

Pavement Primer

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House
Transportation,
Public Works and
Capital
Improvements
Committee

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Transportation



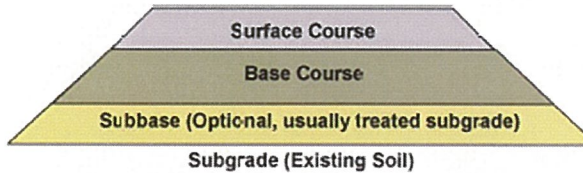
Michael R. Sandoval
Cabinet Secretary





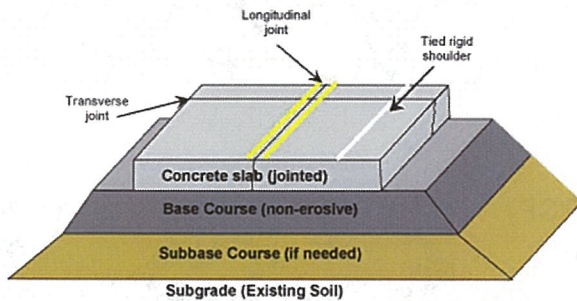
Pavement Types

Flexible: A true **flexible pavement** yields “elastically” to traffic loading. It is constructed with a bituminous surface treatment or a relatively thin surface of hot-mix **asphalt** (HMA) over one or more unbound base courses resting on a subgrade.



flexible (asphalt) pavement

Rigid: Rigid pavements are made from cement concrete or reinforced concrete slabs, laid over a **low** strength concrete layer (Dry lean concrete, DLC) or on a well compacted layer.



Rigid (Concrete) Pavement

Flexible Pavement Treatments



Chip Seal



Micro surfacing



Full-depth Reclamation



cold milling asphalt pavement



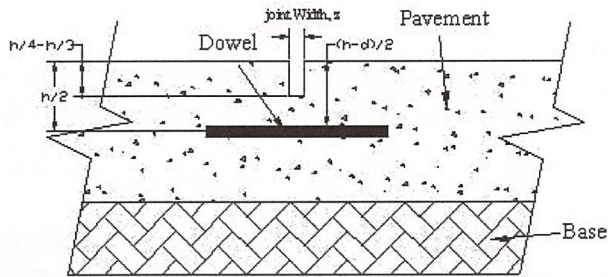
Typical flexible paving



pothole patching

Rigid Pavement

Jointed plain concrete pavement (JPCP)



Continuous reinforced concrete pavement (CRCP)



NMDOT Repair Categories, Definitions & Pavement Treatments

NMDOT Pavement Management and Design Bureau

| Repair Category | Definition | Pavement Treatment |
|--------------------------------------|--|--|
| <p>Preventive Maintenance</p> | <p>A planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity).</p> | <p>Crack Seal - <i>Involves the placement of an adhesive material into and/or over working cracks at the pavement surface in order to prevent the infiltration of moisture into the pavement structure.</i></p> <p>Fog Seal - <i>Fog sealing is overlying an existing pavement surface with an asphalt binder, sometimes topping with sand.</i></p> <p>Joint and Crack Seal (PCCP) - <i>Joint resealing consists of removing existing deteriorated transverse and/or longitudinal joint sealant, refacing and pressure cleaning the joint sidewalls, and installing new sealant material. Crack sealing consists of sawing, power cleaning, and sealing cracks in concrete pavement using high-quality sealant materials.</i></p> |
| <p>Preservation (Minor)</p> | <p>A network-level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices to extend pavement life, improve safety, and meet motorist expectations but does not increase its load carry capacity or strength.</p> | <p>Scrub Seal - <i>A scrub seal is an application that is very close to a chip seal treatment where asphalt emulsion and crushed rock are placed on an asphalt pavement surface. The only difference is that the asphalt emulsion is applied to the road surface through a series of brooms placed at different angles.</i></p> <p>Chip Seal - <i>Chip seals consist of a sprayed application of asphalt (commonly an emulsion, although heated asphalt cement and cutbacks are used as well) directly to the pavement surface (0.35 to 0.50 gal/yd²), followed by application of aggregate chips (15 to 50 lb. /yd²), which are then immediately rolled to achieve 50% to 70% embedment.</i></p> <p>Slurry Seal - <i>consists of a mixture of well-graded aggregates (fine sand and miller filler) and asphalt emulsion that is spread over the surface of the pavement using a squeegee or a spreader box fixed to the back of the truck that is depositing the mixture.</i></p> <p>Cape Seal - <i>Combination of a chip seal and slurry seal, with the slurry seal placed atop the chip seal typically 4 to 10 days after placement of the chip seal.</i></p> |

