Appendix

11

Greenhouse gas emissions analysis

Inner Loop North
Transformation
Planning Study

Greenhouse Gas Emissions Analysis

Inner Loop North Transformation Planning Study

Prepared for:

City of Rochester

Monroe County, NY

Prepared by:

Lu Engineers
ENVIRONMENTAL • TRANSPORTATION • CIVIL
339 East Avenue, Suite 200
Rochester, New York 14604
Ph 585.385.7417

In cooperation with:
Bergmann Associates

February 2022

Inner Loop North Transformation Planning Study
Greenhouse Gas Emissions Analysis

A. Introduction

The City of Rochester is in the process of evaluating and planning to convert some or all of the Inner Loop North Corridor, from its interchange with I-490 to its terminus at East Main Street and Union Street, to another complete street with significant acreage for redevelopment. The Inner Loop Expressway is a Principal Arterial Expressway on the National Highway System. The facility is owned and maintained by New York State and its frontage roads are primarily owned and maintained by the City of Rochester. The City is conducting a planning study to evaluate concepts and advance recommendations for redesign of the corridor, which may include highway removal, similar to the recently completed Inner Loop East Transformation project.

As part of the Inner Loop North Transformation Planning Study, several alternatives have been developed for the Inner Loop North. In support of this study, Lu Engineers has prepared greenhouse gas emissions estimates for the existing condition, as well as the Preferred Concept in order to compare the potential greenhouse gas emissions. This analysis considers both the potential direct and indirect energy impacts of the proposed project and was completed utilizing guidance and procedures developed by NYSDOT for estimating energy impacts from construction and operation of transportation projects. Vehicular emissions are the result of fuel consumption, which are analyzed here for carbon dioxide (CO2), which is a main greenhouse gas associated with global warming.

B. Methodology

Energy Analysis

This Greenhouse Gas Emissions Analysis is based on NYSDOT's *Draft Energy Analysis Guidelines for Project-Level Analysis*, November 2003. The energy analysis addresses direct and indirect energy consumption. Direct energy refers to the fuel consumed by vehicles using the highway facility, while indirect energy refers to energy associated with construction and long term operation of the facility.

Direct Energy

Direct energy impact is the energy consumed by vehicles using a facility based on vehicular volumes, weight and average travel speeds. The direct energy analysis uses the Urban Fuel Consumption Method (UFCM) for light duty vehicles and medium and heavy trucks described in NYSDOT's energy analysis guidelines. The UFCM was utilized in spreadsheet form to calculate

direct energy. The spreadsheet incorporates assumptions for segment links and produces estimates of energy use. The links used are taken from the Traffic Data Modeler Summary by Bergmann, December 2021.

Average Speed

Obtained from the NYSDOT Traffic Data Viewer for the existing condition, and estimated based on similar off-highway vehicle speeds in the vicinity of the project site, where needed for the alternatives analysis.

Vehicle Miles Traveled

Estimated from traffic volumes provided in the Traffic Data Modeler Summary by Bergmann, December 2021. The 'Vehicles per Day' volumes from each segment were multiplied by the segment length to give Vehicle Miles Traveled per Day, to be used in estimating Annual Fuel Use.

Vehicle Mix

NYSDOT's vehicle mix for Region 4 (Monroe County) was applied to the VMT to determine the appropriate mix of light duty vehicles and medium and heavy trucks for each link segment and each alternative.

Fuel Consumption Rate

The fuel consumption rates for light duty vehicles and medium and heavy trucks were determined using values provided in NYSDOT's *Draft Energy Analysis Guidelines*, which adjusts 1980 base year factors The rates are determined based on average vehicle weight, and average speed for each link segment.

Total Vehicular Fuel Use

To estimate the total corridor fuel use for each alternative VMT by link segment was multiplied by its corresponding fuel consumption rate and summed. The daily usage was multiplied by 351 to estimate annual fuel use. The annual multiplier was estimated to account for reduced traffic volumes on weekends and holidays.

Indirect Energy

The remaining energy impacts include indirect energy associated with the construction, operation and maintenance of a facility. The indirect energy analysis was conducted using the Input-Output Approach in NYSDOT's *Draft Energy Analysis Guidelines for Project-Level Analysis*, November, 2003. Maintenance Energy is based on the lane-miles of pavement type for a facility. The indirect energy analysis considers the differences in energy consumed from construction between the No-Build and the Build alternatives. Construction energy covers production and transport of materials, powering on-site equipment, transportation and other factors.

Construction Energy

Construction energy is the energy consumed during construction based on an established energy factor per dollar of construction costs, annualized by dividing total project costs by 20 years. The cost of construction for the Inner Loop North Transformation is: $90,000,000. The energy coefficient per unit cost of construction is derived from a highway construction price index provided in the guidance document. The published 1977 dollar values are adjusted for future years by a factor of 3.71. For this analysis, the construction factor for "Urban Conventional Highway Widen" is used for the Build alternative. The No-Build is assumed not to have construction costs or related energy consumption.

