CANYON LAKE PROPERTY OWNERS ASSOCIATION

REQUEST FOR PROPOSAL (RFP)

ENGINEERING SERVICES TO DEVELOP BID DOCUMENTS AND PROVIDE ASSOCIATED CONSTURCTION MANAGEMENT SERVICES FOR A PAVEMENT MANAGEMENT PROGRAM

Released: **April 27, 2011**
Submittal Deadline: **July 01,, 2011 by 4 p.m.**
Prospective Consultant Interviews: **July, 2011**
Anticipated Start Date: **August 08, 2011**

Canyon Lake Property Owners Association

REQUEST FOR PROPOSAL

For Engineering Services to Develop Bid Documents

and Provide Associated Construction Management Services for a

Pavement Management Program

Notice is hereby given that the Canyon Lake Property Owners Association ("Association") is seeking proposals from qualified engineering firms to provide professional services to develop bid construction documents and associated construction management services for the implementation of the Association's "2011 Pavement Management Program" ("PMP"), as described in this Request for Proposal ("RFP").

PROJECT DESCRIPTION

The selected engineering firm shall provide all labor, materials and equipment necessary to provide: (a) professional services to develop bid construction documents, including plans, specifications, estimated budget and projected construction timelines, and (b) construction management and consultation services for the implementation of the Association's PMP. The PMP includes services for pavement rehabilitation of various levels within the 36 miles of private roads and parking lots in the Canyon Lake community. The PMP identifies roads that need maintenance and/or repair, and specifies repair methods to be used, as well as their priorities. (Refer to the attached PMP.) Although the PMP suggests a grouping of streets to be completed in each of three (3) suggested phases, the Association requests the selected engineering firm review and suggest modifications, if appropriate, of those groupings and of the prioritization of the work to be most cost effective and meet all local/county/state/federal regulations regarding such work.

It is expected that the required repair/rehabilitation activities will be broken into three phases in accordance with the phases suggested in the PMP, to be completed over the next three to five years. The Association anticipates the design work for the second and third phases will occur concurrently with the construction of the preceding phase. Each phase shall be of a reasonable duration to complete the work with minimal inconvenience to the residents.

It is anticipated that the Association may execute the contract associated with this RFP by August 6, 2011, with the selected engineering firm completing Phase I bid documents within forty-five (45) calendar days of execution of the contract. While it is the Association's intention to enter a single contract for all phases of design and construction supervision, the Association will retain the option to terminate the contract at any time and at its sole discretion.

SCOPE OF WORK

The engineering firm selected will be expected to do all the tasks required for the review, implementation and oversight of the PMP, including the following:

A. Thoroughly review the PMP (Attachment "A" hereto) and prepare a report with suggested changes, if any.

B. Obtain from the Association and any relevant entity any as-built plans for existing street improvements and utilities, as necessary. Perform site review and field-verify existing improvements and utilities. Consult with appropriate utility companies for any planned work to be completed on the roadways within the next three to five (3-5) years, in accordance with the Association's guidelines for encroachments into Association Common Area.

C. With the use of the PMP and direction of the Association, prepare a complete set of improvement plans of the selected streets and parking lots within the community. Submit these plans to the Association for review, comment and approval.

D. Prepare a list of contract items and an engineer's estimate, including quantity calculations and costs for the construction of the proposed improvements.

E. In conjunction with the Association and its counsel, as appropriate, prepare a bid package, which shall include, but not be limited to, a list of contract items, schedule of value sheets, corresponding special provisions for the various items of work and any required technical specifications. Submission of electronic files will also be required. Prepare the improvement plans and bid package in accordance with the regulations and standards of the State of California and the Association.

F. Participate in bid reviews, perform contractors' evaluations, chair contractor interviews and provide award recommendation to the Association.

G. Provide documentation for all survey monumentation used in the design for use during construction. Submit electronic files and a plot of all control coordinates for use in construction staking. As necessary, arrange for removal and re-installation of monuments and tie sheets.

H. Work cooperatively with Association designated geo-technical testing and inspection consultants to ensure quality design and completion of the project by construction contractor.

I. Track status of construction to assure that the standards for quality of construction work are satisfactory and meet specifications. Provide weekly written status reports to the assigned Association's contact and/or immediately, when problems occur.

J. Provide technical and engineering design support to properly resolve any unforeseen construction problems that may occur. Notify the Association, obtain approval of the proposed action(s) and identify additional cost impacts, if any, prior to implementation.

SELECTION CRITERIA

The Association intends to select the most qualified engineering firm to provide professional services for the above-stated scope of work. The Association will consider the engineering firm's experience with similar projects, its understanding of the project and work required, its familiarity with the community street network, the qualifications of the Project Manager and individual personnel assigned to the project, the number of staff available for the assignment, the prime and sub-consultants' demonstrated ability to work as a team, the team's proven ability to meet deadlines and the cost of the services.

Proposals shall be limited to fifteen (15) pages (excluding any appendices for personnel resumes, letters of reference for similar projects, company profile and financial status, and sample of similar design work) and include, but not be limited to, the following sections (section page numbers are suggestions only):

1. **Work Plan**: Describe how you would implement the activities identified in the Scope of Work of this RFP. Provide a summary of your approach to the project and a statement as to your ability to schedule and complete the work, as noted in the Project Description. (7 pages)

2. **Cost**: Describe how you would assess costs for the following services (i.e. flat rate, percentage of cost, time and materials, etc.): generation of construction bid documents, review of bids, evaluation of contractors' capabilities, chair contractors' interviews, oversee construction activity, such as pavement repair (i.e., grind and overlays) and/or reconstruction and maintenance activity such as crack sealing and slurry seal for the duration of the contract. (2 pages)

3. **Qualifications and Experience**: A summary of qualifications and experience of the firm and the employees that will be assigned to the contract for implementing the PMP and/or reasonably equivalent engineering services. Include all current state and local licenses for your firm. (3 pages)

4. **References**: Provide a description of similar projects that your firm has completed in the last 5 years and provide contact names, phone numbers and e-mail addresses. (1 page)

5. **Sub-contractors**: Describe services that would be contracted to another company for the performance of the work stated above (i.e. inspection, testing, surveys, etc.). (1 page)

6. **Exceptions to the Contract**: Attached as Attachment "B" is a draft contract ("Contract") that will be entered into by the Association and the selected engineering firm. After review of the Contract, notate in your response to this RFP any exceptions that you have to the Contract language. (1 page)

   Notwithstanding any exceptions, the awardee will be required to enter into a contract substantially in agreement with the attached Contract, though it is anticipated the Contract will be revised to tailor it to the finalized scope of work, phasing, payment schedule and other particular details of the project.

A Selection Committee will review the proposals submitted and may request interviews from the top engineering firms. The Selection Committee will rank the top firms based on qualifications, proposals (including cost) and presentations (if applicable).

The Association hereby notifies all respondents that it will affirmatively insure that any contract entered into pursuant to this advertisement will be awarded without discrimination on the grounds of any protected status.

In addition to all requirements for proposal submission, the selected firm will be required to maintain and provide evidence of insurance as indicated in the Contract.

Only engineering firms demonstrating experience with projects of similar experience and scope of work will be considered.

SUBMITTAL INSTRUCTIONS

Sealed proposals, addressed to: Canyon Lake Property Owners Association, ATTN: RFP - ENGINEERING SERVICES FOR PMP IMPLEMENTATION, 31512 Railroad Canyon Road, Canyon Lake, CA. 92587, will be received until 4 PM, on July 1, 2011. Proposals shall be submitted in sealed envelopes clearly marked on the outside "TO BE OPENED BY ADDRESSEE ONLY." A total of ten (10) copies of each proposal must be submitted for consideration. Each copy shall be bound separately. One copy shall be identified as ORIGINAL and all others identified as copies.

THE COST FOR THE IMPLEMENTATION OF THE PMP, AS DESCRIBED IN THE SCOPE OF WORK, SHALL BE SUBMITTED IN A SEALED ENVELOPE, LABELED "PROPOSAL COST," AND INCLUDED WITH THE ORIGINAL COPY OF THE PROPOSAL. Proposal costs will not be opened until the written proposals have been reviewed and evaluated.

The Association reserves the right to reject any and all proposals, to withdraw the RFP at any time and to waive any irregularities or informalities in the proposals received. The Association also reserves the right to negotiate all aspects of the proposals submitted in response to the RFP at any time during the evaluation period.

The Project Manager, Mr. Paul D. Johnson, whose telephone number is (951) 244-6841 Ext. 510 and e-mail address is pjohnson@canyonlakepoa.com, is the person responsible for opening and examining the proposals submitted to the Association, except when otherwise specified.

All questions must be submitted in writing to Mr. Paul Johnson at 31512 Railroad Canyon Road, Canyon Lake, CA. 92587. All replies will be published for distribution to all prospective respondents.

