

FINAL REPORT

UPDATE OF
PAVEMENT MANAGEMENT PROGRAM
(Citywide)

2014-2019



City of Compton, CA
May 28th, 2014



May 28th, 2014

Mr. Glen Kau, P.E
Director of Public Works
City of Compton
205 S. Willowbrook Ave.
Compton, CA 90220

Subject: Final Report - Update of the Pavement Management Program

Dear Glen:

As part of the 2014 Pavement Management Program for the City of Compton, Bucknam Infrastructure Group, Inc. is pleased to submit the Final Report for the City's pavement management program.

The information contained in this report was used to develop the recommended improvement program for the pavement network. The report covers the following categories:

- **Section I - Executive Summary**
- **Section II - Pavement Management Program Development and Reporting**
- **Section III - Pavement Conditions For Each Segment in the Network, PCI Report**
The Pavement Condition Index report shows the present condition of each street in the pavement network. In addition, the report shows the basic geometry of each street segment.
- **Section IV - Forecast Maintenance Reports**
 - **Recommended Maintenance and Repair (M&R) Strategies**
The recommended maintenance and repair strategies were used to generate the Forecasted Maintenance Report and were based on our 2013 inspections. Additionally, we have assessed and incorporated unit cost and maintenance application practices/types with our strategies.

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- **Projected Projects based on M&R Strategies**

The Forecasted Maintenance Report projects the street maintenance activities required for the next five years, broken down to show maintenance levels for Arterials and Local streets. The report included in this section is broken down by fiscal year.

Our thorough analysis of previous and current Compton PMP strategies enabled our staff to make proactive recommendations to the City's pavement CIP. All comments received from the City have been incorporated in the reports that follow. All of the City's issues and needs that were brought to our attention are included in the report. It has been a pleasure working with you and the City on updating your Pavement Management Program. We look forward to the continued success of this project and future teamwork with City staff.

Sincerely,

Bucknam Infrastructure Group, Inc.



Peter J. Bucknam
Project Manager
Infrastructure Management – GIS Services

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Acronym Listing

Capital Improvement Program (CIP)
Geographic Information System (GIS)
Government Accounting Standards Board Statement 34 (GASB 34)
Hot-Mix Asphalts (HMA)
Los Angeles County MTA (METRO)
Maintenance and Repair (M&R)
Pavement Condition Index (PCI)
Pavement Management Program (PMP)

SECTION I

EXECUTIVE SUMMARY

2013-14 UPDATE OF PAVEMENT MANAGEMENT SYSTEM

As the City of Compton continues to show modest growth with its population, demographics, infrastructure and maintenance needs, the City has identified the essential need to sustain their pavement network at a level which benefits its constituents, economy and long-term growth. The City of Compton developed its Pavement Management Program (PMP) in 2002 with the use of an automated database program. Today, the City is using the Army Corps of Engineers software, MicroPAVER, to manage the street network. This system is essential to the City in that it assists Public Works staff in capturing funding for its arterial street system as well as cost-effectively manages the local network through proactive maintenance and scheduling. Under this project, the City has incorporated the development of a unique Pavement Management – GIS layer that will assist the City in spatially analyzing pavement conditions and other attribute information that resides in the MicroPAVER database.

The Compton PMP has been developed to assist City personnel by providing current data on the City's street network and to develop cost-effective maintenance strategies to maintain a desirable level of pavement performance on a network scale, while optimizing the expenditure of limited fiscal resources. The PMP efforts in 2014 consisted of analyzing the City's 2002 PMP datasets for quality and usability, defining the pavement segmentation, surveying and implementing a pavement CIP. In doing this, we were tasked to generate an updated Capital Improvement Program report that identified recommendations and deficiencies in the current operating and maintenance efforts put forth by the City.

For this project, our staff surveyed all arterial routes to assist the City in complying with Los Angeles County MTA (METRO) PMP requirements as well as surveyed all local streets and analyzed historical maintenance operations.

Specifically, the program provides administrators and maintenance personnel with:

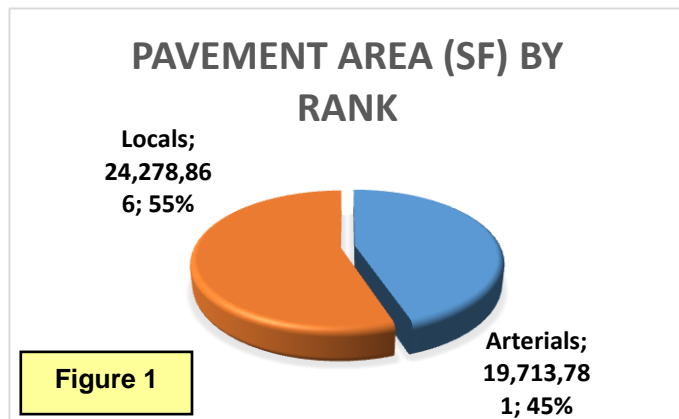
- *The present condition status of the pavement network (arterial and local streets), as a whole and of any grouping or individual component within the City;*
- *A ranked list of all streets, or segments of streets, by condition within the network;*
- *Rehabilitation/maintenance needs of each street segment by year;*
- *An optimized priority maintenance and rehabilitation program based on cost/benefit analysis and various levels of funding;*
- *Optimum annual budget levels for pavement maintenance for the current and the following five (5) years;*
- *Prediction of the future performance of the City's pavement network and each individual street section;*

- Updated PMP data to assist the City with GASB 34 compliance; and
- Pavement condition data and analysis presented in ArcGIS that is compatible with City's existing GIS

Pavement is a dynamic structure where deterioration is constantly occurring; thus the pavement management system needs to be updated on a regular basis to reflect these changes in pavement conditions, pavement maintenance histories, and maintenance strategies based upon budgetary constraints. This report reflects the current state of the City's pavement network and recommended maintenance strategies for the next five (5) years.

CITY'S PAVEMENT NETWORK

Within the Compton pavement management network there are approximately 79.8 miles of Arterial streets. The Arterial network consists of approximately 19,713,781 SF of pavement which consists of 401 pavement sections. The Local network consists of approx. 139.3 miles of streets, 24,278,866 SF of pavement which consists of 909 pavement sections. Combined, the entire network consists of 219.1 miles of streets and 43,992,647 SF of pavement and 1,510 sections.



The City's pavement network is broken down into manageable groups that have similar characteristics, such as pavement rank, surface type and logical segmentation. Pavement segments are identified by their branch and section numbers. Pavement "branches" that have a common usage, such as Central Ave., defines a "branch" within MicroPAVER. Pavement "sections" are pavement segments within the defined branch that have consistent pavement rankings, construction/maintenance histories and use. Representative inspection samples are then selected and visually surveyed to locate distress data. This data is used to calculate the pavement sections Pavement Condition Index (PCI) which includes distress type, extent of the distress and its severity.

The PCI is a condition rating that ranges from 100 (a new pavement section or recently overlaid or reconstructed) to 0 for a section that has structurally failed and deteriorated dramatically. Weighted average PCI of a given area/zone = pavement section PCI * its own area divided by the total square footage of the given area/zone. Table 1 summarizes the section conditions found within the City of Compton pavement network by rank.

- **The weighted average PCI for the City of Compton Arterial network is 62.5**
- **The weighted average PCI for the City of Compton Local network is 54.6**

The weighted PCI value associated with the Arterial and Local routes shown through our survey analysis is timely in that it is showing that a large amount of preventative, slurry seal, and overlay work will be needed over the next several years to increase the level of condition (PCI) to a “preventative maintenance” state.

CURRENT CITYWIDE CONDITIONS (ARTERIALS AND LOCALS)

The overall condition of the City’s pavement network is “Poor” with a weighted average PCI of 58.1 based on the surface area of each segment. The distribution of the City’s overall pavement network is shown in Section III of this report (Condition Distribution).

