Council Agenda #6C
Meeting of July 25, 2006

# Staff Report

INFORMATIONAL REPORT OF THE PAVEMENT MANAGEMENT STATUS

Honorable Mayor and Council Members:

## Summary

This report describes the City's pavement management program. It also provides background on the construction and condition of the City's streets, pavement rehabilitation technologies, cost-effective pavement management, and the City's current funding and expenditures for streets.

Next month, staff will present a second report seeking Council direction for the street rehabilitation priority list and discussing options the City may consider to accelerate completion of the pavement rehabilitation work.

## Background

The City of Belmont owns 68 miles of paved streets. The pavement needs maintenance and periodic repair or rehabilitation to keep it in satisfactory condition. The current deferred maintenance backlog is $12 million and this is projected to grow to $29 million over the next five years at the current funding levels[1]. The City follows a comprehensive pavement management program plan to ensure that it uses the available street rehabilitation funds efficiently to maximize the overall useful life of the street pavement.

### City of Belmont Pavement Management Program

In 1970, the State of California formed the Metropolitan Transportation Commission (MTC) to manage San Francisco Bay Area transportation planning and financing. MTC's mission includes assisting local agencies with pavement management. In the 1980s, MTC determined that Bay Area pavement was deteriorating because local agencies were funding only half the needed maintenance.

[1] Projections from Engineering Information Services, Inc. "City of Belmont Public works Department, Pavement Management Report,: December 2004. Report prepared by MTC consultant on behalf of the City.

MTC requires local agencies to develop and adopt a pavement management program plan as a condition of state grant eligibility[2]. The program requires the City to conduct or complete the following activities:

- Store, review and update city street inventory data every two years,
- Complete a condition distress survey every two years for arterials and collectors and every five years for residential streets,
- Identify pavement sections needing rehabilitation or replacement, and
- Calculate budget needs for rehabilitating or replacing deficient pavement sections.

Belmont developed and submitted its plan which has been certified by MTC through November 2006. MTC provides for consultant services to complete the biannual pavement distress survey and condition assessments. MTC also provides the City the StreetSaver software to store and manipulate the data. StreetSaver can generate maintenance and rehabilitation schedules and cost-estimates. It gives priority to low-cost preventative maintenance of good condition pavement, but does include a small portion of structural rehabilitation or reconstruction.

Staff values StreetSaver as an organizational tool, but believes its output must be tempered by professional judgment and Council direction. Direction is needed to set criteria for prioritization when there are not enough funds to both maintain good condition pavement and reconstruct the poor condition pavement at a reasonable schedule.

**Construction of Asphaltic Concrete Pavement**

Nearly all of Belmont's public streets are constructed of flexible asphaltic concrete (AC) pavement. Flexible pavement deflects when loaded, in contrast with rigid pavement such as cement concrete. Flexible AC pavement has three or more layers of load-bearing materials. All layers have different physical properties but all contribute to the total structural strength of the street. The composite layers are collectively known as the pavement structural section and their specification is called the pavement structural design.

The top layer is typically three to twelve inches of asphaltic concrete compacted to provide a smooth, water-resistant surface. AC is a mixture of asphalt and aggregate, and may include additives. Asphalt is a black, viscous hydrocarbon obtained from the heavy ends of petroleum distillation. When heated, it liquefies and is easy to mix and mold. When cool, it firms to a semi-solid or even brittle material. Aggregates are crushed rock, gravel and sand. When mixed and compacted with the asphalt binder, aggregates lock together to produce a stable, long-wearing, water resistant surface. Supporting the AC layer are four to twelve inches of compacted gravel known as the aggregate base layer. Aggregate base contributes structural strength and also promotes drainage. Beneath the aggregate base is a subgrade or base layer of graded and compacted soil. Native soil is used if it has sufficient strength and stability. Otherwise, it is replaced with a thick layer of engineered fill consisting of balanced portions of silts, sands, and gravels.

