Citywide Pavement Inventory and Management System

EXECUTIVE SUMMARY

City of Oak Hill

Davidson County, Tennessee

Prepared for:

The City of Oak Hill, Tennessee
5548 Franklin Road, Suite 102
Nashville, Tennessee 37220

Prepared by:

Kimley-Horn and Associates, Inc.
Suite 501
209 Tenth Avenue South
Nashville, Tennessee 37203
TEL 615 564 2701
FAX 615 564 2702

Kimley-Horn and Associates, Inc.

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THE CITY OF OAK HILL

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BACKGROUND

A pavement management system was developed by Kimley-Horn and Associates, Inc. (KHA) for the City of Oak Hill (Oak Hill). The purpose of the management system is to provide an accessible pavement inventory of the approximately 43-mile long roadway network under the City's jurisdiction with up-to-date condition information. In addition, the system provides useful management and maintenance information with analysis capabilities. It is used as a tool for developing short and long-term capital funding projections based on conceptual budget predictions. An overall analysis period of 10 years (with 2013 as Year 1) was examined and a specific work plan of recommended projects was produced for the first three years.

This document is intended to summarize the analysis process, results and recommendations of this program. A complete report including data collected and a more detailed description of the analysis process, results and recommendations is available to the public at the City of Oak Hill offices.

DATA COLLECTION

The current condition of all paved roadways within the Oak Hill city limits was assessed by way of digital survey. Using high-resolution images, indications of pavement wear and deterioration were measured and cataloged to determine the current condition of each section of roadway.

PAVEMENT CONDITION RATING SYSTEM

The rating system used calculates the Condition Index (CI) of the pavement (from 0–severe distress to 100–perfect condition) by itemizing individual distresses found in the pavement surface. The distresses are measured and given an extent (percentage of pavement affected) and severity value. A distress rating (0-100) is then assigned using a standardized point deduction system. Table 1 shows each rating category and typical distresses found.

Table 1 – Typical Distresses for CI Rating Categories

CI Rating		Typical Distresses – Asphalt Pavement
100 – 91	Excellent	None.
90 – 81	Excellent	Very few isolated cracks. All cracks sealed or tight (open less than 1/4”).
80 – 71	Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40’ or greater). All cracks sealed or tight (open less than 1/4”).
70 – 61	Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open 1/4”) due to reflection or paving joints. Transverse cracks (open 1/4”) spaced 10’ or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.
60 – 51	Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open 1/4”– 1/2”), some spaced less than 10’. First sign of block cracking. Slight to moderate flushing or polishing. Occasional patching good condition.
50 – 41	Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open 1/ 2”) show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.
40 – 31	Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2” deep or less).
30 – 21	Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (1” or 2” deep). Occasional potholes.
20 – 11	Very Poor	Alligator cracking (More than 25% of surface). Severe distortions (More than 2” deep). Extensive patching in poor condition. Potholes.
10 – 0	Failed	Severe distress with extensive loss of surface integrity.

CURRENT CONDITION OF OAK HILL'S NETWORK

The current distribution of pavement conditions in Oak Hill based on the results of the survey is depicted in Figure 1. The weighted CI average of the roadway network is 73 with over 87% of Oak Hill's pavement assets having a current CI of 60 or greater. This is considered "Good" condition based on the evaluation system described in this report. Figure 2 shows a comparison of Oak Hill's network condition to Nashville's.

Figure 1: Current Pavement Condition Index Distribution

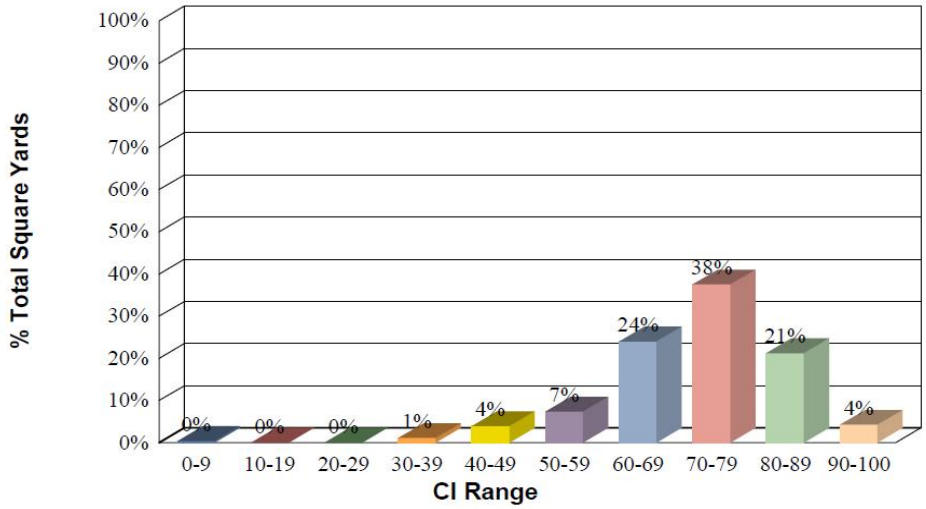
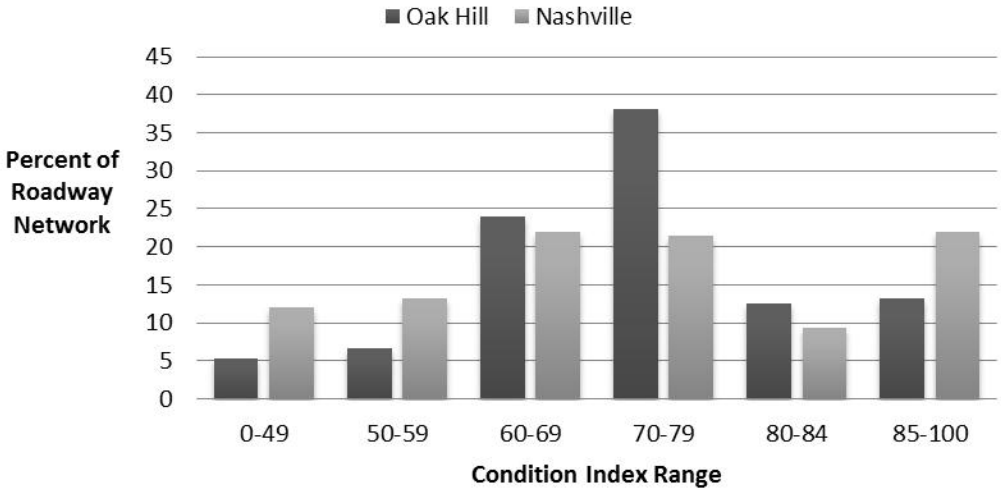