| Repair Category | Definition | Pavement Treatment |
|------------------------------------|--|--|
| | | <p>ROGFC/OGFC – <i>Open graded asphalt mixes are designed to be permeable to water, which differentiates them from dense graded (Superpave) and stone matrix (SMA) mixtures. Typically placed as wearing course, the OGFC improves skid resistance, reduces splash and spray, and reduces noise. ROGFC includes rubberized polymer binder.</i></p> <p>Microsurfacing - <i>Microsurfacing is a mixture of crushed, well-graded aggregate, mineral filler (portland cement), and latex-modified emulsified asphalt spread over the full width of pavement with either a squeegee or spreader box.</i></p> <p>Plant Mix Wearing Course overlay or NovaChip Overlay - <i>A NovaChip Overlay is the placing an asphalt membrane on an existing pavement then overlying it with an ultra-thin, coarse aggregate hot mix.</i></p> <p>Diamond Grinding (PCCP) - <i>Diamond grinding consists of removing a thin layer of concrete (usually between 0.12 and 0.25 in.) from the pavement surface, using special equipment fitted with a series of closely spaced diamond saw blades.</i></p> <p>Diamond Grooving (PCCP) - <i>Diamond grooving consists of cutting narrow, discrete grooves into the pavement surface, which helps to reduce hydroplaning, vehicle splash and spray, and wet-weather crashes.</i></p> |
| <p>Preservation (Major)</p> | <p>A network-level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices to extend pavement life, improve safety, and meet motorist expectations but does not increase its load carry capacity or strength.</p> | <p>Pavement Resurfacing and Curb line milling or Cutler or Dustrol (1.5" to 2.5")</p> <ul style="list-style-type: none"> - Hot In-Place Recycling (Remixing) (1.5" to 2.5") <i>Pavement is heated, loosened, combined with virgin aggregate and new asphalt (and/or new HMA), and relaid for significant mix improvement/modification and/or modest pavement strengthening. The recycled mix can serve as the final wearing surface (low volume roads) or can serve as a base for an HMA overlay or surface treatment (moderate- to high-volume roads).</i> |

| Repair Category | Definition | Pavement Treatment |
|-------------------------------|--|---|
| | | <ul style="list-style-type: none"> - Hot In-Place Recycling (Heater Scarification) (1.5" to 2.5") or Cutler or Dustrol – <i>The wearing surface (typically 1.5" to 2.5") is heated, loosened and mixed with new asphalt binder and re-laid and compacted.</i> - Hot In-Place Recycling (Repaving) (1.5" to 2.5") Cold Mill Asphalt Recycling (Warm or Cold) <i>Pavement surface is heated, loosened, combined with new asphalt, and relaid in tandem with an HMA overlay for the purposes of pavement strengthening and restoration of surface profile and/or friction.</i> <p>HMA/WMA Mill and Inlay (1.5" to 2.5")</p> <p>SMA Mill and Inlay (1.5" to 2.5") – <i>A Hot Mix Asphalt consisting of a mix of asphalt cement, stabilizer material, mineral filler and gap graded aggregate.</i></p> <p>Patch (Full Depth isolated areas) (PCCP) - <i>Patches are used to treat localized slab problems such as spalling, scaling (e.g., reactive aggregate distress, over-finishing the surface), joint deterioration, corner breaks or punchouts. If the problem is limited in depth, then a partial depth patch may be appropriate, otherwise, a full depth patch is recommended.</i></p> <p>Slab Replacement < 5% (PCCP) <i>Selective slab replacement involves removing the deteriorated concrete down to the base, repairing the disturbed base, installing load-transfer devices, and refilling the excavated area with new concrete.</i></p> <p>Dowel Bar Retrofit (PCCP) – <i>Includes the installation of dowel bars to restore load transfer across existing transverse joints. Dowel bars are retrofitted in existing concrete pavements either that do not have dowel bars or in which the existing bars are not working effectively.</i></p> |
| Rehabilitation (Minor) | Nonstructural enhancements (e.g., thin hot-mix asphalt [HMA] overlay, mill and thin HMA overlay) made to | <p>HMA/WMA Mill and Inlay 2.5" to 4"</p> <p>Pavement Resurfacing and Curb line milling Cutler (2.5" to 4")</p> |

