SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT

HOPPING BROOK PARK
ROUTE 16
HOLLISTON, MASSACHUSETTS
EOEA FILE #: 4411

MEPA
626-1021

SUBMITTED IN COMPLIANCE WITH THE:

MASSACHUSETTS ENVIRONMENTAL POLICY ACT
(MGL Chapter 30, Sections 61 through 62H)
AND
REGULATIONS
(301 CMR 11.00 *et seq.*)

SUBMITTED BY:

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July 2003

SES Job No.: 20095

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Route 16
Holliston, Massachusetts
EOEA #: 4411

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Supplemental Environmental Impact Report
Hopping Brook Park, Route 16
Holliston, Massachusetts
EOEA #: 4411

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May 24, 2002

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
NOTICE OF PROJECT CHANGE

PROJECT NAME	: Hopping Brook Park
PROJECT MUNICIPALITY	: Holliston
PROJECT WATERSHED	: Charles River
EOEA NUMBER	: 4411
PROJECT PROPONENT	: Jon Delli Priscoli
DATE NOTICED IN MONITOR	: April 24, 2002

Pursuant to the Massachusetts Environmental Policy Act (G.L. c. 30, ss. 61-62H) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change submitted on this project and hereby determine that it **does require** the preparation of a Supplemental Environmental Impact Report (SEIR).

The original Hopping Brook Park project involved the construction of approximately 3,000,000 square feet (sf) of office and research and development space on 281 acres. The project also included access roadways and 9,684 parking spaces. The buildings were to be served by the public water supply and on-site septic systems. The project was reviewed under MEPA in 1982 and 1983. A Certificate was issued on June 14, 1983 finding the Final EIR on the project to be adequate.

To date, the Phase I portion of the project, 558,000 sf of office, manufacturing, and warehouse space, has been constructed in 16 buildings. Phase I consists of 19 lots and occupies approximately 100 acres of the site.

The Notice of Project Change identifies several changes to the project. The proponent has acquired an adjacent 85 acre parcel which has been added to the site, making the total site 366 acres. The project has been redesigned to eliminate 45 acres of net land alteration and 43 acres of net impervious area. The redesign has reduced wetland alteration from 1,393,920 sf in the original project to 2,810 sf in the current proposal. Additionally, the redesign has provided protection for spotted turtle habitat. Finally, the current proposal includes the construction of a wastewater treatment facility with groundwater disposal of treated effluent on the site.

Other aspects of the project - gross square footage, water/sewer use, traffic generation and parking, remain at the same levels as in the original project.

While I acknowledge that many of the changes in the project are designed to reduce potential impacts associated with the original project, there are new elements to the project, such as the wastewater treatment and disposal system, and a number of new or more stringent regulatory requirements, such as the Massachusetts Endangered Species Act, the Department of Environmental Protection's (DEP) Stormwater Policy, and the Rivers Protection Act*, that require review in a Supplemental EIR.

The SEIR should follow the guidance for form and content found at Section 11.07 of the MEPA Regulations and should address the following specific issues.

PROJECT DESCRIPTION

The SEIR should contain a complete and detailed description of the site and of the master plan for the project. This description should clearly identify resource areas on the site and the spatial relationship between these resource areas and facilities to be constructed as part of the project.

* Although the Rivers Protection Act exempts projects for which a Draft EIR was submitted on or before November 1, 1996, this exemption does not apply to the additional site area that has no undergone MEPA review.

TRANSPORTATION

The NPC contains a technical memorandum dealing with traffic, but which has only analyzed the intersection of the site drive with Route 16. The SEIR should contain an updated traffic analysis that is prepared in accordance with the EOEA/EOTC Guidelines which analyzes the impacts of the project on the Route 16 corridor, between Route 126 to the east and I-495 to the west, and which revisits the mitigation proposed for the original project to determine whether that mitigation is sufficient under the current conditions. Should further mitigation appear necessary, the SEIR should describe that further mitigation. I suggest consultation with the Massachusetts Highway Department in determining the scope of the study and the study area.

AIR QUALITY

This project is expected to generate in excess of 15,000 vehicle trips per day. In order for a project with that generation rate to be consistent with the State Implementation Plan, the proponent will have to conduct an air quality mesoscale analysis for volatile organic compounds. The protocols for this study should be developed in concert with the DEP Division of Air Quality Control and the results of the study, and any Transportation Demand Management proposals or other mitigations measures, should be reported in the SEIR.

WETLANDS, FLOODPLAINS, AND RIVERFRONT AREAS

I acknowledge the significant reduction in wetland alteration from the original project and that the currently proposed alteration of wetlands and riverfront areas is the result of a crossing of wetlands for the access drive into Phase II and for the installation of utilities. The NPC contains a copy of the Notice of Intent that was filed in March with the Holliston Conservation Commission. The SEIR should contain a copy of the Order of Conditions issued as a result of that filing if it is available at the time of filing of the SEIR. If it is not available, the SEIR should contain a discussion explaining why it has not issued.

The SEIR should also provide greater detail on the floodplain alterations identified in the NPC and what mitigation will be provided for floodplain alterations.

ENDANGERED SPECIES

I note that the NPC contains a study of the spotted turtle populations on the site that has resulted in modifications to the project layout that, for the most part, avoid wetland and upland habitat of these species. Nevertheless, the Natural Heritage and Endangered Species Program (NHESP) has reported that the site is also habitat for the four-toed salamander, another rare species. NHESP indicates that the project, as currently configured, will likely result in a "take" of rare species under the Massachusetts Endangered Species Act. The SEIR should contain a section that shows that the proposed project, and any proposed mitigation for rare species, will result in a long-term benefit to the conservation of the populations of rare species on the site. I suggest close coordination with the NHESP during development of this information.

STORMWATER

The NPC contains a stormwater management plan designed to accommodate runoff from the roadway system and to meet the standards contained in the DEP Stormwater Policy. The study does not include other impervious areas such as parking lots and roof drains.

The SEIR should contain a stormwater management plan for all impervious areas to be developed on the site. The plan should be designed to control both the quantity of runoff and the quality of runoff and should be consistent with the DEP Stormwater Policy.

WASTEWATER DISPOSAL

The current proposal includes the construction of a wastewater treatment plant on the site to treat and dispose of the projected 225,000 gallons per day of waste from the Park. The NPC contains little information on this facility.

The SEIR should provide a location for the treatment facility and disposal site. While I don't expect that detailed design will be available at the time the SEIR is filed, I expect that the SEIR will identify one or more siting locations and will identify the disposal methodology and provide some assurance that the selected disposal methodology is feasible.

May 24, 2002
DATE

Bob Durand

Comments received :

Department of Environmental Protection CERO
Department of Environmental Protection DAQC
Natural Heritage and Endangered Species Program
Charles River Watershed Association

BD/rf

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
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MICHAEL S. DUKAKIS
GOVERNOR

JAMES S. HOYTE
SECRETARY

CERTIFICATE OF THE SECRETARY ENVIRONMENTAL AFFAIRS

ON

FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME:	Hopping Brook Park
PROJECT LOCATION:	Holliston
EOEA NUMBER:	4411
PROJECT PROPONENT:	Hopping Brook Trust
DATE NOTICED IN MONITOR:	May 9, 1983

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report submitted in the above referenced project does adequately and properly comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA.

I find the FEIR for this project to have adequately complied with C3Q § 61-62H; however, there remain several issues that have not been thoroughly addressed.

The EIR has defined that the developer will make improvements to Route 16 at the access drive and will install signals at that intersection. Although I agree that the developer should not be responsible for all the improvements in the area, I feel that the so-called railroad access should be the responsibility of the proponent since this will serve only his development.

I also recommend that avoidance of archaeologically sensitive areas be a prime motivation in site planning for the project and that the developer commit to an approved data recovery program for archaeological materials.

6/14/83
DATE

JAMES S. HOYTE, SECRETARY

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs

100 Cambridge Street
Boston, Massachusetts 02202

MICHAEL S. DUKAKIS
Governor

JAMES S. HOYTE
Secretary

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS

ON

DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME:	Hopping Brook Park
PROJECT LOCATION:	Holliston
EOEA NUMBER:	4411
PROJECT PROPONENT:	Hopping Brook Trust
DATE NOTICED IN MONITOR:	February 22, 1983

The Secretary of Environmental Affairs herein issues a statement that the Draft Environmental Impact Report submitted on the above referenced project does adequately and properly comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA.

Although this EIR adequately serves as a Draft EIR, there are some issues that must be elaborated on in the Final EIR.

The FEIR may be circulated as a supplement to the DEIR and should contain the existing Chapter 2, this Certificate and the attached letters of comment and responses to same. My comments are as follows.

Traffic

The 1987 LOS table shows considerable LOS=F at the 109/495 interchange. Would signalization help?

Why does the left turn from Ramp A produce LOS E for Phase III while the same turn produces LOS F for Phase II?

FORM D

In Figure 3.11, are the results the same for Phase II and III? The FEIR should present a table to show percent increases in trafic for all roads studied.

The DEIR identifies traffic improvements that would improve flow in the area. How and by whom would these improvements be implemented?

Air Quality

The FEIR should address the issues raised in the letter of comment from DEQE-DAQC attached.

Water Supply

The proponent should consider the use of on-site water sources for landscape use to reduce the demand on the municipal water system.

Archaeology

Relocate construction to avoid sensitive archaeological areas and sites or, if avoidance is not possible, a data recovery program must be developed.

The comments in the attached letters shall be addressed in the FEIR.

March 31, 1983
DATE

JAMES S. HOYTE, SECRETARY

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

EDWARD J. KING
GOVERNOR
JOHN A. BEWICK
SECRETARY

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS

ON

ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME: Hopping Brook Park

PROJECT LOCATION: Holliston

EOEA NUMBER: 4411

PROJECT PROPONENT: Hopping Brook Trust

DATE NOTICED IN MONITOR: May 10, 1982

Pursuant to M.G.L., Chapter 30, Section 62A and Sections 10.04(1) and 10.04(9) of the Regulations Governing the Implementation of the Massachusetts Environmental Policy Act, I hereby determine that the above referenced project does require the preparation of an Environmental Impact Report. The scope and alternatives for the EIR shall be as follows:

This project consists of 3,000,000 square feet more or less of office and manufacturing space and appurtenances to be built on 280 more or less acres off Route 16 in Holliston. This project is categorically included for preparation of an Environmental Impact Report under 301 CMR, Section 10.32, Class D, (1), (14), and (18).

The EIR for this project should follow the general format outlined in 301 CMR (MEPA Regulations), should include a copy of this scope and the attached comments, and shall include the following specific areas of investigation:

TRAFFIC

Traffic Study Area

The traffic study area shall include, at a minimum, the area defined by the intersections of Route 16/109 to the west, Route 126/16 to the north and east, Rout 126/I-495 to the south, and Route 109 and Main Street in West Medway.

In addition, the study shall investigate all roadways with greater than 1,000 ADT to the point where the project traffic comprises less than 10% increase in ADT over the No-Build ADT. It shall also investigate roadways with less than 1,000 ADT to the point where project traffic compromises less than a 25% increase in ADT over the No-Build ADT.

Special attention should be given to the Data General and Fafard Developments at Routes 109/16/I-495 in Milford and to the Ledgemere Country Development on Rout 126 at the Ashland line.

Traffic Analysis

Identify all roadways and intersections that are within 10% of capacity for build and no-build conditions. Develop v/c ratios for build and no-build conditions and identify amount of exceedance of v/c=1.0.

Bottlenecks and by-pass routes should be identified for both build and no-build and means of minimizing traffic impacts, i.e., traffic control devices, should be presented.

For the purposes of this study, assume that project completion will occur in 1987, and include general background growth of traffic volumes based on recent trends.

The EIR shall present justification of traffic generation methods based on use and mix of development.

Air Quality

The EIR shall contain an analysis of air quality and the potential air quality impacts resulting from the proposal. Details of the study and methodology shall be established by DEQE - NE, AQC, and the proponent.

Hydrology & Wetlands

The proposal calls for construction of storm water detention areas to reduce peak rates of runoff. The EIR should define by what methods this detention will be accomplished and at what locations, including supporting calculations. In addition, the EIR should evaluate the effect of development on the Natural Valley Storage Area P, and on flood storage on the site.

The site contains 32 acres, more or less, of wetlands and the EIR should define what effect development will have on the wetland values of these areas, including stream crossings.

The EIR shall present what methods will be employed to minimize impacts on these systems, including water quality impacts.

UTILITIES

Sewage Disposal

The project is expected to generate 225,000 gpd of sanitary waste that is scheduled to be disposed of through on-site disposal systems. The EIR should identify the water quality impacts from such a system and shall investigate the alternatives of on-site treatment and connection to a public sewer system, and the potential impacts of these alternatives.

Water Supply

The project is expected to require 250,000 gpd of potable water. The early phases of development are expected to be connected to public water with wells to supply future development.

The EIR should define the existing capacity and quality of the public supply and should present sufficient data to show that wells can be developed with adequate volume and qulaity to supply the proposed development, particularly in view of the potential for disposal of 225,000 gpd of sanitary wastes on-site.

In addition, the EIR should identify and assess the potential for impacts to the existing Holliston Wells near the site.

The comments of the Board of Water Commissioners should be included in this discussion.

Archaeology

The concerns of the MHC regarding an archaeological survey should be addressed in be EIR. The required study should be developed in concert with the MHC.

Wastes

The EIR should identify an estimated volume and composition of solid waste to be generated by the project and make some assumptions on how this waste will be disposed of, based on the types of industries intended for the park.

In addition, the EIR should make a general inventory of other wastes to be generated by the industries in the park, based on the general waste lists for the types of industries to be located in the park.

ALTERNATIVES

Access

The EIR should assess the use of a three lane entry with the third land being in-bound in the a.m. and out-bound in the p.m.

In addition, the EIR should assess the possibility of access to I-495 over the abandoned Railroad row.

The present access scheme calls for a loop roadway that will require another stream crossing to be constructed. The EIR should investigate whether or not access can be adequate without constructing the new crossing.

DISTRIBUTION OF EIR

In addition to the distribution mandated by 301 CMR, the EIR shall be distributed to the South Middlesex News, attn: Ron Doyle (1 copy), and to the Holliston Public Library (2 copies), and to the Selectmen and Conservation Commission of the Town of Holliston.

06/17/82
DATE

Samuel G. Mygatt, Jr.
JOHN A. BEWICK, SECRETARY

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Hopping Brook Park
Route 16
Holliston, Massachusetts
EOEA FILE #: 4411

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TECHNICAL APPENDICES

1.0 EXECUTIVE SUMMARY

The project is currently divided into Phase I and Phase II (See Figure 1-1, Site Locus). Phase I consists of the buildings that have been constructed to date and is almost complete (See Figure 1-2, Current Phase I Development). Construction of Phase I of the project began in 1983 and has been on-going. Phase II consists of the development of the remainder of the site; which includes the construction of the access road to the Phase II portion and the construction of the proposed buildings and infrastructure (See Figure 1-3, Proposed Phase II Development). Approximately 558,000 square-feet of the Phase I portion of Hopping brook Park has been constructed. The Phase II portion of Hopping Brook Park is proposed to be 2,215,500 square-feet. The original size of the project area was 281 acres. The proponent acquired an additional 85+/- acres, a portion of which Phase II will be located, making the total acreage of Hopping Brook Park 366 acres. The construction sequence of Phase II will be phased. The construction of the access road and associated activities (i.e. clearing, grading, construction of mitigation areas) will occur first (See Proposed Conditions Plan in the Plan Pocket). Construction of the buildings and infrastructure will follow at a later date. There will not be any additional environmental impacts, to those described in the SEIR, associated with the construction of the buildings in Phase II. The analyses for traffic and air quality and the estimated quantity of wastewater discharge are based on the full build out of the site.

1.1 History of Certificates Issued

The following section is a brief history of the Certificates issued by the Secretary of Environmental Affairs for the project. The former name of the proponent at the time Phase I began was Hopping Brook Trust. The current name of the proponent is New Hopping Brook Realty Trust. The following is the list of filings and Certificates:

- Environmental Notice Form (ENF) filed May 10, 1982
- Certificate of the Secretary issued June 17, 1982; requested the preparation of an Environmental Impact Report (EIR).

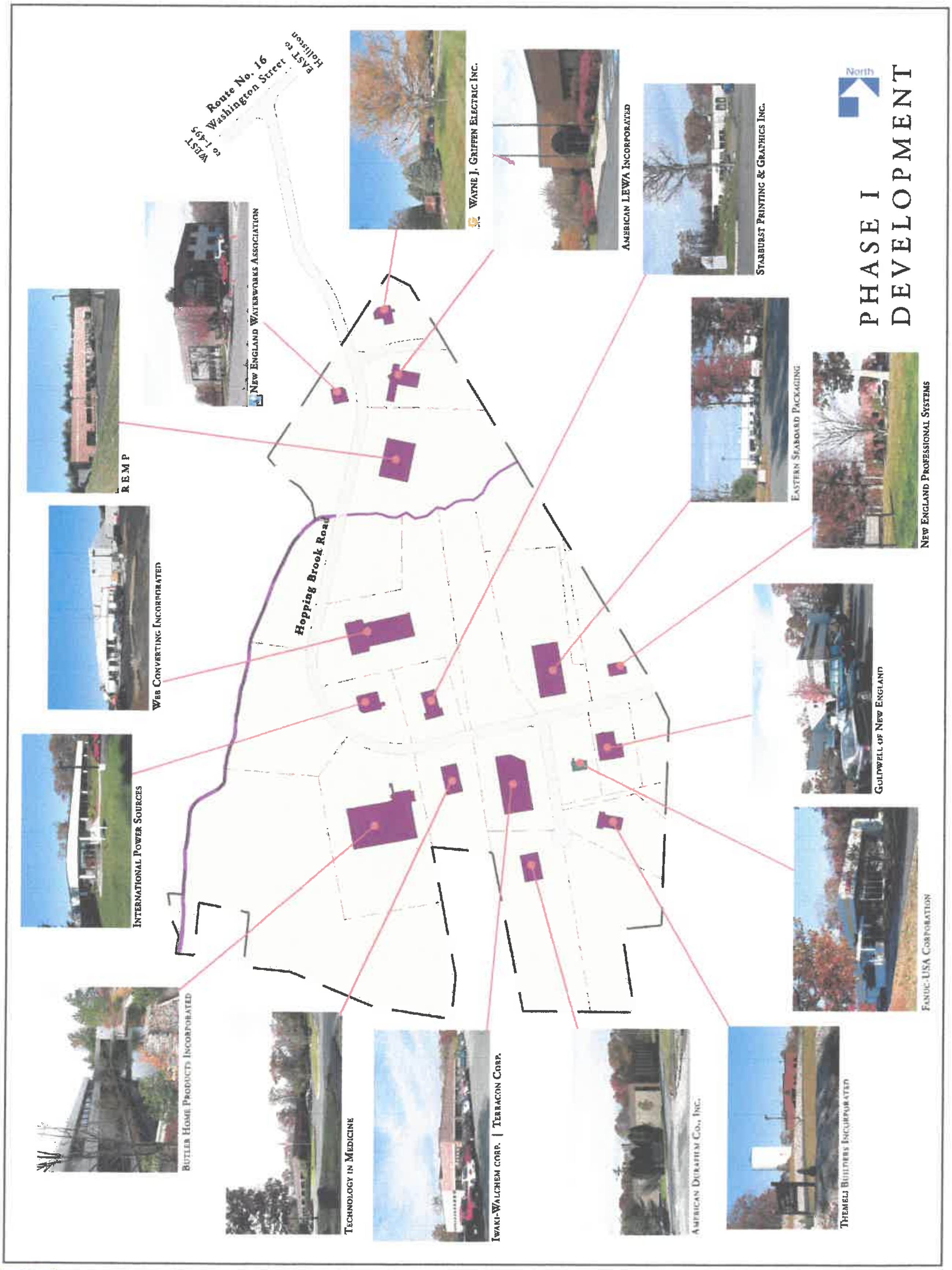
- Draft EIR (DEIR) filed on February 22, 1983
- Certificate of the Secretary issued on March 31, 1983; requested the preparation of a Final EIR (FEIR)

- FEIR filed on May 9, 1983
- Certificate of the Secretary issued on June 14, 1983; determined FEIR adequately complied with M.G.L.c.30, SS. 61-62H. Additional issues were requested to be addressed; these included work on the railroad access and avoidance of archeology sensitive areas

Figure 1-1. Site Locus

HOPPING BROOK PARK | Washington St. West, Rt. 16
Holliston, Massachusetts

Figure 1-2. Current Phase I Development



HOPPING BROOK PARK | Washington St. West, Rt. 16
Holliston, Massachusetts

Figure 1-3. Proposed Phase II Development

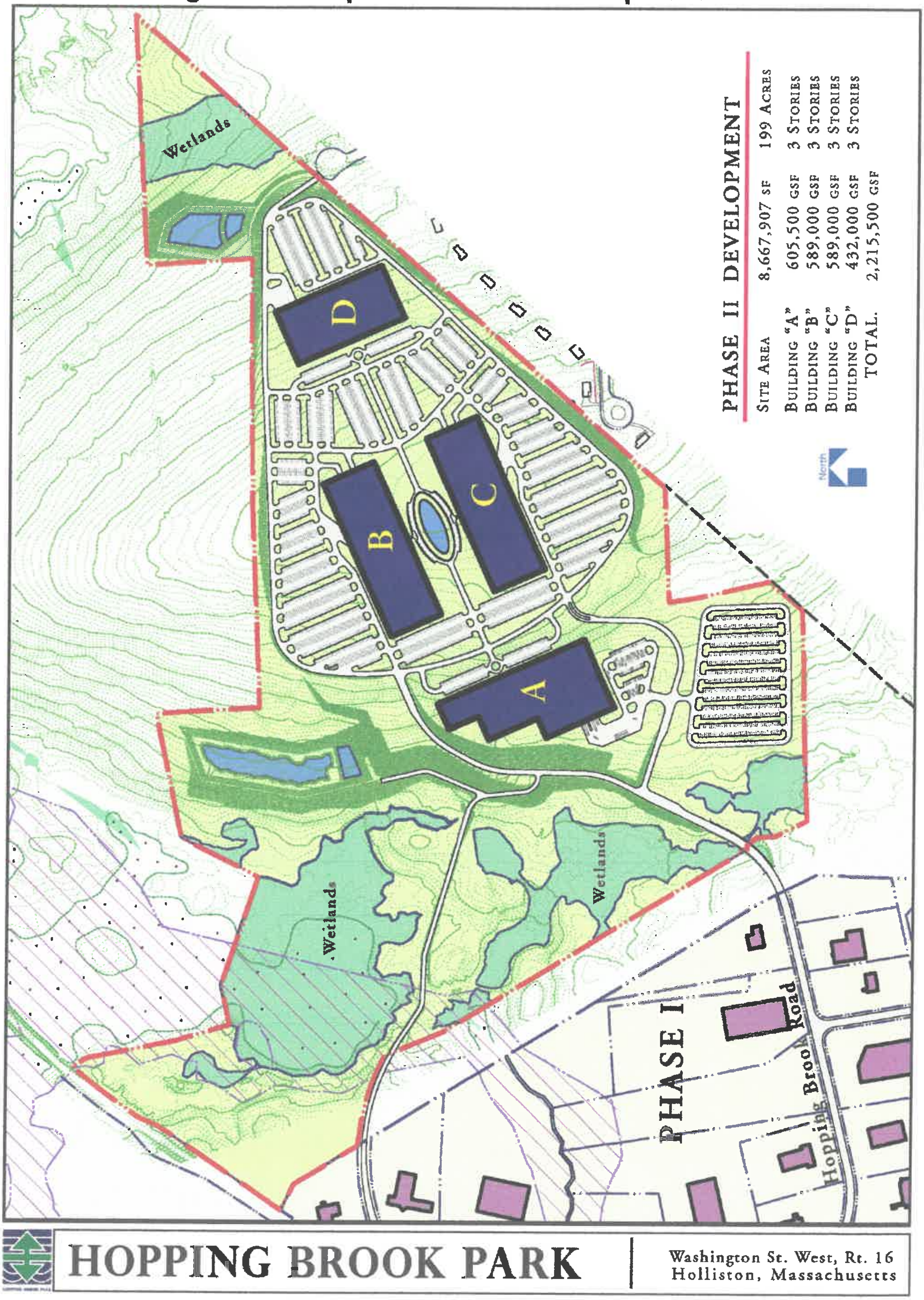


Figure 1-2: Proposed Phase I Development

- A Notice of Project Change was submitted on April 24, 2002 by New Hopping Brook Realty Trust
- Certificate of the Secretary issued May 24, 2002; requested the preparation of a Supplemental Environmental Impact Report (SEIR).

This SEIR includes additional information and analyses requested in the Certificate issued May 24, 2002. The SEIR includes details of the project, wetland resources, mitigation measures for wetland resource impacts, and mitigation for the long-term net benefit to rare species populations. Revised traffic and stormwater analyses, an air quality analysis, and additional information regarding wastewater disposal are also included in the SEIR.

1.2 Project Summary

1.2.1 Site Description

The site is a vacant, wooded lot consisting of a mixed coniferous and deciduous forest. A drumlin is located the central portion of the site. The topography gradually slopes in an easterly direction from the drumlin at an elevation of approximately 336 feet down to 225 feet. The topography slopes from approximately 336 feet to 240 feet in a northwesterly direction from the drumlin then levels out to a wetland. In a southwesterly direction, the topography slopes down to approximately 270 ft and levels out to another wetland. A former gravel pit area is located in the northwest portion of the site. An NSTAR power easement is located along the western boundary of the site. Paths and dirt roads are located on the site. Hopping Brook flows in a southerly direction across the northwest portion of the site. The brook then flows in a southwesterly direction off site.

1.2.2 Project Description

As stated above, the project is currently divided into Phase I and Phase II. Phase II of Hopping Brook Park consists of the development of the remainder of the site; which includes the construction of the access road to the Phase II portion and the construction of additional buildings. The SEIR addresses, in detail, proposed activities and mitigation for the construction of the access road for Phase II (See Proposed Conditions Plan in the Plan Pocket). There will not be any additional environmental impacts, to those described in the SEIR, associated with the construction of the buildings in Phase II. The analyses for traffic and air quality and the estimated quantity of wastewater discharge and water usage are based on the full build out of the site.

Several proposed activities are associated with the construction of the access road; these include clearing, grading, installation of underground utilities, construction of wetland and wildlife habitat mitigation, and construction of the stormwater drainage system. The location of the access road requires a wetland crossing. The alignment of the road has been designed to avoid and minimize impacts to wetland resources to the greatest extent possible. Wetland resources that will be impacted include Bordering Vegetated Wetlands (BVW) and Bank. Impacts to BVW will be mitigated by the construction of a wetland replacement area. Bank impacts will be mitigated by the construction of a rip-rap channel on the north side of the access road and a water quality swale on the south side of the access road. A section of the underground utilities proposed to be installed is in an area on the site that has been identified as Spotted turtle habitat. To minimize impact and maintain an unrestricted migratory pathway for the Spotted turtles, the utilities will be placed in a trench and the trench will be surfaced with gravel. A turtle nesting habitat area will be construction to mitigate for the construction of the trench.

Since the filing of the NPC, additional issues have been addressed and are included in the SEIR. Four-toad salamander habitat has been identified on the site. The proponent's representative has consulted with Natural Heritage and modifications to the project have been made to avoid and minimize impact to the salamander habitat. In addition, a conservation plan to mitigate and protect the habitat of the Four-toed salamander and the Spotted turtle has been submitted to Natural Heritage. The design of the stormwater system has been modified such that the discharge will not impact Hopping Brook; which is identified as a cold water resource. The Division of Fisheries and Wildlife reviewed the stormwater management plan and approved the design.

1.2.3 Description of Resource Areas and Relationship to Proposed Construction

Description of Wetland Resources and Buffer Zones

Wetland resource areas identified on the site that are regulated by the Massachusetts Wetlands Protection Act (MWPA) include Bordering Vegetated Wetlands (BVW), Bank, and Buffer Zone (not considered a resource area). Wetland resource areas identified on the site that are regulated by Holliston Wetland Bylaws include BVW, Bank, Riverfront Area, Buffer Zone (not considered a resource area), Bordering Land Subject to Flooding, Holliston Wetlands (non-state isolated wetlands E and J), Vernal Pool habitat, and Vernal Pool Buffer Zone

The subdivision of the parcels for this project was created prior to November 1, 1996; which is the date the Rivers Protection Act went into effect. As a result, the work within the original subdivision is exempt from the performance standards for Riverfront Area (See Certificate of the Secretary on Page v in the front of the SEIR). Although the performance standards for Riverfront Area apply to land recently acquired by the proponent, all of the Riverfront Area resource is associated with the original subdivision. Work on the newly acquired portion of the project is outside the limits of the Riverfront Area. Although Riverfront Area exists on the site, proposed work in this resource is not reviewed by the state.

The proponent has included information regarding work in the Riverfront Area to clarify all proposed work on the site.

Delineated BVW are associated with Hopping Brook. The Bank resource areas are associated with Hopping Brook and three intermittent streams that were created to control surface water on the site. The Riverfront resource area is associated with Hopping Brook. Two isolated wetlands were delineated on the site. These wetlands do not qualify as state resource areas since they do not hold ¼-acre foot of water, however, they qualify as wetlands under the Holliston Wetlands Bylaw and the Army Corps of Engineers. Bordering Land Subject to Flooding is associated with Hopping Brook. Vernal Pool Habitat and Vernal Pool Buffer Zone are associated with the three certified vernal pools on the site. Spotted turtle (*Clemmys guttata*) and Four-toed salamander (*Hemidactylium scutatum*) habitat have been identified on the site. See Section 6.0 for more information regarding these species.

Proposed Impacts to Wetland Resources and Buffer Zones

Impacts to several wetland resources under the jurisdiction of the Massachusetts Wetland Protection Act (MWPA) and the Holliston Wetlands Bylaw will occur. The impacts include clearing and grading of portions of the site to prepare for the proposed access road, construction of the stormwater facilities, installation of utilities, and the construction of the wetland replacement area and turtle nesting habitat area.

The following table summarizes the square footage of proposed permanent impacts to the resource areas and Buffer Zones under both the MWPA and Holliston Wetlands Bylaw.

Table 5-1. Summary of Resource Area and Buffer Zone Impacts Regulated Under the MWPA and Holliston Wetlands Bylaw

Resource Area and Buffer Zones	**MWPA** (square feet of impact)	**Holliston Wetlands Bylaw** (square feet of impact)
Riverfront Area	14,442	14,442
BVW	3,236	3,236
Freshwater Wetlands (Wetlands E and J)	NA	26,122
Buffer Zone	110,210	147,419
Bank	153	153
Bank Buffer Zone	NA	18,767
Bordering Land Subject to Flooding (not to be impacted; work within 100' of boundary is proposed)	NA	51,074
Vernal Pool Habitat (within 100' of basin)	NA	16,784
Vernal Pool Buffer Zone (100' - 200' of basin)	NA	38,779

NA – wetland resources, specific to this project, not under the jurisdiction of the MWPA

A wetland crossing for the construction of the access road will impact BVW (3,236 square feet) and Bank (153 linear feet). Wetland J, the northernmost isolated non-state wetland, will also be impacted from the construction of the access road. In addition, Wetland E, the southernmost isolated non-state wetland, will be impacted during future build out. The total square footage of the two isolated wetlands is 26,122 square feet (See Table 5.1).

Work is also proposed in the Buffer Zone of BVW under the MWPA. Approximately 110,210 square feet will be impacted from clearing and grading activities. Under the Holliston Wetlands Bylaw, 147,419 square feet of clearing and grading activities will in the Buffer Zone and in the Adjacent Upland Resource Area (i.e. areas within 100 feet of BVW, other Freshwater Wetlands, Bank and Bordering Land Subject to Flooding and areas within 200 feet of the Mean Annual High-Water Line of Hopping Brook).

There are no proposed impacts to the three certified vernal pools under the MWPA. Under the Holliston Wetlands Bylaw, approximately 16,784 square feet of upland vernal pool habitat (within 100 feet of basin boundary) and 38,779 square feet of buffer zone to the vernal pool (100 – 200 feet from basin boundary) will be impacted. Proposed work in these areas include clearing, grading, installation of utilities, creation of the Spotted turtle nesting habitat with a groundwater infiltration system beneath it, and placement of a level spreader for discharge of clean stormwater from a detention basin.

No proposed work will be located within Bordering Land Subject to Flooding. The only activity that will occur in the floodplain is placement of haybales to define limit of work. A total of 51,074 square feet of work is proposed within 100 feet of the boundary. The proposed work includes, 4,059 square feet of grading; 6,625 square feet of clearing; and 40,390 square feet of utility installation. Most of this work is also located in Riverfront Area. Mitigation is not proposed for this work.

The Holliston Conservation Commission, issued an Order of Conditions, on April 30, 2003, for the proposed work and mitigation for Phase II.

1.2.4 Potential Environmental Impacts and Mitigations

Proposed impacts to the wetland resource areas and buffer zones are described above. This section includes the mitigation measures for those impacts. In addition, this section describes proposed impacts and mitigation measures for work in rare species habitat as well as impacts and mitigation for traffic, stormwater, and wastewater.

Wetland Resources, Buffer Zones, and Rare Species
The mitigation package was developed with recommendations from the Holliston Conservation Commission and the Natural Heritage and Endangered Species Program. The proposed mitigation package will provide:

- replacement of wetland resources areas under the MWPA and Holliston Wetlands Bylaw
- construction of a vernal pool, vernal pool habitat, and vernal pool buffer zone (under the Holliston Wetlands Bylaw) for proposed work in these existing areas
- long-term net benefits to rare species identified on the site; benefits

A constructed wetland replacement area, 14,263 square feet in size, is proposed as mitigation for impacts to BVW (state and local wetlands) due to the wetland crossing for the access road and filling of Wetlands E and J (isolated non-state wetlands under the jurisdiction of the Holliston Wetlands Bylaw). Bank will be impacted due to the wetland crossing. Mitigation will consist of the construction of a rip-rap channel on the north side of the access road and a water quality swale on the south side of the access road for a total of 270 linear feet of replacement. In addition, box culverts will be placed under the access road in the location of the two existing Bank resource areas. The proposed mitigation package is designed to protect resource areas from long-term impacts where work is proposed in the adjacent Buffer Zone and Adjacent Upland Resource Area. The elements to protect the resource areas include: 1) stormwater management system designed to avoid the discharge of untreated water to areas adjacent to resource areas as well as directly into resource areas, 2) installation of erosion and sediment control measures to prevent siltation into resource areas until vegetation is re-established, 3) placing a Conservation Restriction on rare species habitat located in Buffer Zone and in the Adjacent Upland Resource Area

Traffic

A revised traffic analysis was conducted and the results show that two intersections in the study area may require improvement with full build out of Phase II. The intersections and proposed mitigation include:

Route 16 at Central Street
The Level of Service, during both morning and evening peak hours, can be improved to level *D* and *C*, respectively, from the current level of service *F*. The proposed improvements include signalizing the intersection and adding turn lanes in both directions along Route 16. Likely, the edge of pavement will not require alterations since the existing lane widths appear sufficient to provide the additional lanes.

Route 16 at Route 126 (South)
Signalizing the intersection and creating a left-turn lane westbound along Route 16 will result in increased Level of Service to *B* during the morning

peak hour and *E* during the evening peak hours. To significantly improve this intersection to a higher Level of Service would likely require land-takings and roadway widening.

Stormwater

Clearing and grading of the site for the proposed work will alter stormwater runoff patterns. The stormwater management plan is designed to meet the standards in the DEP Stormwater Management Policy, Holliston Wetlands Bylaw Regulations, and the Holliston Board of Health Stormwater and Runoff regulations. In addition, the stormwater management system has been designed to meet the criteria in the Surface Water Quality Regulations for Class B cold water resources. The design has been approved by the Division of Fisheries and Wildlife and is considered to not pose a significant risk to Hopping Brook (See correspondence in Appendix F).

Wastewater

An on-site wastewater treatment facility, with on-site disposal, is proposed for Phase II. The impacts of this proposed method will be clearing and grading of the areas where the facility and disposal sites will ultimately be located. If some of the areas are located within the Buffer Zone of wetlands, the proponent will file an NOI with the Holliston Conservation Commission. Appropriate erosion and sedimentation control will be installed where required.

The suitability of the proposed areas to be utilized as disposal sites was determined by field investigations that included analysis of test pits and soil borings, groundwater well installation and monitoring, and conducting the 10-day loading test. The results of the investigations support the use of the proposed areas as disposal sites.

1.2.5 Required Permits and Status

AGENCY	PERMIT	STATUS
Holliston Conservation Commission	-Order of Conditions (work associated with the entrance road, drainage, utilities, and replication within Hopping Brook Phase II)	April 30, 2003
Holliston Building Department	Building Occupancy	Anticipating Anticipating
Natural Heritage and Endangered Species Program	Conservation Permit Request	Anticipating
DEP	Major Groundwater Discharge Permit	Anticipating
MA Highway Department	Highway Access Permit	Anticipating
Environmental Protection Agency	NPDES Construction Permit	Proponent will file prior to commencement of work

2.0 SUMMARY OF FEIR

2.1 Introduction

The Final EIR was approved on June 14, 1983 (see Certificate of the Secretary on Page x in the front of the SEIR). The original project was located on 281 acres of wooded land in the southwest portion of Holliston, Massachusetts. The proposed project called for the construction of a multi-use development covering 3 million square feet of floor space to be utilized for office, research and development, and high technology assembly purposes. Parking consisted of 9,684 spaces. Total area of the buildings, parking areas, and access roads totaled approximately 146 acres. The project was to be serviced by on-site septic systems.

The stormwater management system consisted of two detention basins to be located within two existing wetland areas. The wastewater disposal method was subsurface leaching systems for each building. The internal roadway system was a four-lane road in a circular pattern that was to cross a wetland and pass through spotted turtle habitat. Water supply to the site was estimated to be 250,000 gallons per day.

3.0 SUMMARY OF NOTICE OF PROJECT CHANGE

3.1 Introduction

The proponent filed a Notice of Project Change (NPC) in April 2002. The Secretary of Environmental Affairs issued a Certificate for the NPC on May 24, 2002 (see Page v in the front of the SEIR). The purpose of the NPC was to revise the original project (proposed in the FEIR, approved June 14, 1983) to meet current regulatory standards. The currently proposed project presents several changes that will provide for less impact and that are improvements to the previously certified project.

3.2 Project Changes and Improvements

Section 2.0 describes the previously certified project. The material changes and improvements to the FEIR include the following:

- The proponent has purchased an abutting lot; which is approximately 85.4+/- acres in size and is located within the northern portion of the Phase II area. A portion of the proposed buildings will be located on this lot. The addition of this new lot will create a business park with more open space and a campus-like atmosphere to reduce the density of the building layout.

- A new internal roadway system for the project has been proposed. The layout has been modified and the length has been reduced from 1.9 miles to 0.23 miles. This change will minimize the impact to Spotted turtle habitat. (Since the submission of the NPC, Four-toed salamander habitat has been identified on the site. Subsequently, the project has been modified to avoid Four-toed salamander habitat).

- The prior proposed wastewater disposal method was subsurface leaching systems for each building. The current proposal for wastewater disposal is a centralized on-site treatment plant.

- Two stormwater detention basins were proposed to be located in the wetlands. Since the implementation of the Surface Water Quality Standards Regulations, no discharges of untreated stormwater will occur in wetlands. In addition, the stormwater system was designed to meet the DEP Stormwater Policy. This will increase water quality discharge and decrease impact to the wetlands. The revised stormwater management system was designed to utilize one detention basin for the construction of the access road. Since the filing of the NPC, the stormwater management system has been revised.

Wildlife habitat was not identified in the previous filing. After the completion of a spotted turtle habitat assessment, it was concluded that spotted turtle habitat does exist on the site. The original project proposed a four-lane paved road, 60 feet wide, to be located in the area of the spotted turtle habitat. The current project proposes less impact to the environment by placing only the water and sewer pipes in this area. In addition, the current project proposes to enhance spotted turtle habitat by creating a spotted turtle nesting area.

3.2 Proposed Impacts and Mitigation

Wetland Resources

Bordering Vegetated Wetlands, Bank, two non-state isolated wetlands, and Riverfront Area were proposed to be impacted by the proposed construction. The construction of the access road required a wetland crossing, which will impact BVW and Bank. The mitigation proposed for the wetland crossing is the construction of two wetland replication areas. The replication areas are designed to also offset the impact to the two non-state isolated wetlands. Riverfront Area will be altered by clearing, grading, and trenching activities for the installation of the utilities in the northern portion of the site.

Spotted Turtle Habitat

The previously proposed paved road was located in the area of the site designated as Spotted turtle habitat. Placement of the road in this location would have disrupted the spotted turtle habitat by creating a barrier between the two wetland areas identified as utilized by the spotted turtles.

Mitigation measures include minimizing the use of the road as an emergency access, placing the utilities below the emergency road, and maintaining a gravel surface on the road. In addition, the following measures will reduce the impact to Spotted turtle habitat and enhance the existing habitat:

- Design the project to avoid direct impacts to wetland habitat utilized by the spotted turtles.
- Clearing and trenching work will be done in the winter to avoid interference of spotted turtle migration
- Supplement the existing nesting areas with an approximate ½ acre area; which should be composed of a sandy substrate void of woody vegetation.
- The supplemental area should be located along the existing gravel road in areas where nesting was confirmed as well as areas where nesting was attempted.
- Periodic cleaning of the supplemental area is recommended to maintain open area preferable for nesting habitat of the spotted turtle.

The proposed turtle nesting area is designed to provide nesting habitat in the area currently used by the spotted turtles (the existing gravel road). The recommendation to maintain the nesting area as an open area is essential since the cleared area along the existing gravel road is slowly being overgrown and will eventually be shaded by the encroaching vegetation.

Traffic Update

This traffic update was conducted to determine any changes to the traffic patterns since 1983 when the Final EIR was reviewed. The results concluded that a significant change in the traffic pattern is not anticipated. The results showed that peak morning hour vehicle trips would increase by 22%; however, the evening hour vehicle trips would be 17% less than the previously projected number and the traffic volume would be 16% lower than originally projected. The previously proposed upgrade of the intersection; which included additional lanes and a signal, remains the same. The traffic mitigation package will remain the same as presented in the original FEIR. The results of this analysis confirm that the original mitigation package will adequately accommodate the remaining construction of the proposed project.

4.0 REVISED TRANSPORTATION STUDY AND AIR QUALITY ANALYSIS

The Certificate of the Secretary on the Notice of Project Change, issued May 24, 2002, requested an updated traffic analysis and an air quality mesoscale analysis for volatile organic compounds to be conducted. The certificate requested that the traffic analysis be prepared in accordance with the EOEA/EOTC Guidelines and used to analyze impacts to the Route 16 corridor to determine if the previously proposed mitigation is sufficient under the current conditions. In addition, the Certificate requested that the air quality mesoscale protocols be consistent with the DEP Division of Air Quality Control. The complete traffic analysis for transportation, dated July 2003, was prepared by Abend Associates, Inc., and is presented in Appendix A. Abend Associates, Inc. consulted with the MassHighway Department District 3 Office to determine the scope of the project and the scope of the study area. Appendix B presents the Mesoscale Analysis, dated June 2003, prepared by Epsilon Associates, Inc.

