Michigan Department of TRANSPORTATION

PROJECT JUSTIFICATION
REPORT

I-94BL/M-43 Grade Separation

City of Kalamazoo
Kalamazoo County

BUREAU OF TRANSPORTATION PLANNING
Multi-Regional Planning Division

MICHIGAN DEPARTMENT
OF
TRANSPORTATION

PROJECT JUSTIFICATION REPORT

I-94BL/M-43 Grade Separation

City of Kalamazoo
Kalamazoo County

This report represents the findings and/or professional opinions of the Michigan Department of Transportation and not an official opinion of the State Transportation Commission.

OFFICE MEMORANDUM

DATE: March 10, 1980

TO: Sam F. Cryderman, Deputy Director
Bureau of Transportation Planning

FROM: R.J. Lilly, Administrator
Multi-Regional Planning Division

SUBJECT: I-94BL/M-43 Grade Separation, Project Justification Report

The South Section of the Multi-Regional Planning Division prepared this report to examine the justification for the expenditure of funds for construction of a railroad grade separation in the City of Kalamazoo near the Central Business District on I-94BL/M-43 (Michigan and Kalamazoo Avenues).

The data base used in this report was a delay survey conducted from November 5 through November 9, 1979 by the Transportation Surveys Section of the Planning Services Division. Information was also obtained from DeLeuw Cather, the consulting firm working for the City of Kalamazoo on the Railroad Consolidation Plan.

The information collected in the delay survey was expanded so that energy cost, delay time cost, and accident cost could be calculated for a 50 year time period, the approximate life expectancy of the grade separation. These costs were reduced by 60 percent to take into account the savings that would occur from the railroad consolidation plan itself, without the grade separation.

However, the Comprehensive Plan for the City of Kalamazoo recommends returning Michigan Avenue (I-94BL/M-43) to two-way traffic. This would have an adverse effect on the designated trunkline system. It would not be desirable for the Department to spend its Federal-aid Primary funds to construct a grade separation on a route which the City's Comprehensive Plan recommends changing the trunkline designation and traffic flow pattern. The Department should, therefore, request a resolution from the City Commission rescinding their support for the portion of the Comprehensive Plan that would effect the designation and configuration of the trunkline system on Michigan Avenue in the City of Kalamazoo before approving the construction of a grade separation on Michigan Avenue.

The report conlcudes that with a total value of benefits of $16.8 million over fifty years, and a cost-benefit ratio of 1.6 for an overpass and .86 for an underpass grade separation, the Department should pursue development of plans for the construction of a railroad grade separation.

This report was prepared by Rod Haan, Regional Coordinator under the supervision of William C. Hartwig, South Section Manager.

B. J. Lilly

Administrator

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INTRODUCTION

The City of Kalamazoo has undertaken a railroad consolidation program to effect a more compatible rail/community interface. The City has retained DeLeuw Cather, a Consulting Engineering and Planning Firm, to develop and implement the plan. On May 8, 1979 the voters approved a bond issue which could raise as much as $7 million for the City's share of the consolidation plan. The plan is expected to eliminate 19 surface level rail/street crossings in the City's downtown area. In addition, the plan recommends that a grade separation be constructed at Michigan and Kalamazoo Avenues (I-94BL/M-43) under the proposed railroad relocation near where they merge, east of the downtown area.

It is the objective of this report to evaluate the justification for the proposed grade separation project by evaluating the benefits to the public if the Michigan Department of Transportation (MDOT) would expend the funds necessary for construction of this project.

BACKGROUND

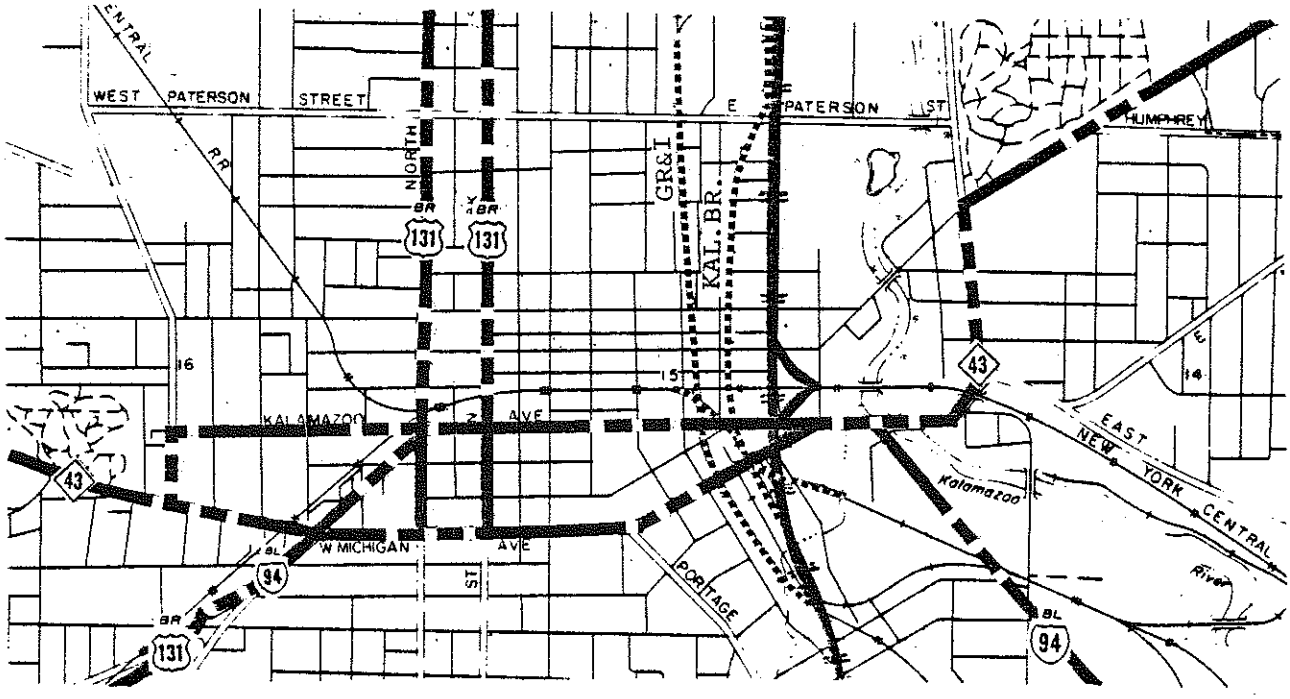
The Railroad Consolidation Program developed by DeLeuw Cather and adopted by the City of Kalamazoo would remove the GR&I and Kal. Br., two Conrail lines, which now cross Michigan and Kalamazoo Avenues approximately 1000 feet west of where these two streets join together. The Consolidation Program recommends construction of a new railroad 500 feet east of the existing Kal. Br. line. The existing and proposed lines are shown in Exhibit 1.