Attachment "A" to Request for Proposal

Association's "2011 Pavement Management Program"

(Attached)

City of Canyon Lake

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Canyon Lake Propert Owners Associatio

Pavement Management Progra Report for 201

Prepared by

WILLDAN Engineering

extending your reach

Canyon Lake Property Owners Association

Pavement Management Program Report for 2011

Submitted by:

Willdan Engineering

2401 E. Katella Avenue, Suite 450

Anaheim, California 92806

January 12, 2011

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Executive Summary

The Canyon Lake Property Owners Association (CLPOA) has tasked Willdan Engineering to develop a report on the options available for upgrading the pavements throughout the CLPOA street network. This report responds to that mandate by assessing the street network as it currently stands; presenting an array of technical options that are tailored to meet the array of problems evident throughout the street network; and evaluating the fiscal implications of conducting the work over our recommended three-year time frame. The key goal is to complete a structural renewal of all street and parking lot pavements so as to provide for a 25-year period of normal use, with only preventive maintenance (sealcoats, etc.) required during that time. Due to the fiercely competitive pricing that is currently available from the construction industry, completing the work within roughly the next 3 years would be very advantageous to the CLPOA.

If this proposed plan is implemented, it should be noted that not all cracking will be eliminated over the 25-year period; the singular shrinkage cracks will force their way to the surface unless extraordinary and very costly measures are taken. Fortunately, such measures are completely unnecessary in terms of preserving structural integrity. These cracks need to be viewed like joints in concrete—rather than diminishing the structure, they are just an unavoidable nuisance.

Our assessment of the street network uncovered an array of conditions of concern, ranging from mild cracking to severe deterioration of the older street segments. A carefully selected mix of repair strategies will bring the aging 36-mile street network to a consistently high level of performance and aesthetic appearance. By selecting the technique that matches the severity of each street segment's condition, the CLPOA's functional objectives (in terms of performance and appearance) will be met, while costs will be kept to the absolute feasible minimum.

For streets in good condition without a recent upgrade, we propose use of a thin overlay to extend life span to the desired 25 years (conforming to the renewal of the deteriorated streets). A comprehensive asphalt rubber hot mix overlay is suggested for the more severe circumstances, and full-depth asphalt recycling will be required for areas with extensive failures and cracking. (Note that if cracked pavement is allowed to completely fail under traffic loads, full pavement reconstruction of that area is necessary. That generally costs three times as much as pavement restructuring that is performed prior to failure.)

A potentially important point is that asphalt rubber pavements do not need seal treatments for quite a long time, because their surface does not ravel or deteriorate in any measurable way. A properly compacted asphalt rubber pavement is impregnable to water, with few fines existing in the surface to ravel. This will yield substantial savings in long-term preventive maintenance.

Willdan Engineering has developed a computerized approach that sets priorities for the upgrade work—street by street—thereby optimizing the construction sequence so as to minimize construction costs and diminish the risks posed by ongoing deterioration. Meticulous sequencing will also ensure that the full array of upgrade projects can be completed in the preferred three-year time frame, minimizing the CLPOA's exposure to the risk of cost inflation that is inevitable as the regional economy improves. This report documents the conditions found; the repair strategies we recommend; and the budgetary implications of the choices available to the CLPOA.

In summary, the study resulted in the following overall outcome:

1. A 3-year annually phased program of one project per year can provide a full renewal of all streets for a 25-year life of the pavement structure, but will exhaust essentially all of the funds accumulated by HOA dues over the next 3 years.

2. Preventive maintenance will be very limited, with the vast majority of streets needing only one seal treatment within the 25-year life of the pavement. Funds for this can easily be set aside after the 3-year program of renewal is completed.

Introduction

Background and Purpose

The pavement management program included in this report was developed to provide the most cost-effective approach to renewal of the pavements within the Canyon Lake Property Owners Association (CLPOA) street network. There are many street segments involved, and they reflect a diverse array of conditions. A computerized program is required to assess those conditions, determine the renewal alternatives available for each segment, and set priorities to establish the order in which network improvements should be made.

The 36-mile roadway system was constructed in phases, and generally many decades in the past. Many of the streets have reached the end of their life span, and a great many others have deteriorated to the point where an upgrade is highly desirable. This renewal effort would extend their life and avoid the even more costly upgrades that will be required if further deterioration is allowed to occur.

Scope and Deliverables

The primary goal of the pavement management program is to develop structural upgrade strategies that will provide at least 25 years of additional life for the network of streets—and at the lowest possible cost. Willdan Engineering has designed this report so as to meet both requirements. The scope of work is to conduct field investigations and gather existing condition information about the pavements on all streets, including parking lots; perform computerized data analysis using Willdan's enhanced MicroPaver program; develop cost-effective strategies, costs, and priorities; prepare an implementation plan with maps detailing the plan specifics; and provide a final report documenting the work performed. The report includes general recommendations about funding the program; detailed listings of each street segment, its condition, and an appropriate upgrade strategy; and maps depicting specific conditions and upgrade strategies. The report also includes an assessment of preventive maintenance measures that will maximize the life span of the upgraded pavements at the lowest possible cost.

Methodology and Approach

The first phase of the study entailed a thorough field investigation of each street segment to determine its condition and identify pavement segments on the same street evincing the same basic condition. This allowed the network to be categorized into segments that would require the same upgrade methods. The segments are generally defined from cross street to cross street or from cross street to cul-de-sac, with further divisions as warranted by any significant change in conditions within the same street.

This first phase of work generated a database of street segments, providing details of their individual conditions. Documentation of street condition observations included structural issues (cracking patterns, length, width, and surface type) and various other pavement distress conditions (such as utility cuts and surface texture). This data was then subjected to computer analysis to develop appropriate structural upgrade strategies that would ameliorate the cracking conditions. There are a number of crack types, and each type requires a somewhat different structural upgrade approach. The upgrade strategies range from a simple overlay with asphalt concrete to full recycling of the existing pavement with an overlay.

Once the upgrade strategy is assigned for each street segment in the database, detailed computer calculations are performed to determine the cost to upgrade each segment. This second analysis encompasses all of the factors involved in the structural upgrade, including utility adjustments, patching repairs, and surface preparations.

By combining the cost and condition information, a system was developed to prioritize the street segment upgrade sequence. This phasing ensures that the structural upgrades will be performed in the most cost-effective manner.

The computer analysis produces detailed listings of the defined street segments. The listings in the appendices include the length and limits of each segment; the appropriate upgrade strategy and its cost for each segment; and general information about the condition of each segment.

This information is then linked with a mapping system to show the street segments in context. The resulting maps in the appendices depict the condition of each segment, its upgrade strategy, and the year in which each segment is budgeted for construction.

With this information in place, the total roadway network upgrade cost can be computed. A fairly straightforward analysis can then be performed to develop a funding program that is based on that total, and the available reserve funds applied to annual projects.

Current Conditions of Pavement Network

Arterial Streets

The arterial streets are Canyon Lake Drive (North and South), Vacation Drive, and Longhorn Drive. All of these streets have recently been reconstructed with new pavement, except for two segments of Canyon Lake Drive North. These latter two segments are in good structural condition, with only a few isolated cracks that are not associated with traffic distress. These are the only two arterial streets that would be considered for structural upgrades at this time. Since the identified cracks are essentially due to shrinkage of the aged asphalt pavement, they pose little concern for increased deterioration. There are a number of options for these two segments. A thin asphalt concrete overlay would enhance the structures and extend their life spans to easily match the remainder of the streets. Unfortunately, this type of cracking has a powerful tendency to reflect through a thin overlay in about 5 years. Again, this is not a structural concern, just an aesthetic one. More costly methods could be used to completely eliminate cracking over a period of 15 years or longer, but at quite a significant increase in cost—usually not something than can be afforded.

Local Residential Streets and Parking Lots

The residential streets reflect a very broad range of conditions. Some streets have no deterioration other than minor surface raveling, while others are severely deteriorated, with a full range of possibilities occurring between those extremes. There are two primary types of cracking involved: alligator cracking and block cracking. Alligator cracking is the result of traffic loading. It produces an appearance much like alligator skin; the cracks form small tiles of asphalt pavement ranging from 3 to 8 inches in size. In contrast, block cracking is formed by simple shrinkage of the old asphalt pavement over a long period of time. This produces individual cracks surrounding large blocks of pavement that range from 4 to 20 feet in size; the cracks resemble shrinkage cracks or joints in cement concrete.

There is one other cracking condition that arises when alligator cracking has progressed to an extreme level. Traffic and water intrusion through the cracking and into the soil inevitably requires the pavement to be reconstructed. This is a separate but important consideration because the cost of such repairs is very high. This type of cracking is often referred to as base failure.