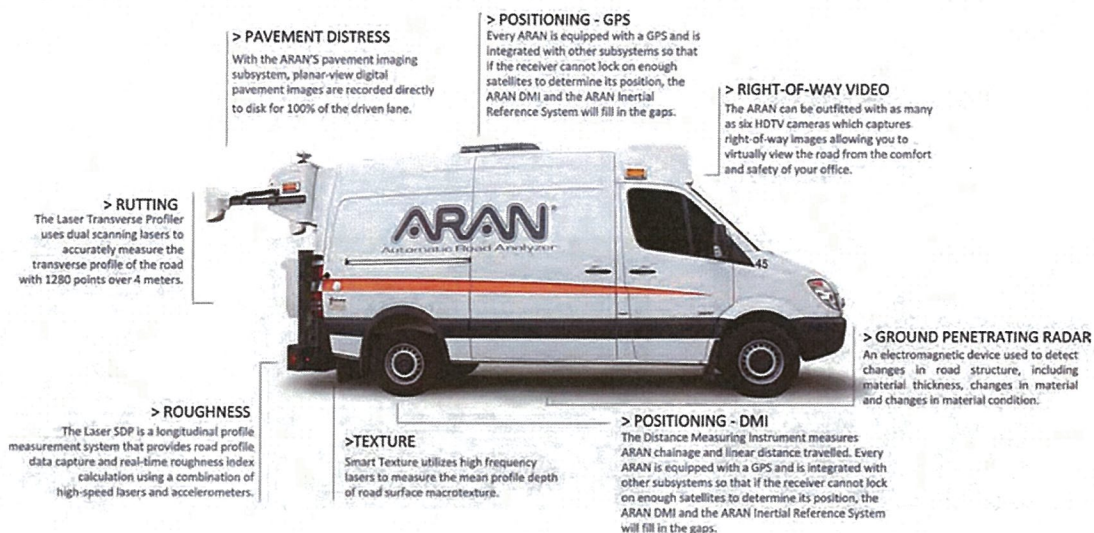
| Repair Category | Definition | Pavement Treatment |
|--------------------------------------|---|--|
| | <p>an existing pavement section to either eliminate age-related, top-down surface cracking that develops in flexible pavements due to environmental exposure or to restore functionality of concrete pavements.</p> | <ul style="list-style-type: none"> - Hot In-Place Recycling (Remixing) (2.5" to 4") <i>Pavement is heated, loosened, combined with virgin aggregate and new asphalt (and/or new HMA), and relaid for significant mix improvement/modification and/or modest pavement strengthening. The recycled mix can serve as the final wearing surface (low volume roads) or can serve as a base for an HMA overlay or surface treatment (moderate- to high-volume roads).</i> - Hot In-Place Recycling (Heater Scarification) <i>The wearing surface (typically 2.5" to 4") is heated, loosened and mixed with new asphalt binder and re-laid and compacted.</i> - (2.5" to 4") HMA/WMA Overlay 2.5" to 4" – <i>Generally used with vertical restrictions or to correct severe surface defects, Mill and overlay may increase the overall pavement height slightly i.e. Mill 3", Overlay 4".</i> <p>SMA Mill and Inlay (2.5" to 4.0") - A Hot Mix Asphalt consisting of a mix of asphalt cement, stabilizer material, mineral filler and gap graded aggregate.</p> <p>Slab Stabilization (isolated joint faulting) (PCCP) – <i>Consists of pressure insertion of a flowable material (commonly a cement based grout or polyurethane material) beneath the concrete pavement slab to fill voids and restore full support.</i></p> <p>HMA Overlay (2.5" to 4") (PCCP)</p> <p>Bonded Overlays (2.5" to 5") (PCCP) – <i>sometimes referred to thin or ultra-thin whitetopping are placed on existing asphalt pavement to eliminate surface distress and correct pavement deformation such as rutting, corrugation and shoving). The treatment is characterized by the placement of a thin concrete layer onto a cold-milled asphalt surface.</i></p> |
| <p>Rehabilitation (Major)</p> | <p>Structural enhancements that extend the service life of an existing pavement or improve its load-carrying capability or both.</p> | <p>HMA/WMA Mill and Inlay greater than 4" –</p> <p>Pavement Resurfacing and Curb line milling Cutler greater than 4" –</p> <ul style="list-style-type: none"> - Hot In-Place Recycling (Remixing) greater than 4" – <i>Pavement is heated, loosened, combined</i> |

