airport (0E0) PCI Branch Map, April, 2010..8

Table 3. Moriarty Airport (0E0) PCI Measurements for 2007 and 2010 Estimates 9

2. Soil and Aggregate Analysis...10

Figure 4. Borehole Locations at Moriarty Airport (0E0) 10

Figure 5. Base and Subgrade Analysis for Runway 8-26 11

Runway 8-26 11

Figure 6. Base and Subgrade Analysis for Taxiway 1 and Apron 3 12

Taxiway 1...12

Apron 3..12

FWD Analysis...13

Skid Resistance...13

3. Airport Maintenance Completed in November, 2009..13

Table 4. Estimated Effect of Coal Tar Seal on PCI 13

4. Predicted Pavement Conditions Assuming No Maintenance 14

Table 5. Predicted Pavement Conditions (PCI) Assuming no Maintenance After 2010 15

Figure 7. Moriarty Airport (0E0) Predicted PCI Branch Map, April, 2009 16

Figure 8. Moriarty Airport (0E0) Predicted PCI Branch Map for 2010..17

Figure 9. Moriarty Airport (0E0) Predicted PCI Branch Map for 2013..18

Figure 10. Moriarty Airport (0E0) Predicted PCI Branch Map for 2018......................................19

5. Recommend Pavement Design 20

Table 6. Design Aircraft Used for Runway Pavement Design 20

Table 7. Recommended Runway Pavement Design 20

6. Pavement Design for Runway 8-26 21

Table 8. Actual Design Conditions for Runway 8-26 (2010) 21

7. Maintenance and Rehabilitation (M&R) Schedule 21

Figure 11. Typical Pavement Condition as a Function of Time 22

Table 9. Estimated Maintenance and Rehabilitation (M&R) Actions by Year 23

8. Maintenance and Rehabilitation (M&R) Options 24

Table 10. Current NMDOT-Aviation Division Pavement Maintenance Options 25

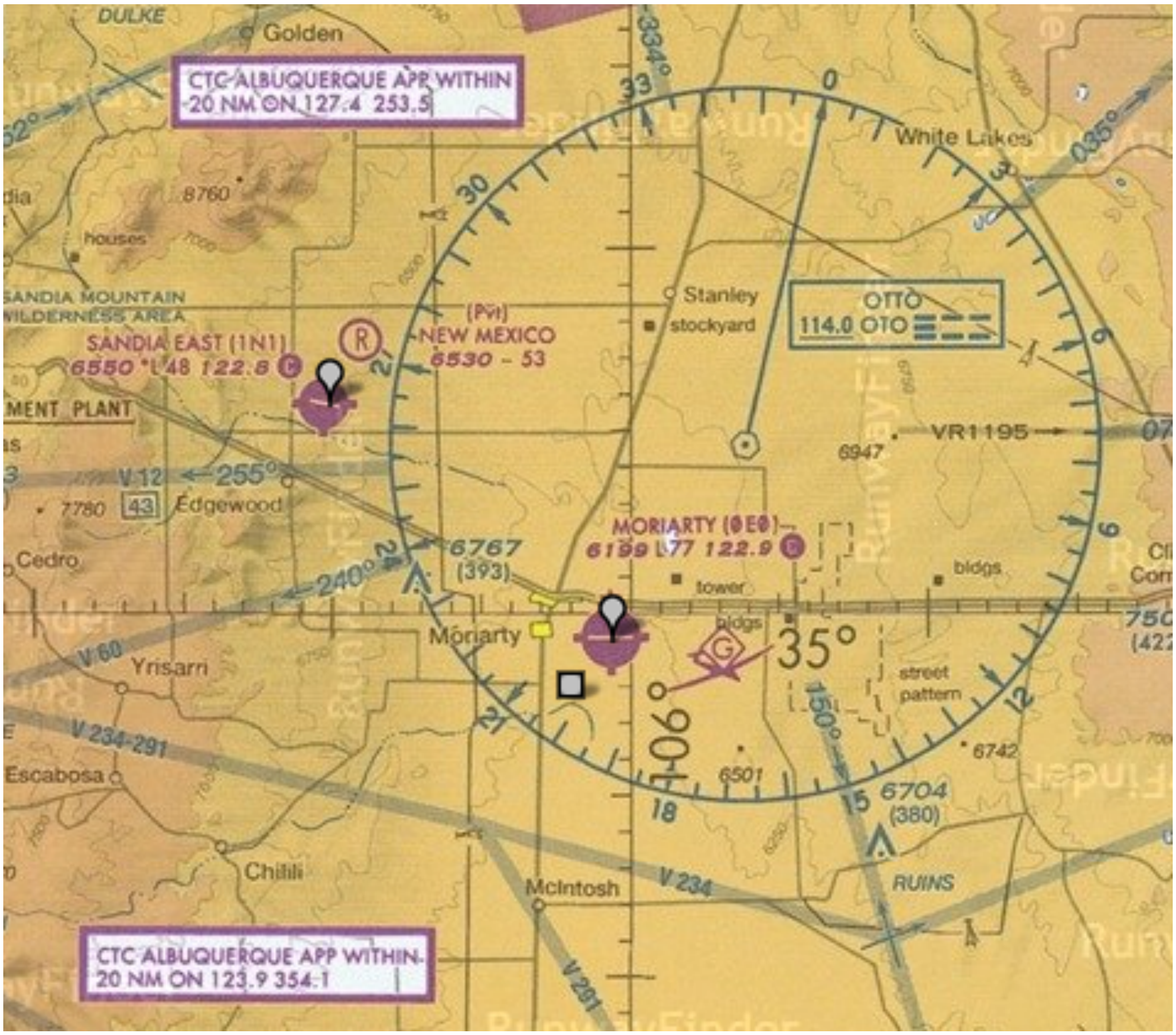
Table 11. Estimated Costs of Seal Coatings at Moriarty Municipal Airport (0E0) Locations 26

9. Bibliography 27

1. Conditions at Moriarty Airport (0E0)

Moriarty Municipal Airport (0E0) is located about 40 miles east of Albuquerque, NM along highway I-80 (Figure 1).