For comparison, Bucknam has performed pavement management studies for several other Los Angeles County agencies and has included their weighted PCI values; El Segundo (63.4), Culver City (62.9), Lomita (59.2), and Huntington Park (60.1).

Condition	PCI Range	Arterials	Locals	Total Mi.	% of Network
Very Good	(86-100)	19.8	28.9	48.7	22%
Good	(75-85)	12.1	32.0	44.1	20%
Fair	(60-74)	12.1	12.0	24.1	11%
Poor	(41-59)	13.7	12.8	26.5	12%
Very Poor	(0-40)	22.1	53.6	75.7	35%
		79.8	139.3	219.1	

Table 1 – Condition Distribution by Mileage for All Streets

As shown above, a large majority of segments are distributed through Fair to Very Poor condition categories (58%, approximately 126.3 miles). These findings indicate that of proper preventative and rehabilitation maintenance has not been performed on the pavement network for some time. These condition ranges are defined by the Army Corps of Engineers.

With 58% of the City’s pavement sections with condition levels at or below “Fair” (approximately 126 miles), a proactive preventative & timely overlay maintenance program needs to be funded immediately; this will establish working capital towards improving the City’s overall weighted PCI to a more manageable level (such as a PCI of 65). This increased funding allocation should be appropriated immediately within FY 2014-15. From our conversations with City staff it looks as this recommendation and plan is already moving forward.

On a positive note, the Arterial network is showing higher condition levels compared to the Local network; there are only a handful of key overlay projects that should be proactively managed in the next few years of the Arterial Streets CIP. This is clear by looking at the number of arterial sections that fall within the Fair to Very Poor condition categories (approximately 47.9 miles of the 79.8 mi., which accounts for approx. 60% of the arterial network).

Local conditions show that 44% of the pavement network is within the condition levels of “Good to Very



Good” (approximately 60.9 miles). The remaining 56% of the Local network should be considered for Slurry/Cape Seal and overlay maintenance; this accounts for approximately 78.4 miles of streets. The City should consider implementing a zone maintenance approach that will focus maintenance efforts, on an annual basis, within a small geographic area thus improving specific areas of the City over the next five years.

These findings are negative in nature in that the amount of revenue needed to maintain the network will need to be aggressively higher than what has traditionally been budgeted annually in the past.

Furthermore, as large overlay and rehabilitation projects are considered for funding, the City should also consider using sub-grade R - Values, structural design, distress severities and extents as parameters for determining whether a pavement section that lies within the Fair to Poor condition range should be overlaid or reconstructed.

PCI conditions reflect “surface” conditions; additional sub-surface data such as coring data, R-Values and asphalt depths will provide City to with a better approach to the maintenance that should be applied.

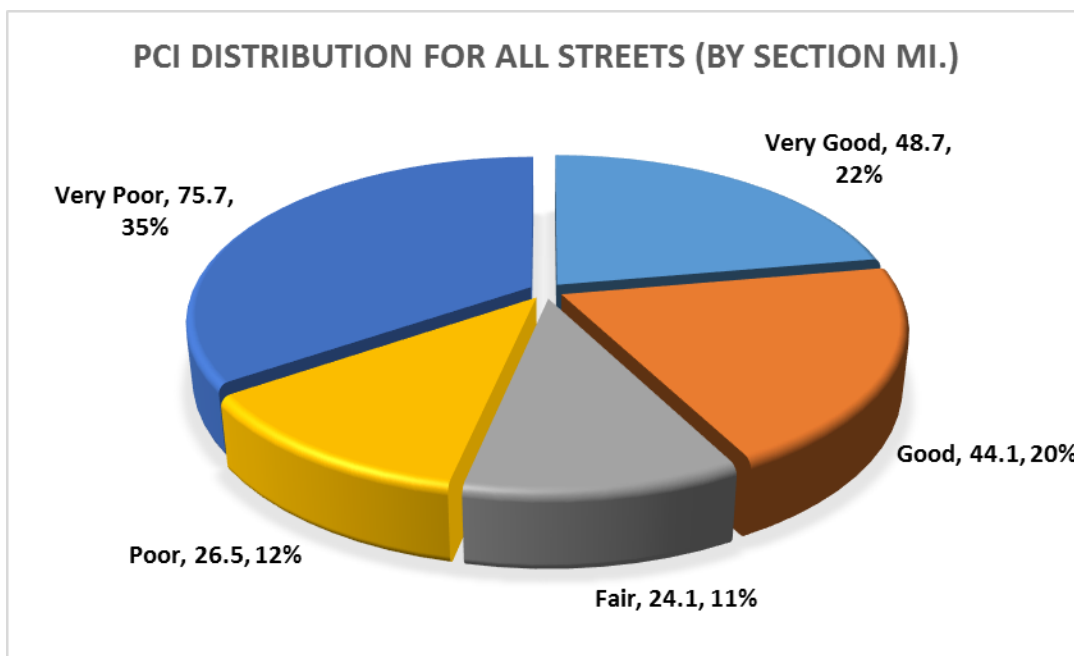


Figure 2 – PCI Condition Distribution by Miles for All Streets
Units shown above indicate total mileage (Table 1)

MAINTENANCE STRATEGY DEVELOPMENT

Based on the results of the condition survey and input from the City, pavement maintenance/rehabilitation strategies were developed. At the outset, the City and Bucknam staff identified a distribution of City maintenance funds that would be applied to the network over the next five years. This was based upon the desire to prevent the decrease in street conditions and not allow an increase in the maintenance backlog funds over the five-year program. Residential zone schedules were also assessed and analyzed.

With this approach, Bucknam has recommended a “minimal level of service” which creates a major dividing line in determining pavement maintenance. Generally within pavement management programs, a PCI range between 55 to 70 determines the threshold of when preventative or major overlay maintenance is activated. Based on the City’s weighted average PCI, condition distribution, maintenance practices, our team has identified a PCI of “65” as the minimum level of service. This means that any pavement section with a PCI greater than 65 will be recommended for preventative maintenance. This recommendation is indicated in Table 5, Section II.

Bucknam developed a multi-year Capital Improvement Program for the City based on the pavement records, yearly capital expenditures and the most recent 2014 inspections. These recommendations and results are shown in Section II of this report where we have demonstrated what level of funding is necessary to maintain the current PCI as well as how the City’s current pavement budget performs against today’s conditions.

As shown in Figure 2, 42% of the City’s streets are in Very Good to Good condition. These sections will be targeted for “preventive” maintenance within our Capital Improvement Program (CIP) recommendations. The reasoning in doing this is to extend the life cycles of those “fair/good” pavement sections which accrues capital saving to aggressively rehabilitate those pavement sections that are below the “minimal level of service”.

In order to achieve the most effective and optimum program for the City, certain strategies have been selected and/or analyzed. Below is a listing of the maintenance activities utilized in strategy development. Each activity is representative of the types of work that have been programmed as part of the long-term maintenance requirements of the City’s street network.

General Repairs-Stop Gap (Localized Maintenance*)

For this maintenance type, small localized surface treatments are utilized as “holding action” solutions (stop gaps) to delay the need for pavement structural strengthening. They typically include activities such as crack sealing, deep patching, skin patching, grinding and leveling.

Slurry Seals (Global Maintenance*)

Surface treatments applied to pavements with minimal surface distress to provide new wearing surfaces and extend pavement life. Generally consists of a mixture of conventional or latex-modified emulsified asphalt, well-graded fine aggregate, mineral filler and water placed over an existing AC surface.



Cape Seals (Global Maintenance*)

This is an application of a single layer of asphalt binder to a road surface immediately followed by a single layer of cover aggregate (chips). The single layer chip seal is then followed with a slurry seal application.