Parking lots have the same general deterioration characteristics as residential streets, but in the CLPOA they are in much better condition than the residential streets overall. Naturally, the parking stalls are in much better condition than the travel ways and entry roads of parking lots. Accordingly, the strategy for renewal was based on addressing problems with the travel ways and entry roads, with the addition of a minimal overlay on the parking stalls themselves. Additional contingency funding was included to account for special factors involved in parking lot designs (principally related to the drainage effects that result from changing the grades).

Table 1 provides a perspective on the structural condition of the pavements of interest. This array is essential for determining the type and cost of upgrades required.

Table 1: Condition Types			
Condition Type	**Condition Description**	**Local Residential and Parking Lots (Percent of Total Residential)**	**Arterial* (Percent of Total Arterial)**
1	Very little cracking	7.34	2.01
2	Significant cracking and failed areas needing reconstruction, but less than 10% of total pavement area	52.75	0.22
3	Failed areas greater than 10% of total pavement area	39.91	0

*Note that the arterial streets are mostly improved at present, so the total is not 100%.

Eighteen Streets of Special Interest

The CLPOA's request for proposals for the PMP listed 18 streets that were to receive special evaluation. All of them have an overlay of asphalt rubber hot mix as their strategy for renewal.

The primary circumstances affecting the 18 streets in question are shown below in table 2, by segment. Their characteristics are as follows:

- A high amount of alligator cracking, with a large percentage of failed pavement
- A relatively high amount of block cracking
- Substantial edge cracking along gutters
- Rough ride characteristics on nearly all segments due to the failing pavement (except for Widgeon Place, where cracking is least extensive compared to the others listed below)

Table 2: Streets Identified for Special Evaluation			
Street	**Limits**		**Characteristic**
Boating Way	Redwood Dr.	Nautical Ct.	Bumpy ride
Boating Way	Cul-de-sac	Nautical Ct.	Bumpy ride
Burning Tree Dr.	Pyramid Point Dr.	Pyramid Point Dr.	Bumpy ride
Burning Tree Dr.	Cul-de-sac	Pyramid Point Dr.	Bumpy ride
Cinnamon Teal Dr.	Emperor Dr.	Emperor Dr.	Bumpy ride
Eagle Point Dr.	Boating Way	Redwood Dr.	Bumpy ride
Emperor Dr.	Continental Dr.	Cul-de-sac	Bumpy ride
Emperor Dr.	Cinnamon Teal Dr.	Continental Dr.	Bumpy ride
Fair Weather Dr.	Outrigger Dr.	Cul-de-sac	Bumpy ride
Nautical Ct.	Cul-de-sac	Boating Way	Bumpy ride
Pecos Pl.	Big Range Rd.	Cul-de-sac	Bumpy ride
Point Marina Dr.	Cul-de-sac	Swan Point Dr.	Bumpy ride
Spray Dr.	Cul-de-sac	Silver Strike Dr.	Bumpy ride
Spray Dr.	Clear Water Dr.	Silver Strike Dr.	Slippage cracking and bumpy ride
Village Way Dr.	420' W/Canyon Lake Dr.	Canyon Lake Dr. S.	Bumpy ride
Widgeon Pl.	Cross Hill Dr.	Cul-de-sac	
Wind Song Pl.	Cul-de-sac	Vacation Dr.	Bumpy ride
Windward Dr.	Skipjack Dr.	Canyon Lake Dr.	Bumpy ride
Windward Dr.	Canyon Lake Dr.	Cul-de-sac	Bumpy ride

The other streets of this group of 18 have a very solid block crack pattern with generally wide cracks with substantial utility cuts, plus alligator cracking. Other characteristics are as noted below in table 3:

Table 3: Streets with Solid Block Crack Pattern

Street	Limits		Characteristic
Cascade Dr.	Vacation Dr.	Redwood Dr.	
Little Creek Dr.	Cul-de-sac	Cutter Dr.	Fairly extensive alligator cracking
Little Pony Dr.	Longhorn Dr.	Cul-de-sac	Bumpy ride
Skippers Way Dr.	Fair Weather Dr.	Cul-de-sac	Bumpy ride

Description of Strategies for Roadway Condition Upgrade

The following three recommendations (see table 4) incorporate the structural upgrades that will provide the longest roadway life at the least possible cost. Their specific details were selected based on discussions with the Facilities Review Committee regarding materials, their costs (including preventive maintenance), and life-span potentials. Willdan Engineering fully supports these decisions as meeting the stated goals. The following table summarizes the strategies as they apply to the three condition categories. A more detailed description of strategy methods appears directly below table 4.

Table 4: Upgrade Strategies

Condition Type—Strategy*	Structural Upgrade Strategy	Funding Required for Local Residential Work	Funding Required for Arterial Work
1 or 1A	1" ARHM overlay	$270,112	$170,498
2 or 2A	1¼" ARHM overlay on ¾" ARHM Interlift	$4,716,493	$32,893
3 or 3A	1 ¼" ARHM overlay on cold in-place recycling	$4,014,359	$0

*Strategy corresponds to a Condition Type with an "A" added if an arterial street.

1. **Thin Overlay.** There are a few streets that are currently in good condition, yet old enough that a progression of cracking is likely to begin in the near future. In order to provide uniform pavement quality throughout the street network, these streets should receive a thin overlay of the material used in the rest of the residential streets (i.e., asphalt rubber hot mix). This same recommendation could apply to the two aged arterial segments on Canyon Lake Drive North; however, asphalt concrete overlay might be preferred in that case because the results would match the remainder of Canyon Lake Drive North. This approach will provide for uniform maintenance procedures and uniform sequencing, while extending all the pavements to the 25-year life desired.

2. **Asphalt Rubber Hot Mix Overlay.** The asphalt rubber hot mix overlay proposed for use would include a 1¼"-thick layer of structural asphalt rubber hot mix placed over a ¾"-thick layer of a specialized high-flexibility asphalt rubber hot mix called Interlift. Before placing these layers, weak spots in the pavement should be removed and reconstructed with asphalt concrete, and block cracks should be filled with crack filler. The Interlift layer and crack filler will resist further block cracks and keep them from working through the new overlay. The stresses involved with block cracks are large because the asphalt blocks are still shrinking and contracting in response to the wide temperature swings that occur in the Canyon Lake area. The added flexibility provided by the Interlift is also very valuable in resisting the stresses generated over the alligator cracking. Cold milling (asphalt grinding) would be performed around the perimeter of the area to be overlaid in order to match the elevation along gutters and other local protrusions. Utilities in the pavement will need to be adjusted to match the new surface elevation, and any ancillary features affected (e.g., striping and stop bars) will need to be replaced.

3. **Full-Depth Asphalt Recycling.** Full-depth recycling of the existing cracked asphalt concrete pavement using a cold in-place recycling process will provide the base layer for the new pavement. The recycling will not extend into the existing base material; only the asphalt concrete will be removed, rejuvenated, and repaved in place. This pavement does not have the same high quality as new pavement from an asphalt plant, but it is an extremely good base for residential street pavement. The asphalt rubber hot mix overlay provides the final structural and surface finish component, yielding a smooth, black, and highly reliable surface pavement. Cold milling (asphalt grinding) would be performed around the perimeter of the area to be overlaid to match the elevation along gutters and other local protrusions. A double adjustment of utilities below the recycling plane and then to the new surface elevation is also needed, plus replacement of any striping and stop bars and other ancillary features that are affected.

Recommended Implementation Plan

Structural Upgrades

Implementation of the pavement upgrades required prioritizing the segments to establish the order in which they will be constructed. The preferred way to determine those priorities is by calculating the benefit/cost ratio of each segment, which normalizes the cost of upgrading a particular segment by weighing it against the benefit achieved by making the expenditure. This allows for a uniform comparison between segments in the network. The "benefit" in this calculation is the avoidance of increased deterioration and the associated additional costs incurred by delaying the construction. For example, many streets that are primarily affected only by block cracking will deteriorate very slowly; there will be little change in the cost of an upgrade over a period of a few years. However, a street with extensive alligator cracking will tend to weaken more rapidly, requiring more reconstruction repairs, yielding a shorter life span, or both.

This was the base method for establishing a priority in the Canyon Lake POA PMP, and it is strictly financial in nature. It should be noted that under this implementation plan, the streets in poorer condition may not be the highest priority because they will undergo the process described in strategy number 3 (above), which entails recycling the entire pavement. Therefore, the upgrade cost will not increase over time. In contrast, for any street where the pavement will simply be overlaid, delaying the work will allow ongoing deterioration that will lead to some losses in terms of the benefit/cost ratio.