Figure 1. Geographic Location of Moriarty Airport (0E0)



Source: www.skyvector.com

The estimated aircraft traffic at the Moriarty Airport, based on average reported flight data from 2007 to 2008, is presented in Table 1 and predicted aircraft traffic is presented in Table 2. Traffic is mostly small general aviation aircraft, such as Cessna's. Air taxis account less than 1% of the traffic. There is also extensive glider activity at the airport.

Table 1. Moriarty Airport (0E0) Aircraft Operations (2007-2008)

Aircraft Category	Yearly Traffic [no.]	Average Daily Traffic [no.]	Annual Aircraft [%]	Estimated Annual Departures [no.]
General Aviation Itinerant (Transient)	2,070	6	7.0%	1,035
General Aviation Local	27,200	75	92.0%	13,600
Air Taxi*	296	1	1.0%	148
Commercial	0	0	0.0%	0
Commuter	0	0	0.0%	0
Military	0	0	0.0%	0
Total	**29566**			
Estimated Departures	**14783**			

Source: Based on an average of air traffic operations data from 2007-2008.
* Estimated to be less than 1% of traffic.

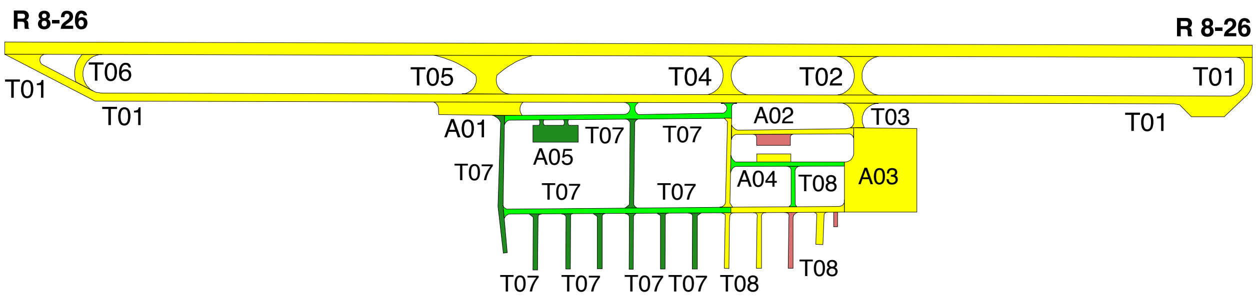
The asphalt concrete pavement on the runway, taxiways, and aprons was last inspected by New Mexico Tech (NMT) during April, 2007. Maps showing the general condition of these areas along with labels for the inspected areas are in presented in Figures 2 and 3. Table 3 shows the results of the April, 2007 pavement inspection, and the 2010 pavement condition index (PCI) estimates, including maintenance completed at the airport in November, 2009, and detailed later in this report.

Table 2. Moriarty Airport (0E0) Predicted Aircraft Operations 2007-2027

	2007	2012	2017	2027
General Aviation Itinerant (Transient)	2,074	2,232	2,403	2,783
General Aviation Local	27,561	29,658	31,927	36,977
Air Taxi	296	296	296	296
Subtotal General Aviation	29,931	32,186	34,626	40,056
Military Itinerant	0	0	0	0
Subtotal Military	0	0	0	0
Total Itinerant	2,370	2,528	2,699	3,079
Total Local	27,561	29,658	31,927	36,977
Total Annual Operations	29,931	32,186	34,626	40,056
GA Itinerant Operations Percentage	6.9%	6.9%	6.9%	6.9%
GA Local Operations Percentage	92.1%	92.1%	92.2%	92.3%
Annual Operations Growth Rate (5 year periods, e.g. 2007-2027)		1.5%	1.5%	1.5%
Average Annual Operations Growth Rate (2007-2027)	1.5%			

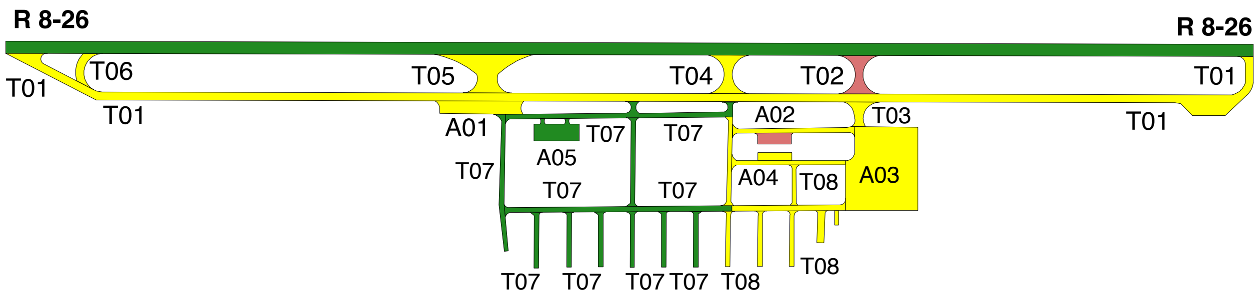
Note: Projections based on *New Mexico System Plan Update*, Wilbur Smith Associates, Inc. (2009).