Long- Term Roadway Maintenance Energy

The energy required to operate and maintain the project is based on the energy consumed for roadway maintenance and considers the total lane-miles for the existing and preferred alternative. Annual energy consumption for maintenance per lane mile is provided in the guidance document.

Greenhouse Gas Emissions Analysis

The majority of greenhouse gas emissions result from fossil fuel combustion. The burning of fossil fuels produce emissions of CO_2. This analysis of potential emissions of greenhouse gases uses the results from the direct energy analyses above and is reported in total carbon emissions.

CO_2 Emissions Estimates from Direct Energy Consumption

It is assumed that CO_2 emissions from Direct Energy Consumption of a roadway project are the result of the combustion of motor vehicle fuel. Therefore, this analysis employed Carbon Emission Coefficients for motor vehicle fuel to calculate the carbon equivalent of CO2emissions resulting from operation of the existing and preferred alternative. These coefficients were provided in NYSDOT's *Draft Energy Analysis Guidelines*.

C. Probable Impacts of Project Alternatives

Energy Analysis

Direct Energy

The results of the analysis show that the potential direct annual energy consumption of the Preferred Concept would be less than the energy consumption of the Existing Condition. This is because of a decrease in Vehicle Miles Traveled for the Preferred Concept from the Existing Condition, also resulting in a decrease in fuel use. The tables below show the Vehicle Miles of Travel along the corridor (Table 1) and the direct vehicular energy consumption (Table 2).

Table 1: Vehicle Miles Traveled for Inner Loop North

	Existing Condition	Preferred Concept
Daily VMT	232,440	185,915
Annual VMT*	81,586,440	65,256,165

*Calculations utilize an annual multiplier of 351 to account for reduced traffic volumes on weekends and holidays

Table 2: Annual Direct Energy Consumption

	Existing Condition	Preferred Concept
Fuel Use (gallons gasoline)*	4,787,289	3,829,059
Fuel Use (Millions of Btu's)	598,411	478,632

*Calculations utilize an annual multiplier of 351 to account for reduced traffic volumes on weekends and holidays

Indirect Energy

The indirect energy calculations consider the energy expended due to the construction proposed under each of the proposed alternatives. Between the No-Build and Build alternatives, the analysis predictably shows that the No Build alternative would result in the least amount of indirect energy expended, and that construction of the Build alternative would produce higher indirect energy demands than for the No-Build alternative. Table 3 shows a summary of the indirect energy results. The resulting indirect energy consumption has been annualized over 20 years (divided by 20).

Table 3: Construction Indirect Energy Consumption

	Construction Cost	Indirect Energy Consumption (billion Btu)
No Build	$0	2.99
Build	$90,000,000	26.69

Greenhouse Gas Emissions Analysis

CO_2 Emissions Estimates from Direct Energy Consumption

As the No-Build alternative resulted in higher direct energy effects than the Concept 6 alternative, the greenhouse gas emissions for the No-Build alternative were also predicted to be slightly higher than for the Build alternative. The Inner Loop North Transformation will likely reduce direct CO_2 emissions. Estimated Annual Carbon Emissions are provided in Table 4.

Table 4: Annual Carbon (CO_2) Emissions Estimated from Direct Energy Consumption

	Existing Condition	Preferred Concept
Fuel Use (Millions of Btu's)	598,411	478,632
Annual Carbon Emissions (Tons/Yr)	11,584	9,265

CO_2 Emissions Estimates from Indirect Energy Consumption

The analysis shows that the No-Build alternative would result in a lower level of greenhouse gas emissions of the two project alternatives. As stated above, the construction work under the Build alternative would contribute to higher indirect energy requirements, and higher predicted emissions of greenhouse gases than for the No-Build alternative. Table 5 presents a summary of the CO_2 emissions estimates from indirect energy consumption, reported as tons of carbon.

Table 5: Annual Carbon (CO_2) Emissions Estimated from Indirect Energy Consumption

	Carbon Emissions (Tons per Year)
No Build	59
Build	592

Annual CO_2 Emissions Estimate for the Total Project

Total carbon emissions for the project are presented in Table 6 with the Preferred Concept producing reduced emissions compared to the No-Build (Existing Condition).

Table 6: Annual Carbon (CO_2) Emissions Estimated from Direct and Indirect Energy Consumption

	Existing Condition	**Preferred Concept**
Annual Carbon Emissions (Tons/Yr)	11,643	9,857

D. Mitigation

The proposed Build alternative improves operating efficiency of the Inner Loop North corridor and, reduces vehicular fuel consumption for the Preferred Concept. Total direct carbon emissions (and therefore CO2 emissions) are reduced as well. Additionally, the total CO2 emissions are also decreased for the Preferred Concept, as compared to No-Build (Existing Condition).

The results for the No-Build (Existing Condition) alternative are greater than the results calculated for the Preferred Concept, showing an improvement (reduction) in greenhouse gas emissions after construction of the Preferred Concept. As a result, no mitigating action is recommended for energy related effects.