| Repair Category | Definition | Pavement Treatment |
|-----------------|------------|--|
| | | <p>with virgin aggregate and new asphalt (and/or new HMA), and re-laid for significant mix improvement/modification and/or modest pavement strengthening. The recycled mix can serve as the final wearing surface (low volume roads) or can serve as a base for an HMA overlay or surface treatment (moderate- to high-volume roads).</p> <ul style="list-style-type: none"> - Hot In-Place Recycling (Heater Scarification) greater than 4" - The wearing surface (typically 2.5" to 4") is heated, loosened and mixed with new asphalt binder and re-laid and compacted. <p>HMA Overlay greater than 4" -</p> <p>Process Place and Compact W/Overlay – Process by which the existing pavement is pulverized into homogeneous mixture. Could include underlying aggregate. Typically does not include additive.</p> <p>Cold Central Plant Recycling (CCPR) - Cold-mix asphalt recycling is defined as a process in which reclaimed asphalt pavement (RAP) materials are combined with new asphalt and/or recycling agents to produce cold base mixtures. The term "cold-mix recycling" generally refers to central plant mixing and is done without application of heat. Central plant recycling is used for asphalt cold- mix recycling projects that require high rates of production or close control of the mix design.⁽¹⁾ Central plant recycling is used when stockpiles of RAP are available or when the existing pavement has to be removed off site for some reason and in-place recycling is not an option. Typical compacted thickness of 2.5 to 3.5 inches.</p> <p>Cold In Place Recycling (CIR) - Cold in-place recycling (CIR) is a process that consists of milling and sizing reclaimed asphalt pavement (RAP) and mixing in-place the RAP with recycling additive and new aggregate (either in the milling machine's cutting chamber or in a mix paver) to produce a recycled cold mix, which is then re-laid and compacted as a new base course. Typical compacted thickness of 2 to 5 inches.</p> |

| Repair Category | Definition | Pavement Treatment |
|-----------------------|---|--|
| | | <p>Full Depth Reclamation (FDR) - A technique in which the full thickness of the existing asphalt pavement and a predetermined portion of the underlying materials (base, subbase, and/or subgrade) are uniformly pulverized and blended to provide a homogeneous material. NMDOT experience has been with foamed asphalt and mineral filler. Typically compacted thickness of 6 to 8 inches.</p> <p>Slab Stabilization (PCCP) - Consists of pressure insertion of a flowable material (commonly a cement based grout or polyurethane material) beneath the concrete pavement slab to fill voids and restore full support.</p> <p>Slab Replacement 5 to 15% (PCCP) - Selective slab replacement involves removing the deteriorated concrete down to the base, repairing the disturbed base, installing load-transfer devices, and refilling the excavated area with new concrete.</p> <p>Unbonded Concrete Overlay (4" - 11") - (50% of Crack/Seal) (PCCP) – Unbonded concrete overlays are essentially designed as new pavement with the overlaid pavement acting as a base.</p> <p>Crack and Sealing with 6" HMA Overlay (PCCP) - A Crack and Seal operation is the fracturing of an existing PCC pavement and overlaying it with 6" HMA.</p> |
| Reconstruction | Replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure. Reconstruction is required when a pavement has either failed or has become functionally obsolete (HMA and PCCP) | <p>Reconstruction – Is the replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure. (HMA and PCCP).</p> <p>Rubblizing (PCCP) – Process of rubblizing the concrete pavement into fragments typically combined with HMA overlay.</p> |