Figure 2. Moriarty Airport (0E0) PCI Branch Map, April 28, 2007



Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

Figure 3. Moriarty Airport (0E0) PCI Branch Map, April, 2010



Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

Table 3. Moriarty Airport (0E0) PCI Measurements for 2007 and 2010 Estimates

Branch ID	Area [ft^2]	PCI 2007	PCI 2010
ALL*	1,542,225	66	79
Apron 1	40,000	64	62
Apron 2	15,750	55	52
Apron 3	226,000	64	62
Apron 4	10,500	69	70
Apron 5	29,400	100	96
Runway 8-26	577,500	60	99
Taxiway 1	302,500	64	62
Taxiway 2	12,000	58	55
Taxiway 3	7,000	59	56
Taxiway 4	12,000	63	61
Taxiway 5	33,600	59	56
Taxiway 6	10,000	64	62
Taxiway 7	156,750	91	95
Taxiway 8	109,225	61	58

Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

*weighted average PCI

During November, 2009, Runway 8-26 at Moriarty (0E0) was resurfaced with a 3-inch mill and an asphalt concrete overlay. A coal tar seal was applied to the aprons and taxiways.

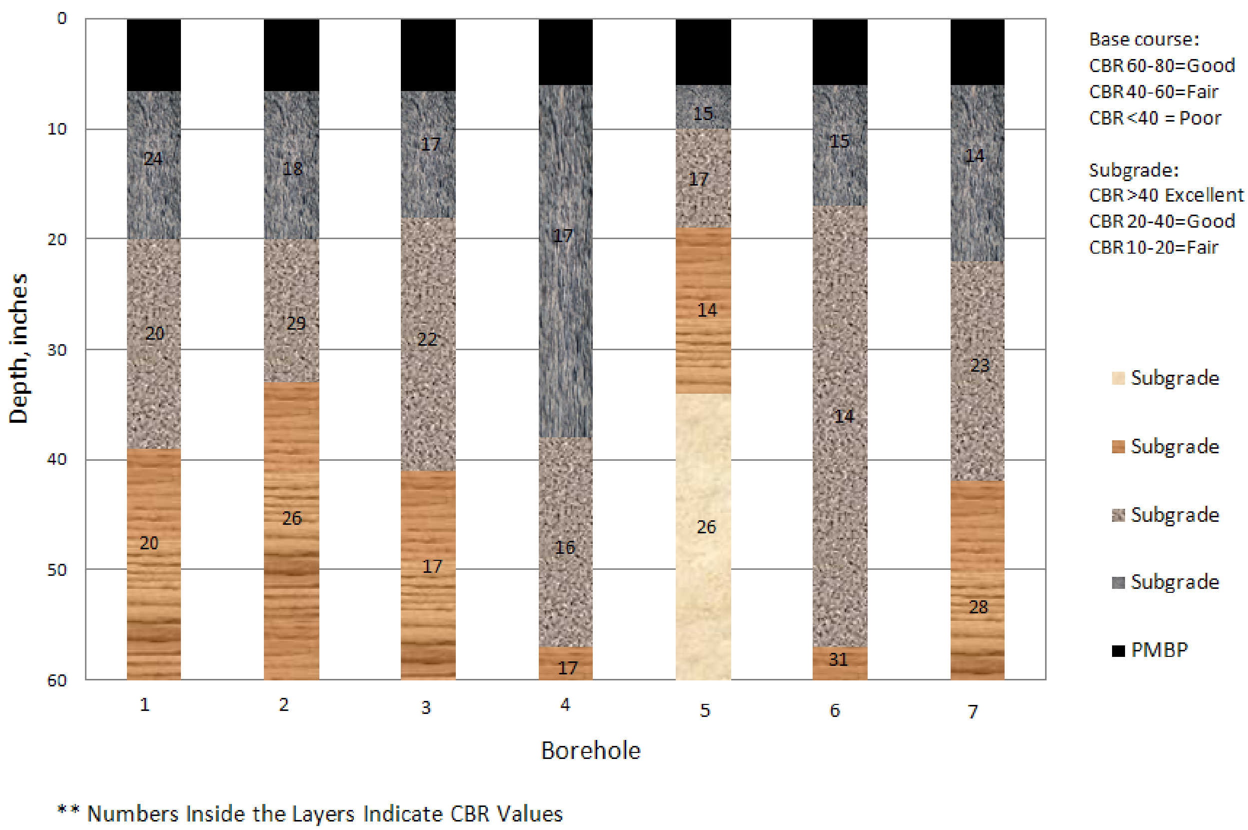
2. Soil and Aggregate Analysis

In March, 2009, the University of New Mexico (UNM) produced a report for the New Mexico Department of Transportation (NMDOT) – Aviation Division on the analysis of boreholes taken from the runways, taxiways and aprons at Moriarty Airport (0E0). The data consisted of asphalt concrete, base and subgrade thicknesses, generalized material compositions and California Bearing Ratio (CBR) for the materials underlying the pavement. In their analysis, samples from 11 boreholes were taken, and most of their locations are shown in Figure 4.

Figure 4. Borehole Locations at Moriarty Airport (0E0)

As part of the March, 2009 pavement and base analysis report, UNM examined Runway 8-26 (Figure 5).