Appendix A

Energy and CO2 Emissions Calculations

Energy Use and Greenhouse Gas Emissions Estimate Calculations

Greenhouse Gas Emissions Analysis
Inner Loop North Transformation Planning Study

Average Speed:
Obtained from the NYSDOT Traffic Data Viewer for the existing condition, and estimated based on similar off-highway vehicle speeds in the vicinity of the project site, where needed for the alternatives analysis.

Vehicle Miles Traveled:
Estimated from traffic volumes provided in the Traffic Data Modeler Summary by Bergmann Associates, December 2021. The 'Vehicles per Day' volumes from each segment were multiplied by the segment length to give Vehicle Miles Traveled per Day, to be used in estimating Annual Fuel Use.

Below is a summary of the Vehicle Miles Traveled (VMT) Results:

Alternative:	**Existing Condition**	**Preferred Concept**
Daily VMT:	232,440	185,915
Annual VMT:	81,586,440	65,256,165

Fuel Consumption Rate:
Provided in NYSDOT's *Draft Energy Analysis Guidelines for Project-Level Analysis,* November 2003 for the base and preferred alternative. Data was updated from the 1980 base using NYSDOT Growth factors to 2021, also considering estimated roadway speeds for the base and Concept alternative.

Total Vehicular Fuel Use:
The total daily fuel use for the corridor was estimated using the spreadsheet analysis as shown in the attached. The total annual fuel use in millions of Btu's was estimated by multiplying the annual fuel consumption by 125,000 and dividing by 1,000,000.

Below is a summary of the Fuel Use Results (Gallons and Btu's):

Alternative:	**Existing Condition**	**Preferred Concept**
Daily Fuel Use: (Gallons of Gasoline)	13,639	10,909
Annual Fuel Use: (Gallons of Gasoline)	4,787,289	3,829,059
Annual Fuel Use: (Millions of Btu's)	598,411	478,632

Note: An annual multiplier of 351 was estimated to account for reduced traffic volumes on weekends and holidays to calculate Annual VMT and Fuel Use.

Indirect Energy Use

Indirect energy is the energy consumed to operate a transportation facility, including the energy required to construct and maintain the facility.

Roadway Construction

This analysis is based on the Input-Output Approach described in NYCDOT's *Draft Energy Analysis Guidelines for Project-Level Analysis*, November, 2003. This approach assigns an energy-to-dollar ratio to construction activities. Analysis assumes construction completed in 2026; that the cost of construction totals $90,000,000 (estimated) and that there is no cost for the No-Build alternative.

Input-Output Approach

	Construction Cost (2026 Dollars)	Project Energy Factor (Btu/1977 Dollars)	Cost Index Adjustment (1977 = 1.0)	Construction Energy (Millions of Btu's)
Total Construction Energy=	$90,000,000	23,300	3.77	556,233
Annualized Construction Energy (over 20 years)				27,811

Note: Project Energy Factor assumes Type of Facility is an Urban Conventional Highway Widen (NYSDOT, Table 11).

Roadway Maintenance

Maintenance energy includes the energy expended during routine maintenance. This includes items such as patching, crack sealing, lighting, landscape maintenance, etc.

	Lane Miles	Annual Energy Consumption (millions of Btu's per lane mile)	Maintenance Energy (millions of Btu's)
No Build Annual Maintenance Energy:	16.87	177.6	2,996
Build Alternative Annual Maintenance Energy:	16.87	177.6	2,996

Note: Assumes Roadway Maintenance Energy for urban conditions for asphalt concrete (NYSDOT, Table 6) in billions of Btu's per lane-mile.

Total Indirect Energy Consumption

No Build	
Annual Maintenance Energy (mil Btu's)	2,996
Build Alternative	
Annual Maintenance + Build Energy (mil Btu's)	29,687

Greenhouse Gas Emissions

CO2 emissions occur in direct proportion to energy consumed. CO2 emissions are included as follows: from vehicular fuel consumed and indirect energy consumption.

Carbon Emissions from Direct Energy Consumption

Alternative:	**Existing Condition**	**Preferred Concept**
Annual Fuel Use: (Millions of Btu's)	598,411	478,632

Assume 3% of this fuel use is diesel with a combustion coefficient of 19.95 million metric tons of carbon per quadrillion Btu vs. 19.34 for gasoline. Correcting the above and estimating annual carbon emissions in tons per year:

Alternative:	**Existing Condition**	**Preferred Concept**
Annual Carbon Emissions: (Tons /Year)	11,584	9,265

Carbon Emissions Estimated from Indirect Energy Consumption

Total Indirect Energy Consumption

No Build

Annual Maintenance Energy (mil Btu's) 2,996

Build Alternative

Annual Maintenance + Build Energy (mil Btu's) 29,687

Carbon Emissions from Indirect Energy Consumption

Assumes all indirect energy consumption is in diesel fuel equivalents with a combustion coefficient of 19.95 million metric tons of carbon per quadrillion Btu estimated in annual carbon emissions in tons per year:

No Build

Annual Carbon Emissions (tons/year) 59

Build Alternative

Annual Carbon Emissions (tons/year) 592

Total Carbon Emissions from Direct and Indirect Energy Consumption

Alternative:	**Existing Condition**	**Preferred Concept**
Annual Carbon Emissions: (Tons /Year)	11,643	9,857