4.1 Transportation

Since the time the original project was certified in 1983, traffic conditions along local streets and the nearby regional highways have changed. The study area for the analysis was developed at the direction of the MassHighway Department District 3 Office. Information on trip generation relies on ITE data as well as information for the existing 558,000 square feet of development associated with Phase I.

This section presents a summary of the Revised Transportation Report focusing on the projected impacts of the project on the Route 16 corridor and proposed mitigation. Twelve intersections in the towns of Milford and Holliston were evaluated. Two intersections and the entrance to the park are recommended to be improved. The proponent is prepared to work with the towns and the state to design and construct the appropriate improvements.

4.1.1 Impact Analysis

The study area intersections have been evaluated based on the **2000 Highway Capacity Manual** using **Synchro 5** software. The methodology incorporates the geometric and volume related data at an intersection and computes a Level of Service, which provides a "grade" for the intersection's operations. The Level of Service grade is based on the average delay per vehicle entering along each approach or entering the intersection as a whole. Grades range from *A*, representing free-flow conditions, to *F* representing over-capacity conditions where long delays occur. A grade of *E* represents close to capacity conditions where flows are unstable and congestion could likely occur. An overall intersection Level of Service grade of *D* or better is considered by traffic engineering professionals to be acceptable for peak hour conditions. Intersections that were evaluated in the analysis include:

- Route 85 at Route 495 northbound ramps, Milford
- Route 85 at Route 495 southbound ramps, Milford
- Route 85 at Dilla Street/Fortune Boulevard, Milford
- Route 16 at Fortune Boulevard/Beaver Street, Milford
- Route 16 at Route 109, Milford
- Route 109 at Beaver Street/Beaver Street Extension, Milford
- Route 109 at Route 495 southbound ramps, Milford
- Route 109 at Route 495 northbound ramps, Milford
- Route 16 at Route 126 (North), Holliston
- Route 16 at Central Street, Holliston
- Route 16 at Route 126 (South), Holliston
- Route 16 at Hopping Brook Road, Holliston

The Level of Service results indicate that the proposed project estimated traffic flows will not significantly impact the intersections in Milford. The Level of Service remained at acceptable levels during both the morning and evening peak hours (See Exhibits 12 and 13 in Appendix A). Development is on-going along the 495 corridor and improvements to intersections are concurrent. The Level of Service results indicate that two intersections, in addition to the entrance to Hopping Brook Road, along Route 16 in Holliston may require improvement. These intersections include:

- Route 16 at Central Street
- Route 16 at Route 126 (South)

4.1.2 Proposed Mitigation

Recommended improvements to the two intersections listed above include:

Route 16 at Hopping Brook Road
The proposed improvements to this intersection include signalizing and adding dedicated turn lanes in both directions along Route 16. The Level of Service during the morning and evening peak hours is estimated to be *B* and *D*, respectively, with these changes.

Route 16 at Central Street
The Level of Service, during both morning and evening peak hours, can be improved to level *D* and *C*, respectively, from the current level of service *F*. The proposed improvements include signalizing the intersection and adding turn lanes in both directions along Route 16. Likely, the edge of pavement will not require alterations since the existing lane widths appear sufficient to provide the additional lanes.

Route 16 at Route 126 (South)
Signalizing the intersection and creating a left-turn lane westbound along Route 16 will result in increased Level of Service to *B* during the morning peak hour and *E* during the evening peak hours. To significantly improve this intersection to a higher Level of Service would likely require land-takings and roadway widening.

4.1.3 Proposed Mitigation Commitments

The proponent is prepared to provide the design and construction for improvements to the intersection of Route 16 and Hopping Brook Road. The proponent is prepared to work with MassHighway Department District 3 and the Town of Holliston to develop appropriate designs for the intersections at Route 16 at Central Street and Route 16 at Route 126 (South). In addition, the proponent is prepared to participate in the design and/or funding of the improvements to these intersections.

Although the project location may not support a typical Travel Demand Management (TDM) Program, an alternative approach for mitigating traffic impacts from the proposed project is available. The proponent is prepared to designate a transportation coordinator for the proposed Phase II portion of Hopping Brook Park. The transportation coordinator will work with the various businesses to encourage carpooling and ridesharing between employees of the various companies on the site, will provide information on the limited transit services, and provide other information related to typical TDM programs. If allowable under the Holliston Zoning Bylaws, the proponent will encourage developers of the individual parcels to consider offering on-site services that accommodate on-site employees and businesses to minimize the number of vehicle trips per day as much as practicable. Examples of services include a coffee shop, an ATM, and cafeteria. See Appendix A for more detailed information.

4.2 Air Quality

The Certificate of the Secretary on the Notice of Project Change requested that a mesoscale analysis for volatile organic compounds be conducted because the proposed project exceeds the 3,000 vehicle trips per day threshold in the MEPA regulations. The complete mesoscale analysis is presented in Appendix B. This section provides a summary of the report.

The mesoscale analysis includes (1) an estimate of the volatile organic carbon (VOC) emissions associated with all project-related vehicle trips, (2) a demonstration that the VOC emissions associated with the Build condition will be less than those of the existing condition in both the short and long term, and (3) mitigation measures. The Massachusetts Department of Environmental Protection was consulted for guidance as well as confirmation of the study area prior to conducting the analysis. The modeling methodology for the mesoscale analysis was developed in accordance with the MA DEP guidelines. A modeling protocol was submitted to MA DEP on March 25, 2003 and approved on April 3, 2003 by Keith Grillo, Regional Planner.

The analysis was conducted at eight intersections. The intersections were chosen because they met one of two of the following criteria: (1) the intersection has a Level of Service *D* where the project increases traffic volumes by 10% or greater or (2) the intersection operates at Level of Service *E* or *F* and the project degrades the location. The analysis was performed at the following intersections:

- Route 16 at Hopping Brook Road
- Route 16 at Route 126 South
- Route 16 at Central Street
- Route 85 at dilla/Fortune
- Route 85 at Route 495 northbound ramps
- Route 85 at Route 495 southbound ramps
- Route 109 at Beaver Street/Beaver Street Expansion
- Route 16 at 109

The results of the analysis show that the daily VOC emissions for the 2008 Build condition will be greater than the daily VOC emissions for the 2008 No-Build condition. The increase in VOC emissions is 13% and 16% for the morning and evening peak hours, respectively. The results show that the daily VOC emissions for the 2008 Build condition will be less than the existing conditions due to cleaner, more efficient vehicles. The reduction in emissions is 28% and 22% for the morning and evening peak hours, respectively. The following table summarizes the results. The complete table is presented in Appendix B.

Table 4-1 Summary of Mesoscale Analysis

Pollutant	Time	Full Build* (2008)	No-Build* (2008)	% Difference Build-No Build	Existing*	% Difference Build-Existing
VOC	AM peak	2,429.7	2,155.8	13%	3,114.8	-28%
	PM peak	2,736.8	2,369.5	16%	3,338.5	-22%
NOx	AM peak	5,172.6	4,589.6	13%	6,916.5	-34%
	PM peak	5,826.5	5,044.6	16%	7,413.1	-27%

Note: *results are in grams/hr

5.0 REVISED WETLANDS, FLOODPLAINS, AND RIVERFRONT AREA

The Certificate of the Secretary for the Notice of Project Change, issued May 24, 2002, requested that the Order of Conditions for the Notice of Intent submitted on March 8, 2002 be included in the Supplemental EIR. An Order of Conditions has been issued and is presented in Appendix C. The Certificate also requested a description of floodplain mitigation. Proposed work in the floodplain was incorrectly indicated in the Notice of Project Change. Work is not proposed in the floodplain. This section includes a description of existing conditions and information concerning proposed conditions and mitigation measures for proposed work that has been added since the issuance of the Certificate.

The subdivision of the parcels for this project was created prior to November 1, 1996; which is the date the Rivers Protection Act went into effect. As a result, the work within the original subdivision is exempt from the performance standards for Riverfront Area (See Certificate of the Secretary on Page v in the front of the SEIR). Although the performance standards for Riverfront Area apply to land recently acquired by the proponent, all of the Riverfront Area resource is associated with the original subdivision. Although Riverfront Area exists on the site, proposed work in this resource is not reviewed by the state. The proponent has included information regarding work in the Riverfront Area to clarify all proposed work on the site.

5.1 Existing Conditions

Phase I of Hopping Brook Park consists of the buildings and infrastructure that have been constructed to date (See Figure 1-2). The Phase I portion is almost complete. Phase II of Hopping Brook Park is the currently proposed project. Work has not started for this phase.

The portion of the site where Phase II is to be constructed is a vacant, wooded lot consisting of a mixed coniferous and deciduous forest. A drumlin is located the central portion of the site. The topography gradually slopes down in all directions away from the top of the drumlin; which is at an elevation of approximately 372 feet. In the northwesterly and southwesterly directions, the drumlin slopes to wetlands associated with Hopping Brook. A former gravel pit area is located in the northwest portion of the site. A power easement, owned by NStar, is located along the western boundary of the site. Paths and dirt roads are located on the site. Hopping Brook flows in a southerly direction across the northwest portion of the site. The brook then flows in a southwesterly direction off site.

Wetland resource areas identified on the site that are regulated by the Massachusetts Wetlands Protection Act (MWPA) include Bordering Vegetated

Wetlands (BVW), Bank, and Buffer Zone (not considered a resource area). Wetland resource areas identified on the site that are regulated by Holliston Wetland Bylaws include BVW, Bank, Riverfront Area, Buffer Zone (not considered a resource area), Bordering Land Subject to Flooding, Holliston Wetlands (non-state isolated wetlands E and J), Vernal Pool habitat, and Vernal Pool Buffer Zone. BVW and wetlands E and J were established by an Order of Resource Area Delineation (DEP# 185-524). Additional BVW and the Mean Annual High Water Line of Hopping Brook were established by an Order of Resource Area Delineation (DEP# 185-538).

Delineated BVW are associated with Hopping Brook. The Bank resource areas are associated with Hopping Brook and three intermittent streams that were created to control surface water on the site. The Riverfront resource area is associated with Hopping Brook. Two isolated wetlands were delineated on the site. These wetlands do not qualify as state resource areas since they do not hold ¼-acre foot of water, however, they qualify as wetlands under the Holliston Wetland Bylaw and the Army Corps of Engineers. Bordering Land Subject to Flooding is associated with Hopping Brook. Vernal Pool Habitat and Vernal Pool Buffer Zone are associated with the three certified vernal pools on the site. Spotted turtle (*Clemmys guttata*) and Four-toed salamander *(Hemidactylium scutatum)* habitat have been identified on the site. See Section 6.0 for more information regarding these species.

5.2 Proposed Conditions

As described in Section 1.0 and shown on Figure 1-1, Hopping Brook Park consists of two phases. Phase I, as described above is almost complete. Phase II is the proposed work described in this SEIR. The construction of Phase II will be phased. The construction of the access road, stormwater management facilities, wetland and wildlife mitigation, and associated activities (i.e. clearing and grading) will occur first. Construction of the buildings and the remaining infrastructure will follow at a later date. Impacts to several wetland resources under the jurisdiction of the Massachusetts Wetland Protection Act (MWPA) and the Holliston Wetlands Bylaw, will occur. The impacts include clearing and grading of portions of the site to prepare for the proposed access road, construction of the stormwater facilities, installation of utilities, and the construction of the wetland replacement area and turtle nesting habitat area. All impacts to wetland resource for the entire Phase II project have been identified. Mitigation for impacts will be provided during construction of the currently proposed phase of work. As outlined in the Order of Conditions (See Section 5.4), mitigation will be provided for impacts to BVW, Bank, and two non-state isolated wetlands. This mitigation includes replication for future impact to one of the non-state isolated wetlands, Wetland E. Any additional work in Buffer Zone, either under the MWPA or Holliston Wetlands Bylaw, will require a Notice of Intent. No additional wetland resource impacts are proposed for the future development. The full build out will occur in upland areas on the site.

The following table summarizes the square footage of proposed permanent impacts to the resource areas and Buffer Zones under both the MWPA and Holliston Wetlands Bylaw.

Table 5-1. Summary of Resource Area and Buffer Zone Impacts Regulated Under the MWPA and Holliston Wetlands Bylaw

Resource Area and Buffer Zones	MWPA (square feet of impact)	Holliston Wetlands Bylaw (square feet of impact)
Riverfront Area	14,442	14,442
BVW	3,236	3,236
Freshwater Wetlands (Wetlands E and J)	NA	26,122
Buffer Zone	110,210	147,419
Bank	153	153
Bank Buffer Zone	NA	18,767
Bordering Land Subject to Flooding (not to be impacted; work within 100' of boundary is proposed)	NA	51,074
Vernal Pool Habitat (within 100' of basin)	NA	16,784
Vernal Pool Buffer Zone (100' - 200' of basin)	NA	38,779

NA – wetland resources, specific to this project, not under the jurisdiction of the MWPA

Riverfront Area in the northern portion of the site will be altered by the installation of the proposed utility easement; which will be constructed to pass under Hopping Brook. The utility easement will be north of the existing gravel road. Riverfront Area will be impacted by clearing and trenching activities. The following table summarizes the area of proposed work in the Riverfront Area.

Table 5-2. Proposed Alterations in Riverfront Area

Existing Area	Riverfront Area Alterations (square feet)		
	within 100' 275,938	**within 200'** 293,073	**Total** 569,011
Clearing	0	1,702	1,702
Trenching	3,738	9,002	12,740
Total Alteration	3,738	10,704	14,442

A wetland crossing for the construction of the access road will impact BVW (3,236 square feet) and Bank (153 linear feet). Wetland J, the northernmost isolated non-state wetland, will also be impacted from the construction of the access road. In addition, Wetland E, the southernmost isolated non-state wetland, will be impacted during future build out. The total square footage of the two isolated wetlands is 26,122 square feet (See Table 5-1).

Work is also proposed in the Buffer Zone of BVW under the MWPA. Approximately 110,210 square feet will be impacted from clearing and grading activities. Under the Holliston Wetlands Bylaw, 147,419 square feet of clearing and grading activities will in the Buffer Zone and in the Adjacent Upland Resource Area (i.e. areas within 100 feet of BVW, other Freshwater Wetlands, Bank and Bordering Land Subject to Flooding and areas within 200 feet of the Mean Annual High-Water Line of Hopping Brook).

There are no proposed impacts to the three certified vernal pools under the MWPA. Under the Holliston Wetlands Bylaw, approximately 16,784 square feet of upland vernal pool habitat (within 100 feet of basin boundary) and 38,779 square feet of buffer zone to the vernal pool (100 – 200 feet from basin boundary) will be impacted. Proposed work in these areas include clearing, grading, installation of utilities, creation of the Spotted turtle nesting habitat with a groundwater infiltration system beneath it, and placement of a level spreader for discharge of clean stormwater from a detention basin.

5.3 Proposed Mitigations

The proposed mitigation package will provide:

- replacement of wetland resources areas under the MWPA and Holliston Wetlands Bylaw
- construction of a vernal pool, vernal pool habitat, and vernal pool buffer zone (under the Holliston Wetlands Bylaw) for proposed work in these existing areas
- long-term net benefits to rare species identified on the site; benefits include:
    - habitat enhancement
    - conservation Restriction on rare species habitat
    - development of monitoring programs for habitat use

The mitigation package was developed with recommendations from the Holliston Conservation Commission and the Natural Heritage and Endangered Species Program. The details of mitigation for the Spotted turtle and Four-toad salamander are discussed in Section 6.0 of this report.

BVW

A constructed wetland replacement area is proposed as mitigation for impacts to BVW (state and local wetlands) due to the wetland crossing for the access road and filling of Wetlands E and J (isolated non-state wetlands under the jurisdiction of the Holliston Wetlands Bylaw). The wetland replacement area will be 14,263 square feet in size; which is 11,027 square feet greater than the proposed impact to the state-regulated wetlands. The replacement area will be located approximately 260 feet south of certified vernal pools 2807 and 2808 and to the east of the Nstar Easement. Figure 5-1 shows the layout of the replacement area and the Proposed Conditions Plan shows the location of the replacement area on the site. The construction of the replacement area will begin after installation of appropriate erosion controls in work areas and the placement of anti-tracking pads at the north and south entrances. No other construction will begin until the replacement area is complete.

Bank
Approximately 153 linear feet of Bank will be impacted due to the wetland crossing. Mitigation will consist of the construction of a rip-rap channel on the north side of the access road and a water quality swale on the south side of the access road for a total of 270 linear feet of replacement (Figure 5-2). In addition, box culverts will be placed under the access road in the location of the two existing Bank resource areas. The box culverts will maintain storm damage prevention and flood control functions of the existing Bank resources.

Buffer Zone
The proposed mitigation package is designed to protect resource areas from long-term impacts where work is proposed in the adjacent Buffer Zone and Adjacent Upland Resource Area. The elements to protect the resource area include:

- design of the stormwater management system to avoid the discharge of untreated water to areas adjacent to resource areas as well as directly into resource areas
- installation of erosion and sediment control measures to prevent siltation into resource areas until vegetation is re-established
- a Conservation Restriction on rare species habitat located in Buffer Zone and in the Adjacent Upland Resource Area

5.4 Order of Conditions

A Notice of Intent (NOI) was originally submitted to the Holliston Conservation Commission on March 8, 2002. It was revised and resubmitted to the Commission on April 18, 2002 and January 29, 2003. The final NOI was submitted on March 13, 2003. An Order of Conditions was issued on April 30, 2003 for the NOI and is presented in Appendix C. Areas where work is proposed are significant to the following interests of the MWPA and will be protected by the conditions listed in the Order.

- Public Water Supply
- Private Water Supply
- Groundwater Supply
- Fisheries
- Storm Damage Prevention
- Prevention of Pollution
- Protection of Wildlife Habitat
- Flood Control

Figure 5-1. BVW Replication Area
(from NOI dated March 13, 2003 prepared by Oxbow Associates, Inc.)

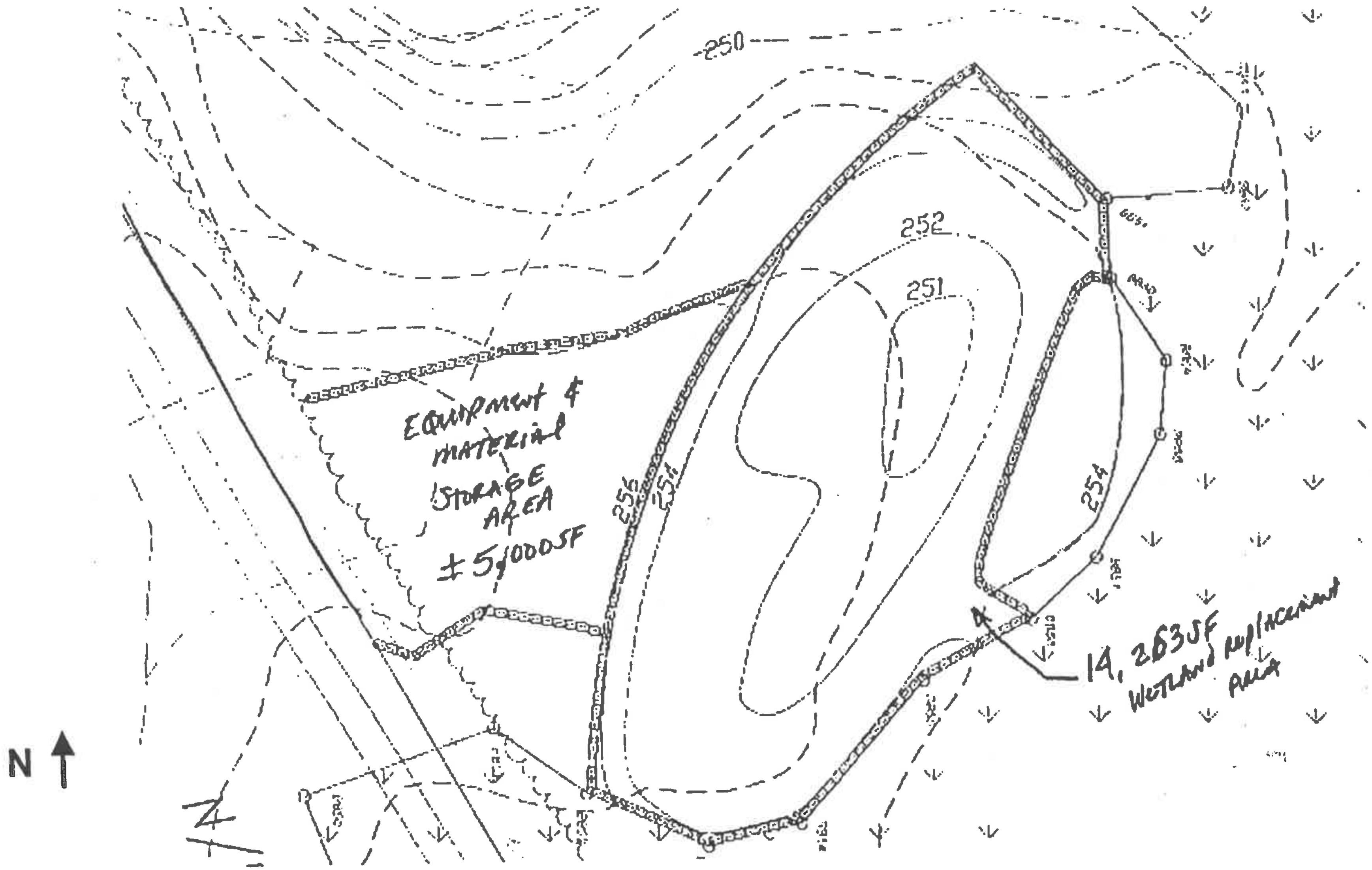
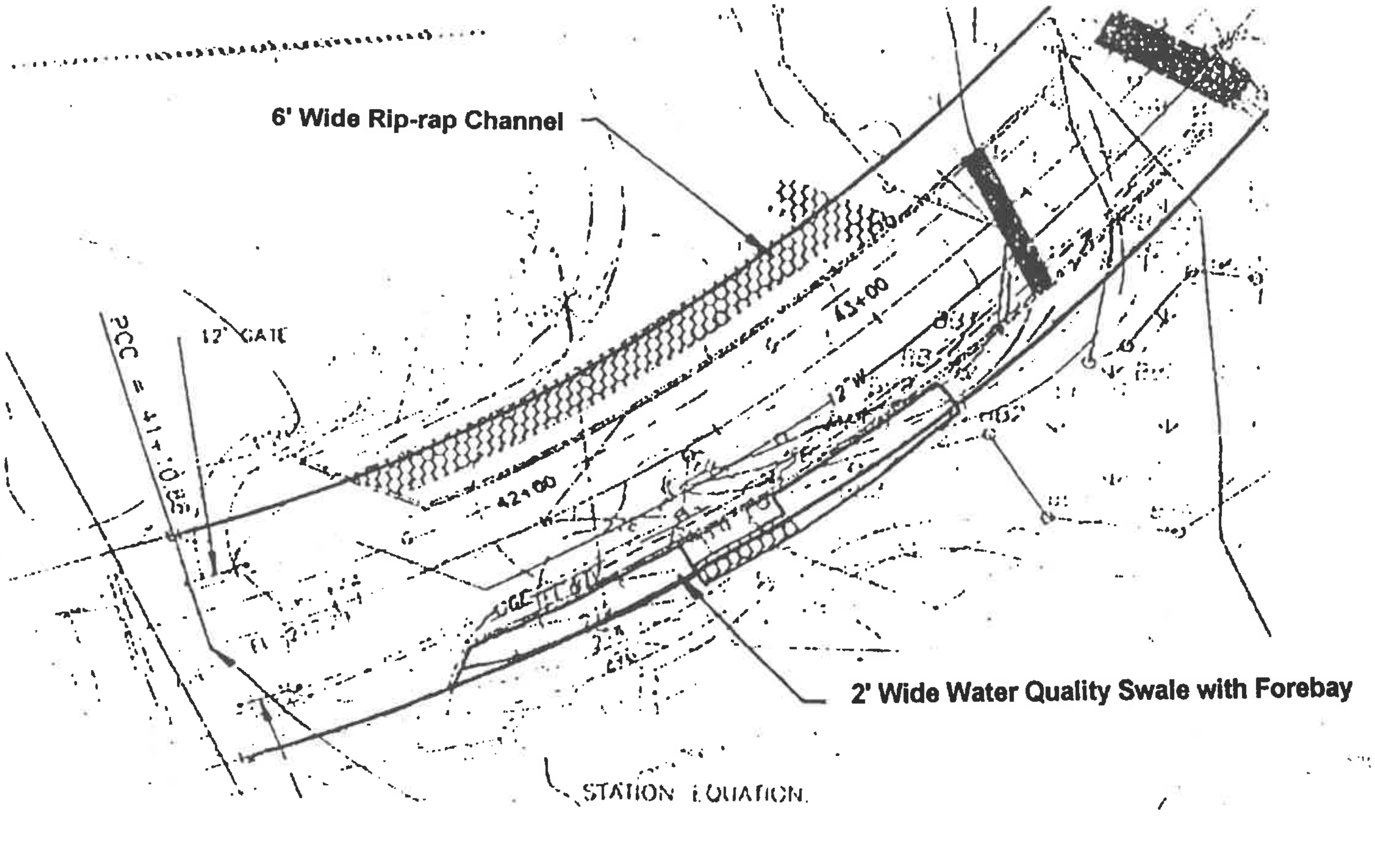


Figure 5-2. Bank Replication Areas
(from NOI dated March 13, 2003 prepared by Oxbow Associates, Inc.)



The Holliston Conservation Commission determined that all proposed mitigation will protect the interests and meet the performance standards in the Town of Holliston Wetlands Bylaw.

5.5 Proposed Work Outside of Floodplain

The Certificate of the Secretary for the SEIR requested more detailed information describing the floodplain alterations and the proposed mitigation. The boundary of floodplain (Bordering Land Subject to Flooding) is defined in the Wetland Protection Act 310 CMR 10.57(2)(a)(3) as "the estimate maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm." Section VI of the Order of Conditions confirms that the Phase II portion of the Hopping Brook Park project will not alter land within the 100-year floodplain boundary. The only activity that will occur in the floodplain is the placement of haybales along a portion of the existing dirt path that is located in the floodplain. The haybales define the limit of work and are used as a measure of sediment and erosion control. The existing dirt path will be used as an access way to the wetland replacement area and the turtle nesting habitat area. A total of 51,074 square feet of work is proposed within 100 feet of the floodplain boundary. The proposed work includes, 4,059 square feet of grading; 6,625 square feet of clearing; and 40,390 square feet of utility installation. Most of this work is also located in Riverfront Area. Mitigation is not proposed for this work.

6.0 REVISED ENDANGERED SPECIES

The Certificate of the Secretary for the Notice of Project Change, issued May 24, 2002, requested a description of proposed mitigation for rare species and how the proposed project will result in a long-term benefit to the conservation of rare species populations on the site. Requested in the Certificate was close coordination with the Natural Heritage and Endangered Species Program (NHESP) while developing the mitigation. As a result, a Conservation Permit Request has been prepared that includes mitigation and the long-term net benefits of the proposed project to the Spotted Turtle (*Clemmys guttata*) and the Four-toed Salamander (*Hemidactylium scutatum*) populations.

6.1 Summary of Conservation Permit Request

The proponent has worked closely with NHESP to develop the Conservation Permit Request. The original Permit Request, prepared by Oxbow Associates, Inc., was submitted on September 23, 2002 and a revised Permit Request submitted November 1, 2002. The final Conservation Permit Request, dated May 1, 2003, was submitted to NHESP on May 8, 2003. The proponent has avoided impacts, to the greatest extent possible, to the wetland and upland areas utilized by the Spotted turtle and Four-toed salamander. The mitigation measures discussed in the Conservation Permit Request will avoid long and short term adverse impacts to wetland habitat and improve and protect existing habitat areas for the Spotted turtle and Four-toed salamander. The mitigation measures to be implemented will provide a "net benefit" to the Spotted turtle and Four-toed salamander populations on the site.

Proposed elements of the Request for the Spotted turtle include the creation of a nesting habitat area, monitoring of the nesting habitat area, placing predator exclosures over turtle nests, and monitoring of the 4' x 11' box culvert to be located beneath the proposed access road. Proposed elements for the Four-toed salamander population include a detailed migration monitoring program and a Conservation Restriction on the breeding and upland habitat this species utilizes on the site.

6.2 Impacts to Spotted Turtle Habitat

The proposed work has avoided impact to the habitat of the Spotted turtle to the greatest extent possible. Work in the upland areas used by the Spotted turtle include clearing and grading for the utility trench, installation of the utilities, and construction of a nesting habitat. Spotted turtles currently utilize the existing gravel path as a nesting habitat area. This area was cleared during previous on-site activities; which created a sandy, open area conducive for Spotted turtle nesting.

6.2.1 Mitigation and Long-Term Net Benefit for the Spotted Turtle

The proposed project has been designed to comply with the performance standards for rare and endangered species wetland habitat in the MWPA (310 CMR 10.59) and the Holliston Bylaw (Regulations Section 6.3.2.4 No Significant Adverse Impact on Wildlife Habitat). The proposed project also complies with the criteria for avoidance of "taking" as defined in the Massachusetts Endangered Species Act (MGL Ch. 131A). The proposed mitigation to provide long-term net benefits to the Spotted turtle population includes creating a nesting habitat area, maintaining corridors between feeding and aestivation areas, developing a post-construction monitoring program of the nesting area, and placing predator exclosures over nests.

The nesting habitat will eventually be lost due to natural succession if the area remains untouched. The proposed nesting habitat is designed to be maintained which will offset the eventual loss of the existing nesting habitat by revegetation. Creating a nesting habitat will also offset the minor impact of the utility trench proposed to be located in a portion of the upland area currently used as nesting habitat. An infiltration gallery for the proposed stormwater management system will be constructed underneath the proposed nesting habitat area. Impact to the upland is minimized by placing this structure underneath the nesting habitat area instead of clearing an additional area for the gallery. The proposed nesting habitat is a benefit to the Spotted turtles by providing an area that will be maintained for nesting and not be lost to natural succession. The construction proposed in this area will be restricted to October 1 to March 15 to avoid disruption of nesting, incubation, or emergence.

The monitoring program and use of the predator exclosures will provide a local benefit to the Spotted turtle population. A study is proposed during five nesting seasons. The information obtained from the monitoring activities will contribute to the conservation knowledge base of the Spotted turtle. Predator exclosures will be placed over nests during the time of the study. This method is used to increase recruitment of individuals each year. The combination of creating a nesting habitat and utilizing exclosures may potentially increase the local population of breeding Spotted turtles over the next 20 years. In addition to monitoring the nesting area, monitoring is proposed at the 4' x 11' box culvert to be located at the crossing in the southeast portion of the site. Monitoring will either confirm that Spotted turtles do not use this area or provide information on the frequency of use. Results of nest restoration and monitoring will be reported to the Natural Heritage and Endangered Species Program (NHESP) annually.

As noted in the Order of Conditions, a conservation restriction will be placed on areas identified to be utilized by Spotted turtles. The areas include wetlands and uplands surrounding certified vernal pools 2807 and 2808 as well as wetland and upland area to the north of the pools.

6.3 Impacts to Four-toed Salamander Habitat

There are no proposed impacts to the breeding habitat of the Four-toed salamander. A portion of the upland area within the 450-foot setback for the Four-toed salamander habitat is already disturbed by approximately 870 linear feet of the NStar easement. Proposed impact will also be located in the upland area. Approximately 790 linear feet of the proposed access road will pass through the 450-foot setback. Approximately 360 linear feet of the proposed access road are located within the already disturbed area of the NStar easement.

6.3.1 Mitigation and Long-Term Net Benefits to the Four-toed Salamander

The proposed mitigation to provide long-term benefit for the Four-toed salamander includes a scientifically based study and the placement of a conservation restriction on the area surrounding the identified breeding habitat. These efforts will provide a net benefit to the Four-toed salamander population on site.

The proposed stormwater management system was modified to remove and relocate all above ground facilities outside of the Four-toed salamander 450-foot setback required by NHESP. The breeding habitat identified on site will not be impacted by the proposed project. To provide a net benefit to the population, a controlled, systematic study has been designed to monitor movement trends of the Four-toed salamander. A configuration of drift nets and pitfall traps are proposed for the study. The data obtained will be essential to the conservation of the Four-toed salamander species. A systematic approach to data collection will provide more complete information about the movement of this species and an estimate of the number of individuals on the site. A Scientific Collecting Permit will be obtained from the Division of Fisheries and Wildlife. A report containing the results of the study will be submitted to NHESP.

A conservation restriction will be placed on the area within the 450-foot setback that is owned by the proponent. This includes the area to the east of the NStar easement and which lies north and south of the proposed access road. A portion of the 450-foot setback is located on the west side of the NStar easement; which is not owned by the proponent. The restriction will provide long-term protection to the wetland and upland habitat utilized by the Four-toed salamander.

7.0 REVISED STORMWATER

The Certificate of the Secretary for the Notice of Project Change, issued May 24, 2002, requested a stormwater management plan that includes all proposed impervious areas on the site.

7.1 Introduction

A stormwater management plan was developed for the construction of the access road, utilities, drainage structures, and mitigation activities. The stormwater management report was submitted to the Holliston Conservation Commission as part of the NOI, dated April 18, 2002, last revised March 13, 2003. Appendix D presents the stormwater management plan and Appendix E presents the Stormwater Pollution Prevention Plan.

As stated previously in Section 1.0, construction of the Phase II portion of the Hopping Brook Park project will be phased. The construction of the access road, utilities, drainage structures, mitigation measures, and associated activities (i.e. clearing and grading) will occur first. Construction of the buildings and infrastructure will follow at a later date. The attached stormwater management plan and Stormwater Pollution Prevention Plan have been designed for the first phase of construction. In addition to the design for the access road, the stormwater management plan also includes the construction of stormwater control structures that will be used during future development. Groundwater recharge units will be located beneath the proposed turtle nesting habitat area. These recharge units will be used when the proposed buildings are constructed. For the second phase, two additional detention basins are proposed to control stormwater runoff for the future build out of the site. These detention basins will be constructed in accordance with DEP and the Town of Holliston guidelines.

This section of the SEIR includes a summary of the revised stormwater management report. Also included in this section is correspondence with the Division of Fish and Wildlife in regards to Hopping Brook and the proposed stormwater management system design.

7.2 Revised Stormwater Management Report

The Stormwater Management Report, prepared by Saluk and Associates, dated April 2002, most recently revised March 31, 2003, has been updated from the previous report, dated February 2002, that was submitted with the Notice of Project Change. The current stormwater report is designed to meet the standards of the DEP Stormwater Management Policy (November 1996 with revisions of March 1997), the Holliston Wetlands Administration Bylaw Regulations (September 2001), and the Holliston Board of Health Stormwater and Runoff regulations (February 1999 with revisions of August 2000).

The previous stormwater management plan proposed one detention basin and an STC 7200 Precast Concrete Stormcepter® to control the runoff from the access road. The revised plan proposes three extended detention basins (with forebays and a separate infiltration area), deep-sump catch basins, and a water quality swale to control the runoff from approximately 77,500 square feet of impervious area. Groundwater recharge units will be constructed beneath the turtle nesting habitat; however they will not be used until the buildings are constructed at a later date. Since the identification of the Four-toad salamander on the site, the one detention basin that was proposed has been relocated out of the 450-foot setback to reduce impact to the upland habitat of the salamander.

Stormwater runoff calculations have been prepared to include the Holliston Board of Health Stormwater and Runoff Regulations (February 1999 with revisions of August 2000) which are based on the "Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada, Cornell University, September 1993, revised August 17, 2000." The design storm events and the amount of rainfall for each event used in the calculations include: the 1-year, 2.6"; 2-year, 3.25"; 5-year, 4.1"; 10-year 4.9"; 25-year, 6.1"; 50-year, 7.3"; and 100-year, 8.5". These standards are more stringent than the state standards. By meeting these standards, the proposed project exceeds state requirements. The calculations show that the proposed stormwater management system associated with the access road will reduce peak rate and volume of stormwater flow off site; which is a benefit to Hopping Brook.

Table 7-1. Reduction of Peak Flow Rates (cfs) Between Existing and Proposed Conditions

Storm Event	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Existing Conditions	12.8	24.22	41.86	60.23	90.10	121.58	154.06
Proposed Conditions	7.26	13.32	23.72	36.16	57.21	84.55	112.61
Flow Reduction	43%	45%	43%	40%	37%	30%	27%

Table 7-2. Reduction of Stormwater Runoff Volume (acre-ft) Between Existing and Proposed Conditions

Storm Event	**1-yr**	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**50-yr**	**100-yr**
Existing Conditions	2.3	3.91	6.37	8.95	13.15	17.64	22.33
Proposed Conditions	1.66	3.35	5.92	8.59	12.91	17.50	22.26
Flow Reduction	28%	14%	7%	4%	2%	1%	0%

A Stormwater Pollution Prevention Plan has been prepared by Saluk and Associates, dated March 21, 2003, for the proposed access road work.

Construction and Post Construction Maintenance Plans have also been prepared.

7.3 Correspondence with the Division of Fisheries and Wildlife

The Division of Fisheries and Wildlife was contacted in regards to the status of Hopping Brook as a cold water resource (as defined by Massachusetts DEP Surface Water Quality Standards Regulations in 314 CMR 4.00) and the design of the proposed stormwater management system. Two letters were received from the Division of Fisheries and Wildlife and are included in Appendix F. This section provides a summary of these letters.

In a letter dated July 29, 2002 from Mr. Richard A. Hartley, Aquatic Biologist with the Division of Fisheries and Wildlife, Hopping Brook is considered a cold water resource since trout can survive in the brook during the summer months. This designation requires that any discharge into Hopping Brook must not exceed thresholds established in the Massachusetts DEP Class B Cold Water criteria in Section 314 CMR 4.05.

Mr. Hartley also reviewed the Stormwater Management Report. In a letter dated October 2, 2002, Mr. Hartley stated that the Stormwater Management Plan will not pose a significant risk to Hopping Brook's fisheries resources. Potential impacts to the brook are minimized by avoiding direct discharge into the brook and incorporating extended detention basins into the design.

8.0 REVISED WASTEWATER DISPOSAL

The Certificate of the Secretary on the Notice of Project Change, issued May 24, 2002, requested additional information regarding the following issues: (1) possible locations for the treatment facility and disposal site, (2) the disposal methodology, and (3) the feasibility of the disposal methodology.

8.1 Introduction

At a Special Town Meeting, held December 17, 2002, the zoning by-law was amended. The purpose of the amendment is as follows: "Private sewage disposal systems or treatment plants shall be allowed in Industrial Districts in conjunction with commercial or industrial development." This allows the proposed treatment plant to be constructed on the site. This amendment is presented in Appendix G.

The proponent, First Colony Development (First Colony) has been working cooperatively with the Town of Holliston (Town) and the Massachusetts Department of Environmental Protection (DEP) over the last several months on our plan to provide in-basin groundwater discharge of the wastewater effluent from an on-site treatment plant for Phase II. The decision to maintain the discharge within the basin was made in accordance with DEP's philosophy of keeping water local. Watershed associations have also enthusiastically supported this philosophy.

8.2 Potential Locations of the Treatment Facility and Disposal Site

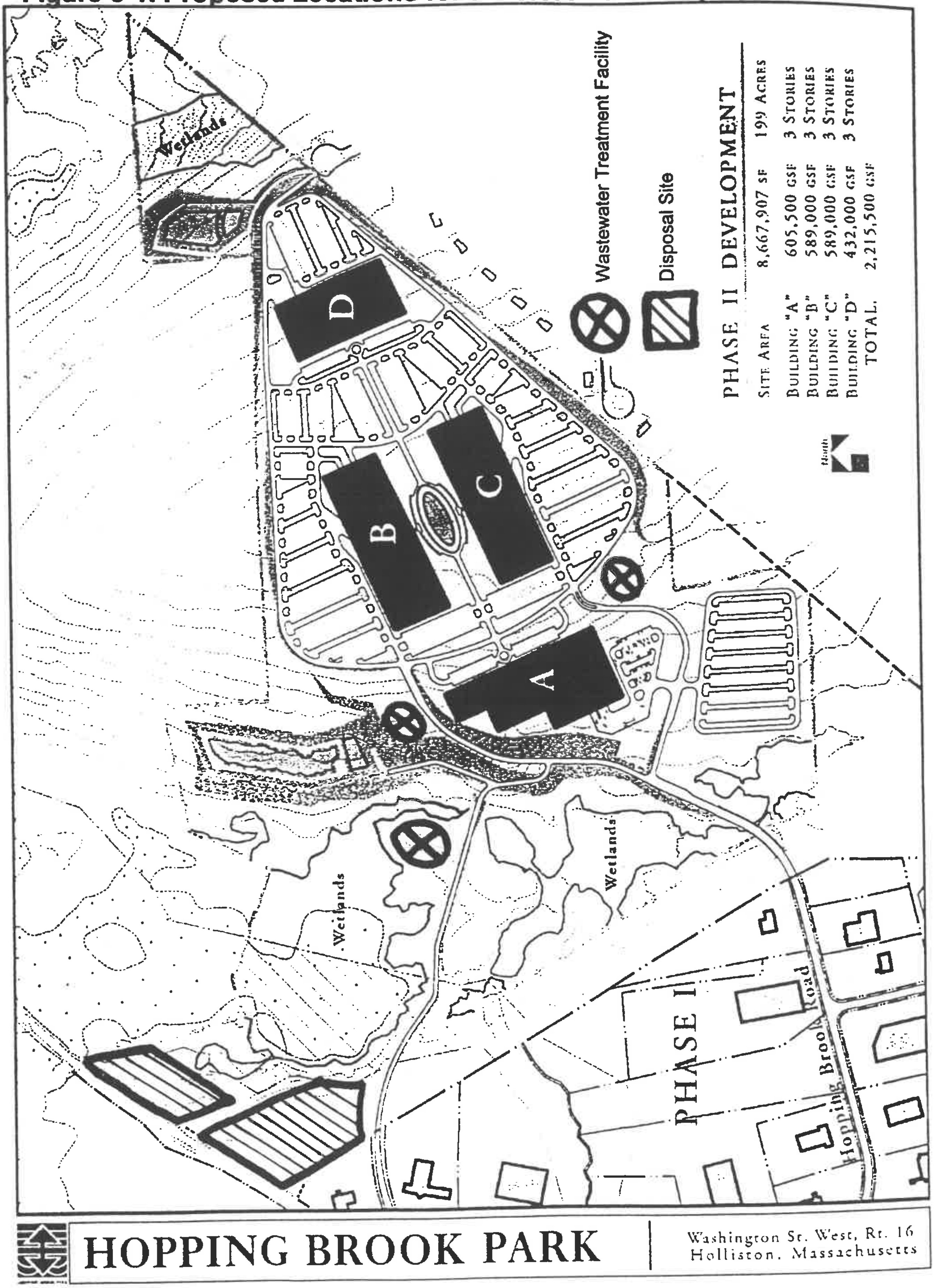
On-site wastewater treatment and disposal is proposed for Phase II. In the preliminary planning, there are three potential locations for the wastewater treatment facility (WWTF) and two potential locations for the disposal site (See Figure 8-1). The potential use of the disposal area located in the NStar easement is reserved for the Town of Holliston.