Leveling Courses (Global Maintenance*)

The existing pavement should be made as smooth as possible before being overlaid. It is difficult to make up elevation differences or smooth out ruts by varying overlay thickness. For flexible overlays, Hot-mix asphalt (HMA) tends to differentially compact; a rule of thumb is that conventional mixes will compact approximately 6 mm per 25 mm (0.25 inches per 1 inch) of uncompacted thickness.

Therefore, before applying the final surface course the existing pavement is typically leveled by one or both of the following methods:

1. Applying a leveling course (HMA pavements). The first lift applied to the existing pavement is used to fill in ruts and make up elevation differences. The top of this lift, which is relatively smooth, is used as the base for the wearing course.
2. Milling (HMA pavements). A top layer is milled off the existing pavement to provide a relatively smooth surface on which to pave. Milling is also commonly used to remove a distressed surface layer from an existing pavement.
3. Diamond Grinding (PCC pavements). A thin top layer can be milled off of an existing pavement to smooth out relatively small surface distortions prior to flexible or rigid overlay.

Overlays (Major Maintenance*)

AC Overlay – Placement of a layer of hot-mixed asphalt concrete over the existing pavement surface (may include pavement fabric). Grinding (milling) is performed prior to the overlay to reduce the total height of asphalt and assure alignment with existing gutter lines. This also includes “dig-outs” and crack sealing prior to the application of an overlay. This treatment provides a new wearing surface and increased structural strength to the pavement section. A conventional overlay should be designed for a ten-year life.

AC Over PCC – Placement of a layer of hot-mixed asphalt concrete over the existing PCC surface. Includes grinding, leveling course, joint sealing and localized repairs prior to AC overlay.

Asphalt Rubber Hot-Mix Overlay - The ASTM definition is: Asphalt-Rubber is a blend of asphalt cement, reclaimed tire rubber and certain additives in which the rubber component is at least 15% by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles. Specifically, using crumb rubber modified binders in pavement application benefit local agencies in that cities find:

- Pavement resists cracking by being more flexible;
- Cost savings come from a longer life cycle (from Bucknam’s experience typically 20% longer), decreased maintenance and the use of less material



- Improvement in skid resistance;
- Decreased noise; and
- It provides long-lasting color contrast for marking and striping

Reconstruction (Major Maintenance*)

Removal of the existing pavement section to a prescribed depth followed by the placement of a conventional flexible pavement section using a structural AC Hot Mix or AR Hot Mix or a full depth asphalt. Each classification of road has a typical design cross-section upon anticipation traffic loading.

*Localized, Global and Major maintenance activities are default terms used within the MicroPAVER pavement software. Specific pavement repair applications are placed within each maintenance activity in order to develop multi-year maintenance forecast recommendations.

ANNUAL BUDGET PROJECTIONS

The budgeting process was approached with the following in mind; generate two unique work programs for the next five (5) years based upon actual road pavement conditions in order to:

1. Demonstrate how the City’s current “Actual” budget allocation for pavement maintenance performs against the conditions found through our surveys
 - a. The City provided the following “Actual” historic and current annual pavement budget

FUNDING SOURCE	2012-2013	2013-2014	2014-2015
Proposition A	\$1,373,223	\$1,428,152	\$1,648,120
Proposition C	\$1,139,052	\$1,184,614	\$1,367,072
Measure R	\$854,297	\$888,483	\$1,025,302
CDBG	\$1,799,657	\$230,000	\$686,713
Gas Tax	\$1,417,954	\$1,481,250	\$1,458,728
Proposition 42	\$1,084,931	\$1,412,135	\$1,046,709
TOTAL	\$7,669,114	\$6,624,634	\$7,232,644

2. Recommend a proactive annual budget that, at a minimum, **maintains** the current weighted PCI on the network

Based on current and future pavement maintenance needs, two annual work programs have been prepared and summarized below. Table 2 demonstrates the pavement maintenance recommendations based upon the revenues available in the Compton five-year CIP program. Table 3 demonstrates the recommended budget that is needed to maintain the current weighted PCI on the network (each scenario addresses arterial and local streets).

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total \$
2014-15	58.1	60.1	\$515,000	\$6,715,000	\$7,230,000
2015-16	59.2	62.4	\$475,000	\$6,972,000	\$7,447,000
2016-17	61.6	63.9	\$613,000	\$7,057,000	\$7,670,000
2017-18	62.8	65.3	\$547,000	\$7,349,000	\$7,896,000
2018-19	64.1	66.4	\$519,000	\$7,607,000	\$8,126,000
			\$2,669,000	\$35,700,000	\$38,369,000

Table 2 – Citywide Projection Utilizing “Actual” Budget

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total \$
2014-15	58.1	58.5	\$451,500	\$5,085,000	\$5,536,500
2015-16	57.2	58.3	\$423,000	\$5,205,000	\$5,628,000
2016-17	57.0	58.5	\$555,000	\$5,337,000	\$5,892,000
2017-18	57.3	59.1	\$498,000	\$5,551,000	\$6,049,000
2018-19	58.2	59.5	\$485,000	\$5,786,000	\$6,271,000
			\$2,412,500	\$26,964,000	\$29,376,500

Table 3 – Five-Year Projection Demonstrating Required Budget to Maintain PCI of 58



Additional detail and breakdown of budget projections are demonstrated in Section IV of this report.
All work program budgets generated are presented in terms of current 2014 dollars. All repair activities were based on distresses observed at the time of the field survey. These are recommendations and are to be used as “the best case scenario” for improving the City of Compton street network.

QUALITY CONTROL EFFORTS

As indicated in our scope of work, Bucknam performed numerous quality control checks in the field during survey efforts as well as assessing the provided 2002 MicroPAVER database. Numerous pavement segmentation corrections had to be made prior to field survey as well as the re-establishment of the PMP-GIS link. This effort extended our data assessment and survey preparation by one week.

Field check efforts were performed at the end of each week of survey. During in-house and field operations, we came across several issues with the previous databases. These included incorrect pavement section widths, lengths and true areas; these were corrected through our field inspections.

Through our internal quality control efforts, we believe we have found all the necessary publicly owned streets that needed to be reported on under this project. Minor area adjustments for specific pavement sections were made by our field technicians in order to create a more accurate network. Numerous pavement sections were missing zone designations and lane counts, or simply were not in the original database, these have been corrected by Bucknam.

FINDINGS AND RECOMMENDATIONS

Arterials

The actual workload requirements identified indicate that the Arterial street network is currently in “Fair” condition. To maintain this condition, it is critical that preventive maintenance and overlay activities are funded at the levels identified in Table 2 and the reports in Section IV to maintain a very good network weighted average PCI value.

Our arterial findings for conditional data and recommendations for revenue expenditures are shown below:

- The Arterial network has a weighted PCI of 62.5;
- Currently, 60% of the arterial network (approx. 47.9 miles) qualify for overlay/reconstruction maintenance;
- Arterial maintenance projects should focus on improving the current weighted PCI of 62.5 to 65 over the next five years;
- Develop a proactive fiscal and planned approach to identify arterial overlay projects based on the deterioration modeling within MicroPAVER;
- Maintain arterial revenues at the levels shown within the Section IV Forecasted Maintenance Report for a minimum of five to seven years to generate the results identified within this report.
- Reassess/re-evaluate the arterial rehabilitation budget program every two years to improve on CIP forecasts for 2014 and beyond to ensure the results shown in Table 2 or 3;
- Perform pavement inspections on the arterial network **every two years** to build a solid planning model within MicroPAVER to track PCI deterioration.
- Demonstrated budgets shown in Tables 2 & 3 are ample enough to increase the arterial weighted PCI to 65 in five years,
- Bucknam recommends that the City proactively budget pavement maintenance at the levels shown in Table 2 in order to improve upon the conditions found today

Locals



The actual workload requirements identified indicate that the Arterial street network is currently in “Fair” condition. To maintain this condition, it is critical that preventive maintenance and overlay activities are funded at the levels identified in Table 2 and the reports in Section IV to maintain a very good network weighted average PCI value.