Figure 5. Base and Subgrade Analysis for Runway 8-26

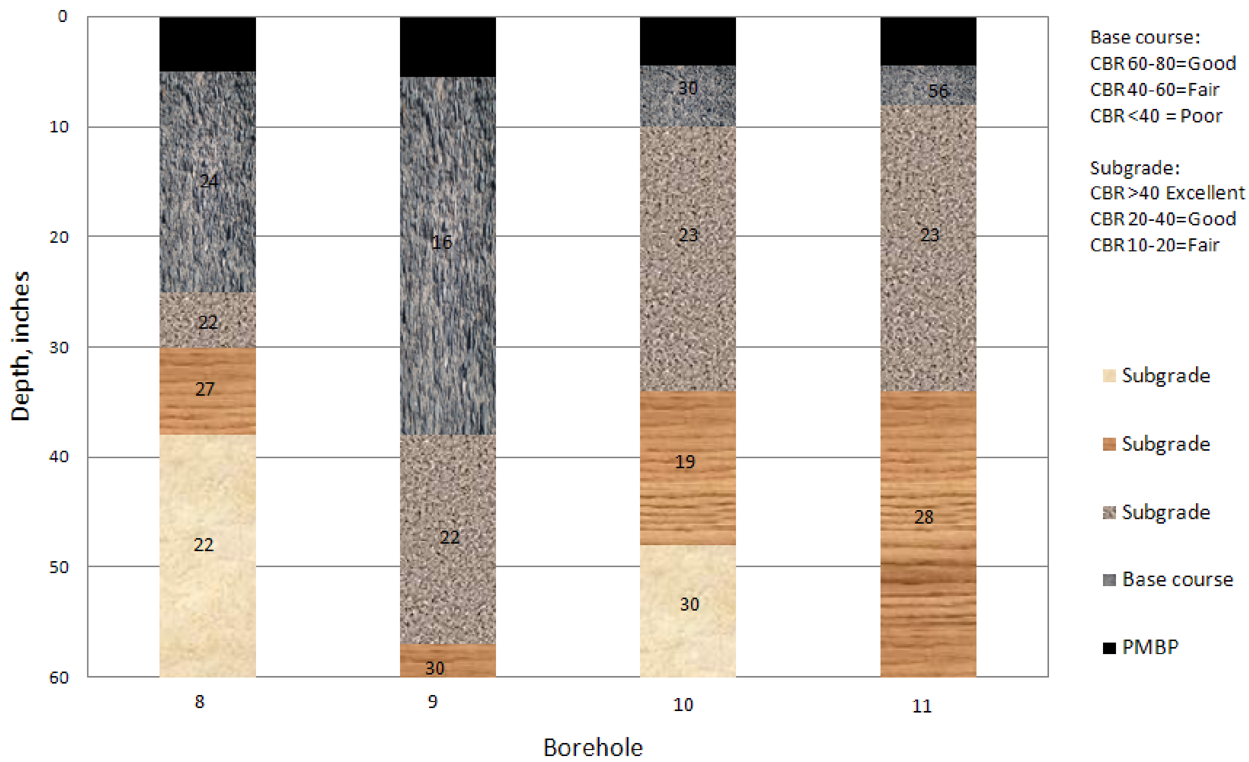


Runway 8-26

Seven borehole samples were taken on *Runway 8-26*. The average asphalt concrete depth was 6-inches. If there was a granular base present under the runway, 6-inches of asphalt concrete would be much more than necessary (see the design section of this report). The asphalt concrete wearing surface was supported mainly by a mixture of silty sand. The average CBR of the silty sand subgrade material was about 21.

During March, 2010, the University of New Mexico (UNM) also produced an analysis of the base and subgrade materials underlying areas of *Taxiway 1* and *Apron 3* (Figure 6).

Figure 6. Base and Subgrade Analysis for Taxiway 1 and Apron 3



** Numbers Inside the Layers Indicate CBR Values

Taxiway 1

Three borehole samples were taken on *Taxiway 1*. The average asphalt depth on Taxiway 1 was 5-inches. The asphalt concrete wearing surface was supported mainly by a mixture of silty sand. The average CBR of the silty sand subgrade material was about 28.

Apron 3

One borehole sample were taken on the *Apron 3*, which is the largest apron. The average asphalt depth on Apron 1 was 5-inches. The asphalt concrete wearing surface was supported mainly by a mixture of silty sand. The average CBR of the silty sand subgrade material was about 28.

FWD Analysis

In a March, 2009 report, the University of New Mexico (UNM) and the New Mexico Department of Transportation (NMDOT) presented data from the use of the falling weight deflectometer (*FWD*) method to analyze the structural capacity of the pavement wearing surface and the subgrade for Runway 8-26. As noted in the report, the modulus values for the asphalt concrete were considered to be satisfactory for the mix of light aircraft utilizing the runway. It was also noted from the *FWD* analysis that the subgrade modulus values were low indicating a weak subgrade. As noted in the CBR analysis, no aggregate base material was present under the pavement areas tested.

Skid Resistance

During March, 2009, the skid resistance of Runway 8-26 was tested at over 70 points along its length on both sides of the runway. The skid resistance of asphalt concrete typically varies from a high of about 70, when the wearing surface is new to a low of about 30, which would be considered critically low. The measured values obtained on Runway 8-26 varied from 24 to 45.

3. Airport Maintenance Completed in November, 2009

In November, 2009, maintenance and reconstruction were completed on Runway 8-26 and the taxiways and aprons. Runway 8-26 was resurfaced with a 3-inch mill and an asphalt concrete overlay, which is considered a major rehabilitation. A coal tar seal was also applied to the aprons and taxiways. Since the airport pavements have not undergone inspection, since April, 2007, the adjustments to the PCI values of the affected areas were estimated using a combination of the previous inspection and engineering judgment. Since Runway 8-26 underwent a major rehabilitation, its PCI value was adjusted to 100. The positive effects of the coal tar seal on the PCI value varied, depending upon the current pavement condition of the affected area (Table 4).