Appendix B

Fuel Consumption Calculations

EXISTING CONDITION

	Link Description	Segment Length (ft)	Segment Length (mi)	Volume (Vehicles/Day)	Vehicle Miles Traveled/Day	Mode Split LD	MT	HT	Speed	Daily Fuel Use (Gallons)
I-490/ BROWN/BROAD/AL LEN INTERCHANGE	Ramp I-490 EB to Brown	617	0.12	1,700	198.66	96%	2%	2%	20	11.66
	Ramp Broad to I-490 WB	709	0.13	4,900	657.97	96%	2%	2%	20	38.61
	Ramp Allen to I-490 EB	537	0.10	3,300	335.63	96%	2%	2%	20	19.69
I-490/ILN INTERCHANGE	Ramp I-490 EB to ILN EB/Plymouth	920	0.17	18,800	3275.76	96%	2%	2%	20	192.22
	Ramp I-490 WB to ILN EB	1081	0.20	2,000	409.47	96%	2%	2%	20	24.03
	Ramp ILN WB/Plymouth to I-490 WB	972	0.18	19,300	3552.95	96%	2%	2%	20	208.48
	Ramp ILN WB to I-490 EB	950	0.18	3,700	665.72	96%	2%	2%	20	39.06
I-490/BOYS CLUB/ S. PLYMOUTH	Ramp Boys Club to I-490 EB	753	0.14	4,000	570.45	96%	2%	2%	20	33.47
	Ramp S. Plymouth to I-490 EB	865	0.16	3,300	540.63	96%	2%	2%	20	31.72
	Ramp I-490 WB to Spring	895	0.17	8,700	1474.72	96%	2%	2%	20	86.53
I-490/SOUTH AVE/CLINTION INTERCHANGE	Ramp I-490 EB to South/Howell	1666	0.32	7,500	2366.48	96%	2%	2%	20	138.86
	Ramp I-490 EB to South	1757	0.33	4,000	1331.06	96%	2%	2%	20	78.11
	Ramp I-490 EB to Howell	1647	0.31	3,500	1091.76	96%	2%	2%	20	64.06
	Ramp Howell to I-490 WB	875	0.17	6,300	1044.03	96%	2%	2%	20	61.26
	Ramp Howell to I-490 EB	2125	0.40	4,700	1891.57	96%	2%	2%	20	111.00
	Ramp South to I-490 EB (South)	745	0.14	4,500	634.94	96%	2%	2%	20	37.26
	Ramp I-490 WB to S. Clinton	1250	0.24	9,700	2296.40	96%	2%	2%	20	134.75
COMBINED ILN AND PARALLEL ROADS	Plymouth to State Combined (Allen+ILN)	850	0.16	43,200	6954.55	96%	2%	2%	35	408.09
	State to St. Paul (Allen+ILN)	1751	0.33	47,200	15652.88	96%	2%	2%	35	918.49
	St. Paul to N. Clinton (Central+ILN+Cumb	626	0.12	42,400	5026.97	96%	2%	2%	35	294.98
	N. Clinton to Joseph (Central+ILN+Cumbe	186	0.04	42,000	1479.55	96%	2%	2%	35	86.82
	Joseph to North (Central+ILN+Cumberlan	1436	0.27	40,800	11096.36	96%	2%	2%	35	651.12
	North to Scio (Lyndhurst+ILN+University)	1348	0.26	38,200	9752.58	96%	2%	2%	35	572.27
	Scio to Union (Lyndhurst+ILN+University)	1920	0.36	27,200	9890.91	96%	2%	2%	35	580.39
CITY GRID RESTORATION	St. Paul over ILN	220	0.04	13,600	566.67	96%	2%	2%	25	33.25
	Central; Between St. Paul & N. Clinton	681	0.13	1,500	193.47	96%	2%	2%	25	11.35
	ILN; Between St. Paul & N. Clinton	631	0.12	41,900	5007.37	96%	2%	2%	25	293.83
	Central; Between N. Clinton & Joseph	466	0.09	1,500	132.39	96%	2%	2%	25	7.77
	ILN; Between N. Clinton & Joseph	162	0.03	40,900	1254.89	96%	2%	2%	25	73.64
	Central; Between Joseph & North	1298	0.25	5,100	1253.75	96%	2%	2%	25	73.57
	ILN; Between Joseph & Franklin Square	684	0.13	35,700	4624.77	96%	2%	2%	25	271.38
	Andrews; Between Joseph & Franklin Squ	758	0.14	6,200	890.08	96%	2%	2%	25	52.23
	ILN; Between Franklin Square & North	720	0.14	35,700	4868.18	96%	2%	2%	25	285.66
	Andrews; Between Franklin Square & No	570	0.11	6,200	669.32	96%	2%	2%	25	39.27
	Lyndhurst; Between North & Scio	1370	0.26	1,100	285.42	96%	2%	2%	25	16.75
	ILN; Between North & Scio	1342	0.25	33,100	8412.92	96%	2%	2%	25	493.66
	University; Between North & Scio	1292	0.24	4,700	1150.08	96%	2%	2%	25	67.49
	Lyndhurst; Between Scio & Union	1025	0.19	1,200	232.95	96%	2%	2%	25	13.67
	University; Between Scio & E. Main	573	0.11	4,600	499.20	96%	2%	2%	25	29.29
UNION STREET	Howell to East	1693	0.32	7,600	2436.89	96%	2%	2%	30	142.99
	East to E. Main	1629	0.31	7,400	2283.07	96%	2%	2%	30	133.97
GENESEE RIVER BRIDGE CROSSINGS	Driving Park	1774	0.34	17,200	5778.94	96%	2%	2%	30	339.10
	Smith/Bausch	1875	0.36	15,300	5433.24	96%	2%	2%	30	318.82
	Inner Loop	1037	0.20	47,200	9270.15	96%	2%	2%	30	543.96
	Andrews	524	0.10	6,300	625.23	96%	2%	2%	30	36.69
	E. Main	555	0.11	12,200	1282.39	96%	2%	2%	30	75.25
	E. Broad	698	0.13	8,600	1136.89	96%	2%	2%	30	66.71