Our Local findings for conditional data and recommendations for revenue expenditures are shown below:

- The Local network has a weighted PCI of 54.6;
- Currently, 56% of the Local network (approx. 78.4 miles) qualify for overlay/reconstruction maintenance;
- Local maintenance projects should focus on improving the current weighted PCI of 54.6 to 65 over the next five years;
- Develop a proactive fiscal and planned approach to identify Local overlay projects based on the deterioration modeling within MicroPAVER;
- Increase Local revenues at the levels shown within the Section IV Forecasted Maintenance Report for a minimum of five years to generate the results identified within this report.
- Reassess/re-evaluate the Local rehabilitation budget program every two years to improve on budget forecasts for 2014 and beyond to ensure the results shown in Table 2 or 3;
- Perform pavement inspections on the Local network **every three years** to build a solid planning model within MicroPAVER to track PCI deterioration (1/3 of the City each year);
- Demonstrated budgets shown in Tables 2 or 3 are ample enough to increase or maintain the Local weighted PCI; proactive funding needs to be implemented to see these results.

SECTION II

PAVEMENT MANAGEMENT SYSTEM

Bucknam performed the following services in accordance with the scope of services that was contracted with the City of Compton. As a quick overview, the following tasks were performed to complete the work over the past several months:

2014 Pavement Management Work Efforts:

- Task 1:** Project Kickoff-Data Management
- Task 2:** Update of Maintenance Activities
- Task 3:** Pavement Condition Survey (approx. 149 miles)
- Task 4:** Budgetary Analysis and Capital Improvement Reports
- Task 5:** Executive Summary and Final CIP Reports
- Task 6:** Mapping of the Pavement Network

Pavement Management Update 2014

As a part of the 2014 update of the pavement management system, a major element of work was to complete a comprehensive assessment of the existing street network and PMP database within the City. This included assessing the City's existing 2002 MicroPAVER database, GIS, street naming conventions and work history information. From there, Bucknam worked with the City to confirm public and private street listings which set the foundation for accurate CIP reporting. All data was then verified or updated within the City's new MicroPAVER database.

Work history information was provided by the City in the form of completed bid documents, institutional knowledge, and previous dataset and Excel documents. This information was entered into the proper pavement segments that match the limits of those projects. From there, CIP pavement recommendations were performed (discussed and demonstrated below) where the pavement maintenance information the City provided (PMP material practices, unit costs, and capital budgets) were used to generate recommendations through the MicroPAVER system.

Table 6 demonstrates PCI ranges defaulted within MicroPAVER. Once a pavement inspection is complete, a PCI is calculated for each pavement section. Each PCI calculated falls within a defined PCI range category (Very Good, Very Poor, etc.). Furthermore, a weighted PCI was calculated for the each functional class within the network (arterials and locals).

The PCI is a condition rating that ranges from 100 (a new pavement section or recently overlaid or reconstructed) to 0 for a section that has structurally failed and deteriorated dramatically. Weighted average PCI of a given area/zone = pavement section PCI multiplied by its own area divided by the total square footage of the given area/zone. This information can also be represented through MicroPAVER to show how much square footage or percentage of area falls within a PCI range category.



<u>PCI RANGE</u>	<u>CONDITION</u>
86-100	Very Good
75-85	Good
60-74	Fair
41-59	Poor (Compton Network 2014 = 58.1)
0-40	Very Poor

Table 4 - PCI Range

These condition ranges are defined by the Army Corps of Engineers and defaulted within the MicroPAVER software. The summary of all roads condition data and their representative PCI's can be seen in the Pavement Condition Report in Section III.

STRATEGY ASSIGNMENT TABLE

Once the appropriate activities from the above listings were selected by the City, a Maintenance Strategy Table was defined within the system that allocated the appropriate actions to the specific repair needs of the street. In defining the maintenance strategy list, emphasis was placed on defining pavement condition thresholds and using the PCI for the specific maintenance activities within these categories.

Strategy Assignment Table

All Streets		
PCI Range	Description	Unit Cost
20 - 100	Preventative, Zipper, Stop Gap, Patching	Varies by Activity
60 - 80	Type II Slurry Seal	\$0.27/SF
Minimal Level of Service (65)		
40 - 60	Cape Seal	\$0.48/SF
20 - 60	2" AC Grind & Overlay (Local)	\$1.55/SF
20 - 60	2" AC ARHM Overlay (Arterial)	\$1.68/SF
0 - 60	Deep Patching, PCC Repair	\$13.50/SF
0 - 20	Recon 4"/6" CAB	\$5.40/SF
Unit Costs shown include a 35% contingency for admin, design, construction, etc.		

Table 5 - Strategy Assignments

The Strategy Assignments List, shown in Table 5, was developed to identify the most critical segments in each of the work programs (Arterial and Local). Segment priorities were established by determining the range of PCI's requiring first attention based on the relative value of each segment's PCI, thus maximizing the annual maintenance budget. Also, distress quantity, area extent, type and severity were critical elements in the decision process for recommending maintenance.



The assignment table is used as a guide within MicroPAVER to recommend maintenance, however, further assessment by City staff and/or outside parties can override maintenance recommendations. This can be done by reviewing and assessing distress extents and their weighted percentages.

Once the strategy assignments were set within the system, budgets and work assignments were generated for each work program on an annual basis. Using pavement deterioration curves for each type of pavement surface and class of road, both current year and future years work requirements for each pavement segment within the City were determined. In forecasting the maintenance requirements in future years, the current PCI value is reduced annually for each pavement segment based on the MicroPAVER deterioration curves within the City's database.

Likewise, maintenance activities performed in a given year increase the PCI value as they are applied to the segment. The overall program is dynamic in that each strategy consists of a cyclic series of actions that simulates the pavement anticipated life cycle.