Michigan Avenue and Kalamazoo Avenue are part of the state trunkline system and operate as a one-way pair. The trunkline system in the Kalamazoo area is shown in Exhibit 2.

Michigan Avenue is classified as a major arterial and operates one-way eastbound. There are three traffic lanes with parking on both sides west of the Conrail crossings and three traffic lanes east of the Conrail crossings with no parking on either side. The 1978 Average Daily Traffic (ADT) on this route was 18,300 and the traffic forecast for 2005 is 27,450 ADT. The 1978 Sufficiency Rating, the method used by MDOT to evaluate highway deficiencies using the categories of capacity, surface, base and safety, rates Michigan Avenue critical in safety and capacity.

Kalamazoo Avenue is also classified as a major arterial and operates one-way westbound. There are four traffic lanes with no parking west of the Conrail crossings and four traffic lanes east of the Conrail crossings to Walbridge with no parking on either side. From Walbridge east there are two traffic lanes with no parking on either side. The 1978 ADT on this route was 18,300 and the traffic forecast for 2005 is 27,450 ADT. The 1978 Sufficiency Rating for Kalamazoo Avenue is critical only in its safety rating.

RAILROAD CONSOLIDATION



N

Existing Track

Removed Track

Consolidated

State Trunkline

EXHIBIT 1

TRUNKLINE SYSTEM

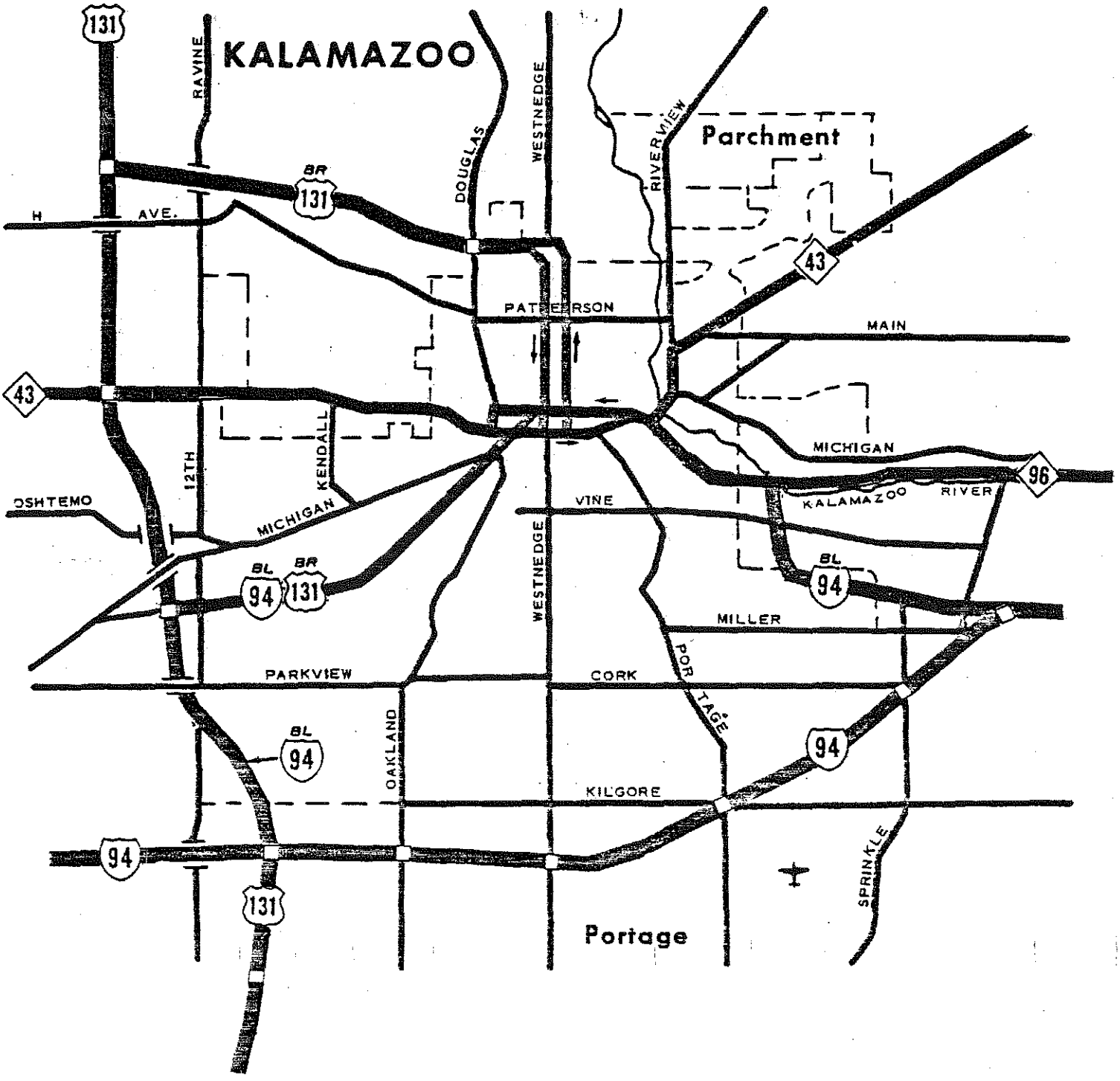


EXHIBIT 2

The Comprehensive Plan for the City of Kalamazoo was adopted by the City Commission on October 11, 1977 and recommends returning Michigan Avenue to two-way traffic from the intersection of Kalamazoo and East Michigan Avenues to West Main Street at Douglas Avenue. In conjunction with this, it also recommended that the direction of traffic on Kalamazoo Avenue from Michigan to Riverview Drive be reversed.

