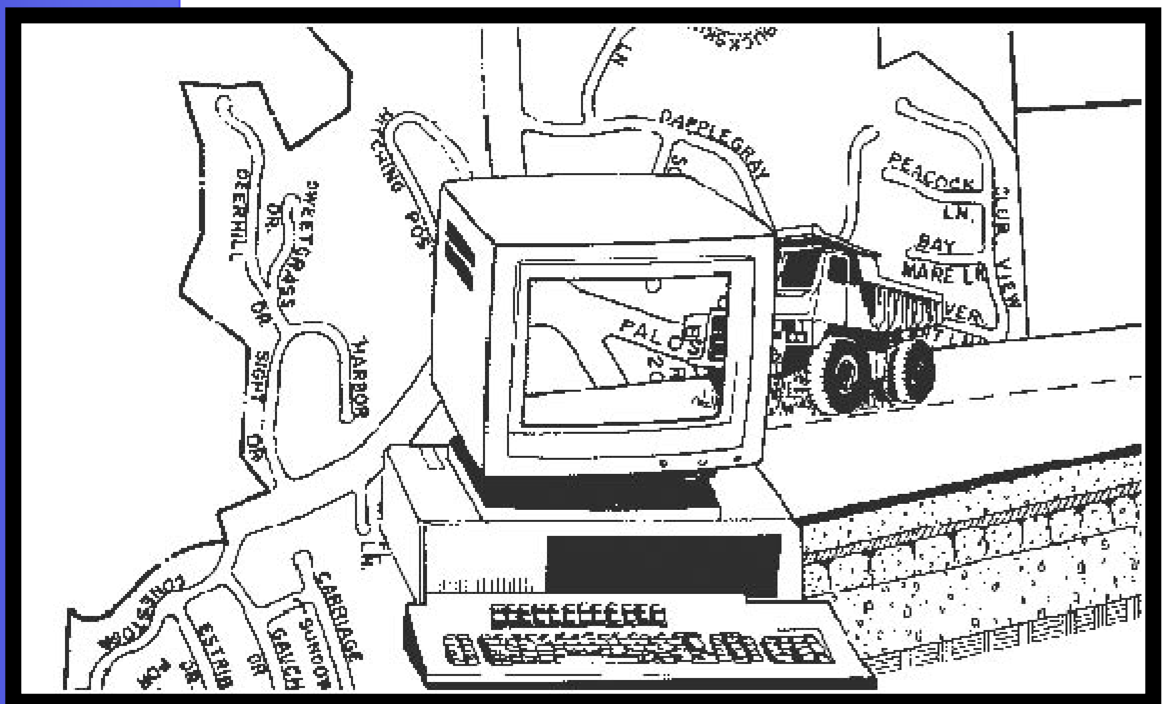
PAVEMENT MANAGEMENT SYSTEM



2002 UPDATE

prepared by
Willdan
Serving Public Agencies

CITY *of* CALABASAS

PAVEMENT MANAGEMENT SYSTEM

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PART 1

GLOSSARY OF TERMS

Certain terms used in this report may not be familiar to all readers. A review of the following list of terms and their definitions will make for easier reading:

MAJOR MAINTENANCE: Includes any improvement to a pavement that adds significantly to structural strength. This usually involves adding a layer of asphalt. Reconstruction is included in the term Major Maintenance.

MINOR MAINTENANCE: Includes any improvements that generally do not add structural strength, for example crack sealing or slurry seals.

RECONSTRUCTION: Involves the removal of existing pavement and replacement with a new pavement.

RESTRUCTURING: Involves addition of layers of pavement that increase the structural strength without removal of the existing pavement.

TI: The Traffic Index is a numerical representation of traffic loading, but not simply traffic volume. It has a range from 4 for neighborhood streets to 12 or more for freeways. It is primarily dependent on percentage of truck traffic.

R-VALUE: The R-Value (resistance value) is an index of the capability of a soil to resist deformations from wheel loads, beyond which the soil will not "spring back" to its original surface elevation. It ranges from 0 to 100.

ORIGINAL CONSTRUCTION: Defined as that portion of the existing pavement that was constructed on the natural soil. (Each latest reconstruction project replaces the previous original construction.)

STRUCTURAL SECTION: Includes all of the layers placed over the natural soil to form the actual structure of the pavement. This includes all aggregate base layers, asphalt concrete, Portland cement concrete, and structural interlayers.

RESURFACING: A supplemental layer of asphalt concrete over the existing pavement surface to restore the ride quality and/or add structural strength.

CROWN: Where central area of street is high in elevation relative to edges of roadway.

PCC: Portland cement concrete (normal concrete).

AC: Asphalt concrete (normal material used to construct street pavement).

ARHM: Asphalt-rubber hot mix, similar to AC, but asphalt-rubber is used as cement instead of plain asphalt oil.

ALLIGATOR CRACKING: Pattern of cracks usually 4 to 6 inches apart, resembling texture of alligator skin.

WHEEL PATH: Area of pavement where wheels of predominant traffic pass directly over.

BASE FAILURE: Area of alligator cracking deteriorated such that the support material underlying the pavement has been damaged and/or where the alligator pavement is loose without interlocking support.

RAVELING: Pavement surface where fine rock particles in the AC have worn away, leaving larger rocks protruding with little surrounding support.

ARAM: Asphalt-rubber and aggregate membrane is placed on a deteriorated street either by itself, with slurry, or with an overlay on top. Forms a layer that is highly resistant to cracks coming through it.

OVERLAY: A layer of AC or ARHM on existing pavement.

INTRODUCTION

BACKGROUND

Nationwide, municipalities are faced with ever increasing street maintenance budget problems due to reduced availability of funds. The problem is compounded, due to an apparent increase in deteriorated streets each year and a disproportionate increase in the cost per mile for maintenance.

Street pavement is one of the major capital investments of a municipality. It is also one of its most important assets. Without a well-maintained street system, the transportation needs of the public, business, industry, and government cannot be met. Therefore, it is important that agencies at all levels of government develop improved means of allocating their limited financial resources to maintain street pavement.

A pavement management system (PMS) is being used increasingly by agencies as a way of meeting this need. PMS is not a new concept. It has been in use for many years but on a limited basis.

The basic idea behind a PMS is to improve the efficiency and effectiveness of management decision-making in the allocation of limited funds for maintenance, resurfacing, and reconstruction of a community's roadway facilities.

A PMS is an orderly listing of all roads maintained by an agency and the condition they are in. This listing includes information such as the type of surface, condition of pavement, width of pavement surface, street length, data of resurfacing or seal coating, etc. The "databank" can be sorted by a computer in a variety of useful ways. In addition, a PMS provides the means to assign meaningful priority rankings of projects and their associated costs to assist in multi-year programming and annual budgeting for maintenance and capital improvements. Once implemented, the PMS must be updated bi-annually in order to be an ongoing, effective management system.

In the City of Calabasas, there are 26.77 miles of streets or approximately 7.1 million square feet of pavement in the arterial system included in this report. The total estimated replacement cost to replace this pavement would be in excess of $31.8 million. Total street mileage is 55.5 miles, approximately 11.7 million square feet with total replacement cost of $38.1 million.

In response to the need to protect the City's large capital investment in streets, the City Council of Calabasas retained Willdan to prepare a PMS update for the City. This report represents the results of that work effort.

PROJECT SCOPE

The PMS developed for the City includes public streets which are considered arterial for traffic circulation within the City. The basic PMS components are:

- Data Base
- Retrieval Methods
- Analysis Methods
- Updating Procedures

The database was established using a combination of field inventory and data research methods to develop the information needed for good pavement maintenance decision making. It included a pavement condition survey and rating of every street to identify structural deterioration, surface deterioration/condition, ride quality, skid resistance, potholes, and related data.

Data was also compiled from record data on pavement width, length, structural sections, maintenance histories, traffic conditions, and soil conditions. One of the main benefits of the database is an inventory of streets.

The collected data, which forms the heart of the PMS, is stored on a microcomputer for ease of data base sorting, updating, and retrieval. The computer program operates on a personal computer.

Once the database was established, the data was used for analyzing each street (between intersections or shorter when necessary), pavement major or minor maintenance identification, ranking the candidate projects, and formulating recommended annual programs based upon different funding scenarios. This is accomplished through the use of a computer.

Updating the database and analysis of the resulting new information should be accomplished every 2 years in conjunction with the budget preparation process. The PMS developed for the City can easily be updated to reflect changed conditions, reflect improvements undertaken during the intervening period, update cost factors, and develop new budget scenarios by the use of the computer.

The following sections of the report provide a more complete description of what a PMS is, of the methodology and information used to compile the City's database, of the data analysis program, and of the results of the analysis, including computer printouts of the various reports and recommendations for a 5-year improvement program.

This update report is a complete update with the one exception that non-arterial streets (traffic index < 5.0) were not investigated as to changes in field condition. This is common practice for low traffic streets as their conditions change much more gradually. The next update should include all streets to reestablish accuracy in priorities and costs.

EXECUTIVE SUMMARY

The City of Calabasas Pavement Management System (PMS) has projected a total of 19.0 miles or 71.1 percent of the City arterial streets qualifying for major maintenance over the next 5 years. Overall, there are 41.8 total miles of streets or 75.29 percent of all City streets qualifying for major maintenance over the next 5 years.

The structural distress in streets within the City is a function of a number of factors: 1) fatigue from repetitive stresses of traffic; 2) temperature changes coupled with advanced oxidation of the asphalt cement (the tendency for asphalt to oxidize with age, making the pavement brittle, amplifies the stresses of both traffic and temperature); and 3) settlement of the road bed, due to water reaching the subgrade soil. Each of these processes leads to extensive cracking.

Once cracked, water can move into the underlying soil causing loss of support to the pavement in surrounding areas. An acceleration of the spread of cracking usually results. Further deterioration of a different type follows, beginning at the originally cracked area. Water and traffic will cause a base failure, such that reconstruction is necessary. This secondary deterioration is also accelerative, in that the more base failure, the faster is the spread of base failure in surrounding areas.