Once the final locations for the WWTF and disposal site are determined, the proponent will submit an NOI to the Holliston Conservation Commission if any of the locations are within Buffer Zone. The NOI will include an alternatives analysis to support the reasons for selecting the final locations.

8.3 Field Investigations and Feasibility of Disposal

The proponent has met with representatives of the Town's Wastewater Committee on several occasions to keep them abreast of the ongoing site investigation and the resulting groundwater discharge capacity. The field investigation included the excavation of 19 test pits, the advancement of nine borings, and the installation of eight monitoring wells. A soil scientist certified by

Figure 8-1. Proposed Locations for the WWTF and Disposal Site



the DEP in accordance with 310 CMR 15.017 evaluated the test pits. The estimated seasonal high groundwater level was determined at each test pit primarily by the presence of redoximorphic features. The test pits were advanced to depths between 96 inches (8 feet) to 124 inches (10 feet). Redoximorphic features were observed at greater than 96 inches in over 50% of the test pits. Fourteen of the 16 percolation tests resulted in rates of less than two minutes. In addition, a 10 day loading test was conducted and the results support the areas applicability as a groundwater disposal site for the discharge of the 225,000 gpd.

As iterated to the Holliston Board of Selectmen and in meetings with the Wastewater Committee, First Colony has provided the Town of Holliston with the first right of refusal for the available discharge capacity in excess to the needs of the Phase II portion of Hopping Brook Park. This commitment is to assist the Town in responding to the Wastewater Committee's ongoing progress in the preparation of a wastewater management plan.

8.4 Wastewater Treatment Facility Design and Methodology of Disposal

First Colony expects to submit a Major Groundwater Discharge Permit (GWDP) this fall for the discharge capacity of the site. The design parameters of the WWTF will be contingent on the DEP's requirements for the groundwater discharge permit. The project design is intended to incorporate effluent re-use for irrigation and toilet flushing as water conservation measures. The opportunity for this technology will be somewhat dependent on the ultimate tenants(s) The disposal methodology for the WWTF effluent is expected to utilize CULTEC distribution galleries.

9.0 RESPONSE TO COMMENTS

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Central Regional Office, 627 Main Street, Worcester, MA 01608

JANE SWIFT
Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

May 15, 2002

Secretary Robert Durand
Executive Office of Environmental Affairs
251 Causeway Street, Suite 900
Boston, MA 02114

Attention: MEPA Unit – Richard Foster

RE: Notice of Project Change
Hopping Brook Industrial Park
Route 16, Holliston
EOEA #4411

Dear Secretary Durand,

The Department of Environmental Protection (the Department), Central Regional Office offers the following comments on the Notice of Project Change (NPC) submitted for the Hopping Brook Industrial Park, located on Route 16 in Holliston, MA. The project dates back to 1983, when the Secretary issued a certificate for the Final Environmental Impact Report.

The changes to the project include: an increase in total site acreage of 85 acres; a reduction of 45 acres of land to be altered; a reduction of 43 acres of impervious area to be created; a reduction of 1,391,110 square feet of bordering vegetated wetland (BVW) to be altered; an increase in building height of 10 feet; an increase of 2.56 miles of water main; a change in the internal roadway pattern to prevent impact to the spotted turtle habitat; a change in the proposed wastewater disposal method from subsurface leaching systems to a centralized on-site treatment plant; and the relocation of a proposed detention basin.

This project is being constructed in two (2) phases. Phase I began in 1983 and is still on-going. Phase II will presumably begin when Phase I is completed. The proposed completion date is in 2005.

The Department has reviewed the NPC and recommends additional MEPA review be required. The following comments are offered for your consideration:

Mary Gardner, DEP, CERO

No comments are required for comments on this page.

- 1 To date, 558,000 square feet of office, manufacturing and warehouse space has been constructed in sixteen buildings on 100+ acres. Of the nineteen lots in Phase 1, three (3) of the lots have not undergone construction, and six (6) of the lots will be expanded. The total build out will be 750,000 square feet. Each lot allegedly has its own septic system. If each building is individually owned, this situation is acceptable. However, if the owner of Hopping Brook Industrial Park leases the buildings to tenants, then the septic system flows should be added together to determine if a groundwater discharge permit is needed.

- 2 Phase II of the construction will add another 2,215,500 square feet of office space, bringing the total building space to just under 3 million square feet. At 75 gallons per day (GPD)/1000 square feet, Phase II would equal a design wastewater flow of 166,162.5 GPD. The NPC predicts a wastewater generation of 225,000 GPD for the entire project. The proponent should state whether all the existing buildings will be sewered, or the existing buildings will continue to use septic systems.

- 3 There was reference in the NPC that sewer and water lines will travel through the habitat of the spotted turtle. Construction activities should be altered to prevent disturbance of this habitat.

- 4 The wastewater treatment facility should be designed for toilet water reuse in the Phase II buildings. This design will minimize the amount of water needed and reduce the amount of water discharging to the ground.

The Department, Central Regional Office, appreciates the opportunity to comment on the proposed project. If you have any questions regarding these comments, please do not hesitate to contact me at (508) 849-4033.

Sincerely,

Mary Gardner
Acting Deputy Regional Director

cc: Robert W. Golledge, Jr., Regional Director, CERO
Paul Anderson, Municipal Coordinator, CERO
Eric Worrall, DEP, Boston

Mary Gardner, DEP, CERO

1. Currently, each building in Hopping Brook Park has separate ownership and individual septic systems. A groundwater discharge permit is not needed.

2. The existing buildings will continue to use septic systems.

3. Utility trenching will occur within the habit of Spotted turtle. A detailed mitigation plan has been developed in coordination with Natural Heritage to minimize the work required and limiting the construction time to occur from October 1 to March 15. The utilities will be placed in a trench and when complete will be surfaced with gravel. In addition, the haybale line will contain critter gaps to avoid disturbing potential movement of wildlife.

4. Effluent re-use for irrigation and toilet flushing will be incorporated into the design of the wastewater treatment facility.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

JANE SWIFT
Governor

BOB DURAN
Secreta

LAUREN A. LI
Commissior

DF

RECEIVED
MAY 15 2002
MEPA

MEMORANDUM

TO: Secretary Durand, Executive Office of Environmental Affairs

ATTN: Dick Foster, MEPA Unit

FROM: Christine Kirby, DEP

DATE: May 14, 2002

SUBJECT: EOEA No. 4411 - Review of the Notice of Project Change for Hopping Brook Park in Holliston

The Department of Environmental Protection (DEP) has reviewed the Notice of Project Change (NPC) submitted for Hopping Brook Park in Holliston. In exercising its responsibility to review projects for potential air quality impacts due to changes in traffic within the project area, DEP offers the following comments.

1 New Hopping Brook Realty Trust prepared the NPC for the review of an on site change to the stormwater management system. This project, originally reviewed by MEPA in 1983, included a 3,000,000 square foot office and research and development space on a 218 acre site located on Hopping Brook Road in Holliston. The proponent plans to develop the remaining 2,215,000 square feet in Phase II of the project on a site expanded to 366 acres. The project, when completed in 2005, will have 9,864 parking spaces to accommodate an average daily traffic of 15,110. Therefore, in order for this project to be consistent with the State Implementation Plan (SIP), it will be necessary for the project proponent to conduct an air quality mesoscale analysis to be presented in a Draft Environmental Impact Report.

2 A proposed indirect source project may have impacts on area traffic characteristics, such as volume and speed of roadway segments. An area which includes all of the project impacted roadway segments is defined as the mesoscale area. The analysis area should include the area within a 0.3 to 16 km radius and include the indirect source project; the exact geographical area depends on local conditions and the impact of a project on area travel patterns. The area should be large enough to include all roadway links that will potentially experience an increase of 10%

Christine Kirby, DEP, Boston

1. An air quality mesoscale analysis was conducted by Epsilon Associates and is included in Appendix B. See Section 4.0 for more details of the analysis.

2. The methodology for the mesoscale analysis model was developed in accordance with MADEP guidelines. The modeling protocol for the mesoscale analysis was approved by Keith Grillo on April 3, 2003. See Section 4.0 and Appendix B for more details of the analysis.

in traffic due to the project and currently operate at level of service (LOS) D or lower or will be degraded to LOS D or lower. A mesoscale analysis should be performed for volatile organic compounds (VOC). The total amount of the pollutant expected from each of the project alternatives, including "No Build" in the base and future years should be selected in consultation with the Massachusetts Environmental Policy Act (MEPA) staff and the DEP staff as well ~~as~~ the input parameters to the Mobile5ah emissions factor model.

VOC emissions for the base case can be calculated using existing characteristics on the roadway segments. Emissions for the estimated time of completion can be calculated by changing the traffic characteristics on the roadway segments to those that are expected to occur when the indirect source project is completed. VOC emissions for the build and no build cases for future years can be similarly calculated.

Once the analysis has been completed it can be determined if the project will result in an
increase or decrease in emissions of VOC. Emissions will increase or decrease based upon the
effects of traffic volumes and on speeds on the roadway segments in the project area as a result
3 of the indirect source project. If the project is shown to result in an emissions increase,
mitigation measures should be presented to offset the increase.

4 In addition to the requirements for an air quality analysis, every facility located on this site which employs 250 or more daytime employees at any time over the course of one year will be required to comply with DEP's Ridesharing Regulation (310 CMR 7.16).

Should you have any questions regarding this memorandum please contact Keith Grillo of the DEP at 292-5773.

Christine Kirby, DEP

3. Results of the mesoscale analysis demonstrate that the Build condition will have higher emissions than the No-Build condition as shown on Table 4-1. The focus of the mitigation measures will be implementation of services on-site rather than a travel demand management consisting of local transit services. See Section 4.0 and the Travel Demand Management section of the Revised Traffic Analysis for more details.

4. The proponent will comply with DEP's Ridesharing Regulation (310 CMR 7.16) if 250 or more daytime employees are working at each building.

DF

CRWA

Charles River Watershed Association

MAY 17 2002
MEPA

BY FAX AND MAIL

May 14, 2002

Robert Durand, Secretary
Executive Office of Environmental Affairs
251 Causeway Street
Boston, MA 02114

05-17-02 P03:26 IN

Attn: Richard Foster, MEPA Unit

Re: Notice of Project Change Hopping Brook Park, Holliston, MA, EOEA #: 4411

Dear Secretary Durand:

The Charles River Watershed Association (CRWA) has reviewed the notice of project change (NPC) for this project that will alter over 100 acres of land, create well over 50 acres of impervious area,[1] involve work in the riverfront area, fill two isolated wetlands and a portion of a rare species inhabited wetland system, and impact spotted turtle habitat. This NPC was filed for an industrial park project that received final environmental impact report approval 19 years ago. There is no question, as discussed below, that this project -- of which less than 20% was built in the intervening years since the Secretary's certificate on the FEIR issued in June, 1983 -- will have significant environmental consequences. The undeveloped portion of the site is largely forested and contains an important wetland system and both Hopping Brook and a tributary to Chicken Brook, which feed into the Charles River.

The proponent has not provided any information in the NPC from which it can be found that the lapse of time does not require the filing of a new environmental notification form. Pursuant to 301 CMR 11.10(3) "the Secretary shall deem MEPA review of a Project closed if more than five years have elapsed between:

(a) the publication of the notice of the availability of the single or final EIR; and
(b) the earlier of:
1. notification of Commencement of Construction in accordance with 301 CMR 11.05(9), provided that the Proponent has not thereafter suspended or abandoned construction for more than three years; and
2. commencement of non-construction related work or activity, including expenditure of funds for final design, property acquisition, or marketing, provided

[1] The NPC does not state how many acres of imperviousness will be created in Phase II of the project. However, the buildings alone will encompass 2,215,500 s.f. Surficial parking may double this figure.

2391 Commonwealth Avenue, Auburndale, Massachusetts 02466-1773, Telephone (617) 965-5975, Fax (617) 332-7465
Website: www.crwa.org Email: crwa@crwa.org

Margaret Van Deusen, Charles River Watershed Association

No responses are required for comments on this page.

> that the Proponent has continued to take major steps in a continuous sequence to advance the Project.
>
> The Proponent shall file a new ENF to open a new MEPA review, provided that the new Project meets or exceeds one or more review thresholds. In the certificate on the new ENF, the Secretary shall ordinarily make specific findings regarding segmentation. (Emphasis added).

The NPC states only that "Construction of the Project began in 1983 and has continued gradually to the present time. The completion date has been extended from 1993 to 2005." NPC at 4.

CRWA believes that it would set an extraordinarily bad precedent if a development requiring a mandatory EIR in the ordinary course if submitted today, were allowed to proceed without careful review and determination of whether the lapse of time requires a new ENF under 301 CMR 11.10(3). The proponent should be required to submit documentation as required by MEPA (see 301 CMR 11.06(5)) to support a factual finding that the construction was not suspended or abandoned for more than three years after commencement of construction. If in fact this lapse occurred, the proponent should be required to submit a new ENF. We note that the businesses located in "Phase I" of the project -- the 18.6% of the project that was completed -- are now nearly a decade later seeking to expand. See NPC at Attachment 3.

MEPA review has become increasingly sophisticated and public participation in the MEPA process has grown over the last 20 years as our knowledge of the impacts of development on land and water resources and habitat has increased by quantum leaps. The project today could not alter 32 acres of important wetlands as was apparently approved in 1983.[2] And major environmental statutory and regulatory changes have occurred since then: the Massachusetts Rivers Protection Act, the Endangered Species Act and the Department of Environmental Protection's (DEP) Stormwater Guidance.[3] The MEPA regulations were also overhauled.

Impairment of water quality caused by stormwater runoff and construction activities has become a critical issue.[4] Groundwater quantity and stream flow, both in Holliston and throughout the Upper Charles Watershed, are now issues of serious and

[2] It is not even clear that this project was subject to the 1983 regulations that contained standards for work affecting inland wetlands.

[3] We note that according to the NPC at Attachment 2, only the Secretary of Environmental Affairs was sent a copy of the NPC. Therefore, presumably, no agency or person received or commented on the original ENF. See 301 CMR 11.10(7). An explicit finding should be made as to whether the NPC has been circulated in compliance with section 11.10(7).

[4] In the original project two stormwater detention basins were proposed to be located <u>in</u> the wetlands themselves.

Margaret Van Deusen, Charles River Watershed Association

No responses are required for comments on this page.

permanent concern and the watershed is experiencing significant stress. The Town of Holliston is located in the rapidly growing I-495 region. Holliston's growth has resulted in the proliferation of impervious surfaces and increased water demand. Its water demand exceeds its registered withdrawal volume and the town is currently seeking a water withdrawal permit for a new well. The town is also exploring localized treatment— and discharge of its wastewater through comprehensive wastewater management planning in an effort to keep its "water local."

Sidestepping the lapse of time issue, the proponent argues in the NPC that because another 85.4 acres of land has now been added to the project, this will result in only 28% of the land being developed, as opposed to 52% of the land that was to be developed. The NPC does not identify the location of the additional 85.4 acres except to say it is in the "northern portion of the Phase II area," NPC at 2, and we could not discern its precise location.[5] In fact, the NPC states that "a portion of the proposed buildings will be located on this lot." NPC at 2. The only plan of the proposed Phase II development is contained in Figure 4 of the NPC. Contrary to the assertion in the NPC that the addition of this lot will result in more open space and reduce the density of the building layout, NPC at 2, an examination of Figure 4 shows that almost all of the buildable space in the now delineated Phase II portion of the project will be utilized for buildings, surface parking and a detention basin. The overall reduction in density appears to us to be based instead on the relatively low density of the "current" Phase I development. See NPC at Figure 3.

The regulations at 301 CMR 11.10 (6) (a)-(g) provide factors the Secretary should consider in determining whether a project change or lapse of time "might significantly increase environmental consequences." While section 11.10(6)(a) states that a change in a Project is ordinarily insignificant "if it results solely in an increase in square footage . . . or other relevant measures of the physical dimensions of the Project of less than 10% over estimates previously reviewed; provided the increase does not meet or exceed any review thresholds." here, the project is adding 85 acres of land and some portion of the project's buildings to this area. The area of the entire project has increased by over 10%; it is unknown whether the increase will exceed any review threshold for say, impervious area. In the ENF for the Phase II development, the proponent should be required to delineate clearly and to describe the existing conditions of this additional 85 acres, and the alterations planned for this area. This is also a change in the project site, which is another factor for the Secretary's consideration pursuant to 301 CMR 11.10(6)(d).

Additionally, during the lapse of time there have been changes to the ambient environment or information concerning the ambient environment. See 301 CMR 11.10(g). For instance, the spotted turtle habitat on the project site (and some 40 spotted turtles identified by the consultant during field observations) was discovered in 2001.[6]

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[5]The NPC references the "Index Sheet in the Plan Set, dated March 4, 2002;" however, the Index sheet does not show the additional lot and we are still uncertain about its boundaries or the buildings planned for it.

[6] While the proponent proposes creating 25,410 s.f. of turtle nesting habitat, its consultant admits that there is little information known about the effectiveness of creating such habitat.

Margaret Van Deusen, Charles River Watershed Association

1. The Index Sheet provided in the Plan Set dated March 4, 2002, submitted with the Notice of Project Change, shows a parcel in the northern portion of the site labeled "Parcel II, Area = 85.4 +/- acres." This parcel is also shown on the enclosed Proposed Conditions Plan. This area is forested with wetland areas in the far northwestern portion and far northeastern portion of the parcel. No work will occur on this parcel under the currently proposed phase of the project. Future development, though still in conceptual phase, could include buildings, parking, and stormwater detention basins, as shown on Figure 1-3 of this report. No additional impact will occur in wetland areas.

The Hopping Brook wetland is also an important over-wintering habitat for turtles. Water and sewer pipes are proposed to be placed in the area identified as spotted turtle habitat. We note that because Oxbow Associates, Inc.'s report contained no maps identifying the spotted turtle habitat, it was extremely difficult to locate and evaluate the
2 project's impacts to this habitat. The ENF should clearly delineate the habitat area and –
the gravel road. The effectiveness of box culverts underneath the proposed construction of Hopping Brook Road to preserve turtle migratory function should be discussed. The
4 statement in the Oxbow report that if the old gravel road is used only for emergencies, the
5 mortality probability is near zero should also be explained. The ENF should make it clear whether this gravel road will be the only emergency access road to the site.
6 Measures should also be discussed to eliminate any use of this road during nesting season. The richness of the project's eastern area containing wetlands, three certified vernal pools, and streams for habitat is underscored by the recent discovery of another species of special concern, four-toed salamanders, which were found nesting in the southernmost wetland on the site.[7]

It is unclear whether the two isolated wetlands comprising 26,122 s.f. that are proposed to be filled were identified or even existed[8] at the time of the original MEPA filing.

Additionally, water supply issues -- increased demand and reduced aquifer recharge and streamflow are changes in the ambient environment since 1983. Both the original MEPA filing and the NPC state that water use will be 250,000 gallons per day (gpd). While CRWA does not know how much water is being consumed by Phase I of the project, 250,000 gpd demand will place a significant burden on an already hard-
7 pressed municipal water supply system. The proponent should discuss the project in relation to the ability of the town to supply this water and incorporate water conservation measures such as reuse of grey water, and landscaping requiring minimal irrigation.
8 Stormwater should be infiltrated to the greatest degree possible.

The proponent asserts that there will be no generation of further impacts, which is another of the factors in 301 CMR 11.10(6)(b) for the Secretary to consider. The problem with this argument is that the proponent, in essence, is asking you to turn back the clock to 1983 and to compare impacts with what was permissible then. For instance, the proponent argues that stormwater management will be improved because stormwater will not discharge directly to two wetland areas -- a scenario that clearly would not be permitted today. While catch basins, a stormceptor system and a large detention basin are proposed for controlling stormwater runoff from the extension of Hopping Brook Road, there is no discussion of the increased runoff associated with the huge amount of impervious surface that will be created by the buildings and parking areas in Phase II or how it will be handled.

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[7] Telephone conversation with Jane Pierce, Holliston Conservation Agent, May 14, 2002.

[8] According to Attachment C to the NPC, the two isolated wetlands were "created or embellished" by clearing that took place some 20 years ago.

Margaret Van Deusen, Charles River Watershed Association

2. The location of the proposed utility trench and associated gravel road is shown on Plan Sheets C7 and 8 of the Plan Set dated March 4, 2002 submitted with the Notice of Project Change. The Spotted turtle habitat is located in the wetlands and uplands to the north and south of the proposed utility trench.

3. Two box culverts are proposed to be located beneath the proposed access road as mitigation for the impact to the Bank resource in this area. The proponent has worked closely with the NHESP to develop a comprehensive Conservation Plan to protect the habitat of the Spotted turtle. At the request of the Natural Heritage and Endangered Species Program, the size of one box culvert has been increased to 4' x 11', the other will remain 4' x 6'. The box culverts will allow unrestricted movement of wildlife, between the wetlands, in the area of the wetland crossing.

4. The utility corridor that will be cleared during this phase of work will also be used as the emergency access for the site. The probability of mortality is low because there will be no regular traffic on the gravel road and no migratory barriers will result from the construction of the work.

5. In addition to the gravel road within the utility corridor, there will be two additional locations for limited emergency access to the site. These locations are on the east side of the site. Carriage House Way and Summit Road are within the Claybrook I and Claybrook II developments in Medway. These roads were approved to be used only for residential access and not an option as a primary access to an industrial park. However, use of these roads only as an emergency access for Hopping Brook Park is acceptable.

6. The gravel road will be the only emergency access, and its use cannot be predicted. A turtle nesting habitat is proposed to be constructed as mitigation for work in the habitat of the Spotted turtle by creating and maintaining a nesting area conducive to the Spotted turtle.

7. For the future development, the proponent will incorporate low flow fixtures and low flow toilets into the design of the buildings. In addition, the effluent will be re-used for irrigation and toilet flushing. The proponent has been working cooperatively with the Town of Holliston and the MA DEP concerning the design of the wastewater treatment facility.

8. The revised stormwater management system is designed in accordance with DEP Stormwater Management Policy, the Holliston Wetlands Administrative Bylaw Regulations, and the Holliston Board of Health Stormwater and Runoff regulations. The stormwater detention basins have been designed to reduce peak rate and volume off site. See Section 7.0 and Appendix D of the SEIR for more details.

CRWA is concerned about the cumulative impacts of stormwater runoff on wetland water quality and aquifer recharge. While the proponent may assert that compliance with DEP's stormwater management policy is only required for areas under the jurisdiction of the Wetlands Protection Act, it is important to note that almost without exception, every significant development project in the upper watershed in the past several years has agreed to site-wide compliance with the DEP policy. Moreover, U.S. Environmental Protection Agency's Phase II stormwater regulations which take effect next year require towns like Holliston to adopt comprehensive stormwater management
9 bylaws for development projects over one acre. A comprehensive stormwater management plan for Phase II should be developed based on drainage patterns and runoff
10 rates throughout the project area, and discussed in the MEPA process. The plan should include a discussion of stormwater runoff to the east of the site and any impacts to the wetland in this northeast portion of the site. Grading activities that will alter drainage patterns should also be discussed and infiltration of stormwater should be maximized.

The project will also alter 5,630 s.f of riverfront area where a proposed utility easement will cross Hopping Brook. In addition over 300,000 s.f. of grading and clearing work is proposed in the wetland resource buffer zone.

11 Additionally, the traffic study in the NPC appears to have been conducted only at the exit of the site onto Route 16. While the NPC asserts that there will be no traffic impacts because the number of vehicle trips was overestimated in the original MEPA filing, this fails to take into account increased traffic on Route 16 and I-495 that has occurred in the past decade.

Lastly, while the proponent has not yet filed a new application for a permit, see 301 CMR 11.10(6)(e), the project will require a groundwater discharge permit for on-site wastewater treatment. Almost no information is provided in the NPC with respect to the wastewater system, including its location, capacity or potential environmental impacts.
12 The wastewater treatment system should be analyzed and discussed in the context of Holliston's comprehensive wastewater management planning.

In sum, CRWA believes that the lapse of time and the environmental consequences of this project require that a new ENF be filed and that the project undergo full environmental impact review. We believe that the proponent is a responsible developer willing to work through the MEPA process to create a project that will avoid, minimize or mitigate damage to the environment.

Sincerely,

Margaret Van Deusen

Margaret Van Deusen
Deputy Director and General Counsel

cc: Jay Wickersham
Patricia Huckery
Jane Pierce

Margaret Van Deusen, Charles River Watershed Association

9. A comprehensive stormwater management plan has been developed for the proposed construction of the access road, utilities, stormwater drainage for the access road, and mitigation. Stormwater management for the future development has been taken into account in the current stormwater management plan. In addition, two additional stormwater detention basins are proposed to control stormwater for the future development. See Section 7.0 and Appendix D of the SEIR for additional information.

10. No wetland resources are proposed to be impacted by the future development. All wetland impacts are proposed to be mitigated during the current phase of the proposed work. A separate stormwater management plan will be developed in accordance DEP Stormwater Management Policy, the Holliston Wetlands Administrative Bylaw Regulations, and the Holliston Board of Health Stormwater and Runoff regulations for the future development. In addition, any work within Buffer Zone to a regulated resource will require submission of a separate NOI to the Holliston Conservation Commission (See Order #19 of the Order of Conditions).

11. A revised Traffic Study has been conducted. See Section 4.0 and Appendix A of the SEIR for detailed information.

12. The proponent has been working cooperatively with the Town of Holliston and the MA DEP concerning the design of the wastewater treatment facility. The proponent is prepared to work with the Holliston Wastewater Committee towards their preparation of a wastewater management plan. See Section 8.0 for more information.

zavolas, nicholas (ENV)

From: Huckery, Pat (FWE)
Sent: Wednesday, May 15, 2002 5:48 PM
To: Zavolas, Nicholas (DEP)
Subject: EOEA#4411 Hopping Brook Park, Holliston

Richard Foster was assigned this project according to the MEPA Monitor, but he is no longer on the state's e-mail list. Please make sure that the appropriate MEPA analyst receives this e-mail. Thank you very much.

Two recently discovered, rare wildlife populations of spotted turtles and
four-toed salamanders, have been documented to occur at the Hopping Brook
Park site. The project as currently proposed will result in the "take" of
1 these species under the Massachusetts Endangered Species Act. The proponent
should continue working with the NHESP to avoid, minimize and mitigate the
2 impacts from the proposed business park. They must show that the proposed
activities will result in a long-term net benefit to the conservation of the
populations of these species.

Pat Huckery, Natural Heritage and Endangered Species Program

1. The proponent has had several meetings with Natural Heritage to modify the proposed project and develop a Conservation Plan that will avoid, minimize and mitigate impacts to and protect the habitat of the rare species. A final Conservation Permit Request was submitted to Natural Heritage on May 8, 2003. See Section 6.0 of the SEIR for more details.

2. The mitigation measures proposed will provide a long-term net benefit to the conservation of the rare species populations. See Section 6.0 of the SEIR for more details.

APPENDIX A

Revised Traffic Impact Assessment

TRAFFIC APPENDIX

INTRODUCTION/PURPOSE

This traffic impact assessment has been prepared to evaluate the Notice of Project Change filed for the Hopping Brook Business Park in Holliston, Massachusetts. The project change related strictly to non-traffic related features of the proposal and will not affect the land use mix or the overall square footage originally proposed for development. Therefore, the proposed project change will not alter the traffic impact originally projected for the site. This having been said, however, it is acknowledged that the underlying traffic conditions along local streets and the nearby regional highways have changed significantly since the original project was approved. Therefore, this analysis, as per the Secretary's scope for the Supplemental Environmental Impact Report (SEIR) combined with input from MassHighway Department, evaluates the as-yet-undeveloped portion of the project as though it were a new project. This "new project" consists of 2.4 million square feet. The study area for the analysis was developed at the direction of the MassHighway Department District 3 Office. Information on trip generation relies on ITE data as well as information available at the already built 558,000 square foot park on the site.

This assessment follows the standard methodologies established for environmental impact reports including an evaluation of existing conditions in the vicinity of the site, estimation of future no build conditions, an estimation of peak hour and daily traffic flows associated with the project, an evaluation of the level of service for the existing, future no build and future build conditions, recommendations as to what roadway and intersection improvements are necessary to bring study area locations up to acceptable operating standards, and finally recommends mitigating measures. In most cases, the proponent will contribute towards or construct the recommended improvements.

Exhibit 1 is a general location map showing the site in relation to the local roadway and regional highway network. This analysis has the benefit of the fact that the project already has an access roadway that has been in operation for a number of years. Monitoring of the traffic in and out of this roadway (Hopping Brook Road) provides information on trip generation and directional distribution that would not otherwise be so conveniently available or as relevant. In addition, information from the existing business park allows us to better estimate the mix of land uses that can be expected at the site used in estimating the trip generation for the project.

GENERAL LOCATION MAP

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 1

EXISTING CONDITIONS

Study Area

The study area for this project was established in order to assess the impacts of the project at key locations. To the east of the site, what was considered one of the most critical locations within the center of town, Central Street, was selected as were the two intersections of Route 16 and Route 126 (Concord Street to the north and Summer Street to the south). While there are one or two intersections east of the site that might have warranted inclusion in the study area, the discussions with MassHighway indicated that there were already plans in the works at some of these locations to address existing deficiencies and it was believed that further study of them as part of this analysis would not shed any more light on those improvement plans. To the west of the site, the study area network was developed to include access to Route 495, the major regional highway in the area. Because Route 16 does not interchange with Route 495 both the Route 85 and Route 109 interchanges have been evaluated; it is expected that traffic to and from the north will use the Route 85 interchange and traffic to and from the south will use the Route 109 interchange. Finally, the intersection west of the interchange area, Route 16 at Route 109, was also included in the analysis.

Roadways

Hopping Brook Business Park is located on **Hopping Brook Road**, a two-way, two-lane private roadway that has a single access along Route 16, Washington Street. Hopping Brook Road was proposed as part of the original development and is complete in the vicinity of Route 16. It includes an overall width of approximately 40 feet with curbing and dirt/grass shoulders with no sidewalks. This roadway generally operates as a single lane in each direction with the pavement width at Route 16 wide enough to accommodate left and right turns out of the site. The intersection at Hopping Brook Road is controlled by a stop sign for the Hopping Brook Road approach.

Route 16, Washington Street, is a two-way, two-lane roadway that traverses through Holliston. To the east it travels through Sherborn, toward the Wellesley area. To the southwest it connects through downtown Milford as well as the commercial areas in the vicinity of the Route 495 corridor. The roadway has a double yellow centerline and edge lines with a posted speed limit varying between 30 and 45 miles per hour. Observed speeds seem to be generally consistent with normal operating speeds, i.e., between 5 miles per hour below and 5 miles per hour above posted speed limits. The roadway traverses gently rolling terrain including level areas and gentle curves. Land uses along Route 16 through the study area include a mix between commercial, retail, industrial, and residential purposes. Hopping Brook Road is approximately halfway between Holliston Center and the Route 495 corridor. The roadway is under state jurisdiction. The roadway is approximately 26 feet wide with no curbs and no sidewalks in the vicinity of the site. There are sidewalks farther east and farther west, once Route 16 enters Holliston Center and the commercial district west of Route 495.

Route 85 (Cedar Street) at Route 495 Ramps, Milford – This diamond-shaped interchange is unsignalized. Route 85 is straight and flat through the interchange with a single travel lane and a wide shoulder in each direction, with raised curbs and no sidewalks. The pavement width is sufficient to allow for through traffic to bypass vehicles waiting to turn left onto either the northbound or southbound on-ramp. There are also short, right-turn lanes onto both ramps from each direction along Route 85. Traffic along the ramps is controlled by stop signs for the left-turn movement and by yield signs for the right-turn movements.

Route 85 (Cedar Street) at Dilla Street/Fortune Boulevard, Milford – The four-way signalized intersection is located just south of the Route 495 interchange with Route 85. The traffic signal here is actuated and has multi-lane approaches on all four-legs. Northbound on Route 85 there is a left-turn lane and a through/right turn lane, southbound on Route 85 there is a double left turn lane, a through lane, a through lane, and a right-turn lane. Westbound on Fortune Boulevard there is a left/through lane and a right-turn lane, while eastbound on Dilla Street there is a left-turn lane and a left/through/right-turn lane. The Dilla Street approach is on a slight upgrade, while the Fortune Boulevard approach is on a slight downgrade. The actuated signal allows for a variety of phases to accommodate the various turning movements.

Route 16 (East Main Street) at Fortune Boulevard/Beaver Street, Milford – At this four-way signalized intersection, Route 16 eastbound has a left/through lane and a through/right lane; Route 16 westbound has a left/through lane, a through lane, and a right-turn-only lane. Northbound on Beaver Street there is a left/through lane and a through/right lane; southbound on Fortune Boulevard there is a left/through lane, a through lane, and a right-turn lane separated by an island and operating under yield control. This right-turn lane, however, is relatively short so that more than two vehicles queued in the queue lane block access to this right-turn lane. The signal is actuated and there is a lead-green phase to facilitate the southbound left turns from Fortune Boulevard onto Route 16 east. The intersection is generally flat on all approaches.

Route 16 (East Washington Street) at Route 109 (Medway Street/Prairie Street), Milford – This is a four-way, signalized intersection; although Prairie Street is a very low volume roadway it has volumes consistent with a small commercial driveway. Route 109 east of the intersection intersects Route 16 at a shallow angle, so that the right turn from Route 16 eastbound to Route 109 eastbound operates almost as a straight through movement. Similarly, the left turn from

Route 16 westbound onto Route 109 eastbound is a sharper than ninety-degree turn. Eastbound on Route 16 there is a left/through lane, a through lane, and a right-turn lane. The right-turn lane operates under yield control and is channelized with a raised traffic island. Westbound on Route 16 there is a left-turn lane and a through/right lane. Westbound on Route 109 there is a left/through lane and a right-turn only lane. While out of Prairie Street there is one approach lane shared by all movements. There are vertical granite curbs throughout the intersection. The layout of the intersection is generally flat and there are several phases to the intersection signal cycle including a lead green for left turns from Route 16 westbound onto Route 109 eastbound. Prairie Street and Route 109 westbound have separate phases even though they are "opposite" approaches.

Route 109 (Medway Street) at Beaver Street/Beaver Street Extension, Milford – This signalized intersection adjacent to the Route 495 interchange. All approaching roadways are at ninety-degrees and the grades are flat. The intersection has multi-lane approaches on all legs and Beaver Street Extension is one-way entering the intersection. Eastbound on Route 109 there is a left/through lane and a through lane; westbound there are two through lanes and a right-turn lane onto Beaver Street north. South along Beaver Street there is a double left-turn lane and a right-turn lane; northbound on Beaver Street Extension this is a left-turn lane, a through lane, and a right lane. The signal generally works on three phases with Route 109 on one phase and Beaver Street and Beaver Street Extension each having their own phase. There are vertical curbs throughout the intersection.

Route 109 (Medway Street) at Route 495 Ramps, Milford – This diamond-shaped interchange were recently upgraded and signalized. Through the interchange Route 109 has two through lanes and a dedicated turn lane at each ramp intersection – a left-turn lane or a right-turn lane depending on the ramp movements. Each of the ramps has two left turn lanes controlled by the signal and right turns separated by a traffic island. Yield signs control the right-turn movements. Each of the approaches is flat and the roadways are generally straight. There are curbs but no sidewalks.

Route 16 (Washington Street) at Route 126 north (Concord Street) – This intersection was upgraded within the last few years by the MassHighway Department. The upgrade included signalization and formalization of approach lanes. Also included was the reconstruction of the access to the adjacent businesses across from Concord Street. There are sidewalks and curbs throughout the intersection. Each of the approaches has excellent visibility and is generally flat. Westbound on Route 16 there is a single lane, while there are two lanes along the other approaches; although the storage length of the southbound left turn lane on Concord Street is quite short, only one or two vehicles long. The signal is actuated.

Route 16 (Washington Street) at Central Street – This unsignalized T intersection is located in the downtown business district of Holliston. Central Street has a single approach lane shared by left and right turning traffic with a stop sign controlling movements. An overhead flasher reinforces the stop sign with a red flasher facing Central Street and a yellow flasher facing the Route 16 approaches. Route 16 is exceptionally wide in this area, accommodating a through lane and a turn lane in each direction as well as parking along both sides for the adjacent businesses. The roadways are both flat and straight through the intersection with excellent visibility even with the presence of parking. There are vertical curbs and sidewalks through the intersection, which represents the central crossroads of the small business district.

Route 16 (Washington Street) at Route 126 South (Summer Street) – This intersection is an unsignalized T intersection controlled by stop signs along the Route 126 northbound approach. Both roadways have a two-way, two-lane layout although Summer Street splits as it intersects with Route 16 so that left and right turns queue separately. Left turns outs of Route 16 travel to the left of a triangular island with sufficient queuing capacity to accommodate about two vehicles waiting to turn left onto Route 16 before they might block right turning traffic. One of the most noteworthy features of the intersection is that it sits at a small crest along Route 16. Because of this crest, traffic approaching from the east cannot see oncoming traffic along Route 16 until they reach the intersection itself. This is a notable safety concern when a driver traveling west is taking the left turn into Route 126. These left turning drivers cannot anticipate a gap in opposing traffic because of this limited visibility and, therefore, must come to almost a complete stop before proceeding left into Route 126 south (Holliston Street). Combined with this vertical alignment is the proximity of the adjacent homes, which create a feeling of congestion at this location. Traffic waiting to turn left or right out of Route 126 has good visibility because of the crest and the straight alignment of Route 16.

Route 16 at Hopping Brook Road – This unsignalized T intersection has one lane approaches along Route 16 and two lanes approaching along Hopping Brook Road, one for left turns and one for right turns; this approach is controlled by a stop sign. There is a small median separating inbound and outbound lanes on Hopping Brook Road. All approaches are flat and straight, with excellent visibility.

Traffic Volumes

As a basis for the technical analysis, turning movement counts were conducted on weekdays between 7:00 and 9:00 AM and between 4:00 and 6:00 PM for the study area intersections. The four consecutive fifteen-minute periods with the highest approach volume is designated as the peak hour for this analysis. A review of data for seasonality from the MassHighway website indicates that December, when the counts for this study were collected, is three percent below the annual average (adjustment factor of 0.97). This adjustment has been made to the existing data to develop an average condition as a base for this analysis. These base volumes are shown in Exhibits 2 and 3 for the morning and evening peak hours, respectively.

In addition to these counts, an automatic traffic recorder (ATR) count was done along Route 16 in front of the site. This indicates that there were a total of about 16,000 vehicles per day passing the site. During the morning peak hour there were a total of about 1,200 vehicles with approximately 58 percent eastbound and 42 percent westbound. In the evening the volumes were about 1,400 vehicles with about 34 percent eastbound and 66 percent westbound. All of the count data is included in the appendix.

Accident History

Data on traffic accidents for the study area intersections was collected from MassHighway Department records. The MassHighway Department records are compiled from the accident reports filed with the Registry of Motor Vehicles, as per state law. The data used includes information for the most recent three-year period available, 1998 through 2000. Summaries and accident listings are included in the appendix. Each intersection is discussed below:

Route 85 (Cedar Street) at Route 495, Milford – Due to the fact that the accident records are not clear as to which ramp an accident occurred at, all the accidents at the interchange are combined. In total, there were 55 accidents at this interchange, generally evenly divided among the three years. Eighty percent occurred on weekdays with sixty percent occurring during the peak morning or evening weekday peak hours. Two-thirds were property damage only and there was one fatality. Of those that listed a specific type of accident, seventy percent were rear-end collisions and thirteen percent were angle collisions; the rest were single-vehicle accidents with vehicles running off the road. The visibility at the intersection appears to be excellent for all approaches and many of the accidents occur under good weather conditions. With this in mind, it appears that there are no specific design features that are specifically contributing to the accidents. With so many accidents occurring during the peak hours, it may be that traffic conditions are a contributing factor, either due to queuing or driver impatience. Because the data reflects a combination of both intersections, a crash rate has not been calculated.

Route 85 (Cedar Street) at Dilla Street/Fortune Boulevard, Milford – This four-way intersection had 24 accidents between 1998 and 2000 with a generally even distribution over the three-year period. Interestingly, only one of the 24 accidents occurred during the morning peak hour, while half of the accidents occurred during the evening peak hour. Two-thirds of the accidents involved property-damage only, with one-third involving injury. Just over half were angle-type accidents with the rest of the others with a type listed as being rear-end collisions.

Approximately two-thirds occurred during the daytime and/or under dry conditions. This intersection was recently improved and expanded in relation to local commercial development. It is not know whether or not those improvements addressed previous safety concerns or not; however, the layout of the intersection appears to be properly designed. There may be some issues having to do with the double left-turn from Dilla Street and the northbound merge into Dilla Street; however, this is speculation.

Route 16 (East Main Street) at Fortune Boulevard/Beaver Street, Milford – This four-way signalized intersection had a total of 29 accidents in the three-year period. Approximately forty percent occurred during the peak hours, while approximately forty percent occurred at night or on weekends. Approximately sixty percent involved property damage only. It is noteworthy that approximately eighty percent of the accidents were either angle-type or head-on collisions. It is not clear why this might have been the case since the intersection appears to be well laid out. Ice and snow were factors in only one accident. This intersection is currently being upgraded as part of the Dunkin' Donuts project on the corner. It is likely that the high number of angle and head-on accidents may be do to the predominantly permissive left turns with two-lane approaches.

Route 16 (East Washington Street) at Route 109 (Medway Street)/Prairie Street, Milford – This signalized intersection had a total of 23 accidents, although more than half occurred in 1998 with fewer in the last couple of years. Given the heavy commercial activity in the area, it is not surprising that twenty-five percent of the accident occurred during the weekday evening peak hour with only two occurring during the morning peak hour. About eighty percent were property damage only with the remaining being injury accidents. About one-third involved angle-type collisions, another third involved rear-end accidents, and the remaining incidents involved vehicles going off the road or were unknown. A higher percentage of accidents occurred at night but rain and snow were cited in only one-third of the incidents. This intersection is relatively constrained and includes an awkward intersection angle along Route 109. This along with the proximity of many commercial driveways may be contributing to the accidents here.

Route 109 (Medway Street) at Beaver Street/Beaver Street Extension, Milford – This intersection had 38 incidents over the three-year period. Less than half occurred during the peak hours with a significant number of them occurring during the middle of the day and on weekends (just over fifty percent). Almost two-thirds of those were property-damage only with the remaining third involving personal injury. Most of the accidents occurred during daylight hours and/or under clear/dry conditions. This intersection was recently upgraded as part of the interchange improvements. It is not clear whether or not safety improvements were included. It is noteworthy that eastbound left turns along Route 109 into Beaver Street share a lane with through traffic and have only a permitted phase. It is possible that this type of phasing contributes to accidents at this location.