Table 4. Estimated Effect of Coal Tar Seal on PCI

Current PCI Value	Change to PCI Per Year	Number of Years PCI Increased
PCI > 85	PCI + 2	5 years max
65 < PCI < 85	PCI + 3	4 years max
55 < PCI < 65	PCI + 4	3 years max
PCI < 55	PCI + 5	2 years max

4. Predicted Pavement Conditions Assuming No Maintenance

MicroPAVER 6 was used to predict the PCI values of the various pavement sections present at Moriarty Airport, assuming that no future maintenance occurs (Tables 5 and 9 and Figures 7-10). The pavement prediction relies on initial construction dates, when known, the April, 2007 on-site pavement inspection, and engineering judgement, as discussed in *Section 3*. Additional inspection or construction data would increase the reliability of the predictive capabilities of the model.

Table 5. Predicted Pavement Conditions (PCI) Assuming no Maintenance After 2010

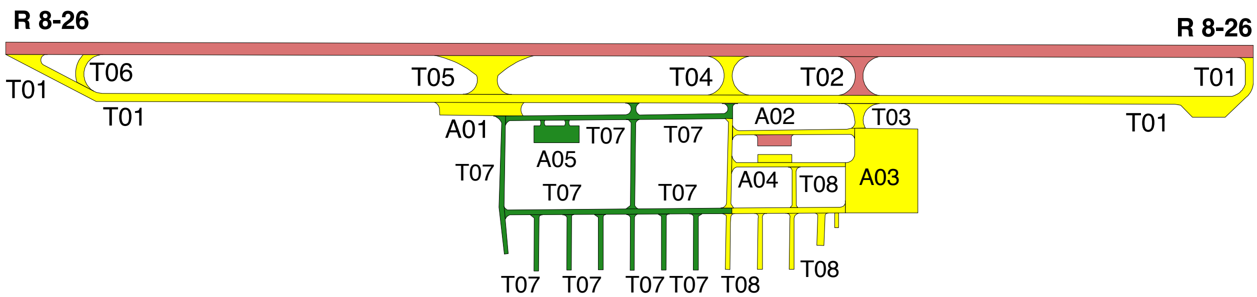
Branch ID	2007	2009	2010	2013	2018
ALL*	66	58	79	70	52
Apron 01	64	56	62	48	24
Apron 02	55	46	52	39	12
Apron 03	64	56	62	48	24
Apron 04	69	62	70	61	39
Apron 05	100	98	96	91	78
Runway 8-26	60	52	99	95	85
Taxiway 01	64	56	62	48	24
Taxiway 02	58	50	55	44	18
Taxiway 03	59	51	56	44	18
Taxiway 04	63	55	61	48	24
Taxiway 05	59	51	56	44	18
Taxiway 06	64	56	62	48	24
Taxiway 07	91	87	95	89	75
Taxiway 08	61	53	58	44	18

Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

*weighted average PCI

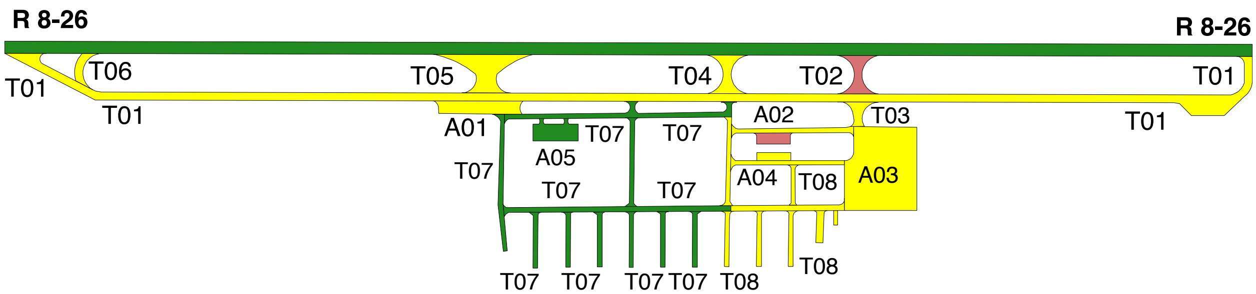
During November, 2009, Runway 8-26 at Moriarty (0E0) was resurfaced with a 3-inch mill and an asphalt concrete overlay. A coal tar seal was applied to the aprons and taxiways.

Figure 7. Moriarty Airport (0E0) Predicted PCI Branch Map, April, 2009



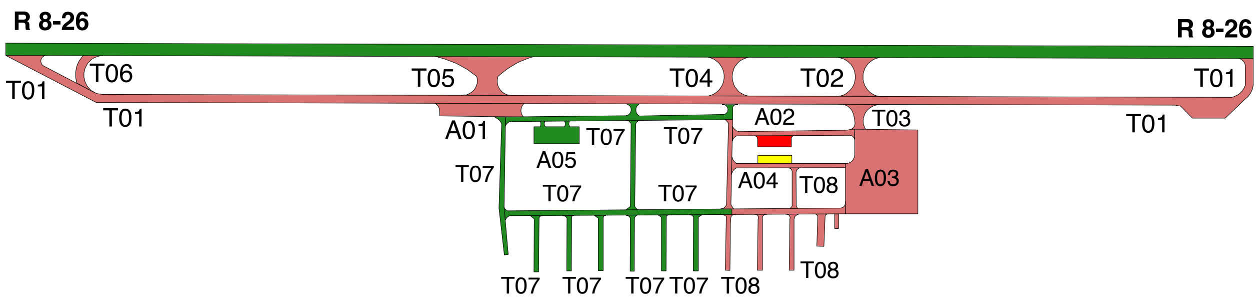
Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	
No Data		