Stopping all of these processes requires major maintenance and is a primary function of the PMS. This is also the foundation for priorities in the system. The savings from providing major maintenance before deterioration occurs is the basis from which priorities are developed.

The major maintenance strategy recommended is dependent upon the extent to which the pavement has failed or deteriorated and represents a cost-effective method of repair. The strategies vary from a 1.50-inch asphalt concrete (AC) overlay to a 3.0-inch overlay with localized reconstruction.

Full reconstruction of the pavement is also a potential strategy. Whether to use this strategy in any particular case will be decided after further testing in conjunction with the final engineering, with the year of implementation also depending on the outcome of testing. The strategy of using a rubberized interlayer with an asphalt-rubber or asphalt-concrete overlay may be viable in specific instances. This is a relatively new treatment, which can substitute quite effectively for reconstruction. It is less expensive and avoids the problems of change orders on contracts where wet subgrade soil is encountered.

It is estimated that the City would realize a total savings of $455,160 over the next 5 years by implementing the recommended improvement projects.

The savings are realized through avoidance of reconstruction of pavement, via the timely restructuring recommended in the budget report. Due to the long time span of the program, savings are expected to increase for projects in later years.

Present day estimated costs of all streets identified for major maintenance is $7.1 million. Of this complete maintenance inventory, 26.85 percent is programmed for implementation over the next 5 years.

The minor maintenance inventory has identified 6.95 miles or 12.52 percent of the City streets to receive slurry seal treatments over the next 5 years. These streets can be completed within an amount of $173,735. Only 3 percent of these show characteristics of raveling, the indication of strong need for slurry.

By updating this report bi-annually, the effectiveness of the program can be maintained throughout succeeding years.

A more detailed discussion of the report findings can be found in the Findings and Recommendations section of this report.

PAVEMENT MANAGEMENT SYSTEMS

This section presents an overview of pavement management systems (PMS), how they are used and ways that a system can be beneficial to a community. Included are an historical overview and a general description of the types of systems that have been used by other agencies. This material is presented for the benefit of those who want to more fully understand what a PMS is and the associated benefits.

HISTORY

Diminished funding or lack of funding increases has caused cities to reevaluate their historical approach to pavement maintenance and seek other alternatives for pavement management. Earlier non-systematic approaches resulted in gradual overall deterioration and higher than necessary costs.

Prior to the development of PMS, cities typically established yearly street maintenance budgets that emphasized maintenance improvements on a worst-case first basis, or in response to citizen complaints and political priorities. This approach worked satisfactorily for most communities, as long as sufficient funding was available. However, while funding sources dried up and maintenance budgets decreased or stayed constant, the need for improvements increased due to greater traffic volumes, aging of pavement and inflated material costs.

Instead of providing preventive maintenance at an early stage, streets were left until much more expensive reconstruction was needed. Unfortunately, the short span of extra service years, during the delay of maintenance, was purchased at a very high price in terms of increased upgrade costs. To orderly prioritize streets for maintenance at the earlier, cost-effective time, a PMS was needed.

Initial efforts to use PMS occurred in the late 1960s. The States of Texas and California were researching various uses of system procedures for application to pavement design and management. In 1973, the first definitive publication on PMS was authored. By 1974, a number of states had initiated studies and developed programs designed to improve pavement management processes, which included simple data base management programs. The Federal Highway Administration recognized the importance and benefits associated with the PMS concept and designated pavement management as an emphasis area in Fiscal Year 1979. The significance of such a decision was to encourage states and local agencies to review PMS and appreciate their usefulness.

A number of cities and counties throughout California have developed and are currently implementing pavement management programs.

WHAT IS A PMS?

In order to discuss the benefits and uses of a PMS, it is first necessary to understand the major components of PMS. The primary purposes of any PMS are: 1) to improve the efficiency of making decisions; 2) to provide feedback as to the consequences of these decisions; 3) to ensure consistency of decisions made at different levels within the same organization; and 4) to improve the effectiveness of all decisions in terms of efficiency of results. These all relate to maintaining good control over street maintenance. The general means for accomplishing these purposes include:

1. A systematic method for collecting and storing data.

2. A method to effectively analyze data.

3. A process to retrieve data in a meaningful format.

4. Procedures for decision-making based on data (often incorporating research outside of the system).

5. Procedures for updating the database (including data from outside research).

Figure 1 summarizes the general components of a PMS.

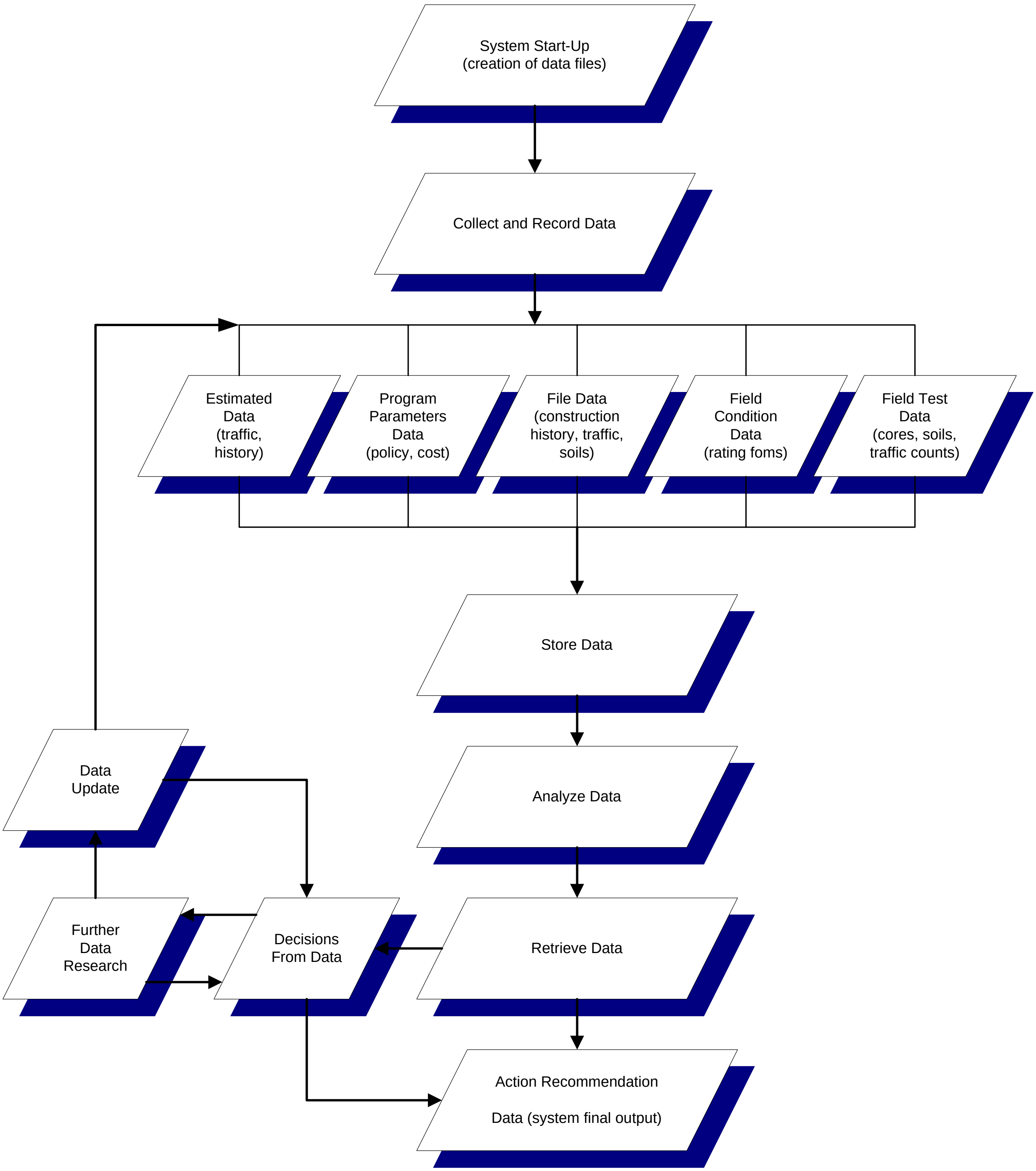
The Data

The effectiveness of any PMS is dependent upon the data being used. Four primary types of data are needed: pavement condition ratings, costs, roadway construction and maintenance history, and traffic loading.

A major emphasis of any PMS is to identify and evaluate pavement conditions and determine the causes of deterioration. To accomplish this, a pavement evaluation system should be developed that is rapid, economical and easily repeatable.

Pavement condition data must be collected periodically to document the changes of pavement conditions.

FIGURE 1
PMS COMPONENTS



Typically, condition inventories are input, stored, and retrieved on a roadway segment basis. Segments are ideally defined as reasonably sized projects of 1,000 feet to ¼ mile in length, beginning and ending at intersections. Occasionally, varying traffic or construction history make shorter segments necessary.

The maintenance costs used in a PMS usually include the best available information on the cost of activities normally conducted in the community. Costs are typically shown as total unit cost per square foot for activities. Cost information must be easily updated to reflect current dollar values. The cost data is used to make estimates for maintaining a pavement at a given condition and for projecting long-range budgets, based on the condition of the pavement.

Additional data that can be used for pavement management systems include drainage conditions, roadway shoulder conditions, ride quality, utility cuts, and soil conditions. This listing is not meant to be exhaustive, since any other unique information or conditions can be included within the database. However, the extent of such additional data should be evaluated to determine its usefulness versus cost for collecting the information. It is important to keep in mind that a PMS is only as accurate and useful as the type and quality of data stored in the database.

Data Analysis

The analysis of the database can be done at any one of the following levels: 1) network; 2) project; and 3) implementation. The network level analysis is best used for overall budget estimates, scenario building, or for policy "what if" situations. The project level analysis involves assessing the causes of pavement deterioration, determining potential solutions, analyzing alternative benefits, carrying out lifecycle costing, and ultimately designing and selecting the preferred approach. Implementation level analyses are generally developed on an "as-needed" basis in the form of tables, charts or graphs, depending on specific requirements. They are usually concerned with assessing the results of projects after completion.

