Section I
IDENTIFICATION OF SYSTEM DEFICIENCIES

The identification of system deficiencies is a prerequisite to the examination of alternatives and selection of projects. The traditional long range transportation plan development process addressed deficiency analysis near exclusively through the modeling process.[1] While this is still a key analytical tool, the management systems, basic traffic engineering analysis, and other approaches have advanced in relative importance. This advancement has been promoted by the increasing necessity to preserve (and improve) the structural and functional integrity of the existing system. Sensitivity to social, environmental, and economic factors place increased emphasis on making better use of the existing system.

CAPACITY DEFICIENCIES

The travel demand forecasting model was the basic tool used to identify capacity deficiencies. The modeling process is discussed in Section H of this document.

Three of the different alternative scenarios developed for the 2025 Transportation Plan are compared in this section:

- Existing trips (based on 1998 socio-economic data) on the existing system (road system as it stood in 1998). This is the "calibrated," existing network/scenario. This is a prerequisite for the other two scenarios. This scenario will be referred to as 1998 in the following tables.

- Future trips (based on 2025 socio-economic data) on the committed network (road system as it will stand in 2004). Future trips are assigned to the committed network. This alternative displays future capacity and congestion problems if no improvements to the system are made beyond those that are currently committed. This is called the 2025 Base or "do nothing" alternative and includes the existing system, plus any projects which are committed to be built in the future (2004). This scenario will be referred to as 2025 B in the following tables.

- Future trips (based on 2025 socio-economic data) on the future system (road system as it is proposed to be in 2025). This scenario is the future 2025 Transportation Plan Action or "build" network. It includes suggested improvements to alleviate congested subareas or corridors. This scenario will be referred to as 2025 A in the following tables.

The three models can be compared on vehicle miles of travel (VMT), vehicle hours of travel (VHT), and total number of trips. VMT is defined as the assignment volume on a link multiplied by the distance on the link. VHT is defined as the assigned volume on a link multiplied by the travel time on the link. As congestion increases travel time increases and VHT reflects this. VMT and VHT are measures of travel intensity and are shown in Table I-1. Average trip lengths by trip purpose are shown in Table I-2 and are used as an indication of general model reasonableness. As trips increase in the future average trip lengths are also increasing.

[1] Consideration of "immediate action programs," Transportation Systems Management, the traffic operations program to increase capacity and safety (TOPICS), and others, have been emphasized in the process at different points in time.

Table I-1
Kalamazoo Area Travel Characteristics
Network Summaries

	1998	2025 B	2025 A
Vehicle Trips	862,970	1,128,234	1,128,234
VMT	6,062,534	8,309,470	8,311,618
VHT	141,072	201,210	199,803

Table I-2
Trip Length Frequency Distribution
Average Trip Length in Minutes

Purpose	1998	2025 B	2025 A
HBW	17.34	17.81	17.76
HBNW	17.05	17.42	17.38
NHB	14.95	15.64	15.60

Deficient links or "sections of roadways" are determined by the comparison of volume/capacity (v/c) ratios. These ratios are initially identified by comparing base year volumes to the existing network capacities (V_{1998}/C_{1998}). This is an indication of where current network problems exist. To evaluate the ability of the existing system to handle future traffic, the V_{2025}/C_{2004} ratios are reviewed. These two deficiency indicators provide the initial basis for selection of projects where capacity improvements may be merited.

A third and final step in the comparison of 2025 traffic volumes to the capacity of an improved network with proposed projects included (V_{2025}/C_{2025}). This third step may be cyclical and redone several times to arrive at the optimum improvement proposals. Once projects are selected, it is this data set that is also used for Air Quality Conformity analysis, when required. An air quality analysis was not required for this Plan.

The following tables present both an overview of current deficiencies and the impacts of future travel demand and systems improvement.

- Vehicle Miles of Travel
- Miles of Network by Level of Service (LOS)
- Vehicle Miles of Travel by Level of Service
- Number of Deficient Links
- Deficient Network Miles
- Vehicle Miles of Travel on Deficient Links

A second deficiency analysis process used in the identification of projects is the Pavement Management System. In contrast to the measurement of inadequate capacity to serve existing and future travel demand (modeling), PMS measures the condition of the existing system. This is a direct measurement of the existing systems relative ability to serve the motoring public in a safe, comfortable, and efficient manner. Three key indexes are determined through field measurement:

- Riding Comfort Index (RDI);
- Structural Adequacy Index (SAI); and
- Surface Distress Index (SDI).