Some other factors may enter into the final decisions; they relate to specific CLPOA circumstances. For example, confining a particular year's projects to a group of localized or even adjacent streets would avoid the cost of the contractor moving his equipment long distances between streets. Also, pavement upgrades may have to work around utility company trenching that is scheduled ahead of the pavement work. Edison currently has a substantial amount of this type of work scheduled. The information available indicates that shifting the streets that are worked on to avoid conflict will not create any significant costs for the CLPOA. A list of streets where work is scheduled by Edison is shown in table 5 below. The "3" strategy segments will go in the second year in this area in the annual phasing sequence based on benefit/cost ratio, and the "2" strategy segments n this group can be performed as part of that same later project. They are all in the same area on the map, on the south side of the lake east of Canyon Lake Drive South.

Table 5: Streets with Work Currently Scheduled by Edison

Street	Limits		Strategy
Continental Dr.	Cruise Circle Dr.	Canyon Lake Dr.	2
Golden Gate Dr.	Continental Dr.	Cul-de-sac	3
Cinnamon Teal Dr.	Continental Dr.	Cul-de-sac	2
White Cove Ct.	Continental Dr.	Cul-de-sac	2
Emperor Dr.	Continental Dr.	Cul-de-sac	3

Once the streets are prioritized in the proper order through consultation with CLPOA representatives, the budget amounts available for each year will determine where the cutoff occurs on the list for each year's projects. This is reflected in the annual phasing project list in appendix 8, and represented on the annual phasing map in appendix 12.

Preventive Maintenance

Asphalt rubber pavements are dark and have a pleasing appearance for at least 10 years. If constructed properly, the pavements should still be very attractive after 15 years.

Asphalt concrete pavements tend to lose fine particles from the surface, making them coarse textured within approximately 5 years. Therefore, asphalt concrete pavements need a slurry seal about 5 years after the original construction. The new pavements on Canyon Lake Drive, Vacation Drive, and Longhorn Drive are of this type. A second slurry seal on asphalt concrete pavement would not be necessary for 8 to 10 years, and the need for a second slurry seal is generally driven only by appearance (rather than the slurry actually wearing down from service).

To optimize the pavement's appearance it is best to use as dark a slurry as possible, because conventional slurry bleaches out within a few years of its original placement. There are basically two recommended approaches to producing dark slurries: (a) use a slurry made from aggregate that has been recycled from asphalt concrete, known as recycled asphalt pavement (RAP) slurry, and (b) use a tire rubber modified slurry seal (TRMSS), a slurry made from a true asphalt rubber binder.

In summary, it is recommended that the residential roads that are overlaid with asphalt rubber hot mix receive a seal coat in 12 to 15 years, but thereafter they would not need any other treatment until about 25 years after the original construction of the pavement upgrade. This would include all of the residential streets and parking lots, subject to implementation of the full plan (including the strategy for Condition Type 1 above). Asphalt concrete roads require slurry approximately 6 years after construction, and then on a cycle of 8 to 10 years for each slurry thereafter. This is recommended for all the arterial roadways.

Crack filling is the other consideration, and this poses a significant aesthetic problem. Crack filling tends to flush up through a slurry, leaving the pavement with a black stripe that follows the crack in the road. There are ways to avoid this problem, but it is particularly difficult to overcome in very hot climates because the crack filler will soften in the summer. Some of the block cracking can be expected to return after a number of years, so crack filling is a consideration. There are two approaches that have demonstrated reasonable results:

1. Provide a conventional RAP slurry and do not crack fill. This approach offers an attractive pavement, but there will be hairline cracks where the block cracks have reflected through the overlay.

2. Provide a banded crack fill $^5/_{32}$" thick and 2" to 3" wide over all block cracks. Let the crack filler cure a minimum of eight months, and through at least one full summer. Then perform a slurry seal over the street using either RAP slurry or TRMSS. The results will vary depending on climatic conditions and the size of the blocks formed by the block cracking. Some cracks on larger blocks can begin to show somewhat. Under extreme temperatures a slight amount of flushing of crack filler can also occur. The Canyon Lake area is susceptible to this latter factor, but not so much to the former. This is a fairly new combined treatment of crack filling, and slurry has only been used in the past four or five years. Therefore, more results will be available by the time a slurry is needed. (The arterial streets will need a slurry much sooner, but they will not have significant cracks to deal with.)

3. Provide a commercial sealcoat along with a squeegeed crack fill to the ARHM streets and parking lots, and a slurry as discussed in item 1 above for arterial streets.

Number 3 above is recommended. More details on these techniques can be found in appendix 2, in the "Strategies" section.

Summary of Cost Estimate/Funding Strategies and Final Implementation Plan

Construction costs have been very low for a couple of years, and it is anticipated that they will remain low for at least two or three more years. One of the primary goals of this program is to take advantage of this situation and improve the roadway system in its entirety before the economy starts to improve and inflation begins to affect construction industry pricing.

The costs used in this study are based on recent bids of similar projects of a similar magnitude and involving a similar haul distance from local asphalt plants. Minor adjustments are made from that basis. The assumption is that costs will remain relatively stable in the next few years, with a nominal 3% inflation rate.

It is difficult to estimate expenditures from the approximate total of $1,700,000 that is accrued toward reserves each year. The range in the recent past has been 10% to 82% of the annual amount expended. In 2010–11 the expenditures exceeded the accruals. Currently there is a total of $4,864,518 projected for reserves for improvements of the roadway system by the end of April 2011, which is well in advance of the expenditure on the first annual construction contract.

To provide some perspective based on these budgetary levels, all of the needed construction for the 25-year life span (Conditions 1, 2, and 3) on roads and parking lots could be improved within a 5-year time frame if expenditures other than for the roadways were limited to 45% of the current annual accrual of $1,700,000 (no inflation factored in). Included within this figure is 16% for design and construction engineering and 10% contingency. This contingency is considered quite adequate to address any repairs of curbs and gutters that may be necessary to provide the sound concrete edges needed to protect the new pavement. The association is fortunate that damaged curbs and gutters that could adversely affect the pavement are quite rare, and primarily limited to a few driveways where the gutter has broken down.

Unfortunately, it is probably not safe to assume that construction costs will stay in the 3% inflation range for a full five years. Therefore, on the same basis as above, completing the work in three years would require all of the accruals at current levels to be added to reserves that are to be devoted to the road construction. Therefore, a three-year program is recommended as follows:

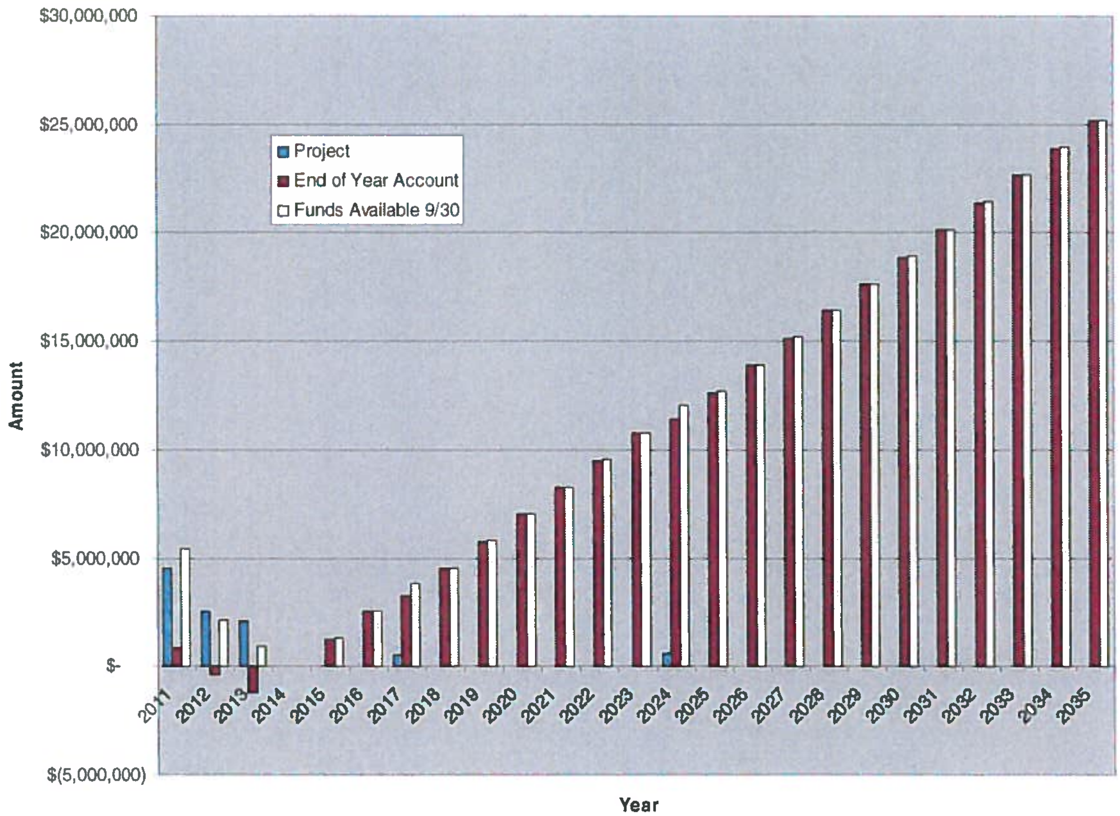
Project Funded	Funds Available	Project	Avail for Other	With Dues thru 12/30	Assumed Other Expense	End of Year Account
9/30/2011	$ 5,392,852	$ 4,500,000	892,852.16	1,317,852.16	450,000.00	867,852.16
9/30/2012	$ 2,142,852	$ 2,500,000	(357,147.84)	67,852.16	450,000.00	(382,147.84)
9/30/2013	$ 892,852	$ 2,100,000	(1,207,147.84)	(782,147.84)	450,000.00	(1,232,147.84)