Data Retrieval

It is critical that the data be easily retrieved, and in such a format that it is meaningful.

The computer has the advantage of quick retrieval at a single source, plus the flexibility to display data in any format desired. The computer is essentially unlimited in this capacity to prepare tables, graphs, and charts. In comparison, doing the simplest tasks of this type from files is very time consuming.

The database can be used to answer special questions at each level of decision-making. Questions concerning the entire system, individual projects or implementation can be asked, and the PMS can provide answers. Such questions could include: What will be the effect and budget implications of increased improvement costs? If additional funding can be provided each year, what is the increase in number of streets improved?

A PMS has the potential to answer numerous questions of this type, through straightforward manipulation of data. Usually a simple computer program is developed to provide the information in the desired format, from the database within the computer memory.

Updating Data

As mentioned previously, an efficient procedure for updating of the database must be included within the PMS. The procedures should easily update information on pavement conditions, pavement history, cost of improvements, and traffic loading.

USE OF A PMS

With an understanding of the database, an examination of the typical uses of a PMS can be undertaken. The following material briefly describes the main areas where a PMS is applied and the benefits achieved from each:

Street Inventory

The most immediate use of the PMS is in having a complete and readily accessible inventory of the City's street system including up-to-date conditions. This information is frequently very valuable for day-to-day use in tracking maintenance work and for reference in preparing reports or studies.

Developing Maintenance Budgets

Rather than preparing the typical 1-year maintenance budget, a PMS allows a city to prepare a series of budgets. These budgets can be in the form of a multi-year program, identifying not only short-term (1 year) needs, but outlining needs over the course of many years. Further, alternatives or options can be prepared and presented to the budget decision makers.

Prioritization

A PMS allows for the prioritization of maintenance projects based on cost and condition ratings and other factors such as traffic. The next step can be the selecting and ranking of projects for the upcoming budget year, as well as for long term financial planning.

SUMMARY

These are the components and capabilities that are typically found in a PMS, resulting in numerous benefits including:

- Inventory of Street System
- Overall Pavement Condition Rating
- Annual Budget Estimates for Various Scenarios
- Project Identification and Ranking
- Improved Decision Making

Obviously, some of the benefits are more quantifiable than others. Regardless, implementation of a PMS results in improved pavement conditions and more effective use of limited funding resources.

THE CALABASAS PAVEMENT MANAGEMENT SYSTEM

The Calabasas Pavement Management System (PMS) has four basic components:

1. Collection and Storage of Data
2. Analysis of Data
3. Retrieval of Data
4. Update of Data

Further extensions of these are: 1) decision making based on data; and 2) outside research related to those decisions.

The following sections of the report cover the four main forms of data handling in the Calabasas PMS:

DATA COLLECTION AND STORAGE

Parameters

The first step in developing the PMS for the City of Calabasas was to select specific fixed parameters, under which the program would operate such as construction inflation rates and nominal design lifespans of improvements. The specific parameters used within this report are contained in Appendix A. These parameters apply Citywide and are fixed for each program run on the computer. They can be adjusted between program runs for updates.

Pavement Condition Survey

Each street in the arterial system within the City of Calabasas was visually surveyed to determine the condition of the pavement. The survey concentrated on determining structural deterioration, which is the primary source of increased maintenance cost. Two hundred fifty-two rating forms were prepared for roadway segments covering all streets with traffic index of 5.0 or greater. The information contained on the rating forms was used as part of the data system bases for the PMS.

Soil Data

The bearing capacities of the soils within the City were assessed, and corresponding values were assigned to each roadway segment. Soils reports throughout the City indicate fairly uniform soil for these purposes in all areas.

This conforms to information in the General Soil Map of Los Angeles County, as prepared by the U. S. Department of Agriculture.

Traffic Data

A detailed review of 24-hour traffic counts, including estimates of truck volumes, was performed by Willdan's staff. By reviewing traffic volumes, including the percentage of truck traffic, a traffic index (T.I.) was assigned to each roadway segment of the City.

Cost Data

Cost factors used in estimating costs of improvements were determined from average recent construction bids on representative projects for each type of construction within this report. Appendix A outlines the average cost per square foot used in the analysis.

All costs have been increased by 25 percent to account for engineering, construction inspection, and administration.

The cost estimates used in the PMS are considered to be representative for the upcoming year. To give a general indication of future years costs, an inflation factor of 3 percent has been included within the computer program to adjust for expected increases in cost.

To ensure accuracy for future program years, it is recommended that cost data be updated annually to give an accurate account of the fluctuations in construction costs.

A Total Cost is calculated by multiplying the area of pavement by the unit cost.

DATA ANALYSIS

Having accumulated the information contained within the database, the next step was to proceed with analysis of the data. The data analysis phase involved the development of a computer program that utilized the database to determine project recommendations. The following discussion describes the components of the data analysis:

Strategies

Roadway conditions vary in the City of Calabasas and, therefore, a system for grouping street segments with similar conditions was needed. The extent of structural failure and other deterioration factors determine street condition groupings. The condition groupings and their corresponding strategies for major maintenance are shown in Table 1. Once strategies were selected for the various condition states, costs and other factors were determined for the construction activities used to implement a strategy. Essentially, a preliminary design for each segment was developed by selecting the strategies followed by computer calculation of variable structural factors and then final costs.

The selected strategy is a general representation of the type of improvement which may be undertaken for each segment in order to arrive at estimated improvement costs. It should be recognized that the final scope of improvements for any segment will have to be determined through more detailed field investigation and engineering analysis including soils investigations. The final costs will vary from these preliminary estimates.

Thirteen different primary strategies were developed for the City of Calabasas, based on the condition of street segments. Minor maintenance is one of the primary strategies. It encompasses 11 possible "sub-strategies," designated as B through L shown in Table 2. Each strategy or "sub-strategy" in Table 2 recommends a specific set of construction operations and identifies a cost for each of these operations within the strategy. A letter B-L attached to a strategy number means the operation corresponding to the letter is the minor maintenance strategy. The letters B-L will only be attached to strategy numbers 1 and 2. Strategy 1 is no major maintenance required and Strategy 2 with a letter is localized repairs only, plus minor maintenance designated by the letter.

The strategy numbering system is a progression system with Strategy 1 representing the need for, at most, only minor maintenance with no localized reconstruction. The larger the strategy number, the more significant is the amount of structural improvement needed. Strategy 6 and 6A represent the worst roadway condition, where serious overall structural failure has occurred. In these cases, the entire roadway pavement would normally be removed and replaced. To reduce costs and avoid problems with wet subgrade soil, strategy 6 and 6A are asphalt-rubber hot mix overlays with asphalt-rubber stress absorbing membranes. Strategy 6X is a reconstruction project that is manually selected by the user.

Priority

The primary basis for the priority rating of each street segment requiring major maintenance is the estimated annual cost savings divided by the current total cost of the recommended improvement for that segment. For the purposes of this report, this is defined as the Financial Priority.

Each segment is analyzed using formulas to determine a design strategy. Calculations are made for 2 succeeding years, and the difference between the resulting costs, to perform the necessary improvements, is the annual cost savings. Based on existing pavement structural conditions, soil bearing value and traffic loading, the trend towards loss of pavement stability is assessed. This trend is the predominant factor used to determine cost savings. All of the cost savings values are small, but relative to each other, they provide a good basis for the spread of priorities, e.g., .015 is 50 percent larger than .01.

This annual savings is used as the basis to quantify the benefit from the proposed improvement, as it is used in the financial priority, the base index for each segment.

To obtain the final priority, the financial priority is adjusted by factors which are not of a monetary nature. These factors consider the following:

1. If they are not corrected, there may be an increased number of potholes.

2. Existing conditions, which indicate a need for maintenance or repair to extend the life of the street pavement, (e.g., raveling).

During the field review, these conditions are noted. They include such items as low skid resistance, potholes, sags, bumps, buckling, and ripples in the pavement, along with ride quality. Based upon the quantity and severity of the various conditions noted in the review, the computer program establishes the amount of adjustment that is to be made to the financial priority to arrive at the final priority.

By adjusting the financial priority in this manner the program is able to establish a final priority which is based upon both cost and need. The greater the number, the higher the priority. Major maintenance priorities are always less than 1.0, as opposed to minor maintenance with priorities starting at 1.0 and increasing.

Some street segments have complicating considerations such as, high crowns coupled with serious surface cracking. Under normal circumstances, the pavement could be overlayed, but might be better suited to reconstruction because of the existing high crown of the street. The high crown would be aggravated by the overlay. A careful analysis of pavement thickness and stratification of layers of past overlays, deflection testing, plus the consideration of anticipated increases in traffic volumes and other considerations must be part of a final decision to reconstruct or not in these cases.

Minor Maintenance Priority

The basis of priority for minor maintenance is relative severity of deterioration. This yields a simple ranking system where the street in greatest need has a priority 1.0 and the one with the next greatest need has a priority 2.0 and so forth.

Special Analysis of Portland Cement Concrete Segments

The strategies and priorities are directly applicable to asphalt streets. However, due to the very special nature of pavements constructed of Portland cement concrete (PCC), with or without an asphalt concrete (AC) overlay, special analyses of these cases must be performed.

The failure mechanisms for PCC are quite different and much more varied than for AC. The joints in PCC are the primary failure mechanisms in PCC pavements. AC pavements in general do not have joints. The positioning and sealing of joints in PCC are the critical factors affecting lifespan. If the joints are positioned properly and kept sealed, PCC pavements have very long lifespans. As a result of all this, deterioration rates are indeterminate, and therefore, the financial priority should be viewed as only representative of a need for preventative maintenance.

The City of Calabasas PMS is founded on visual rating of field conditions. Problems are usually evident from visual observation. A priority is extended from the field ratings. These are developed very similarly to those for AC pavements.

In the case of PCC, a cost-effective priority and its corresponding strategy do not stand as specific recommendations. An engineering evaluation should be performed whenever a PCC segment shows a cost-effective priority. PCC streets with their long lifespans are high-value facilities that must be protected rather than cyclically restructured as for AC. There are a number of possible rehabilitation strategies appropriate depending on the specialized problems in each case.

