PAVEMENT MANAGEMENT REPORT 2011

COUNTY OF RIVERSIDE
TRANSPORTATION DEPARTMENT

PAVEMENT MANAGEMENT REPORT

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EXECUTIVE SUMMARY

This report presents a summary of the Riverside County pavement management system and provides condition data regarding the County's roadway system. It provides an explanation of the importance of having a pavement management system that guides and supports the County in determining pavement needs and priorities within the funding budget. It further describes certain critical key points as far as understanding pavement life cycle and its ranking approach in implementing cost-effective strategies such as the use of pavement preservation through preventive maintenance on roads in good condition.

The County of Riverside Transportation Department uses a Pavement Management Program (PMP) that serves as a management tool providing an inventory of all roadways, assessment and rating of pavement condition, records of historical maintenance, budget needs forecasting, and impacts of funding on Countywide pavement condition over time. The PMP has also been updated to reflect the decrease in County maintained roads due to the recent (within the last 5 years) incorporation of the cities of Wildomar, Menifee, Eastvale, and Jurupa Valley.

♦ CURRENT TOTAL MILES

Riverside County maintains 2,147 centerline miles of paved road as of the end of fiscal year 2011. The table below shows the breakdown of the road network grouped by functional classification with the average network Pavement Condition Index (PCI). The total miles shown reflect the redistricting of all five (5) supervisory districts.

Total Miles (Countywide)

FUNCTIONAL CLASSIFICATION[1]	CENTERLINE MILES[2]	LANE MILES[3]
Arterial	474	1008
Collector	615	1,232
Residential/Local	1,058	2,116
TOTAL	2,147	4,356
Overall PCI [FY 2011]	**69**	

1) Functional classification is the grouping of roads based on traffic and degree of land access they provide.

2) Centerline mile represents the total length of a road from its starting point to its end point regardless of the pavement width or the number of lanes.

3) Lane mile represents the total length and the lane count of a road from its starting point to its end point. Lane mile takes into account the number of lanes of a road maintained by the County.

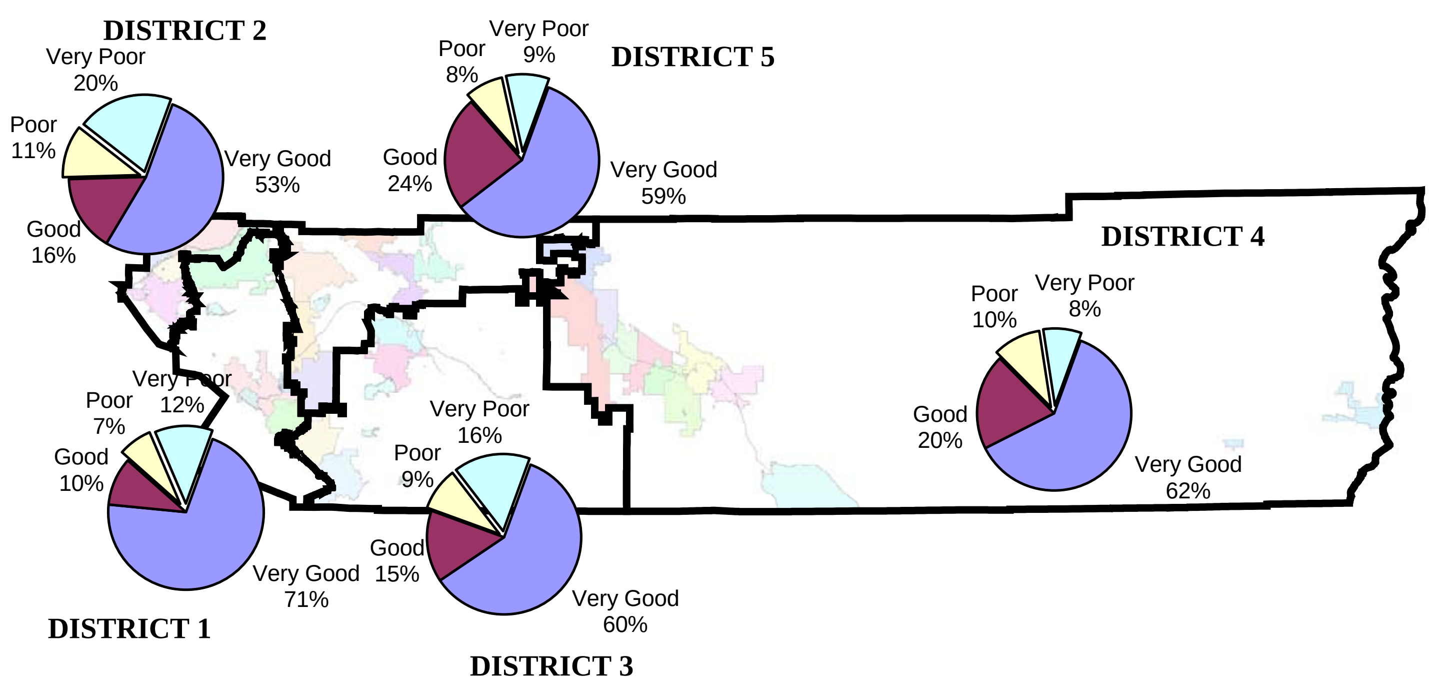
♦ CURRENT ROAD NETWORK CONDITION

The table below shows the current pavement condition categorized by condition category and functional classification throughout the county. It also illustrates the total percentage of distressed roads, which covers roads from the AT RISK, POOR, and VERY POOR categories.

Pavement Condition By Category (FY 2011) - Countywide

CLASSIFICATION	GOOD TO EXCELLENT PCI 70-100	AT RISK PCI 50-69	POOR PCI 25-49	VERY POOR PCI 0-24	TOTAL
ARTERIAL	14%	5%	3%	3%	25%
COLLECTOR	19%	4%	2%	4%	29%
RESIDENTIAL	31%	8%	4%	3%	46%
TOTAL	64%	17%	9%	10%	100%
DISTRESSED ROADS		36%			

♦ CURRENT ROAD CONDITION BY DISTRICT (FY 2011)