Route 109 (Medway Street) at Route 495 Ramps, Milford – This interchange had 70 accidents associated with it for the three-year period between 1998 and 2000. Half the accidents occurred during the peak hours and about two-thirds were property-damage only, with the remaining involving personal injury. Approximately forty percent were angle-type accidents, forty-five percent were rear-end collisions, and fifteen percent were single vehicle accidents. About three-quarters occurred during daylight hours or under clear/dry conditions. It is likely that congestion contributed significantly to these accidents, given that the alignment of the intersections at the ramps is excellent and visibility is also excellent. It is also likely that the signalization of these two ramps, which was recently completed, will address many of the safety issues at this interchange.

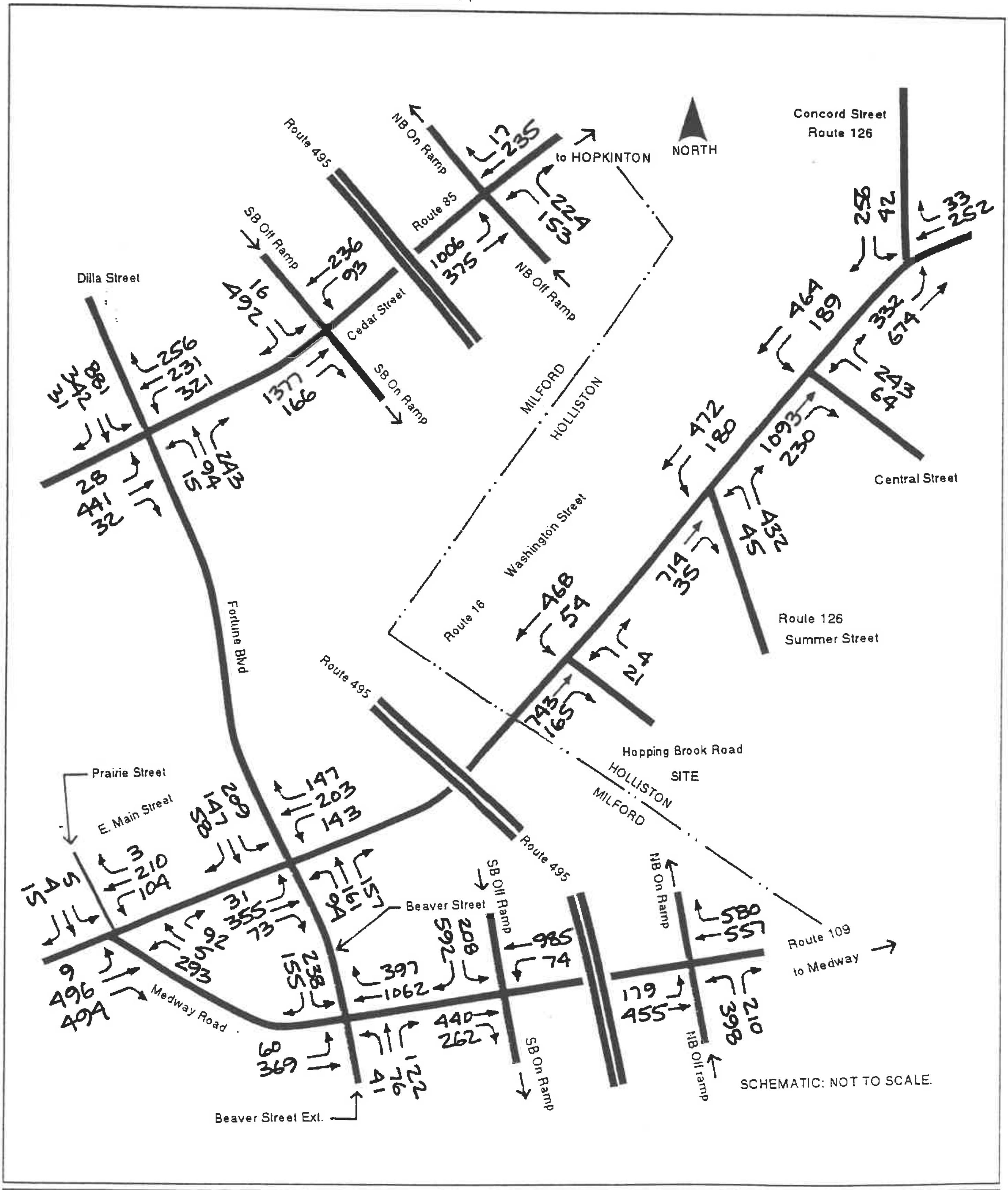
Route 16 (Washington Street) at Route 126 north (Concord Street), Holliston – This signalized T intersections had a total of 11 accidents over three years. Five of the 11 incidents occurred during the weekday peak hours and a total of six involved personal injury. This is a majority of the accidents, which is unusual. This intersection also had five angle accidents and four that occurred in wet conditions. While this intersection was improved several years ago, the overall configuration has narrow lanes, tight radii on the corners, and adjacent businesses close to the intersection, resulting in a lot of visual distractions. These factors may be contributing to the accidents here, although the overall number of accidents is not considerable.

Route 16 (Washington Street) at Route 126 South (Summer Street), Holliston – This unsignalized T intersection had a total of 13 accidents, although the last year for which data is compiled only had a single accident. It is noteworthy that 8 of the 13 (about 60%) occurred during the weekday peak hours; 9 of the 13 involved property damage only with the remaining 4 involving personal injury. Nine of the 13 were rear-end collision (many of them being southbound/westbound on Route 16). This may be the result of sudden stops associated with vehicles not knowing if they have a large enough gap to make the left turn onto Summer Street southbound until the last second. Most occurred during the daylight hours under dry conditions.

Route 16 (Washington Street) at Route 126, Holliston – There were 11 other incidents listed at "Route 16/Route 126" that did not provide enough information to determine whether or not they occurred at one junction or the other. Five of the 11 occurred during weekday peak hours and 10 of the 11 involved property-damage only. Of these, five involved rear-end collisions, two angle-types accidents, one head-on collision, and the remaining were off-road/unknown. Most occurred during the day and under dry conditions.

Route 16 (Washington Street) at Central Street, Holliston – This intersection had a total of 15 accidents in the three-year period. Only four occurred during the weekday peak hours, while 7 occurred between 10:00 AM and 3:00 PM. This may be an indication that the accidents were related to the general "clutter" of this area associated with the local businesses and the on-street parking. Ten of the 15 accidents involved property-damage only and 12 of the accidents were angle-type accidents with the remaining listed as either pedestrian related or unknown. Most occurred during the daylight hours and almost all occurred under dry conditions.

Route 16 (Washington Street) of Hopping Brook Road, Holliston – This intersection had a total of two accidents over the three-year period, both angle-type accidents during the middle part of the day.

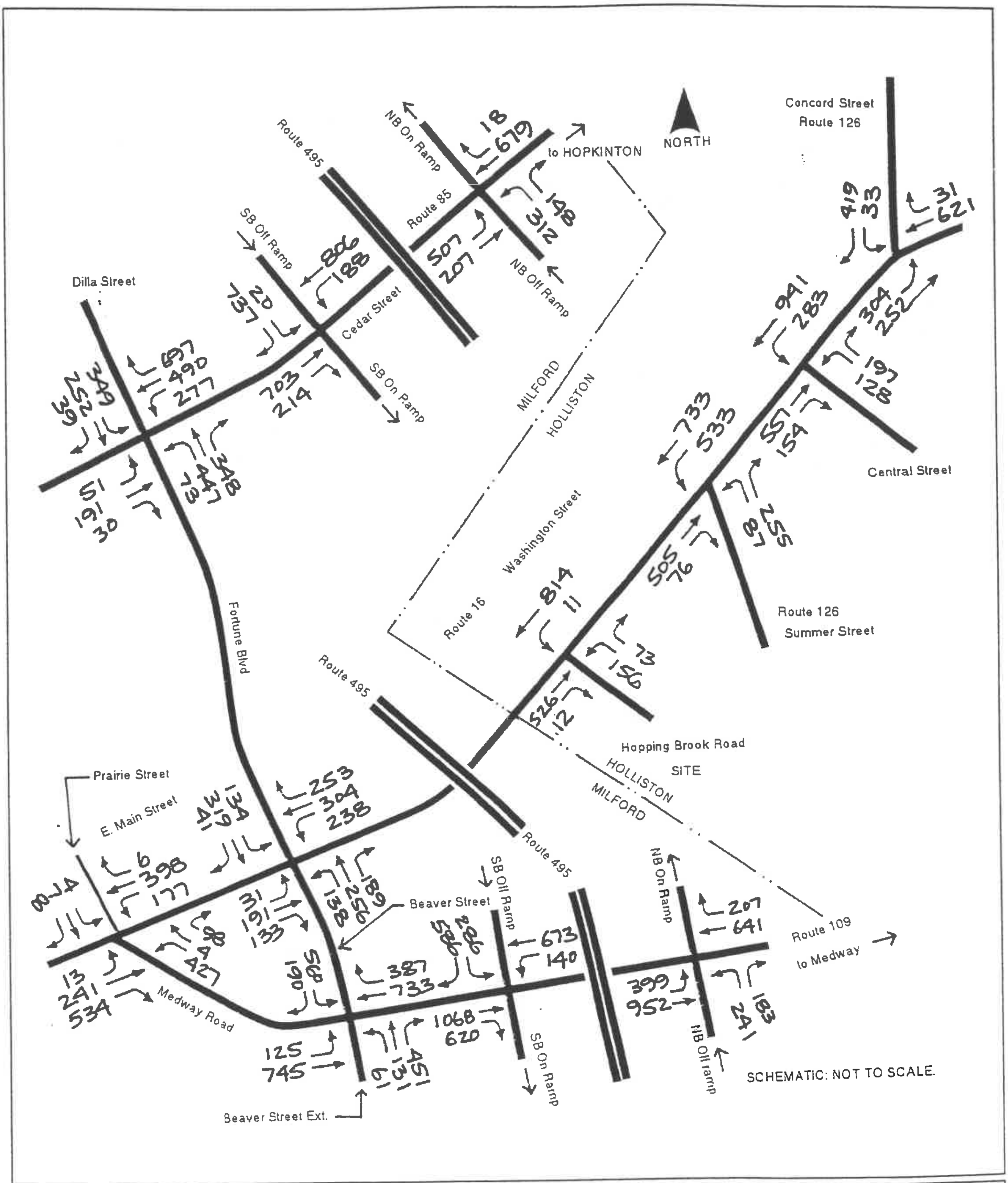


2003 EXISTING VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 2



2003 EXISTING VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit
3

FUTURE NO BUILD CONDITIONS

In evaluating the impacts of the project, future conditions without the project must be developed. A five-year horizon, to the year 2008, has been used. Three components are incorporated into the development of this no build condition: general traffic growth trends, traffic growth associated with specific development in the local area, and planned roadway improvements within the study area. Each of these is considered below:

General Traffic Growth – In order to estimate traffic growth trends for this no build condition, information from the MassHighway Department's database is used, which includes information from continuous count stations throughout the state that allow for year-to-year comparisons. Holliston falls within MHD District 3. Based on the most recent data from the MassHighway web page, District 3's traffic volumes increased 2.9 percent from 1999 to 2000. While this is not specifically intended to be a "growth rate", it does serve this purpose. This regional growth is being fueled by developments such as those within the study area, particularly along Route 16 west of Route 495, and along Fortune Boulevard.

Generally, economic activity in the region has slowed over the last several years since 2000. Because of this, it is believed that these numbers reflect a conservative (i.e., high) estimate of traffic growth trends. In this case, however, it is considered appropriate due to the fact that many of the specific developments that were planned several years ago that still have not yet been completed within the study area are not specifically included in this analysis but are accounted for by this general growth rate. Thus, as a first step in developing the future no build conditions, existing volumes are increased by 15.4 percent to reflect conditions in 2008 (2.9% compounded over five years).

Site-Specific Growth – Two specific projects have been incorporated into the analysis. The first is the Target Store along Fortune Boulevard that was not quite open when the counts were done. Information from that project was collected from traffic studies done related to that project. The second project is a proposed Dunkin' Donuts and additional commercial development at the corner of Route 16 and Fortune Boulevard. That project is currently under construction and expected to open this summer. Both of these projects have been incorporated based on the traffic generation data included in the traffic studies for those projects.

Future no build volumes are presented in Exhibits 4 and 5 for the morning and evening peak hours, respectively. These volumes apply a 2.9 percent growth factor for a five-year period to the existing volumes and then add the site-specific development discussed above.

Roadway/Intersection Improvements – There are several roadway improvements that are currently underway or expected to be completed during the current construction season. Each of these is discuss below. They include locations such as the interchanges along Route 495 at Route 85 and at Route 109 and the intersection of Route 16 at Beaver Street/Fortune Boulevard. Route 495 at Route 109 is in the process of being signalized. These signals are operating, although the construction has not been completed yet. The improvements included creating double left-turn lanes off each ramp and dedicated left-turn lanes on Route 109 onto each ramp. These improvements are already operational even though the construction is not complete; as such, the new configuration has been used in the evaluation of existing, future no build, and future build conditions.

At Route 495 and Route 85, the northbound ramp intersection is currently in the process of being designed for signals. Only the northbound ramp intersection is planned for signalization since the left turns off of the southbound ramp are relatively low. The improvement will include a southbound right-turn lane along Route 85 and the addition of a northbound left-turn lane along Route 85. This information was obtained from VHB who are currently preparing the plans on behalf of the MassHighway Department. These design plans for this improvement are currently being finalized and so they have been incorporated into the future no build and future build conditions of this analysis.

In conjunction with the Dunkin' Donuts project, the Route 16/Fortune Boulevard/Beaver Street intersection is being redesigned slightly to better accommodate approach flow patterns. The Fortune Boulevard approach is being redesigned to accommodate a dedicated left-turn lane and a through/right lane along with a pedestrian crossing signal across the north and east legs of the intersection. These improvements are currently being constructed and have been incorporated into the future no build and future build conditions of this analysis.

Besides these specific improvements, there are several other improvements currently being considered for study area intersections in both Holliston and Milford. For these locations, however, the improvements are only in the discussion stage and have not been specifically included in any development plans or tied to any specific development projects. Consistent with standard procedures, those improvements are not included in this assessment.

2008 NO BUILD VOLUMES MORNING PEAK HOUR	*Hopping Brook Business Park* *Holliston, Massachusetts* Abend Associates	Exhibit 4

2008 NO BUILD VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 5

Project-Related Traffic

Trip Generation

In estimating the number of vehicle trips associated with the proposed completion of the Hopping Brook Business Park, information the Institute of Transportation Engineers (ITE) and data collected at the site are useful. A detailed trip generation comparison was included in the Notice of Project Change that was filed with MEPA. That memorandum by Abend Associates, dated March 28, 2002, is included in the appendix to this report.

Information from counts done at the site (prior to preparation of that memorandum) were compared with the original projections from the traffic study done as part of the EIR process in 1982 and also compared to the latest edition of the ITE publication **Trip Generation** (6th edition, 1997). Five hundred and fifty-eight thousand square feet (558,000 SF) of the park has already been built, including a mix of office, research and development (R&D), manufacturing, and warehouse space. The current park includes approximately 31 percent office space, 14 percent R&D space, 18 percent manufacturing space, and 37 percent warehouse space. The primary conclusions of the March 28, 2002 memorandum was that the existing business park generates traffic at a rate significantly below what would be expected if the latest ITE rates were applied to the various land uses that exist at the park now.

There are many possible reasons for this lower than "average" trip rate but one of the most likely, in our opinion, is that this park is not located along a major highway corridor such as Route 495, which would provide excellent and direct access for employees and visitors. Therefore, businesses that would more likely be catering to the convenience of a high number of employees and/or customers (i.e., those that rely on such convenient access for success in their business) would tend not to locate here, but instead would choose locations closer to the interstate highway system. Conversely, there would be a tendency for businesses with less demand for convenient access to locate here, where rents and/or land costs are lower.

Prior to preparing this SEIR traffic study, Abend Associates met with MassHighway personnel to discuss the appropriate trip generation methodology. After the discussion it was determined that trip generation for the business park should be done by the following procedure:

1. Estimate the vehicle trips to the over 3,000,000 square foot business park based on the current ITE data and the expected land use mix. Based on discussions with the proponent, the current mix of land uses mirrors the expected full build-out of the park.

2. Adjust the ITE projections from step one above by an adjustment factor, determined by comparing the existing trips to what would be expected for the existing 558,000 square feet already developed. This is done independently for the morning peak hour (inbound/outbound) trips, evening peak hour (inbound/outbound) trips, and daily trips.
3. Subtract out the existing volumes at the site. This results in the additional trips expected from the completion of the park.

Exhibit 6 summarizes the results of this methodology. Included in the exhibit are the projected trips associated with the entire park, as well as those associated with that part of the park that is already built. It is important to note that subsequent to filing the Notice of Project Change (and the preparation of our March 22, 2002 memorandum), traffic counts were retaken at the site as part of the counts done throughout the entire study area for this analysis. The results of this second count indicated higher volumes at the site than previously documented. Those higher volumes have been used in this analysis. That is, a higher, more conservative estimate is used than was initially suggested by MassHighway when this method was accepted.

Directional Distribution

The distribution of site trips is primarily based on the existing volumes at the site driveway documented in the traffic counts. The data indicates that almost two-thirds of the traffic is oriented toward the southwest along Route 16 with one-third oriented to and from the northeast on Route 16. From this point trips are distributed based on our familiarity with the area, common commuter trends, and a likely route to reach certain population areas. About fifty percent of the traffic is expected to be oriented to Route 495 with half of this to and from the north and half to and from the south. Of the thirty-five percent expected to be oriented to the east along Route 16, various percentages are expected to use the many local routes that serve commuters throughout the region such as Route 126 to the north and south, Central Street to the east and Route 16 to the east. The trips in this direction are distributed throughout these various sub-regional commuter routes. Exhibit 7 presents a directional distribution for the site-related trips associated with the full build-out of this project.

Based on the trip generation projections and the distribution percentages documented above, the site trips along the street network can be estimated. This information is presented in Exhibits 8 and 9, respectively, for the morning and evening peak hours.

	Peak Hour Volumes				Average Daily Volumes	
	Morning		Evening			
	In	Out	In	Out	In	Out
Step 1:						
Trips to/from 558,000 SF existing based on ITE rates:	462	85	110	415	1,990	1,991
Step 2:						
A: Trips to/from 558,000 SF existing based on actual counts:	219	25	23	229	1,212	1,212
B: Actuals as a Percentage of ITE:	47.4%	29.4%	20.9%	55.2%	60.9%	60.9%
Step 3:						
A: Projected trips to/from 3,000,000 SF full build out, based on ITE rates:	2,389	442	572	2,288	8,952	8,952
B: Apply Percentage from Step 2B:	1,132	130	120	1,263	5,452	5,452
C: Subtract existing, actual trips from Step 2A:	(219)	(25)	(23)	(229)	(1,212)	(1,212)
D: Additional trips related to full build out:	913	105	97	1,034	4,240	4,240

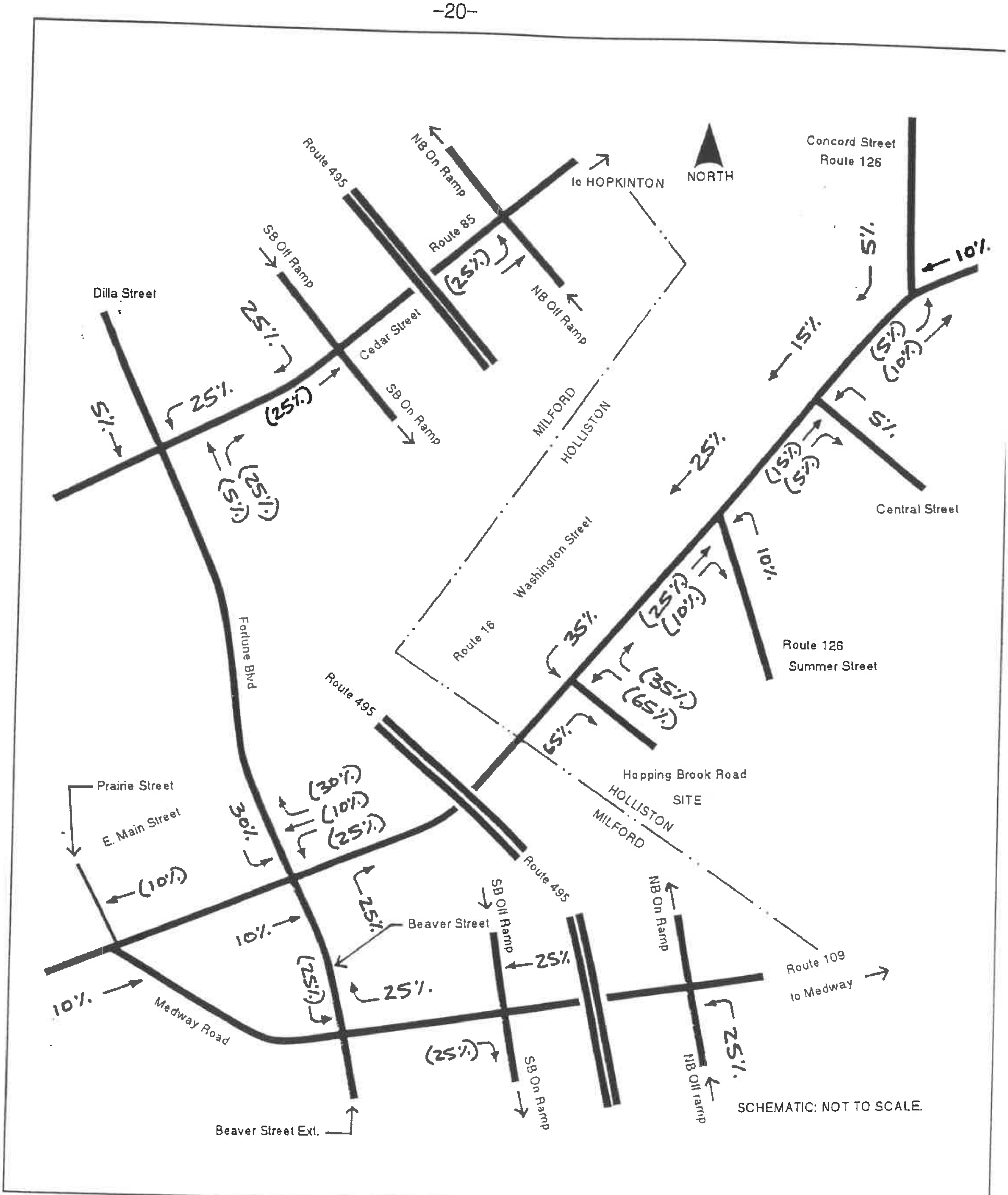
See appendix for detailed calculations for Steps 1 and 3A.

TRIP GENERATION SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 6

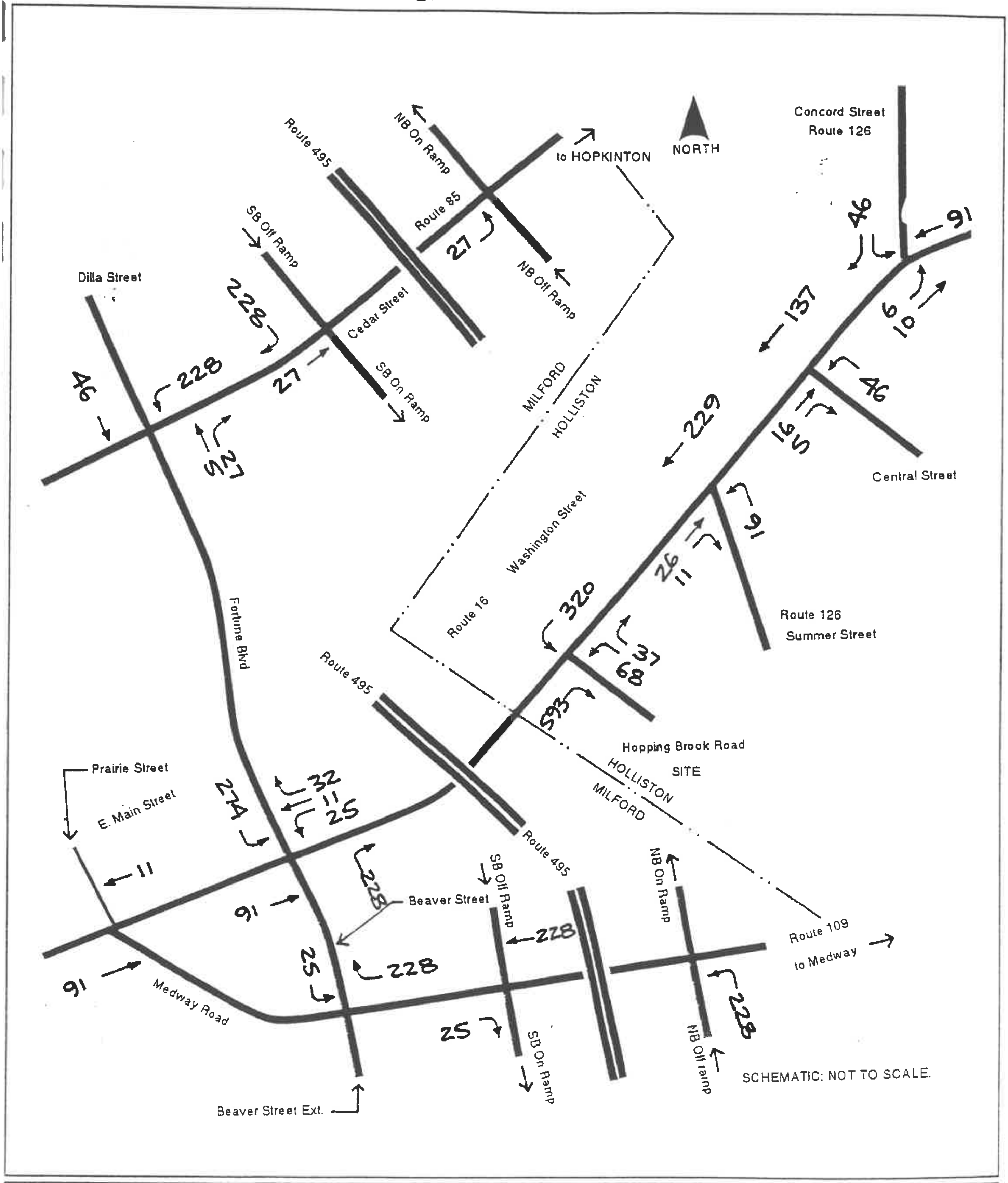


DIRECTIONAL DISTRIBUTION

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 7

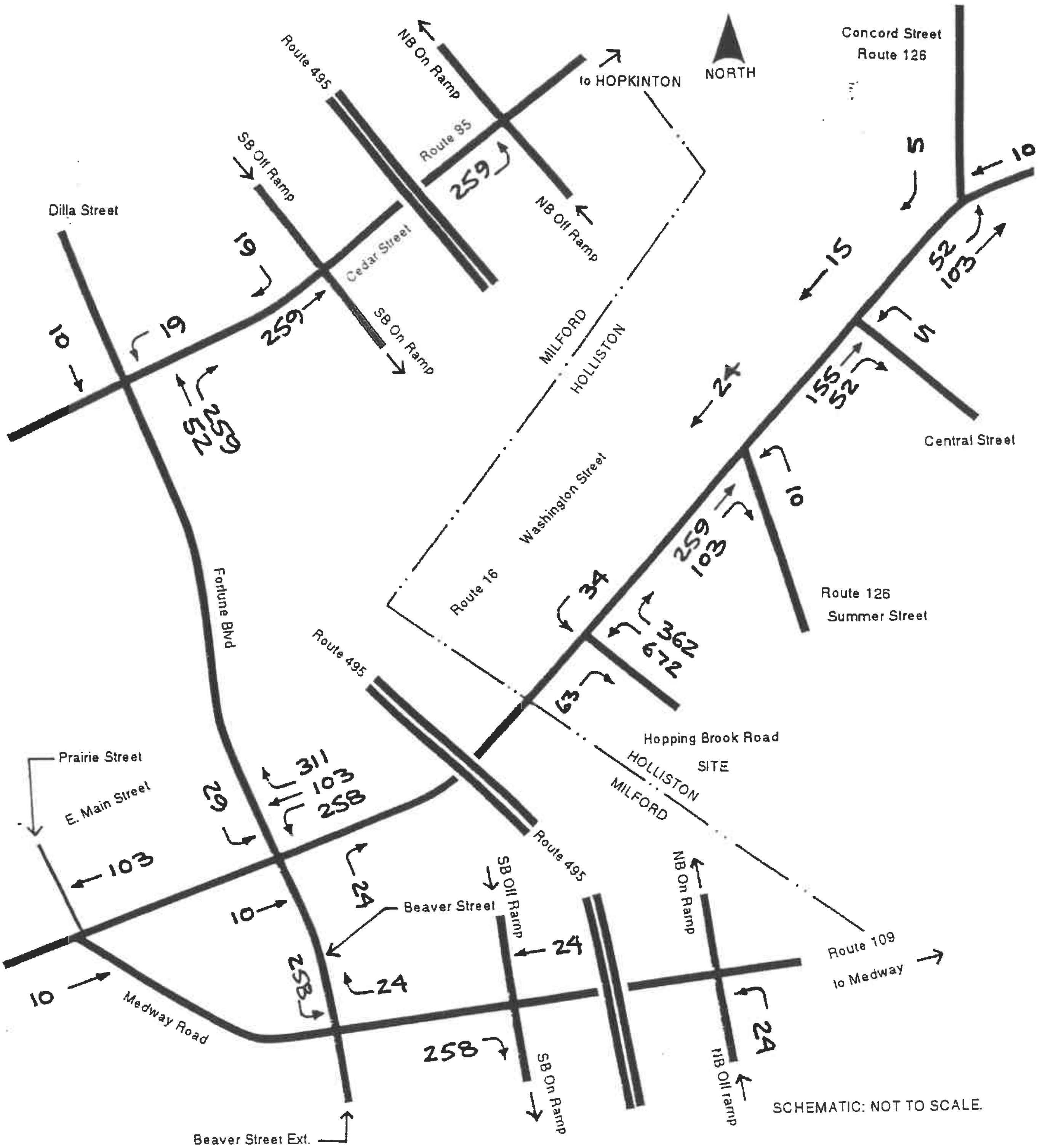


PROJECT–RELATED VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Exhibit
8

Abend Associates



PROJECT-RELATED VOLUMES
EVENING PEAK HOUR

Hopping Brook
Business Park
Holliston, Massachusetts

Abend Associates

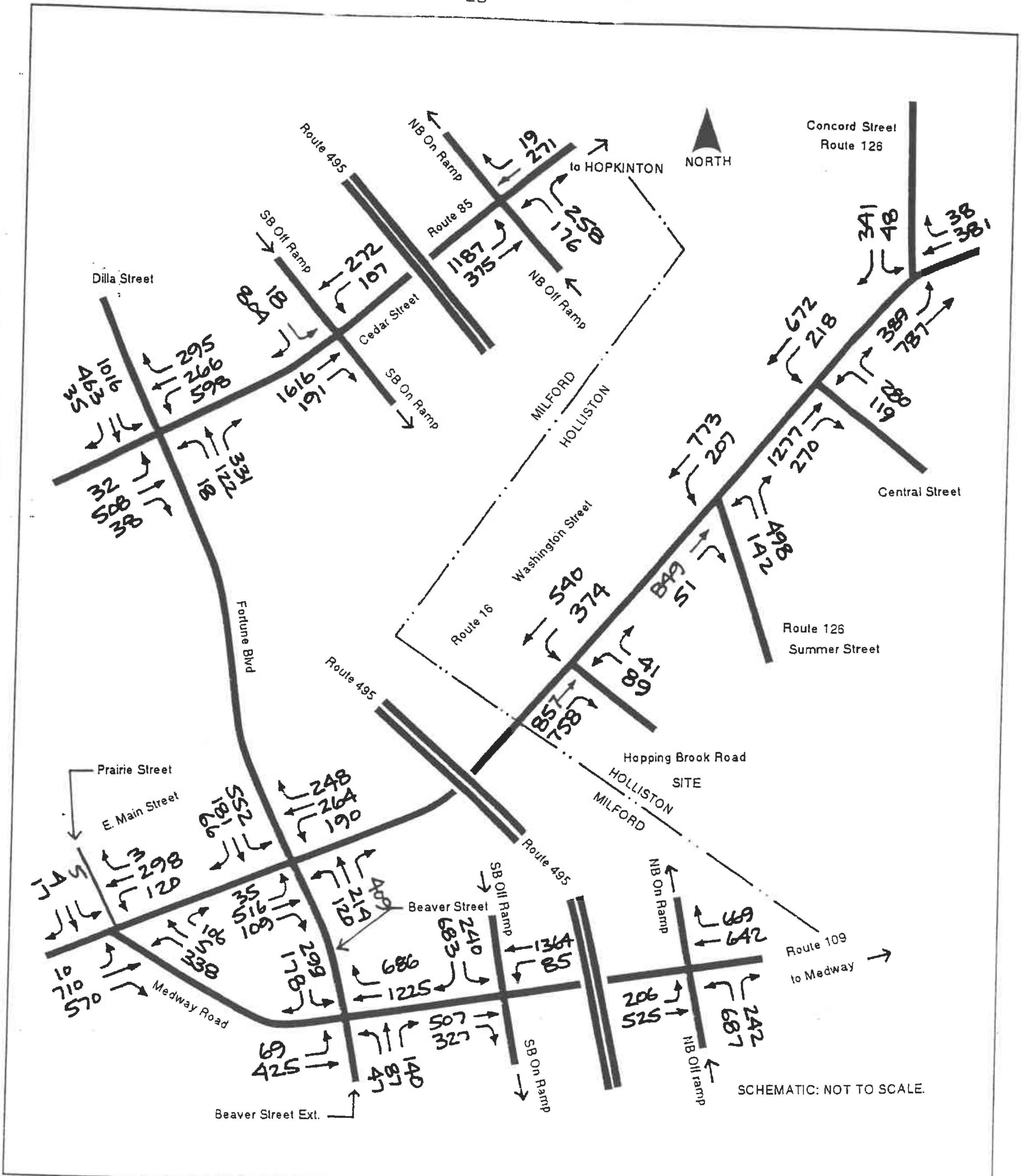
Exhibit
9

SITE ACCESS DESIGN

Access to the Hopping Brook Business Park already exists as Hopping Brook Road. This roadway intersects Route 16 at a ninety-degree angle; generally halfway along a one-quarter mile stretch that is both straight and flat. A review of the accident data presented previously indicates that there are only two accidents at this location. A review of field conditions does not indicate any design concerns that might cause safety problems. This intersection will be signalization and additional lanes are added as part of the full build-out of the park. These are discussed later in this report.

FUTURE BUILD CONDITIONS

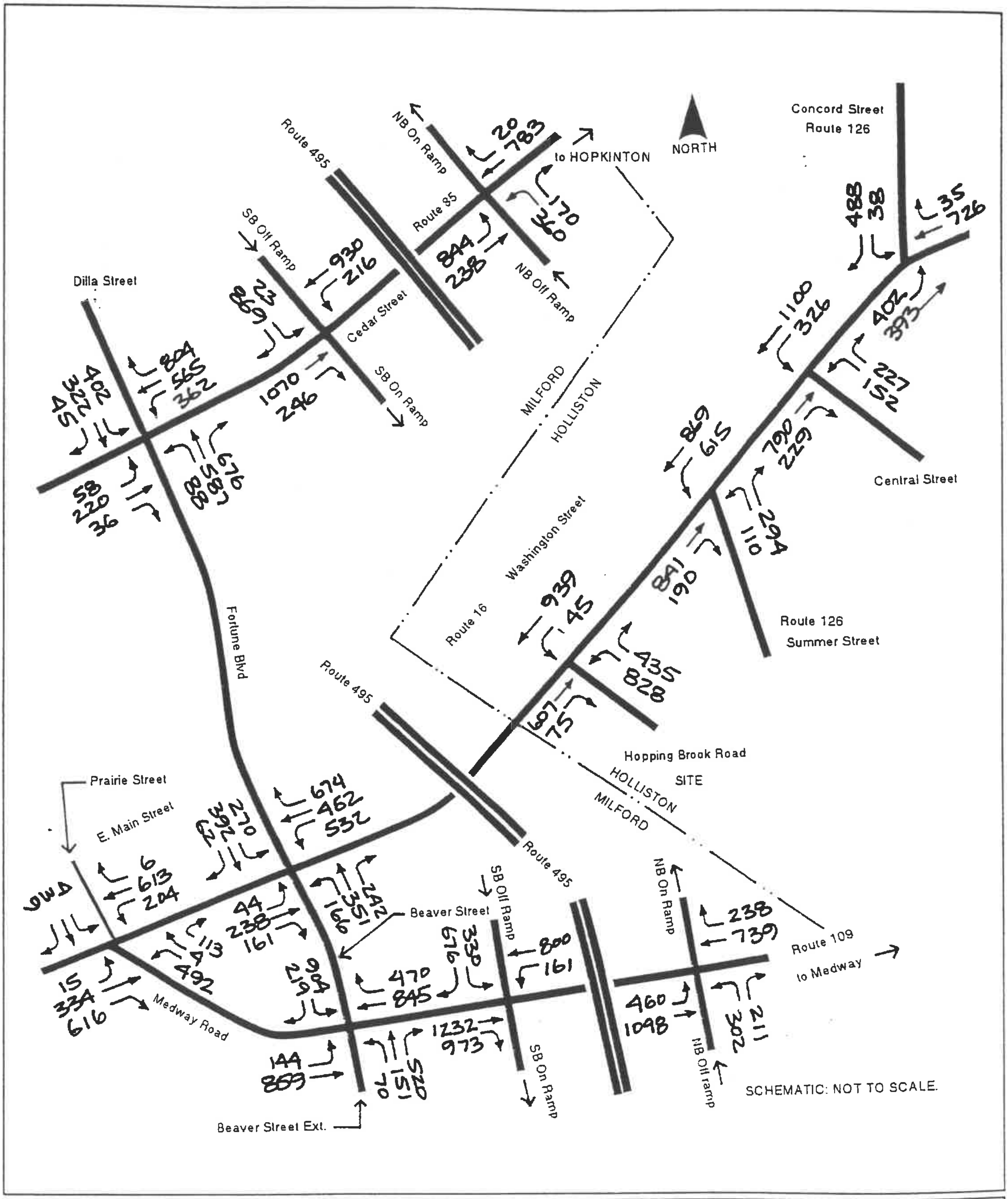
Combining the future 2008 No Build traffic volumes with the project-related traffic volumes provides the turning movement volumes expected once the project is in place. These volumes for the weekday morning and evening peak hours are presented in Exhibits 10 and 11. Evaluating the traffic operations of the intersections for the various conditions provides an assessment of the impacts of the project. This analysis is conducted in the ***Impact Analysis*** section.



2008 BUILD VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts
Abend Associates

Exhibit
10



2008 BUILD VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts
Abend Associates

Exhibit 11

Impact Analysis

The study area intersections have been evaluated based on the **2000 Highway Capacity Manual** using ***Synchro5*** software. The methodology incorporates the geometric and volume related data at an intersection and computes a Level of Service, which provides a "grade" for the intersection's operations. The Level of Service grade is based on the average delay per vehicle entering along each approach or entering the intersection as a whole. Grades range from *A*, representing free-flow conditions, to *F*, representing over-capacity conditions where long delays occur. A grade of *E* represents close to capacity conditions where flows are unstable and congestion could likely occur. An overall intersection Level of Service grade of *D* or better is considered by traffic engineering professionals to be acceptable for peak hour conditions.

At unsignalized intersections, the Level of Service for each critical movement is calculated; a critical movement is one that must yield to another movement at the intersection. Typically, the left turns along the major street and all movements from the minor street must yield to other movements and are designated as critical movements. The methodology provides an estimate of delay for each of these critical movements.

At signalized intersections, the Level of Service for each group of lanes is calculated. The methodology provides an estimate of delay for each approach. Levels of Service of *D* or better are acceptable for normal operations. Average delays of ten seconds or less are designated as Level of Service *A*; average delays greater than 55 seconds are designated as Level of Service *E*; average delays greater than 80 seconds are Level of Service *F*.

Descriptions of Level of Service are included in the appendix of this report. The results for each intersection are discussed below. The Level of Service results are presented in Exhibits 12 for unsignalized locations and Exhibit 13 for signalized locations. The ***Synchro5*** computer printouts from the calculations are also included in the appendix.

Route 85 at Route 495 northbound Ramps, Milford – This ramp intersection is currently unsignalized and operates at level of service *F* during both the morning and evening peak hours with the left turn from the ramp being the most delayed approach. Route 85 flows are at levels of service *B* or *C*. As noted under the no build discussion, the signalization of this intersection will include creating a double left turn from the ramp onto Route 85 as well as a northbound left-turn lane on Route 85 onto the Route 495 ramp. In the future no build condition the level of service is at *D* with average delays are 40 and 50 seconds for the morning and evening peak hours, respectively. Under build conditions, the added traffic related to the project, only involving left turns onto Route 495 northbound. This leads to a level of service *D* during the morning peak hour and level of service *E* during the evening peak hour.

Route 85 at Route 495 southbound Ramps, Milford – This unsignalized intersection operates at level of service *A* during the morning peak hour and level of service *F* during the evening peak hour. Unlike the northbound ramps, there are no plans to signalize this intersection, primarily because the critical left turn from the ramp onto Route 85 northbound is made by only about 15-to-20 vehicles during the peak hours. Under the no build conditions, the overall level of service is at *A* during the morning and *F* during the evening. With the project traffic included, the morning peak hour drops to level of service *C* while the evening peak hour remains at level of service *F*.

Route 85 at Dilla Street/Fortune Boulevard, Milford – This intersection was recently upgraded as part of mitigation associated with other projects in the area. Under existing conditions it operates at level of service *D* during the morning peak hour and *C* during the evening peak hour. As traffic growth occurs, the no build condition is at level of service *E* during the morning and *C* in the evening with average delay of approximately 70 and 35 seconds, respectively. With project-related traffic added, the level of service drops to *F* in the morning and to *D* in the evening with average delay of approximately 95 and 40 seconds, respectively.

Route 16 at Fortune Boulevard/Beaver Street, Milford – This intersection operates at level of service *A* under existing conditions during both the morning and evening peak hours. Under future conditions the level of service remains at *A* during the morning peak hour and drops to *B* during the evening peak hour with delays between 10 and 15 seconds. Under no build and build conditions the intersection will have been improved associated with the adjacent retail project discussed previously. With project-related traffic included through this intersection the level of service is at *C* for both peak hours, with an average delay of about 25 seconds during the morning peak hour and 35 seconds during the evening peak hour.

Route 16 at Route 109, Milford – This intersection currently operates at level of service *D* during the morning peak hour and level of service *F* during the evening peak hour with average delays of 50 and 85 seconds, respectively. Under no build conditions, level of service is expected to be at *E* during the morning peak hour and *F* during the evening peak hour with average delays of approximately 65 and 90 seconds, respectively. With project-related traffic added, the level of service remains unchanged; the volumes associated with the project are complementary to the existing flows through the intersection and therefore do not add to the overall delay here.