[2] California Streets and Highway Code, Section 2108.1

Engineers design the thickness of structural layers by balancing construction costs against the desired service life for the intended use and loading. Arterials such as Ralston Avenue are most expensive to construct because they need a thick structural section to handle frequent, heavy truck traffic. Collectors such as Masonic Avenue convey residential traffic to and from arterials. They have thinner sections and are less expensive to construct. Residential streets intended for low speed, local traffic can get by with the thinnest structural section. The following table shows the breakdown of the City's paved streets by classification use the construction cost in today's dollars.

| BELMONT STREET PAVEMENT CLASSIFICATION | | | | |
|---|---|---|---|---|
| | Lane Miles | Structural Section | Construction Cost per square yard[3] | Construction Cost per Class |
| Arterials | 13 | Thick | $160 | $6 million |
| Collector | 35 | Medium | $100 | $8 million |
| Local Residential | 135 | Thin | $85 | $22 million |

**Pavement Condition Index**

The typical service life of Bay Area AC pavement ranges from about 15 to 30 years, depending on its structural design and use. Flexible pavement can withstand only a finite number of loading deflection cycles before it breaks down. Overloaded pavement develops alligator cracking, or deep interlocking cracks that look like alligator skin. The separated chunks of alligatored AC are easily dislodged to produce potholes. Trench cuts are localized pavement patches usually from utility repair. Surface ruts and bumps develop from shifting of aggregate base and base layers from shoving (vehicle braking) or subsurface instability. Weathering and raveling describe loss of surface aggregates from aging asphalt binder.

MTC's pavement condition index (PCI) is a ranking system that assesses, weighs, and combines various deflects to give an overall indication of the pavement condition. The PCI scale runs from 0 to 100 as follows:

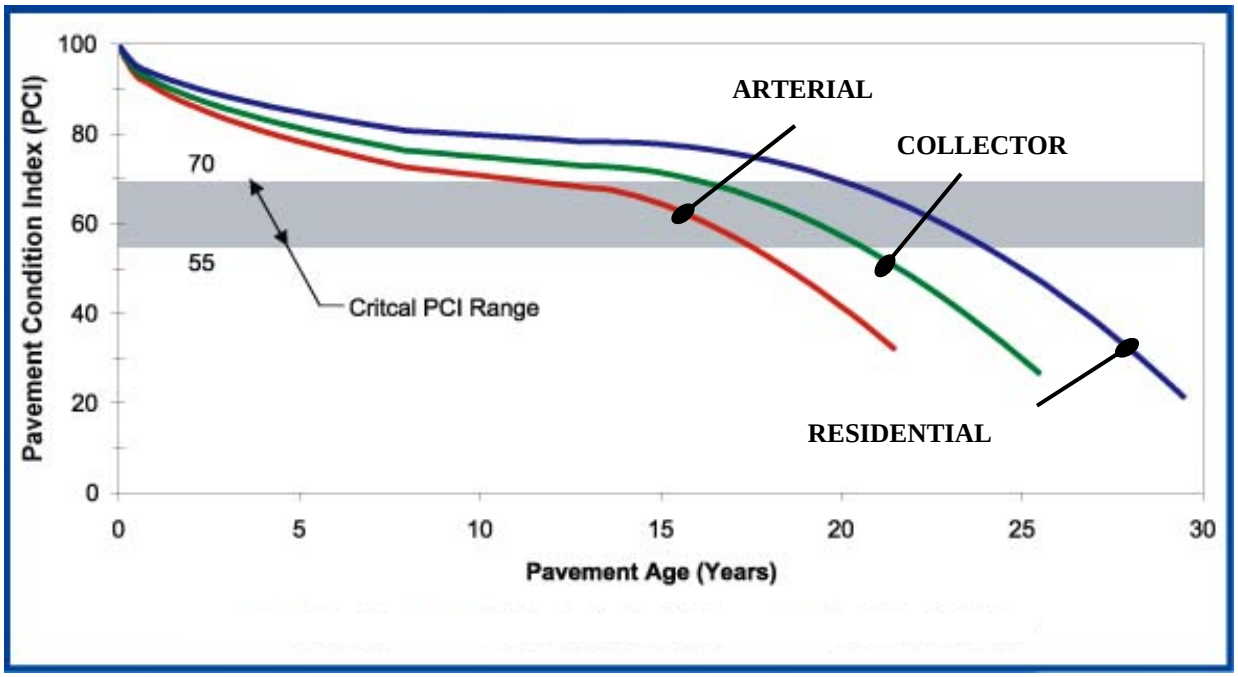
- 85 to 100 Good to excellent - pavement is fairly new, well constructed, and not damaged by trench cuts. At lower end of range, pavement will benefit from surface treatments to extend service life.
- 50 to 69 Satisfactory – AC layer has become worn to the point where it needs overlay.
- 25 to 49 Fair – AC layer is failing and requires structural rehabilitation or reconstruction.
- 0 to 24 Poor – entire structural section has failed and requires reconstruction.