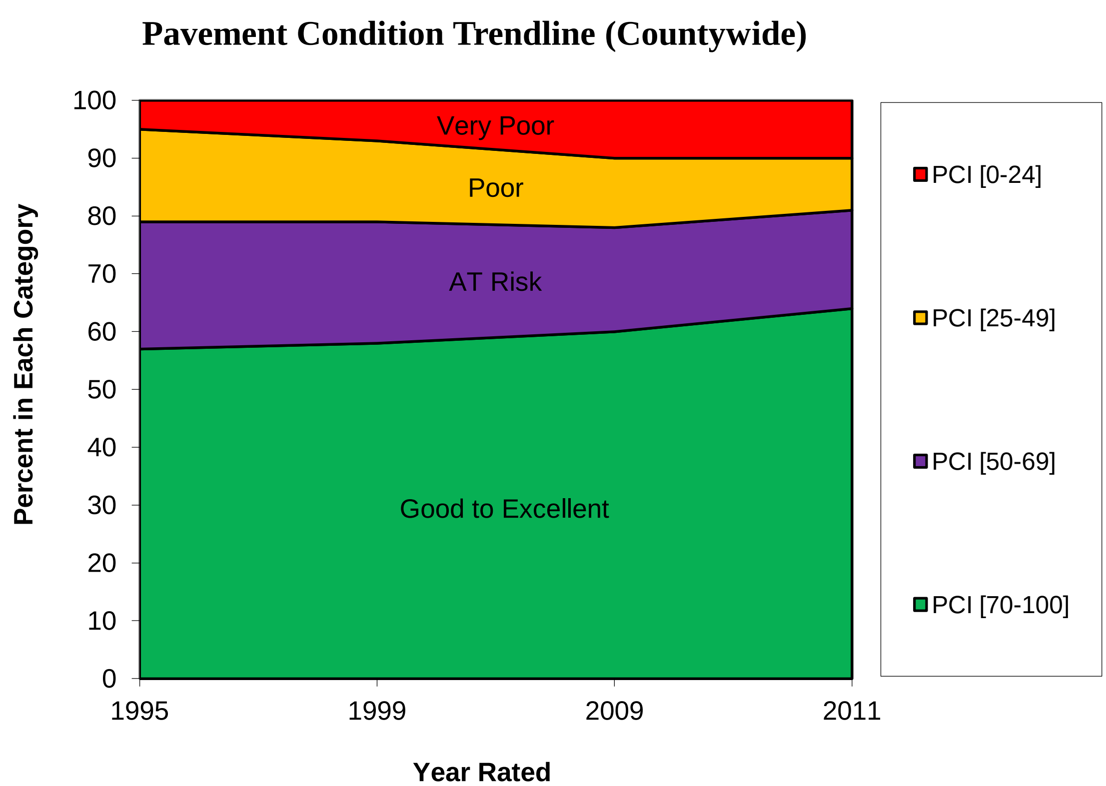


♦ ROAD NETWORK CONDITION TRENDLINE

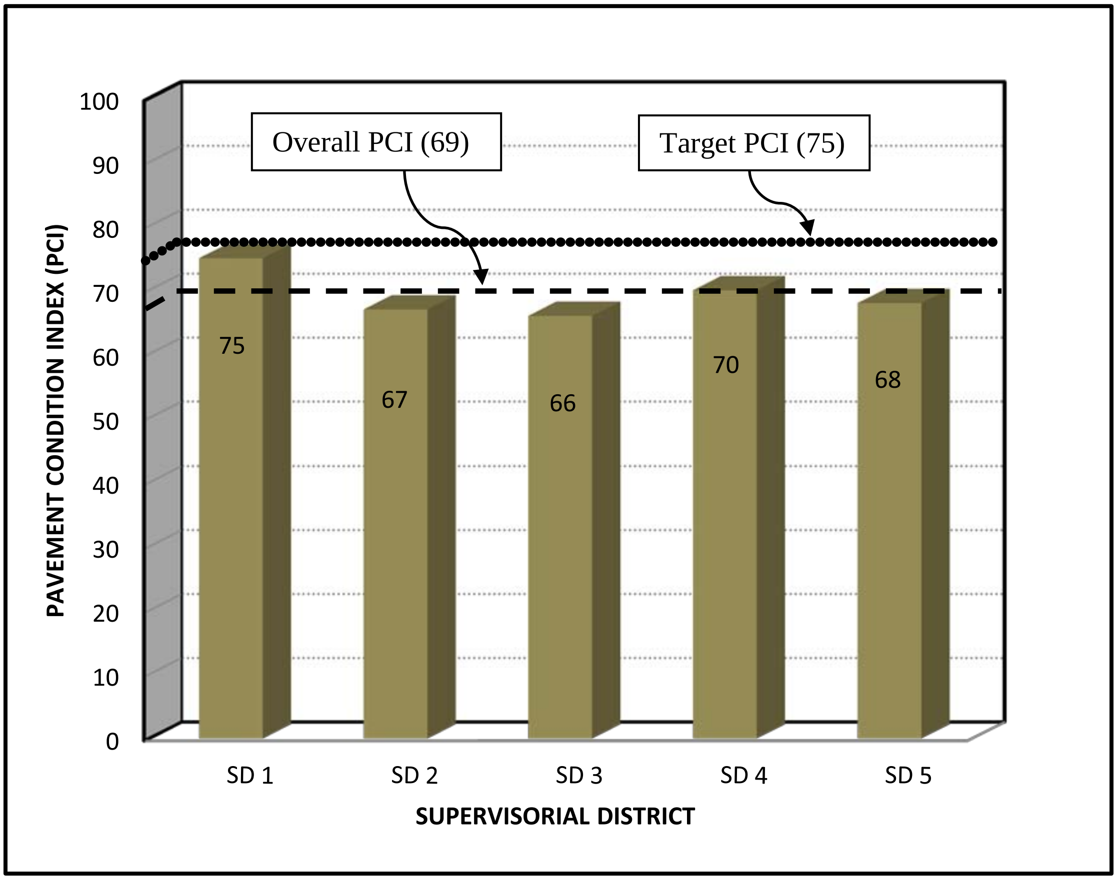
The percentage of mileage categorized by condition rating (good to excellent, at risk, poor, and very poor) over the last 15 years is summarized below. This table is also presented graphically showing the pavement condition trend in the figure below.

	GOOD TO EXCELLENT PCI 70-100	AT RISK PCI 50-69	POOR PCI 25-49	VERY POOR PCI 0-24	DISTRESSED ROADS[1]
FY 2011	64%	17%	9%	10%	36%
FY 2009	60%	18%	12%	10%	40%
FY 1999	58%	21%	14%	7%	42%
FY 1995	57%	22%	16%	5%	43%

1) Distressed roads include roads from the AT RISK, POOR, AND VERY POOR categories. Over the last 16 years, the percentage of distressed roads has been gradually declining from 43% to 36%.



♦ CURRENT ROAD NETWORK RATING BY DISTRICT (FY 2011)

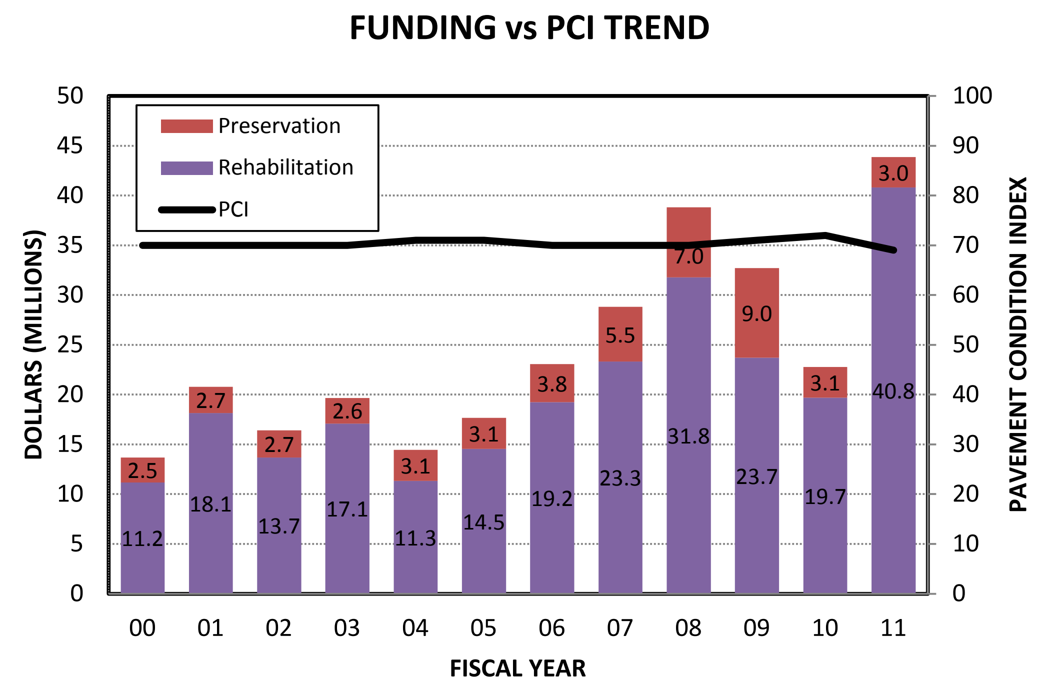


The Target PCI of 75, as shown above, is based on a set goal that all pavements throughout the County road network system need to reach a condition where Best Management Practices (BMP) can occur. This means that only the most cost-effective pavement preservation treatments are needed, such as, chip seal, slurry seal, and cape seal. Reaching and maintaining the target PCI offers other benefits (other than cost) such as reduced impact to the public in terms of:

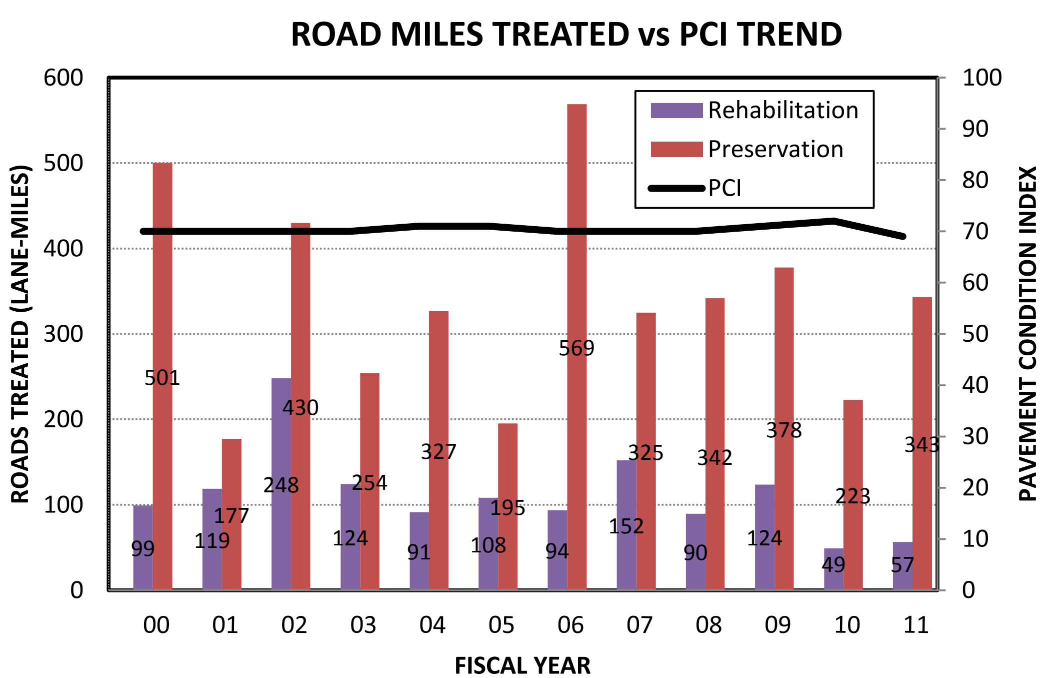
- Construction delays
- Environment (noise, dust, energy usage – less greenhouse gas emissions)

As noted on the chart above, the overall (avg) PCI of 69 is considered "At Risk" by definition of PCI shown in Table 1, "Relationship between PCI and Condition," of this report. While it seems just a point away from the "Good" category, it has significant implications for the future. From the generalized pavement deterioration curve shown in Table 2, "Pavement Deterioration Curve," of this report, this PCI is nearing 75 percent of the roadway network's life and deterioration accelerates rather rapidly if repairs are delayed by just a few years. Delaying preventative maintenance could increase the cost of the treatment significantly, as much as ten times.

♦ FUNDING HISTORY & MILES TREATED BY SURFACE TREATMENT TYPE



Preservation includes Chip Seal, Slurry Seal, and Cape Seal.
Rehabilitation includes Overlays and Reconstruction.



Preservation includes Chip Seal, Slurry Seal, and Cape Seal.
Rehabilitation includes Overlays and Reconstruction.

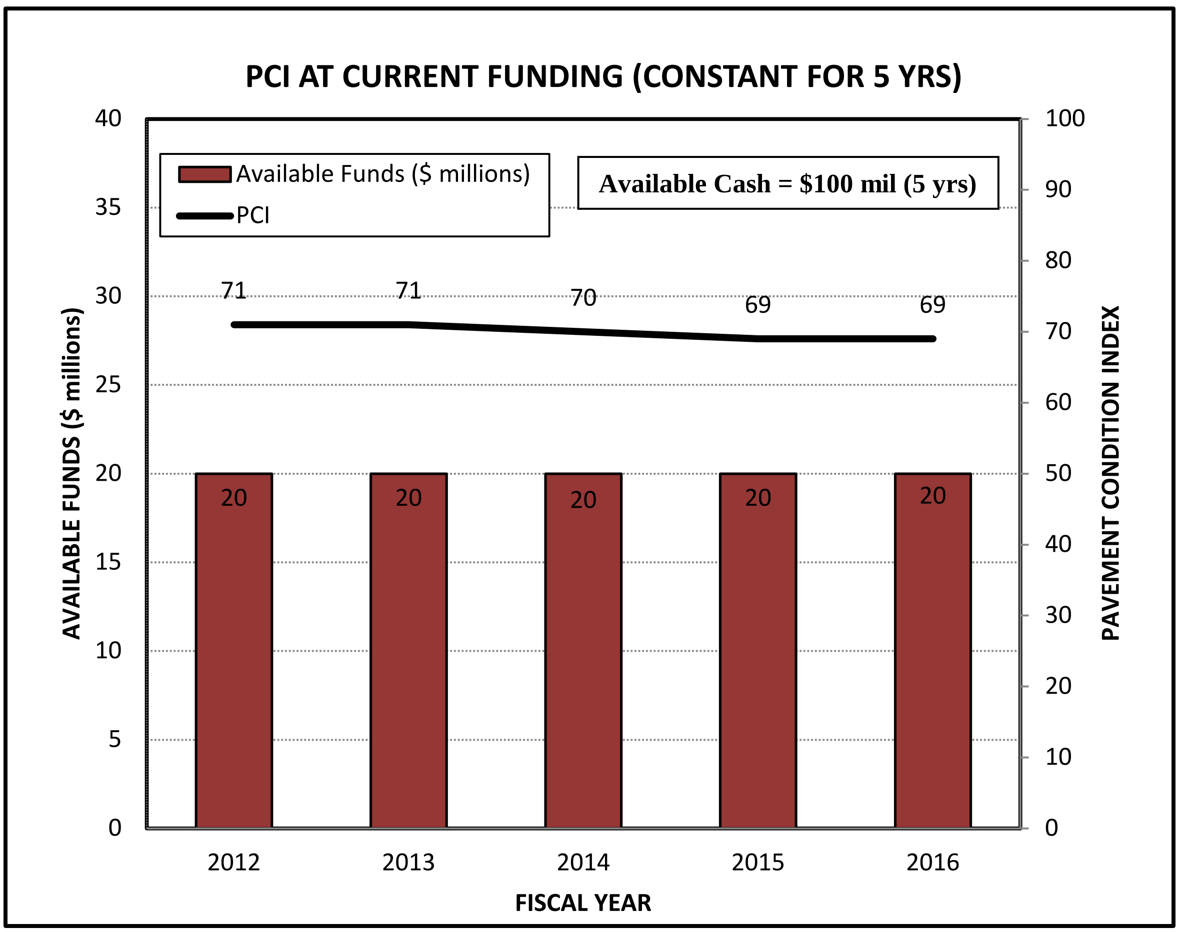
♦ NEEDS ASSESSMENT GOAL

In determining the pavement needs to maintain the network condition at an acceptable level, a needs assessment goal must first be defined. The goal is as follows:

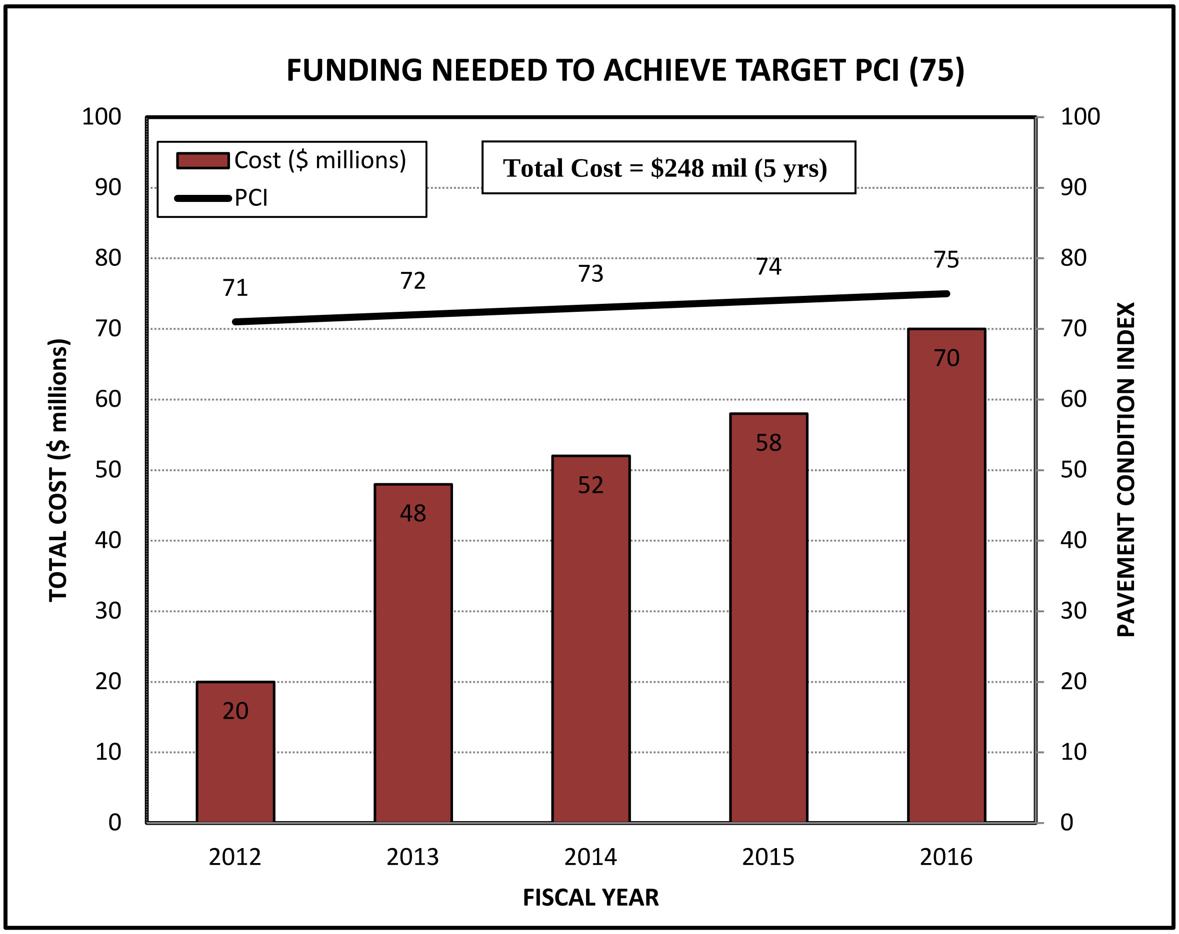
- attain a PCI of 75 or higher where Best Management Practices (BMPs) can be implemented. These BMPs encompass the use of the most cost-effective pavement preservation treatments.

For this goal to be effective, it should be attainable within a specific timeframe. Two funding scenarios were analyzed to determine the impact of various funding levels in terms of the overall change in PCI. These scenarios are:

1. Impact of current funding on PCI
2. Funding required to achieve BMP in 5 years



As illustrated by the funding scenario above, maintaining the current funding of $20 million annually for the next 5 years will have an impact on the PCI of the road network. Initially for the first 2 years, the PCI will reach 71 (from 69 of FY 2011) starting in 2012 then gradually declining to 69 over a 5-year period.



♦ FUNDING SHORTFALL

Given the 2 funding scenarios illustrated above for the needs and available cash, the funding shortfall can be easily calculated. For each scenario, the total cost or available cash is simply the sum of each cost or available cash per year for 5 years. From the table below, the shortfall is $148 million. Clearly, the available funding is inadequate in meeting the BMP goal within the period analyzed. Based on the results of this analysis, approximately $148 million of additional funding is needed to bring the pavement condition of the county roads to a PCI of 75.

Goal	5-Year Needs ($ millions)	Available Funds ($ millions)	Funding Shortfall ($ millions)
Achieve BMP (PCI=75) in 5 years	$ 248	$ 100	**$ (148)**

♦ PROJECT LISTS FOR FY 11-12

Lists of projects for rehabilitation and pavement preservation including slurry seal and chip seal are available in the County's website at:

http://rctlma.org/trans/documents/pamphlets/fy12_tip.pdf

INTRODUCTION

A Pavement Management System (PMS) is a decision-making process or system that assists the County in making cost-effective decisions related to the maintenance and rehabilitation of roadway pavements. It provides tools for rating pavement condition, establishing a consistent maintenance and repair schedule, and evaluating the effectiveness of maintenance treatment strategies. The PMS used by the County of Riverside Transportation Department is called "StreetSaver." This Pavement Management Program (PMP) was developed by the Metropolitan Transportation Commission (MTC), which is the transportation planning, coordinating, and financing agency for the nine-county San Francisco Bay Area - Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma. Other users of the PMP from outside the bay region are cities, counties, universities, and consulting firms in Southern California.

► Pavement Condition Index

In the MTC StreetSaver software, the pavement condition assessment is based on collecting data to determine the type, amount, and severity of surface distress for each segment of pavement being managed. The distress data is used to calculate a Pavement Condition Index (PCI), which is based on a visual survey of the pavement and a numerical index between 0 and 100, with 0 being defined as failed roadway and 100 representing an excellent pavement (newly paved). Table 1 shows the relationship between the PCI and pavement condition. Photos showing examples of pavement in excellent through very poor conditions are shown in Figure 1A through 1F.

Table 1. Relationship Between PCI and Condition

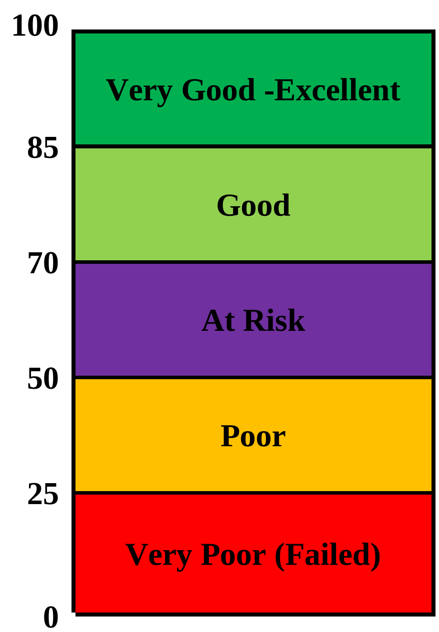


Figure 1A. PCI=98 (Excellent Condition)

Figure 1B. PCI=85 (Very Good Condition)