	Court	540	0.10	5,800	593.18	96%	2%	2%	30	34.81
	I-490	558	0.11	92,000	9722.73	96%	2%	2%	30	570.52
	Ford	883	0.17	21,700	3629.00	96%	2%	2%	30	212.95
PERPENDICULAR ROADWAYS	Plymouth; North of ILN	836	0.16	4,800	760.00	96%	2%	2%	25	44.60
	Plymouth; South of ILN	969	0.18	11,400	2092.16	96%	2%	2%	25	122.77
	State; North of ILN	866	0.16	24,700	4051.17	96%	2%	2%	25	237.72
	State; South of ILN	1304	0.25	17,500	4321.97	96%	2%	2%	25	253.61
	St. Paul; North of ILN	451	0.09	14,300	1221.46	96%	2%	2%	25	71.67
	St. Paul; South of ILN	1288	0.24	9,000	2195.45	96%	2%	2%	25	128.83
	N. Clinton; North of ILN	455	0.09	10,000	861.74	96%	2%	2%	25	50.57
	N. Clinton; South of ILN	595	0.11	10,900	1228.31	96%	2%	2%	25	72.08
	Joseph; North of ILN	1052	0.20	10,600	2111.97	96%	2%	2%	25	123.93
	North; North of ILN	642	0.12	11,200	1361.82	96%	2%	2%	25	79.91
	North; South of ILN	895	0.17	12,100	2051.04	96%	2%	2%	25	120.35
	Scio; North of ILN	1196	0.23	9,000	2038.64	96%	2%	2%	25	119.62
	Scio; South of ILN	379	0.07	3,800	272.77	96%	2%	2%	25	16.01
	E. Main; West of University	1431	0.27	9,100	2466.31	96%	2%	2%	25	144.72
	E. Main; East of University	1072	0.20	20,200	4101.21	96%	2%	2%	25	240.65
AQUEDUCT	Exchange (North of Main)	969	0.18	17,400	3193.30	96%	2%	2%	30	187.38
	Exchange (Main to Broad)	478	0.09	13,500	1222.16	96%	2%	2%	30	71.71
	Exchange (Broad to Court)	537	0.10	13,400	1362.84	96%	2%	2%	30	79.97
	Exchange (South of Court)	850	0.16	10,600	1706.44	96%	2%	2%	30	100.13
	South (Main to Broad)	727	0.14	8,400	1156.59	96%	2%	2%	30	67.87
	South (Broad to Court)	393	0.07	15,000	1116.48	96%	2%	2%	30	65.51
	South (South of Court)	424	0.08	15,300	1228.64	96%	2%	2%	30	72.10
	Clinton (Main to Broad)	789	0.15	12,100	1808.13	96%	2%	2%	30	106.10
	Clinton (Broad to Court)	396	0.08	14,200	1065.00	96%	2%	2%	30	62.49
	Clinton (Court to Woodbury)	447	0.08	17,100	1447.67	96%	2%	2%	30	84.95
	Clinton (South of Woodbury)	891	0.17	17,500	2953.13	96%	2%	2%	30	173.29
	Main (West of Exchange)	872	0.17	10,700	1767.12	96%	2%	2%	30	103.69
	Main (Exchange to South)	1026	0.19	12,200	2370.68	96%	2%	2%	30	139.11
	Main (South to Clinton)	368	0.07	10,600	738.79	96%	2%	2%	30	43.35
	Broad (West of Exchange)	835	0.16	7,500	1186.08	96%	2%	2%	30	69.60
	Broad (Exchange to South)	1064	0.20	8,600	1733.03	96%	2%	2%	30	101.69
	Broad (South to Clinton)	684	0.13	7,800	1010.45	96%	2%	2%	30	59.29
	Court (Exchange to South)	1034	0.20	5,800	1135.83	96%	2%	2%	30	66.65
	Court (South to Clinton)	680	0.13	6,100	785.61	96%	2%	2%	30	46.10
	Woodbury (South to Clinton)	677	0.13	17,000	2179.73	96%	2%	2%	30	127.90
UNIVERSITY AVE NEIGHBORHOOD	North (North of Central)	135	0.03	12,400	317.05	96%	2%	2%	25	18.60
	North (South of Central)	637	0.12	16,300	1966.50	96%	2%	2%	25	115.39
	Chestnut (South of University)	567	0.11	11,400	1224.20	96%	2%	2%	25	71.84
	Scio (North of Lyndhurst)	332	0.06	9,000	565.91	96%	2%	2%	25	33.21
	Scio (Lyndhurst to Delevan)	313	0.06	6,200	367.54	96%	2%	2%	25	21.57
	Scio (Delevan to University)	356	0.07	3,900	262.95	96%	2%	2%	25	15.43
	Scio (South of University)	454	0.09	3,800	326.74	96%	2%	2%	25	19.17
	Central (West of North)	1298	0.25	5,100	1253.75	96%	2%	2%	25	73.57
	Lyndhurst (North to Scio)	1370	0.26	1,100	285.42	96%	2%	2%	25	16.75
	Lyndhurst (Scio to Union)	1025	0.19	1,200	232.95	96%	2%	2%	25	13.67
	University (North to Windsor)	1021	0.19	4,700	908.84	96%	2%	2%	25	53.33
	University (Windsor to Scio)	266	0.05	4,800	241.82	96%	2%	2%	25	14.19
	University (Scio to Main)	573	0.11	4,600	499.20	96%	2%	2%	25	29.29
	Andrews (West of North)	589	0.11	6,200	691.63	96%	2%	2%	25	40.58
	E. Main; West of University	1431	0.27	9,100	2466.31	96%	2%	2%	25	144.72
	E. Main; East of University	1072	0.20	20,200	4101.21	96%	2%	2%	25	240.65
				Total:	**232,440.87**				**Total:**	**13,639.38**