MDOT has not endorsed this plan nor does the Department support recommendations effecting Michigan and Kalamazoo Avenues. Before the Department constructs a grade separation, a resolution should be transmitted from the Kalamazoo City Commission rescinding their support for the recommendations in the Comprehensive Plan which would impact future operation of the state trunkline system.

The existing traffic flow pattern in the downtown area is consistent with the long range transportation plan adopted by the Kalamazoo Area Transportation on June 20, 1979. The grade separation was included as part of this plan.

The principle reason for constructing a grade separation at the proposed location would be to eliminate delays which occur when Michigan and Kalamazoo Avenues are blocked by trains on the Conrail crossings. To help evaluate the need for this proposal, MDOT conducted a railroad delay study in Kalamazoo at the proposed location of the grade separation. The purpose of this survey was to collect data which could be used to measure the amount of delay caused by trains. This report deals primarily with the expansion and analysis of the information in determining the justification for construction of the grade separation.

The major assumptions of this report are:

1. The delay information collected in the November survey is representative of the delay caused by trains during the entire year and can be expanded to represent the total delay that occurs in a year.
2. The delay that resulted because of train failure was excluded from survey data because this is not a normal occurrence.
3. That the vehicles delayed arrive in a uniform progression.
4. There will be a 50 percent increase in ADT on Kalamazoo and Michigan Avenues and no increase in the number or length of trains by 2005.
5. The total amount of time that trains occupy the crossings will not change in the future with the exception of the reduction that occurs because of the railroad consolidation program.
6. The delay of vehicles on side streets was not included in the delay time totals.
7. All values are in late 1979 dollars.
8. Drivers leave their vehicle running and in neutral while waiting for a train.
9. An average auto-occupancy rate of 1.5.
10. The average hourly pay rate of $6.69 in Kalamazoo can be halved to represent the value of travel time.
11. There will be a 61 percent reduction in accidents on Kalamazoo and Michigan Avenues after construction of a grade separation and this will result in an equivalent reduction in the accident costs.

12. The cost of replacing the bridge over the Kalamazoo River was excluded from the cost of the project because it needs to be replaced because of its condition.

13. The maintenance cost for the railroad crossings and grade separation were not included.

14. The railroad consolidation program will result in a 60 percent reduction in highway user costs without including a grade separation at Kalamazoo and Michigan Avenues.

RAILROAD DELAY STUDY

A railroad delay survey was conducted by MDOT during the week of November 5, 1979 for the purpose of collecting data relating to the amount of vehicle delay caused by trains blocking Michigan and Kalamazoo Avenues. This type of survey would provide direct information relative to the amount of delay resulting from the lack of a particular facility such as a grade separation. The location of the survey is shown in Exhibit 3.

Listed below are the locations, dates, and times for when the survey was conducted.

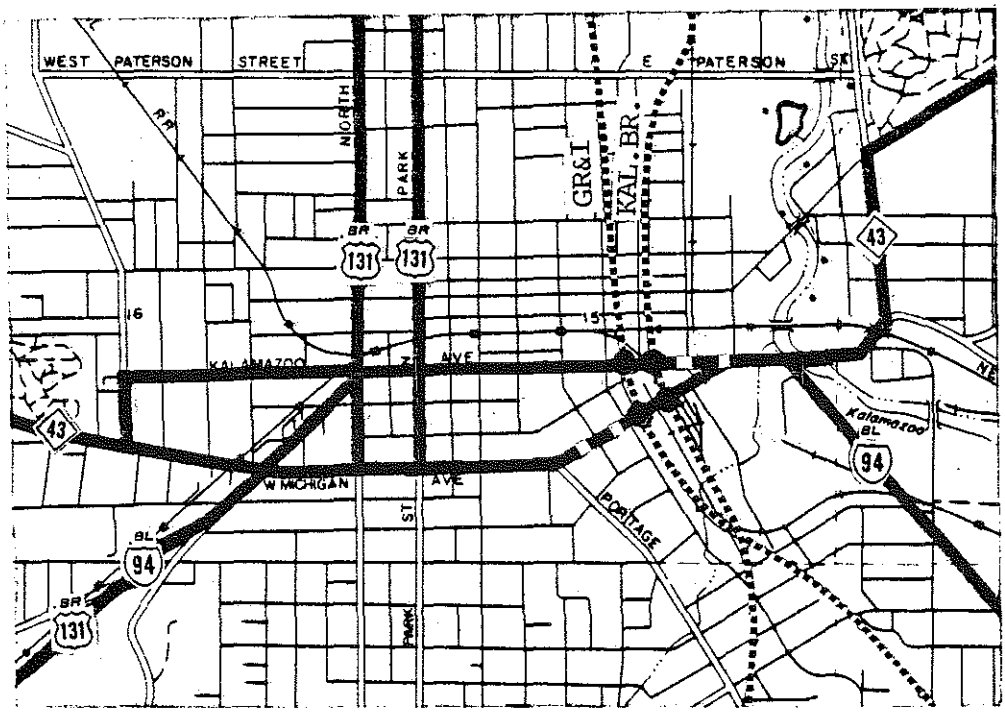
LOCATION	DATE	TIME
Michigan Avenue	11-5-79 (M)	1P-9P
Michigan Avenue	11-6-79 (T)	7A-6P
Michigan Avenue	11-7-79 (W)	7A-1P
Kalamazoo Avenue	11-7-79 (W)	2P-9P
Kalamazoo Avenue	11-8-79 (T)	7A-6P
Kalamazoo Avenue	11-9-79 (F)	7A-1P

The information collected is shown in Appendix A and includes the following:

1. Track Number
2. Time Flashers Came On
3. Time Train Enters Crossing
4. Time Train Cleared Crossing
5. Time Flashers Went Off
6. Number of Cars in Train
7. Number of Vehicles Delayed
8. Length of Delay
9. Vehicles Backed Up on Side Streets

The survey was conducted for 25 hours out of a possible 48 hours on Michigan Avenue and 24 hours out of a possible 48 hours on Kalamazoo Avenue. Information was collected for 42 trains crossing Michigan Avenue and 49 trains crossing Kalamazoo Avenue for a total of 91 trains.