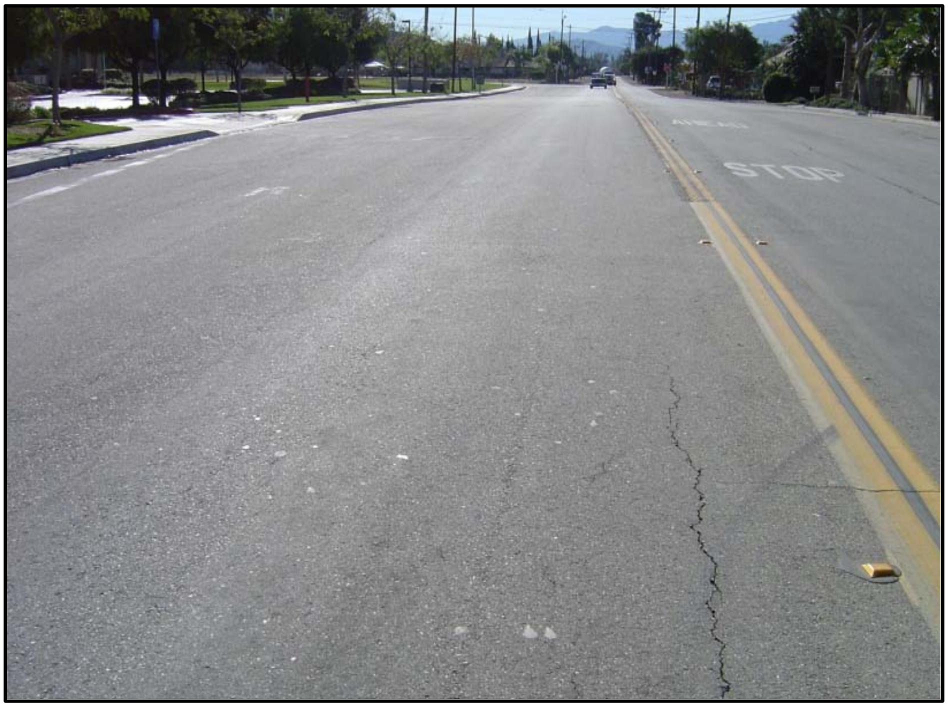


Figure 1C. PCI=78 (Good Condition)

Figure 1D. PCI=56 (At Risk Condition)

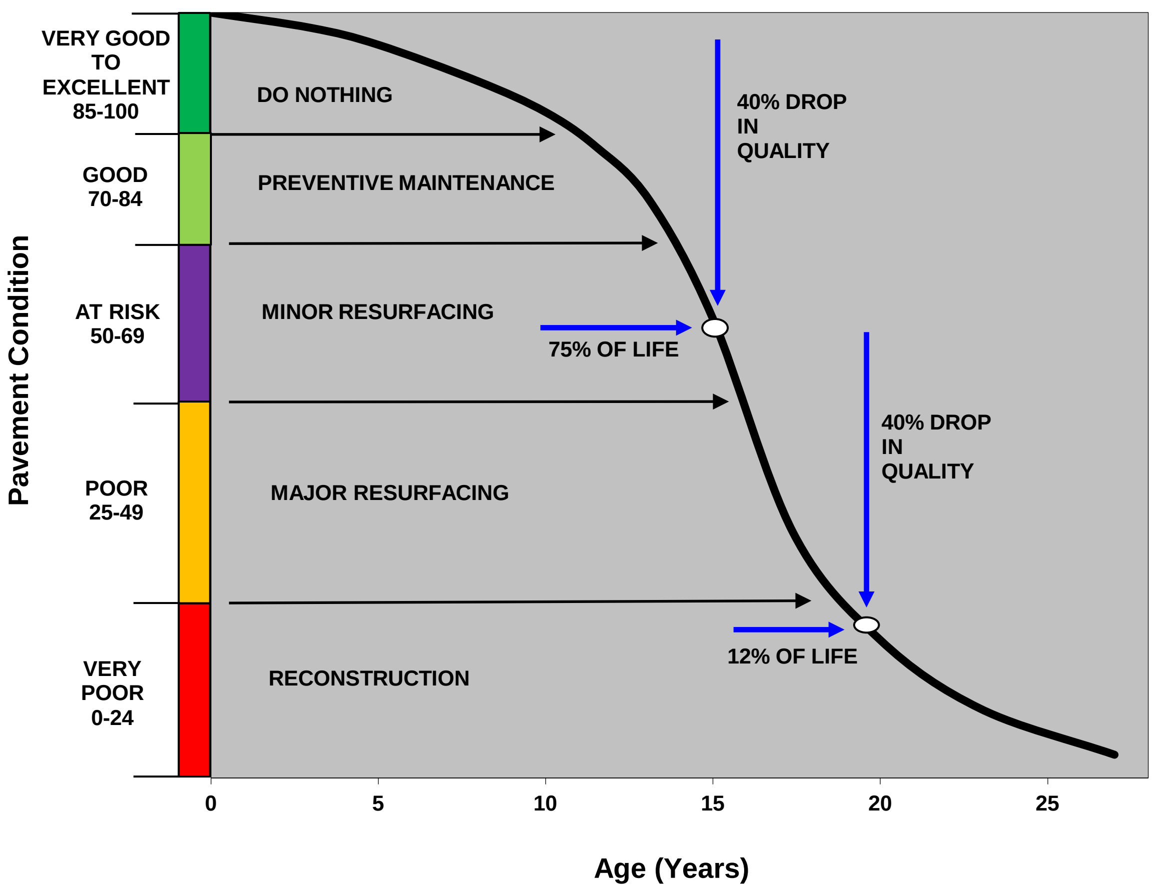
Figure 1E. PCI=30 (Poor Condition)

Figure 1F. PCI<10 (Very Poor Condition)

► Pavement Life Cycle

A critical concept in overall pavement life is the timing of maintenance and rehabilitation (resurfacing or reconstruction) actions being undertaken before the pavement falls beyond the optimum rehabilitation point. Figure 2 demonstrates this concept. Notice that for the first 75 percent of pavement life, the pavement condition drops by about 40 percent. However, if left untreated, it only takes another 12 percent of pavement life for the pavement condition to drop another 40 percent. Additionally, in order to restore pavement condition to a predetermined or an acceptable minimum level (i.e., PCI of 70 or higher), it will cost 4 to 5 times as much if the pavement is allowed to deteriorate for 2 to 3 years beyond the optimum rehabilitation point (PCI of 50).

Figure 2. Pavement Deterioration Curve



PAVEMENT PRESERVATION

As defined by the Federal Highway Administration (FHWA) Pavement Preservation Expert Task Group, "Pavement Preservation is a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations." Pavement preservation represents a proactive approach in maintaining existing roadways to reduce costly, time-consuming rehabilitation and reconstruction and the associated traffic disruptions to the traveling public.

An effective pavement preservation program will treat pavements while they are still in good condition and prior to the need for major reconstruction work. By applying a cost-effective treatment at the right time, the pavement is restored almost to its original condition. The figure below illustrates the concept of pavement preservation as it relates to enhancing pavement performance, extending pavement life, and ensuring taxpayer dollars are utilized wisely while providing improved safety and mobility to the public.