The PCI is a quick method of comparing the overall condition of pavement and magnitude of rehabilitation needs. It does not provide sufficient information to describe the types, causes, and

[3] Quoted costs are from MTC regional surveys and recent Belmont construction. They are representative of standard pavement construction and may be assumed to be within a -50% to +100% range of precision. Costs do not include ancillary construction such as pavement markings or curb, gutter and sidewalk.

remedies for specific defects in a street segment.

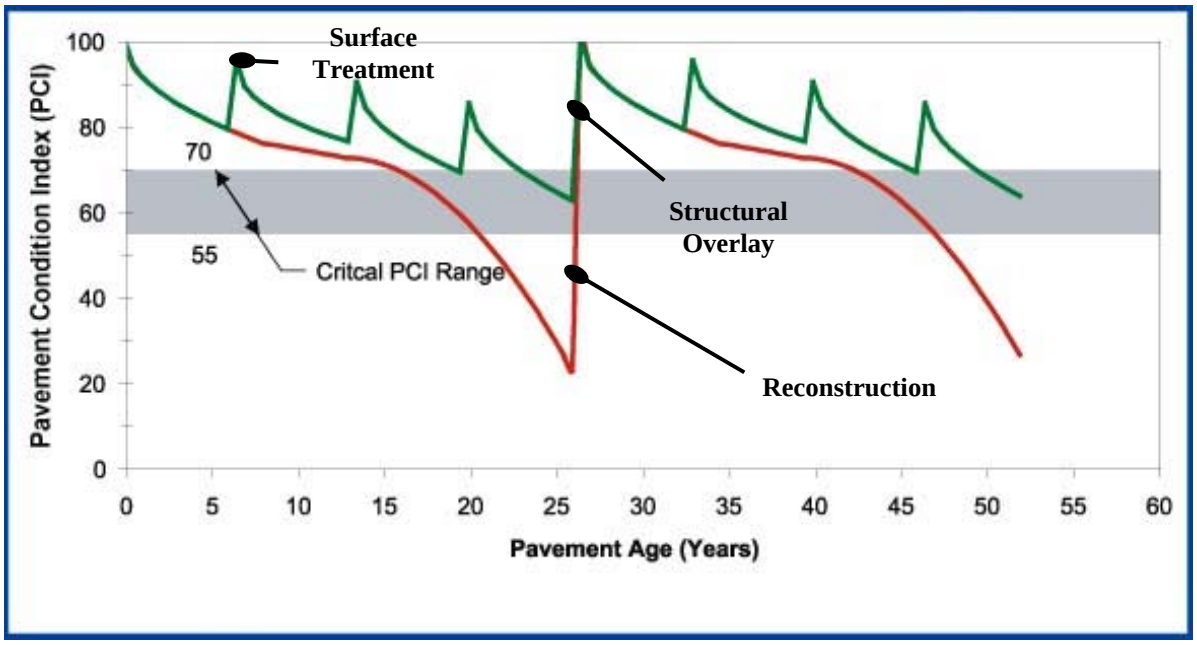
The following figure shows how pavement condition deteriorates over time. Actual pavement life can vary significantly from these idealized curves depending on construction, use and environment, but most pavement follows similar deterioration curves. The new pavement holds its good condition for a long period, but once it begins to fail, its condition drops rapidly. Pavement is at the onset of rapid failure when its condition drops into the 55 to 70 PCI range.




**Extending Pavement Life through Maintenance and Rehabilitation**

Pavement life can be extended at relatively low cost by timely maintenance and rehabilitation. MTC's recommended strategy is to prioritize funding to hold all good condition street segments at that level while using remaining available funds to rebuild poorer condition pavement. The regional goal is to eventually bring all Bay Area pavement up to a PCI range of 80 to 85. This is the PCI the yields the lowest long-term pavement maintenance cost.

The following figure compares two pavement management strategies. The first strategy allows the new pavement to deteriorate over a life of about 25 years. The failed pavement is then fully reconstructed. The second strategy uses a series of low cost surface treatments to keep the pavement condition above the critical PCI range. After about 25 years, this second pavement needs some structural rehabilitation, but it does not need complete reconstruction.