DATA UPDATE

The budget projections are considered to be relatively accurate for the first year and to a lesser extent the second and third years. Projects requiring minor or major maintenance will increase in cost-effectiveness as years go by. Updates of the PMS every 2 years will automatically shift priorities and bring all factors within good relative accuracy. Also, updated cost values must be programmed into the system on the update.

The updating of the system should include a review of the pavement condition data and incorporation of any revised data on the soil type, traffic conditions, and changes in structural section and surface treatment of each street segment.

This report included a field condition update of only the arterial streets, though otherwise was fully updated. To maintain reasonable accuracy in priorities and costs, a full update should be performed the next time.

TABLE 1 **CONDITION STATES/STRATEGIES**		
CONDITION STATE	**CODE**	**STRATEGY**
No alligator cracking.	1	No maintenance.
No alligator cracking. Low traffic volume.	1A	No maintenance.
Minimal wheel path alligator. Cracking less than approximately 2% of total area.	2	Minimum 1.5-inch AC overlay.
Minimal wheel path alligator. Cracking less than 2% of total area. Low traffic volume.	2A	Repairs by City forces.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3	Minimum 1.50-inch AC overlay with base failure repairs.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3A	Minimum 1.5-inch AC overlay with base failure repairs. ARAM
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area.	4	Minimum 1.75-inch AC overlay with base failure repairs.
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area. Low traffic Volume/	4A	Minimum 1.5-inch AC overlay with base failure repairs. ARAM
Extensive wheel path base failure greater than 3.5%, but less than 7% of total.	5	Minimum 2.0-inch AC overlay with base failure repairs.

TABLE 1 **CONDITION STATES/STRATEGIES**		
CONDITION STATE	**CODE**	**STRATEGY**
Extensive wheel path base failure greater than 3.5%, but less than 7% of total. Low traffic volume.	5A	Minimum 1.75-inch AC overlay with base failure repairs.
Serious overall structural failure: Wheel path base failure greater than 7% of total area.	6	Reconstruction.
Serious overall structural failure: Wheel path base failure greater than 7% of total area. Low traffic volume.	6A	Reconstruction.
Pre-selected for this strategy regardless of condition due to special factors.	6X	Reconstruction.

TABLE 2
MINOR MAINTENANCE: CONDITION STATES/STRATEGIES

CONDITION STATE	CODE	STRATEGY
PCC open joints and AC. Raveled or polished surface.	B	Crackseal and slurry.
PCC open joints and dry AC. High traffic volume.	C	Crackseal.
PCC open joints and dry AC. Low traffic volumes	D	Crackseal.
PCC open joints with or without AC overlay.	E	Crackseal.
AC block cracking and raveled or polished aggregate.	F	Slurry.
AC block cracking and dry AC. High traffic volume.	G	No action.
AC block cracking and dry AC. Low traffic volume.	H	Slurry.
AC block cracking.	I	No action.
AC raveled or polished aggregate.	J	Slurry.
AC dry surface. High traffic volume.	K	Slurry.
AC dry surface. Low traffic surface.	L	Slurry.
Strategies 2B, 2C ... 2L include pavement repairs provided by Strategy 2A.		

PART 2

FINDINGS AND RECOMMENDATIONS

1. There are 26.77 miles of arterial streets in the City of Calabasas which have been inventoried for the pavement management system (PMS). The respective pavement area is 7.1 million square feet. Overall, there are 55.5 total miles of streets with an area of 11.7 million square feet. 75.9 percent of streets are in need of overlay.

2. Based on the field survey ratings and analysis of the available data, the existing street pavement conditions are characterized as being in fair to good condition. There are very few streets with a significant number of potholes. There are 11 streets with improvement costs of $573,413, in relatively serious condition, indicated by Strategy 5, 5A, or 6A, listed in the Maintenance Inventory. Two of these, valued at $138,529, are in the 2002-03 budget year.

   There are two streets in particular that are in need of attention: Rolling Hills Road north of Tanglewood and Rustler Road north of Silver Spur. These streets are in a reconstruction category. Their reconstruction costs are estimated at $241,000. Due to the magnitude of this situation, the streets should be investigated for an asphalt rubber treatment, which would cut the cost to between 1/2 to 1/3 if appropriate.

3. The assumed funding levels for major maintenance and minor maintenance for a 5-year improvement program between Fiscal Year (FY) 2002-03 and FY 2006-2007 are:

FISCAL YEAR	MAJOR	MINOR
2002-03	$ 500,000.00	$ 300,000.00
2003-04	500,000.00	175,000.00
2004-05	500,000.00	175,000.00
2005-06	500,000.00	175,000.00
2006-07	500,000.00	175,000.00
Total	$ 2,500,000.00	$ 1,000,000.00

   Based on this funding level, it is anticipated that the City can provide for 26.85 percent of street major maintenance needs by implementing the 5-year program ($1.9 million in today's dollars). These figures are inflated by 3 percent compounded in each succeeding year.

The budget includes a number of segments showing limited structural deterioration. Most of these are being continuously maintained by the City's ongoing patching program and therefore, should deteriorate only gradually. However, after 5 years, more arterial streets may have deteriorated and require resurfacing.

The total present maintenance needs are $1.9 million (in today's dollars) for major maintenance and $173,735 for minor maintenance, as indicated in the Maintenance Inventory Report.

4. The Major Maintenance Budget Report lists 9.38 miles, or 16.9 percent of the City's streets included within the funding for the 5-year program. The last 3 years of the budget projection are not considered to be sufficiently accurate for budget purposes. Updated reports are recommended every 2 years, and since only arterial streets were field rated for this report, a full system update is recommended in 2004.

5. Implementation of the Major Maintenance improvements listed in the Budget Report is estimated to save $455,160 over the span of the 5-year program. These savings will be realized through avoidance of reconstruction of pavement that probably would fail without the maintenance.

6. The minor maintenance program has identified 6.95 miles or 12.5 percent of City streets that could benefit from slurry seal treatments over the next 5 years. The precise benefits of such a treatment vary depending on the history of the pavement and other factors. In order to conserve funds for more important structural upgrades, a project applying slurry only to streets with serous raveling should be planned at some point in the future. At this point in time, only 3 percent of the streets are raveled, but over the next 5 years, any overlay project over 5 years of age will become significantly raveled.

IMPLEMENTATION

The main function of the pavement management system lies in the implementation of capital improvements such that every dollar spent is maximized towards extending the lifespan of the street network. The Budget Report is the system's recommendation toward this end. Each year the report can be used directly as a guide to budgeting funds for the following year.

Though the report is a powerful tool for planning and budgeting, there are always special considerations, such as aesthetics, which the pavement management system (PMS) cannot always incorporate fully into its prioritization method. The City is not bound to the recommendations of the PMS. Projects can be manually added to or deleted from the list of recommended projects during the preparation of the report or future updates, and in any year between. The system will incorporate the changes as part of the normal update process.

Updates should be performed bi-annually in the City of Calabasas as part of overall implementation procedures. To maintain the key goal of maximum cost-effectiveness of funding, the data must be kept current. Changing pavement conditions have a major effect on costs and priorities and so need to be updated on a regular basis.

At time of preparing design plans for each street, the details of the strategies for maintenance are refined based on testing and more involved calculations with the more precise test data. Special factors also must be considered on some streets where these factors impact the roadway design. Drainage is the most common factor of this type. It can influence the design such that a street may need reconstruction instead of an overlay to change the drainage characteristics of the roadway.

The costs presented in the PMS reports include enough contingency to cover the occasional problem of this type. The costs presented also are set to encompass design, contract administration, and inspection for each street. With these understandings, the budget report can be used directly as a guide for implementing the capital improvement program for the City's network of roadways.

DATA RETRIEVAL

The City of Calabasas pavement management system (PMS) contains the following reports, which have been generated using the information in the database:

1. Inventory of Roadways. This is a complete inventory of the City's street and alley systems.

2. Overall List of Segments. This listing is in alphabetical order for all street and alley segments.

   This list can serve as a cross-reference to Item Nos. 3 and 4 below by use of the priority number.

3. Priority Budget Listing. This is a listing of those streets and alleys, which if maintained in the manner recommended, would provide the City with the highest benefit to cost ratio. These segments are listed in order of priority, except for projects selected manually for a particular year.

4. Maintenance Inventory. This is a listing of all projects identified as needing maintenance. There is a list for Minor Maintenance and another for Major Maintenance. These segments are listed in order of priority.

INVENTORY OF ROADWAYS (STREET SEGMENTS)

STREET ID		DISTRICT	CLASS	SERVICE	LANES	TRAF-VAL	LENGTH	WIDTH	RUNOFF	R-VALUE	CONSTRUCTION HISTORY
BLUEBIRD DR 20	(O/W OF MEADOWLARK) (---------------------------------) (O/E OF OLD TOPANGA)		D	1	2	6.00	300	26	00033	35	(6/98) SLURRY (D)

The following information is provided to assist the user in reading and analyzing these reports.

Street I.D.

The name of the roadway appears as the first item on the left. The number underneath is a reference record number for the segment in the computer. Each segment has two limits that are defined in parentheses. Within each set of parentheses the first character is a number of feet in the direction designated by the next character North N, South S, East E, or West W from a reference which is the last entry in parentheses. The last entry could be a street, alley, city limit, or end (end of segment).

The example segment above has the record number 20. It is defined as Bluebird between its intersection with Meadowlark and Old Topanga.

District

There are no districts designated in the City at this time.

Class

Class is a traffic designation category of level of traffic volume represented by the following codes:

CLASS CODE	CLASS	DESCRIPTION
A	Alley	
B	Cul-De-Sac	
C	Local	Used by traffic from just a few surrounding streets.
D	Local Collector	Serving as a collector for a group of streets.
E	Area Collector	Serving as a collector for a large areas
F	Major Collector	Serving as a collector from area collectors to arterials.
G	Arterial	Small highways or major thoroughfares.
H	Major Arterial	Highways. (freeways are beyond this class and the scope of this report)

Class for the example segment is D, designating a local collector.