DELAY SURVEY



N

● Conrail Crossing

▬ ▬ Direction of Backup

▬▬ State Trunkline

EXHIBIT 3

VEHICLE DELAY FROM SURVEY

The vehicle hours of delay which occurred during each train was calculated by taking the length of delay, which included the time the crossing was occupied plus the time required for the last vehicle stopped for the train to clear the crossing, and multiplying it by the total number of vehicles delayed. Assuming that the vehicles arrived in a uniform progression, the total was divided by two in order to obtain the total delay time for each train.

CALCULATION:

$$\text{Total Delay Time Per Train} = \frac{\text{Length of Delay X Number of Vehicles Delayed}}{2}$$

The total delay during the time of the survey calculated for Michigan Avenue for 42 trains was 143 hours and 30 minutes with 2,537 vehicles being delayed for an average delay per vehicle of 3 minutes and 23 seconds. The total delay during the time of the survey calculated for Kalamazoo Avenue for 49 trains was 226 hours and 34 minutes with 3,062 vehicles being delayed for an average delay per vehicle of 4 minutes and 26 seconds.

The number of vehicles delayed and backed-up on side streets because of trains was recorded. In most cases the number of vehicles backed up on side streets was not significant and therefore their delay time was not included in the totals. This information is shown in Appendix A.

EXPANSION OF SURVEY DATA

The total number of vehicles that passed over the Conrail crossings on Michigan Avenue during the 48-hour period of the survey from 1:00 p.m. on November 5, 1979 to 1:00 p.m. on November 7, 1979 was 41,121. Of this total, 32,217 (78%) passed over the crossing during the survey and 8,904 (22%) passed over the crossing when the survey was not in operation.

The total number of vehicles that passed over the Conrail crossings on Kalamazoo Avenue during the 48-hour period of the survey from 12:00 noon on November 7, 1979 to 12:00 noon on November 9, 1979 was 35,619. Of this total, 26,752 (75%) passed over the crossing during the survey and 8,867 (25%) passed over the crossing when the survey was not in operation.

Information provided to MDOT by DeLeuw Cather indicates that there is on an average, 33 trains per day that pass over the GR&I and Kalamazoo Branch crossings on Michigan and Kalamazoo Avenues.

In order to calculate the delay for a 24-hour period, the delay had to be calculated for the period when no survey data was collected. In order to do this a factor was developed based on the total delay divided by the number of vehicles multiplied by the number of trains.

CALCULATION:

$$\text{Delay per Auto-Train} = \frac{\text{Total Delay (HRS)}}{(\text{Traffic})\quad(\text{Number of Trains})}$$

Michigan Avenue:

$$\text{Delay per Auto-Train} = \frac{143.50}{(32{,}217)\quad(42)} = .000106$$

Kalamazoo Avenue:

$$\text{Delay per Auto-Train} = \frac{226.57}{(26{,}752)\quad(49)} = .000173$$

The delay was then calculated for the part of the 48-hour time period when the survey was not in operation by multiplying the traffic and trains that passed over the crossing during the time when the survey was not being conducted by the Delay per Auto-Train factor.

Calculation for delay during non-survey time:

Delay Time = (Traffic) (Trains) (Delay per Auto-Train Factor)

Michigan Avenue

Delay Time = (8904) (24) (.000106) = 22.65 HRS.

Kalamazoo Avenue

Delay Time = (8867) (17) (.000173) = 26.08 HRS.

The average daily delay was then calculated by adding the delay time during the survey to the delay time when the survey was not in operation. The 24-hour total was obtained by dividing by 2.

Michigan Avenue	HRS
Delay Time During Survey	143.50
Delay Time Non-Survey Time	22.65
48 Hour Total	166.15
24 Hour Total	83.08

Kalamazoo Avenue	
Delay Time During Survey	226.57
Delay Time Non-Survey Time	26.08
48 Hour Total	252.65
24 Hour Total	126.33

TOTAL 24 HOUR DELAY = 209.41 HOURS

The number of vehicles delayed was also calculated for 24 hours. The number of vehicles delayed was increased by the percent of vehicles that passed over the crossing when the survey was not in operation to determine the total number of vehicles stopped in a 48 hour period. This figure was then divided by two to obtain a 24 hour total.

Michigan Avenue

Vehicles Delayed During Survey	2,537
22% Increase for Non-Survey Time	558
48 Hour Total	3,095
24 Hour Total	1,548

Kalamazoo Avenue

Vehicles Delayed During Survey	2,062
25% Increase for Non-Survey Time	766
48 Hour Total	3,828
24 Hour Total	1,914

TOTAL NUMBER OF VEHICLES DELAYED IN 24 HOURS	3,462

Considering the relatively stable characteristics of traffic volumes in urban areas during the year, the daily totals were expanded to annual totals by multiplying by 260, the approximate number of working days in a year.

Hours of Delay (Annual-Weekday)	54,446.6
Number of Vehicles Stopped (Annual-Weekday)	900,120

Traffic forecasts for the section of Michigan Avenue and Kalamazoo Avenue where the GR&I and Kalamazoo Branch tracks cross Michigan Avenue and Kalamazoo Avenue in the MDOT TAR #391, December 1979 show that the average daily traffic is expected to increase from 18,300 to 27,450 on

Michigan Avenue and 18,300 to 27,450 on Kalamazoo Avenue by the year 2005. This is a 50 percent increase in 25 years. Assuming no change in train traffic, the total vehicle delay and number of vehicles being delayed would increase by 50 percent by the year 2005.

Hours of Delay (25 Years - Weekdays Only)	1,701,456
Number of Vehicles Stopped (25 Years - Weekdays Only)	28,128,750

The hours of delay and number of vehicles stopped during the weekdays were expanded to include weekend traffic by using traffic count information recorded at the Permanent Traffic Recorder (PTR) #917, located on M-43 (W. Main) near Douglas Avenue. Data from this PTR for November shows that weekday traffic is 105.7 percent of Average Daily Traffic (ADT), Saturday traffic is 100.0 percent of ADT, and Sunday traffic is 71.9 percent of ADT. Based on these percentages and an ADT of 18,300 on Kalamazoo and Michigan Avenues, the November weekday traffic would be 19,343, Saturday traffic 18,300, and Sunday traffic 13,158. Weekly traffic totals for November would be 128,174 and November weekend traffic 31,458 or 24.5 percent of the weekly traffic.