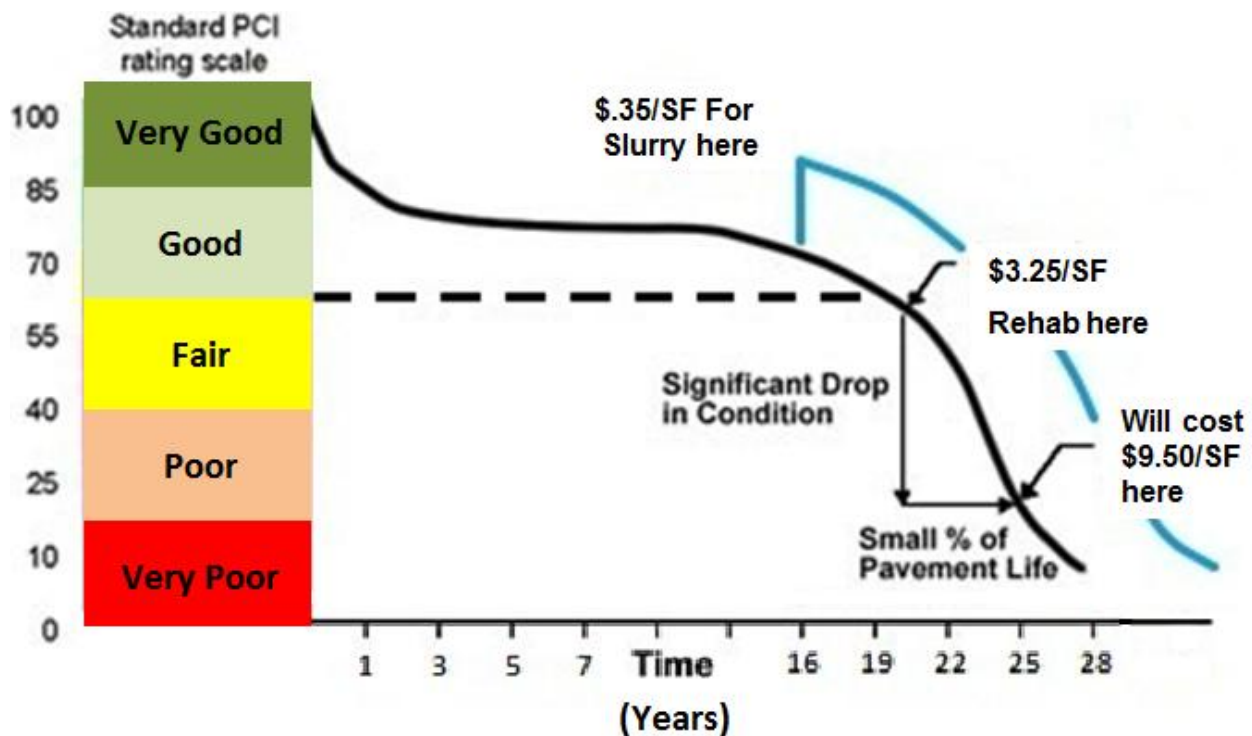


Figure 3 – Sample Pavement Life Cycle

MULTI-YEAR ANNUAL WORK PROGRAM PROJECTIONS

The goal of these projections is to assist City policy makers in utilizing the recommendations of the MicroPAVER system. By using the City of Compton’s current budgets and maintenance practices the system will develop “section unique” improvements and strategies. Each segment will be tied to a specific fiscal year. As shown in the following pages, we have assessed the budgets that have been projected to meet the maintenance and rehabilitations needed to maximize the City’s return on investment. The budget forecasting goal for the City network focused on:

- ❖ Establishing a proactive multi-year Maintenance & Rehabilitation Program;
- ❖ Developing a preventive maintenance program; and
- ❖ Selecting the most cost-effective repairs based on City strategies

ACTUAL BUDGET – The Actual budget was generated for the City to demonstrate how the City’s 5-Year Roadway Infrastructure funding allocation performs against the current citywide conditions.

- City’s Actual budget includes:

FUNDING SOURCE	2012-2013	2013-2014	2014-2015
Proposition A	\$1,373,223	\$1,428,152	\$1,648,120
Proposition C	\$1,139,052	\$1,184,614	\$1,367,072
Measure R	\$854,297	\$888,483	\$1,025,302
CDBG	\$1,799,657	\$230,000	\$686,713
Gas Tax	\$1,417,954	\$1,481,250	\$1,458,728
Proposition 42	\$1,084,931	\$1,412,135	\$1,046,709
TOTAL	\$7,669,114	\$6,624,634	\$7,232,644

- Projects are funded through Prop A & C, Measure R, CDBG, Gas Tax and Prop. 42

MAINTAIN BUDGET – A Maintain budget was generated for the City to demonstrate the necessary funding that is required to maintain the current weighted PCI level of 58 through a five year model.

**All multi-year budget projections include a 3% inflation rate for the term of the budget forecast.*



**ARTERIAL / LOCAL
BUDGET PROJECTIONS**



ACTUAL – The first key step in developing a proactive PMP is to model the City’s existing conditions against the “actual” annual budget. In doing this, PCI performance, deferred maintenance and pavement application uses are able to be benchmarked and demonstrated in a positive or negative result. The City’s existing 5-Yr Roadway Infrastructure budget was used for this model; the City provided Bucknam with current 2014 unit costs for pavement maintenance applications.

The resulting PCI conditions and maintenance distributions are shown below. Bucknam worked with the City’s Public Works staff to review previous methodologies and schedules applied by the City. The City provided information on the current work schedules and yearly goals for asphalt application. With this scenario, our initial goal is to provide the City with a budgetary outlook and conditional impact report that can be used to eventually create a solid, preventative maintenance program.

ACTUAL BUDGET PROGRAM

Actual Budget Program incorporates pavement sections that have a functional class of Arterial (A/B), Collector (C) and Locals (E).

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total \$
2014-15	58.1	60.1	\$515,000	\$6,715,000	\$7,230,000
2015-16	59.2	62.4	\$475,000	\$6,972,000	\$7,447,000
2016-17	61.6	63.9	\$613,000	\$7,057,000	\$7,670,000
2017-18	62.8	65.3	\$547,000	\$7,349,000	\$7,896,000
2018-19	64.1	66.4	\$519,000	\$7,607,000	\$8,126,000
			\$2,669,000	\$35,700,000	\$38,369,000

Table 6 – Citywide Projection Utilizing “Actual” Budget (\$7.2 mil/yr)

By modeling the existing pavement conditions against the City’s available funding, we have found that two major positive results occur over the five year CIP. (See Figure 4 on the following page). First, the weighted PCI for the entire network increases from a level of 58.1 to a level of 66.4 over the five year CIP which meets one of our recommended goals (minimum level of service = 65).

Secondly, the resulting deferred maintenance backlog shows that it decreases as well from \$63.7 million to \$45.5 million after the five years program which indicates that an annual pavement budgets are ample enough to improve upon the deferred maintenance (or backlog of maintenance) on the network. The backlog that has been identified above only consists of slurry/cape/overlay and reconstruction maintenance. Combined with the positive results found with the weighted PCI we recommended that this 5-yr maintenance schedule be followed.

This situation is good for the City in that with a continued proactive slurry seal program combined with strategic and timely overlays the City will be in a “preventative” state of condition. This equates to lower cost maintenance and proactive management of Compton streets and right-of-ways.



As shown, this projection model does meet the initial goal of maintaining or increasing the City’s pavement network PCI. With today’s economic issues at the Federal, State and local levels; the City should continuously monitor the management of overlay deferred maintenance. The potential delay in projects and the resulting build-up of more overlay work in the five-year time frame is not a debt that City will want to accept.

Through Bucknam’s analysis of the previous pavement database, work history dates and our experience with AC Overlay deterioration rates, it is important to point out that pavement sections that were overlaid in fiscal year 2003 will need proper overlay maintenance approximately around fiscal year 2014-15 and beyond.

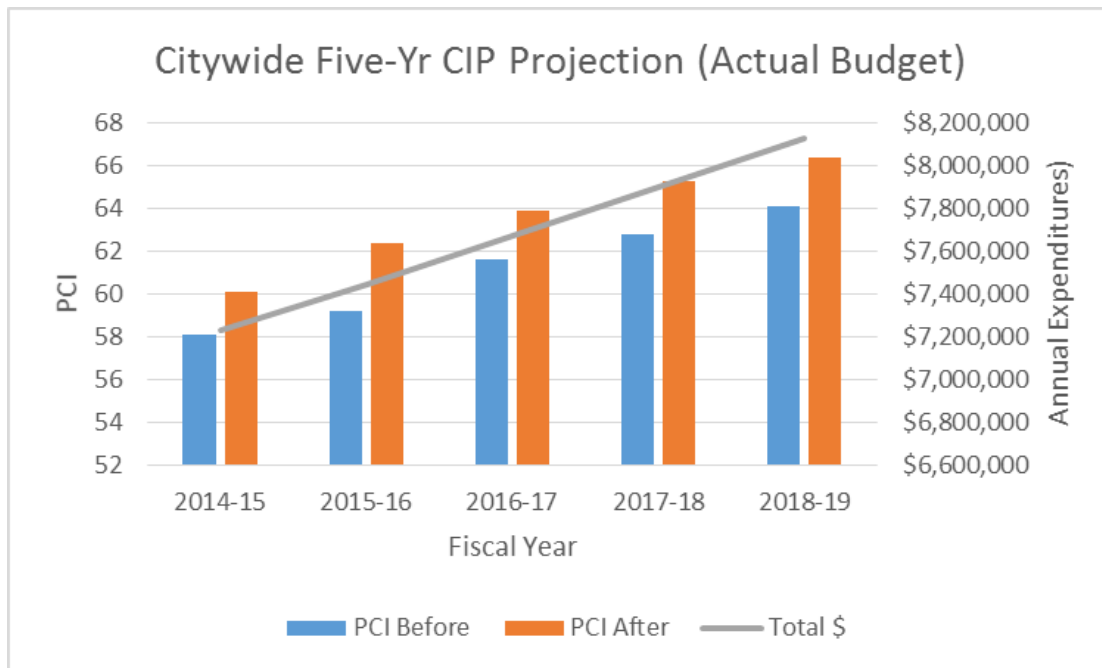


Figure 4 – Resulting Network PCI and Budget Expenditures (Actual Budget)

The resulting “increase of the weighted PCI” for the entire network demonstrates how applying proper funds to the network is preventing the City’s pavement from deteriorating at a rate that is not conducive to a PMP success. Based on available funding or programmed funding identified by the City’s long-term CIP, there may be an opportunity to proactively schedule or appropriate funds to areas of the City that have been annually deferred due to high maintenance costs.