Pavement Data Collection in New Mexico

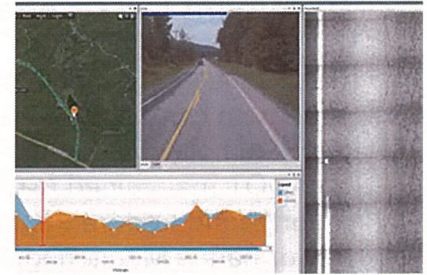
NMDOT issued a Request for Proposals in 2013 to initiate automated data collection for pavement condition and asset collection. This was a single year contract which included collection on the state maintained network of approximately 27,400 lane miles, non-DOT maintained National Highway System roads and additional routes required to report to the Federal Highway Administration (FHWA) for the annual Highway Performance Monitoring System (HPMS) requirements. A second RFP was issued in 2014 to collect pavement condition data on the Interstates and National Highway System (NHS) routes on an annual basis and the remainder of the state maintained system on a two-year cycle. The contract was a four-year contract. The current contract is also a four-year contract; however, through the RFP process a different contractor was selected. The picture below is of one of the collection vehicles.



The contractor provides NMDOT with pavement data to assist with federal reporting and to populate our pavement management system database (PMSdb). Rutting, International Roughness Index (IRI) and cracking are collected for each tenth mile for flexible pavements and faulting, cracking and IRI are collected for rigid pavements. In addition, the contractor provides forward facing photos of every mile collected as well as downward facing photos of the pavement.

The pavement data is collected in the right lane (driving lane) on multi-lane highways and in both directions. On two-lane highways, the pavement condition data is collected

in the northbound or eastbound direction of the route. Pavement data collection is approximately \$700,000 per year for approximately 15,000 lane miles per year. The contractor is responsible for following the NMDOT's Pavement Data Quality Management Plan which includes preparing their internal quality control plan. NMDOT Pavement Management and Design Bureau staff are responsible for performing quality assurance reviews of the pavement data as well as the photolog images. NMDOT staff perform random sampling of approximately ten percent of the data provided by the contractor. The contractor provides a desktop application that offers synchronized viewing of pavement data. The current contractor is Fugro and their iVision application is web-based. Once the data collection cycle has been completed each year and the quality assurance reviews have been completed, the data is uploaded into the PMS database.



Pavement Distress

Flexible Pavements



Raveling



Bleeding



Alligator Cracking



Transverse Cracking



Longitudinal Cracking



Edge Cracking

The above pictures represent the typical distresses that are collected through our pavement data collection efforts on flexible or asphalt pavements. Each type of distress tells us something different about the pavement and whether the distress is due to aging, environmental or structural factors and how NMDOT treats that distress in determining the overall pavement condition index of the pavement.