Speed	LDV	MT	HT
20	72.0	182.2	245.0
25	66.1	164.5	224.0
30	62.2	151.2	210.0
35	59.4	140.7	200.0
Fuel Correction Factor:	0.75	0.68	0.89

PREFERRED CONCEPT

	Link Description	Segment Length (ft)	Segment Length (mi)	Volume (Vehicles/Day)	Vehicle Miles Traveled/Day	Mode Split LD	MT	HT	Speed	Daily Fuel Use (Gallons)	Volume Difference from Base
I-490/ BROWN/BROAD/AL LEN INTERCHANGE	Ramp I-490 EB to Brown	617	0.12	1,900	222.03	96%	2%	2%	20	13.03	200
	Ramp Broad to I-490 WB	709	0.13	5,600	751.97	96%	2%	2%	20	44.12	700
	Ramp Allen to I-490 EB	537	0.10	900	91.53	96%	2%	2%	20	5.37	-2,400
I-490/ILN INTERCHANGE	Ramp I-490 EB to ILN EB/Plymouth	920	0.17	13,200	2300.00	96%	2%	2%	20	134.96	-5,600
	Ramp I-490 WB to ILN EB	1081	0.20	6,600	1351.25	96%	2%	2%	20	79.29	4,600
	Ramp ILN WB/Plymouth to I-490 WB	972	0.18	9,600	1767.27	96%	2%	2%	20	103.70	-9,700
	Ramp ILN WB to I-490 EB	950	0.18	10,200	1835.23	96%	2%	2%	20	107.69	6,500
I-490/BOYS CLUB/ S. PLYMOUTH	Ramp Boys Club to I-490 EB	753	0.14	4,800	684.55	96%	2%	2%	20	40.17	800
	Ramp S. Plymouth to I-490 EB	865	0.16	1,900	311.27	96%	2%	2%	20	18.26	-1,400
	Ramp I-490 WB to Spring	895	0.17	6,600	1118.75	96%	2%	2%	20	65.65	-2,100
I-490/SOUTH AVE/CLINTION INTERCHANGE	Ramp I-490 EB to South/Howell	1666	0.32	12,400	3912.58	96%	2%	2%	20	229.59	4,900
	Ramp I-490 EB to South	1757	0.33	4,700	1564.00	96%	2%	2%	20	91.77	700
	Ramp I-490 EB to Howell	1647	0.31	7,700	2401.88	96%	2%	2%	20	140.94	4,200
	Ramp Howell to I-490 WB	875	0.17	10,100	1673.77	96%	2%	2%	20	98.21	3,800
	Ramp Howell to I-490 EB	2125	0.40	5,500	2213.54	96%	2%	2%	20	129.89	800
	Ramp South to I-490 EB (South)	745	0.14	4,500	634.94	96%	2%	2%	20	37.26	0
	Ramp I-490 WB to S. Clinton	1250	0.24	10,100	2391.10	96%	2%	2%	20	140.31	400
COMBINED ILN AND PARALLEL ROADS	Plymouth to State Combined (Allen+ILN)	850	0.16	22,300	3589.96	96%	2%	2%	35	210.66	-20,900
	State to St. Paul (Allen+ILN)	1751	0.33	16,400	5438.71	96%	2%	2%	35	319.14	-30,800
	St. Paul to N. Clinton (Central+ILN+Cumb	626	0.12	21,700	2572.77	96%	2%	2%	35	150.97	-20,700
	N. Clinton to Joseph (Central+ILN+Cumbe	186	0.04	19,500	686.93	96%	2%	2%	35	40.31	-22,500
	Joseph to North (Central+ILN+Cumberlan	1436	0.27	17,800	4841.06	96%	2%	2%	35	284.07	-23,000
	North to Scio (Lyndhurst+ILN+University)	1348	0.26	10,100	2578.56	96%	2%	2%	35	151.31	-28,100
	Scio to Union (Lyndhurst+ILN+University)	1920	0.36	9,400	3418.18	96%	2%	2%	35	200.58	-17,800
CITY GRID RESTORATION	St. Paul over ILN	220	0.04	15,700	654.17	96%	2%	2%	25	38.39	2,100
	Central; Between St. Paul & N. Clinton	681	0.13	12,500	1612.22	96%	2%	2%	25	94.60	11,000
	ILN; Between St. Paul & N. Clinton	631	0.12	9,200	1099.47	96%	2%	2%	25	64.52	-32,700
	Central; Between N. Clinton & Joseph	466	0.09	10,600	935.53	96%	2%	2%	25	54.90	9,100
	ILN; Between N. Clinton & Joseph	162	0.03	8,900	273.07	96%	2%	2%	25	16.02	-32,000