Additionally, the City should continue to implement local, stop gap maintenance (i.e. deep patching, crack sealing, etc.) prior to any major slurry / cape seal or overlay maintenance. By performing stop gap measures to individual pavement sections the overall performance of the sections condition will increase and sustain itself longer than if no preventative maintenance was performed.

MAINTAIN PCI PROGRAM (FIVE YEAR MODEL)

With the City striving to show proactive maintenance across all City pavements, a budget program was generated to show the greatest return on investment through the application of slurry seal, mill & cap, and alternative overlay maintenance. Our goal under this model is to maintain the current 2014 weighted PCI of 58.1 through a five-year program. This model will demonstrate the necessary funding to achieve this goal.

Again, we used the “Actual” 5-yr PMP model (shown above) as a cornerstone for our modeling within the “maintain” program. Combining the previous reporting model with a realistic and achievable annual budget, we found positive results.

The Recommended Program incorporates pavement sections that have a functional class of Arterial (A/B), Collector (C) and Local (E).

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total \$
2014-15	58.1	58.5	\$451,500	\$5,085,000	\$5,536,500
2015-16	57.2	58.3	\$423,000	\$5,205,000	\$5,628,000
2016-17	57.0	58.5	\$555,000	\$5,337,000	\$5,892,000
2017-18	57.3	59.1	\$498,000	\$5,551,000	\$6,049,000
2018-19	58.2	59.5	\$485,000	\$5,786,000	\$6,271,000
			\$2,412,500	\$26,964,000	\$29,376,500

Table 7– Five-Year Projection Demonstrating Required Budget to Maintain PCI of 58

Referring to Table 7, it is noted that the weighted PCI slightly decreases through the five-year projection (58.1 to 59.5). However, the annual deferred maintenance total also decreases from \$63.7 million to \$72.5 million at the end of the five-years if the City utilizes an annual budget average of \$5,875,000/yr for slurry, overlay, and reconstruction maintenance. We found that annual average square footage breakdowns of maintenance areas were consistent and well balanced.

We recommend that a stronger focus be placed on the Local network improvements due to the fact that the Local network is twice the amount of total square footage and has a worse weighted PCI than the arterials. We still recommend minor maintenance to the arterial network, i.e. localized patching, slurry seal and the use of awarded Proposition A/C & 42 funds. But again, with the Local network showing a higher degree of negative results, a new focus for zoned area maintenance and proactive overlays should be implemented.

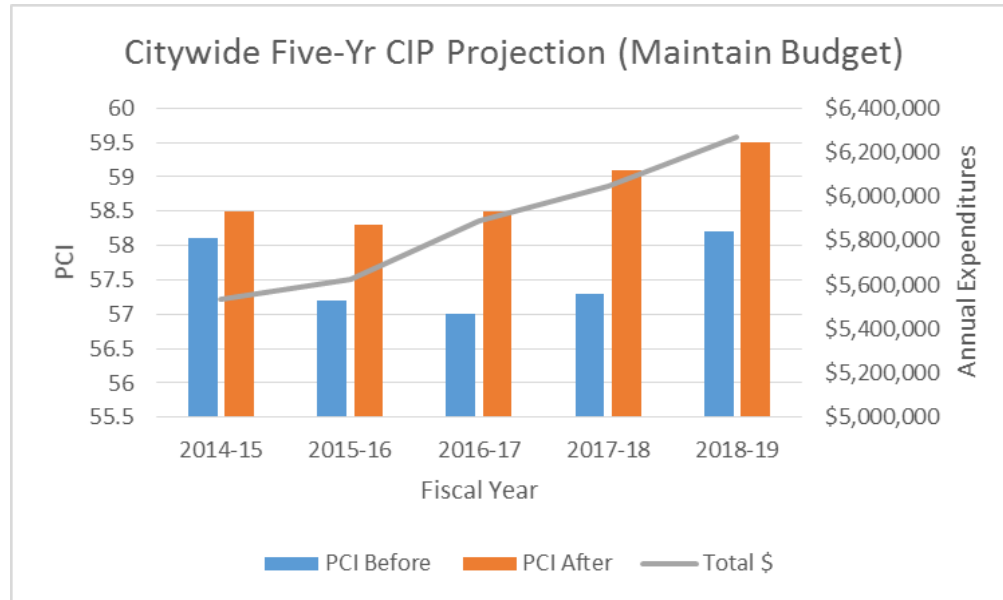


Figure 5 – Resulting Network PCI and Budget Expenditures (Maintain Budget)

As mentioned above, a local slurry/overlay maintenance “zone/area” strategy should be continued for several reasons. With the City applying a maintenance area methodology to the local network, four beneficial impacts occur:

- 1) Planned / Maintenance areas are addressed every seven years which creates a dedicated project schedule for City staff and constituent inquiries;
- 2) Deferred overlay maintenance can be addressed in a more effective manner due to accrued revenues
- 3) A preventative maintenance strategy is more cost-effective in a long-term PMP rather than implementing a maintenance approach that addresses only the “worst-first” streets.
- 4) All maintenance alternatives are available due to the increased funding and focused maintenance within one zone per year.

On the negative side, if low weighted PCI values occur within a given zone, all streets within that zone may not be able to be addressed with maintenance when that zone is scheduled for maintenance. The deferred maintenance will have to be scheduled for maintenance in future years or simply will have to wait until the zone cycle repeats.

The Local maintenance model that has been developed under the Actual budget can be used as a benchmark to monitor the City’s annual budget allocations as the network continues to mature and age; the proper amount of funding for slurry seal and overlay maintenance needs to be the City’s highest priority.

Additionally, it is recommended that the City continue to monitor the application of Slurry / Cape Seal or Grind & Overlay as an asphalt application for the specific local sections. Specific sections are now qualifying for maintenance that warrants a stronger application rather than a typical slurry seal.

With a five to seven year cycle in motion, it is essential to address local sections that have PCI's less than 65 with the proper maintenance since crews will not be back within that area for five to six years.

PAVEMENT MANAGEMENT SYSTEM REPORTS

In addition to the annual budget scenario, this report contains a comprehensive and complementary assemblage of pavement management reports ranging from summary reports to annual maintenance and rehabilitation schedules (Forecasted Maintenance Report, Section IV). Collectively as well as individually, the reports represent reasonable projections of pavement maintenance needs and performance based on visual condition assessments, unit cost estimates, and pavement deterioration models.

It is important to note that pavement segment dimensions and surface area (recorded during 1999-2006, 2013 inspections, along with the action and repair costs, as presented within the reports are accurate within tolerable limits. This is noteworthy due to the "implied" accuracy of reporting length and width to the nearest foot, surface area to the nearest square foot, and action and repair unit costs and project estimates to the nearest penny and dollar, respectively.