The number of trains on the weekend does not vary significantly from weekday traffic according to information provided by DeLeuw Cather. Therefore, the hours of delay and number of vehicles stopped on weekdays over the 25 year time period was expanded by 24.5 percent to include weekend figures.

Hours of Delay (25 Year Total)	2,118,313
Number of Vehicles Stopped (25 Year Total)	35,020,294

ENERGY COST

The cost of the energy that is consumed because of delays caused by trains was calculated. The excess fuel consumed for stopping and starting because the road was blocked by a train and the amount of fuel consumed while waiting for a train was calculated. The extra fuel consumed by vehicles slowing down because of the existence of the crossings and the extra fuel required for ascending and descending the grade for the grade separation were found to be off-setting and insignificant.

The fuel rates used, unless otherwise noted, were taken from "Energy and Transportation Systems," Final Report, December 1978, prepared for the Transportation Research Board, National Research Council by J.A. Apostolos, W.R. Shoemaker, and E.C. Shirley, California Department of Transportation. The rates are adjusted to account for the change in fuel economy expected from 1974 to 2000.

The excess fuel consumed for stopping and starting is 7.95 gallons per thousand stops, according to the report "Economic Analysis for Highways," Winfrey, Robley, International Textbook Company, 1969. The excess fuel consumed for stopping and starting was calculated by multiplying the number of stops over 25 years by 7.95 gallons, by .769, the fuel adjustment factor and dividing by 1000.

Excess fuel consumed for stopping and starting =

(No. of Stops) (7.95 Gallons) (.769 Fuel Adj.) $\div$ 1000

Calculation: (35,020,294) (7.95) (.769) $\div$ 1000 = 214,098 Gallons

Fuel consumed while idling when the transmission is in neutral is .58 gallons/hour. The fuel consumed while idling was calculated by multiplying the hours of delay over 25 years by .58 gallons by the .769 fuel adjustment factor.

Fuel consumed while idling = (Hours of Delay) (.58 Gallons)
(.769 Fuel Adjustment)

Calculations: (2,118,313) (.58) (.769) = 944,810 Gallons

In calculating energy costs, the price of fuel in late 1979 was used because this is the base on which the cost of the grade separation was calculated. The average price of gasoline in Kalamazoo in November 1979 was $1.05 per gallon. The energy cost that could be saved by constructing a grade separation over 25 years was calculated by adding the excess fuel consumed for stopping and starting to the amount consumed while idling and multiplying this sum by $1.05.

Energy Cost = Excess Fuel Consumed for Stopping and Starting
+ Fuel Consumed While Idling X Price of Fuel

Calculations: 214,098 + 944,810 X $1.05 = $1,216,853

DELAY TIME COST

A value needs to be placed on the time spent by the public while waiting for a train and included in determining the costs to the public for delays caused by trains. It is realized that this is not necessarily an out-of-the-pocket cost but yet it is a cost to the motorist.

The average hourly pay for employees in Kalamazoo County for the third quarter of 1979 was $6.69. This figure was obtained from the Michigan Employment Security Commission 202 Report. This average hourly rate includes all employees who are covered by unemployment insurance. The amount of $6.69 was halved to $3.35 for use in calculating the cost to the public for the time they were delayed. This is the traditional method used to calculate the value of travel time.

The hours of delay has to be expanded because it did not account for a vehicle occupancy of greater than one. An Origin-Destination Survey conducted in Battle Creek in 1976 found that the average occupancy for all types of trips was 1.5. The National Cooperative Highway Research Program Report 187 of the Transportation Research Board, dated 1978, supports the Battle Creek occupancy rate. The information in this report also shows the average daily auto-occupancy rate in 1976 for an area with an urbanized area population of 100,000 to 250,000 would be 1.5 for trips of all purposes.

Delay Cost = (Hours of Delay) (1.5 Auto Occupancy Rate)
($3.35 Hourly Rate)

Calculations: (2,118,313) (1.5) (3.35) = $10,644,523

ACCIDENT COST

Accident information for 1974-1979 was compiled by the MDOT Accident Analysis Section and is listed below for the section of Michigan Avenue from the Penn Central Railroad Crossing west 768 feet and for the section of Kalamazoo Avenue east 1024 feet from the rail crossing. Severity cost factors developed by the National Safety Council (NSC) in NSC Report #113 are also listed.

ACCIDENT DATA

Kalamazoo Avenue (Conrail Crossing - 1024 feet east)

Michigan Avenue (Conrail Crossing - 768 feet west)

	1974	1975	1976	1977	1978
Ped. Acc.	56	65	96	66	66
Inj. Acc.	8	10	11	15	18
Injured	8	22	12	27	26
Fatal Acc.	0	0	0	0	0
Killed	0	0	0	0	0
Total	64	75	107	81	84
Rear-end	21	19	46	25	27
% Rear-end	33	25	43	31	32

National Safety Council Cost Estimates

YEAR	PROPERTY DAMAGE ACCIDENT	INJURY ACCIDENT
1974	$530	$4000
1975	570	4200
1976	670	4700
1977	800	5500
1978	850	5800

The NSC recommends that injury figures be used per person injury but it has been MDOT practice to use these figures per injury accident.

The following accident costs on Kalamazoo and Michigan Avenues were calculated using cost per injury accident. The 1979 costs were estimated based on the rate of increase from 1977 to 1978.

ACCIDENT COSTS

YEAR	$
1974	71,680
1975	79,050
1976	116,020
1977	135,300
1978	160,500
1979	190,995 (est.)

It is not possible to determine how many of these accidents were a direct result of the railroad crossing. However, an average of 34 percent of the accidents from 1974 to 1978 were rear-end type accidents. These are probably caused by back-ups resulting from trains blocking the roads.

A comparison was also made of the accident rate on Kalamazoo and Michigan Avenues with the accident rate on a section of state trunk-line with similar characteristics and traffic and an existing grade separation. This comparison revealed that the accident rate was 61 percent lower where there was a grade separation. It was therefore assumed that 61 percent of the accident costs on Kalamazoo and Michigan Avenues would be saved by construction of a grade separation. It was also assumed that with a 50 percent increase in traffic over the next 25 years, the accident costs would also go up 50 percent in 25 years.