	Central; Between Joseph & North	1298	0.25	10,000	2458.33	96%	2%	2%	25	144.25	4,900
	ILN; Between Joseph & Franklin Square	684	0.13	7,800	1010.45	96%	2%	2%	25	59.29	-27,900
	Andrews; Between Joseph & Franklin Squ	758	0.14	6,400	918.79	96%	2%	2%	25	53.91	200
	ILN; Between Franklin Square & North	720	0.14	8,500	1159.09	96%	2%	2%	25	68.01	-27,200
	Andrews; Between Franklin Square & No	570	0.11	900	97.16	96%	2%	2%	25	5.70	-5,300
	Lyndhurst; Between North & Scio	1370	0.26	1,000	259.47	96%	2%	2%	25	15.23	-100
	ILN; Between North & Scio	1342	0.25	0	0.00	96%	2%	2%	25	0.00	-33,100
	University; Between North & Scio	1292	0.24	9,900	2422.50	96%	2%	2%	25	142.15	5,200
	Lyndhurst; Between Scio & Union	1025	0.19	1,000	194.13	96%	2%	2%	25	11.39	-200
	University; Between Scio & E. Main	573	0.11	11,900	1291.42	96%	2%	2%	25	75.78	7,300
UNION STREET	Howell to East	1693	0.32	14,700	4713.47	96%	2%	2%	30	276.58	7,100
	East to E. Main	1629	0.31	12,500	3856.53	96%	2%	2%	30	226.30	5,100
GENESEE RIVER BRIDGE CROSSINGS	Driving Park	1774	0.34	19,600	6585.30	96%	2%	2%	30	386.42	2,400
	Smith/Bausch	1875	0.36	17,800	6321.02	96%	2%	2%	30	370.91	2,500
	Inner Loop	1037	0.20	16,400	3220.98	96%	2%	2%	30	189.00	-30,800
	Andrews	524	0.10	9,400	932.88	96%	2%	2%	30	54.74	3,100
	E. Main	555	0.11	15,800	1660.80	96%	2%	2%	30	97.45	3,600
	E. Broad	698	0.13	0	0.00	96%	2%	2%	30	0.00	-8,600
	Court	540	0.10	10,700	1094.32	96%	2%	2%	30	64.21	4,900
	I-490	558	0.11	105,600	11160.00	96%	2%	2%	30	654.86	13,600
	Ford	883	0.17	22,500	3762.78	96%	2%	2%	30	220.80	800
PERPENDICULAR ROADWAYS	Plymouth; North of ILN	836	0.16	4,400	696.67	96%	2%	2%	25	40.88	-400
	Plymouth; South of ILN	969	0.18	9,500	1743.47	96%	2%	2%	25	102.30	-1,900
	State; North of ILN	866	0.16	21,100	3460.72	96%	2%	2%	25	203.07	-3,600
	State; South of ILN	1304	0.25	18,700	4618.33	96%	2%	2%	25	271.00	1,200
	St. Paul; North of ILN	451	0.09	18,000	1537.50	96%	2%	2%	25	90.22	3,700
	St. Paul; South of ILN	1288	0.24	9,900	2415.00	96%	2%	2%	25	141.71	900
	N. Clinton; North of ILN	455	0.09	10,900	939.30	96%	2%	2%	25	55.12	900
	N. Clinton; South of ILN	595	0.11	9,700	1093.09	96%	2%	2%	25	64.14	-1,200
	Joseph; North of ILN	1052	0.20	11,500	2291.29	96%	2%	2%	25	134.45	900
	North; North of ILN	642	0.12	12,800	1556.36	96%	2%	2%	25	91.33	1,600
	North; South of ILN	895	0.17	10,200	1728.98	96%	2%	2%	25	101.45	-1,900
	Scio; North of ILN	1196	0.23	5,800	1313.79	96%	2%	2%	25	77.09	-3,200
	Scio; South of ILN	379	0.07	4,400	315.83	96%	2%	2%	25	18.53	600
	E. Main; West of University	1431	0.27	12,000	3252.27	96%	2%	2%	25	190.84	2,900
	E. Main; East of University	1072	0.20	17,000	3451.52	96%	2%	2%	25	202.53	-3,200
AQUEDUCT	Exchange (North of Main)	969	0.18	17,200	3156.59	96%	2%	2%	30	185.23	-200
	Exchange (Main to Broad)	478	0.09	11,500	1041.10	96%	2%	2%	30	61.09	-2,000