Rigid Pavements



Corner Break



Faulting



Joint Seal Damage



Longitudinal Cracking



Spalling of transverse cracks



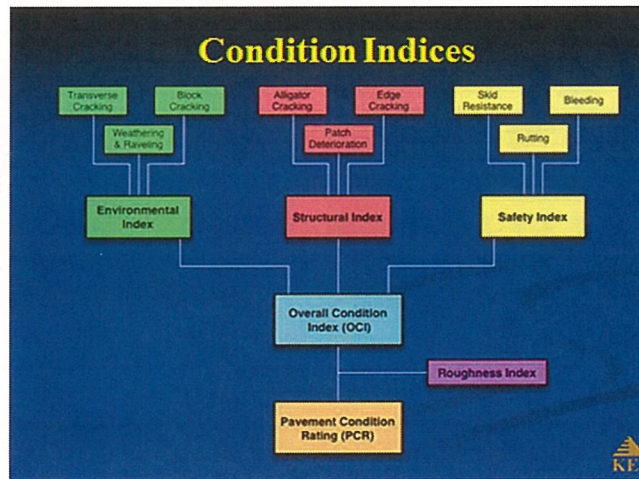
Transverse Cracks

The types of distresses on jointed concrete pavement and continuously reinforced concrete pavement are similar. NMDOT only has one location where continuously reinforced concrete pavement (CRCP) is used in the state on NM 136 near Santa Teresa and it is currently being constructed. All of the above distresses are for jointed concrete pavement (JCP). Faulting and corner breaks are not expected on CRCP and joints are typically limited to between lanes.

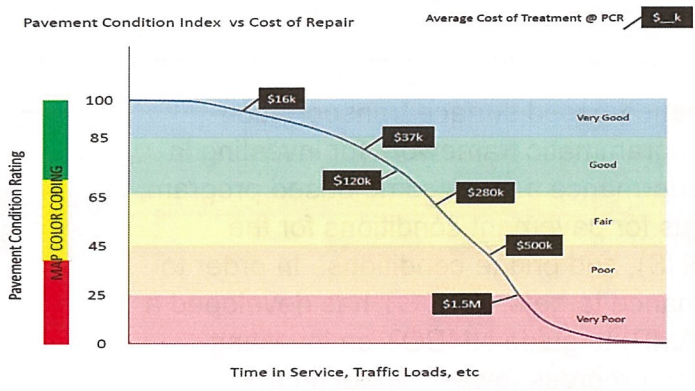
Pavement Management

MAP-21 created a streamlined and performance-based surface transportation program which transforms the policy and programmatic framework for investing in transportation. In order to transition to a performance and outcome based program, NMDOT has established performance targets for pavement conditions for the Interstate and National Highway System (NHS), and bridge conditions. In order to show progress towards meeting the performance targets, NMDOT has developed a Transportation Asset Management Plan (TAMP) to guide NMDOT on investing resources in a program of projects that shows progress towards meeting the performance targets. The TAMP establishes the condition of highway and bridge assets across the state and provides a strategy for efficiently maintaining these assets in a state of good repair over the long term. For NMDOT, Transportation

Asset Management ensures better operation, increased maintenance and overall improvement of physical assets through a process of continuous improvement by better locating and understanding performance gaps, prioritizing and programming asset needs and streamlining business processes. In order to track condition of our pavements based on the data collected, NMDOT uses the PMSdb to store the data and determine which roads to provide the proper treatment at the proper time. The PMSdb contains many decision trees based on the type of pavement, flexible or rigid, last treatment type and date and overall condition index. The pavement distresses described under the Pavement Data Collection section are entered into the PMSdb.

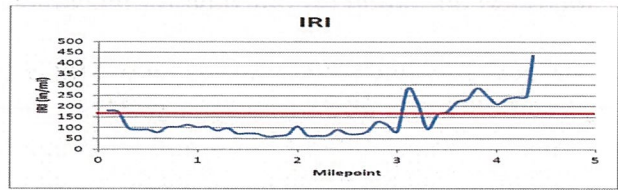
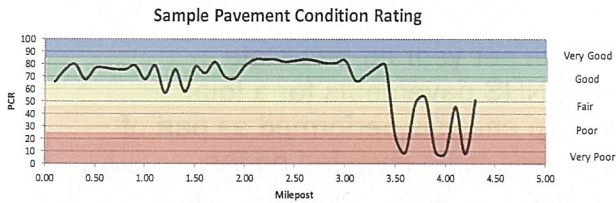


The data are used to assign a pavement condition rating to each two-mile managed segment in the PMSdb. There are several different types of cracking in flexible pavements and each type of cracking is assigned to a category based on the condition index and then combined to determine an overall condition index. The IRI is converted to the roughness index and accounts for twenty percent of the Pavement Condition Rating (PCR). NMDOT uses a 0 to 100 scale for the PCR. The current PCR is used to determine what treatment should be made to the pavement in order to maintain or improve the current condition rating. The chart below shows the cost per lane mile for each treatment category in the PMSdb and definitions of the action NMDOT should take based on the PCR and last treatment performed.