Service

Service is a traffic designation of traffic usage type represented by codes as follows:

SERVICE CODE	SERVICE TYPE
1	Residential
2	Commercial
3	Industrial
4	General

The example segment is designated service category 1, or residential. By combining class and service designations, a complete categorization results, e.g., C1 denotes a local street with residential traffic.

Lanes

Lanes designate the total number of travel lanes within the roadway.

The example segment has 2 lanes.

Runoff

+=Irrigated Med. -=Non Irrigated Med.	Central Drainage 0-2	N or W Med. Edge 0-9	S or E Med. Edge 0-9	N or W Pvmt. Edge 0-9	S or E Pvmt. Edge 0-9
Blank	0	0	0	0	0

The plus or minus designation does not appear. This would have signified either an irrigated, +, or non-irrigated, -, median. There is no median in this case, so the space for + or - is blank.

The next possible character (to the right) denotes drainage in the central area of the roadway. In this case a zero appears, denoting no drainage in the center of the roadway; the roadway drains outwards.

The next character represents the north or west median edge. The example code is a zero denoting no median. Any other digit, 1-9, would have indicated the type of edge on a median.

The following character is the opposite median edge, south or east. The example code is again, zero, or no median.

The next character to the right represents the north or west outside edge of the roadway. The example code is a 3, denoting AC berm with flow line.

The last character is for the south or east outside edge of the roadway. The example code is a 3, again denoting AC berm with flow line.

The example segment, therefore, has no median with all runoff outwards to either edge of the roadway, where it drains off of the street to an unimproved earth area.

TABLE 3
RUNOFF CONTROL CODES

Integer Field Range –29999……..+29999

+=Irrigated Med. -=Non Irrigated Med.	Central [1] Drainage	N or W Med. Edge	S or E Med. Edge	N or W Pvmt. Edge	S or E Pvmt. Edge

MEDIAN CODES		CURB CODES	
0=	No median	0=	No improvements E.P. only, drains off street
1=	Paved median drained to center of median	1=	No improvements E.P. only, drains to center of street
2=	Paved median drained away from median	2=	AC swale / inverted shoulder
3=	E.P. only drained to center of median	3=	AC berm with flow line
4=	E.P. only drained away from median	4=	AC berm drains to center of street
5=	AC berm with flow line	5=	PCC curb and 2-foot flow line gutter
6=	AC berm drained away from median	6=	PCC curb only with flow line
7=	PCC curb with flow line	7=	PCC curb and 1-foot flow line gutter
8=	PCC curb or curb and gutter drained away from median	8=	PCC swale or rolled curb
9=	PCC curb and F.L. gutter	9=	PCC curb or curb and gutter drains

CENTRAL DRAINAGE CODES[1]	
0=	Central area drains out
1=	Flow line in the central area
2=	PCC "V" – gutter in central area

FOOTNOTE:
1. "Central" refers to center of either median or street (if no median).

R-Value

The soil value is the R-Value commonly used in pavement analysis. It has a range from 0 to 100.

The R-Value for the example segment is 35.

Construction History

Construction projects are categorized in five primary types as listed below under Construction Categories. These categories are always preceded by the date of construction.

To the right of the construction category are details of components of the construction within the category. The letters out of parentheses are codes for these components:

CODE LETTER	COMPONENT
A	Asphalt
B	Base
C	Crack Treatment
F	Flexible Interlayer (Used under an overlay to inhibit cracks in overlay)
G	Grind (Planning or profiling)
P	Portland Cement Concrete
R	Recycle
S	Sub Base (Lesser quality material under base)

These components are further detailed by entries in parentheses directly to the right of the component code letter. Number entries are inches of thickness, and letters correspond to a clarification of the specific type of component, represented by sub-codes. A blank entry means that the component was not a part of the construction. These sub-codes are listed below under the construction category and component to which they apply.

CONSTRUCTION CATEGORIES

ORIGINAL CONSTRUCTION

(Date) ORIG.CONSTR. S(inches) B(inches) P(inches) A(inches)

This line defines the original construction of the roadway, from the ground up. Subbase, S, Base, B, P.C. Concrete, P, and Asphalt Concrete, A, thickness are shown in parentheses. The date of construction is on the left.

For the example segment the original construction was not investigated.

At any time a segment is reconstructed, this data is entered on Original Construction and all previous data is removed from the data bank.

RESTRUCTURE

(Date) Restructure C(code) G(inches) A(inches) F(code)(inches) R(code)(inches)

In the example segment, previous restructures were not investigated. Only segments with recent restructuring were investigated to allow prioritization of slurry projects under minor maintenance.

The possible sub-codes for components, C, F, and R are listed below.

C, Crack Treatment, is designated by sub-codes as follows:

SUB CODE	CRACK TREATMENT TYPE
A	Routed Hot Applied
B	Non-Routed Hot Applied
C	Cold Applied (Composite fabric with mastic strip)
D	Mastic / Fabric
E	Rubberized AC / Woven Fabric (Strip)
F	Rubberized AC / Fabric (Strip)

There is no crack treatment in the last restructure.

G, Grind, is shown as inches of thickness.

No overall grind was performed in the last restructure.

A, Asphalt, is shown as inches of thickness.

The overlay was 1.5 inch in thickness for the last restructure.

F, Flexible Interlayer, is shown as inches of thickness and a sub-code letter of type as follows:

A	Asphalt-Rubber Chip Seal (ARAM)
B	Soft Fabric
C	Hard Fabric
D	Rubberized AC / Fabric
E	Mastic / Fabric
F	Latex AC
G	Rubber Granule AC
H	Asphalt-Rubber and Aggregate Membrane Cape Seal (ARAM with Slurry)
I	Asphalt-Rubber Hot Mix (ARHM) Overlay-ARHM is the overlay of thickness shown in A( ).
J	ARHM on ARAM – Thickness of ARHM in A( ).

No special flexibility was added to the restructure, so the overlay was of regular AC material with no interlayer.

R, Recycle, is shown as inches of thickness and sub-code letter of type as follows:

Sub Code	**Recycle Type**
A	Heater / Scarification (In place surface recycling)
B	Plant Remix (Recycle)
C	Cold Recycle (In place)

REHAB

(Date) REHAB (Code)

Rehabilitation, localized structural repairs on the roadway segment, has no components and is designated as to type of rehabilitation by code letter in parentheses, directly following the word REHAB. Codes for REHAB follow:

Sub Code	**Rehab Type**
A	Remove and Replace
B	Local Recycle
C	Local Latex Recycle
D	Local Heater Replace AC
E	Local Heater Replace Rubber AC

No special rehab was performed on the street segment and so the category is not listed.

SEAL

(Date) SEAL (Code)

Seal, an operation that seals the pavement surface of the overall roadway segment, has no components, and is designated as to type of seal by a code letter in parentheses, directly following the word SEAL. Codes for SEAL follow:

Code	**Seal Type**
E	Fog Seal
G	Latex Fog Seal
H	Chip Seal
I	Cape Seal (Slurry on Chip Seal)
J	Reclamite
K	Cold Crack Sealer Seal

Seal category construction has not been performed on the example segment, therefore this category is not listed.

SLURRY

(Date) SLURRY (Code)

Slurry, spread over the overall roadway segment, has no components, and is designated as to type by code letters in parentheses, directly following the word SLURRY. Codes for SLURRY follow:

CODE	**SLURRY TYPE**
D	Slurry, Type I
F	Latex Slurry
L	Slurry, Type II

The example segment received a SLURRY treatment in June 1998, of Type D or Type I slurry.

CRACKFILL

(Date) CRACKFILL (Code)

Crackfilling is an operation performed to fill cracks individually. If a crackfill and a seal or slurry were both performed in the same project they would be listed separately with the same date. Crackfills have no components, and the code for type of crackfill appears in the parentheses, immediately following the word CRACKFILL. Codes for CRACKFILL are as follows:

CODE	**CRACKFILL TYPE**
A	Routed Hot Applied Crack Seal
B	Non-Routed Hot Applied Crack Seal
C	Cold Applied Crack Seal

Crackfill category construction has not been performed on the example segment, therefore, this category is not listed.

OVERALL LIST OF STREET SEGMENTS

STREET ID		LENGTH	WIDTH	STRATEGY	PRIORITY	TRAFF INDEX
BLUEBIRD 20	(O/W OF MEADOWLARK) (---------------------------------) (O/E OF OLD TOPANGA)	300	26	4	0.285	6.0

Street I.D.

The name of the roadway appears as the first item on the left. The number underneath is a reference record number for the segment in the computer. Each segment has two limits that are defined in parentheses. Within each set of parentheses the first character is a number of feet in the direction designated by the next character North N, South S, East E, or West W from a reference which is the last entry in parentheses. The last entry could be a street, alley, city limit, or end (end of segment).

The example segment above has the record number 20. It is defined as Bluebird between its intersection with Meadowlark and Old Topanga.

District

There are no districts designated in the City at this time.

Class

Class is a traffic designation category of level of traffic volume represented by the following codes:

The example segment has a major maintenance strategy 4, or a 1.75-inch minimum AC overlay.

Priority

The priority number is used to create lists of streets for maintenance. The street segments are in order of priority, highest first.

The example segment has a priority of 0.285.

Traffic Value

Traffic Value is the Traffic Index for a 10-year period on the roadway in both directions.

The example segment has a traffic value of 6.0.

MAJOR MAINTENANCE INVENTORY

STREET ID		PRIORITY	STRATEGY	OVER LAY	UNIT COST	FINANCIAL PRIORITY	AREA	TOTAL SAVINGS	TOTAL COST	CUMULATIVE COST
BLUEBIRD 20	(O/W OF MEADOWLARK) (---------------------------------) (O/E OF OLD TOPANGA)	0.285	4	1.75	1.08	0.176	7800	1476	8394	1849682

The above format is the same for the Budget Report and the Maintenance Inventory

Street I.D.

The information contained in this column is the same as that for the Overall List of Street Segments.

Again, sample segment 20 will be used as an example for all columns.