This is the best estimate based on available information, and just shows a minor shortfall in the last year. The shortfall is 17.2% of the total construction projects estimate, so it seems a reasonable goal to work around it. All of the figures are based on present value, since inflation is unknown, and bringing in escalating costs creates a lot of confusion when viewing the numbers. At this time it is best to simply assume that incoming revenues will rise—at least over the next 3 years—in line with the inflation rate.

There is an option to put the Strategy 1 streets outside of this set of projects and at least buy some time and bring the second year into balance. This is approximately $440,000 for these Strategy 1 projects.

Below is a projection of costs and funding over the next 25 years. The projects needed beyond the 3-year time frame are listed below:

Slurry Arterials	9/30/2017	$ 515,975
Sealcoat ARHM	9/30/2024	$ 603,822



Recommendations

Specific recommendations are as follows:

1. Provide a structural upgrade for all streets, including those still in relatively good condition, to ensure that all the streets can be supported through a fairly uniform maintenance program, and that all achieve at least a 25-year life span before any further major maintenance is required. This would mean applying the upgrade strategies as outlined in this report for each street and parking lot. This would be accomplished over a sequence of three annual projects, as funds become available. This is the greatest challenge of all the recommendations listed here, because as discussed in the previous section of this report, an increase in HOA fees could be necessary to accomplish the work in a time frame that avoids construction cost inflation.

2. As part of the structural upgrade, repair any curbs and gutters that could compromise the new pavement condition.

3. On the few streets that are currently in good structural condition (aside from the arterial streets recently reconstructed), there exists the option to provide a thin overlay to extend the life span and provide the same surface condition as the remainder of the pavement. Asphalt rubber hot mix is recommended for residential upgrades, and conventional asphalt concrete for the two segments on Canyon Lake Drive North. This work is desirable, but budgetary concerns may lead to delay of this work because the potential losses from delay are negligible.

4. Use the two primary strategies for the structural rehabilitation upgrades on streets with significant cracking: (a) asphalt rubber hot mix overlay on asphalt rubber hot mix (Interlift), and (b) asphalt rubber hot mix overlay on cold in-place recycled asphalt concrete.

5. Carry out the pavement improvements in three annual contracts—performing as much work as possible as early as possible to minimize inflationary impacts overall—with bidding starting in the early part of 2011. Winter is generally the slowest time of the year for construction, and contractors bid most competitively during that time. The first contract would be awarded in the spring, and construction would begin in spring or early summer (when paving conditions are ideal in the Canyon Lake area). The second and third projects could be bid in January (preferably).

6. Prioritize the sequencing of streets to be constructed using the computed benefit/cost ratio *unless special factors override that determination.* Under this approach the worst streets will not be reconstructed first, because their cost will generally be the highest while the financial benefit of their improvements would be minimal. Grouping streets in local areas can also affect costs, with increases of perhaps 1% if moving considerable distances between areas of paving where paving is continuous for three days in each area. If moving more frequently, costs would increase substantially (e.g., 2.7% for a move after one day's paving, and 1.5% after two days of continuous paving in an area). Another factor when establishing an order to proceed with the paving projects is utility trenching, which must be accomplished before the paving work. As noted above, Edison currently has a substantial amount of this type of work scheduled.

7. For the streets where strategies 2A and 2 are recommended, where localized reconstruction repairs are necessary, it is extremely important that the repair areas be marked by a highly experienced pavement engineer. If not, either missed areas will lead to early failure, or too much of an area will be marked and costs will quickly become excessive—with no attendant advantage. Careful selection of just the right areas is absolutely necessary for success. Such selections must be based on numerous specific factors and experienced judgment must be applied to the repair condition relative to the circumstances of the repair location and its weakness relative to the pavement overall.

8. The importance of providing quality asphalt rubber hot mix and good compaction for the overlay cannot be overstated. It is important that the binder be properly manufactured, the aggregate provide the appropriate gap-grading or open-grading (Interlift), and the compaction be executed in keeping with industry standards. This entails some basic materials approvals and testing. It is, therefore, highly recommended that basic compaction testing and plant inspection (ARHM mix plant and asphalt rubber binder plant) be performed. Nonconformance with specifications in either of these crucial areas can dramatically shorten the time before cracking occurs in the pavement, and could possibly lead to other deleterious performance.

Conclusion

By following the recommendations outlined above, the association will achieve its major goal: acquiring what is essentially a new street system at a reasonable cost. The ongoing roadway deterioration—and the cost increases resulting from that progressive decay—will be brought to a halt. On a network level, it is estimated that the progressive deterioration alone will increase the overall cost to improve the roadways by approximately $1,607,000 in 10 years (if nothing is done in the interim). By investing in the improvements now, and sidestepping those increases, the association would in effect glean an average annual return on investment of $160,700 per year, or nearly 1.8% of the total expenditure of $9.1 million for the full upgrade of all of the roadways in Conditions 1, 2, and 3 (see tables 1 and 4). By itself, this is a relatively low rate of return. However, the work must be done—and the longer it is deferred, the more it will ultimately cost.

More important are the potential losses that the association could incur due to a significant increase in inflation. Since construction costs could rise 15% to 20% very quickly, completing the roadways before that occurs would in effect add that percentage (the saved costs) to the return on investment. In other words, investing in the improvements *now* will avoid substantial future cost vulnerability. Reasonably safe investments of association funds are limited in number, and generally do not yield a return of more than perhaps 2%. The association must choose between passively investing its funds to obtain those very modest returns, or using the money to fund the upgrades in order to avoid much larger costs later. Since the estimated total return on investment over the three-year period for the roadway upgrade would be in the neighborhood of 7.5% (based on all factors presented in this report), it is clearly a very good investment.

GLOSSARY OF TERMS

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

ALLIGATOR CRACKING: A pattern of cracks usually 4 to 6 inches apart, and resembling the texture of alligator skin.

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

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

BASE FAILURE: An area of alligator cracking that has deteriorated such that the support material underlying the pavement has been damaged, the alligator pavement is loose and lacking interlocking support, or both.

COE: U.S. Army Corps of Engineers.

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

INTERLIFT: A layer of highly flexible interlayer material between the overlay and the underlying pavement; it absorbs the stresses of reflection cracking so that the overlay only experiences low stresses. The material is ¾" thick, and provides a structural element of that same thickness.

MAJOR MAINTENANCE: Includes any improvement to a pavement that adds significantly to structural strength. This usually involves adding a layer of asphalt. Reconstruction is considered a form of "major maintenance."

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

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.)

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

PCC: Portland cement concrete (normal concrete).

PCI: Pavement condition index. Ranging from 0 to 100, the PCI indicates the overall condition of the pavement based on distresses identified, where 0 is extremely poor and 100 is excellent.

RAP: Recycled asphalt pavement slurry.

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

RECONSTRUCTION: Removal of existing pavement and replacement with a new pavement.

RESTRUCTURING: Entails the addition of layers of pavement to increase the structural strength without removing the existing pavement.

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

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. The R-value ranges from 0 to 100.

SI: Structural index, ranging from 0 to 100; an index of 100 means there is no cracking in the wheel path, and 0 means full wheel-path alligator cracking has occurred.

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.

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

TRMSS: TRM Slurry Seal.

WHEEL PATH: The area of pavement where the wheels of predominant traffic pass directly over.

APPENDIX 1

PAVEMENT MANAGEMENT SYSTEMS

INTRODUCTION

Nationwide, agencies with roadway networks are faced with ever-increasing street maintenance budget problems due to the reduced availability of funds. The CLPOA has confronted this issue directly by developing a pavement management program to get ahead of these problems and avoid long-term budgetary difficulties. The remainder of this section is to simply provide an overall perspective on what a PMS is and how it can be used as a tool to address these issues.