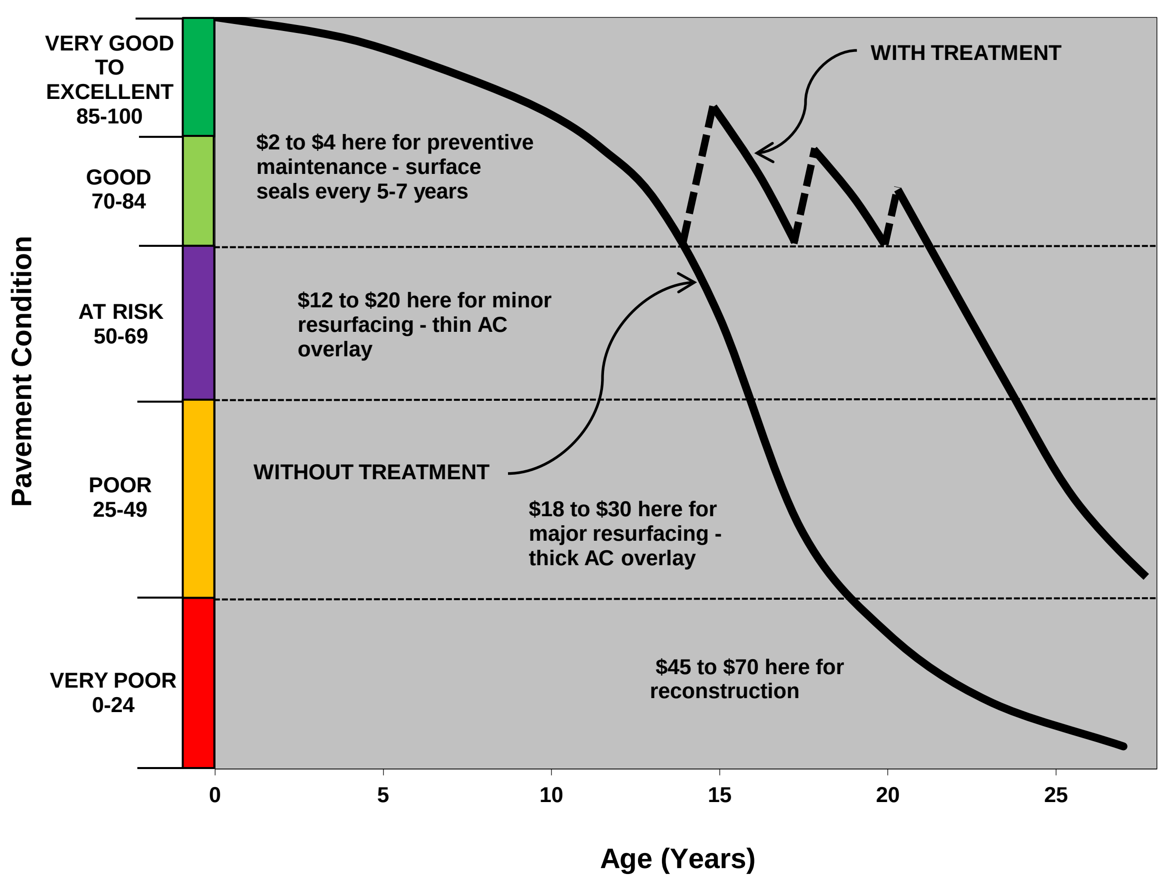


Figure 3. Pavement Deterioration Curve With and Without Treatment

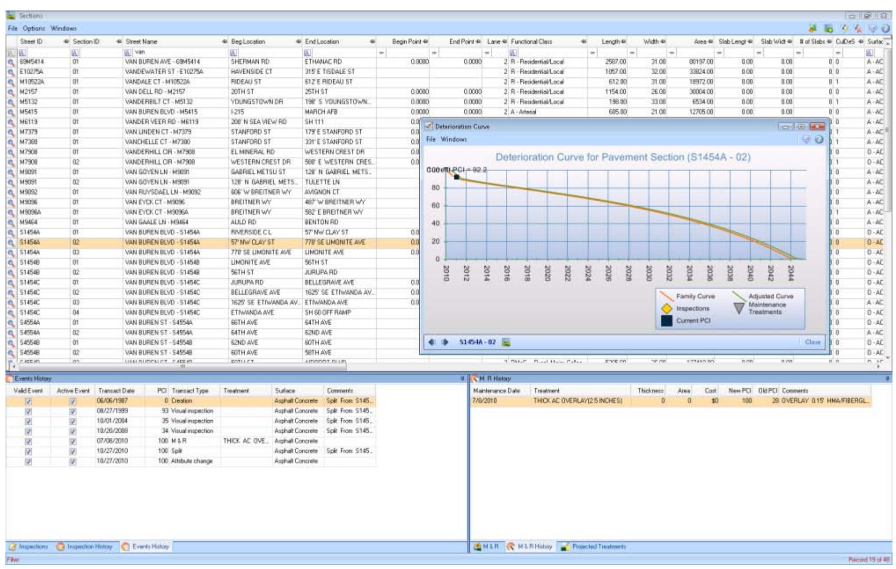
As depicted in Figure 3, the cumulative effect of systematic, successive preservation treatments is the postponement of costly resurfacing and reconstruction. During the life of a pavement, the cumulative discount value of the series of pavement preservation treatments is substantially less than the discounted value of the more extensive, higher cost of reconstruction and generally more economical than the cost of major resurfacing.

PAVEMENT MANAGEMENT SYSTEM

► Pavement Management System – StreetSaver

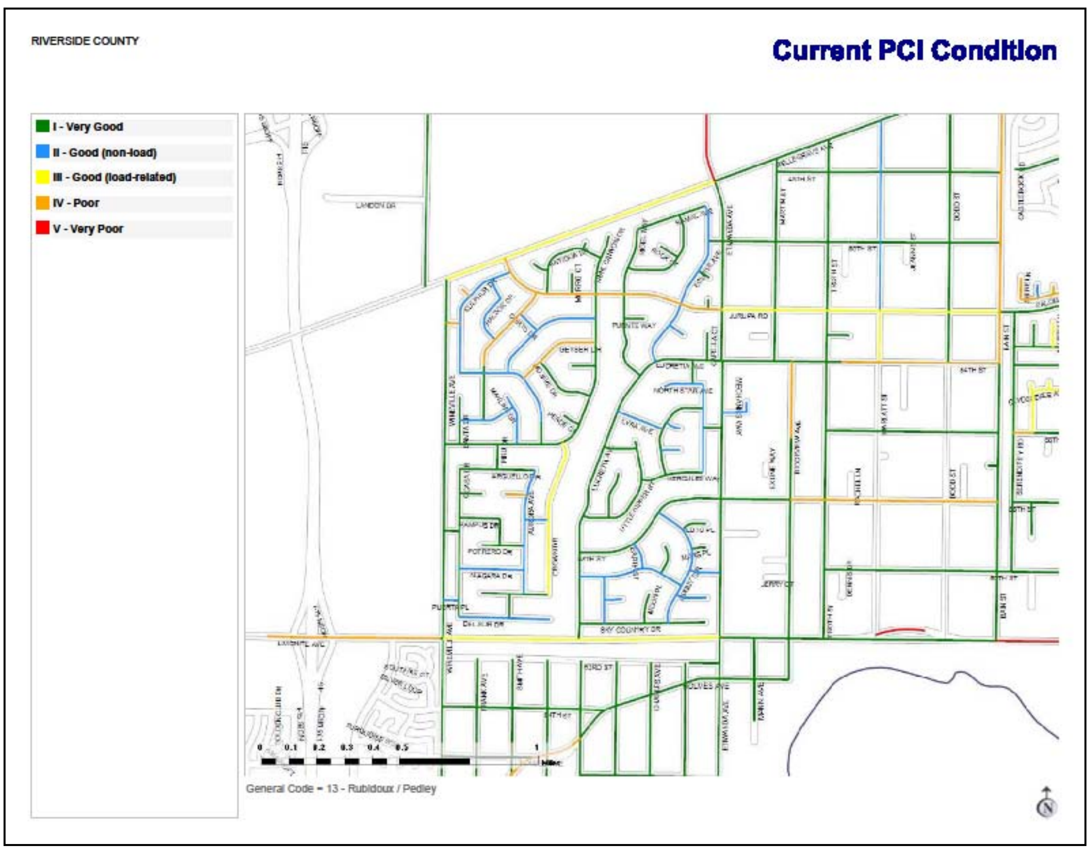
A Pavement Management System (PMS) is a decision-making process or system that assists the County in making cost-effective decisions related to the maintenance and rehabilitation of roadway pavements. It provides tools for rating pavement condition, establishing a consistent maintenance and repair schedule, and evaluating the effectiveness of maintenance treatment strategies. A PMS is also an optimizing tool that facilitates the prioritization of current and future needs to make the best use of available funds. The goal of a pavement management system is to strategize cost effective treatments to pavement sections that will deliver the best performance for the funds allocated. Simply put, a pavement management system saves public funds.

In the absence of a PMS, jurisdictions that lack the tools to strategize how to spend limited funds are likely to choose the "Worst First" approach to repair their roads. This approach makes use of limited funds into costly reconstruction where few roads can be repaired. Long-term use of this strategy will return the least performance for the public funds and result in decline of the overall quality of the jurisdictions' pavement network.