If the severity cost factors remained the same, the accident cost that could be saved with the construction of a grade separation were calculated by averaging the 2005 and 1979 accident cost, multiplying by 61 percent savings and multiplying by 25 years.

$$\text{Accident Cost for 25 Years} = \frac{\frac{\text{2005 Acc. Cost} + \text{1979 Acc. Cost}}{2}}{(.61 \text{ savings})} \quad (25 \text{ years})$$

Calculations: $\frac{286{,}493 + 190{,}995}{2}$ (.61) (25) = $3,640,846

OTHER BENEFITS

There are other benefits that the public would realize from elimination of the railroad crossings on Michigan and Kalamazoo Avenues. The crossings, which are difficult to maintain, would be removed, thereby eliminating the potential of damage to vehicles passing over the crossings. Drivers would not have to worry about the possibility of being delayed because of being stopped by a train. A grade separation would provide a delay-free route for dispatching emergency vehicles (fire, police, and ambulance) between various portions of the City.

Another effect of the grade separation would be the elimination of three intersections on Kalamazoo and Michigan Avenues. If a grade separation is constructed over the railroad, Harrison Street, Porter Street, and Walbridge Street would go underneath the structure. This would eliminate these intersections and reduce the traffic interference from these streets and also reduce the accident potential. This could, however, cause the motorist some inconvenience because they would not have access to Kalamazoo or Michigan Avenues.

There would be a reduction in the amount of air pollution that results when vehicles stop and wait for trains. The operators of the railroad would also benefit by the elimination of the crossings because their operations would not have to take into account the time they have the crossing blocked. Neither maintenance of the crossing nor maintenance of the grade separation was considered as far as how their relative costs would effect the total costs of the project.

SUMMARY OF COSTS

The total costs to the public resulting from the crossings of the Conrail lines on Kalamazoo and Michigan Avenues which have been calculated are summarized on the following page.

Implementation of the railroad consolidation program will decrease total highway user costs by 60 percent for Kalamazoo and Michigan Avenues traffic according to the DeLeuw Cather report. This results from train speed being increased from 5-10 m.p.h. before consolidation to 15-25 m.p.h. after consolidation, the elimination of ten switching movements and shorter movements. Therefore, the total highway user costs were reduced by 60 percent to discount the benefits that would be realized from consolidation without a grade separation at Kalamazoo and Michigan Avenues.

The savings that would result from fewer accidents was included after the reduction for the consolidation plan had been taken into account because the consolidation plan itself would not have a significant influence in reducing accidents. The construction of the grade separation would eliminate the back-ups caused by trains blocking the roads and also the interference from side streets. This is where the savings will occur by a reduction of accidents.

These costs, which were calculated for 25 years, were doubled to reflect the 50 year life expectancy of the grade separation.

COST SUMMARY

Energy Cost	$ 1,216,853
Delay Time Cost	10,644,523
TOTAL	$11,861,376
Savings Resulting from Railroad Consolidation (60%)	7,116,826
Savings Resulting from Grade Separation	4,744,550
Accident Cost	3,640,550
25 Year Total	$ 8,385,396
50 Year Total	$16,790,792

ESTIMATED PROJECT COST

Engineering Report 1908, prepared by the Michigan Department of Transportation, Bureau of Highways, developed estimated costs for the various alternatives, which included an underpass grade separation and an overpass grade separation. The cost estimates for both of these concepts, included the cost for replacing the bridge that carries M-43, Michigan Avenue, over the Kalamazoo River just east of King Highway.

This structure was built in 1927 and the annual bridge inspection report of October 1978 describes the bridge as being in fair condition. The Inspection Report recommended that the bridge be considered for eventual replacement, probably within ten years. The estimated cost for replacing the bridge ranges from $2,857,000 to $2,864,000, depending upon the alternative. This cost was therefore subtracted from the project cost so that a comparison could be made between the costs caused by the at-grade crossings to the cost to provide a grade separation.

The total project estimated cost combining the construction of right-of-way cost minus the Kalamazoo River bridge are shown on the following page for the four alternatives. Alternatives B-1 and B-2 include an underpass grade separation and Alternatives C-1 and C-2 include an overpass grade separation. Maintenance costs for this improvement and existing maintenance costs are not included.

PROJECT ESTIMATE COST
(In Thousands)

	ALTERNATIVES			
	B-1	B-2	C-1	C-2
Total Cost	22,263	21,552	13,378	13,192
Kalamazoo River Bridge	2,857	2,864	2,857	2,864
Grade Separation Cost	19,406	18,688	10,521	10,328

CONCLUSION

There are many factors that could be considered in evaluating the proposed railroad grade separation. Some are quantifiable and a value placed on them. Others are more difficult to define and evaluate. The factors considered in this report were those on which it was felt that a realistic value could be determined. However, even in this process the values placed on time and energy are somewhat subjective.

The calculations in this report indicate that approximately one million gallons of fuel and 1.6 million person hours of delay could be saved over 50 years if the delay caused by trains were eliminated. The total hours of delay that could be saved is a substantial amount of time and when a value is placed on this time, it is the most significant factor in this evaluation. The total that was calculated for savings from accidents of over $3.5 million was also significant. In addition, the construction of a grade separation would eliminate the potential of a fatal accident occurring involving a vehicle and a train.

The total dollar value of the benefits calculated was $16,790,792. It should be noted that this is the savings after the railroad consolidation plan is completed. The railroad consolidation plan itself, without the grade separation, will decrease the total highway user costs by about 60 percent. Without the railroad consolidation plan, the benefits from a grade separation would be significantly greater.

The total project estimated cost for an overpass grade separation is $10,600,000 and the estimated cost for an underpass grade separation is $19,500,000. This results in a cost-benefit ratio of 1.6 for an overpass grade separation and .86 for an underpass grade separation.

Some of the alternatives are justified based on a cost-benefit ratio of greater than 1.0 over a 50 year time period. It is therefore appropriate for MDOT to pursue development of plans for the railroad grade separation.