Route 109 at Beaver Street/Beaver Street Extension, Milford – This intersection operates at level of service *C* under existing conditions with average delays of about 20 seconds during the morning peak hour and 35 seconds during the evening peak hour. Under future no build conditions the morning peak hour remains at *C* while the evening peak hour drops to level of service *E* with average delays of about 20 and 60 seconds, respectively. With project-related traffic incorporated, the intersection remains at *C* with an average delay of about 20 seconds during the morning peak hour. Virtually all the traffic associated with the project during the morning peak hour is comprised of westbound right turns that are complementary to other flows at the intersection and therefore result in no change in the overall operations here. During the evening the southbound left turn will increase as a result of the project and increase the average delay to about 70 seconds per vehicle. The level of service will remain at *E*, however.

Route 109 at Route 495 southbound Ramps, Milford – This intersection currently operates at level of service *B* during the morning peak hour and level of service *C* during the evening peak hour with average delays of 15-to-20 seconds per vehicle. Under no build conditions the level of service is at *C* with average delays of about 20 seconds in the morning and about 35 seconds in the evening. Under build conditions with project-related traffic, average delays at this intersection are at about 25 seconds per vehicle during the morning and 35 seconds per vehicle during the evening peak hour with the level of service at *C* for both peak hours.

Route 109 at Route 495 northbound Ramps, Milford – This intersection operates at level of service *B* under existing conditions with the newly installed signal. Average delays are 10-to-15 seconds per vehicle. Under no build conditions the level of service remains at *B* with average delays of about 15-to-20 seconds per vehicle. With the project-related traffic included, the level of service remains at *B* for both peak hours and the average delays remain between 15 and 20 seconds per vehicle.

Route 16 at Route 126 (North), Holliston – This intersection operates at level of service *A* during the morning peak hour and *B* during the evening peak hour with average delays of about 5 and 15 seconds, respectively. Under future no build conditions the average delay remains the same during the morning peak hour with the level of service remaining at *A*. During the evening the level of service remains at *B* but the average delay increases to about 20 seconds per vehicle. Under future build conditions with project-related traffic, the average delay during the morning increases to about 10 seconds per vehicle while in the evening the average delay increases by about two seconds per vehicle. The level of service drops to *B* during the morning peak hour and *C* during the evening peak hour as a result of these increases.

Route 16 at Central Street, Holliston – The level of service at this unsignalized intersection is at *F* during both peak hours with considerable delays for Central Street traffic. The level of service will remain at *F* in the future, with excessive delays for Central Street, regardless of the impact of this project.

Route 16 at Route 126 (South), Holliston – This unsignalized intersection operates at level of service *D* in the morning, level of service *F* in the evening. Under future no build conditions the level of service is at *F* for both peak hours. This level of service remains at *F*, with the delays becoming greater, as a result of this project.

Route 16 at Hopping Brook Road, Holliston – This unsignalized intersection currently operates at level of service *A* with average delays of five seconds or less in the morning and level of service *C* in the evening with average delays of about 15 seconds. Under no build conditions the traffic will increase along Route 16 but no traffic is added to Hopping Brook Road. The level of service remains at *A* in the morning with average delays continuing at less than five seconds. In the evening the traffic increases along Route 16 and drivers the overall level of service here to *D* with an average delay of 30 seconds. Under future build conditions the project will add significantly to the volumes in and out of Hopping Brook Road and this would result in a significant delay for the Hopping Brook Road traffic, if the intersection were not being improved. However, under build conditions the proponent proposes to signalize the intersection and add dedicated turn lanes in each direction along Route 16. This will result in a level of service *B* in the morning and level of service *D* in the evening with average delays of 20 and 55 seconds, respectively.

	Morning								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 Northbound Ramps, Milford									
Overall	**F**	*****	**--**	SEE SIGNALIZED					
Route 85 EB LT	C	17	0.79						
Route 495 NB LT	F	*	*						
Route 495 NB RT	B	13	0.35						
Route 85 at Route 495 Southbound Ramps, Milford									
Overall	**A**	**5**	**--**	**A**	**8**	**--**	**C**	**25**	**--**
Route 85 WB LT	C	16	0.23	C	21	0.33	C	22	0.34
Route 495 SB LT	F	119	0.35	F	290	0.70	F	315	0.74
Route 495 SB RT	C	17	0.64	C	24	0.78	F	82	1.09
Route 16 at Central Street, Holliston									
Overall	**F**	**109**	**--**	**F**	*****	**--**	**F**	*****	**--**
Route 16 EB LT	C	17	0.38	C	23	0.53	C	24	0.54
Central St NB LT/RT	F	803	2.61	F	*	*	F	*	*
Route 16 at Route 126 South (Summer Street), Holliston									
Overall	**D**	**27**	**--**	**F**	**64**	**--**	**F**	**621**	**--**
Route 16 WB LT/TH	A	5	0.22	A	7	0.28	A	8	0.29
Route 126 NB LT	F	82	0.52	F	203	0.90	F	*	3.73
Route 126 NB RT	F	101	1.08	F	249	1.46	F	270	1.52
Route 16 at Hopping Brook Road, Holliston									
Overall	**D**	**1**	**--**	**E**	**2**	**--**	SEE SIGNALIZED		
Route 16 WB LT/TH	A	2	0.08	A	2	0.09			
Hopping Brook Rd LT	D	34	0.15	E	43	0.20			
Hopping Brook Rd RT	B	14	0.01	C	16	0.01			

UNSIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts
Abend Associates

Exhibit
12A
1 of 2

	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 Northbound Ramps, Milford									
Overall	**F**	*	--						
Route 85 EB LT	B	15	0.59		SEE SIGNALIZED				
Route 495 NB LT	F	*	*						
Route 495 NB RT	B	10	0.18						
Route 85 at Route 495 Southbound Ramps, Milford									
Overall	**F**	**141**	--	**F**	**237**	--	**F**	**234**	--
Route 85 WB LT	B	12	0.27	B	14	0.35	C	17	0.44
Route 495 SB LT	F	172	0.53	F	464	1.07	F	*	1.85
Route 495 SB RT	F	504	2.05	F	843	2.80	F	871	2.86
Route 16 at Central Street, Holliston									
Overall	**F**	*	--	**F**	*	--	**F**	*	--
Route 16 EB LT	B	11	0.33	B	13	0.42	C	16	0.50
Central St NB LT/RT	F	*	*	F	*	*	F	*	*
Route 16 at Route 126 South (Summer Street), Holliston									
Overall	**F**	*	--	**F**	*	--	**F**	*	--
Route 16 WB LT/TH	B	13	0.56	C	22	0.70	F	82	0.96
Route 126 NB LT	F	*	*	F	*	*	F	*	*
Route 126 NB RT	C	18	0.50	D	25	0.64	F	83	0.98
Route 16 at Hopping Brook Road, Holliston									
Overall	**C**	**17**	--	**C**	**30**	--			
Route 16 WB LT/TH	A	<1	0.01	A	<1	0.01			
Hopping Brook Rd LT	F	166	1.10	F	336	1.49		SEE SIGNALIZED	
Hopping Brook Rd RT	B	13	0.14	B	14	0.16			

UNSIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook
Business Park
Holliston, Massachusetts

Abend Associates

Exhibit
12B
2 of 2

	Morning								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 Northbound Ramps, Milford									
Overall				**D**	**40**	--	**D**	**44**	--
Route 85 EB LT				D	43	0.99	D	49	1.01
Route 85 EB TH				A	2	0.24	A	2	0.24
Route 85 WB TH		see unsignalized		F	100	0.98	F	100	0.98
Route 85 WB RT				C	20	0.08	C	20	0.08
Route 495 NB LT				E	64	0.59	E	64	0.59
Route 495 NB RT				A	7	0.69	A	7	0.69
Route 85 at Dilla Street/Fortune Boulevard, Milford									
Overall	**D**	**45**	--	**E**	**71**	--	**F**	**96**	--
Route 85 EB LT	D	53	0.32	E	68	0.41	E	68	0.41
Route 85 EB TH/RT	E	58	0.94	F	98	1.06	F	125	1.14
Route 85 WB LT	F	81	0.97	F	114	1.06	F	137	1.16
Route 85 WB TH	C	28	0.35	D	35	0.39	C	32	0.37
Route 85 WB RT	A	4	0.36	A	4	0.39	A	3	0.37
Fortune NB LT/TH	D	49	0.40	E	64	0.52	E	64	0.53
Fortune NB RT	B	17	0.74	C	32	0.94	C	26	0.85
Dilla SB LTR	D	48	0.94	E	79	1.04	F	119	1.16
Route 16 at Fortune Boulevard/Beaver Street, Milford									
Overall	**A**	**6**	--	**A**	**10**	--	**C**	**27**	--
Route 16 EB LT/TH/RT	A	5	0.36	B	12	0.53	C	23	0.69
Route 16 WB LT/TH	A	8	0.42	B	14	0.62	C	25	1.01
Route 16 WB RT	A	2	0.23	A	1	0.22	A	1	0.23
Beaver St NB LT/TH/RT	A	5	0.40	B	11	0.65	D	40	0.92
Fortune Blvd SB LT	A	8	0.46	A	9	0.59	D	38	0.93
Fortune Blvd SB TH	A	8	0.46	A	7	0.19	A	7	0.16
Fortune Blvd SB RT	A	3	0.10	A	2	0.08	A	2	0.07
Route 16 at Route 109, Milford									
Overall	**D**	**48**	--	**E**	**65**	--	**E**	**64**	--
Route 16 EB LT/TH	D	47	0.89	C	22	0.75	C	26	0.83
Route 16 EB RT	A	4	0.72	A	2	0.69	A	2	0.68
Route 16 WB LT	D	41	0.70	B	14	0.56	B	14	0.56
Route 16 WB TH/RT	C	28	0.44	B	14	0.43	B	14	0.43
Route 109 NB LT/TH	F	153	1.33	F	333	2.69	F	328	2.74
Route 109 NB RT	B	13	0.59	A	8	0.52	A	8	0.52
Prairie St SB LT/TH/RT	D	44	0.48	B	15	0.15	B	15	0.15

SIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit
13A
1 of 4

	Morning								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 109 at Beaver Street/Beaver Street Extension, Milford									
Overall	**C**	**21**	--	**C**	**21**	--	**C**	**20**	--
Route 109 EB LT/TH	B	19	0.65	B	19	0.67	B	19	0.67
Route 109 WB TH	C	33	0.95	C	32	0.95	C	32	0.95
Route 109 WB RT	A	1	0.38	A	1	0.41	A	1	0.57
Beaver St Ext. NB LT	B	17	0.07	C	21	0.10	C	21	0.10
Beaver St Ext. NB TH	B	18	0.13	C	21	0.17	C	22	0.18
Beaver St Ext. NB RT	A	5	0.21	A	5	0.26	A	5	0.27
Beaver St SB LT	C	23	0.41	C	25	0.46	C	24	0.46
Beaver St SB RT	A	4	0.39	A	4	0.42	A	4	0.4
Route 109 at Route 495 Southbound Ramps, Milford									
Overall	**B**	**17**	--	**C**	**21**	--	**C**	**27**	--
Route 109 EB TH	B	18	0.50	B	19	0.52	B	20	0.48
Route 109 WB LT	C	28	0.58	D	52	0.74	D	42	0.64
Route 109 WB TH	B	16	0.77	B	19	0.85	C	28	0.95
Route 495 SB LT	A	9	0.13	A	9	0.15	B	10	0.15
Route 495 SB RT	B	19	0.76	C	28	0.91	C	34	0.95
Route 109 at Route 495 Northbound Ramps, Milford									
Overall	**B**	**12**	--	**B**	**13**	--	**B**	**14**	--
Route 109 EB LT	B	13	0.60	C	22	0.65	C	25	0.69
Route 109 EB TH	A	8	0.29	A	7	0.29	A	8	0.30
Route 109 WB TH	B	18	0.66	B	18	0.71	B	18	0.71
Route 495 NB LT	B	14	0.29	B	15	0.40	B	16	0.59
Route 495 NB RT	A	3	0.28	A	3	0.35	A	3	0.35
Route 16 at Route 126 North (Concord Street), Holliston									
Overall	**A**	**7**	--	**A**	**7**	--	**B**	**10**	--
Route 16 EB LT	A	5	0.56	A	5	0.62	B	13	0.70
Route 16 EB TH	A	6	0.63	A	6	0.67	A	6	0.66
Route 16 WB TH/RT	B	13	0.50	B	15	0.65	C	20	0.75
Route 126 SB LT	B	16	0.13	B	18	0.17	B	18	0.17
Route 126 SB RT	A	3	0.52	A	3	0.59	A	3	0.64
Route 16 at Hopping Brook Road, Holliston									
Overall							**B**	**18**	--
Route 16 EB TH							C	27	0.91
Route 16 EB RT							A	5	0.78
Route 16 WB LT			SEE UNSIGNALIZED				D	46	0.9
Route 16 WB TH							A	3	0.35
Hopping Brook NB LT							C	34	0.46
Hopping Brook NB RT							A	6	0.07

SIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 13B

	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 Northbound Ramps, Milford									
Overall		**see**		**D**	**50**	**--**	**E**	**76**	**--**
Route 85 EB LT		unsignalized		E	70	1.00	F	91	1.1
Route 85 EB TH				A	3	0.16	A	2	0.16
Route 85 WB TH				E	60	1.00	F	93	1.09
Route 85 WB RT				B	11	0.03	B	18	0.03
Route 495 NB LT				D	51	0.79	F	86	0.94
Route 495 NB RT				A	7	0.48	A	8	0.52
Route 85 at Dilla Street/Fortune Boulevard, Milford									
Overall	**C**	**25**	**--**	**C**	**35**	**--**	**D**	**40**	**--**
Route 85 EB LT	D	52	0.55	E	75	0.72	E	77	0.76
Route 85 EB TH/RT	C	26	0.58	C	30	0.64	D	38	0.79
Route 85 WB LT	C	32	0.60	D	40	0.76	C	34	0.59
Route 85 WB TH	C	32	0.83	D	47	0.94	D	49	0.93
Route 85 WB RT	A	9	0.80	B	19	0.92	C	23	0.93
Fortune NB LT/TH	C	29	0.74	D	38	0.87	D	40	0.89
Fortune NB RT	A	4	0.51	A	6	0.63	C	28	0.95
Dilla SB LTR	D	39	0.85	D	50	0.92	E	64	0.96
Route 16 at Fortune Boulevard/Beaver Street, Milford									
Overall	**A**	**7**	**--**	**B**	**13**	**--**	**C**	**34**	**--**
Route 16 EB LT/TH/RT	A	4	0.27	A	10	0.40	B	16	0.38
Route 16 WB LT/TH	A	9	0.58	C	22	0.90	D	46	1.25
Route 16 WB RT	A	2	0.33	A	2	0.37	A	8	0.63
Beaver St NB LT/TH/RT	A	7	0.61	B	17	0.81	D	50	0.93
Fortune Blvd SB LT	A	9	0.57	B	13	0.67	E	55	0.94
Fortune Blvd SB TH	n/a	n/a	n/a	A	10	0.40	C	25	0.47
Fortune Blvd SB RT	A	4	0.07	A	3	0.07	B	12	0.08
Route 16 at Route 109, Milford									
Overall	**F**	**85**	**--**	**F**	**91**	**--**	**F**	**84**	**--**
Route 16 EB LT/TH	C	35	0.56	C	22	0.54	B	19	0.52
Route 16 EB RT	A	4	0.76	A	3	0.75	A	2	0.71
Route 16 WB LT	D	44	0.83	C	24	0.74	B	17	0.64
Route 16 WB TH/RT	D	38	0.86	C	22	0.82	C	23	0.85
Route 109 NB LT/TH	F	294	2.07	F	368	3.41	F	356	3.32
Route 109 NB RT	B	17	0.63	A	9	0.55	A	8	0.54
Prairie St SB LT/TH/RT	C	29	0.15	C	21	0.12	B	18	0.09

SIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit
13C

	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 109 at Beaver Street/Beaver Street Extension, Milford									
Overall	**C**	**33**	--	**E**	**60**	--	**E**	**69**	--
Route 109 EB LT/TH	D	43	0.97	F	87	1.10	E	65	1.04
Route 109 WB TH	C	20	0.52	C	26	0.54	C	24	0.51
Route 109 WB RT	A	1	0.35	A	2	0.47	A	1	0.37
Beaver St Ext. NB LT	C	25	0.13	D	36	0.15	D	47	0.24
Beaver St Ext. NB TH	C	26	0.26	D	38	0.30	D	50	0.49
Beaver St Ext. NB RT	D	49	0.94	F	97	1.10	F	230	1.66
Beaver St SB LT	D	53	0.94	F	100	1.09	E	76	1.03
Beaver St SB RT	A	5	0.44	A	6	0.48	A	8	0.40
Route 109 at Route 495 Southbound Ramps, Milford									
Overall	**C**	**20**	--	**C**	**33**	--	**C**	**33**	--
Route 109 EB TH	C	24	0.90	D	36	0.95	D	36	0.95
Route 109 WB LT	C	34	0.80	F	81	0.93	F	81	0.93
Route 109 WB TH	B	12	0.38	B	14	0.43	B	14	0.44
Route 495 SB LT	B	14	0.24	B	19	0.25	B	19	0.25
Route 495 SB RT	C	23	0.87	D	45	0.97	D	48	0.98
Route 109 at Route 495 Northbound Ramps, Milford									
Overall	**B**	**15**	--	**B**	**19**	--	**B**	**19**	--
Route 109 EB LT	B	17	0.88	C	32	0.90	C	32	0.90
Route 109 EB TH	B	11	0.48	A	8	0.53	A	8	0.53
Route 109 WB TH	C	21	0.75	C	30	0.88	C	30	0.88
Route 495 NB LT	B	17	0.24	B	19	0.30	B	19	0.32
Route 495 NB RT	A	7	0.34	B	12	0.43	B	12	0.43
Route 16 at Route 126 North (Concord Street), Holliston									
Overall	**B**	**13**	--	**B**	**20**	--	**C**	**22**	--
Route 16 EB LT	B	19	0.70	C	32	0.80	D	36	0.84
Route 16 EB TH	A	4	0.20	A	4	0.22	A	4	0.29
Route 16 WB TH/RT	C	20	0.85	C	27	0.91	C	31	0.92
Route 126 SB LT	C	22	0.13	C	30	0.15	C	31	0.16
Route 126 SB RT	A	4	0.74	A	8	0.85	A	8	0.85
Route 16 at Hopping Brook Road, Holliston									
Overall	SEE UNSIGNALIZED						**D**	**54**	--
Route 16 EB TH							D	42	0.89
Route 16 EB RT							A	<1	0.06
Route 16 WB LT							B	20	0.41
Route 16 WB TH							E	73	1.06
Hopping Brook NB LT							E	71	1.06
Hopping Brook NB RT									

SIGNALIZED
LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts
Abend Associates

Exhibi[t] 13[D]
4 of 4

Possible study area Intersection Improvements

A review of the level of service results and the project's traffic flows suggest that the impact of the project on the intersections in Milford will not result in significant degradation of traffic operations. The multiple ongoing traffic improvements are addressing the traffic impacts of several other development projects in this area and further improvements do not appear warranted by this project. Along Route 16 in Holliston, however, there are two locations besides the entrance to Hopping Brook Road that might be improved. These are noted below and the level of service results for these improvements are shown in Exhibit 14.

Route 16 at Central Street, Holliston – This intersection operates at level of service *F* now with significant delays along the Central Street approach. Signalizing the intersection and adding turn lanes in both directions along Route 16 will result in a level of service improvement to *D* during the morning peak hour and *C* during the evening peak hour. There appears to be sufficient widths to provide these added lanes without changing the edge of pavement here. The proponent is prepared to participate in funding this improvement.

Route 16 at Route 126 (South), Holliston – This unsignalized intersection currently operates at poor levels of service, particularly during the evening peak hour when there is a high volume of left turns off of Route 16 that blocks the westbound through flow. Creating a left-turn lane westbound along Route 16 and signalizing the intersection would result in a level of service *B* during the morning peak hour and level of service *E* during the evening peak hour. A more significant level of service improvement would probably require landtakings and significant roadway widening. The proponent is prepared to participate in funding this improvement.

The proponent is prepared to participate in the improvements noted above, working with the state and town to develop an appropriate design and level of contribution. In addition to these locations, we make recommendations for changes to one other location, as noted below.

Route 85 at Dilla Street/Fortune Boulevard, Milford – The level of service at this intersection has the potential to be improved by reassigning lanes. Northbound on Fortune Boulevard, the left-turn lane is designated for left and through movements, while southbound there is a left-turn lane and a left/through/right lane. Considering the flows on the various approaches, it appears that converting the northbound approach to a left-turn lane, a through lane, and a right-turn lane and the southbound approach to a double left-turn lane and a through/right-turn lane, the level of service could be improved overall. This configuration and a rephrasing of the signal would result in level of service *D* during both peak hours with average delays of about 55 and 45 seconds, respectively. Note that this lane change would result in an increase in average delay for the evening peak hour. Although it is not known for sure, it is speculated that the design of this intersection was developed as part of improvements to accommodate the retail projects along Fortune Boulevard, which would not have specifically considered the morning peak hour traffic conditions, hence the poor level of service during the morning under future conditions. It is not recommended that this intersection be adjusted at all at this point but that consideration be given in the future to revising the lane assignments as traffic volumes grow. The proponent is not proposed to participate in any changes here.

	AM Peak Hour			PM Peak Hour		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Dilla Street/Fortune Boulevard, Milford						
Overall	**D**	**54**	--	**D**	**43**	--
Route 85 EB LT	E	71	0.46	F	125	0.92
Route 85 EB TH/RT	F	91	1.02	D	37	0.59
Route 85 WB LT	E	67	0.92	D	44	0.70
Route 85 WB TH	C	26	0.31	D	40	0.87
Route 85 WB RT	A	3	0.34	D	49	1.02
Fortune NB LT	F	163	0.76	D	46	0.52
Fortune NB TH	F	127	0.98	E	69	1.01
Fortune NB RT	D	39	0.68	B	16	0.77
Dilla SB LTR	D	48	0.91	D	51	0.84
Dilla SB TH/RT	D	38	0.71	C	29	0.56
Route 16 at Route 126 (South), Holliston						
Overall	**B**	**13**	--	**E**	**20**	--
Route 16 EB TH/RT	C	19	0.70	F	32	0.80
Route 16 WB LT	C	4	0.20	F	4	0.22
Route 16 WB TH	A	20	0.85	A	27	0.91
Route 126 NB LT	C	22	0.13	E	30	0.15
Route 126 NB RT	C	4	0.74	B	8	0.85
Route 16 at Central Street, Holliston						
Overall	**D**	**53**	--	**C**	**24**	--
Route 16 EB TH	E	72	1.11	C	32	0.95
Route 16 EB RT	A	2	0.25	A	2	0.27
Route 16 WB LT	F	125	1.23	C	33	0.88
Route 16 WB TH	A	6	0.50	B	16	0.89
Central NB LT/RT	E	70	1.02	C	34	0.89

LEVEL OF SERVICE SUMMARY
WITH IMPROVEMENTS

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit
14

TRAVEL DEMAND MANAGEMENT

While the proponent is committed to providing measures to minimize vehicle trips to and from the site, the opportunities for Travel Demand Management (TDM) measures is limited. The site is not located in a place that is conducive to such measures nor is the type of use conducive to such measures.

The effectiveness of TDM programs is dependant on a critical mass of employees and/or customers that will find alternative travel mode options convenient and/or less expensive than driving themselves to and from the site. These sorts of programs are not likely to be effective at this site for several reasons. First, there is no specific transit service in the area that could be connected to the site conveniently. The project is not close enough to the Route 9 corridor to be included in any programs in the Metro West area, nor is it close enough to the Route 495 corridor to be included in any measures along that area. Further, there is no transportation node that the project could link with. Second, the types of uses at the site not only vary in terms of land use category but also within the various categories the types of businesses vary in terms of their schedules and business types. That is, manufacturing and distribution uses tend to have less standard 9-to-5 operations than office/employee intensive uses might have. Even if some type of shuttle service were to be developed between the site and the commercial areas in Milford, there is no central location within that commercial area that would serve as a focal point for such a service. Basically, the various trips to and from the site are so varied that creating enough of a concentration of one type or another to support a TDM program of that sort does not seem realistic.

This having been said, the proponent is still prepared to provide services on-site to encourage ridesharing as much as possible to comply with DEP regulations related to air quality as well as to reduce vehicle trips for congestion/delay reasons. A transportation coordinator will be designated on-site and will work with the various businesses to encourage carpooling and ridesharing between employees of the various companies on the site. This will include coordinating carpools (including setting up a guarantee ride home program within the park), providing information on the limited transit service available in the area and provide other information related to typical TDM programs. In addition, the proponent is prepared to encourage developers of individual parcels within the park to create on-site concessions that will cater to employees to minimize ancillary trips. Such services might include a coffee shop or on-site café, ATMs. etc. In addition, more centralized services such as an ATM or a cafeteria that is open to non-company personnel might also reduce overall trips along Route 16. All these options will be considered since not only will these services reduce vehicle trips but they will also enhance the marketability of the park for the proponent.

To a very large extent the land use mix will help mitigate the impacts of the project. As noted in the trip generation discussion, the types of tenants that are already located here tend to be less traffic intensive. The reason for this is possibly due to the location of the site as well as the types of tenants (i.e., not employee intensive 9-to-5 type operations) who tend to have less strict 9-to-5 operations.

While this section does not provide a specific TDM program, the proponent is prepared to develop one and submit it to the MassHighway Department prior to their issuance of a Section 61 Finding.

SUMMARY CONCLUSIONS

This traffic analysis has presented the impacts of the proposed completion of the Hopping Brook Business Park in Holliston, Massachusetts. The project includes a variety of land uses including office, R&D, warehousing, and manufacturing. Currently about 560,000 square feet of space has been built out with the total build out to reach 3,000,000 square feet. The current mix of the various land uses is expected to be mirrored by the overall development. This study has evaluated a total of twelve intersections within the towns of Milford and Holliston including the interchanges along Route 495 at Route 85 and Route 109. There is considerable commercial development in Milford along the Route 495 corridor and improvements to many of the intersections along that corridor have been made in recent years and are currently ongoing to accommodate the development in the area.

Generally, those intersections will be able to accommodate the additional traffic associated with this project without needing further traffic improvements. In one particular case, Route 85 at Dilla Street/Fortune Boulevard, the current layout appears to favor a retail land use mix since it appears to work fine during the evening peak hour but not during the morning peak hour. With this in mind, recommendations have been included in the analysis that might better accommodate all traffic flows.

With full development of the site it will be necessary to improve the intersection of Route 16 and Hopping Brook Road, which serves as the entrance to the project. These improvements will include creating turn lanes for traffic approaching the site in both direction as well as signalization of the intersection. The proponent is prepared to provide the design and construction of this improvement as part of his development work. In addition, the Route 16 intersections at Route 126 (Summer Street) and at Central Street currently suffer significant delays a peak times. The proponent is prepared to work with the state and the town of Holliston to development solutions for both of these intersections. Further, he is prepared to contribute to the improvements themselves at a level to be determined among the parties. Beyond these physical improvements, the proponent is prepared to designate a Transportation Coordinator for the park to serve as manager of the TDM programs that would be practical for this type of facility and that are consistent with state regulations regarding ridesharing. In addition, to the extent that the Holliston Zoning Bylaws allow, he is prepared to consider developing on-site complementary services (i.e., cafeterias, bank ATMs, etc.) that accommodate on-site employees and businesses to minimize the number of vehicle trips as much as practical.

Count Data

Accurate Counts
978-664-2565

Page
2014400
Site Code: 20144001

Location : Route 16 West of
Location : Hopping Brook Road
City/State: Holliston, MA
Counter : 2377

Start Time	10-Dec-0 Tue	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		20	155			11	90				
12:15		12	116			9	102				
12:30		4	151			2	103				
12:45		5	161	41	583	5	107	27	402	68	985
01:00		9	153			2	101				
01:15		6	169			2	107				
01:30		5	168			4	99				
01:45		2	109	22	599	6	125	14	432	36	1031
02:00		2	192			0	94				
02:15		5	180			4	108				
02:30		1	206			1	94				
02:45		9	184	17	762	3	105	8	401	25	1163
03:00		9	193			4	89				
03:15		6	196			5	99				
03:30		3	233			11	120				
03:45		8	188	26	810	2	126	22	434	48	1244
04:00		12	228			9	112				
04:15		12	186			10	105				
04:30		3	230			20	118				
04:45		7	195	34	839	29	99	68	434	102	1273
05:00		12	287			25	114				
05:15		15	230			57	115				
05:30		24	212			98	125				
05:45		39	186	90	915	105	118	285	472	375	1387
06:00		32	199			128	97				
06:15		62	151			177	89				
06:30		63	111			211	68				
06:45		94	117	251	578	185	77	701	331	952	909
07:00		65	101			200	72				
07:15		118	103			181	79				
07:30		92	88			201	78				
07:45		148	93	423	385	234	60	816	289	1239	674
08:00		140	63			175	48				
08:15		140	48			222	55				
08:30		120	71			175	35				
08:45		118	57	518	239	151	30	723	168	1241	407
09:00		114	61			115	40				
09:15		118	50			109	33				
09:30		97	48			80	34				
09:45		96	38	425	197	91	35	395	142	820	339
10:00		103	22			88	18				
10:15		94	46			92	35				
10:30		101	29			98	17				
10:45		112	24	410	121	69	28	347	98	757	219
11:00		120	24			110	17				
11:15		133	25			83	12				
11:30		128	9			87	15				
11:45		144	12	525	70	78	8	358	52	883	122
Total		2782	6098			3764	3655			6546	9753
Percent		31.3%	68.7%			50.7%	49.3%			40.2%	59.8%

Location : Route 16 West of
Location : Hopping Brook Road
City/State: Holliston, MA
Counter : 2377

Start Time	11-Dec-0 Wed	WB Morning	WB Afternoon	Hour Totals Morning	Hour Totals Afternoon	EB Morning	EB Afternoon	Hour Totals Morning	Hour Totals Afternoon	Combined Totals Morning	Combined Totals Afternoon
12:00		21	160			9	107				
12:15		20	138			5	96				
12:30		8	122			7	112				
12:45		4	129	53	549	3	124	24	439	77	988
01:00		7	139			7	118				
01:15		5	133			4	113				
01:30		2	127			3	119				
01:45		2	126	16	525	5	117	19	467	35	992
02:00		1	154			1	114				
02:15		3	145			3	81				
02:30		5	144			2	113				
02:45		9	159	18	602	8	109	14	417	32	1019
03:00		11	171			3	113				
03:15		5	160			6	104				
03:30		3	228			3	128				
03:45		9	209	28	768	8	103	20	448	48	1216
04:00		5	202			8	117				
04:15		6	179			13	122				
04:30		3	227			23	96				
04:45		8	208	22	816	19	121	63	456	85	1272
05:00		13	266			31	117				
05:15		19	233			48	135				
05:30		34	216			91	127				
05:45		23	176	89	891	127	104	297	483	386	1374
06:00		33	166			129	94				
06:15		61	116			175	95				
06:30		64	116			216	77				
06:45		75	74	233	472	187	75	707	341	940	813
07:00		71	110			194	59				
07:15		99	93			200	63				
07:30		123	91			206	70				
07:45		104	75	397	369	211	55	811	247	1208	616
08:00		131	55			177	51				
08:15		133	56			188	52				
08:30		93	68			186	58				
08:45		126	52	483	231	141	53	692	214	1175	445
09:00		87	51			125	47				
09:15		106	45			96	34				
09:30		108	44			91	32				
09:45		90	58	391	198	95	40	407	153	798	351
10:00		96	36			92	35				
10:15		101	28			93	27				
10:30		98	43			95	23				
10:45		105	25	400	132	86	20	366	105	766	237
11:00		100	19			87	17				
11:15		104	33			101	16				
11:30		123	25			95	17				
11:45		119	23	446	100	107	6	390	56	836	156
Total		2576	5653			3810	3826			6386	9479
Percent		31.3%	68.7%			49.9%	50.1%			40.3%	59.7%
Grand Total		5358	11751			7574	7481			12932	19232
Percent		31.3%	68.7%			50.3%	49.7%			40.2%	59.8%

ADT Not Calculated

Hopping Brook Road
Holliston, Massachusetts
Counted by Traffic Counting Unlimited
Box #734

JAMAR Technologies, Inc.
TAS for Windows

Site Code : 734
Start Date: 08/13/2001
File I.D. : C:\PROGRAM FI

Begin	Mon.	08/13	Tues.		Wed.		Thur.		Fri.		Sat.		Sun.		Week	Avg.
Time	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
12:00 am	*	*	0	8	0	5	*	*	*	*	*	*	*	*	0	6
01:00	*	*	0	2	1	6	*	*	*	*	*	*	*	*	0	4
02:00	*	*	1	1	0	2	*	*	*	*	*	*	*	*	0	2
03:00	*	*	2	2	1	0	*	*	*	*	*	*	*	*	2	1
04:00	*	*	3	0	4	2	*	*	*	*	*	*	*	*	4	1
05:00	*	*	26	3	23	2	*	*	*	*	*	*	*	*	24	2
06:00	*	*	141	24	121	13	*	*	*	*	*	*	*	*	131	18
07:00	*	*	166	56	189	34	*	*	*	*	*	*	*	*	178	45
08:00	*	*	197	39	184	50	*	*	*	*	*	*	*	*	190	44
09:00	*	*	114	60	60	33	*	*	*	*	*	*	*	*	87	46
10:00	*	*	68	65	55	38	*	*	*	*	*	*	*	*	62	52
11:00	65	75	56	70	50	76	*	*	*	*	*	*	*	*	57	74
12:00 pm	104	131	101	156	98	138	*	*	*	*	*	*	*	*	101	142
01:00	85	62	142	80	114	72	*	*	*	*	*	*	*	*	114	71
02:00	53	76	70	75	41	52	*	*	*	*	*	*	*	*	55	68
03:00	57	75	62	90	63	113	*	*	*	*	*	*	*	*	61	93
04:00	64	124	43	148	57	142	*	*	*	*	*	*	*	*	55	138
05:00	61	157	37	190	*	*	*	*	*	*	*	*	*	*	49	174
06:00	10	39	5	49	*	*	*	*	*	*	*	*	*	*	8	44
07:00	9	25	13	22	*	*	*	*	*	*	*	*	*	*	11	24
08:00	6	15	5	6	*	*	*	*	*	*	*	*	*	*	6	10
09:00	3	5	1	4	*	*	*	*	*	*	*	*	*	*	2	4
10:00	5	2	5	7	*	*	*	*	*	*	*	*	*	*	5	4
11:00	2	6	5	5	*	*	*	*	*	*	*	*	*	*	4	6
Totals	524	792	1263	1162	1061	778	0	0	0	0	0	0	0	0	1206	1073
	1316		2425		1839		0		0		0		0		2279	
Avg. Day	43.4%	73.8%	104.7%	108.2%	87.9%	72.5%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%		
AM Peaks	11:00	11:00	08:00	11:00	07:00	11:00									08:00	11:00
Volume	65	75	197	70	189	76									190	74
PM Peaks	12:00	05:00	01:00	05:00	01:00	04:00									01:00	05:00
Volume	104	157	142	190	114	142									114	174

ADTs

Hopping Brook Road
Holliston, Massachusetts
Counted by Traffic Counting Unlimited
Box #734

JAMAR Technologies, Inc.
TAS for Windows

Site Code : 734
Start Date: 08/13/2001
File I.D. : C:\PROGRA

Begin Time	08/13 SB	Mon.	A.M. NB		Combine------> Total		08/13 SB	Mon.	P.M. NB		Combine------> Total	
12:00	*		*		*		22		45		67	
12:15	*		*		*		23		28		51	
12:30	*		*		*		21		27		48	
12:45	*	*	*	*	*	*	38	104	31	131	69	235
01:00	*		*		*		28		24		52	
01:15	*		*		*		19		11		30	
01:30	*		*		*		16		14		30	
01:45	*	*	*	*	*	*	22	85	13	62	35	147
02:00	*		*		*		11		24		35	
02:15	*		*		*		10		23		33	
02:30	*		*		*		18		15		33	
02:45	*	*	*	*	*	*	14	53	14	76	28	129
03:00	*		*		*		15		12		27	
03:15	*		*		*		15		21		36	
03:30	*		*		*		13		28		41	
03:45	*	*	*	*	*	*	14	57	14	75	28	132
04:00	*		*		*		18		54		72	
04:15	*		*		*		12		26		38	
04:30	*		*		*		17		27		44	
04:45	*	*	*	*	*	*	17	64	17	124	34	188
05:00	*		*		*		24		71		95	
05:15	*		*		*		17		28		45	
05:30	*		*		*		14		32		46	
05:45	*	*	*	*	*	*	6	61	26	157	32	218
06:00	*		*		*		0		9		9	
06:15	*		*		*		7		17		24	
06:30	*		*		*		2		11		13	
06:45	*	*	*	*	*	*	1	10	2	39	3	49
07:00	*		*		*		3		9		12	
07:15	*		*		*		4		1		5	
07:30	*		*		*		1		8		9	
07:45	*	*	*	*	*	*	1	9	7	25	8	34
08:00	*		*		*		3		8		11	
08:15	*		*		*		1		2		3	
08:30	*		*		*		1		2		3	
08:45	*	*	*	*	*	*	1	6	3	15	4	21
09:00	*		*		*		2		0		2	
09:15	*		*		*		0		1		1	
09:30	*		*		*		1		3		4	
09:45	*	*	*	*	*	*	0	3	1	5	1	8
10:00	*		*		*		0		1		1	
10:15	*		*		*		2		0		2	
10:30	*		*		*		1		1		2	
10:45	*	*	*	*	*	*	2	5	0	2	2	7
11:00	18		15		33		1		2		3	
11:15	20		18		38		0		3		3	
11:30	14		15		29		0		1		1	
11:45	13	65	27	75	40	140	1	2	0	6	1	8
Totals	65		75		140		459		717		1176	
Split %	46.4%		53.5%				39.0%		60.9%			
Peak Hour	11:00		11:00		11:00		12:15		05:00		12:00	
Volume	65		75		140		110		157		235	
P.H.F.	.81		.69		.87		.72		.55		.85	

Hopping Brook Road
Holliston, Massachusetts
Counted by Traffic Counting Unlimited
Box #734

JAMAR Technologies, Inc.
TAS for Windows
Copyright 1998

Site Code : 734
Start Date: 08/13/2001
File I.D. : C:\PROGRAM FI
Page : 2

Begin	08/14	Tues.	A.M.		Combine------>		08/14	Tues.	P.M.		Combine------>	
Time	SB		NB		Total		SB		NB		Total	
12:00	0		6		6		15		72		87	
12:15	0		2		2		23		27		50	
12:30	0		0		0		29		28		57	
12:45	0	*	0	8	0	8	34	101	29	156	63	257
01:00	0		0		0		62		20		82	
01:15	0		0		0		25		25		50	
01:30	0		2		2		29		18		47	
01:45	0	*	0	2	0	2	26	142	17	80	43	222
02:00	0		0		0		21		29		50	
02:15	0		0		0		22		18		40	
02:30	0		1		1		10		15		25	
02:45	1	1	0	1	1	2	17	70	13	75	30	145
03:00	0		1		1		11		14		25	
03:15	0		0		0		18		28		46	
03:30	1		1		2		19		29		48	
03:45	1	2	0	2	1	4	14	62	19	90	33	152
04:00	0		0		0		15		53		68	
04:15	0		0		0		11		28		39	
04:30	2		0		2		9		38		47	
04:45	1	3	0	*	1	3	8	43	29	148	37	191
05:00	0		0		0		14		80		94	
05:15	3		0		3		10		41		51	
05:30	9		3		12		9		40		49	
05:45	14	26	0	3	14	29	4	37	29	190	33	227
06:00	18		2		20		3		19		22	
06:15	20		3		23		1		14		15	
06:30	41		5		46		0		14		14	
06:45	62	141	14	24	76	165	1	5	2	49	3	54
07:00	12		18		30		1		7		8	
07:15	54		14		68		6		8		14	
07:30	46		15		61		2		5		7	
07:45	54	166	9	56	63	222	4	13	2	22	6	35
08:00	51		11		62		3		3		6	
08:15	66		8		74		0		0		0	
08:30	42		14		56		1		1		2	
08:45	38	197	6	39	44	236	1	5	2	6	3	11
09:00	31		12		43		0		2		2	
09:15	31		18		49		0		2		2	
09:30	25		18		43		0		0		0	
09:45	27	114	12	60	39	174	1	1	0	4	1	5
10:00	22		13		35		0		1		1	
10:15	14		9		23		3		3		6	
10:30	17		26		43		0		0		0	
10:45	15	68	17	65	32	133	2	5	3	7	5	12
11:00	13		18		31		0		3		3	
11:15	9		14		23		2		2		4	
11:30	17		14		31		0		0		0	
11:45	17	56	24	70	41	126	3	5	0	5	3	10
Totals	774		330		1104		489		832		1321	
Split %	70.1%		29.8%				37.0%		62.9%			
Peak Hour	07:30		10:30		07:30		12:30		04:45		12:00	
Volume	217		75		260		150		190		257	
P.H.F.	.82		.72		.87		.60		.59		.73	

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Hopping Brook Road
Holliston, Massachusetts
Counted by Traffic Counting Unlimited
Box #734

JAMAR Technologies, Inc.
TAS for Windows
Copyright 1998

Site Code : 734
Start Date: 08/13/
File I.D. : C:\PRO
Page : 3

Begin Time	08/15 SB	Wed.	A.M. NB		Combine------> Total		08/15 SB	Wed.	P.M. NB		Combine------> Total	
12:00	0		4		4		19		58		77	
12:15	0		0		0		30		36		66	
12:30	0		1		1		22		28		50	
12:45	0	*	0	5	0	5	27	98	16	138	43	236
01:00	1		3		4		40		24		64	
01:15	0		3		3		28		15		43	
01:30	0		0		0		29		22		51	
01:45	0	1	0	6	0	7	17	114	11	72	28	186
02:00	0		1		1		11		14		25	
02:15	0		0		0		13		10		23	
02:30	0		0		0		6		17		23	
02:45	0	*	1	2	1	2	11	41	11	52	22	93
03:00	0		0		0		14		18		32	
03:15	0		0		0		14		25		39	
03:30	0		0		0		16		30		46	
03:45	1	1	0	*	1	1	19	63	40	113	59	176
04:00	2		0		2		24		43		67	
04:15	0		0		0		11		29		40	
04:30	0		0		0		11		35		46	
04:45	2	4	2	2	4	6	*	*	*	*	*	153
05:00	2		0		2		*		*		*	
05:15	3		1		4		*		*		*	
05:30	9		1		10		*		*		*	
05:45	9	23	0	2	9	25	*	*	*	*	*	*
06:00	15		2		17		*		*		*	
06:15	22		6		28		*		*		*	
06:30	30		4		34		*		*		*	
06:45	54	121	1	13	55	134	*	*	*	*	*	*
07:00	35		7		42		*		*		*	
07:15	55		10		65		*		*		*	
07:30	43		10		53		*		*		*	
07:45	56	189	7	34	63	223	*	*	*	*	*	*
08:00	48		15		63		*		*		*	
08:15	60		6		66		*		*		*	
08:30	49		12		61		*		*		*	
08:45	27	184	17	50	44	234	*	*	*	*	*	*
09:00	26		8		34		*		*		*	
09:15	16		2		18		*		*		*	
09:30	9		11		20		*		*		*	
09:45	9	60	12	33	21	93	*	*	*	*	*	*
10:00	9		9		18		*		*		*	
10:15	12		4		16		*		*		*	
10:30	19		10		29		*		*		*	
10:45	15	55	15	38	30	93	*	*	*	*	*	*
11:00	14		16		30		*		*		*	
11:15	17		17		34		*		*		*	
11:30	8		17		25		*		*		*	
11:45	11	50	26	76	37	126	*	*	*	*	*	*
Totals	688		261		949		362		482		844	
Split %	72.5%		27.5%				42.8%		57.1%			
Peak Hour	07:45		11:00		07:45		12:45		03:45		12:00	
Volume	213		76		253		124		147		236	
P.H.F.	.88		.73		.95		.77		.85		.76	