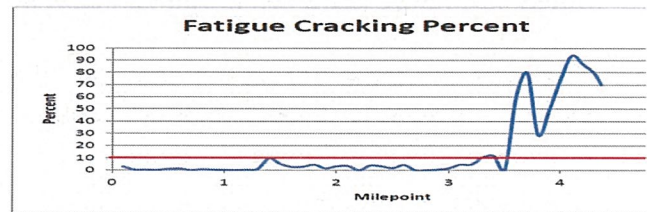
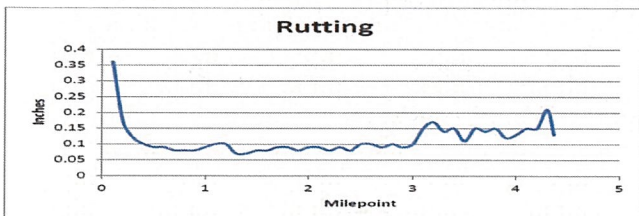


| PCR Range | Condition | Suggested Treatment |
|-----------|-----------|---|
| 100-86 | Very Good | Monitor – Minor preservation: monitor, fog seals, surface coats, chip seal |
| 85-66 | Good | Major preservation: thin hot in-place recycling, thin mill and inlay |
| 65-51 | Fair | Minor – Major preservation: mill and inlay between, hot in-place recycling 2.5-4" |
| 50-46 | At Risk | Minor – Major rehabilitation |
| 45-26 | Poor | Major rehabilitation – 5 inches deep to PPC, FDR |
| 25-0 | Very Poor | Reconstruction |

For each project in the Statewide Transportation Improvement Program (STIP), NMDOT prepares a pavement condition report and preliminary pavement design which includes graphs for PCR, IRI, Rutting and Cracking.

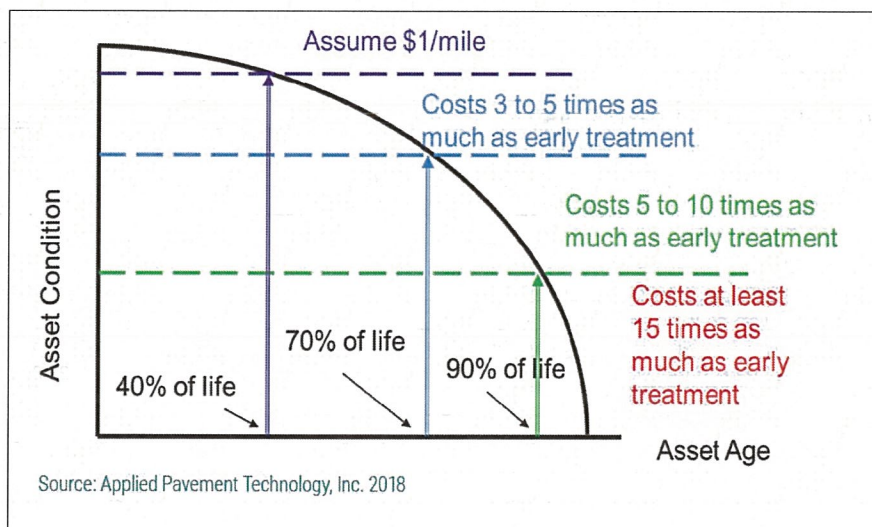


The section from approximately 3.0-end of route fails this metric.



The section from approximately 3.2-end of route fails this metric.

NMDOT is utilizing the prediction capabilities built into the PMSdb to model future conditions, at defined funding levels in order to produce recommended treatments for each two-mile managed segment of NMDOT maintained roads. The PMSdb decisions trees were developed to optimize funding and to prioritize the roads in good condition. Many roads that are in the poor category aren't identified for funding using this methodology until they fail due to funding constraints. The following graph is a representation of the cost differential due to deferring maintenance.