Priority

The street segments are listed in order of priority, highest first. The major maintenance list has priority numbers less than one with the higher number having highest priority. The minor maintenance listing uses integer numbers from one to the number of streets on the list. The priority number is the street's place on the priority list, one corresponding to first priority, for example.

The example segment has a priority of 0.285.

Strategy

The Strategy is the selected proposed improvement for the street segment.

The street segment has been rated as a Strategy 4.

Overlay

The Overlay is the thickness of AC overlay required to improve the structural section of the street.

This street segment requires 1.75 inches of asphalt overlay on the existing pavement.

Unit Cost

The Unit Cost is the cost per square foot for construction of the Strategy. Minor Maintenance projects requiring local repair (strategies 2B-L) will not have the average unit cost of these repairs included in the Unit Cost because the City crews perform such repairs.

The cost for constructing this strategy is estimated to be 1.08 dollars per square foot.

Financial Priority

The Financial Priority is the basis of the benefit/cost ratio. It is defined as the Savings (benefit) divided by the Cost. The Financial Priority of this segment is 0.176.

Area

The Area is the area of the pavement in the street segment.

The subject project involves approximately 7,800 square feet of roadway.

Total Savings

The Total Savings is the total savings realized in 1 year by not deferring the work until the next year.

The City of Calabasas will save approximately $1,476 by performing the recommended improvements in the 2006-2007 budget year.

Total Cost

The Total Cost is the cost of constructing the strategy. It is the product of the unit cost times the pavement area.

The cost for constructing the recommended improvements on the sample segment is estimated at $8,394. This can be used for a budget estimate, since it includes not only the construction cost but also costs for construction contingency, administration, engineering design, and inspection.

The cost of nominal overhead for administration, engineering, and inspection is set at 18 percent of the construction costs.

Cumulative Cost

The Cumulative Cost is the sum of Total Costs of all projects to the point in descending order on the list for the budget year.

The cost of the preceding recommended projects in this report plus this project total $1,849,682.

TRAFFIC CODES

CLASS CODES	
A.	Alley
B.	Cul-De-Sac
C.	Local
D.	Local Collector
E.	Area Collector
F.	Major Collector
T.	Arterial
H.	Major Arterial

SERVICE CODES	
1.	Residential
2.	Commercial
3.	Industrial
4.	General

CONSTRUCTION CODES

ORIGINAL CONSTRUCTION	RESTRUCTURE	MINOR MAINTENANCE
B&S - BASE AND SUBBASE (A) Crushed Aggregate Base (B) Miscellaneous Processed Base (C) Cement Treated Base (D) Asphalt Treated Base (E) Cement or Lime Stabilized Base (F) Grandular Base	C – CRACK TREATMENT (A) Routed Hot Applied (B) Non-Routed Hot Applied (C) Cold Applied (D) Mastic / Fabric (E) Rubberized AC / Fiberglass (F) Rubberized AC / Fabric F – INTERLAYER CODES (A) Asphalt Rubber Chip Seal (B) Soft Fabric (C) Hard Fabric (D) Rubberized AC / Fabric (E) Mastic / Fabric (F) Latex AC (G) Rubber Granule AC (H) ARAM with Cape Seal (I) Asphalt-Rubber Overlay (J) Asphalt-Rubber Overlay with ARAM R – RECYCLE CODES (A) Heater / Scarification (B) Heater / Remix (C) Cold Recycle	SEALS (A) Routed Hot Applied Crack Seal (B) Non-Routed Hot Applied Crack Seal (C) Cold Applied Crack Seal (D) Slurry, Type I (E) Fog Seal (F) Latex Slurry (G) Latex Fog Seal (H) Chip Seal (I) Cape Seal (J) Reclamite (K) Cold Crack Sealer (L) Slurry, Type II (M) Granulated Rubber Slurry

APPENDIX A PROGRAM PARAMETERS

PAVEMENT MANAGEMENT SYSTEM

PROGRAM PARAMETERS

GUIDE AND RECORD
PAMPHLET

FOR

THE CITY OF CALABASAS

WILLDAN
PAVEMENT MANAGEMENT SYSTEM

TABLE OF CONTENTS

CITY PARAMETERS

Introduction

The items that follow cover considerations that vary from city to city. Parameters must be set for the program to meet specific needs. This pamphlet will serve as a guide to selection of the parameters and a place to record those selections.

District Priority Factors

If special priorities are to be assigned for certain districts or just designations are to be provided for districts, enter information in the spaces provided. Examples of districts could be commercial district, or a council district. A factor between 1 and 2 should be selected for priority and it will be used as a direct multiplier to priorities of streets in that district. Factors higher than 2 could be used but would provide a very high weighting of that district. Substantial loss of cost-effectiveness of the improvement program would likely result. If districts are not yet defined as A, B, etc., also make notation to identify district.

District	Priority
None	

Nominal Yearly Budgets

Spaces are provided on page 2 to establish the projected yearly budgets for the proposed improvement program. Enter either the base year budget and its expected annual percentage increase in A, or enter the anticipated yearly budgets in real dollars for the year of budget in B.

The Total Yearly Budget includes minor maintenance. Enter minimum percentage or dollar amount of Total Yearly Budget to be applied to minor maintenance (seal coats, crack filling, etc.), regardless of other priority considerations within the program. If that percentage causes a delay of higher priority major maintenance projects, it will affect the direct cost-effectiveness of the improvement program. A zero percentage entry would allow higher priority projects to be listed first with minor maintenance projects following in order of cost-effectiveness.

A. Total Base Year Budget __________, including Minor Maintenance Budget, with annual percentage increase _______.

FISCAL YEAR	MAJOR	MINOR
2002-03	$ 500,000.00	$ 300,000.00
2003-04	500,000.00	175,000.00
2004-05	500,000.00	175,000.00
2005-06	500,000.00	175,000.00
2006-07	500,000.00	175,000.00

Number of Years for Protection 5
Total Years

The program base year is the 1st year for which funding will be applied to the proposed improvement program as defined by the pavement management system. Beyond the base year the system will project proposed budgets in future years. Enter in the space provided the total number of years (including the base year) for which projected budgets are desired.

Nominal Rates 4.0 3.0
Interest Rate Inflation Rate

To obtain accurate projections for the proposed improvement program in future years, the computer program takes into account two rates. The first is the interest rate that would apply if money were to be saved and received interest, or spent in some other manner that would yield an equivalent percentage return on investment. Alternatively, if the money for the proposed improvement program comes from borrowed funds such as municipal bonds, the borrowing interest rate would be the most appropriate. Enter the appropriate rate in the space for interest rate.

The second rate is the construction inflation rate. An estimate of the expected inflation rate for the construction industry, in the street construction sector, is to be entered in the space for inflation rate.

Rainfall Factor 17

Enter the average yearly rainfall for the City.

Vehicles/Year Power

Enter a number between 0 and .5 to adjust priorities of streets based on vehicles/year. Priorities are always based on traffic loading in all cases, leaning most heavily on truck volume. A further weighing is available based on the actual number of vehicles passing over the roadway. Direct cost effectiveness is exchanged for the benefit of the high numbers of vehicles traversing a roadway. This gives higher priorities to those streets with the greatest number of users or taxpayers. A zero power will leave the priorities unchanged while a power of .5 will multiply priorities by a maximum of approximately 2, on major arterials, for example.

Nominal Design Lifespan

Enter nominal design lifespans that would generally be desired for both restructuring and reconstruction of the three traffic load groupings.

NOMINAL DESIGN LIFESPAN		
	RESTRUCTURE	**RECONSTRUCTION**
Local	15	20
Collector	15	20
Arterial	15	20

MAJOR MAINTENANCE STRATEGIES

Condition States and Strategies

To project accurate costs for major maintenance, a strategy for improvement must first be developed. Strategies, of course, vary depending on street condition. The full range of the progression of deterioration is therefore divided into condition states. A strategy can be assigned to each condition state and in turn also a cost.

The condition states have boundaries or defining parameters where one condition state begins and another ends. These boundaries are set at certain levels of quantity of alligator cracking and quantity of base failure. The levels are set based on the cost-effectiveness of various general strategies. For example, at a certain level of quantity of alligator cracking, local pretreatments become less cost-effective than overall treatments. That level of alligator cracking is set as the boundary of a condition state.

Further, the progression of deterioration of a low traffic volume street is quite different than for a high traffic volume street. Separate condition states are defined for each.

Once a strategy is selected for a condition state, costs, and other factors are set for the various construction operations within the strategy. This is done on the Strategy Table.

The Strategy Table

Table 1, Major Maintenance Strategy Selections, list the condition states and their defining parameters. A strategy is defined by entering yes or no in the overlay space. Then similarly in the appropriate spaces, enter any local or overall pretreatments selected as part of the strategy. The program automatically assumes a dig out and full section replacement on base failures in all cases. A minimum thickness of overlay should be entered in the space provided as appropriate to complete the strategies. A complete recommended set of strategies is preprinted in the spaces. If an alternate is preferred, simply line out the preprinted entry and write in your selection.

Average costs are needed to fill the spaces provided. Any input is welcomed in this area to add to our records of average bids on recent projects.

In Condition States 6 and 6A, reconstruction strategies would normally apply. However, an alternate is now available which is appropriate in most cases. This is the use of asphalt-rubber hot mix (ARHM) with an asphalt-rubber and aggregate membrane (ARAM) interlayer in several cases, with a leveling course if necessary. This method normally reduces costs to about half and eliminates the major expense and difficulty with reconstructing a wet subgrade.

ARHM is also very cost-effective for normal overlay projects, with cost-effectiveness decreasing as the traffic level and condition of the street decrease. Enter ARHM instead for Asphalt Concrete (AC) for strategies that should have this type of overlay. Normally a pretreatment is not necessary with ARHM.

A list of pretreatments and average costs is included on page ten. If different costs are preferred, simply line out the preprinted amount and enter your selection.

Also, if the desired budget is to include costs of engineering, inspection, etc., an entry of overhead is needed, either as a percentage or actual cost per square foot.