/S Street : Route 85
W Street : Route 495 NB Ramps
y/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144001
Site Code : 20144001
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 85 From North			Route 495 NB Off Ramp From East			Route 85 From South			Route 495 NB On Ramp From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	0	42	1	29	0	33	224	94	0	0	0	0	423
07:15	0	55	4	34	0	43	270	79	0	0	0	0	485
07:30	0	63	3	47	0	51	234	103	0	0	0	0	501
07:45	0	57	8	34	0	69	227	108	0	0	0	0	503
Total	0	217	16	144	0	196	955	384	0	0	0	0	1912
08:00	0	53	1	34	0	55	246	75	0	0	0	0	464
08:15	0	56	0	26	0	41	230	99	0	0	0	0	452
08:30	0	71	1	46	0	33	204	81	0	0	0	0	436
08:45	0	60	1	57	1	31	175	78	0	0	0	0	403
Total	0	240	3	163	1	160	855	333	0	0	0	0	1755
Grand Total	0	457	19	307	1	356	1810	717	0	0	0	0	3667
Apprch %	0.0	96.0	4.0	46.2	0.2	53.6	71.6	28.4	0.0	0.0	0.0	0.0	
Total %	0.0	12.5	0.5	8.4	0.0	9.7	49.4	19.6	0.0	0.0	0.0	0.0	

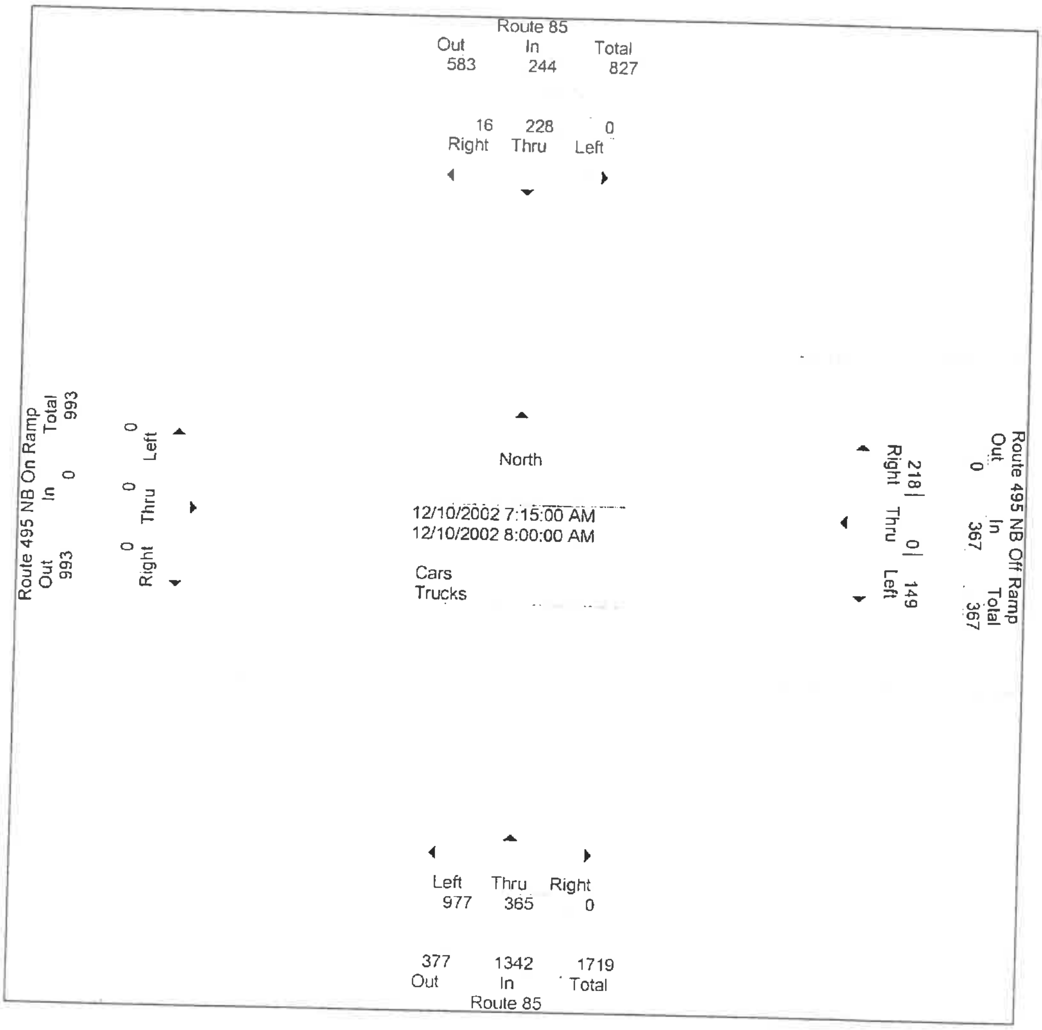
	Route 85 From North				Route 495 NB Off Ramp From East				Route 85 From South				Route 495 NB On Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:15																
Volume	0	228	16	244	149	0	218	367	977	365	0	1342	0	0	0	0	1953
Percent	0.0	93.4	6.6		40.6	0.0	59.4		72.8	27.2	0.0		0.0	0.0	0.0		
Volume	0	228	16	244	149	0	218	367	977	365	0	1342	0	0	0	0	1953
Volume	0	57	8	65	34	0	69	103	227	108	0	335	0	0	0	0	503
Peak Factor																	0.971
High Int.	07:30				07:45				07:15				6:45:00 AM				
Volume	0	63	3	66	34	0	69	103	270	79	0	349					
Peak Factor				0.924				0.891				0.961					
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
y Approach	07:45				07:15				07:15				07:00				
Volume	0	237	10	247	149	0	218	367	977	365	0	1342	0	0	0	0	
Percent	0.0	96.0	4.0		40.6	0.0	59.4		72.8	27.2	0.0		-	-	-		
High Int.	08:30				07:45				07:15				-				
Volume	0	71	1	72	34	0	69	103	270	79	0	349	-	-	-	-	
Peak Factor				0.858				0.891				0.961				-	

N/S Street : Route 85
E/W Street : Route 495 NB Ramps
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 2014
Site Code : 2014
Start Date : 12/10
Page No : 1

	Route 85 From North				Route 495 NB Off Ramp From East				Route 85 From South				Route 495 NB On Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	T
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:15																
Volume	0	228	16	244	149	0	218	367	977	365	0	1342	0	0	0	0	19
Percent	0.0	93.4	6.6		40.6	0.0	59.4		72.8	27.2	0.0		0.0	0.0	0.0		
Volume	0	228	16	244	149	0	218	367	977	365	0	1342	0	0	0	0	19
Volume	0	57	8	65	34	0	69	103	227	108	0	335	0	0	0	0	5
Peak Factor																	0.97
High Int.	07:30				07:45				07:15				6:45:00 AM				
Volume	0	63	3	66	34	0	69	103	270	79	0	349					
Peak Factor				0.924				0.891				0.961					



N/S Street : Route 85
E/W Street : Route 495 NB Ramps
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 2014
Site Code : 2014
Start Date : 12/10
Page No : 1

Groups Printed- Cars - Trucks

	Route 85 From North			Route 495 NB Off Ramp From East			Route 85 From South			Route 495 NB On Ramp From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. T
16:00	0	123	2	75	1	26	122	40	0	0	0	0	3
16:15	0	123	5	78	0	32	117	34	0	0	0	0	3
16:30	0	155	0	66	0	27	117	42	0	0	0	0	4
16:45	0	135	5	85	0	31	103	53	0	0	0	0	4
Total	0	536	12	304	1	116	459	169	0	0	0	0	15
17:00	0	158	3	79	1	38	138	49	0	0	0	0	4
17:15	0	172	5	65	0	39	131	56	0	0	0	0	4
17:30	0	175	7	72	0	42	115	45	0	0	0	0	4
17:45	0	155	3	87	1	25	109	51	0	0	0	0	4
Total	0	660	18	303	2	144	493	201	0	0	0	0	18
Grand Total	0	1196	30	607	3	260	952	370	0	0	0	0	341
Apprch %	0.0	97.6	2.4	69.8	0.3	29.9	72.0	28.0	0.0	0.0	0.0	0.0	
Total %	0.0	35.0	0.9	17.8	0.1	7.6	27.9	10.8	0.0	0.0	0.0	0.0	

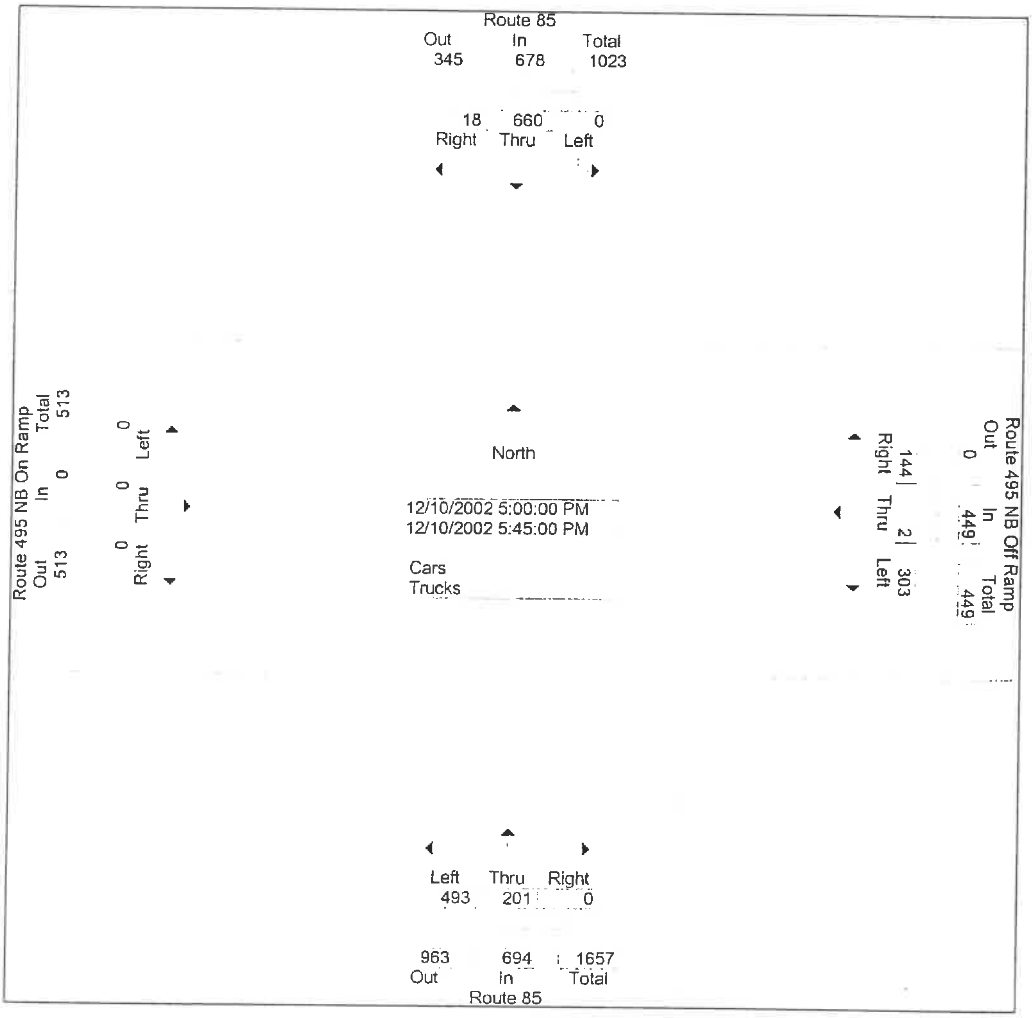
	Route 85 From North				Route 495 NB Off Ramp From East				Route 85 From South				Route 495 NB On Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	17:00																
Volume	0	660	18	678	303	2	144	449	493	201	0	694	0	0	0	0	1821
Percent	0.0	97.3	2.7		67.5	0.4	32.1		71.0	29.0	0.0		0.0	0.0	0.0		
Volume	0	660	18	678	303	2	144	449	493	201	0	694	0	0	0	0	1821
Volume	0	172	5	177	65	0	39	104	131	56	0	187	0	0	0	0	468
Peak Factor																	0.973
High Int.	17:30				17:00				17:00								
Volume	0	175	7	182	79	1	38	118	138	49	0	187					
Peak Factor				0.931				0.951				0.928					
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
By Approach	17:00				16:45				17:00				16:00				
Volume	0	660	18	678	301	1	150	452	493	201	0	694	0	0	0	0	
Percent	0.0	97.3	2.7		66.6	0.2	33.2		71.0	29.0	0.0		-	-	-		
High Int.	17:30				17:00				17:00				-				
Volume	0	175	7	182	79	1	38	118	138	49	0	187	-	-	-	-	
Peak Factor				0.931				0.958				0.928				-	

N/S Street : Route 85
E/W Street : Route 495 NB Ramps
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 2014400
Site Code : 2014400
Start Date : 12/10/20
Page No : 1

	Route 85 From North				Route 495 NB Off Ramp From East				Route 85 From South				Route 495 NB On Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection 17:00																	
Volume	0	660	18	678	303	2	144	449	493	201	0	694	0	0	0	0	1821
Percent	0.0	97.3	2.7		67.5	0.4	32.1		71.0	29.0	0.0		0.0	0.0	0.0		
Volume	0	660	18	678	303	2	144	449	493	201	0	694	0	0	0	0	1821
Volume	0	172	5	177	65	0	39	104	131	56	0	187	0	0	0	0	468
Peak Factor																	0.973
High Int.	17:30				17:00				17:00								
Volume	0	175	7	182	79	1	38	118	138	49	0	187					
Peak Factor				0.931				0.951				0.928					



; Street : Route 85
/ Street : Route 495 SB Ramps
/State : Milford, MA
ather : Clear

Accurate Counts
978-664-2565

File Name : 20144002
Site Code : 20144002
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 85 From North			Route 495 SB On Ramp From East			Route 85 From South			Route 495 SB Off Ramp From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	19	49	0	0	0	0	0	319	48	2	1	85	523
07:15	25	67	0	0	0	0	0	351	34	1	0	86	564
07:30	21	91	0	0	0	0	0	349	46	4	0	109	620
07:45	19	78	0	0	0	0	0	341	39	4	0	121	602
Total	84	285	0	0	0	0	0	1360	167	11	1	401	2309
08:00	26	62	0	0	0	0	0	322	39	3	0	123	575
08:15	25	59	0	0	0	0	0	325	38	5	0	125	577
08:30	29	81	0	0	0	0	0	270	38	11	0	100	529
08:45	24	98	0	0	0	0	0	237	48	6	0	94	507
Total	104	300	0	0	0	0	0	1154	163	25	0	442	2188
Grand Total	188	585	0	0	0	0	0	2514	330	36	1	843	4497
Apprch %	24.3	75.7	0.0	0.0	0.0	0.0	0.0	88.4	11.6	4.1	0.1	95.8	
Total %	4.2	13.0	0.0	0.0	0.0	0.0	0.0	55.9	7.3	0.8	0.0	18.7	

	Route 85 From North				Route 495 SB On Ramp From East				Route 85 From South				Route 495 SB Off Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:30																
Volume	91	290	0	381	0	0	0	0	0	1337	162	1499	16	0	478	494	2374
Percent	23.9	76.1	0.0		0.0	0.0	0.0		0.0	89.2	10.8		3.2	0.0	96.8		
Volume	91	290	0	381	0	0	0	0	0	1337	162	1499	16	0	478	494	2374
Volume	21	91	0	112	0	0	0	0	0	349	46	395	4	0	109	113	620
Peak Factor																	0.957
High Int.	07:30				6:45:00 AM				07:30				08:15				
Volume	21	91	0	112	0	0	0	0	0	349	46	395	5	0	125	130	
Peak Factor				0.850								0.949				0.950	
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
By Approach	08:00				07:00				07:00				07:30				
Volume	104	300	0	404	0	0	0	0	0	1360	167	1527	16	0	478	494	
Percent	25.7	74.3	0.0		-	-	-		0.0	89.1	10.9		3.2	0.0	96.8		
High Int.	08:45				-				07:30				08:15				
Volume	24	98	0	122	-	-	-	-	0	349	46	395	5	0	125	130	
Peak Factor				0.828				-				0.966				0.950	

N/S Street : Route 85
E/W Street : Route 495 SB Ramps
City/State : Milford, MA
Weather : Clear

Accurate Counts
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File Name : 2
Site Code : 2
Start Date : 1
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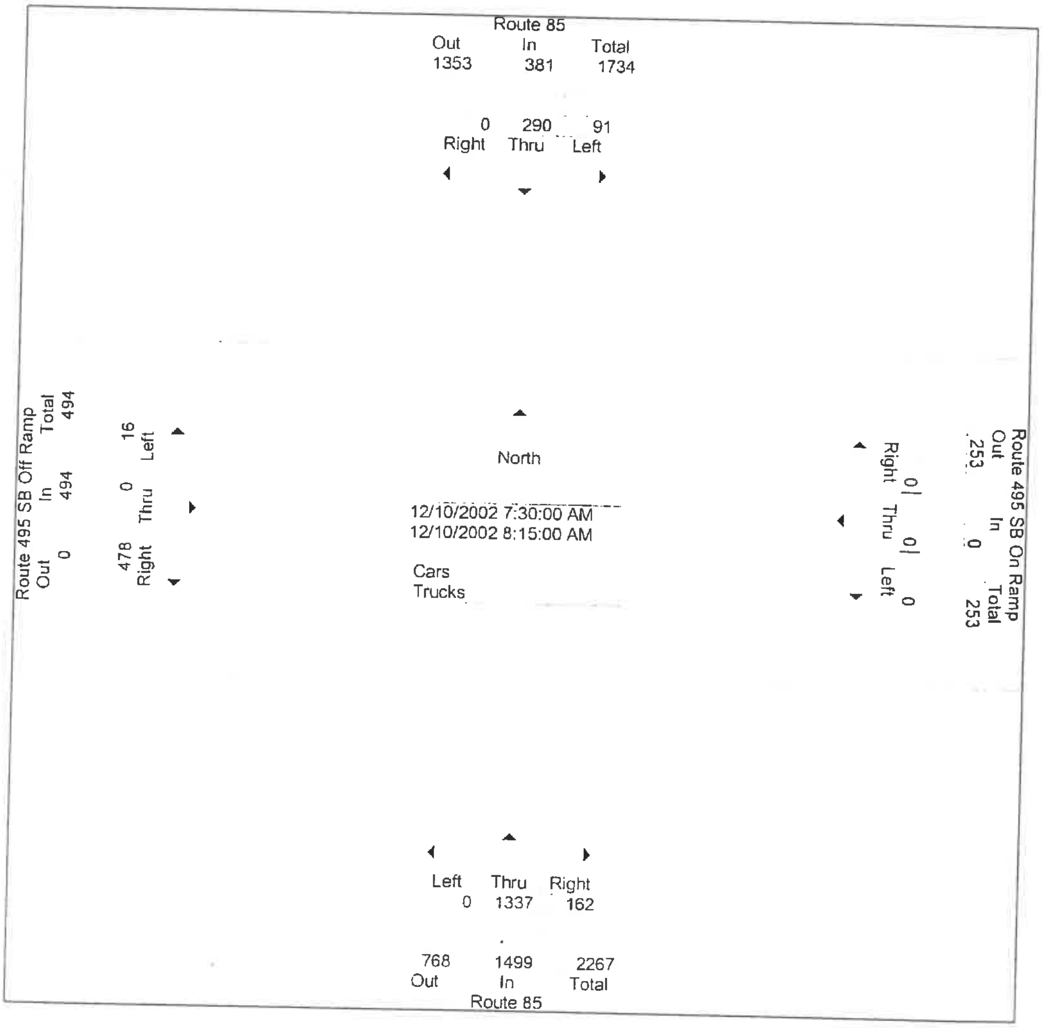
	Route 85 From North				Route 495 SB On Ramp From East				Route 85 From South				Route 495 SB Off Ramp From West			
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																
Intersection	07:30															
Volume	91	290	0	381	0	0	0	0	0	1337	162	1499	16	0	478	494
Percent	23.9	76.1	0.0		0.0	0.0	0.0		0.0	89.2	10.8		3.2	0.0	96.8	
Volume	91	290	0	381	0	0	0	0	0	1337	162	1499	16	0	478	494
Volume	21	91	0	112	0	0	0	0	0	349	46	395	4	0	109	113
Peak Factor																
High Int.	07:30				6:45:00 AM				07:30				08:15			
Volume	21	91	0	112	0	0	0	0	0	349	46	395	5	0	125	130
Peak Factor				0.850								0.949				0.950



let : Route 85
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ite : Milford, MA
er : Clear

Accurate Counts
978-664-2565

File Name : 20144002
Site Code : 20144002
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 85 From North			Route 495 SB On Ramp From East			Route 85 From South			Route 495 SB Off Ramp From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	46	156	0	0	0	0	0	162	37	4	0	163	568
16:15	26	175	0	0	0	0	0	154	38	1	0	185	579
16:30	40	159	0	0	0	0	0	161	47	2	0	149	558
16:45	31	184	0	0	0	0	0	159	35	6	0	181	596
Total	143	674	0	0	0	0	0	636	157	13	0	678	2301
17:00	48	188	0	0	0	0	0	189	52	2	0	188	667
17:15	60	179	0	0	0	0	0	192	56	4	0	183	674
17:30	33	215	0	0	0	0	0	149	46	9	0	155	607
17:45	42	201	0	0	0	0	0	153	54	5	0	190	645
Total	183	783	0	0	0	0	0	683	208	20	0	716	2593
Grand Total	326	1457	0	0	0	0	0	1319	365	33	0	1394	4894
Apprch %	18.3	81.7	0.0	0.0	0.0	0.0	0.0	78.3	21.7	2.3	0.0	97.7	
Total %	6.7	29.8	0.0	0.0	0.0	0.0	0.0	27.0	7.5	0.7	0.0	28.5	

	Route 85 From North				Route 495 SB On Ramp From East				Route 85 From South				Route 495 SB Off Ramp From West				
art Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Hour From 16:00 to 17:45 - Peak 1 of 1																	
rsection	17:00																
Volume	183	783	0	966	0	0	0	0	0	683	208	891	20	0	716	736	2593
Percent	18.9	81.1	0.0		0.0	0.0	0.0		0.0	76.7	23.3		2.7	0.0	97.3		
Volume	183	783	0	966	0	0	0	0	0	683	208	891	20	0	716	736	2593
Volume	60	179	0	239	0	0	0	0	0	192	56	248	4	0	183	187	674
ak Factor																	0.962
High Int.	17:30								17:15				17:45				
Volume	33	215	0	248	0	0	0	0	0	192	56	248	5	0	190	195	
ak Factor				0.974								0.898				0.944	

	Route 85 From North				Route 495 SB On Ramp From East				Route 85 From South				Route 495 SB Off Ramp From West			
Hour From 16:00 to 17:45 - Peak 1 of 1																
Approach	17:00				16:00				16:30				17:00			
Volume	183	783	0	966	0	0	0	0	0	701	190	891	20	0	716	736
Percent	18.9	81.1	0.0		-	-	-		0.0	78.7	21.3		2.7	0.0	97.3	
High Int.	17:30				-				17:15				17:45			
Volume	33	215	0	248	-	-	-	-	0	192	56	248	5	0	190	195
ak Factor				0.974				-				0.898				0.944

N/S Street : Route 85
E/W Street : Route 495 SB Ramps
City/State : Milford, MA
Weather : Clear

Accurate Counts
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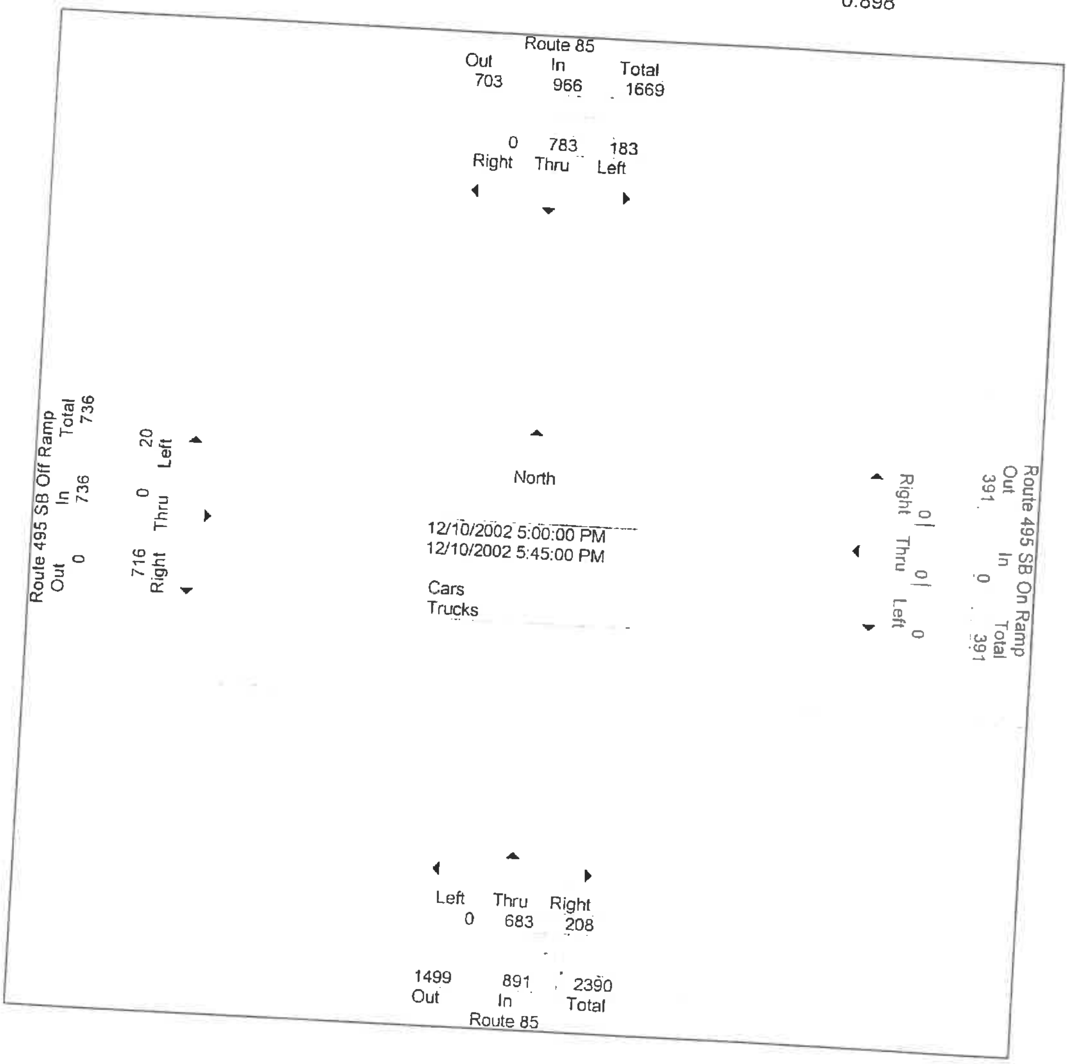
File Name : 2(
Site Code : 2(
Start Date : 12
Page No : 1

	Route 85 From North				Route 495 SB On Ramp From East				Route 85 From South				Route 495 SB Off Ramp From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	17:00																
Volume	183	783	0	966	0	0	0	0	0	683	208	891	20	0	716	736	
Percent	18.9	81.1	0.0		0.0	0.0	0.0		0.0	76.7	23.3		2.7	0.0	97.3		
Volume	183	783	0	966	0	0	0	0	0	683	208	891	20	0	716	736	
Volume	60	179	0	239	0	0	0	0	0	192	56	248	4	0	183	187	
Peak Factor																	
High Int.	17:30								17:15				17:45				0.
Volume	33	215	0	248	0	0	0	0	0	192	56	248	5	0	190	195	
Peak Factor				0.974								0.898				0.944	



Accurate Counts
978-664-2565

File Name : 20144003
Site Code : 20144003
Start Date : 12/11/2002
Page No : 1

et : Route 85
eet : Fortune Blvd / Dilla St
e : Milford, MA
: Clear

Groups Printed- Cars - Trucks

	Route 85 From North			Fortune Blvd From East			Route 85 From South			Dilla St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	36	29	53	2	12	37	4	86	1	276	63	9	608
07:15	46	32	64	1	22	56	5	117	3	235	74	6	661
07:30	70	51	58	4	19	69	4	136	6	213	67	9	706
07:45	90	76	81	5	28	53	6	94	10	216	92	8	759
Total	242	188	256	12	81	215	19	433	20	940	296	32	2734
08:00	81	56	47	3	24	56	9	106	6	211	91	10	700
08:15	71	42	63	3	21	58	9	93	10	216	83	4	673
08:30	90	55	68	5	13	49	11	83	8	201	78	12	673
08:45	88	52	85	2	28	63	4	86	3	178	66	18	673
Total	330	205	263	13	86	226	33	368	27	806	318	44	2719
Grand Total	572	393	519	25	167	441	52	801	47	1746	614	76	5453
Apprch %	38.5	26.5	35.0	3.9	26.4	69.7	5.8	89.0	5.2	71.7	25.2	3.1	
Total %	10.5	7.2	9.5	0.5	3.1	8.1	1.0	14.7	0.9	32.0	11.3	1.4	

	Route 85 From North				Fortune Blvd From East				Route 85 From South				Dilla St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection 07:30																	
Volume	312	225	249	786	15	92	236	343	28	429	32	489	856	333	31	1220	2838
Percent	39.7	28.6	31.7		4.4	26.8	68.8		5.7	87.7	6.5		70.2	27.3	2.5		
Volume	312	225	249	786	15	92	236	343	28	429	32	489	856	333	31	1220	2838
Volume	90	76	81	247	5	28	53	86	6	94	10	110	216	92	8	316	759
Peak Factor																	0.935
High Int.	07:45				07:30				07:30				07:45				
Volume	90	76	81	247	4	19	69	92	4	136	6	146	216	92	8	316	
Peak Factor				0.796				0.932				0.837				0.965	
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
By Approach	07:45				07:30				07:15				07:00				
Volume	332	229	259	820	15	92	236	343	24	453	25	502	940	296	32	1268	
Percent	40.5	27.9	31.6		4.4	26.8	68.8		4.8	90.2	5.0		74.1	23.3	2.5		
High Int.	07:45				07:30				07:30				07:00				
Volume	90	76	81	247	4	19	69	92	4	136	6	146	276	63	9	348	
Peak Factor				0.830				0.932				0.860				0.911	

N/S Street : Route 85
E/W Street : Fortune Blvd / Dilla St
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20
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Start Date : 12.
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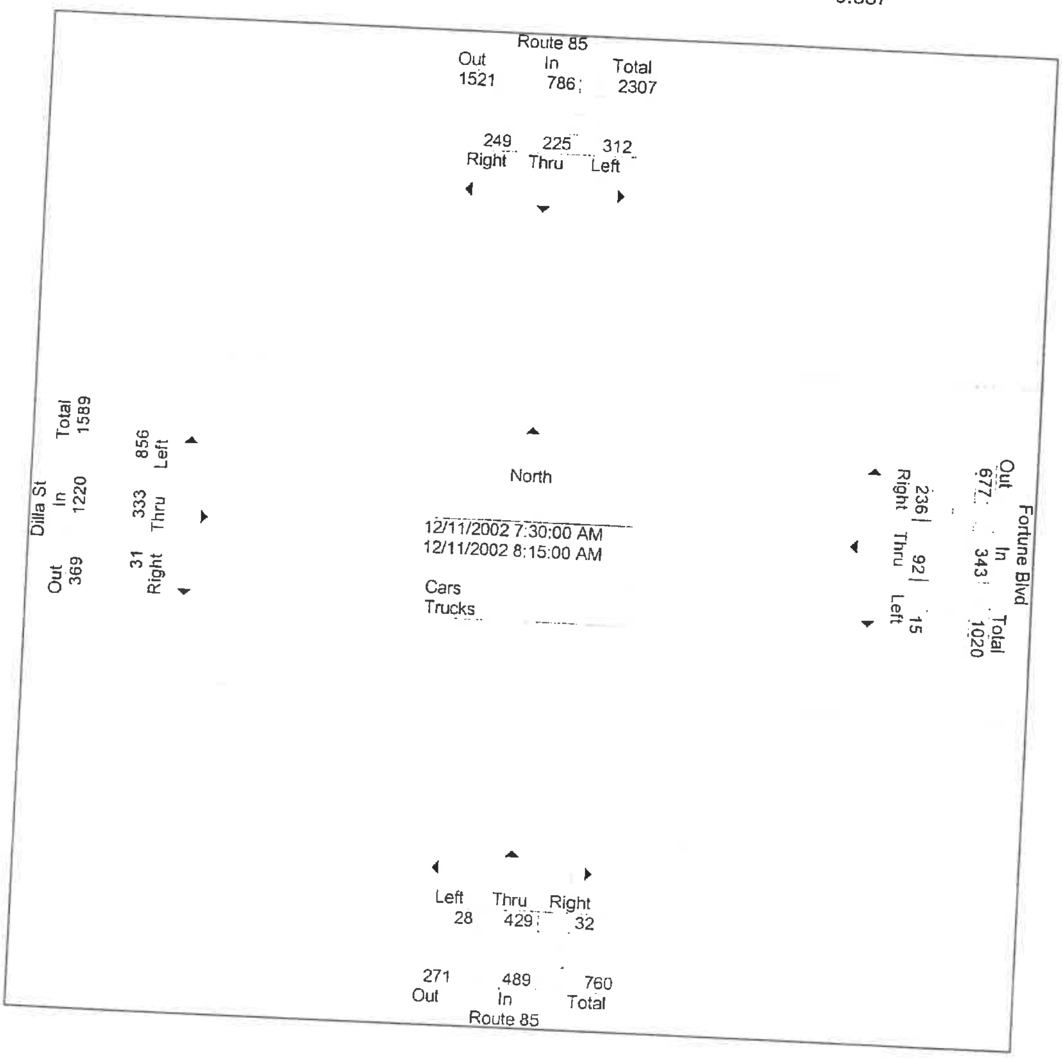
Start Time	Route 85 From North Left	Thru	Right	App. Total	Fortune Blvd From East Left	Thru	Right	App. Total	Route 85 From South Left	Thru	Right	App. Total	Dilla St From West Left	Thru	Right	App. Total	
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection 07:30																	
Volume	312	225	249	786	15	92	236	343	28	429	32	489	856	333	31	1220	
Percent	39.7	28.6	31.7		4.4	26.8	68.8		5.7	87.7	6.5		70.2	27.3	2.5		
Volume	312	225	249	786	15	92	236	343	28	429	32	489	856	333	31	1220	
Volume	90	76	81	247	5	28	53	86	6	94	10	110	216	92	8	316	
Peak Factor																	
High Int.	07:45				07:30				07:30				07:45				
Volume	90	76	81	247	4	19	69	92	4	136	6	146	216	92	8	316	
Peak Factor				0.796				0.932				0.837				0.965	0.9



Street :	Route 85
V Street :	Fortune Blvd / Dilla St
y/State :	Milford, MA
eather :	Clear

Accurate Counts
978-664-2565

File Name	: 20144003
Site Code	: 20144003
Start Date	: 12/11/2002
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Groups Printed- Cars - Trucks

	Route 85 From North			Fortune Blvd From East			Route 85 From South			Dilla St From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	56	79	173	18	124	70	27	54	7	58	55	13	734
16:15	66	115	160	20	110	71	21	39	8	72	48	11	741
16:30	62	80	166	22	118	73	12	58	5	69	35	7	707
16:45	63	110	186	18	99	59	14	39	9	93	60	7	757
Total	247	384	685	78	451	273	74	190	29	292	198	38	2939
17:00	68	109	136	21	115	95	12	46	7	73	59	14	755
17:15	77	124	174	16	118	98	11	52	4	98	69	7	848
17:30	61	133	181	16	102	86	13	49	10	75	57	10	793
17:45	75	90	187	15	88	70	23	35	5	82	62	15	747
Total	281	456	678	68	423	349	59	182	26	328	247	46	3143
Grand Total	528	840	1363	146	874	622	133	372	55	620	445	84	6082
Apprch %	19.3	30.8	49.9	8.9	53.2	37.9	23.8	66.4	9.8	54.0	38.7	7.3	
Total %	8.7	13.8	22.4	2.4	14.4	10.2	2.2	6.1	0.9	10.2	7.3	1.4	

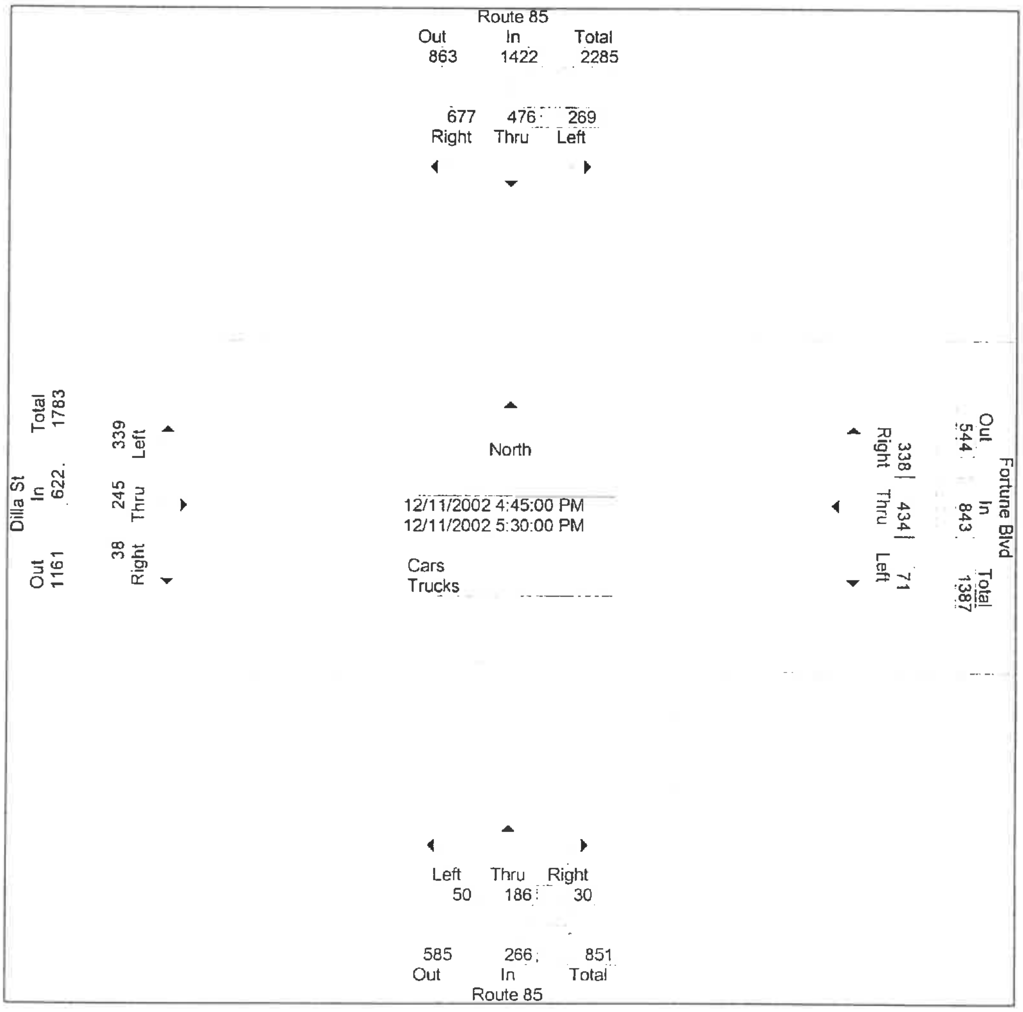
	Route 85 From North				Fortune Blvd From East				Route 85 From South				Dilla St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
ntersection	16:45																
Volume	269	476	677	1422	71	434	338	843	50	186	30	266	339	245	38	622	3153
Percent	18.9	33.5	47.6		8.4	51.5	40.1		18.8	69.9	11.3		54.5	39.4	6.1		
Volume	269	476	677	1422	71	434	338	843	50	186	30	266	339	245	38	622	3153
Volume	77	124	174	375	16	118	98	232	11	52	4	67	98	69	7	174	848
'eak Factor																	0.930
High Int.	17:15				17:15				17:30				17:15				
Volume	77	124	174	375	16	118	98	232	13	49	10	72	98	69	7	174	
'eak Factor				0.948				0.908				0.924				0.894	
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
y Approach	16:45				16:30				16:00				16:45				
Volume	269	476	677	1422	77	450	325	852	74	190	29	293	339	245	38	622	
Percent	18.9	33.5	47.6		9.0	52.8	38.1		25.3	64.8	9.9		54.5	39.4	6.1		
High Int.	17:15				17:15				16:00				17:15				
Volume	77	124	174	375	16	118	98	232	27	54	7	88	98	69	7	174	
'eak Factor				0.948				0.918				0.832				0.894	

N/S Street : Route 85
E/W Street : Fortune Blvd / Dilla St
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 2014400
Site Code : 2014400
Start Date : 12/11/20
Page No : 1

	Route 85 From North				Fortune Blvd From East				Route 85 From South				Dilla St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	269	476	677	1422	71	434	338	843	50	186	30	266	339	245	38	622	3153
Percent	18.9	33.5	47.6		8.4	51.5	40.1		18.8	69.9	11.3		54.5	39.4	6.1		
Volume	269	476	677	1422	71	434	338	843	50	186	30	266	339	245	38	622	3153
Volume	77	124	174	375	16	118	98	232	11	52	4	67	98	69	7	174	848
Peak Factor																	0.930
High Int.	17:15				17:15				17:30				17:15				
Volume	77	124	174	375	16	118	98	232	13	49	10	72	98	69	7	174	
Peak Factor				0.948				0.908				0.924				0.894	



eet : Fortune Blvd / Beaver St
treet : Route 16
ate : Milford, MA
er : Clear

Accurate Counts
978-664-2565

File Name : 20144013
Site Code : 20144013
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Fortune Blvd From North			Route 16 From East			Beaver St From South			Route 16 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	37	18	3	26	37	25	17	23	22	8	97	10	323
07:15	52	21	5	26	30	32	15	34	30	4	92	12	353
07:30	54	23	8	32	52	27	17	35	26	5	95	12	386
07:45	45	28	17	31	53	34	24	32	43	11	106	14	438
Total	188	90	33	115	172	118	73	124	121	28	390	48	1500
08:00	51	26	13	34	64	52	24	39	30	10	84	28	455
08:15	62	43	10	39	44	30	22	48	41	6	90	16	451
08:30	45	46	17	35	37	27	22	38	39	4	65	13	388
08:45	42	49	8	30	42	28	26	46	37	7	69	14	398
Total	200	164	48	138	187	137	94	171	147	27	308	71	1692
Grand Total	388	254	81	253	359	255	167	295	268	55	698	119	3192
Apprch %	53.7	35.1	11.2	29.2	41.4	29.4	22.9	40.4	36.7	6.3	80.0	13.6	
Total %	12.2	8.0	2.5	7.9	11.2	8.0	5.2	9.2	8.4	1.7	21.9	3.7	