These indices are recorded for the entire federal aid system and are "weighted" to provide a composite index (Pavement Quality Index or PQI).[2] The PMS model uses these data, combined with traffic volume data, unit construction pricing, comparative remedial action selection, and life cycle cost determination to establish a preliminary set of priorities for improvement actions. System output is then evaluated considering available revenues and projects system continuity for final projects selection.

This over-simplification of a relatively complex and extensive process provides a summary review of the deficiency determination and selection process for preserve projects for both the agencies Capital Improvement Programs and this 2025 Transportation Plan.

Other deficiencies are identified using data from the Safety Management System, traffic volume counting programs, operational studies, and several other methods.

These basic data and operations evaluations promote more detailed analysis and studies. Only through this range of system evaluation processes can a full system review be achieved and a reasonable Plan be developed.

Figure I-1
National Functional Classification (NFC) System

Rural

1	Interstate
2	Other Principal Arterial, including Non-Interstate Freeway
5	Principle Other Freeway
6	Minor Arterial
7	Major Collector
8	Minor Collector
9	Local Street or Road

Urban

11	Interstate
12	Other Principal Arterial, including Non-Interstate Freeway
14	Other Principal Arterial (Non-Freeway)
16	Minor Arterial
17	Urban Collector
19	Local Street or Road

[2] As previously mentioned, over 95% of the system has been evaluated through field measurement.

Table I-3
Network Summaries
Vehicles Miles of Travel

NFC	1998	2025B	2505A
1	489,319	682,503	683,019
2	114,187	147,777	148,817
5	304,412	414,747	414,145
6	457,227	612,739	616,149
7	540,078	819,159	801,739
8	156,826	243,704	237,367
9	58,352	107,706	105,478
11	835,330	1,105,438	1,114,487
12	641,698	843,600	825,999
14	1,193,767	1,500,223	1,519,356
16	936,300	1,328,130	1,349,299
17	305,221	460,807	454,460
19	29,817	42,937	41,303
Total	6,062,534	8,309,470	8,311,618

Table I-4
Level of Service Comparisons (LOS C - LOS F)
Miles of Network

	1998	2025 B	2025 A
LOS F	1.09	1.24	.85
LOS E	1.02	11.02	10.49
LOS D	5.57	41.57	41.08
LOS C	28.77	64.69	54.25
Total	36.45	118.52	106.67

Table I-5
Level of Service Comparisons (LOS C - LOS F)
Vehicle Miles of Travel

	1998	2025 B	2025A
LOS F	51,421	50,203	36,523
LOS E	36,560	296,787	299,165
LOS D	149,753	1,172,093	1,218,094
LOS C	585,739	1,547,794	1,343,487
Total	823,473	3,066,877	2,897,269

Table I-6
Network Deficiency Comparisons
Number of Deficient Links (VOL/CAP 1.21 or more)

Functional Classification	1998	2025 B	2025 A
1			
2		1	1
5			
6		5	6
7			
8			
9			
11		1	1
12			
14		38	38
16	16	7	3
17	1	1	
19			
Total	17	53	49

Table I-7
Network Deficiency Comparisons
Deficient Network Miles (VOL/CAP 1.21 or more)
(LOS E & LOS F)

Functional Classification	1998	2025 B	2025 A
1			
2		.25	.25
5			
6		3.15	3.22
7			
8			
9			
11		.42	.42
12			
14	2.00	6.03	6.60
16	.11	2.16	.85
17		.25	
19			
Total	2.11	12.26	11.34

Table I-8
Network Deficiency Comparisons
Vehicle Miles of Travel on Deficient Links
(VOL/CAP 1.21 or more)
(LOS E & LOS F)

Functional Classification	1998	2025 B	2025 A
1			
2		8,708	8,754
5			
6		61,989	62,654
7			
8			
9			
11		8,514	8,619
12			
14	86,590	216,009	239,635
16	1,391	48,600	16,026
17		3,170	
19			
Total	87,981	346,990	335,688