MAJOR MAINTENANCE STRATEGY SELECTIONS

TABLE 1

Definitions:

Base Cost	=	Overall area pretreatment cost/square foot of construction
Base Failure	=	Settlement of cracked pavement to the extent that contamination of base material has resulted or that interlocking of alligatored pavement has been substantially diminished.
Local Cost	=	Local areas pretreatment cost/square foot of construction
Min. Thickness	=	Minimum overlay thickness
ARAM	=	Asphalt-rubber and aggregate membrane interlayer or surfacing.
E and I	=	Engineering, contract administration, and inspection

CONDITION STATE NO. 1 — **STRATEGY NO. 1**

No Alligator Cracking — Minor Maintenance

CONDITION STATE NO. 1A — **STRATEGY NO. 1A**

No Alligator Cracking
Low Traffic Volume — Minor Maintenance

CONDITION STATE NO. 2 — **STRATEGY NO. 2**

Minimal Wheel Path Alligator Cracking Less Than Approximately 2% of Total Area

AC
Overlay

1.50"
Min. Thickness

Local Pretreatment

Local Cost | % E&I | Total Cost

CONDITION STATE NO. 2A — **STRATEGY NO. 2A**

Yes
City Forces*

Minimal Wheel Path Alligator Cracking Less Than Approximately 2% of Total Area

Overlay

Min. Thickness

Local Repairs

Local Cost | % E&I | Total Cost

** If City forces are to do rehab under a separate budget item, enter yes.*

CONDITION STATE NO. 3

Substantial Wheel Path Alligator Cracking Greater Than Approximately 2%, But Less Than Approximately 6% of Total Area

STRATEGY NO. 3

AC	1.50”			
Overlay	Min. Thickness			
			%	
Local Pretreatment		Local Cost	E&I	Total Cost
			%	
Overall Pretreatment		Base Coat	E&I	Total Cost

CONDITION STATE NO. 3A

Substantial Wheel Path Alligator Cracking Greater Than 2%, But Less Than Approximately 6% of Total Area

Low traffic volume.

STRATEGY NO. 3A

Overlay	Min. Thickness			
			%	
Local Pretreatment		Local Cost	E&I	Total Cost
			%	
Overall Pretreatment		Base Coat	E&I	Total Cost

CONDITION STATE NO. 4

Extensive Wheel Path Alligator Cracking Greater Than Approximately 6% of Total Area with No Upper Limit Base Failure Less Than 3.5% of Total Area

STRATEGY NO. 4

AC	1.75”			
Overlay	Min. Thickness			
			%	
Local Pretreatment		Local Cost	E&I	Total Cost
			%	
Overall Pretreatment		Base Coat	E&I	Total Cost

CONDITION STATE NO. 4A

Extensive Wheel Path Alligator Cracking Greater Than Approximately 6% of Total Area with No Upper Limit Base Failure Less Than 3.5% of Total Area

Low traffic volume.

STRATEGY NO. 4A

Overlay	Min. Thickness

Local Pretreatment	Local Cost	% E&I	Total Cost
Overall Pretreatment	Base Coat	% E&I	Total Cost

CONDITION STATE NO. 5

Extensive Wheel Path Base Failure Greater Than 3.5% But Less Than 7% of Total Area.

STRATEGY NO. 5

AC	2.0"
Overlay	Min. Thickness

Local Pretreatment	Local Cost	% E&I	Total Cost
Overall Pretreatment	Base Coat	% E&I	Total Cost

CONDITION STATE NO. 5A

Extensive Wheel Path Base Failure Greater Than 3.5% But Less Than 7% of Total Area.
Low traffic volume.

STRATEGY NO. 5A

AC	1.75"
Overlay	Min. Thickness

Local Pretreatment	Local Cost	% E&I	Total Cost
Overall Pretreatment	Base Coat	% E&I	Total Cost

Condition State No. 6	Strategy No. 6			
Serious Overall Structural Failure Wheel Path Base Failure Greater Than 7% of Total Area	Reconstruct Overlay	2.25” Min. Thickness		
	Overall Pretreatment	Base Coat	% E&I	Total Cost

Condition State No. 6A	Strategy No. 6A			
Serious Overall Structural Failure Wheel Path Base Failure Greater Than 7% of Total Area. Low traffic volume.	Reconstruct Overlay	2.00” Min. Thickness		
	Overall Pretreatment	Base Coat	% E&I	Total Cost

Miscellaneous Costs	Construction	Engineering and Inspection	Total Cost
Grind Cost / sf / in.	0.16	25%	0.20
AC Cost / sf / in.	0.32	25%	0.40
Remove and Replace Cost / sf	4.48	25%	5.60
ARHM Cost / sf / in.	0.45	25%	0.56

LIST OF OVERLAY PRETREATMENTS

Local Pretreatments

Local Surface Removal is the removal of a layer Asphalt Concrete (AC) by grinding or heating of the surface layer over distressed AC. The surface is then overlayed and/or heater/scarified as usual. Average Cost $1.00/Square Foot, per area treated.

Local Surface Recycling is the process of heating and scarifying local areas of the street. Average Cost $2.50/Square Foot, per area treated with a thin overlay on the repair or $1.95/Square Foot without the overlay.

Specialty Fabrics are fabric with rubberized asphalt or mastic in a composite sheet, usually provided in a roll of varying widths for application to local repair areas. Average Cost $2.00/Square Foot.

Overall Pretreatments

Fabrics are installed as an interlayer between the existing and proposed road surface. Average Cost $.14/Square Foot.

Asphalt-Rubber and Aggregate Membrane (ARAM) is a layer of aggregate 1/4-inch to 3/8-inch in size with no fines mixed with rubberized asphalt oil during construction. This treatment can be used alone or with an AC overlay or slurry. Average Cost $.44/Square Foot.

Heater/Scarification is the process of heating and scarifying the roadway surface. A rejuvenating agent is applied by spray. Average Cost $.15/Square Foot.

MINOR MAINTENANCE STRATEGIES

Introduction

Eleven minor maintenance condition states are defined within the program. Each condition state is a class or combination of classes of minor deterioration that may or may not be selected for treatment. A list of treatments is on page 13. A treatment or a combination of treatments should be selected as desired for each condition stated in Table 2.

Enter the desired strategies, for example, joint seal and slurry. Then for Dry Asphalt Concrete (AC) Surface categories, enter the maximum years desired between the surface treatments specified. For example, to specify a 7-year slurry program, enter 7 years in the appropriate spaces.

Any cost information is again very welcome. Records maintained by Willdan of recent project average bids will be used otherwise. Overhead cost per square foot as percentage of base cost is needed if the budget is to reflect costs such as engineering, inspection, etc.

The cost of crack sealing is the cost needed where that treatment is selected. The surface seal treatment cost is automatically taken from the corresponding strategy for the same surface condition without cracks.

Three Limiting Traffic Values are available to finish the minor maintenance strategy table, defined as follows:

Dry AC Surface limiting value refers to the division between low and high traffic volume for surface treatments on AC only sections. This value only applies to seal coat programs not actual raveled conditions as assessed by field rating.

AC Block Cracking limiting value refers to the minimum traffic level which a crack seal would be used.

TABLE 2

No.	Condition State	Strategy	Years	Base Coat	Over Head	Total Cost
B	PCC open joints and AC raveled or polished	Crack seal & slurry		.42	18%	.50
C	PCC open joints and dry AC	N/A				
D	PCC open joints and dry AC Low traffic volume	N/A				
E	Open joints with or without AC overlay	N/A		.42	25%	.50
F	AC block cracking and raveled or polished	Slurry		.08	25%	.10
G	AC block cracking and dry	N/A				
H	AC block cracking and dry Low traffic volume	Slurry	8	.08	25%	.10
I	AC block cracking	N/A				
J	AC raveled or polished surface	Slurry		.08	25%	.10
K	AC dry surface	N/A				
L	AC dry surface Low traffic volume	Slurry	8	.08	25%	.10

Limiting Traffic Values

	Traffic Value and Type
Dry AC on PCC	N/A
AC Block Cracking	N/A
Dry AC Surface	8.0 TI 10-year

LIST OF MAINTENANCE TREATMENTS

Crack and Joint Sealing is the sealing of cracks or joints with Asphalt Concrete (AC) or Rubberized AC compound. Average Cost Portland Cement Concrete (PCC) $.42/Lineal Foot, Average Cost AC $.42/Lineal Foot.

Fog Seal is a spray application of asphalt emulsion or hot asphalt oil. Average Cost $.02/Square Foot.

Slurry Seal, is a blended emulsion and fine aggregate. Average Cost $.085/Square Foot.

Chip Seal is fine gravel size aggregate mixed with an asphalt emulsion or hot asphalt oil during construction of the pavement surface the installation of a chip seal. No recommendation is made for this treatment.

Cape Seal is a chip seal with a slurry over it. No recommendation is made for this treatment.

TRAFFIC PARAMETERS

Minimum Traffic Levels

A minimum traffic level is assigned to local residential and residential cul-de-sac or dead-end streets even though traffic is actually less. Age and weather factors make up the difference between the minimum and actual traffic levels. Deterioration on these streets occurs over 25 to 30 years or more. This extended time frame allows weather and age factors to take a toll similar to an equivalent traffic loading. If a specific value is desired, enter those values in the appropriate spaces. Otherwise, TI (10-year) values of 4.0 (EAL = 3.0) for cul-de-sacs and 4.5 (EAL=3.5) for residential local streets will be used.

TRAFFIC VALUE TYPE ____TI 10 yr.__

RESIDENTIAL CUL-DE-SAC ___________

RESIDENTIAL LOCAL ___________

Fixed Category Levels

Within traffic categories, e.g., residential local or residential local collector, etc., there is a potential range of values. Normally, these ranges are incorporated in the pavement management system, giving a somewhat more precise prioritization. If specific fixed values for each category are preferred instead, indicate those choices in spaces provided.

Accepted

Residential Local Cul de Sac ___________4.0

Residential Local ____________________<4.8

Residential Local Collector ___________<6.0 Traffic Value Type TI 10 yr.