In 1998, the County began monitoring its roadway system using a Pavement Management Program (PMP) called MTC PMS. In 2003, the MTC PMS software was renamed to StreetSaver. This PMP, as described herein, was developed by the Metropolitan Transportation Commission (MTC), which is the transportation planning, coordinating, and financing agency for the nine-county San Francisco Bay. It is widely used by cities and counties throughout the State of California and used by some jurisdictions nationwide and other countries.

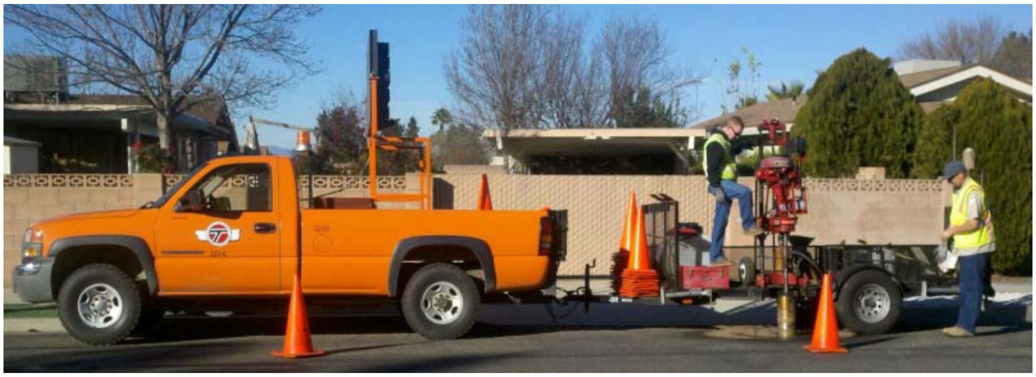
Inspection of pavement conditions is performed every year on one-fourth of the County's pavement network, which places all roads on a four-year inspection cycle. Field inspection or visual inspection survey is conducted by pavement raters (two-man crew) who walk each individual road segment evaluating the pavement for signs of distresses. Early last year, the County switched its data collection approach from paper inspection sheets to a hand-held computer device. Not only does a hand-held device accelerate the collection of pavement distress data, but it is also an environmentally friendly methodology that reduces paper usage.



The integration of the PMP with Geographic Information Systems (GIS) has provided the County a snapshot of the roadway network to better organize and facilitates in the decision-making in finding roads needing treatments.

► Data Collection Technique and Equipment

The County invests millions of dollars each year in pavement maintenance activities. Records of performance of the pavement maintenance treatments placed during these activities are crucial in order to determine which treatment alternative is the best option to use. With advancements in data collection practices and equipment, the County invested in a Ground Penetrating Radar (GPR) and a Falling Weight Deflectometer (FWD) in addition to its already established data collection methodology of using coring and visual inspection survey.



County's Coring Rig

The GPR is used to measure pavement layer thickness and detect groundwater or voids beneath the pavement. The FWD characterizes pavement structural condition. Data collected from this state of the art equipment provide new information that can be used to improve pavement management recommendations as well as support the County's pavement rehabilitation and design activities.

FWD and GPR Data Collection Equipment

IMPLEMENTATION OF PAVEMENT PRESERVATION USING BEST MANAGEMENT PRACTICES

In Riverside County, implementation of pavement preservation is just as important as other services provided to the public in terms of restoring and improving roadways for public safety. The maintenance activities performed through public contracts and in-house County forces are the County's top priority and include routine maintenance, responding to public safety concerns (repairing of potholes, patching localized deteriorated pavements, etc.), and pavement preservation treatments.

Preserving roads already in good condition rather than allowing them to deteriorate is the County's objective in spending the taxpayer's money cost effectively. Consistent with this approach, the costs associated in developing road treatments and repairs are based on achieving a roadway pavement condition using Best Management Practices (BMPs). Implementing this BMP improves the roadway condition to a level where roads need only preventive maintenance treatments (i.e., chip seals, slurry seals, cape seals). These treatments have the least impact on the public's mobility and commerce. Furthermore, these types of treatments are more environmentally friendly than the next level of construction (thick overlay and reconstruction) that would be required.

► Seal Coat (Preventive) Treatments

A seal coat treatment follows the concept of preventive maintenance for preserving the pavement while it is still in good condition and prolonging its serviceable life. The following seal coat treatments are as described and implemented by the County by in-house forces and contracts.

Chip Seal

A chip seal is a surface treatment applied to pavement with minimal surface distress to provide a new wearing surface, extend pavement life, and delay major rehabilitation or reconstruction. It is a process in which an asphalt emulsion is sprayed on the pavement then immediately covered by aggregate.

Slurry Seal

A slurry seal is a maintenance treatment applied to pavement to improve the functional characteristics of the pavement surface. It is a mixture of asphalt emulsion, aggregates and mineral fillers, which is mixed and placed in a continuous basis using a truck mixer. Prior to application, any surface distresses, such as cracks, are filled and sealed. After thoroughly mixing the emulsion, aggregates and mineral fillers in the slurry truck's built-in pug mill, the slurry mixture is poured into a spreader box. As the truck moves forward, the slurry is extruded from the back side of the spreader box. The box is capable of spreading the slurry over the width of a traffic lane in a single pass resulting in a uniform application. The slurry cures as the water evaporates and turns the freshly placed brown slurry into black slurry. Traffic can be returned once the slurry has cured, which is usually four to six hours.

Cape Seal

Cape seal consist of a bottom course of chip seal covered with a wearing course of slurry seal. Both pavement surface treatments are non-structural preventive maintenance applications that are classified as pavement preservation techniques. Such techniques can extend pavement life and improve safety. In a cape seal application, covering a single layer of chip seal with slurry seal prevents the aggregate from the chip seal application from being dislodged especially for roads with curb and gutter.

"GREEN" MATERIALS

The focus of this section is on recycling and reuse of materials in construction projects. Consideration is given whenever such materials meet the minimum engineering standards and are economically feasible including materials recycled from existing pavements as well as other recycled materials such as scrap tires. It should be noted that the use of recycled materials is made on a case-by-case basis based on thorough evaluation of material properties, past performance of the recycled material, benefit/cost analysis, and engineering judgment.

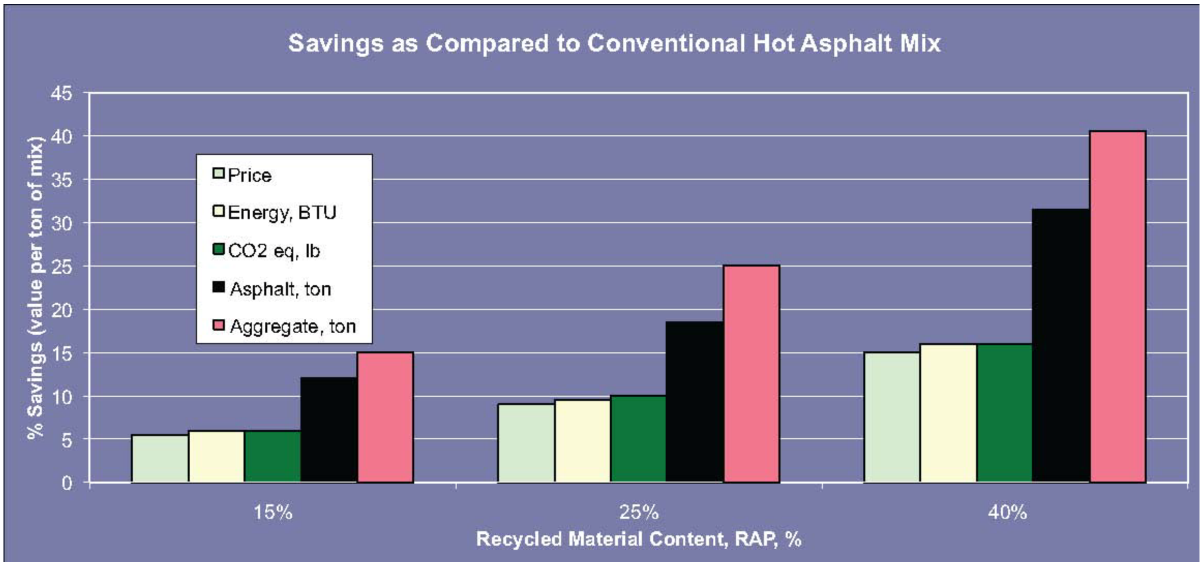
With high-volume industrial by-products, construction and demolition debris, and scrap tires being generated each year, hundreds of millions of waste materials are added to landfills and are a potential threat to both the environment and public health and safety. Such materials can have beneficial uses, particularly in roadway construction. Pavement made with these materials can be stronger, more durable and less costly. Recycling and reusing these materials saves energy, conserves natural resources, and reduces greenhouse gas emissions (carbon footprint).