The problem is compounded by an apparent increase in the number of 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 an agency/organization such as CLPOA with a network of pavements. It is also one of its most important assets. Without a well-maintained street system, the transportation needs of the residents cannot be met. In general, local real property values tend to suffer when streets are poorly maintained. Therefore, it is important that CLPOA develop improved means of allocating their limited financial resources to maintain street pavement.

A pavement management system (PMS) is being used increasingly by owners of street systems as a way of meeting this need. PMS is not a new concept. It has been in use for many years, and has become fairly prevalent in public works administration. 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 the owner, and the specific condition they are in. This listing usually includes information such as the type of surface, condition of pavement, width of pavement surface, street length, and data on resurfacing or seal coating. A computer can sort the "databank" 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 multiyear programming and annual budgeting for maintenance and capital improvements. Once implemented, the PMS usually needs to be updated every three years in order to be an ongoing, effective management system. However, in the case of the CLPOA, the renewal program will provide complete coverage of the entire pavement network. Therefore, the next update would be delayed for many years.

HISTORY

Diminished funding (or the lack of needed 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 costs that were higher than necessary. Major work backlogs were common.

Prior to the development of PMS, owners 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 some communities—as long as sufficient funding was available. However, even as 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 structural maintenance at an early stage, streets were left unattended until much more expensive reconstruction was needed. Unfortunately, that short span of extra service years (during the delay of maintenance) was purchased at a very high price in terms of increased structural upgrade costs. To prioritize streets for maintenance in an orderly manner at an 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 database 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. This decision encouraged states and local agencies to review the PMS approach and appreciate its usefulness. Every city and county in California has developed and is currently implementing some form of pavement management program.

PAVEMENT MANAGEMENT SYSTEMS (PMS) DEFINED

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

1. A systematic method for collecting and storing data.
2. A method to effectively analyze data.
3. A process for retrieving 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.

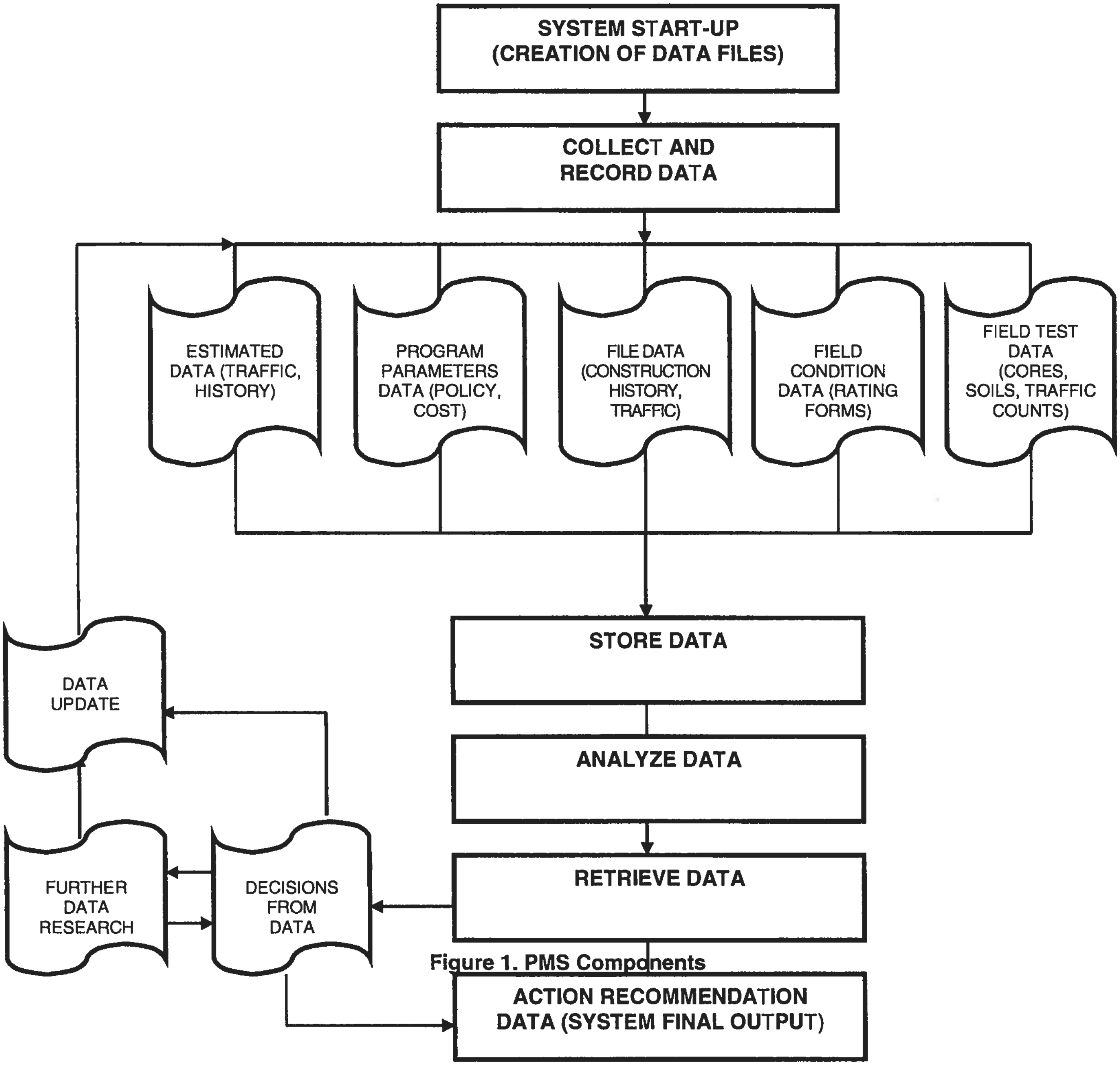


Figure 1. PMS Components

PROJECT SCOPE

A PMS is developed for roadways that provide traffic circulation within the roadway network, and occasionally for parking lots and other facilities. Basic PMS components are as follows:

- Data acquisition process
- Database
- Retrieval methods
- Analysis methods
- Update procedures

The PMS database is established using a combination of field inventory and data research methods to develop the information needed for good pavement maintenance decision making. It includes 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 is also compiled from record data on pavement width, length, structural sections, maintenance histories, and traffic conditions. This inventory of streets is one of the main benefits of the database.

The collected data, which forms the heart of the PMS, is stored on a computer for ease of sorting, updating, and retrieval. The computer program operates effectively on a personal computer. Once the database is established, the data is used for analyzing each street (between major intersections, or even shorter segments when necessary); identifying pavement requiring major or minor maintenance; ranking the candidate projects; and formulating recommended annual programs based on different funding scenarios.

Updating the database and analyzing the resulting new information should be accomplished every three years in conjunction with the budget preparation process. A PMS developed for an owner can easily be updated to reflect changed conditions, reflect improvements undertaken during the intervening period, update cost factors, and develop new budget scenarios.

The following sections of the report provide a more complete description of what a PMS is. They also describe the methodology and information used to compile the city's database, the data analysis program, and the results of the analysis—including computer printouts of the various reports.

The Data

The effectiveness of any PMS is dependent on 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 quick, economical, and easily repeatable. Pavement condition data must be collected periodically to document the changes of pavement conditions.

Typically, condition inventories are input, stored, and retrieved on a roadway segment basis. Segments are ideally defined as reasonably sized projects ranging from 1,000 feet to a quarter of a mile in length, beginning and ending at intersections. Occasionally, varying traffic or construction history may 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 specified activities. Cost information must be easily updatable to reflect current dollar values. The data is used to estimate the cost of maintaining a pavement at a given condition and for projecting long-range budgets, based on the condition of the pavement.

Additional data elements 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 the cost for collecting the information. A PMS is only as accurate and useful as the type and quality of data stored in the database.

Data Analysis
Having accumulated the information contained within the database, the next step is to analyze the data. The data analysis phase involves the development of a computer program that utilizes the database to develop specific project recommendations.

Data Retrieval
It is critical that the data be easily retrieved, and in such a format that it is meaningful. The computer program has the advantage of enabling quick retrieval from a single source, and the flexibility to display data in any format desired. The computer program is essentially unlimited in its capacity to prepare tables, graphs, and charts. In comparison, doing the simplest tasks of this type from manual 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 the following:

- 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 the number of streets that can be improved?

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

Updating Data
An efficient procedure for updating 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 the understanding of the database provided above, an examination of the typical uses of a PMS can be undertaken. The material that follows briefly describes the main areas where a PMS is applied, and the benefits achieved from each such application.

Street Inventory
The most immediate benefit 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 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 one-year maintenance budget, a PMS allows a city to prepare a series of budgets. These budgets can be in the form of a multiyear program, identifying not only short-term (one-

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 primarily on condition ratings, but other factors of traffic and cost can be incorporated as well. The next step can be the selection and ranking of projects for the upcoming budget year, as well as for long-term financial planning.