RAILROAD DELAY STUDY

I-94BL, M-43(Michigan) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-5-79 Monday 1P - 9P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 1	1:18P	1' 0"	4'10"	5'10"	* 20	50	3'33"
# 1	2:12P	1' 0"	2" 0"	3' 0"	14	51	1'30"
# 2	3:25P	1'45"	2'10"	2'18"	26	47	2'51"
# 1	4:15P	1'22"	2'52	3' 3"	12	53	3'21"
# 1	4:23P	1'23"	4' 7"	4'16"	27	116	6'49"
# 1	4:49P	0'58"	1'23"	1'45"	2	41	1'10"
# 1	5:07P	0'42"	1'38"	1'43"	14	84	2'48"
# 1	5:22P	0'54"	1'43"	1'50"	9	46	2' 8"
# 1	5:26P	1'53"	3'50"	3'58"	26	49	3'45"
# 1	6:21P	1'57"	4'26"	4'30"	12	41	3'17"
# 2	7:03P	2' 4"	9'20"	9'27"	45	86	9'30"
# 1	7:20P	1' 2"	5'12"	5'19"	41	--	- - -
# 2	7:25P	0'24"	8'51"	8'59"	151	192	16'42"

Note: Tracks #1 and #2 delays are combined. (7:20P - 7:25P)

* Train pulled into intersection, then backed up.

Track #1 - East Track.

Track #2 - West Track

RAILROAD DELAY STUDY

I-94BL, M-43(Michigan) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-6-79 Tuesday 7A - 6P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO. OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 1	8:46A	1' 7"	4' 8"	- - -	* 13	32	3'47"
# 1	- - -	6' 6"	7'10"	7'20"	12	26	0'37"
# 1	9:05A	1'11"	3'51"	3'55"	27	41	3'35"
# 2	9:16A	2' 6"	5'34"	5'37"	26	46	3'34"
# 1	9:26A	Note: Flasher tripped due to repair of track. Continuous till 10:33 train enters and clears.					
# 2	10:27A	1'34"	2'42"	2'45"	19	21	1'35"
# 1	Continuous	10:33A	0'45"	0'51"	7	11	0'51"
# 1	11:35A	1'18"	8'14"	8'23"	72	108	10'14"
# 1	1:23P	1'27"	1'34"	1'43"	2	17	0'40"
# 1	1:28P	1'12"	2'15"	- - -	* 4	44	2' 5"
		Note: Flasher continued until 1:34P					
# 2	1:32P	1'17"	1'32"	1'38"	2	16	0'38"
# 1	1:51P	0'34"	3'48"	3'58"	25	59	4'45"
# 1	2:05P	1' 6"	2'45"	3'15"	10	--	- - -
# 2	2:04P	2' 0"	2'15"	2'26"	14	44	2' 4"
	Note: Tracks #1 and #2 delays are combined.						
# 1	2:15P	1'12"	3'48"	4' 3"	14	66	3'36"
# 1	2:35P	0'49"	2'55"	3' 5"	17	73	3'39"
# 1	2:52P	1' 0"	2'45"	3'12"	* 8	41	2'49"
# 1	3:49P	1'15"	1'20"	1'29"	2	18	0'28"
# 1	4:25P	0'49"	3' 0"	3'10"	14	57	3'34"
# 1	4:34P	0'50"	2'18"	2'50"	* 7	57	3' 2"
# 2	4:40P	0'31"	1'42"	1'46"	19	56	3'10"
# 1	5:02P	7' 7"	12'33"	12"40"	50	197	8'57"
# 2	5:45P	0'38"	9'48"	9'53"	97	270	12'51"
# 1	5:56P	1'31"	2'17"	2'23"	12	88	2'10"

* Train entered intersection, then backed up.

RAILROAD DELAY STUDY

I-94BL, M-43(Michigan) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-7-79 Wednesday 7A - 1P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO. OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 1	8:15A	Note: Lights flashed only. Off at 3 1/2 minutes. Train did not enter intersection.					
# 1	8:26A	1' 0"	10'35"	10'45"	102	81	11' 3"
# 1	8:53A	1' 8"	1'34"	1'40"	6	11	0'49"
# 1	9:16A	1'22"	5'53"	5'57"	43	55	5'32"
# 1	9:25A	Note: Flashers on. Triggered by repairman. Off at 10:38A.					
# 2	9:30A	1'32"	9'24"	9"29"	44	116	10'33"
# 1	Continuous	10:37A	0'54"	0'56"	6	9	0'36"
# 1	10:54A	Note: Flashers on. Triggered by repairman. Off at 11:10A.					
# 2	11:50A	Note: Flashers on. No train. Off at 11:58A					
# 2	Continuous	11:57A	0'26"	0'31"	4	21	0'51"
# 1	12:14P	Note: Flashers on. Repairing track. Off at 12:26P					
# 1	12:52P	Note: Flashers on. Repairing track.					

RAILROAD DELAY STUDY

I-94BL, M-43(Michigan) @ Pitcher St.
City of Kalamazoo, Kalamazoo County

Vehicles Backed up on Pitcher St.

Monday, 11-5-79, 1P-9P

TIME	N. OF MICH.	S. OF MICH.
2:12P	3	1
3:25P	3	0
4:15P	7	2
4:23P	5	3
4:49P	0	0
5:07P	10	2
5:22P	0	0
5:26P	3	2
6:22P	1	0
7:03P	1	1
7:20P	1	2
7:25P	--	--

Wednesday, 11-7-79, 7A-1P

TIME	N. OF MICH.	S. OF MICH.
8:26A	0	0
8:53A	0	0
9:16A	1	1
9:25A	Note: Work on tracks tripped signal	
9:30A	2	0
10:37A	0	0
11:50A	0	0

Tuesday, 11-6-79, 7A-6P

TIME	N. OF MICH.	N. OF MICH.
8:46A	0	0
8:53A	0	0
9:05A	0	0
9:16A	0	0
9:26A	Note: Signal tripped by crew working on tracks next to intersection.	
10:27A	1	1
10:33A	0	0
11:35A	1	4
1:23P	0	0
1:28P	0	0
1:51P	0	0
2:04P	1	0
2:15P	2	1
2:35P	1	1
2:52P	3	0
3:49P	0	0
4:25P	0	5
4:34P	1	2
4:40P	0	0
5:02P	19	15
5:45P	2	2
5:56P	2	0