	Fortune Blvd From North				Route 16 From East				Beaver St From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
k Hour From 07:00 to 08:45 - Peak 1 of 1																	
ntersection 07:45																	
Volume	203	143	57	403	139	198	143	480	92	157	153	402	31	345	71	447	1732
Percent	50.4	35.5	14.1		29.0	41.2	29.8		22.9	39.1	38.1		6.9	77.2	15.9		
Volume	203	143	57	403	139	198	143	480	92	157	153	402	31	345	71	447	1732
Volume	51	26	13	90	34	64	52	150	24	39	30	93	10	84	28	122	455
eak Factor																	0.952
High Int.	08:15				08:00				08:15				07:45				
Volume	62	43	10	115	34	64	52	150	22	48	41	111	11	106	14	131	
eak Factor				0.876				0.800				0.905				0.853	
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
y Approach	08:00				07:30				08:00				07:30				
Volume	200	164	48	412	136	213	143	492	94	171	147	412	32	375	70	477	
Percent	48.5	39.8	11.7		27.6	43.3	29.1		22.8	41.5	35.7		6.7	78.6	14.7		
High Int.	08:15				08:00				08:15				07:45				
Volume	62	43	10	115	34	64	52	150	22	48	41	111	11	106	14	131	
Peak Factor				0.896				0.820				0.928				0.910	

N/S Street : Fortune Blvd / Beaver St
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

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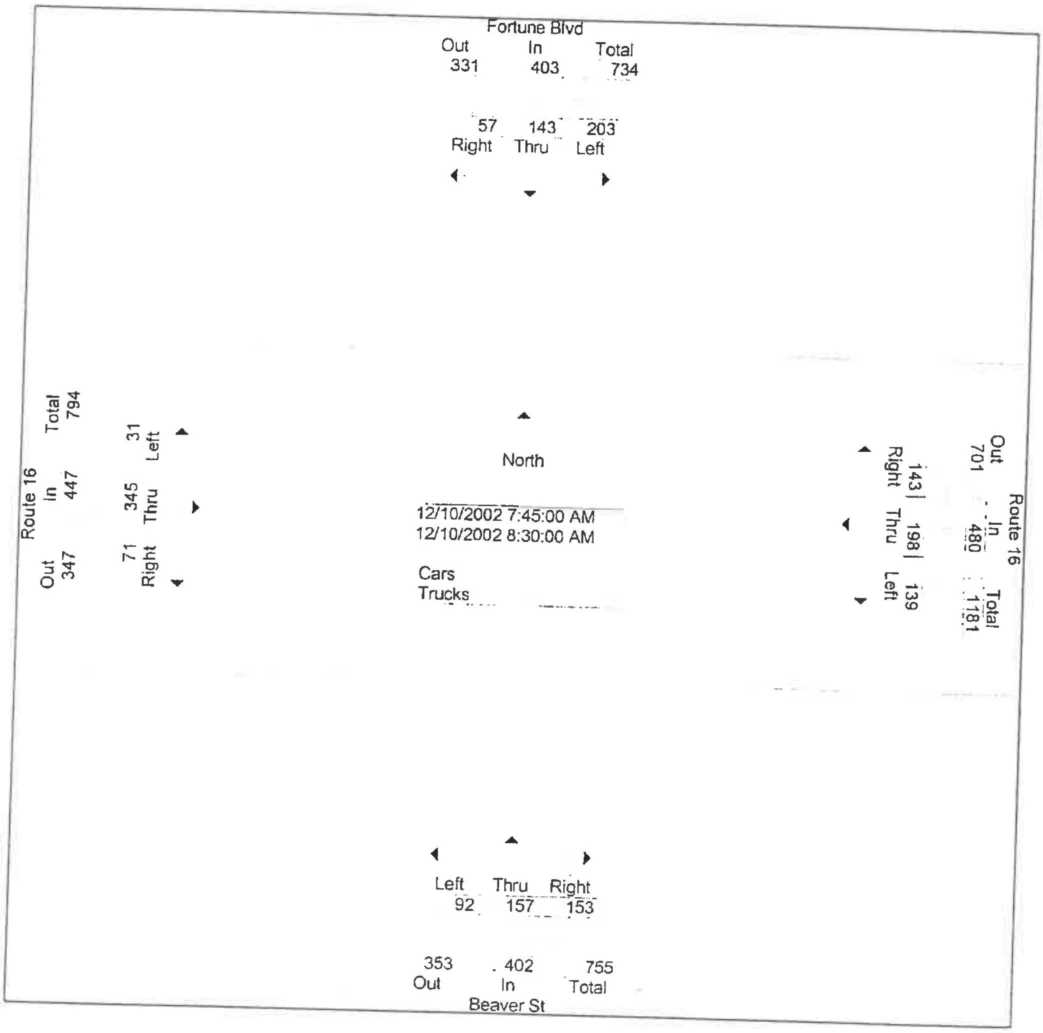
File Name
Site Code
Start Date
Page No

	Fortune Blvd From North				Route 16 From East				Beaver St From South				Route 16 From West			
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																
Intersection	07:45															
Volume	203	143	57	403	139	198	143	480	92	157	153	402	31	345	71	447
Percent	50.4	35.5	14.1		29.0	41.2	29.8		22.9	39.1	38.1		6.9	77.2	15.9	
Volume	203	143	57	403	139	198	143	480	92	157	153	402	31	345	71	447
Volume	51	26	13	90	34	64	52	150	24	39	30	93	10	84	28	122
Peak Factor																
High Int.	08:15				08:00				08:15				07:45			
Volume	62	43	10	115	34	64	52	150	22	48	41	111	11	106	14	131
Peak Factor				0.876				0.800				0.905				0.853



N/S Street : Fortune Blvd / Beaver St
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20
Site Code : 20
Start Date : 12
Page No : 1

Groups Printed- Cars - Trucks

	Fortune Blvd From North			Route 16 From East			Beaver St From South			Route 16 From West			Int
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
16:00	25	70	10	55	69	73	36	68	30	15	55	55	
16:15	22	46	8	54	69	53	29	46	33	7	62	39	
16:30	28	45	8	55	73	62	27	49	48	6	55	36	
16:45	22	53	11	55	68	63	27	55	32	12	42	31	
Total	97	214	37	219	279	251	119	218	143	40	214	161	
17:00	32	87	12	60	73	60	23	54	54	5	50	39	
17:15	33	82	14	57	68	80	43	51	47	9	45	32	
17:30	29	75	6	56	73	59	42	81	42	11	51	26	
17:45	37	66	9	59	83	47	26	63	41	6	40	33	
Total	131	310	41	232	297	246	134	249	184	31	186	130	
Grand Total	228	524	78	451	576	497	253	467	327	71	400	291	
Apprch %	27.5	63.1	9.4	29.6	37.8	32.6	24.2	44.6	31.2	9.3	52.5	38.2	
Total %	5.5	12.6	1.9	10.8	13.8	11.9	6.1	11.2	7.9	1.7	9.6	7.0	

	Fortune Blvd From North				Route 16 From East				Beaver St From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	17:00																
Volume	131	310	41	482	232	297	246	775	134	249	184	567	31	186	130	347	2
Percent	27.2	64.3	8.5		29.9	38.3	31.7		23.6	43.9	32.5		8.9	53.6	37.5		
Volume	131	310	41	482	232	297	246	775	134	249	184	567	31	186	130	347	2
Volume	33	82	14	129	57	68	80	205	43	51	47	141	9	45	32	86	
Peak Factor																	
High Int.	17:00				17:15				17:30				17:00				0.96
Volume	32	87	12	131	57	68	80	205	42	81	42	165	5	50	39	94	
Peak Factor				0.920				0.945				0.859				0.923	

	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																
By Approach	17:00				17:00				17:00				16:00			
Volume	131	310	41	482	232	297	246	775	134	249	184	567	40	214	161	415
Percent	27.2	64.3	8.5		29.9	38.3	31.7		23.6	43.9	32.5		9.6	51.6	38.8	
High Int.	17:00				17:15				17:30				16:00			
Volume	32	87	12	131	57	68	80	205	42	81	42	165	15	55	55	125
Peak Factor				0.920				0.945				0.859				0.830

N/S Street : Fortune Blvd / Beaver St
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

Accurate Counts
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File Name : 20144013
Site Code : 20144013
Start Date : 12/10/2002
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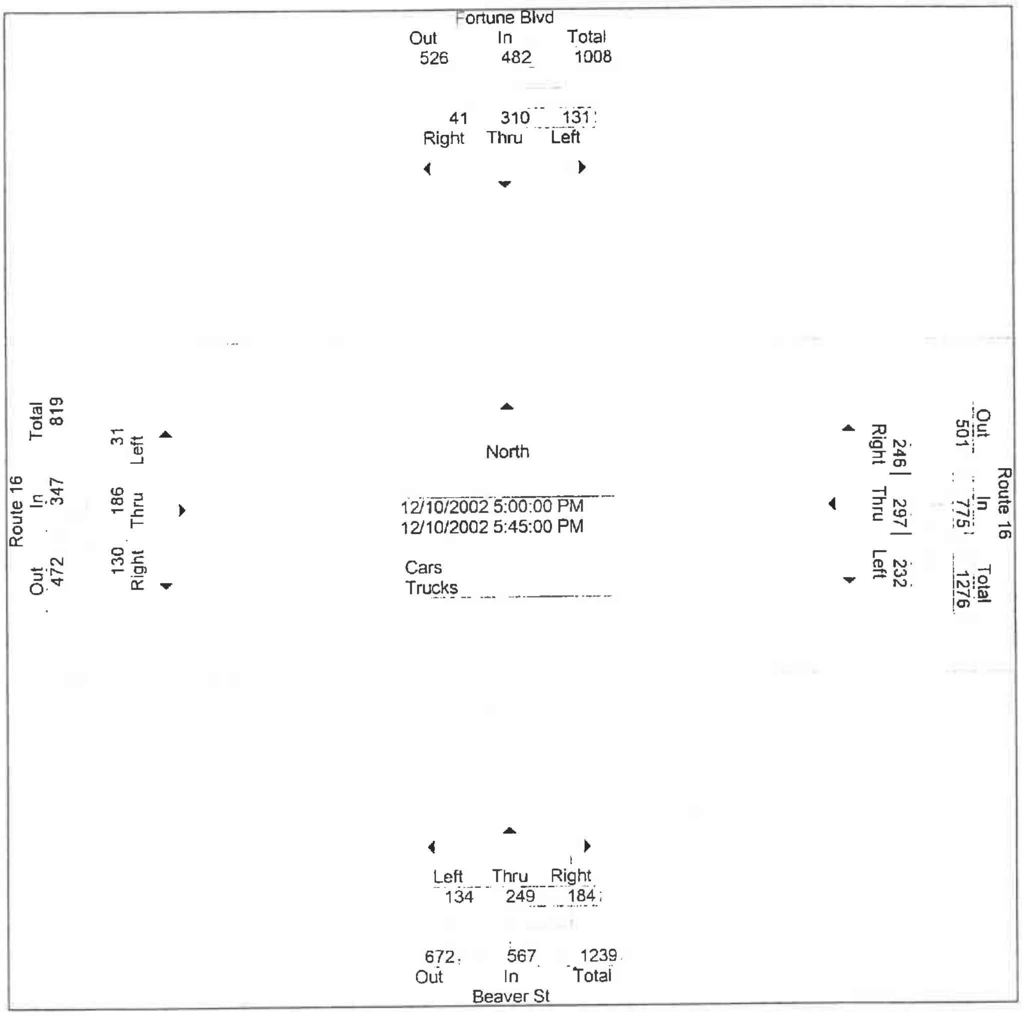
	Fortune Blvd From North				Route 16 From East				Beaver St From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	17:00																
Volume	131	310	41	482	232	297	246	775	134	249	184	567	31	186	130	347	2171
Percent	27.2	64.3	8.5		29.9	38.3	31.7		23.6	43.9	32.5		8.9	53.6	37.5		
Volume	131	310	41	482	232	297	246	775	134	249	184	567	31	186	130	347	2171
Volume	33	82	14	129	57	68	80	205	43	51	47	141	9	45	32	86	561
Peak Factor																	0.967
High Int.	17:00				17:15				17:30				17:00				
Volume	32	87	12	131	57	68	80	205	42	81	42	165	5	50	39	94	
Peak Factor				0.920				0.945				0.859				0.923	



Accurate Counts
978-664-2565

File Name : 20144012
Site Code : 20144012
Start Date : 12/11/2002
Page No : 1

et : Prairie St/Route 109
eet : Route 16
e : Milford, MA
: Clear

Groups Printed- Cars - Trucks

	Prairie St From North			Route 16 From East			Route 109 From South			Route 16 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	0	4	2	25	34	0	37	0	18	0	119	119	358
07:15	3	1	1	12	37	1	42	1	17	3	112	97	327
07:30	0	0	2	16	28	1	48	1	21	2	119	129	367
07:45	1	2	8	20	50	0	62	1	29	5	132	133	443
Total	4	7	13	73	149	2	189	3	85	10	482	478	1495
08:00	1	0	2	37	63	0	72	1	14	3	116	122	431
08:15	3	2	3	30	51	1	76	2	24	0	116	114	422
08:30	0	0	1	20	40	2	75	1	23	1	118	111	392
08:45	1	0	3	16	40	7	87	4	20	0	108	118	404
Total	5	2	9	103	194	10	310	8	81	4	458	465	1649
Grand Total	9	9	22	176	343	12	499	11	166	14	940	943	3144
Apprch %	22.5	22.5	55.0	33.1	64.6	2.3	73.8	1.6	24.6	0.7	49.6	49.7	
Total %	0.3	0.3	0.7	5.6	10.9	0.4	15.9	0.3	5.3	0.4	29.9	30.0	

	Prairie St From North				Route 16 From East				Route 109 From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
k Hour From 07:00 to 08:45 - Peak 1 of 1																	
itersection 07:45																	
Volume	5	4	14	23	107	204	3	314	285	5	90	380	9	482	480	971	1688
Percent	21.7	17.4	60.9		34.1	65.0	1.0		75.0	1.3	23.7		0.9	49.6	49.4		
Volume	5	4	14	23	107	204	3	314	285	5	90	380	9	482	480	971	1688
Volume	1	2	8	11	20	50	0	70	62	1	29	92	5	132	133	270	443
'eak Factor																	0.953
High Int.	07:45				08:00				08:15				07:45				
Volume	1	2	8	11	37	63	0	100	76	2	24	102	5	132	133	270	
'eak Factor				0.523				0.785				0.931				0.899	

	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1																
3y Approach	07:00				07:45				08:00				07:30			
Volume	4	7	13	24	107	204	3	314	310	8	81	399	10	483	498	991
Percent	16.7	29.2	54.2		34.1	65.0	1.0		77.7	2.0	20.3		1.0	48.7	50.3	
High Int.	07:45				08:00				08:45				07:45			
Volume	1	2	8	11	37	63	0	100	87	4	20	111	5	132	133	270
Peak Factor				0.545				0.785				0.899				0.918

N/S Street : Prairie St/Route 109
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 2
Site Code : 2
Start Date : 1.
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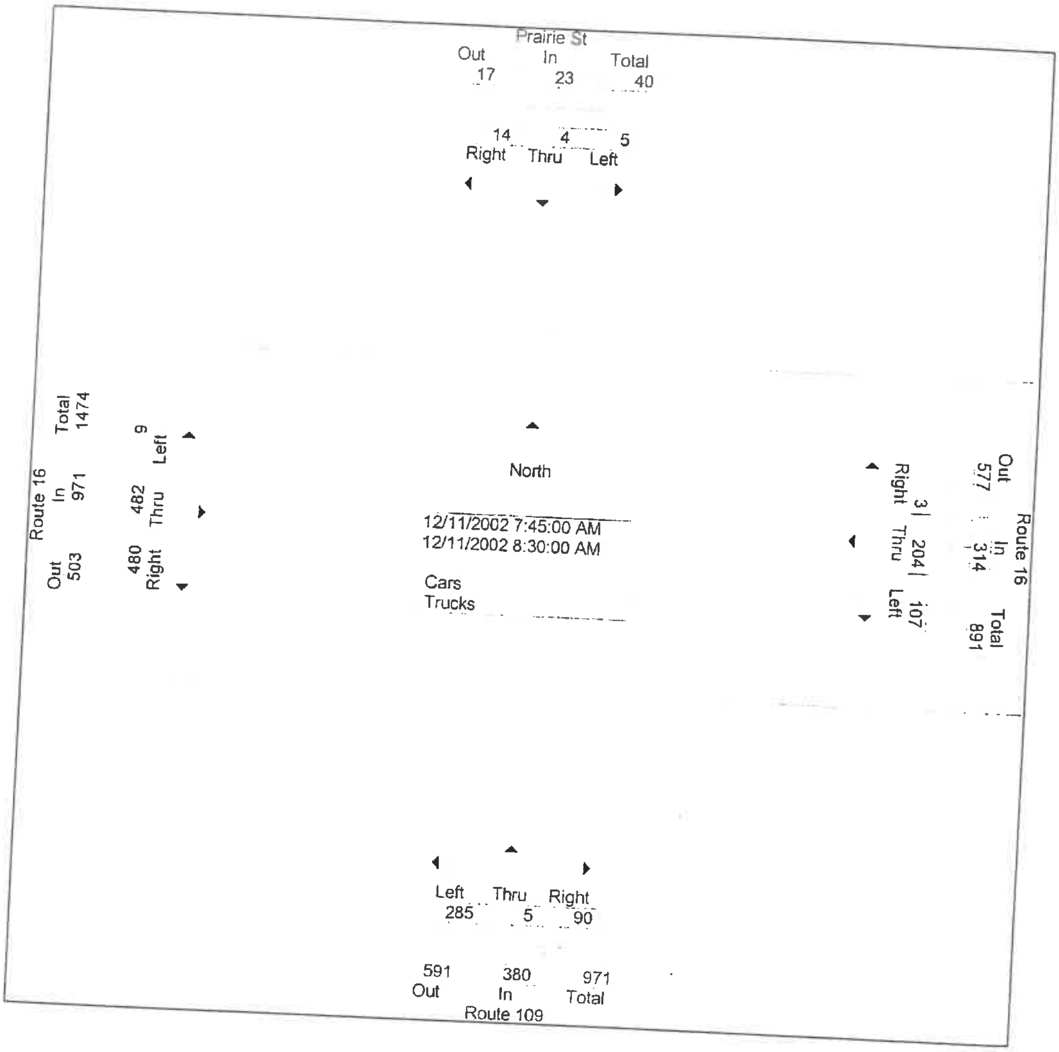
	Prairie St From North				Route 16 From East				Route 109 From South				Route 16 From West			
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																
Intersection 07:45																
Volume	5	4	14	23	107	204	3	314	285	5	90	380	9	482	480	971
Percent	21.7	17.4	60.9		34.1	65.0	1.0		75.0	1.3	23.7		0.9	49.6	49.4	
Volume	5	4	14	23	107	204	3	314	285	5	90	380	9	482	480	971
Volume	1	2	8	11	20	50	0	70	62	1	29	92	5	132	133	270
Peak Factor																
High Int.	07:45				08:00				08:15				07:45			
Volume	1	2	8	11	37	63	0	100	76	2	24	102	5	132	133	270
Peak Factor				0.523				0.785				0.931				0.899



S Street : Prairie St/Route 109
W Street : Route 16
ty/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144012
Site Code : 20144012
Start Date : 12/11/2002
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Groups Printed- Cars - Trucks

	Prairie St From North			Route 16 From East			Route 109 From South			Route 16 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	0	1	1	56	114	0	85	0	26	2	68	93	446
16:15	0	0	3	43	77	2	116	0	26	0	61	97	425
16:30	1	2	3	39	77	1	115	1	25	3	60	106	433
16:45	0	1	1	40	89	2	111	2	20	4	53	140	463
Total	1	4	8	178	357	5	427	3	97	9	242	436	1767
17:00	1	2	4	45	110	0	98	0	26	3	56	133	478
17:15	3	2	2	40	94	1	100	0	23	3	64	134	466
17:30	0	2	1	47	94	3	106	2	27	3	61	112	458
17:45	3	0	4	34	86	3	91	0	24	1	68	125	439
Total	7	6	11	166	384	7	395	2	100	10	249	504	1841
Grand Total	8	10	19	344	741	12	822	5	197	19	491	940	3608
Apprch %	21.6	27.0	51.4	31.4	67.5	1.1	80.3	0.5	19.2	1.3	33.9	64.8	
Total %	0.2	0.3	0.5	9.5	20.5	0.3	22.8	0.1	5.5	0.5	13.6	26.1	

	Prairie St From North				Route 16 From East				Route 109 From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	4	7	8	19	172	387	6	565	415	4	96	515	13	234	519	766	1865
Percent	21.1	36.8	42.1		30.4	68.5	1.1		80.6	0.8	18.6		1.7	30.5	67.8		
Volume	4	7	8	19	172	387	6	565	415	4	96	515	13	234	519	766	1865
Volume	1	2	4	7	45	110	0	155	98	0	26	124	3	56	133	192	478
Peak Factor																	0.975
High Int.	17:00				17:00				17:30				17:15				
Volume	1	2	4	7	45	110	0	155	106	2	27	135	3	64	134	201	
Peak Factor				0.679				0.911				0.954				0.953	
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
y Approach	17:00				16:45				16:15				16:45				
Volume	7	6	11	24	172	387	6	565	440	3	97	540	13	234	519	766	
Percent	29.2	25.0	45.8		30.4	68.5	1.1		81.5	0.6	18.0		1.7	30.5	67.8		
High Int.	17:00				17:00				16:15				17:15				
Volume	1	2	4	7	45	110	0	155	116	0	26	142	3	64	134	201	
Peak Factor				0.857				0.911				0.951				0.953	

N/S Street : Prairie St/Route 109
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144012
Site Code : 20144012
Start Date : 12/11/2002
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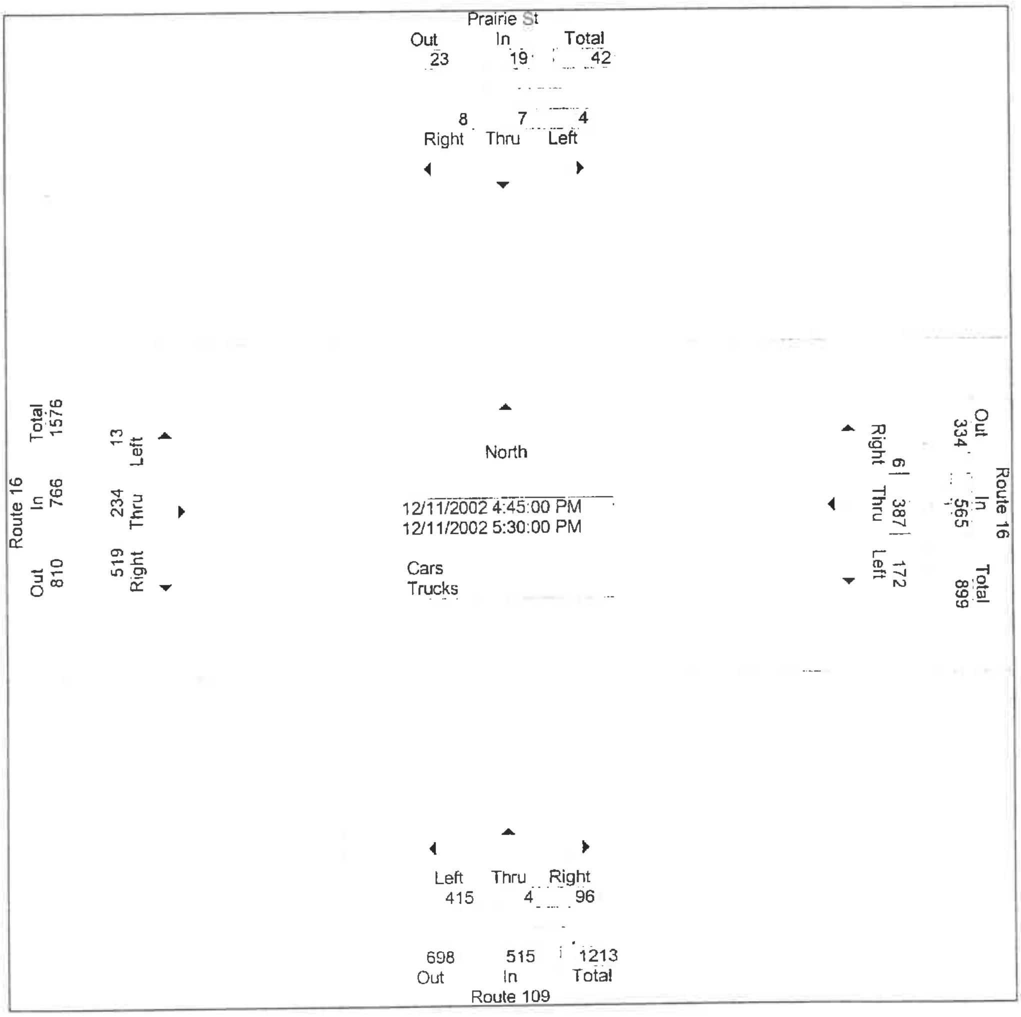
	Prairie St From North				Route 16 From East				Route 109 From South				Route 16 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	4	7	8	19	172	387	6	565	415	4	96	515	13	234	519	766	1865
Percent	21.1	36.8	42.1		30.4	68.5	1.1		80.6	0.8	18.6		1.7	30.5	67.8		
Volume	4	7	8	19	172	387	6	565	415	4	96	515	13	234	519	766	1865
Volume	1	2	4	7	45	110	0	155	98	0	26	124	3	56	133	192	478
Peak Factor																	0.975
High Int.	17:00				17:00				17:30				17:15				
Volume	1	2	4	7	45	110	0	155	106	2	27	135	3	64	134	201	
Peak Factor				0.679				0.911				0.954				0.953	



S Street : Beaver Street
W Street : Route 109
ty/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144004
Site Code : 20144004
Start Date : 12/11/2002
Page No : 1

Groups Printed- Cars - Trucks

	Beaver St From North			Route 109 From East			Beaver St From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	41	0	18	0	118	86	4	14	15	7	90	1	394
07:15	42	0	13	0	204	67	6	6	30	9	97	0	474
07:30	52	3	21	0	214	66	6	20	38	6	103	0	529
07:45	57	0	36	0	219	72	7	24	42	8	105	0	570
Total	192	3	88	0	755	291	23	64	125	30	395	1	1967
08:00	56	1	37	0	275	92	11	23	33	13	90	0	631
08:15	70	0	46	0	248	95	10	27	41	14	92	0	643
08:30	69	0	34	0	241	103	8	11	25	19	78	0	588
08:45	37	3	34	0	268	96	11	13	20	13	99	0	594
Total	232	4	151	0	1032	386	40	74	119	59	359	0	2456
Grand Total	424	7	239	0	1787	677	63	138	244	89	754	1	4423
Apprch %	63.3	1.0	35.7	0.0	72.5	27.5	14.2	31.0	54.8	10.5	89.3	0.1	
Total %	9.6	0.2	5.4	0.0	40.4	15.3	1.4	3.1	5.5	2.0	17.0	0.0	

	Beaver St From North				Route 109 From East				Beaver St From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
eak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	08:00																
Volume	232	4	151	387	0	1032	386	1418	40	74	119	233	59	359	0	418	2456
Percent	59.9	1.0	39.0		0.0	72.8	27.2		17.2	31.8	51.1		14.1	85.9	0.0		
Volume	232	4	151	387	0	1032	386	1418	40	74	119	233	59	359	0	418	2456
Volume	70	0	46	116	0	248	95	343	10	27	41	78	14	92	0	106	643
Peak Factor																	0.955
High Int.	08:15				08:00				08:15				08:45				
Volume	70	0	46	116	0	275	92	367	10	27	41	78	13	99	0	112	
Peak Factor				0.834				0.966				0.747				0.933	
eak Hour From 07:00 to 08:45 - Peak 1 of 1																	
By Approach	07:45				08:00				07:30				07:15				
Volume	252	1	153	406	0	1032	386	1418	34	94	154	282	36	395	0	431	
Percent	62.1	0.2	37.7		0.0	72.8	27.2		12.1	33.3	54.6		8.4	91.6	0.0		
High Int.	08:15				08:00				08:15				07:45				
Volume	70	0	46	116	0	275	92	367	10	27	41	78	8	105	0	113	
Peak Factor				0.875				0.966				0.904				0.954	

N/S Street : Beaver Street
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

Accurate Counts
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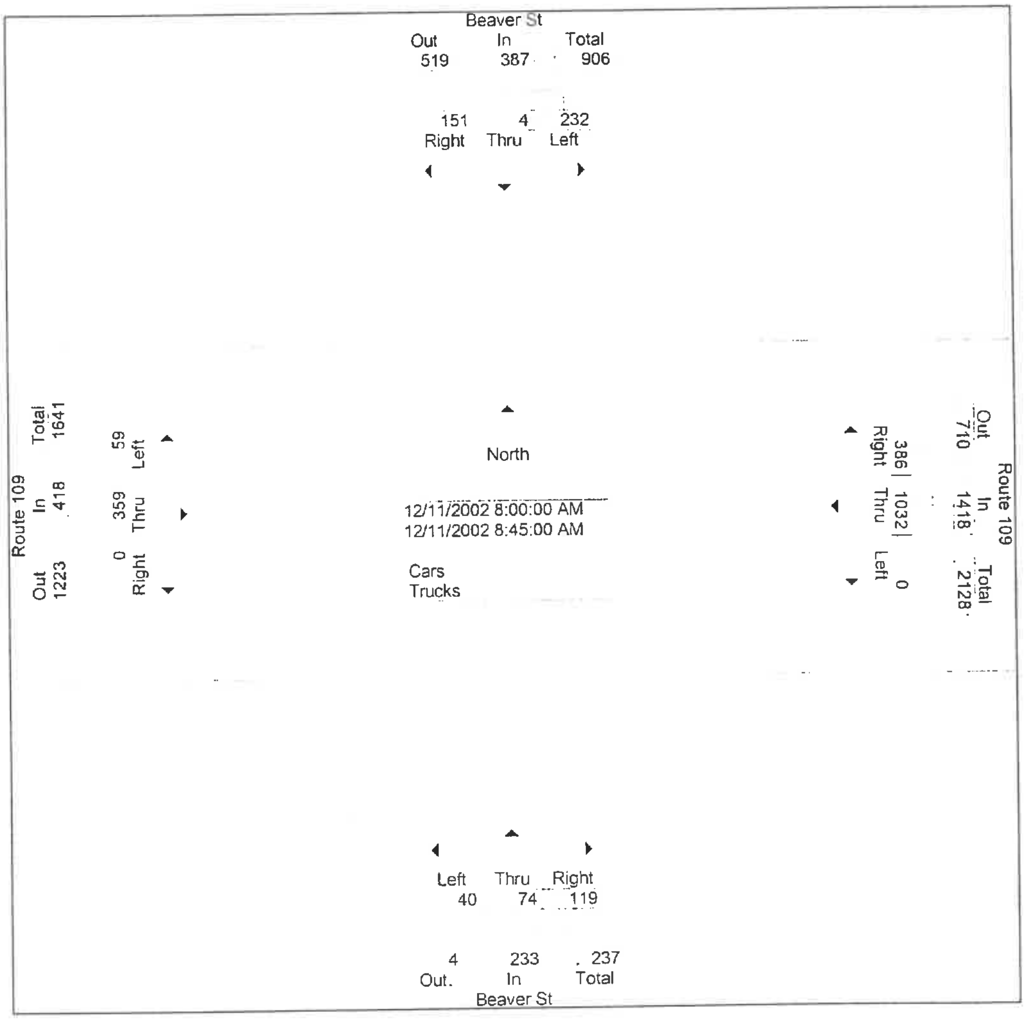
File Name : 20144004
Site Code : 20144004
Start Date : 12/11/2002

	Beaver St From North				Route 109 From East				Beaver St From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	08:00																
Volume	232	4	151	387	0	1032	386	1418	40	74	119	233	59	359	0	418	2456
Percent	59.9	1.0	39.0		0.0	72.8	27.2		17.2	31.8	51.1		14.1	85.9	0.0		
Volume	232	4	151	387	0	1032	386	1418	40	74	119	233	59	359	0	418	2456
Volume	70	0	46	116	0	248	95	343	10	27	41	78	14	92	0	106	643
Peak Factor																	0.955
High Int.	08:15				08:00				08:15				08:45				
Volume	70	0	46	116	0	275	92	367	10	27	41	78	13	99	0	112	
Peak Factor				0.834				0.966				0.747				0.933	



S Street : Beaver Street
V Street : Route 109
ty/State : Milford, MA
eather : Clear

Accurate Counts
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File Name : 20144004
Site Code : 20144004
Start Date : 12/11/2002
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Groups Printed- Cars - Trucks

	Beaver St From North			Route 109 From East			Beaver St From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	136	7	45	0	145	76	7	22	88	25	175	0	726
16:15	133	0	50	0	202	79	10	22	76	20	178	0	770
16:30	133	0	53	0	181	83	8	31	101	19	166	0	775
16:45	105	1	48	0	175	82	15	27	92	22	178	0	745
Total	507	8	196	0	703	320	40	102	357	86	697	0	3016
17:00	164	0	41	0	178	103	16	33	131	28	159	0	853
17:15	166	0	44	0	192	103	21	32	121	36	181	0	896
17:30	109	0	52	0	167	88	8	36	94	36	206	0	796
17:45	140	0	43	0	159	80	11	17	84	22	166	0	722
Total	579	0	180	0	696	374	56	118	430	122	712	0	3267
Grand Total	1086	8	376	0	1399	694	96	220	787	208	1409	0	6283
Apprch %	73.9	0.5	25.6	0.0	66.8	33.2	8.7	19.9	71.4	12.9	87.1	0.0	
Total %	17.3	0.1	6.0	0.0	22.3	11.0	1.5	3.5	12.5	3.3	22.4	0.0	

	Beaver St From North				Route 109 From East				Beaver St From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	544	1	185	730	0	712	376	1088	60	128	438	626	122	724	0	846	3290
Percent	74.5	0.1	25.3		0.0	65.4	34.6		9.6	20.4	70.0		14.4	85.6	0.0		
Volume	544	1	185	730	0	712	376	1088	60	128	438	626	122	724	0	846	3290
Volume	166	0	44	210	0	192	103	295	21	32	121	174	36	181	0	217	896
Peak Factor																	0.918
High Int.	17:15				17:15				17:00				17:30				
Volume	166	0	44	210	0	192	103	295	16	33	131	180	36	206	0	242	
Peak Factor				0.869				0.922				0.869				0.874	
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
By Approach	17:00				16:30				16:30				16:45				
Volume	579	0	180	759	0	726	371	1097	60	123	445	628	122	724	0	846	
Percent	76.3	0.0	23.7		0.0	66.2	33.8		9.6	19.6	70.9		14.4	85.6	0.0		
High Int.	17:15				17:15				17:00				17:30				
Volume	166	0	44	210	0	192	103	295	16	33	131	180	36	206	0	242	
Peak Factor				0.904				0.930				0.872				0.874	

N/S Street : Beaver Street
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

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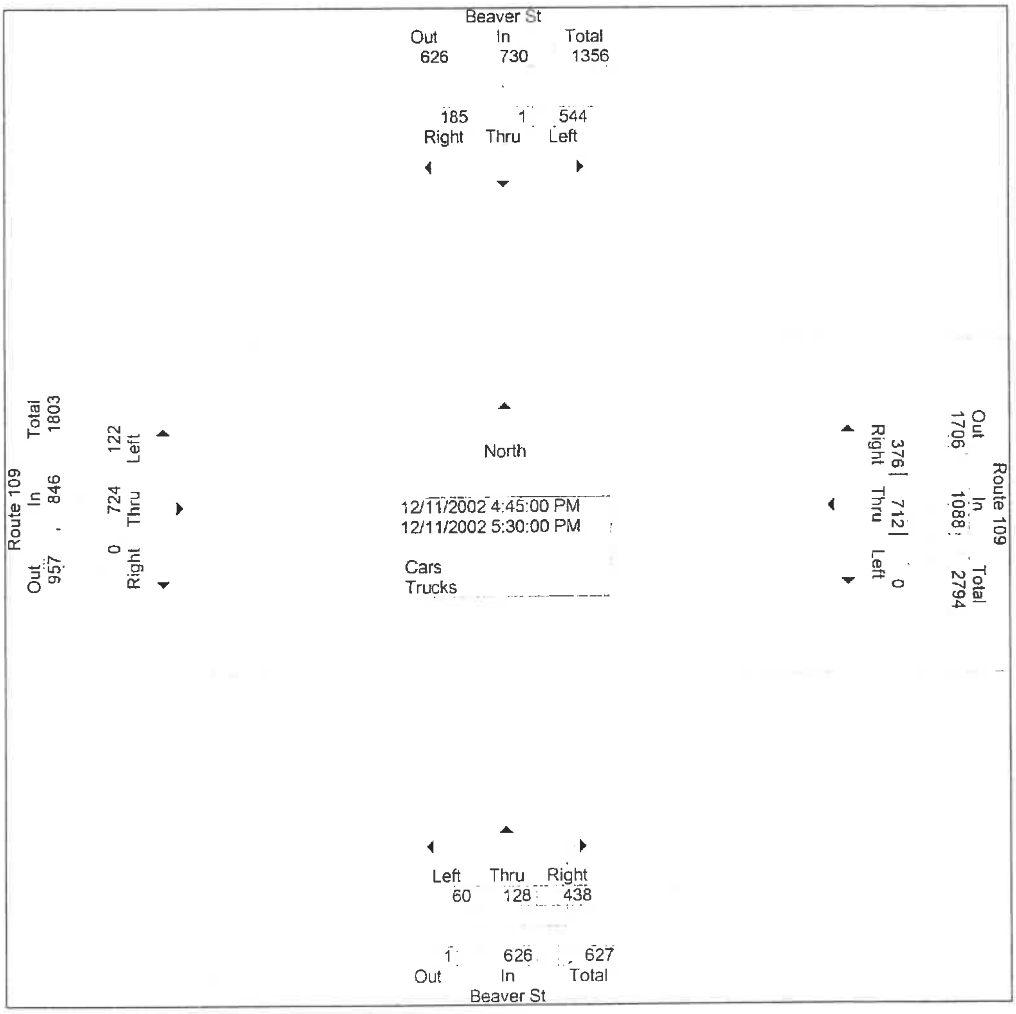
	Beaver St From North				Route 109 From East				Beaver St From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	544	1	185	730	0	712	376	1088	60	128	438	626	122	724	0	846	3290
Percent	74.5	0.1	25.3		0.0	65.4	34.6		9.6	20.4	70.0		14.4	85.6	0.0		
Volume	544	1	185	730	0	712	376	1088	60	128	438	626	122	724	0	846	3290
Volume	166	0	44	210	0	192	103	295	21	32	121	174	36	181	0	217	896
Peak Factor																	0.918
High Int.	17:15				17:15				17:00				17:30				
Volume	166	0	44	210	0	192	103	295	16	33	131	180	36	206	0	242	
Peak Factor				0.869				0.922				0.869				0.874	



Street : Route 495 SB Ramps
V Street : Route 109
y/State : Milford, MA
ather : Clear

Accurate Counts
978-664-2565

File Name : 20144007
Site Code : 20144007
Start Date : 12/11/2002
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Groups Printed- Cars - Trucks

	Route 495 SB Off Ramp From North			Route 109 From East			Route 495 SB On Ramp From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	36	0	68	23	140	0	0	0	0	0	91	72	430
07:15	29	1	111	13	175	0	0	0	0	0	105	64	498
07:30	43	0	87	20	185	0	0	0	0	0	118	83	536
07:45	60	2	146	19	211	0	0	0	0	0	109	86	633
Total	168	3	412	75	711	0	0	0	0	0	423	305	2097
08:00	55	0	164	28	223	0	0	0	0	0	105	63	638
08:15	44	0	148	11	248	0	0	0	0	0	117	51	619
08:30	43	0	117	14	275	0	0	0	0	0	97	55	601
08:45	58	0	113	23	245	0	0	0	0	0	67	39	545
Total	200	0	542	76	991	0	0	0	0	0	386	208	2403
Grand Total	368	3	954	151	1702	0	0	0	0	0	809	513	4500
Apprch %	27.8	0.2	72.0	8.1	91.9	0.0	0.0	0.0	0.0	0.0	61.2	38.8	
Total %	8.2	0.1	21.2	3.4	37.8	0.0	0.0	0.0	0.0	0.0	18.0	11.4	

	Route 495 SB Off Ramp From North				Route 109 From East				Route 495 SB On Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:45																
Volume	202	2	575	779	72	957	0	1029	0	0	0	0	0	428	255	683	2491
Percent	25.9	0.3	73.8		7.0	93.0	0.0		0.0	0.0	0.0		0.0	62.7	37.3		
Volume	202	2	575	779	72	957	0	1029	0	0	0	0	0	428	255	683	2491
Volume	55	0	164	219	28	223	0	251	0	0	0	0	0	105	63	168	638
Peak Factor																	0.976
High Int.	08:00				08:30				6:45:00 AM				07:45				
Volume	55	0	164	219	14	275	0	289	0	0	0	0	0	109	86	195	
Peak Factor				0.889				0.890								0.876	
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
By Approach	07:45				08:00				07:00				07:15				
Volume	202	2	575	779	76	991	0	1067	0	0	0	0	0	437	296	733	
Percent	25.9	0.3	73.8		7.1	92.9	0.0		-	-	-		0.0	59.6	40.4		
High Int.	08:00				08:30				-				07:30				
Volume	55	0	164	219	14	275	0	289	-	-	-	-	0	118	83	201	
Peak Factor				0.889				0.923				-				0.912	

N/S Street : Route 495 SB Ramps
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