SUMMARY

A PMS can generate numerous benefits by drawing on its many components and capabilities, which typically include the following:

- Inventory of street system
- Overall pavement condition rating
- Annual budget estimates for various scenarios
- Project identification and ranking
- Improved decision-making tools

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

APPENDIX 2

THE CANYON LAKE PROPERTY OWNERS ASSOCIATION PAVEMENT MANAGEMENT SYSTEM

The Canyon Lake Property Owners Association (CLPOA) 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 sound, objective data, and (2) the beneficial use of outside research related to those decisions.

The system used to store and process such data is MicroPaver. It is a useful system to store PMS data and provide data output and certain types of reports. However, the Willdan system goes further, extracting data from the MicroPaver database to allow for very specific and accurate assessment of street segments on a structural and financial basis. This enhancement is not available in MicroPaver alone. The generation of capital improvement reports is much more flexible and straightforward using the Willdan enhanced software.

The following sections of the report cover the four main forms of data handling in the Canyon Lake Property Owners Association PMS.

DATA COLLECTION AND STORAGE

Parameters
The first step in developing the PMS for the CLPOA was to select specific fixed parameters under which the program would operate, such as construction inflation rates, the nominal design life span of various improvements, and potential strategies for implementing overlays. These issues were addressed at the outset of the project, during a conference with the CLPOA Road Committee. Inflation was considered to be 3% for the next few years, design lifespan was to be 25 years, and the strategies elected are outlined in the Strategy section below.

Pavement Condition Survey
Each street and parking lot within the CLPOA community 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 costs.

Over 245 rating forms were prepared for roadway segments within the city. These forms were later entered on a matching computer screen by a trained pavement technician. The information contained on the rating forms was used as part of the database system for the PMS.

"As Built" and Maintenance History Records
Historical records of streets within the CLPOA municipality were acquired for the period since the last update. A default date of 1965 was assumed for streets without any available construction history. (This assumption is a database convenience that does not affect processing.)

Traffic Data
Willdan's staff performed a review of traffic conditions, including estimates of truck volumes. After reviewing traffic volumes in the field and expected usage situations, an estimated traffic index (TI) was

assigned to each roadway segment of the in the CLPOA network. This is important for determining the overlay thickness for major maintenance, and the benefit/cost ratio for use in assigning project priorities. TIs are typically rounded up to the nearest 0.5 value. The table below shows how the TI was derived.

	TI Period:	25 Years		
	Short Culdesac	**Long Culdesac**	**Local Street**	**Arterial**
Qualifier	Less than 600 ft long			
Traffic General	4 Trash Truck Axles per week	Same as Local	4 Trash Truck Axles per week and 5 other truck axles per week	9600 cars per day and 2% trucks
Equiv. Axle Loads	5200	Same as Local	9100	Caltrans Chart
Traffic Index (TI)	4.81		5.14	7.1
TI Rounded	5.0	5.5	5.5	7.5

Parking lots were assigned the same TI as short cul-de-sacs, due to the limited traffic flow noted in CLPOA parking lots.

Cost Data

Cost factors used in estimating the costs of improvements were determined from average recent construction bids on representative projects for each type of construction within this report. All costs have been increased by 16% to account for engineering, construction inspection, and administration. An additional 10% was included for contingencies. This sum is considered adequate to account for curb and gutter repairs that would affect pavement performance (though an inventory of such repairs was not performed in this study).

The cost estimates used in the PMS are considered to be representative for the upcoming year. To give a general indication of future year's costs, an inflation factor of 3% for the next 5 years has been included within the program to adjust for expected cost increases. A total cost for each segment is calculated by multiplying the area of pavement in the segment by the unit cost.

DATA ANALYSIS

Having accumulated the information contained within the database, the next step was to analyze the data. The data analysis phase entailed 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 considerably within the CLPOA community. Therefore, a system for grouping street segments with similar conditions was needed to assign appropriate maintenance treatments. 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 figure 2. Once strategies were assigned to each of the various condition states, base costs were determined for the construction activities to be used.

STRATEGY LOGIC TREE FOR MAJOR MAINTENANCE

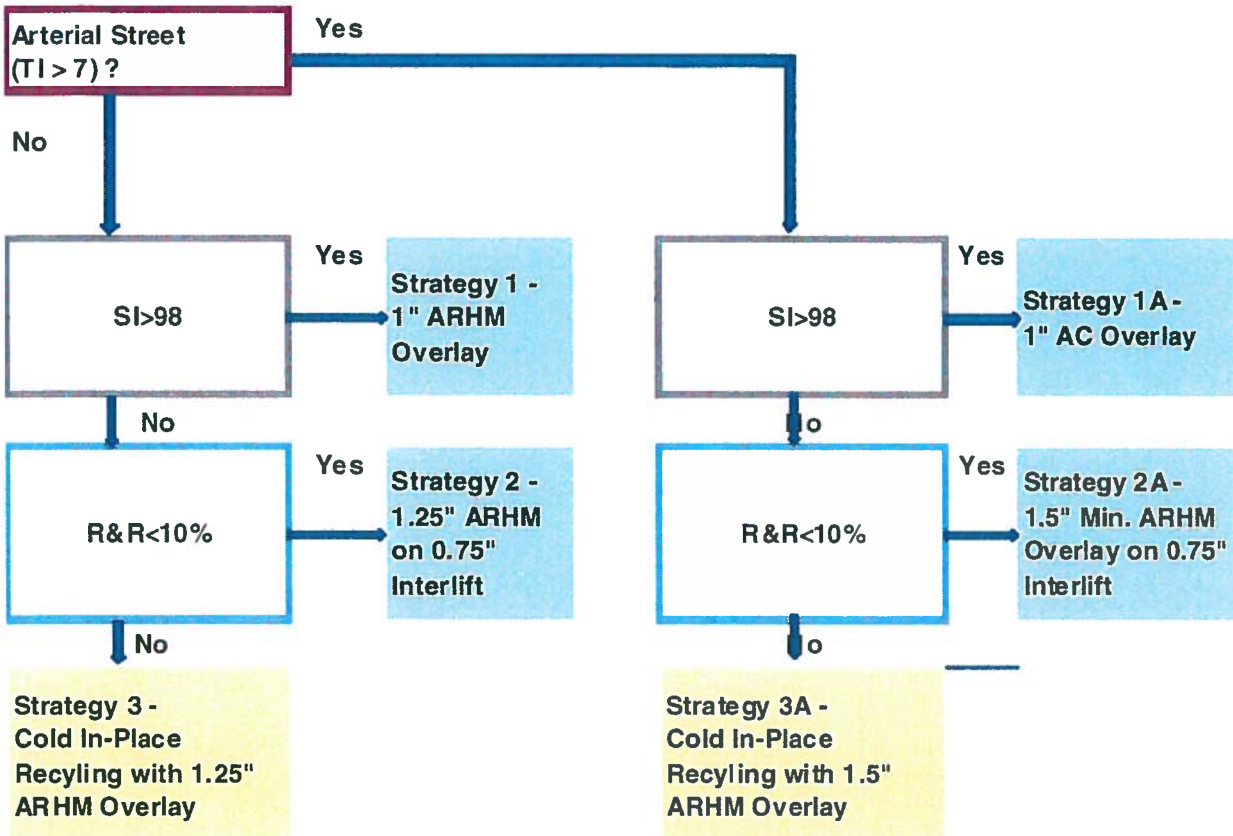


Figure 2. Strategy Logic Tree for Major Maintenance

The assigned strategy is the improvement that is recommended to be undertaken for each segment in order to arrive at estimated improvement costs. The precise scope of reconstruction repairs for any segment would have to be determined through detailed field investigation during design. Therefore, the actual costs of construction will vary somewhat from these estimates, though on average any variations would be fairly insignificant for any particular group of streets. In fact, bidding conditions in the industry will have by far the greatest impact of costs.

Priority

Simply put, the benefit/cost ratio is a way of assessing the benefits you get against the money you must spend to get them. This ratio is useful for setting priorities for roadway segment upgrades. To maximize your return on investment, projects that earn the highest benefit/cost ratio should get the highest priority for rework; that will ensure the CLPOA gets "the biggest bang for the buck."

However, setting those priorities requires a sophisticated algorithm that determines the benefit/cost ratio for each segment. The benefit/cost ratio is the engineering economics method used to prioritize street projects against each other by determining their relative advantage. Such a comparison provides a sound economic basis for decision making, and that is precisely what the CLPOA PMS does. The estimated increase in cost per year due to delay of major maintenance is divided by the cost of the prospective major maintenance overlay. The resulting number represents an annual return on investment that can be obtained by performing the overlay on the street. That is the benefit/cost ratio for the segment.