RAILROAD DELAY STUDY

I-94BL, M-43(Kalamazoo) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-7-79 Wednesday 2P - 9P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO. OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 2	3:00P	27"	3'48"	3'56"	40	72	4'29"
# 2	3:39P	1'11"	3'55"	4' 4"	11	43	3' 9"
# 1	4:06P	1'11"	2'28"	2'37"	16	56	2'21"
# 2	4:25P	33"	2' 3"	2' 8"	20	48	2'38"
# 2	4:33P	29"	43"	48"	3	15	38"
# 2	4:52P	52"	3'15"	3'26"	12	70	3'38"
# 1	4:57P	1'27"	8'37"	8'53"	98	130	11'15"
# 2	5:27P	24"	3'23"	3'30"	42	53	3'55"
# 2	6:22P	46"	8'30"	8'40"	47	--	- - -
# 1	6:31P	1'15"	3'38"	3'44"	32	197	12'31"
		Note: 2nd train came as 1st train was ending.					
# 2	6:46P	1'17"	3'56"	4' 5"	25	45	3'12"
# 2	8:08P	44"	2'48"	2'54"	30	23	2'29"
# 2	8:14P	1'41"	4' 1"	4'37"	13	33	3' 8"

Track #1 - West Track

Track #2 - East Track

RAILROAD DELAY STUDY

I-94BL, M-43(Kalamazoo) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-8-79 Thursday 7A - 6P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO. OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 2	8:15A	45"	6'29"	6'33"	95	68	7'15"
# 2	8:32A	38"	3'24"	5' 0"	14	46	3'45"
# 2	9:12A	47"	3'19"	3'29"	25	47	3'43"
# 2	9:16A	48"	1'38"	1'45"	12	22	1'44"
# 1	9:23A	1'45"	4'37"	4'45"	24	53	3'55"
# 1	9:48A	38"	12'48"	12'53"	137	240	14'59"
# 2	10:11A	31"	1'11"	1'19"	9	12	1' 3"
# 1	10:48A	1' 3"	1'35"	1'40"	7	11	46"
# 1	11:42A	1'26"	3'17"	3'32"		36	2'29"
		Note: Work Crew - 6 Vehicles					
# 2	12:30P	7' 6"	8'34"	8'42"		32	2'19"
		Note: Work Crew - 5 Vehicles					
# 1	1:04P	49"	7'35"	7'40"	82	126	2' 8"
# 2	1:05P	1'21"	5' 9"	5'40"	16	--	- - -
		Note: Both trains came through at same time.					
# 2	1:18P	1' 5"	13' 6"	13'14"	74	217	15'20"
# 2	1:33P	55"	10'58"	11' 3"	113	189	13'25"
# 2	1:51P	1'17"	3' 8"	3'15"	8	28	2'14"
# 2	2:01P	45"	4'54"	4'58"	44	83	5'29"
# 2	2:17P	1' 2"	1'59"	2' 7"	12	19	1'33"
# 2	2:25P	30"	43"	49"	2	10	25"
# 1	2:31P	1'20"	1'32"	1'37"	2	5	33"
# 1	3:21P	1'32"	2'26"	2'31"	12	24	1'27"
# 2	3:37P	37"	1'28"	1'31"	12	32	1'43"
# 2	3:41P	1'31"	2'56"	4'35"	8	50	2'21"
# 2	3:57P	24"	32"	37"	2	14	32"
# 2	4:38P	1' 5"	4'21"	4'27"	16	93	5'45"
# 2	4:55P	30"	1 Hr.+ 7' 0"	1 Hr.+ 7' 9"	113	307+	*

*Note: Blew air hose. Brakes locked. Cars in delay are finding alternate routes. Still being timed for delay. Stopped counting vehicles at 307. The time this delay ends will be when traffic is moving freely. Unable to keep up with number of vehicles because so many are turning off. Traffic moving freely at 6:06PM. (1 hour, 10 min., 26 sec.)

RAILROAD DELAY STUDY

I-94BL, M-43(Kalamazoo) @ Conrail Crossing
City of Kalamazoo, Kalamazoo County

11-9-79 Friday 7A - 1P

TRACK NO.	TIME FLASHERS COME ON	TIME TRAIN ENTERS INT.	TIME TRAIN CLEARS INT.	TIME FLASHERS GO OFF	NO. OF CARS IN TRAIN	NO. OF VEHICLES DELAYED	LENGTH OF DELAY
# 1	7:03A	25"	17'50"	17'57"	83	- - -	- - -
# 2	7:06A	1'10"	15' 5"	15'16"	121	176	20'30"
	Note: Both trains came through at same time.						
# 2	7:58A	50"	8'27"	8'36"	115	124	10'33"
# 2	8:17A	37"	2'28"	4'25"	10	44	3'30"
# 2	9:05A	33"	1'30"	1'39"	15	15	1'25"
# 2	9:29A	41"	8'38"	8'42"	100	101	10'16"
# 2	9:48A	44"	2'24"	2'32"	24	29	2'11"
# 1	9:59A	2'24"	4' 7"	4'12"	14	32	2'32"
# 2	10:25A	49"	1'12"	1'21"	4	6	37"
# 2	10:59A	- - -	- - -	3'13"	- -	- - -	- - -
	Note: Train backed up without entering intersection.						
# 1	11:25A	50'	1' 6"	1'12"	5	11	29"
# 1	11:43A	43"	6'38"	6'43"	89	132	9' 8"
# 2	12"16P	- - -	- - -	2'28"	- - -	- - -	- - -
	Note: Train backed up without entering intersection.						

RAILROAD DELAY STUDY

I-94BL, M-43(Kalamazoo) @ Walbridge & Porter
City of Kalamazoo, Kalamazoo County

Vehicles Backed Up on Walbridge St.

DAY DATE	TIME	WALBRIDGE NO. OF KALAMAZOO	WALBRIDGE SO. OF KALAMAZOO
Wed, 11-7-79	2P-9P	No Backups	No Backups
Thu, 11-8-79	4:38P	0	2
	7A-6P	No other backups on Walbridge	
Fri, 11-9-79	9:29A	1	0
	7A-1P	No other backups on Walbridge	

Vehicles Backed Up on Porter

DAY DATE	TIME	PORTER N. OF KALAMAZOO	PORTER S. OF KALAMAZOO
Wed, 11-7-79	4:57P	14	0
	2P-9P	No other backups on Porter	
Thu, 11-8-79	9:23A	1	0
	1:04P	2	0
	7A-6P	No other backups on Porter	
Fri, 11-9-79	7:03A	5	0
	9:59A	1	0
	11:43A	12	0
	7A-1P	No other backups on Porter	