Figure 8. Moriarty Airport (0E0) Predicted PCI Branch Map for 2010



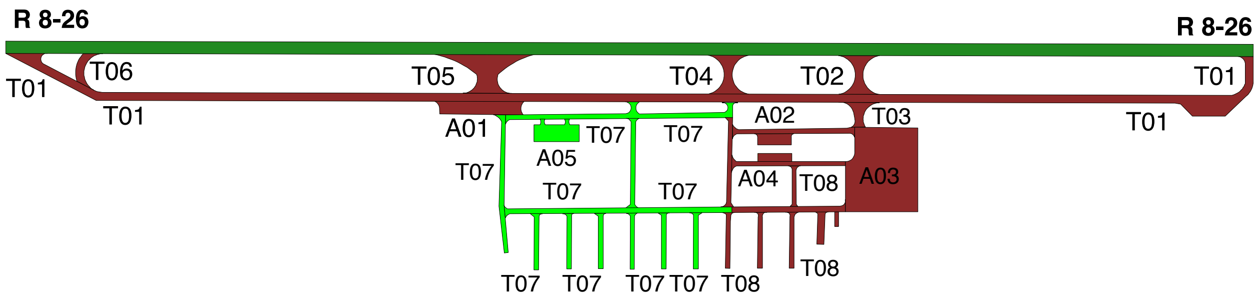
Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

Figure 9. Moriarty Airport (0E0) Predicted PCI Branch Map for 2013



Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

Figure 10. Moriarty Airport (0E0) Predicted PCI Branch Map for 2018



Condition	Scale	Color
Good	100-86	
Satisfactory	85-71	
Fair	70-56	
Poor	55-41	
Very Poor	40-26	
Serious	25-11	
Failed	10-0	

5. Recommend Pavement Design

The recommend asphalt concrete pavement construction was determined using FAA design procedures for the design aircraft detailed in Table 6. FAA designs were completed using the *FAARFIELD version 1.302* airfield pavement design software. A normal FAA asphalt concrete design life of 20 years was assumed for the case listed below. The *CBR* of the subgrade was modeled at values of 10 and 15, which are slightly lower values than attributed to the soil present at Moriarty Municipal Airport. The design pavement and aggregate thicknesses were rounded to the nearest 1/2-inch thickness.

Table 6. Design Aircraft Used for Runway Pavement Design

Aircraft Category	Gross Weight [lb]	Estimated Annual Departures [number]	Annual Aircraft [%]	Annual Growth [%]
Cessna Skyhawk 172	2,558	15,000	99.0%	0%
Super King Air 350	15,100	150	1.0%	0%
Total		15,150		

Table 7. Recommended Runway Pavement Design

Layer Material	Thickness [in]	Modulus [psi]
HMA Asphalt Concrete Surface (P-401/P-403)[1]	2	200,000
Crushed Aggregate (P-209)[2]	3 to 3.5	28,000 to 37,000
Subgrade[3]	CBR = 10 to 15	15,000 to 22,500

1. The asphalt concrete modulus is assumed to have a constant value of 200,000 psi.
2. The crushed aggregate modulus depends upon thickness, and it is estimated by the *FAARFIELD* program.
3. The subgrade modulus (E) is estimated from the *CBR*-value, where $E = 1500 \times CBR$ [psi].

6. Pavement Design for Runway 8-26

Runway 8-26 is currently constructed as follows (Table 8):

Table 8. Actual Design Conditions for Runway 8-26 (2010)

Layer Material	Thickness [in]
Asphalt Concrete (AC)	6.0
Base Course	0
Subgrade (avg. CBR = 21)	≥ 53

Using the design aircraft traffic specified in Table 6, and the data obtained from borehole analysis of the runways, it is determined that Runway 8-26 is adequately designed for lifetime of 20 years, assuming that the design load capacity is not greatly exceeded. Although the runway is adequately designed to support the current aircraft loads, the runway should have a granular aggregate base material present under the pavement wearing surface. The granular base material provides support for the pavement surface and allows for better drainage. It can also help mitigate the effects of climatic conditions such as freezing and thawing.

7. Maintenance and Rehabilitation (M&R) Schedule

The FAA recommends a 20-year lifespan for asphalt concrete airport pavements. As shown in Figure 11, it is much more expensive to perform maintenance on pavements that have deteriorated below a Pavement Condition Index (PCI) of about 60. At this PCI, a major rehabilitation or reconstruction (mill and overlay) is required to substantially increase the PCI-value. This type of treatment would incur a much greater expense compared to rehabilitating pavements with PCI values greater than 60. Rehabilitation of pavements with PCI values below 60 can cost 4 to 5 times as much compared to the rehabilitation of pavements with PCI values greater than 60. It is generally accepted that the maintenance and rehabilitation of taxiways and aprons is of a lower priority than runways, so a lower PCI threshold of around 40 could be used. Therefore, funding priorities typically favor runways.

A combination of data from *MicroPAVER* 6 and engineering judgment was used to generate the data for the estimated M&R schedule presented in Table 9. PCI-values where recommended maintenance should be performed are listed in the table legend. The M&R schedule relies greatly on the pavement inspection performed by NMT during April, 2007, but this inspection only represents a single set of pavement inspection data. Additional inspection data would increase the reliability of the predictive capabilities of the M&R model.