NEXT STEPS

As with any infrastructure management software program, time investments need to be made by key Public Works staff to maintain the integrity of the data as well as the accuracy. Bucknam can perform training sessions in the use of the MicroPAVER system and demonstrate how to generate standard maintenance reports to assist City staff in developing yearly budgets, project level analysis, and CIP projections. This will be key to future staff management of the pavement program and reporting. City personnel need to maintain their commitment to the preventive maintenance system, while working toward reducing the City's present backlog of rehabilitation projects.

In order to ensure that report outputs are accurate and credible, it is essential that the integrity of all data files be maintained. This will require performing all necessary updates when changes are made to scheduling scenarios, unit cost information, historical data, etc. In addition, the entire pavement network will have to be re-inventoried at regular intervals. This typically includes surveying arterial every two years and locals every three. One recommendation the City may consider to keep the program "managed" is"

- Survey half the arterials each year (2 year turn over cycle); and
- One-third of the locals each year (3 year turn over cycle)

This will not only allow work to be scheduled based on the most current condition data available, but will provide City personnel with a means to monitor actual rates of pavement deterioration so appropriate modifications can be made to the system curves. To be compliant with the MTA requirements, the City must generate a triennial (every three years) Arterial network pavement management report indicating condition ratings.



Bucknam will be supporting the City with staff level support to assist in the continuous updates with the MicroPAVER system. This will include work history updates, generating reports from the system, unit cost updates, and future inspections.

ALTERNATIVE PMP FINANCING OPTIONS

Through Bucknam's experience with PMP financing and maintenance forecasting, we have been involved with numerous PMP projects that include alternative funding. We have included below several examples and alternatives to PMP funding that the City may want to consider if annual PMP funding becomes limited:

- **Grants - State funding for alternative asphalt applications (i.e. Rubber Asphalt Concrete through the Cal Recycle Grant Program)**
<http://www.calrecycle.ca.gov/Tires/Grants/default.htm#RAC>
- **Bond Measures** - Bonds maybe issued to fund the amount of the unpaid assessments. The bonds are secured by a pledge of the assessment installments. The amount of bonds issued equals the amount of the unpaid assessment plus additional bond issuances costs and establishment of a reserve. If the City Council determines that it is not convenient to collect the amount assessed in a single year, then the amount of the proposed assessment maybe collected in installments over a period of years. Property owners are given an opportunity to pay all or a portion of the amount assessed.
- **Special Assessments** – Through our experience, we have seen several local agencies perform Special Assessment Feasibility studies and eventually form Special Assessment Districts for the purpose of funding pavement improvements beyond the annual allocated City funding.

The purpose of a feasibility study for the formation of an assessment district within the City would provide insight as to how an assessment district would be formed within the City's boundaries. The analysis utilizes a common approach by comparing average daily trip miles among the different land uses and the average units per acre to obtain EDU rates. The EDU rates are then multiplied by the parcel's individual number of units or acres to establish the parcel's assessment amount.

The City's possible options in forming the street maintenance assessment district are set forth below. These options can be implemented in combination; however, it is highly recommended that the City establish communication with affected property owners as early as possible, prior to the City moving forward with the initial proceedings of district formation.

- **Conduct Outreach Efforts to Inform Property Owners**

It is recommended that the City hold informational sessions for affected property owners. Participation of residents in the process will build cooperation and trust and ensures the viability of the proposed assessment district. Input from residents is important in gaining understanding of the process and the reasons for levying the assessments. The City might also create a citizens' committee to disseminate information and express concerns to and from the residents and the City.

- **Public Opinion Survey**

In addition, it is recommended that a Public Opinion Survey be conducted to further gauge the resident's interest or desire to participate in being assessed for street and pavement rehabilitation. Response from the survey would also guide the City in determining whether a Citywide or Phased Assessment District is warranted.

- **Form Assessment Districts in Phases**

The City may time the initial formation of separate assessment districts with the street improvement schedule of each zone as opposed to a one-time formation of a citywide assessment district. A zone's start date for street improvements would trigger the assessment for parcels in that particular zone. If each zone improvements were separately initiated on an annual basis, the assessment for the twelfth zone will begin in the twelfth year. The City has the option to accelerate the improvement schedule of each zone.

Through our review and assessment, several local agencies have successfully implemented Special Assessments for pavement improvements, see below:

A. City of San Clemente

The City of San Clemente's Citywide Street Improvement Program was adopted by City Council in July 1995 as Street Improvement Assessment District 95-1 (AD 95-1). The program was to restore approximately 60 miles (one-half) of the City's streets over a span of 18 years. The program is funded by a combination of various revenues from (1) Street Assessment District 95-1, which assesses all developed properties; (2) the General Fund; (3) the Gas Tax Fund. Water, sewer and storm drain funds pay for work done on underground facilities in conjunction with street work. The final assessment for AD 95-1 was collected in Fiscal Year 2010-11. In that year, only the maintenance portion of the assessment was collected (approximately \$45 per parcel), which was one-half the normal assessment amount. The final bond redemption, paid in September 2011, was paid for by the mandatory reserve funds held since the bonds were issued. AD 95-1 is expired and fully paid.

B. City of Elk Grove

Beginning with Zone No. 1 in 2003, the City of Elk Grove formed Street Maintenance Assessment District No. 1. The City of Elk Grove's Street Maintenance District No. 1 funds street maintenance costs associated with local, collector and arterial streets. The assessment amounts for developed property are prepared by the City annually.

The City levies an assessment according to the Engineer's Reports prepared for Zone Nos. 1 to 5. The assessment formula uses EDU factors to establish assessment amounts per unit or acre.

C. City of La Habra Heights



The City of La Habra Heights established the Citywide Street Maintenance Assessment District No. 4 in 2007. The City of La Habra Heights levied the assessments for five years. The first levy of assessments occurred in Fiscal Year 2007-08 and the final levy for District No. 4 has been prepared for Fiscal Year 2011-12.

CONDITION DISTRIBUTION REPORT

This report graphically depicts the distribution of the pavement condition throughout the street network by area.

The condition scheme ranges from “Very Good” to “Very Poor”; with a “Very Good” condition corresponding to a pavement at the beginning of its life cycle, and a “Very Poor” condition representing a badly deteriorated pavement with virtually no remaining life.

The table below shows the general description for each pavement condition:

Condition Description – PCI Range - Description

- Very Good (86-100)** - Minor to low distress, no significant distress. Little distress, with the exception of utility patches in good condition, or slight hairline cracks; may be slightly weathered

- Good (75-85)** - Slight to moderately weathered, slight distress, possibly patching

- Fair (60-74)** - Severely weathered or slight to moderate levels of distress, generally limited to patches and non-load-related cracking.

- Poor (41-59)** - Moderate to severe distresses including load-related types, such as alligator cracking. ***(City of Compton citywide weighted average PCI is 58.1).***

- Very Poor (0-40)** - Severely distressed, large quantities of distortion or alligator cracking. Failure of the pavement, distress has surpassed tolerable rehabilitation limits.