Slurry seal is an appropriate surface treatment for good condition pavement. Pavement with slight surface damage is restored with a thin AC overlay. Both slurry seals and overlays restore water resistance and improve the ride and appearance of aging, mottled or patched pavement. Thick AC overlays are needed to restore structural strength to a cracked AC layer and are appropriate when the underlying layers are still stable. Pavement that has completely failed through the base layers must be excavated and reconstructed. The most expensive repairs are to streets with unstable earth beneath the base layer. Construction of retaining walls add a cost of additional $50 to $500 per linear foot of wall.

The following table shows relative costs for these treatments. It also compares the amount of pavement that can be treated by a $100,000 construction contract. All quoted costs are for typical construction and are not intended to represent actual Belmont street rehabilitation projects.

| **Pavement Treatment Obtained from $100,000 Construction Contract** | | |
|---|---|---|
| Treatment | Cost per Square Yard | Amount of Treatment |
| Slurry Seal | $2 | 50,000 $yd^2$ or 25 lane miles |
| Thin Overlay | $5 - $15 | 10,000 $yd^2$ or 5 lane miles |
| Structural Overlay | $25 to $35 | 3,000 $yd^2$ or 2 lane miles |
| Reconstruction | $85 to $135 | 900 $yd^2$ or 1/2 lane mile |

**Funding for Capital Street Construction**

Most of the City's revenues for street improvement and maintenance are from the gasoline tax and Measure A sales tax. The City also receives vehicle impact fees from Allied Waste and the

C/CAG vehicle registration fee. The City may also use Redevelopment District Agency (RDA) funds for street improvements with the RDA district. The following table shows these expected revenues for fiscal year 2007. The table shows the majority of revenues drawn from all sources, but it is not intended to correspond directly to the FY07 budget. It cannot be used as a budget reference.

| Fiscal Year 2007- Revenue for Street Improvement and Maintenance | | |
|---|---|---|
| Gas Tax | $747,835 | 48% |
| Sales Tax (Measure A) | $515,000 | 33% |
| Federal Grants – (STIP for Old County Overlay) | $134,000 | 9% |
| RDA – (Old County Overlay grant match) | $41,000 | 3% |
| Vehicle Impact Fee | $110,000 | 7% |
| AB 1546: Congestion Management Vehicle Registration Fee | $10,000 | 1% |
| **Total** | **$1,557,835** | **100%** |

The City uses these revenues for all streets improvement and maintenance activities including staff engineering and maintenance labor, equipment, materials, and construction. Street maintenance and improvements include pavement management, traffic operations and controls (signals, signage, markings, etc.) and street lights.

The City will use about a third to one-half of its street revenues for pavement maintenance and rehabilitation. This includes routine maintenance performed by the City's crew for pothole repair and crack sealing, project design and construction management performed by the City's engineering division, and contracts for slurry seal ($231,000) and AC pavement overlay ($360,000). Staff will present the proposed slurry seal and overlay project locations with next month's pavement rehabilitation priority report.

## Discussion

### City of Belmont Pavement Condition

The City's most recent pavement assessment was completed in 2004 by an MTC consultant[4]. Staff expects to be notified shortly that MTC will provide consultant service to complete a new assessment this summer. The 2004 distress survey showed that the overall average PCI for Belmont streets is 63, placing them in the mid-range of the satisfactory category. MTC reports that the overall average Bay Area PCI is 62 and shows Belmont ranking 78th out of 105 Bay Area jurisdictions.

As shown in the following table, Belmont's arterials are generally in excellent condition. The collectors and the residential streets are in satisfactory condition on average, but are also entering the onset of rapid failure stage.