In the interest of energy conservation, the environment and reduction of greenhouse gases, state and federal agencies as well as contractors placed emphasis on building "green" in highway construction industry. The use of Reclaimed Asphalt Pavement (RAP) in hot mix asphalt, base stabilization and subgrade treatment using the Full Depth Reclamation (FDR) process, and rehabilitation/maintenance of existing roadways using Cold-in-place Recycling (CIR) method, are some of the recycling technologies being practiced in the County to date.

► Reclaimed Asphalt Pavement

Reclaimed Asphalt Pavement (RAP) – removed/reprocessed asphalt concrete pavement – is a commonly recycled material incorporated in the production of new Hot-Mixed Asphalt (HMA). RAP can be generated from a number of different sources including cold milling, full-depth removal, and pulverize-in-place operations of existing pavements. The use of RAP in HMA is the most efficient use of this material as it provides a reduction in virgin asphalt binder and aggregate demand, thus conserving natural resources. In California, Caltrans goal is 15 percent RAP in HMA. In Riverside County, the same percentage of RAP was used to substitute 15 percent of the virgin aggregate required over the last 10 years and remains the County's goal. RAP is also used as recycled aggregate base and helps reduce the pavement structural section due to its increased strength in comparison to conventional aggregate base.

From the chart illustrated below, some environmental benefits and cost savings of using at least 15 percent RAP in conventional HMA will yield a reduction in asphalt by about 12%, a decrease of virgin aggregate by about 15%, and a reduction of greenhouse gas emissions at a rate of 5 pounds per ton of RAP used in the hot mix asphalt.



Source: Meyer, Wendall L., *FHWA Update*, Proceedings of the North Dakota Asphalt Conference, 2010.
Based on data from: Robinette, C. and J. Epps, Energy, Emissions, Material Conservation and Prices Associated with Construction, Rehabilitation and Materials Alternatives for Flexible Pavement, Proceeding of the 89th Annual TRB Meeting, 2010.

Price corresponds to materials, construction, rehabilitation, and maintenance costs based on Life Cycle Cost Analysis (LCCA) with environmental impact assessment. Energy (BTU) represents the requirements for construction materials processing and construction material production. CO2 eq (lb) is a measure of greenhouse emissions and it includes the production of raw materials, transportation, production and laydown of materials. Asphalt and Aggregate in tons are considered the natural resources. [Sources: Transportation Research Board and Federal Highway Administration (FHWA)].

Since 2005, the County has used over 100,000 tons of RAP in its pavement rehabilitation and reconstruction projects. This translates to approximately 90 lane miles of recycled county maintained roads and a reduction of 500,000 pounds of carbon emissions or the equivalent of about 45 passenger cars removed from the County roads.

► Full-Depth Reclamation (FDR)

The asphalt layers of the pavement and a portion of the underlying materials are pulverized in-place four to ten inches deep to produce a stabilized material. The stabilized material is mixed with asphalt emulsion, then shaped and compacted in preparation for a new wearing surface such as hot mix asphalt. The wearing surface is placed within one to three days of completing the FDR material. The FDR methodology is ideal for straightaway roadways such as arterials and collector roads.

► Cold, In-Place Recycling (CIR)

Pavement is removed by cold planing to a depth of 3 to 4 inches leaving a small amount of pavement to support the equipment during the construction process. The material is crushed, sized and mixed with an asphalt emulsion and other additives. Then the material is placed and compacted. Within two to five days of placing the CIR material, a layer of hot mix asphalt is laid down. Typically, a 3-piece "train" is used consisting of a cold planing machine, a screening/crushing/mixing unit, and conventional laydown and rolling equipment. This "train" occupies only one lane, thus maximizing traffic flow. This process is also ideal for high volume roads.

► Rubberized Asphalt Concrete (RAC)

Rubberized asphalt concrete (RAC) is a road paving material made by blending ground tire rubber with asphalt to produce a binder, which is then mixed with conventional aggregate materials. This mix is then placed and compacted into a road surface. Benefits of using RAC are as follows:

<u>Cost-effective</u>
In most applications, RAC can be used at a reduced thickness compared to conventional asphalt overlays--in some cases at half the thickness of conventional material--which may results in significant material reduction and cost savings.

<u>Durable, Safe and Quiet</u>

RAC is long lasting. It resists cracking, which can reduce maintenance costs. RAC provides better skid resistance, which can provide better traction. Moreover, RAC retains its darker color longer so that road markings are more clearly visible and can reduce road noise.

<u>Environmentally Friendly</u>

California produces more than 40 million waste tires annually, of which approximately 75 percent are diverted from landfill disposal. Over the past few years, California has used more than 10 million waste tires in RAC paving projects, diverting them from landfills or illegal disposal.

Use of RAC in Riverside County

The County of Riverside has been using RAC since 1995. The county typically uses a 2-inch thick overlay on all RAC resurfacing projects. A 2-inch thick RAC overlay uses over 1,200 scrap tires per lane mile. This means that for a one-mile section of a four-lane highway, over 4,800 scrap tires can be used in creating a safer, quieter, longer-lasting road. Since 2005, the County has used over 300,000 scrap tires in its pavement rehabilitation projects. This translates to at least <u>250 lane miles</u> of rubber treated county maintained roadway.

ROAD NETWORK SUMMARY

► Road Miles

Riverside County maintains approximately 2,147 centerline miles of paved road as of the end of fiscal year 2011. The total miles may not reflect all new tract/subdivision roads being approved and entered into the county maintained public road system. There is approximately a 3 to 6 month lag time from the time a new road is fully constructed to the time it enters into the county maintained roadway system. Table 2 shows the breakdown of the road network grouped by functional classification with the average network Pavement Condition Index (PCI). Table 3 through Table 7 exhibits total miles and PCI by supervisorial district.

Table 2. Total Miles (Countywide)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	474	1,008
Collector	615	1,232
Residential/Local	1,058	2,116
TOTAL	2,147	4,356
Overall (avg) PCI [FY 2011]	**69**	

Table 3. Total Miles (District 1)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	121	271
Collector	76	152
Residential/Local	241	482
TOTAL	438	905
Average PCI	**75**	

Table 4. Total Miles (District 2)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	14	38
Collector	19	40
Residential/Local	40	80
TOTAL	73	158
Average PCI	**67**	

Table 5. Total Miles (District 3)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	138	297
Collector	149	298
Residential/Local	279	558
TOTAL	566	1,153
Average PCI	**66**	

Table 6. Total Miles (District 4)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	130	260
Collector	304	608
Residential/Local	350	700
TOTAL	784	1,568
Average PCI	**70**	

Table 7. Total Miles (District 5)

FUNCTIONAL CLASSIFICATION	CENTERLINE MILES	LANE MILES
Arterial	71	142
Collector	67	134
Residential/Local	148	296
TOTAL	286	572
Average PCI	**68**	