	Exchange (Broad to Court)	537	0.10	20,500	2084.94	96%	2%	2%	30	122.34	7,100
	Exchange (South of Court)	850	0.16	10,800	1738.64	96%	2%	2%	30	102.02	200
	South (Main to Broad)	727	0.14	10,400	1431.97	96%	2%	2%	30	84.03	2,000
	South (Broad to Court)	393	0.07	13,300	989.94	96%	2%	2%	30	58.09	-1,700
	South (South of Court)	424	0.08	14,800	1188.48	96%	2%	2%	30	69.74	-500
	Clinton (Main to Broad)	789	0.15	12,200	1823.07	96%	2%	2%	30	106.98	100
	Clinton (Broad to Court)	396	0.08	13,100	982.50	96%	2%	2%	30	57.65	-1,100
	Clinton (Court to Woodbury)	447	0.08	17,200	1456.14	96%	2%	2%	30	85.44	100
	Clinton (South of Woodbury)	891	0.17	17,900	3020.63	96%	2%	2%	30	177.25	400
	Main (West of Exchange)	872	0.17	14,200	2345.15	96%	2%	2%	30	137.61	3,500
	Main (Exchange to South)	1026	0.19	15,800	3070.23	96%	2%	2%	30	180.16	3,600
	Main (South to Clinton)	368	0.07	13,200	920.00	96%	2%	2%	30	53.98	2,600
	Broad (West of Exchange)	835	0.16	3,400	537.69	96%	2%	2%	30	31.55	-4,100
	Broad (Exchange to South)	1064	0.20	0	0.00	96%	2%	2%	30	0.00	-8,600
	Broad (South to Clinton)	684	0.13	3,700	479.32	96%	2%	2%	30	28.13	-4,100
	Court (Exchange to South)	1034	0.20	10,900	2134.58	96%	2%	2%	30	125.26	5,100
	Court (South to Clinton)	680	0.13	9,200	1184.85	96%	2%	2%	30	69.53	3,100
	Woodbury (South to Clinton)	677	0.13	16,400	2102.80	96%	2%	2%	30	123.39	-600
UNIVERSITY AVE NEIGHBORHOOD	North (North of Central)	135	0.03	13,300	340.06	96%	2%	2%	25	19.95	900
	North (South of Central)	637	0.12	13,500	1628.69	96%	2%	2%	25	95.57	-2,800
	Chestnut (South of University)	567	0.11	11,800	1267.16	96%	2%	2%	25	74.36	400
	Scio (North of Lyndhurst)	332	0.06	5,900	370.98	96%	2%	2%	25	21.77	-3,100
	Scio (Lyndhurst to Delevan)	313	0.06	4,000	237.12	96%	2%	2%	25	13.91	-2,200
	Scio (Delevan to University)	356	0.07	4,000	269.70	96%	2%	2%	25	15.83	100
	Scio (South of University)	454	0.09	3,700	318.14	96%	2%	2%	25	18.67	-100
	Central (West of North)	1298	0.25	10,000	2458.33	96%	2%	2%	25	144.25	4,900
	Lyndhurst (North to Scio)	1370	0.26	1,000	259.47	96%	2%	2%	25	15.23	-100
	Lyndhurst (Scio to Union)	1025	0.19	1,000	194.13	96%	2%	2%	25	11.39	-200
	University (North to Windsor)	1021	0.19	9,900	1914.38	96%	2%	2%	25	112.33	5,200
	University (Windsor to Scio)	266	0.05	8,200	413.11	96%	2%	2%	25	24.24	3,400
	University (Scio to Main)	573	0.11	11,900	1291.42	96%	2%	2%	25	75.78	7,300
	Andrews (West of North)	589	0.11	900	100.40	96%	2%	2%	25	5.89	-5,300
	E. Main; West of University	1431	0.27	12,000	3252.27	96%	2%	2%	25	190.84	2,900
	E. Main; East of University	1072	0.20	17,000	3451.52	96%	2%	2%	25	202.53	-3,200
				Total:	**185,915.30**					**Total:**	**10,909.31**

Speed	LDV	MT	HT
20	72.0	182.2	245.0
25	66.1	164.5	224.0
30	62.2	151.2	210.0
35	59.4	140.7	200.0
Fuel Correction Factor:	0.75	0.68	0.89