[4] Engineering Information Services, Inc. "City of Belmont Public Works Department, Pavement Management Program Budget Options Report," December 2004.

| Weighted Average PCI by Functional Classification | | | | |
|---|---|---|---|---|
| **Classification** | **Average PCI** | **Condition** | **Total Miles** | **Total Lane Miles** |
| Arterial | 86 | Excellent | 8 | 13 |
| Collector | 62 | Satisfactory | 17 | 35 |
| Residential | 59 | Satisfactory | 44 | 87 |
| City Total | 63 | Satisfactory | 68 | 135 |

Averaging PCIs over the entire City or functional class obscures the fact that individual street segment conditions range from excellent to failed. The breakdown of streets by condition category is shown below.

| Condition Distribution | | | |
|---|---|---|---|
| **Condition Category** | **PCI Range** | **Percent** | **Total Miles** |
| Excellent | 85 – 100 | 18 | 11 |
| Good | 70 – 84 | 38 | 24 |
| Satisfactory | 50 – 69 | 16 | 10 |
| Fair | 50 – 69 | 18 | 11 |
| Poor to Failed | 0 – 25 | 10 | 6 |

**Pavement Maintenance and Rehabilitation Scenarios**

MTC's consultant modeled several pavement maintenance scenarios to show the relationship between investment and pavement condition. The objective of the first scenario was to show the funding needed to quickly attain the optimum PCI and thereby yield the lowest long term costs. The second scenario estimated the funding needed to hold the pavement condition at its level. The final scenario projects the impact on future pavement PCI if the City maintains its current funding level. These scenarios are just a few that can be modeled, but they roughly bracket the range of best to worst situations.

Scenario One - Cost to Attain Optimum PCI of 80 to 85

MTC's pavement management goal is for all agencies to raise and maintain their pavement PCI into the 80 to 85 range, as this yields the lowest long-term maintenance cost. It would cost Belmont about $30 million over the next six years to improve the condition of its pavement from the current 63 to the optimum 80 to 85. This would eliminate the current $12 million backlog of deferred maintenance and rehabilitation and would aggressively address anticipated maintenance needs.

The cost breakdown by functional classification is as follows.

| Functional Class | Lane Miles | Preventative Maintenance Needs | Rehabilitation Needs | Total Needs |
|---|---|---|---|---|
| Arterial | 13 | $523,675 | $1,085,802 | $1,609,477 |
| Collector | 35 | $487,404 | $9,390,425 | $9,877,829 |
| Residential | 87 | $493,296 | $18,264,789 | $18,758,085 |
| Total | 135 | $1,504,375 | $28,741,015 | $30,245,390 |

These costs are for the pavement component of street improvements only. They do not include other improvements such as slope stabilization, drainage, traffic flow improvements, or pavement markings and signage.

The breakout of recommended preventative maintenance and rehabilitation is as follows:

| Deferred Maintenance By Type | | |
|---|---|---|
| Preventative Maintenance | Square Yards | Cost |
| Slurry Seal | 400,986 | $1,411,407 |
| Crack Seal (linear foot) | 13,928 | $21,764 |
| AC Overlay | 3,000 | $71,204 |
| Maintenance Subtotal | | $1,504,375 |
| Rehabilitation | | |
| Patch and Slurry Seal | 160,411 | $1,081,715 |
| Thin AC Overlay | 155,499 | $4,376,137 |
| Mill and Thick AC Overlay | 64,331 | $1,941,641 |
| Reconstruct Structure | 262,159 | $21,341,522 |
| Rehabilitation Subtotal | | $28,741,015 |
| Total | | $30,245,000 |

Belmont would need to complete a significant amount of pavement reconstruction, primarily in residential neighborhoods, to attain an overall PCI in the 80 to 85 range.

Scenario 2 - Cost to Maintain Current PCI of 63

The minimum cost to maintain the City's current average PCI 63 over the next six years is approximately $1,700,000 per year. This scenario does not improve the backlog of deferred maintenance that will continue to grow from $12 million to $23 million over the next six years. This is because at this funding level, the aggregate average can be held to a PCI of 63, but the street condition distribution shifts as more streets fail into the expensive "full reconstruction" remedial range.

Scenario 3 - Impact of Long Term PCI at Current Funding Levels

At current funding levels, the overall PCI will drop several points per year to 53 in 2010 and the deferred maintenance and rehabilitation backlog will grow from $12 million to $29 million. Current funding is nearly sufficient to keep the City's good condition pavement in good condition through slurry seal, but does not provide sufficient resources to improve poor condition pavement.

## General Plan/Vision Statement

The City's pavement management program is consistent with the General Plan. The Circulation Element, Description of Trafficways (Paragraph 2103) notes that there are a number of streets with substandard pavement condition and that the ongoing phased street overlay program will improve pavement condition and extend the life of existing streets.

## Fiscal Impact

There is no fiscal impact from this informational report.

## Public Contact

The Council agenda was posted.