Figure 2: Oak Hill and Nashville Network Condition Comparison



EXISTING OAK HILL BUDGET

Oak Hill does not currently have a specific or consistent budget allocation for roadway pavement maintenance. In recent years, funding for various roadway maintenance and construction projects have ranged from $50,000 to $150,000 annually.

PAVEMENT MANAGEMENT STRATEGY

Pavement repair techniques may be grouped into three basic categories—preventive maintenance, rehabilitation, and reconstruction. As pavement condition deteriorates over time, maintenance costs increase significantly. Postponing maintenance until road failure requires costly reconstruction of roadways and has been proven to be less cost-effective than applying preventive maintenance techniques at earlier stages of deterioration. Therefore, the philosophy behind pavement management is to apply preventive maintenance and rehabilitation treatments at the appropriate times when they are most cost-effective—slowing the rate of deterioration and avoiding more costly reconstruction at pavement failure.

3-YEAR WORK PLAN DEVELOPMENT

One of the primary goals of this pavement management system is to develop a conceptual, network wide, 3-year work plan to help predict future repairs and funding requirements. The work plan uses a budget based on Oak Hill's projected funding allocations and distributes the funds across preventive maintenance, rehabilitation, and reconstruction repairs. Using input parameters for each section of roadway and user-defined prioritization, the system is able to analyze the overall network and determine which sections receive funding, how much funding is received, and how the conceptual repairs will improve the overall network condition and pavement deterioration rates. The program can be easily customized to fit the requirements and philosophies of Oak Hill – modifying budgets, network priorities, or accounting for special projects.

SCENARIO RESULTS AND BUDGET RECOMMENDATIONS

The more funding applied, the more repair activities can be performed and ultimately, the higher the network level CI will be at the end of the 10-year analysis period. The point of this pavement management program, however, is to find the balance between funding and average condition. This will determine the appropriate budget for efficiently slowing pavement deterioration,

avoiding costly reconstruction repairs, controlling backlog accrual (projects that need to be done but lack sufficient funding), and sustaining the network at an acceptable level. Several maintenance scenarios were modeled using various conditions and budgets. Results are summarized in Table 2.

Certain factors have a considerable impact on pavement performance which makes projecting the future condition difficult. Elements such as new roadways, developments, traffic patterns, and available funding simply cannot be precisely accounted for years in advance. Therefore, when considering these results, the 10-year projections should be regarded as largely conceptual.

Table 2 – Scenario Results Summary

Scenario	Average Annual Budget	Backlog		10 Year Δ Backlog	CI (Year 10)	10 Year Δ CI
		Year 1	Year 10			
No Action	$0	$1,555,000	$8,507,000	$6,952,000	49	-24
100K	$100,000	$1,455,000	$6,398,000	$4,943,000	54	-19
200K	$200,000	$1,355,000	$4,517,000	$3,162,000	59	-14
300K	$300,000	$1,255,000	$2,302,000	$1,047,000	64	-9
350K	$350,000	$1,205,000	$1,540,000	$335,000	67	-6
400K	$400,000	$1,155,000	$23,000	-$1,132,000	72	-1
450K	$450,000	$1,105,000	$54,000	-$1,051,000	74	1
500K	$500,000	$1,055,000	$0	-$1,055,000	75	2

Considering both the 3- and 10-year term, a budget of $100,000 or $200,000 is insufficient. The average CI falls below 60 after 10 years and would most likely result in costly and inefficient reconstruction repairs with an exponentially increasing backlog. Therefore, current funding is inadequate to maintain the network.

A $350,000 budget scenario still shows a declining average CI from 73 to 67 in 10 years. However, the backlog continues to stay relatively constant. This indicates a more balanced program. With a budget of more than $350,000, the backlog decreases so greatly that the maintenance program has, in effect, “caught up” with the pavement’s deterioration. By the end of the 10 year period, the backlog has been virtually eliminated and in some cases, leaving

substantial budget surplus. Similarly, the $400,000 budget scenario eradicates all backlog by Year 10. This indicates an over-funded program. Backlog is expected and if controlled, a characteristic of a sustainable network.

In the short term, a minimum budget of $300,000 would suffice for maintaining Oak Hill's network. Though the backlog is held constant over the first 4 years, an increasing backlog with a decreasing CI beginning in Year 5 demonstrates early signs of an unsustainable maintenance program. The CI would continue to decrease while the backlog increased—eventually resulting in very costly reconstruction repairs in future years. It is therefore recommended to regularly update the management system and reevaluate these budget recommendations at the end of the first 3 years.