Source: Applied Pavement Technology, Inc. 2018

Based on ten-year scenarios modeled during development of the TAMP and future performance targets, the NMDOT identified a significant funding and performance

gap. Based on output from the model, NMDOT is unable to maintain current conditions over a ten-year period at current funding levels. In order to maintain current condition over the next ten-years, it was determined that NMDOT needs to increase spending on our pavements which requires additional recurring revenues.

NMDOT has historically spent an average of \$62 million per year on Interstate pavements and \$68 million per year on non-Interstate NHS pavements for a total annual NHS pavement budget of \$130 million. The gap analysis performed as part of the Initial TAMP showed that \$81.5 million per year needs to be invested on the Interstate system and \$212.5 million on the remainder of the NHS; however, this does not take into account areas where the pavement needs to be reconstructed as those segments were not prioritized with the available \$240 million in funding.

The following table shows the cost per mile information contained in the PMSdb and staff are reviewing to determine frequency of updating this information.

| Repar Category | Treatment | Average Cost | |
|------------------------|---|----------------|----------------|
| Monitor | Monitor | | |
| Preventative | Crack Seal | \$19,221.33 | \$11,773.07 |
| | Fog Seal | \$4,324.80 | |
| Patch | Patch | \$10,451.60 | |
| Preservation (Minor) | Scrub Seal | \$11,412.67 | \$106,489.79 |
| | Chip Seal | \$14,416.00 | |
| | Slurry Seal | \$36,892.50 | |
| | Cape Seal | \$36,892.50 | |
| | OGFC | \$44,449.33 | |
| | Micro Surfacing | \$42,046.67 | |
| | Plant Mix Wearing Course overlay - Nova Chip | \$69,677.33 | |
| Preservation (Major) | Pavement Resurfacing and Curb line milling Cutler (1.5" to 2.5") | \$114,126.67 | |
| | Hot In-Place Recycling (remixing) (1.5" to 2.5") | \$132,146.67 | |
| | Hot In-Place Recycling (Heater Scarification) (1.5" to 2.5") | \$120,133.33 | |
| | Cold Mill Asphalt Recycling (Warm or Cold) | \$66,073.33 | |
| | HMA/WMA Mill and Inlay (1.5" to 2.5") | \$120,133.33 | |
| | SMA Mill and Inlay (1.5" to 2.5") | \$144,160.00 | |
| Rehabilitation (Minor) | HMA/WMA Mill and Inlay (2.5" to 4") | \$279,910.67 | \$230,437.36 |
| | Hot In-Place Recycling (Remixing) (2.5" to 4") | \$275,105.33 | |
| | Hot In-Place Recycling (Heater Scarification) (2.5" to 4") | \$249,877.33 | |
| | Pavement Resurfacing and Curb line milling Cutler (2.5" to 4") | \$192,213.33 | |
| | HMA/WMA Overlay (2.5" to 4") | \$128,542.67 | |
| | SMA Mill and Inlay (2.5" to 4") | \$336,373.33 | |
| Rehabilitation (Major) | HMA/WMA Mill and Inlay greater than 4" | \$609,076.00 | \$492,126.20 |
| | Hot In-Place Recycling (Remixing) greater than 4" | \$535,194.00 | |
| | Hot In-Place Recycling (Heater Scarification) greater than 4" | \$502,758.00 | |
| | Pavement Resurfacing and Curb line milling Cutler greater than 4" | \$432,480.00 | |
| | HMA Overlay greater than 4" | \$297,330.00 | |
| | Process Place and Compact W/Overlay | \$257,686.00 | |
| Reconstruction | Full Depth Reclamation (FDR) | \$540,600.00 | |
| | Reconstruction | \$1,802,000.00 | \$1,802,000.00 |

References:

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- Strategic Highway Research Program 2 (SHRP 2), 2011 *Guidelines for Preservation of High-Volume Roadways*
- National Cooperative Highway Research Program (NCHRP) Report 673, "A Manual for Design of Hot Mix Asphalt with Commentary"
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- New Mexico Department of Transportation (NMDOT), 2018 *Initial Transportation Asset Management Plan*.
- Applied Pavement Technology, Inc. 2018 graphs