Calculation of the pavement condition index (PCI) also requires a highly sophisticated algorithm that assigns points to be deducted from a maximum score of 100 (the starting number for a street that is in excellent condition in every respect). These "deduct" points are assigned individually, using one set for each of three severity levels (low, medium, and high) for each type of deterioration. For example, alligator cracking is one important type of deterioration. The assessed quantity of each level of deterioration (low, medium, and high) is stored separately. Quantities of 15 types of deterioration are stored in a similar manner. This is the same method used by the U.S. Army Corps of Engineers (COE) in their standard protocols, and it is used by many other public agencies nationwide. This protocol provides a perspective on the general overall condition of a roadway based on all perceived factors. It is not used for assigning a priority directly; however, it would trigger an overlay when PCI becomes very low.

The PCI algorithm assigns deduct points for each severity level of each deterioration type. The sophistication of the COE system is in the way these points are combined; the total deduct points never reach 100, so the final PCI is never less than zero. Drawing on our experience, Willdan has enhanced this system such that the principal driver of PCI is cracking in the traffic area (although other factors still have a major effect on the final value). This ensures that the primary consideration is once again the potential financial loss that will occur if cracked pavement is allowed to completely fail under traffic loads. When that occurs full pavement reconstruction is necessary, which generally costs *three times as much* as pavement restructuring that is performed prior to failure.

A third way to view the priority of pavements is the structural index (SI) value. This is the way people first see the need for an overlay—by looking at the cracks in the road. It is a very effective way to assess the need for an overlay, but the benefit/cost ratio is preferred for assigning the ultimate priority (because of economic and traffic factors that are not obvious based on cracking alone).

Minor Maintenance Priority

The need for minor surface maintenance is primarily established by a single factor: the raveling off of fine aggregate particles from the surface due to weathering. As a secondary consideration, there are singular crack treatments available. In the desert climate of Canyon Lake this is generally just an aesthetic consideration, since the singular cracks are not significant structural issues.

A potentially important aspect concerning slurry seals is that asphalt rubber pavements do not need slurry treatments for quite a long time because their surface does not ravel or deteriorate in any measurable way. A properly compacted asphalt rubber pavement is impregnable to water, with few fines existing in the surface to ravel. The tough resilient asphalt rubber binder tightly binds the few fines that do exist in the surface. The surface binder does have some potential for degradation from sun and rain, but the anti-aging chemicals provided by the tires used in production of asphalt rubber strongly inhibit even this action. Since the cracking that ultimately limits the life span of ARHM pavements begins at the bottom of the layer, at the interface with the cracks in the old pavements underneath, the slight degradation of the surface binder properties is not particularly consequential.

It is not that slurries cannot be applied to asphalt rubber; they can, in the same manner as for AC pavements. The serious drawback is that once the ARHM is slurry-sealed with conventional slurry, the potential for in-place recycling of the ARHM as an interlayer for the next overlay is lost. Slurries always make recycling difficult, and with ARHM the problem is compounded because the binder in the slurry will contaminate the asphalt rubber binder. If properly recycled, the old ARHM overlay can provide a flexible structural element for the subsequent overlay. The advantages include reduced thickness for the next overlay and less change in the street profile, plus the ongoing savings as the cost of asphalt and aggregate continue their steep increase. Fortunately a true asphalt rubber slurry—known as tire rubber modified slurry seal (TRMSS)—is available now, so if an ARHM is determined to be appropriate for slurry seal, it can be done without losing the recycling potential.

The minor maintenance treatment for streets is usually a Type I or Type II slurry with possibly crack filling beforehand. A seal coat can also effective, especially on local streets with light traffic. This may be the preferred option, because it stays black in color and will seal the pavement and protect it. At the time when a surface treatment is needed, in about 15 years after an ARHM overlay, this may be the best option to consider (see the discussion below on slurry and crack filling). It should be especially advantageous on ARHM pavements, because the seal will remain in the relatively more porous surface of ARHM (as compared to AC pavements). The result even after 5 years will be an attractive salt-andpepper finish, with the tops of the exposed rocks being light in color and the surrounding areas being very dark because they are in-filled with the seal.

Unfortunately, at this time few ARHM pavements have reached a stage where they need a seal, so no one has yet tried the seal-coat approach. The concept does seem very attractive for ARHM pavements, with very limited downside aspects. The seal-coat approach has the following advantages over a slurry:

1. It stays black over an extended time.
2. It remains flexible over an extended time (slurries become brittle almost immediately).
3. Because of item 2 above, crack filling would be more effective than with slurry; the seal coat will not show cracking nearly as much.
4. It is much less expensive, and in fact a thin coat would be preferable since filling the pores in the ARHM is the primary goal (not a full layer covering the pavement).
5. Crack filling could be applied with a squeegee, and the thick layer that is needed to inhibit cracking in a brittle slurry would not be required.
6. In-place recycling of an ARHM surface pavement is possible with a seal coat, though it is not reasonable with a slurry.

Regarding item 4 above, a thin coat is also preferred because curing of the seal coat requires a 24-hour interval, whereas slurry can take traffic after just a few hours. This is a potential drawback of the seal-coat approach. Parking would have to be coordinated; it may be necessary to complete the work by doing half-streets at a time to facilitate overnight parking for residents (in order to provide parking within a reasonable distance).

Crack filling works better with seal coats than with slurry. The crack filler and the seal stay essentially the same color, so the unsightliness of a black crack-fill line running across a light-colored pavement is alleviated. Regardless, however, crack filler for a seal coat can only be installed on a crack about ¼" wide in AC pavements. Crack filler will not penetrate in a narrow crack and, if left as a layer above the crack, the ride quality and appearance will be degraded. On an ARHM pavement the crack filler is the same material as the binder in the pavement, so squeegeeing the filler into narrow cracks with a flexible seal coat on top would be fairly effective in masking the cracks. A wide crack that has been filled and squeegeed with seal coat would also be well masked.

Crack filling is not recommended with slurry seals unless the crack fill is applied at least eight months in advance, which should include a full summer season. The crack filler can disrupt the thin hard layer of the slurry, often yielding multiple hairline cracks and other distortions of the uniform slurry coating. In warm climates the uncured crack filler commonly flushes through the slurry after a few years, creating a dark black strip along the crack; the contrast is readily apparent against the lighter gray color of the slurry. If instead the cracks are blown clean of debris and dirt just prior to slurry, the slurry will fill the cracks and yield a uniform surface. The only imperfection will be a single hairline crack that returns within a few weeks.

However, if the crack filler is allowed to cure prior to slurry, there is an application method that can provide an essentially crack-free pavement. A good product to use for slurry in this case is TRMSS. This is the same as a conventional slurry except that a tire rubber modified binder—as used in tire rubber modified AC (TMAC)—is used, because it is specified in the *Standard Specifications for Public Works Construction* (*Greenbook*). This asphalt rubber binder stays dark much longer, and is more compatible with the crack fill material. It also will allow for a surface recycling treatment for ARHM pavements if they were to be slurried.

Another effective product is recycled asphalt pavement (RAP) slurry, where the sands in the recycled pavement are used instead of virgin sand. As with TRMSS, this provides a blacker slurry that maintains its dark color longer, though it has no asphalt rubber attributes.

The minor maintenance program generally prioritizes the raveled streets first, based on severity. Then AC streets that have gone the longest time since the last slurry or overlay are considered, but that elapsed time must be greater than the minimum elected slurry seal cycle time. The streets included based on cyclical considerations are prioritized, with the highest priority going to the segments with the longest time since the last treatment. The cycle time has been selected to be 8 years. Slurries generally do not wear off for at least 12 years, but tend to discolor and gather stains within a much shorter period.

Cost

The Willdan system uses pavement conditions and traffic to calculate the required overlay thicknesses. The overlay thickness plus the actual reconstruction repair quantities extrapolated from field survey data are then used to calculate the overlay cost of each roadway segment. Other costs such as cold milling and reconstruction repairs do vary between streets, so those are incorporated individually into the cost calculation. This is the process used to produce the major maintenance inventory and budget reports. The great value here is that budgetary planning in the short term of three years is reliable and accurate, and produces a cost-effective program of expenditures. The calculation of the benefit/cost ratio uses the same data.

DATA UPDATES

The budget projections are considered to be relatively accurate for the first year, and to a lesser extent for the second and third years. Projects requiring major maintenance will increase in cost-effectiveness as years go by. Updates of the PMS every three years will automatically adjust priorities and consider all pertinent factors to enhance the relative accuracy of the projections. However, with the PMP program of renewal of all streets, an update would not be needed for many years. If the pavements were to be reviewed again after a number of years, it would only involve a windshield-type survey to observe the surface condition and the width of block cracks in preparation for a seal project.

Naturally, updated cost values must be programmed into the system whenever the updates occur.