Figure 11. Typical Pavement Condition as a Function of Time

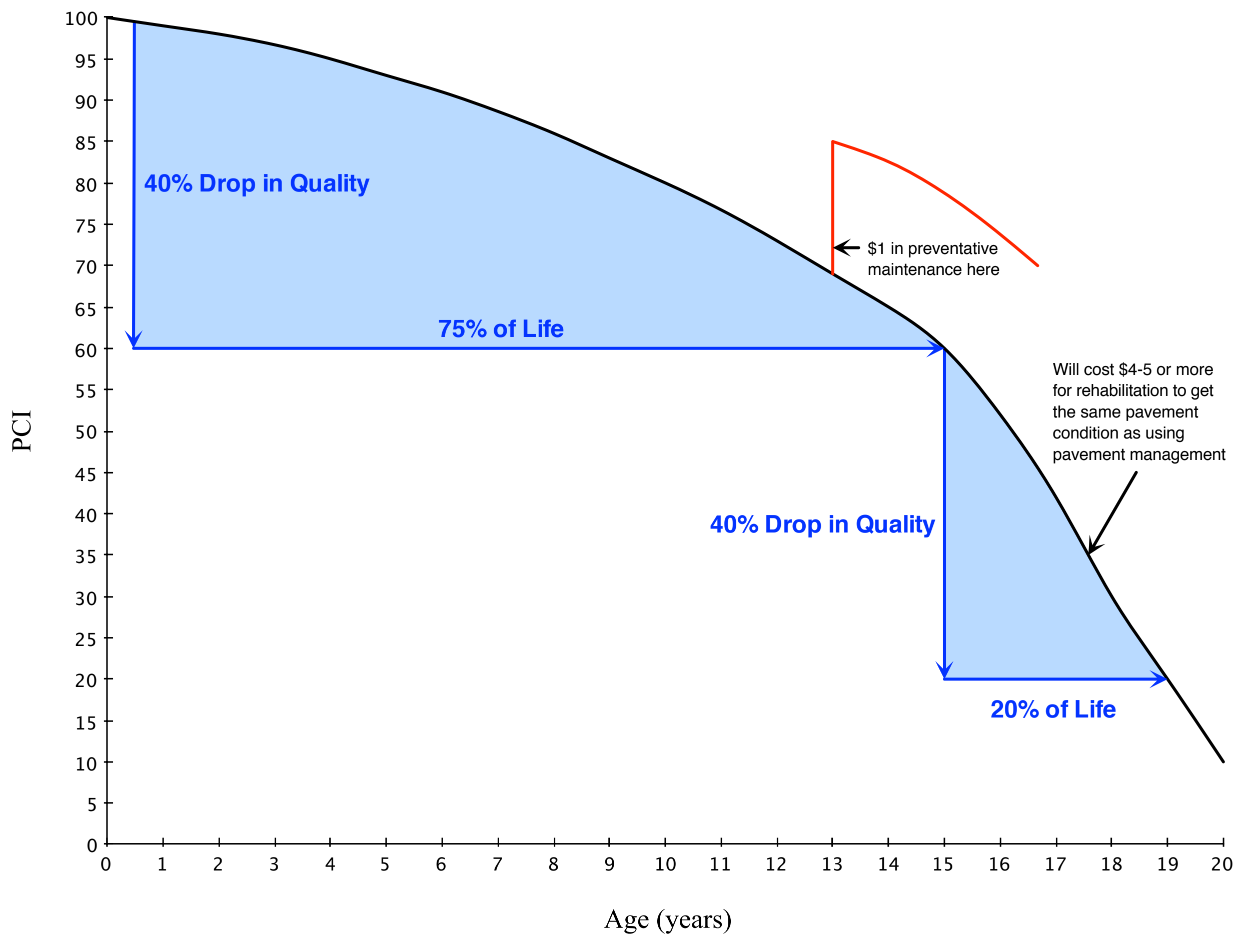


Table 9. Estimated Maintenance and Rehabilitation (M&R) Actions by Year

Branch ID	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ALL*	58	79	76	73	70	67	64	60	56	52
Apron 01	56	62	57	52	48	44	39	34	29	24
Apron 02	46	52	48	44	39	34	29	24	18	12
Apron 03	56	62	57	52	48	44	39	34	29	24
Apron 04	62	70	68	64	61	57	52	48	44	39
Apron 05	98	96	95	93	91	89	86	84	81	78
Runway 8-26	52	99	98	97	95	94	92	90	87	85
Taxiway 01	56	62	57	52	48	44	39	34	29	24
Taxiway 02	50	55	52	48	44	39	34	29	24	18
Taxiway 03	51	56	52	48	44	39	34	29	24	18
Taxiway 04	55	61	57	52	48	44	39	34	29	24
Taxiway 05	51	56	52	48	44	39	34	29	24	18
Taxiway 06	56	62	57	52	48	44	39	34	29	24
Taxiway 07	87	95	93	91	89	86	84	81	78	75
Taxiway 08	53	58	52	48	44	39	34	29	24	18

Legend (maintenance required – general condition)

None - Excellent		PCI ≥ 90 – maintenance is probably not necessary.
Light - Very Good		80 ≤ PCI ≤ 90 – light maintenance, such as crack sealing may be necessary.
Medium - Good		65 ≤ PCI ≤ 80 – medium maintenance, such as crack sealing and surface coating.
Medium to Major - Fair		40 ≤ PCI ≤ 65 – thin mill (half-depth) and overlay.
Major to complete - Poor or worse		PCI ≤ 40 – full-depth mill and overlay, or entire rebuild, if not structurally sound.

During November, 2009, Runway 8-26 at Moriarty (0E0) was resurfaced with a 3-inch mill and an asphalt concrete overlay. A coal tar seal on the aprons and taxiways.