Area Collector ______________________<6.7

Major Collector _____________________<7.4

Arterial ____________________________<8.5

Major Arterial _______________________>8.5

APPENDIX B

MAPS AND GRAPHS

APPENDIX C

INVENTORY OF ROADWAYS

TABLE 3
RUNOFF CONTROL CODES

Integer Field Range –29999……..+29999

+=Irrigated Med. -=Non Irrigated Med.	Central [1] Drainage	N or W Med. Edge	S or E Med. Edge	N or W Pvmt. Edge	S or E Pvmt. Edge

MEDIAN CODES		CURB CODES	
0=	No median	0=	No improvements E.P. only, drains off street
1=	Paved median drained to center of median	1=	No improvements E.P. only, drains to center of street
2=	Paved median drained away from median	2=	AC swale / inverted shoulder
3=	E.P. only drained to center of median	3=	AC berm with flow line
4=	E.P. only drained away from median	4=	AC berm drains to center of street
5=	AC berm with flow line	5=	PCC curb and 2-foot flow line gutter
6=	AC berm drained away from median	6=	PCC curb only with flow line
7=	PCC curb with flow line	7=	PCC curb and 1-foot flow line gutter
8=	PCC curb or curb and gutter drained away from median	8=	PCC swale or rolled curb
9=	PCC curb and F.L. gutter	9=	PCC curb or curb and gutter drains

CENTRAL DRAINAGE CODES[1]	
0=	Central area drains out
1=	Flow line in the central area
2=	PCC "V" – gutter in central area

FOOTNOTE:

1. "Central" refers to center of either median or street (if no median).

TRAFFIC CODES

CLASS CODES	
A.	Alley
B.	Cul-De-Sac
C.	Local
D.	Local Collector
E.	Area Collector
F.	Major Collector
T.	Arterial
H.	Major Arterial

SERVICE CODES	
1.	Residential
2.	Commercial
3.	Industrial
4.	General

CONSTRUCTION CODES

ORIGINAL CONSTRUCTION	RESTRUCTURE	MINOR MAINTENANCE
B&S - BASE AND SUBBASE (A) Crushed Aggregate Base (B) Miscellaneous Processed Base (C) Cement Treated Base (D) Asphalt Treated Base (E) Cement or Lime Stabilized Base (F) Grandular Base	C – CRACK TREATMENT (A) Routed Hot Applied (B) Non-Routed Hot Applied (C) Cold Applied (D) Mastic / Fabric (E) Rubberized AC / Fiberglass (F) Rubberized AC / Fabric F – INTERLAYER CODES (A) Asphalt Rubber Chip Seal (B) Soft Fabric (C) Hard Fabric (D) Rubberized AC / Fabric (E) Mastic / Fabric (F) Latex AC (G) Rubber Granule AC (H) ARAM with Cape Seal (I) Asphalt-Rubber Overlay (J) Asphalt-Rubber Overlay with ARAM R – RECYCLE CODES (A) Heater / Scarification (B) Heater / Remix (C) Cold Recycle	SEALS (A) Routed Hot Applied Crack Seal (B) Non-Routed Hot Applied Crack Seal (C) Cold Applied Crack Seal (D) Slurry, Type I (E) Fog Seal (F) Latex Slurry (G) Latex Fog Seal (H) Chip Seal (I) Cape Seal (J) Reclamite (K) Cold Crack Sealer (L) Slurry, Type II (M) Granulated Rubber Slurry

APPENDIX D

Overall List of Segments

TABLE 1
CONDITION STATES/STRATEGIES

CONDITION STATE	CODE	STRATEGY
No alligator cracking.	1	No maintenance.
No alligator cracking. Low traffic volume.	1A	No maintenance.
Minimal wheel path alligator. Cracking less than approximately 2% of total area.	2	Minimum 1.5-inch AC overlay.
Minimal wheel path alligator. Cracking less than 2% of total area. Low traffic volume.	2A	Repairs by City forces.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3	Minimum 1.5-inch AC overlay with base failure repairs.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3A	ARAM
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area.	4	Minimum 1.75-inch AC overlay with base failure repairs.
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area. Low traffic Volume/	4A	ARAM
Extensive wheel path base failure greater than 3.5%, but less than 7% of total.	5	Minimum 2.0-inch AC overlay with base failure repairs.

TABLE 1 CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
Extensive wheel path base failure greater than 3.5%, but less than 7% of total. Low traffic volume.	5A	Minimum 1.75-inch AC overlay with base failure repairs.
Serious overall structural failure: Wheel path base failure greater than 7% of total area.	6	Reconstruction.
Serious overall structural failure: Wheel path base failure greater than 7% of total area. Low traffic volume.	6A	Reconstruction.
Pre-selected for this strategy regardless of condition due to special factors.	6X	Reconstruction.

TABLE 2 **MINOR MAINTENANCE: CONDITION STATES/STRATEGIES**		
CONDITION STATE	**CODE**	**STRATEGY**
PCC open joints and AC. Raveled or polished surface.	B	Crack seal and slurry.
PCC open joints and dry AC. High traffic volume.	C	Crack seal.
PCC open joints and dry AC. Low traffic volumes	D	Crack seal.
PCC open joints with or without AC overlay.	E	Crack seal.
AC block cracking and raveled or polished aggregate.	F	Slurry.
AC block cracking and dry AC. High traffic volume.	G	No action.
AC block cracking and dry AC. Low traffic volume.	H	Slurry.
AC block cracking.	I	No action.
AC raveled or polished aggregate.	J	Slurry.
AC dry surface. High traffic volume.	K	Slurry.
AC dry surface. Low traffic surface.	L	Slurry.
Strategies 2B, 2C ... 2L include pavement repairs provided by Strategy 2A.		

APPENDIX E

MAINTENANCE INVENTORY

TABLE 1
CONDITION STATES/STRATEGIES

CONDITION STATE	CODE	STRATEGY
No alligator cracking.	1	No maintenance.
No alligator cracking. Low traffic volume.	1A	No maintenance.
Minimal wheel path alligator. Cracking less than approximately 2% of total area.	2	Minimum 1.5-inch AC overlay.
Minimal wheel path alligator. Cracking less than 2% of total area. Low traffic volume.	2A	Repairs by City forces.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3	Minimum 1.5-inch AC overlay with base failure repairs.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3A	ARAM
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area.	4	Minimum 1.75-inch AC overlay with base failure repairs.
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area. Low traffic Volume/	4A	ARAM
Extensive wheel path base failure greater than 3.5%, but less than 7% of total.	5	Minimum 2.0-inch AC overlay with base failure repairs.

TABLE 1 CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
Extensive wheel path base failure greater than 3.5%, but less than 7% of total. Low traffic volume.	5A	Minimum 1.75-inch AC overlay with base failure repairs.
Serious overall structural failure: Wheel path base failure greater than 7% of total area.	6	Reconstruction.
Serious overall structural failure: Wheel path base failure greater than 7% of total area. Low traffic volume.	6A	Reconstruction.
Pre-selected for this strategy regardless of condition due to special factors.	6X	Reconstruction.

TABLE 2 MINOR MAINTENANCE: CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
PCC open joints and AC. Raveled or polished surface.	B	Crack seal and slurry.
PCC open joints and dry AC. High traffic volume.	C	Crack seal.
PCC open joints and dry AC. Low traffic volumes	D	Crack seal.
PCC open joints with or without AC overlay.	E	Crack seal.
AC block cracking and raveled or polished aggregate.	F	Slurry.
AC block cracking and dry AC. High traffic volume.	G	No action.
AC block cracking and dry AC. Low traffic volume.	H	Slurry.
AC block cracking.	I	No action.
AC raveled or polished aggregate.	J	Slurry.
AC dry surface. High traffic volume.	K	Slurry.
AC dry surface. Low traffic surface.	L	Slurry.
Strategies 2B, 2C ... 2L include pavement repairs provided by Strategy 2A.		

APPENDIX F

BUDGET REPORT

TABLE 1 CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
No alligator cracking.	1	No maintenance.
No alligator cracking. Low traffic volume.	1A	No maintenance.
Minimal wheel path alligator. Cracking less than approximately 2% of total area.	2	Minimum 1.5-inch AC overlay.
Minimal wheel path alligator. Cracking less than 2% of total area. Low traffic volume.	2A	Repairs by City forces.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3	Minimum 1. 5-inch AC overlay with base failure repairs.
Substantial wheel path alligator. Cracking greater than approximately 2%, but less than approximately 6% of total area.	3A	ARAM
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area.	4	Minimum 1.75-inch AC overlay with base failure repairs.
Extensive wheel path alligator. Cracking greater than approximately 6% of total area with no upper limit. Wheel path base failures less than 3.5% of total area. Low traffic Volume/	4A	ARAM
Extensive wheel path base failure greater than 3.5%, but less than 7% of total.	5	Minimum 2.0-inch AC overlay with base failure repairs.

TABLE 1 CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
Extensive wheel path base failure greater than 3.5%, but less than 7% of total. Low traffic volume.	5A	Minimum 1.75-inch AC overlay with base failure repairs.
Serious overall structural failure: Wheel path base failure greater than 7% of total area.	6	Reconstruction.
Serious overall structural failure: Wheel path base failure greater than 7% of total area. Low traffic volume.	6A	Reconstruction.
Pre-selected for this strategy regardless of condition due to special factors.	6X	Reconstruction.

TABLE 2 MINOR MAINTENANCE: CONDITION STATES/STRATEGIES		
CONDITION STATE	**CODE**	**STRATEGY**
PCC open joints and AC. Raveled or polished surface.	B	Crack seal and slurry.
PCC open joints and dry AC. High traffic volume.	C	Crack seal.
PCC open joints and dry AC. Low traffic volumes	D	Crack seal.
PCC open joints with or without AC overlay.	E	Crack seal.
AC block cracking and raveled or polished aggregate.	F	Slurry.
AC block cracking and dry AC. High traffic volume.	G	No action.
AC block cracking and dry AC. Low traffic volume.	H	Slurry.
AC block cracking.	I	No action.
AC raveled or polished aggregate.	J	Slurry.
AC dry surface. High traffic volume.	K	Slurry.
AC dry surface. Low traffic surface.	L	Slurry.
Strategies 2B, 2C ... 2L include pavement repairs provided by Strategy 2A.		