## Recommendation

Staff recommends that Council accept this informational report.

## Alternatives

1. Take no action.
2. Refer back to staff for further information.

## Attachments

A. Map of Belmont Street PCIs

Respectfully submitted,

| | | |
|---|---|---|
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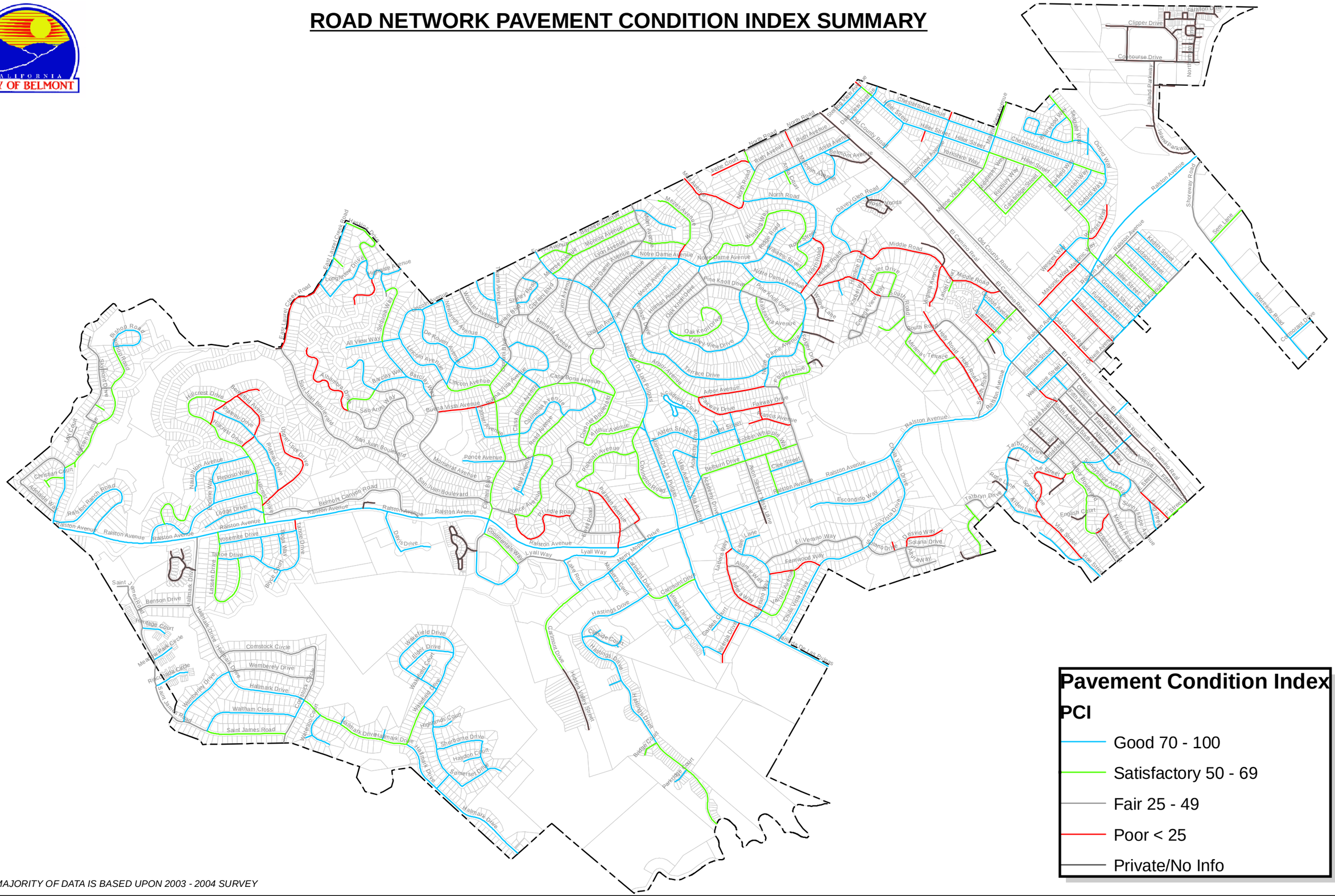
# ROAD NETWORK PAVEMENT CONDITION INDEX SUMMARY




*NOTE: MAJORITY OF DATA IS BASED UPON 2003 - 2004 SURVEY*