8. Maintenance and Rehabilitation (M&R) Options

NMDOT-Aviation Division currently uses the following pavement maintenance options:

- **Seal coat** – an asphalt seal placed on the top surface of the asphalt concrete pavement. It is used to seal small cracks, reduce pavement binder oxidation at the surface, and improve friction. Typical lifetime is 3-6 years.
- **Crack sealing** – typically, compressed air is used to clean cracks in the pavement, and then the cracks are filled with a sealant. This method reduces water infiltration, and it can prevent cracks from developing into more serious distresses, such as larger pavement pieces breaking loose. Typical lifetime is 3 years.
- **Crack filling (Mastic)** – this method is similar to crack sealing, but the preparation may vary, since more material has to be removed from the cracked area. This method is used for wide cracks. Typical lifetime is 2-3 years.
- **Thermoplastic coal tar emulsion slurry seal** – a proprietary thermoplastic compound derived from coal tar that is also resistant to surface fuel spillage. The thermoplastic coal tar emulsion slurry seal is mixed with aggregate material, and placed on the pavement wearing surface. It can be used for new pavement construction and also for rehabilitation. Typical lifetime is 5-7 years for rehabilitated pavements, and 15 years for new pavements.
- **Emulsified pavement sealer and rejuvenator** – an emulsified sealer and binder that is placed on the pavement wearing surface. The seal provides an anti-oxidative seal for the asphalt pavement surface. Typical lifetime is 3-5 years.
- **Fog seal** – a diluted emulsion, typically 1 part emulsion and 1 part dilutant (e.g. water), is added to the pavement surface. This treatment is used to delay raveling and oxidation. Typical lifetime is 1-2 years.
- **Slurry seal** – a mixture of fine aggregate, asphalt emulsion, water and mineral filler added to the pavement surface. This treatment is used, when excessive oxidation and hardening of the surface is a problem. Slurry seals retard surface raveling, seal small cracks, and improve surface friction. Typical lifetime is 3-5 years.

Estimated and relative costs for typical maintenance options are presented in Table 10. Table 11 contains the cost estimates for seal coating of the various branches at Moriarty Municipal Airport (apron, runway, taxiway), assuming that the entire surface is coated. Since crack treatments depend upon the number and severity of cracks, any cost estimate would have to be based upon visual inspection of the affected areas.

Table 10. Current NMDOT-Aviation Division Pavement Maintenance Options

Crack Treatments	Estimated Cost (Applied) [linear ft]	Relative Cost	Estimated Additional Lifetime [years]
Crack sealing	$0.20	0.80	3
Crack filling	$0.25	1.00	2-3
Surface Treatments	[yd^2]		
Fog seal	$0.15	0.03	1-2
Coal tar sealer (seal coat)	$0.55	0.10	3-6
Emulsified pavement sealer and rejuvenator	$1.00	0.18	3-5
Slurry seal	$1.50	0.28	3-5
Thermoplastic coal tar emulsion slurry seal	$5.42	1.00	5-7

Table 11. Estimated Costs of Seal Coatings at Moriarty Municipal Airport (0E0) Locations

Branch ID	Area [ft^2]	Fog Seal [$]	Seal Coat [$]	Emulsified Pavement Sealer [$]	Slurry Seal [$]	Thermoplastic Coal Tar Emulsion Slurry Seal [$]
Apron 01	40,000	$ 667	$ 2,444	$ 4,444	$ 6,667	$ 24,089
Apron 02	15,750	$ 263	$ 963	$ 1,750	$ 2,625	$ 9,485
Apron 03	226,000	$ 3,767	$ 13,811	$ 25,111	$ 37,667	$ 136,102
Apron 04	10,500	$ 175	$ 642	$ 1,167	$ 1,750	$ 6,323
Apron 05	29,400	$ 490	$ 1,797	$ 3,267	$ 4,900	$ 17,705
Runway 8-26	577,500	$ 9,625	$ 35,292	$ 64,167	$ 96,250	$ 347,783
Taxiway 01	302,500	$ 5,042	$ 18,486	$ 33,611	$ 50,417	$ 182,172
Taxiway 02	12,000	$ 200	$ 733	$ 1,333	$ 2,000	$ 7,227
Taxiway 03	7,000	$ 117	$ 428	$ 778	$ 1,167	$ 4,216
Taxiway 04	12,000	$ 200	$ 733	$ 1,333	$ 2,000	$ 7,227
Taxiway 05	33,600	$ 560	$ 2,053	$ 3,733	$ 5,600	$ 20,235
Taxiway 06	10,000	$ 167	$ 611	$ 1,111	$ 1,667	$ 6,022
Taxiway 07	156,750	$ 2,613	$ 9,579	$ 17,417	$ 26,125	$ 94,398
Taxiway 08	109,225	$ 1,820	$ 6,675	$ 12,136	$ 18,204	$ 65,778

9. Bibliography

Cal, M.P., *Moriarty Municipal Airport (0E0) Inspection and MicroPAVER Database,* New Mexico Tech, Socorro, NM (2007).

Ahmed, M.U. and Tarefder, R.A., *Analysis of FWD Data of the Airfield Pavements at Moriarty Municipal Airport*, University of New Mexico, Albuquerque, NM, March (2009).

Bisht, R. and Tarefder, R.A., *Laboratory Evaluation of the Airfield Pavements at Moriarty Municipal Airport*, University of New Mexico, Albuquerque, NM, March (2009).

Federal Aviation Administration (FAA), *FAARFIELD version 1.302*, Pavement Design Software (3/11/2009).