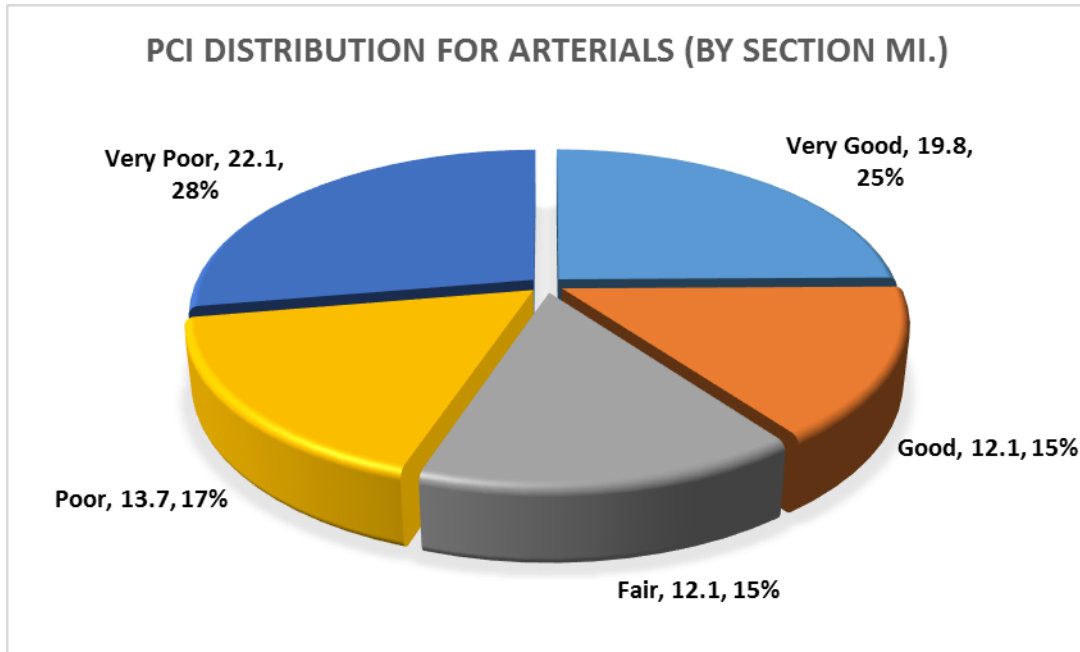


Figure 6 – Arterial Condition Distribution

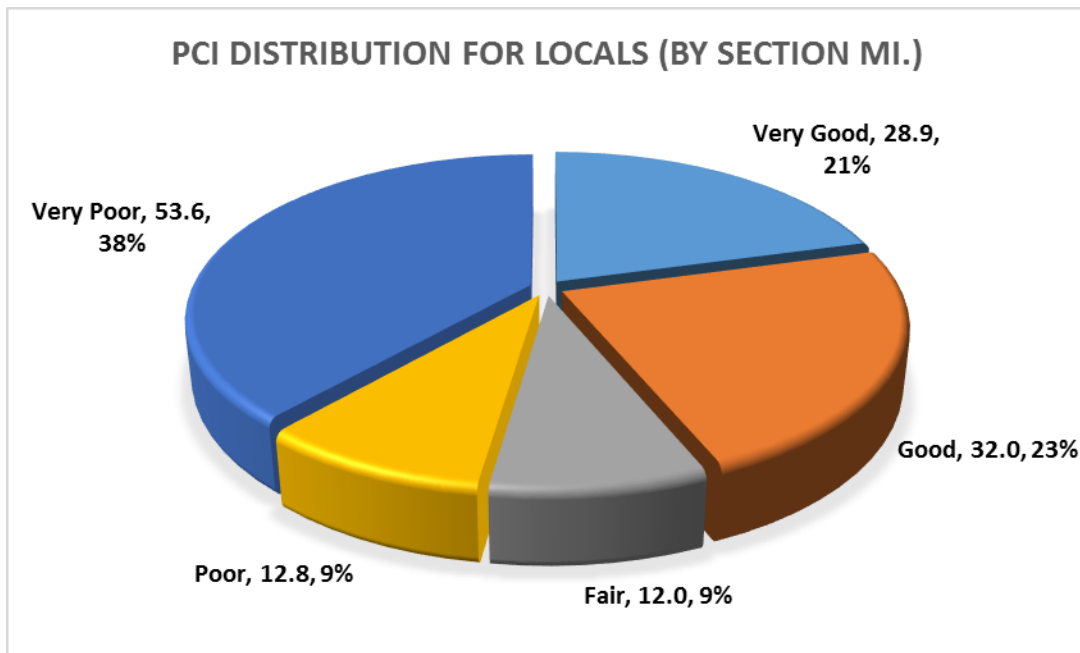


Figure 7 – Local Condition Distribution

SECTION III
CITYWIDE
PAVEMENT CONDITION INDEX REPORT

- A. PCI Map
- B. A to Z
- C. PCI Order



PAVEMENT CONDITION INDEX REPORT

Listed alphabetically by street name or PCI, this report provides the City with a listing of pertinent inventory and pavement condition data for each inventory unit within the City's pavement network. The Pavement Condition Index (PCI) Report notes the names, limits, classification, dimension, surface type, and lane configuration of each inventory unit.

Detailed descriptions of the information appearing on this report are presented below:

BRANCH NAME - The name of each inventory unit appears in this column. Generally, the inventory unit name is taken directly from a street sign; however, where no street signs are posted, the name appearing on the network map is noted instead.

A sample set of street name suffix abbreviation definitions is presented below:

AV - Avenue	CT - Court	CIR - Circle
DR - Drive	LN - Lane	RD - Road
ST - Street	WAY - Way	EB - East Bound
NB - North Bound	SB - South Bound	WB - West Bound

FROM - A description of the beginning limit of each inventory unit appears in this column. If the beginning limit exists between intersections, then the beginning limit description may be an address, post mile marker, or a distance from a known point of reference (e.g., "500' N/MAIN ST").

TO - A description of the ending limit of each inventory unit appears in this column. Like BEGIN limit, the END limit description may consist of a street name, an address, or a distance from a known point of reference. In the case of cul-de-sacs, or dead-ends, the END limit consists of an address, or a directional reference, such as "NORTH END," when no address is available.

RANK - The codes for the five functional classifications as the inventory unit appears in this column are represented below. Basically, units are classified according to traffic volume.

<u>CODE</u>	<u>DESCRIPTION</u>
A/B	Primary Arterial, Arterial
C	Collector
E	Local
P	Private
O	Alley

SURFACE TYPE - A code was assigned to each inventory unit to describe surface type.

<u>CODE</u>	<u>DESCRIPTION</u>
AC	Asphalt Concrete
PCC	Concrete



LENGTH - The length of the section within each branch.

UNITS - The unit of measurement for the section length, typically linear feet (LF).

AREA - The area of each section within a branch.

UNITS - The unit of measurement for the section area, typically square feet (SF).

PCI - Pavement Condition Indices were calculated for inventory units based on severity and extent of distress manifestations observed within the inventory unit. Ranging between 0 and 100, a PCI of "100" corresponds to a pavement at the beginning of its life cycle, while a PCI of "0" corresponds to a badly deteriorated pavement which is at or near the end of its life cycle.

FINAL PCI MAP HERE



SECTION IV
FORECASTED MAINTENANCE REPORT

A. Actual Budget, Five Year Plan (2014-2019)



FORECASTED MAINTENANCE REPORT

Listed in chronological order by plan year then alphabetically by street name, this report presents the year and action corresponding to the next scheduled work activity for each segment within the pavement network.

ACTUAL BUDGET – The Actual budget was generated for the City to demonstrate how the City’s 5-Year Roadway Infrastructure funding allocation performs against the current citywide conditions.

- City’s Actual budget includes:

FUNDING SOURCE	2012-2013	2013-2014	2014-2015
Proposition A	\$1,373,223	\$1,428,152	\$1,648,120
Proposition C	\$1,139,052	\$1,184,614	\$1,367,072
Measure R	\$854,297	\$888,483	\$1,025,302
CDBG	\$1,799,657	\$230,000	\$686,713
Gas Tax	\$1,417,954	\$1,481,250	\$1,458,728
Proposition 42	\$1,084,931	\$1,412,135	\$1,046,709
TOTAL	\$7,669,114	\$6,624,634	\$7,232,644

- Projects are funded through Prop A & C, Measure R, CDBG, Gas Tax and Prop. 42

The following report is sorted by Fiscal Year, then by Rank (functional classification), then by street name.