Accurate Counts
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File Name : 20144007
Site Code : 20144007
Start Date : 12/11/200
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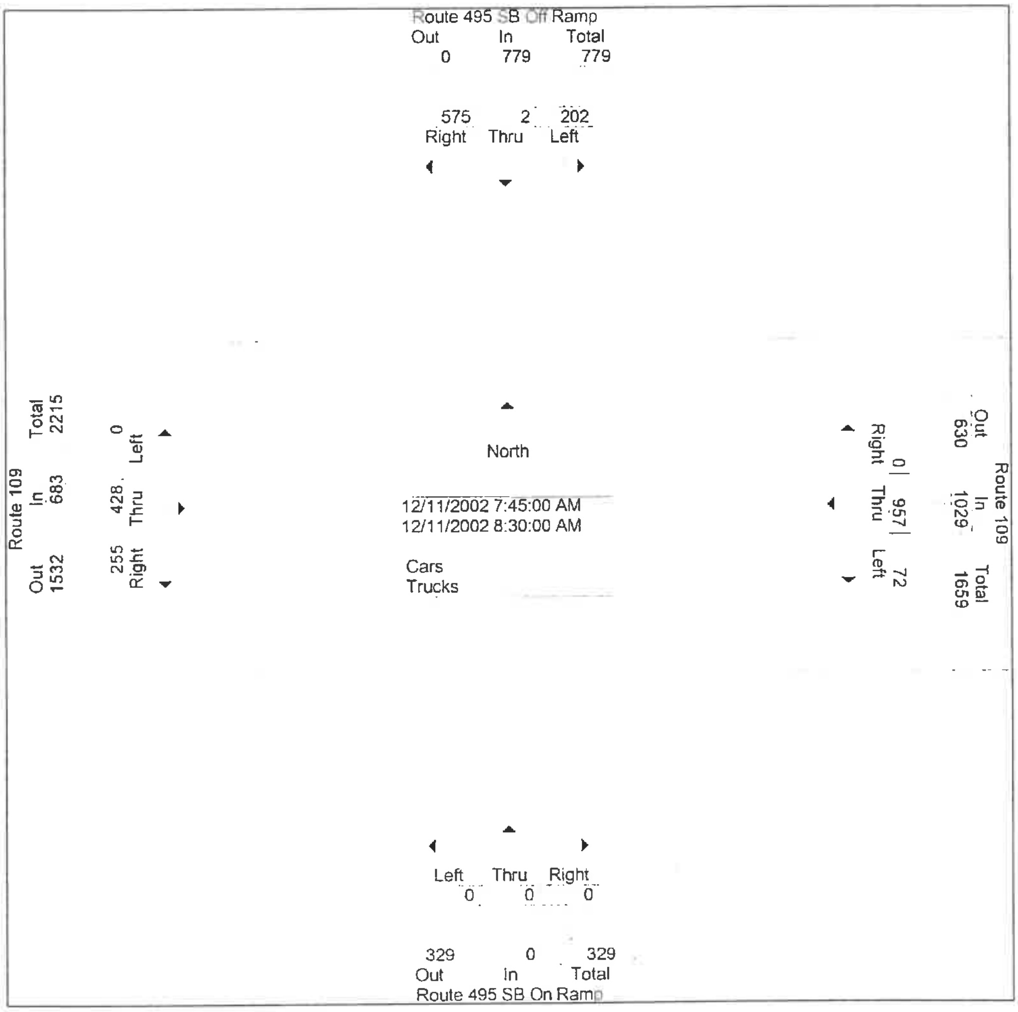
	Route 495 SB Off Ramp From North				Route 109 From East				Route 495 SB On Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:45																
Volume	202	2	575	779	72	957	0	1029	0	0	0	0	0	428	255	683	2491
Percent	25.9	0.3	73.8		7.0	93.0	0.0		0.0	0.0	0.0		0.0	62.7	37.3		
Volume	202	2	575	779	72	957	0	1029	0	0	0	0	0	428	255	683	2491
Volume	55	0	164	219	28	223	0	251	0	0	0	0	0	105	63	168	638
Peak Factor																	0.976
High Int.	08:00				08:30				6:45:00 AM				07:45				
Volume	55	0	164	219	14	275	0	289	0	0	0	0	0	109	86	195	
Peak Factor				0.889				0.890								0.876	



S Street : Route 495 SB Ramps
W Street : Route 109
ty/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144007
Site Code : 20144007
Start Date : 12/11/2002
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Groups Printed- Cars - Trucks

	Route 495 SB Off Ramp From North			Route 109 From East			Route 495 SB On Ramp From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	54	0	62	22	160	0	0	0	0	0	228	201	727
16:15	82	1	135	21	182	0	0	0	0	0	251	132	804
16:30	83	0	138	22	152	0	0	0	0	0	266	116	777
16:45	66	1	96	32	180	0	0	0	0	0	258	123	756
Total	285	2	431	97	674	0	0	0	0	0	1003	572	3064
17:00	61	31	176	36	177	0	0	0	0	0	262	149	892
17:15	73	3	188	37	149	0	0	0	0	0	255	170	875
17:30	78	3	109	31	148	0	0	0	0	0	262	160	791
17:45	79	1	93	38	144	0	0	0	0	0	230	163	748
Total	291	38	566	142	618	0	0	0	0	0	1009	642	3306
Grand Total	576	40	997	239	1292	0	0	0	0	0	2012	1214	6370
Apprch %	35.7	2.5	61.8	15.6	84.4	0.0	0.0	0.0	0.0	0.0	62.4	37.6	
Total %	9.0	0.6	15.7	3.8	20.3	0.0	0.0	0.0	0.0	0.0	31.6	19.1	

	Route 495 SB Off Ramp From North				Route 109 From East				Route 495 SB On Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	278	38	569	885	136	654	0	790	0	0	0	0	0	1037	602	1639	3314
Percent	31.4	4.3	64.3		17.2	82.8	0.0		0.0	0.0	0.0		0.0	63.3	36.7		
Volume	278	38	569	885	136	654	0	790	0	0	0	0	0	1037	602	1639	3314
Volume	61	31	176	268	36	177	0	213	0	0	0	0	0	262	149	411	892
Peak Factor																	0.929
High Int.	17:00				17:00								17:15				
Volume	61	31	176	268	36	177	0	213	0	0	0	0	0	255	170	425	
Peak Factor				0.826				0.927								0.964	
ak Hour From 16:00 to 17:45 - Peak 1 of 1																	
By Approach	16:30				16:15				16:00				17:00				
Volume	283	35	598	916	111	691	0	802	0	0	0	0	0	1009	642	1651	
Percent	30.9	3.8	65.3		13.8	86.2	0.0		-	-	-		0.0	61.1	38.9		
High Int.	17:00				17:00				-				17:15				
Volume	61	31	176	268	36	177	0	213	-	-	-	-	0	255	170	425	
Peak Factor				0.854				0.941				-				0.971	

N/S Street : Route 495 SB Ramps
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

Accurate Counts
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File Name : 20144007
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Start Date : 12/11/2002
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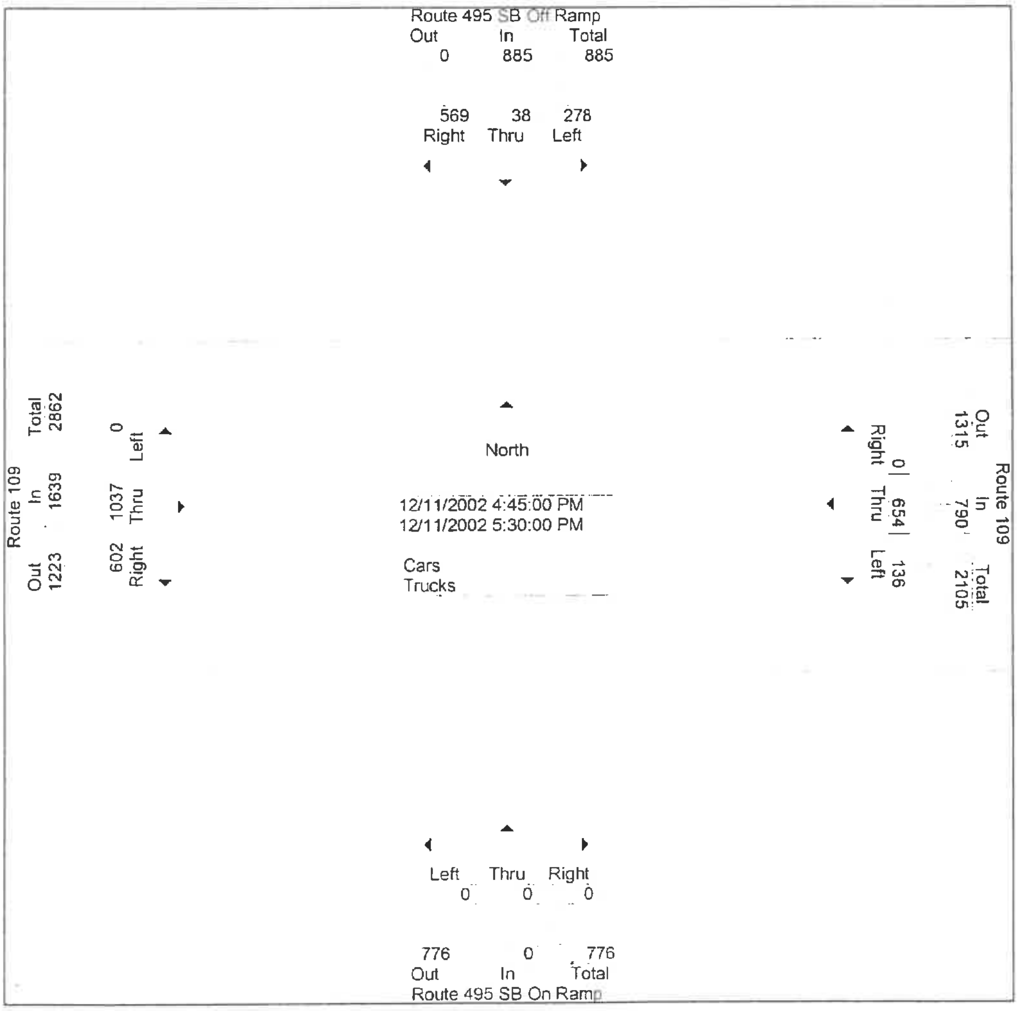
	Route 495 SB Off Ramp From North				Route 109 From East				Route 495 SB On Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection	16:45																
Volume	278	38	569	885	136	654	0	790	0	0	0	0	0	1037	602	1639	3314
Percent	31.4	4.3	64.3		17.2	82.8	0.0		0.0	0.0	0.0		0.0	63.3	36.7		
Volume	278	38	569	885	136	654	0	790	0	0	0	0	0	1037	602	1639	3314
Volume	61	31	176	268	36	177	0	213	0	0	0	0	0	262	149	411	892
Peak Factor																	0.929
High Int.	17:00				17:00								17:15				
Volume	61	31	176	268	36	177	0	213	0	0	0	0	0	255	170	425	
Peak Factor				0.826				0.927								0.964	



S Street : Route 495 NB Ramps
W Street : Route 109
y/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144006
Site Code : 20144006
Start Date : 12/11/2002
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Groups Printed- Cars - Trucks

	Route 495 NB On Ramp From North			Route 109 From East			Route 495 NB Off Ramp From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
07:00	0	0	0	0	79	136	92	0	16	33	87	0	443
07:15	0	0	0	0	79	142	113	0	29	43	90	0	496
07:30	0	0	0	0	107	143	97	0	24	50	103	0	524
07:45	0	0	0	0	140	160	94	0	61	44	120	0	619
Total	0	0	0	0	405	581	396	0	130	170	400	0	2082
08:00	0	0	0	0	152	127	98	1	60	38	119	0	595
08:15	0	0	0	0	142	134	98	0	59	42	100	0	575
08:30	0	0	0	0	148	87	113	0	49	33	90	0	520
08:45	0	0	0	0	165	85	100	0	33	33	104	0	520
Total	0	0	0	0	607	433	409	1	201	146	413	0	2210
Grand Total	0	0	0	0	1012	1014	805	1	331	316	813	0	4292
Apprch %	0.0	0.0	0.0	0.0	50.0	50.0	70.8	0.1	29.1	28.0	72.0	0.0	
Total %	0.0	0.0	0.0	0.0	23.6	23.6	18.8	0.0	7.7	7.4	18.9	0.0	

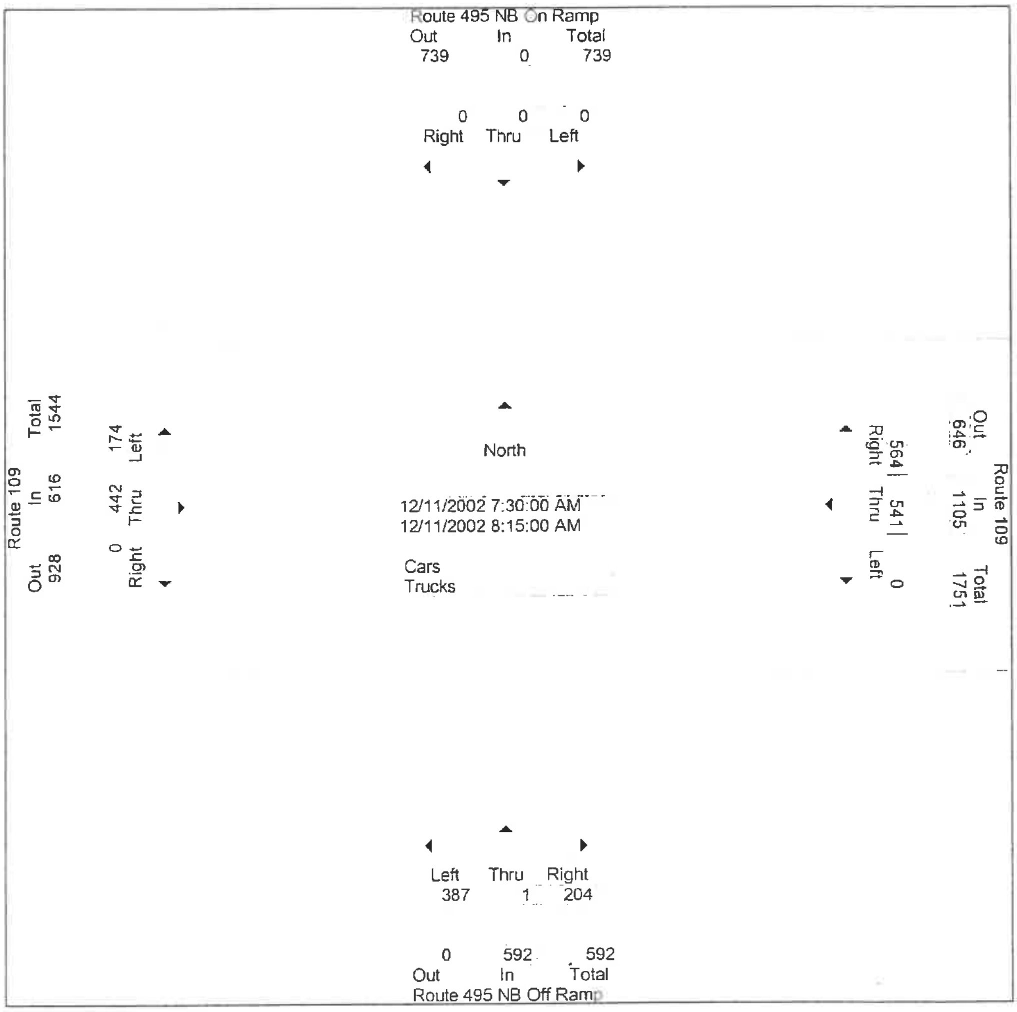
	Route 495 NB On Ramp From North				Route 109 From East				Route 495 NB Off Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:30																
Volume	0	0	0	0	0	541	564	1105	387	1	204	592	174	442	0	616	2313
Percent	0.0	0.0	0.0		0.0	49.0	51.0		65.4	0.2	34.5		28.2	71.8	0.0		
Volume	0	0	0	0	0	541	564	1105	387	1	204	592	174	442	0	616	2313
Volume	0	0	0	0	0	140	160	300	94	0	61	155	44	120	0	164	619
Peak Factor																	0.934
High Int.	6:45:00 AM				07:45				08:00				07:45				
Volume	0	0	0	0	0	140	160	300	98	1	60	159	44	120	0	164	
Peak Factor								0.921				0.931				0.939	
ak Hour From 07:00 to 08:45 - Peak 1 of 1																	
y Approach	07:00				07:30				07:45				07:30				
Volume	0	0	0	0	0	541	564	1105	403	1	229	633	174	442	0	616	
Percent	-	-	-		0.0	49.0	51.0		63.7	0.2	36.2		28.2	71.8	0.0		
High Int.	-				07:45				08:30				07:45				
Volume	-	-	-	-	0	140	160	300	113	0	49	162	44	120	0	164	
Peak Factor				-				0.921				0.977				0.939	

N/S Street : Route 495 NB Ramps
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144006
Site Code : 20144006
Start Date : 12/11/2002
Page No : 1

	Route 495 NB On Ramp From North				Route 109 From East				Route 495 NB Off Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1																	
Intersection	07:30																
Volume	0	0	0	0	0	541	564	1105	387	1	204	592	174	442	0	616	2313
Percent	0.0	0.0	0.0		0.0	49.0	51.0		65.4	0.2	34.5		28.2	71.8	0.0		
Volume	0	0	0	0	0	541	564	1105	387	1	204	592	174	442	0	616	2313
Volume	0	0	0	0	0	140	160	300	94	0	61	155	44	120	0	164	619
Peak Factor																	0.934
High Int.	6:45:00 AM				07:45				08:00				07:45				
Volume	.0	0	0	0	0	140	160	300	98	1	60	159	44	120	0	164	
Peak Factor								0.921				0.931				0.939	



S Street : Route 495 NB Ramps
W Street : Route 109
ty/State : Milford, MA
'eather : Clear

Accurate Counts
978-664-2565

File Name : 20144006
Site Code : 20144006
Start Date : 12/11/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 495 NB On Ramp From North			Route 109 From East			Route 495 NB Off Ramp From South			Route 109 From West			
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
16:00	0	0	0	0	105	51	66	0	31	104	177	0	534
16:15	0	0	0	0	137	57	57	0	46	94	240	0	631
16:30	0	0	0	0	136	49	46	0	28	90	258	0	607
16:45	0	0	0	0	131	48	46	0	41	86	235	0	587
Total	0	0	0	0	509	205	215	0	146	374	910	0	2359
17:00	0	0	0	0	169	66	52	0	40	83	240	0	650
17:15	0	0	0	0	163	55	62	0	47	92	240	0	659
17:30	0	0	0	0	141	40	60	0	42	109	239	0	631
17:45	0	0	0	0	150	40	60	0	49	104	206	0	609
Total	0	0	0	0	623	201	234	0	178	388	925	0	2549
Grand Total	0	0	0	0	1132	406	449	0	324	762	1835	0	4908
Apprch %	0.0	0.0	0.0	0.0	73.6	26.4	58.1	0.0	41.9	29.3	70.7	0.0	
Total %	0.0	0.0	0.0	0.0	23.1	8.3	9.1	0.0	6.6	15.5	37.4	0.0	

	Route 495 NB On Ramp From North				Route 109 From East				Route 495 NB Off Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
eak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection 17:00																	
Volume	0	0	0	0	0	623	201	824	234	0	178	412	388	925	0	1313	2549
Percent	0.0	0.0	0.0		0.0	75.6	24.4		56.8	0.0	43.2		29.6	70.4	0.0		
Volume	0	0	0	0	0	623	201	824	234	0	178	412	388	925	0	1313	2549
Volume	0	0	0	0	0	163	55	218	62	0	47	109	92	240	0	332	659
Peak Factor																	0.967
High Int.					17:00				17:15				17:30				
Volume	0	0	0	0	0	169	66	235	62	0	47	109	109	239	0	348	
Peak Factor								0.877				0.945				0.943	
eak Hour From 16:00 to 17:45 - Peak 1 of 1																	
By Approach 16:00					17:00				17:00				16:15				
Volume	0	0	0	0	0	623	201	824	234	0	178	412	353	973	0	1326	
Percent	-	-	-		0.0	75.6	24.4		56.8	0.0	43.2		26.6	73.4	0.0		
High Int. -					17:00				17:15				16:30				
Volume	-	-	-	-	0	169	66	235	62	0	47	109	90	258	0	348	
Peak Factor				-				0.877				0.945				0.953	

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N/S Street : Route 495 NB Ramps
E/W Street : Route 109
City/State : Milford, MA
Weather : Clear

Accurate Counts
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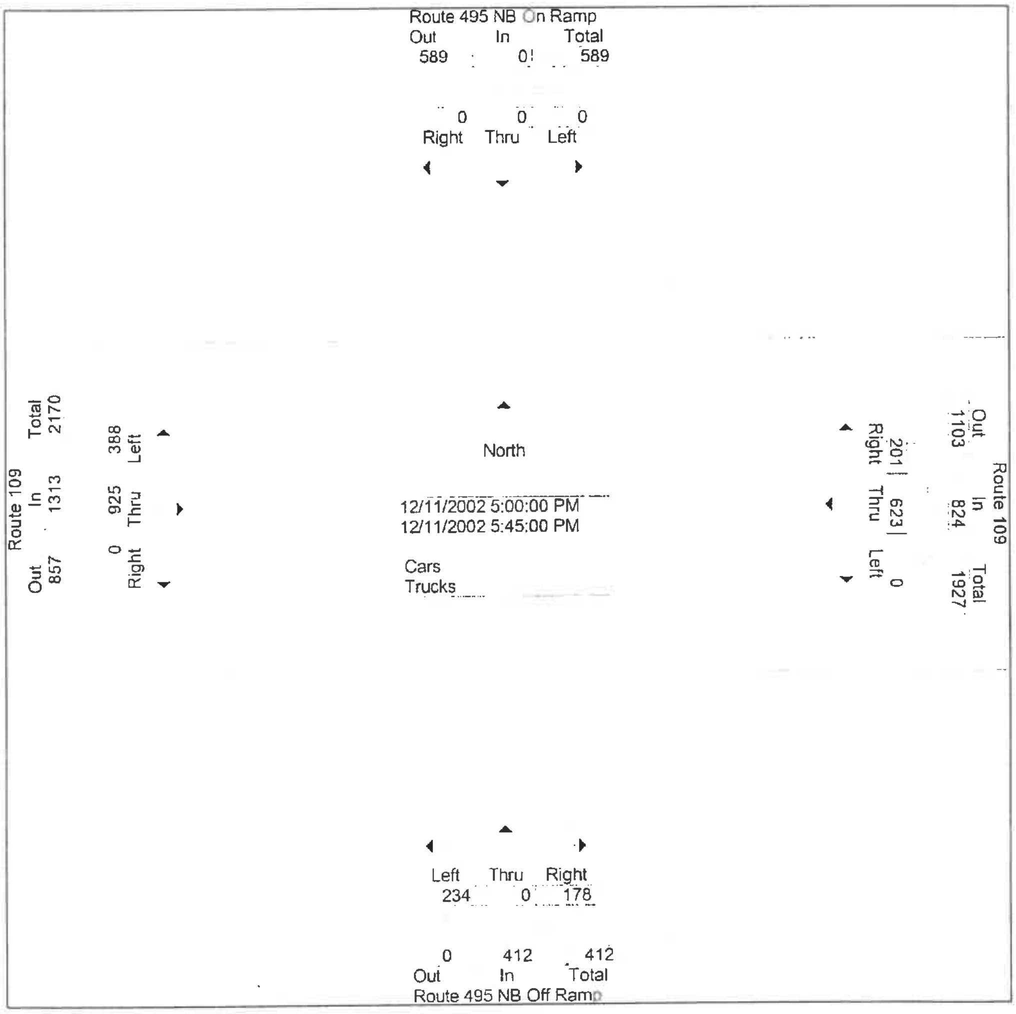
File Name : 20144006
Site Code : 20144006
Start Date : 12/11/2002
Page No : 1

	Route 495 NB On Ramp From North				Route 109 From East				Route 495 NB Off Ramp From South				Route 109 From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																	
Intersection 17:00																	
Volume	0	0	0	0	0	623	201	824	234	0	178	412	388	925	0	1313	2549
Percent	0.0	0.0	0.0		0.0	75.6	24.4		56.8	0.0	43.2		29.6	70.4	0.0		
Volume	0	0	0	0	0	623	201	824	234	0	178	412	388	925	0	1313	2549
Volume	0	0	0	0	0	163	55	218	62	0	47	109	92	240	0	332	659
Peak Factor																	0.967
High Int.					17:00				17:15				17:30				
Volume	0	0	0	0	0	169	66	235	62	0	47	109	109	239	0	348	
Peak Factor								0.877				0.945				0.943	



/S Street : Route 126 North
/W Street : Route 16
ity/State : Holliston, MA
/eather : Clear

Accurate Counts
978-664-2565

File Name : 20144011
Site Code : 20144011
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 126 From North		Route 16 From East		Route 16/126 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
07:00	12	45	66	4	61	121	309
07:15	12	52	52	17	84	144	361
07:30	5	54	44	6	73	140	322
07:45	5	49	59	12	81	143	349
Total	34	200	221	39	299	548	1341
08:00	10	69	59	7	78	175	398
08:15	8	53	67	9	97	142	376
08:30	12	63	54	9	79	179	396
08:45	11	64	65	8	69	159	376
Total	41	249	245	33	323	655	1546
Grand Total	75	449	466	72	622	1203	2887
Apprch %	14.3	85.7	86.6	13.4	34.1	65.9	
Total %	2.6	15.6	16.1	2.5	21.5	41.7	

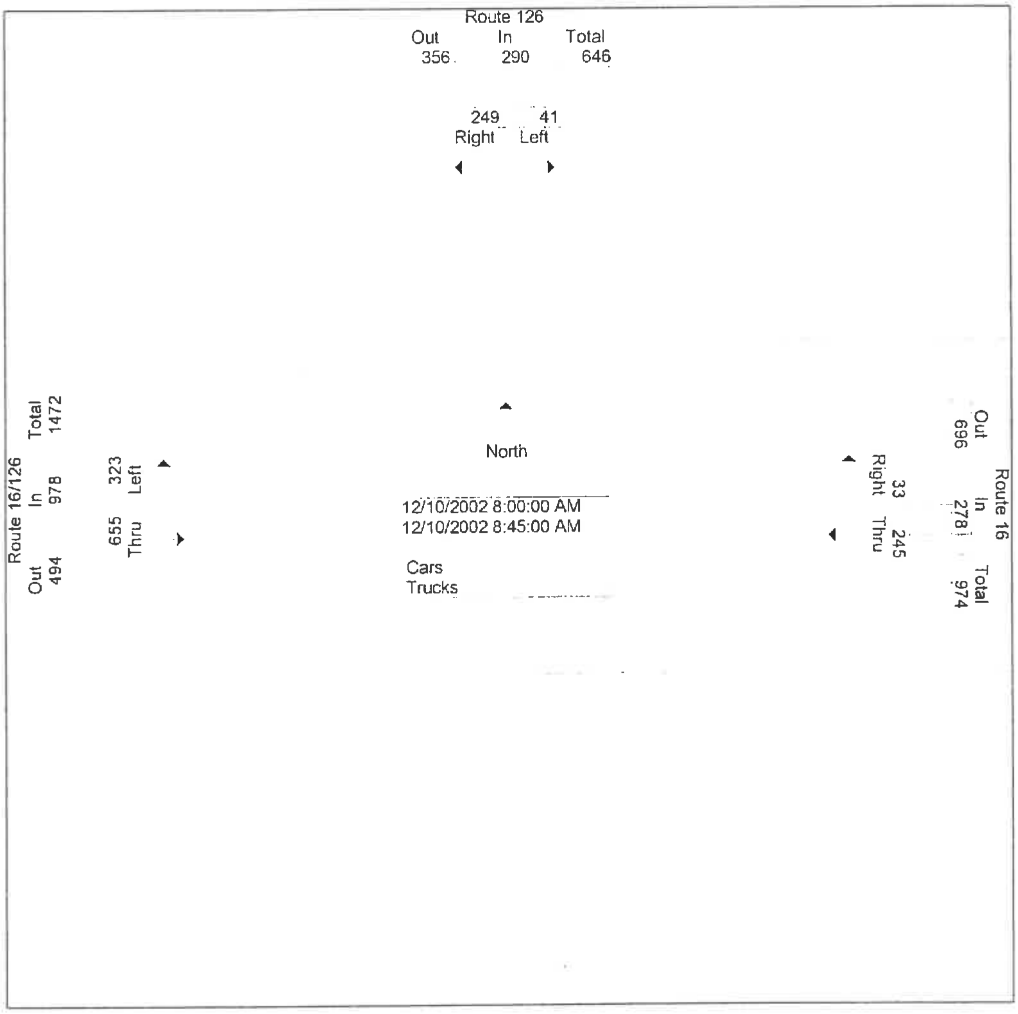
	Route 126 From North			Route 16 From East			Route 16/126 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
eak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	08:00									
Volume	41	249	290	245	33	278	323	655	978	1546
Percent	14.1	85.9		88.1	11.9		33.0	67.0		
Volume	41	249	290	245	33	278	323	655	978	1546
Volume	10	69	79	59	7	66	78	175	253	398
Peak Factor										0.971
High Int.	08:00			08:15			08:30			
Volume	10	69	79	67	9	76	79	179	258	
Peak Factor			0.918			0.914			0.948	
eak Hour From 07:00 to 08:45 - Peak 1 of 1										
By Approach	08:00			08:00			08:00			
Volume	41	249	290	245	33	278	323	655	978	
Percent	14.1	85.9		88.1	11.9		33.0	67.0		
High Int.	08:00			08:15			08:30			
Volume	10	69	79	67	9	76	79	179	258	
Peak Factor			0.918			0.914			0.948	

N/S Street : Route 126 North
E/W Street : Route 16
City/State : Holliston, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144011
Site Code : 20144011
Start Date : 12/10/200
Page No : 1

	Route 126 From North			Route 16 From East			Route 16/126 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection 08:00										
Volume	41	249	290	245	33	278	323	655	978	1546
Percent	14.1	85.9		88.1	11.9		33.0	67.0		
Volume	41	249	290	245	33	278	323	655	978	1546
Volume	10	69	79	59	7	66	78	175	253	398
Peak Factor										0.971
High Int. 08:00				08:15			08:30			
Volume	10	69	79	67	9	76	79	179	258	
Peak Factor			0.918			0.914			0.948	



S Street : Route 126 North
W Street : Route 16
ty/State : Holliston, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144011
Site Code : 20144011
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 126 From North		Route 16 From East		Route 16/126 From West		
Start Time	Left	Right	Thru	Right	Left	Thru	Int. Total
16:00	8	106	146	8	74	52	394
16:15	3	86	147	11	55	52	354
16:30	5	99	109	7	70	53	343
16:45	5	96	153	15	69	55	393
Total	21	387	555	41	268	212	1484
17:00	10	105	148	5	59	58	385
17:15	12	96	142	3	90	75	418
17:30	6	110	160	8	78	57	419
17:45	10	87	164	7	60	62	390
Total	38	398	614	23	287	252	1612
Grand Total	59	785	1169	64	555	464	3096
Apprch %	7.0	93.0	94.8	5.2	54.5	45.5	
Total %	1.9	25.4	37.8	2.1	17.9	15.0	

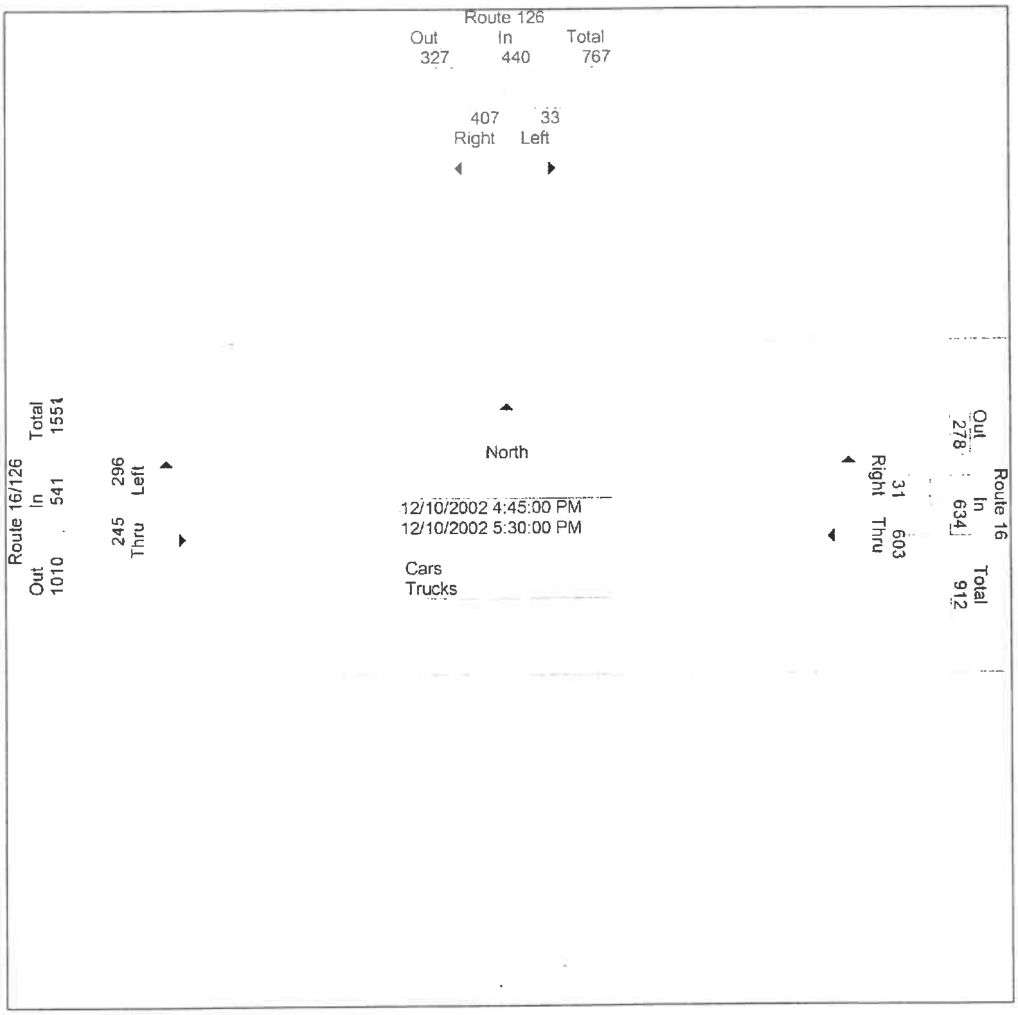
	Route 126 From North			Route 16 From East			Route 16/126 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection 16:45										
Volume	33	407	440	603	31	634	296	245	541	1615
Percent	7.5	92.5		95.1	4.9		54.7	45.3		
Volume	33	407	440	603	31	634	296	245	541	1615
Volume	6	110	116	160	8	168	78	57	135	419
Peak Factor										0.964
High Int. 17:30				16:45			17:15			
Volume	6	110	116	153	15	168	90	75	165	
Peak Factor			0.948			0.943			0.820	
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
By Approach 16:45				17:00			16:45			
Volume	33	407	440	614	23	637	296	245	541	
Percent	7.5	92.5		96.4	3.6		54.7	45.3		
High Int. 17:30				17:45			17:15			
Volume	6	110	116	164	7	171	90	75	165	
Peak Factor			0.948			0.931			0.820	

N/S Street : Route 126 North
E/W Street : Route 16
City/State : Holliston, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144011
Site Code : 20144011
Start Date : 12/10/2002
Page No : 1

	Route 126 From North			Route 16 From East			Route 16/126 From West			
Start Time	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection	16:45									
Volume	33	407	440	603	31	634	296	245	541	1615
Percent	7.5	92.5		95.1	4.9		54.7	45.3		
Volume	33	407	440	603	31	634	296	245	541	1615
Volume	6	110	116	160	8	168	78	57	135	419
Peak Factor										0.964
High Int.	17:30			16:45			17:15			
Volume	6	110	116	153	15	168	90	75	165	
Peak Factor			0.948			0.943			0.820	



/S Street : Route 16/126
/W Street : Central Street
ity/State : Holliston, MA
Veather : Clear

Accurate Counts
978-664-2565

File Name : 20144010
Site Code : 20144010
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 16/126 From North		Central St From East		Route 16/126 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00	38	72	16	57	216	39	438
07:15	53	99	11	86	261	46	556
07:30	50	112	16	50	266	58	552
07:45	32	123	19	48	265	56	543
Total	173	406	62	241	1008	199	2089
08:00	49	117	17	52	270	64	569
08:15	35	102	28	53	237	60	515
08:30	39	107	16	48	242	45	497
08:45	40	124	20	46	236	45	511
Total	163	450	81	199	985	214	2092
Grand Total	336	856	143	440	1993	413	4181
Apprch %	28.2	71.8	24.5	75.5	82.8	17.2	
Total %	8.0	20.5	3.4	10.5	47.7	9.9	

	Route 16/126 From North			Central St From East			Route 16/126 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
eak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	07:15									
Volume	184	451	635	63	236	299	1062	224	1286	2220
Percent	29.0	71.0		21.1	78.9		82.6	17.4		
Volume	184	451	635	63	236	299	1062	224	1286	2220
Volume	49	117	166	17	52	69	270	64	334	569
Peak Factor										0.975
High Int.	08:00			07:15			08:00			
Volume	49	117	166	11	86	97	270	64	334	
Peak Factor			0.956			0.771			0.963	

eak Hour From 07:00 to 08:45 - Peak 1 of 1									
By Approach	07:15			07:00			07:15		
Volume	184	451	635	62	241	303	1062	224	1286
Percent	29.0	71.0		20.5	79.5		82.6	17.4	
High Int.	08:00			07:15			08:00		
Volume	49	117	166	11	86	97	270	64	334
Peak Factor			0.956			0.781			0.963

N/S Street : Route 16/126
E/W Street : Central Street
City/State : Holliston, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144010
Site Code : 20144010
Start Date : 12/10/2002
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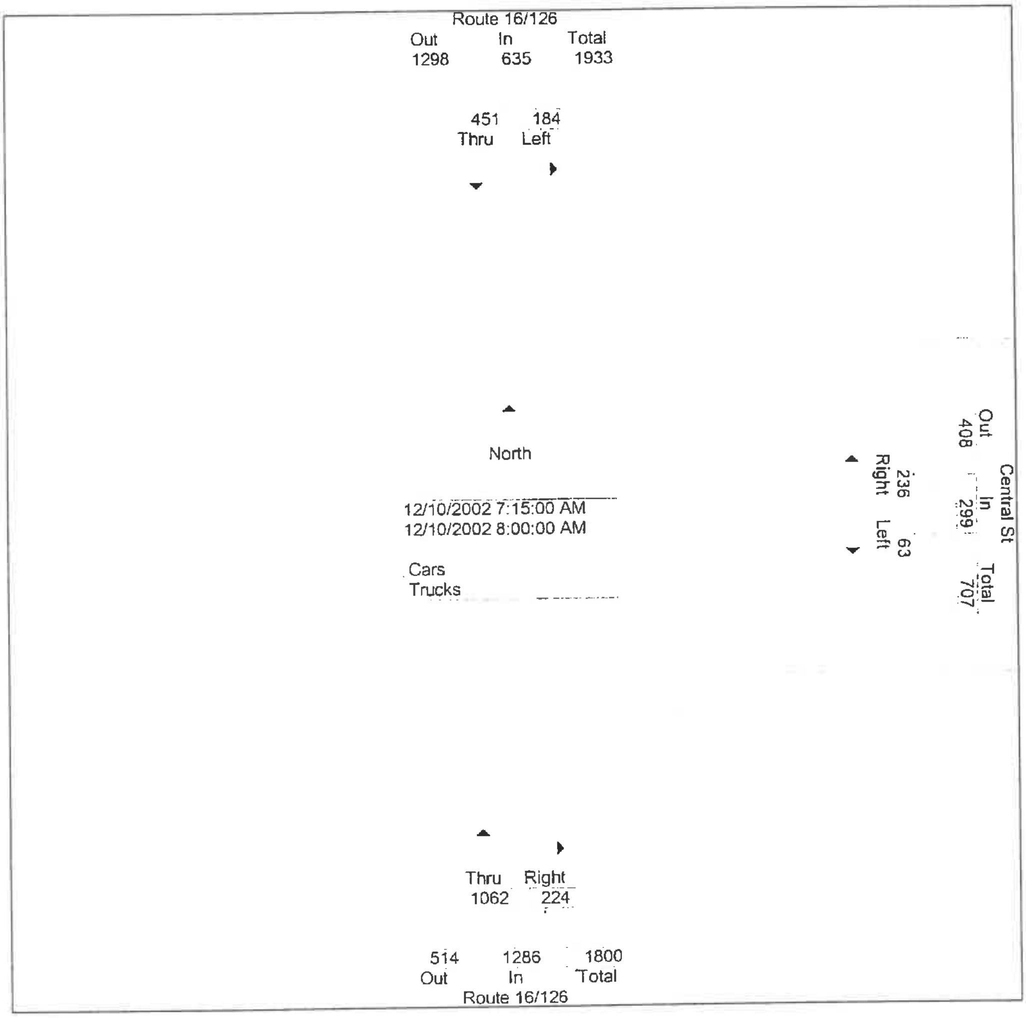
	Route 16/126 From North			Central St From East			Route 16/126 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	07:15									
Volume	184	451	635	63	236	299	1062	224	1286	2220
Percent	29.0	71.0		21.1	78.9		82.6	17.4		
Volume	184	451	635	63	236	299	1062	224	1286	2220
Volume	49	117	166	17	52	69	270	64	334	569
Peak Factor										0.975
High Int.	08:00			07:15			08:00			
Volume	49	117	166	11	86	97	270	64	334	
Peak Factor			0.956			0.771			0.963	



/S Street	: Route 16/126	Accurate Counts 978-664-2565	File Name : 20144010
:/W Street	: Central Street		Site Code : 20144010
ity/State	: Holliston, MA		Start Date : 12/10/2002
Veather	: Clear		Page No : 1

Groups Printed- Cars - Trucks

	Route 16/126 From North		Central St From East		Route 16/126 From South		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
16:00	43	225	37	44	156	52	557
16:15	57	229	29	65	130	37	547
16:30	53	234	30	37	131	39	524
16:45	55	235	29	52	132	44	547
Total	208	923	125	198	549	172	2175
17:00	65	234	31	51	116	26	523
17:15	70	221	32	44	163	44	574
17:30	85	224	33	45	124	36	547
17:45	54	236	36	45	132	33	536
Total	274	915	132	185	535	139	2180
Grand Total	482	1838	257	383	1084	311	4355
Apprch %	20.8	79.2	40.2	59.8	77.7	22.3	
Total %	11.1	42.2	5.9	8.8	24.9	7.1	

	Route 16/126 From North			Central St From East			Route 16/126 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection	16:45									
Volume	275	914	1189	125	192	317	535	150	685	2191
Percent	23.1	76.9		39.4	60.6		78.1	21.9		
Volume	275	914	1189	125	192	317	535	150	685	2191
Volume	70	221	291	32	44	76	163	44	207	574
Peak Factor										0.954
High Int.	17:30			17:00			17:15			
Volume	85	224	309	31	51	82	163	44	207	
Peak Factor			0.962			0.966			0.827	
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
By Approach	16:45			16:15			16:00			
Volume	275	914	1189	119	205	324	549	172	721	
Percent	23.1	76.9		36.7	63.3		76.1	23.9		
High Int.	17:30			16:15			16:00			
Volume	85	224	309	29	65	94	156	52	208	
Peak Factor			0.962			0.862			0.867	

N/S Street : Route 16/126
E/W Street : Central Street
City/State : Holliston, MA
Weather : Clear

Accurate Counts
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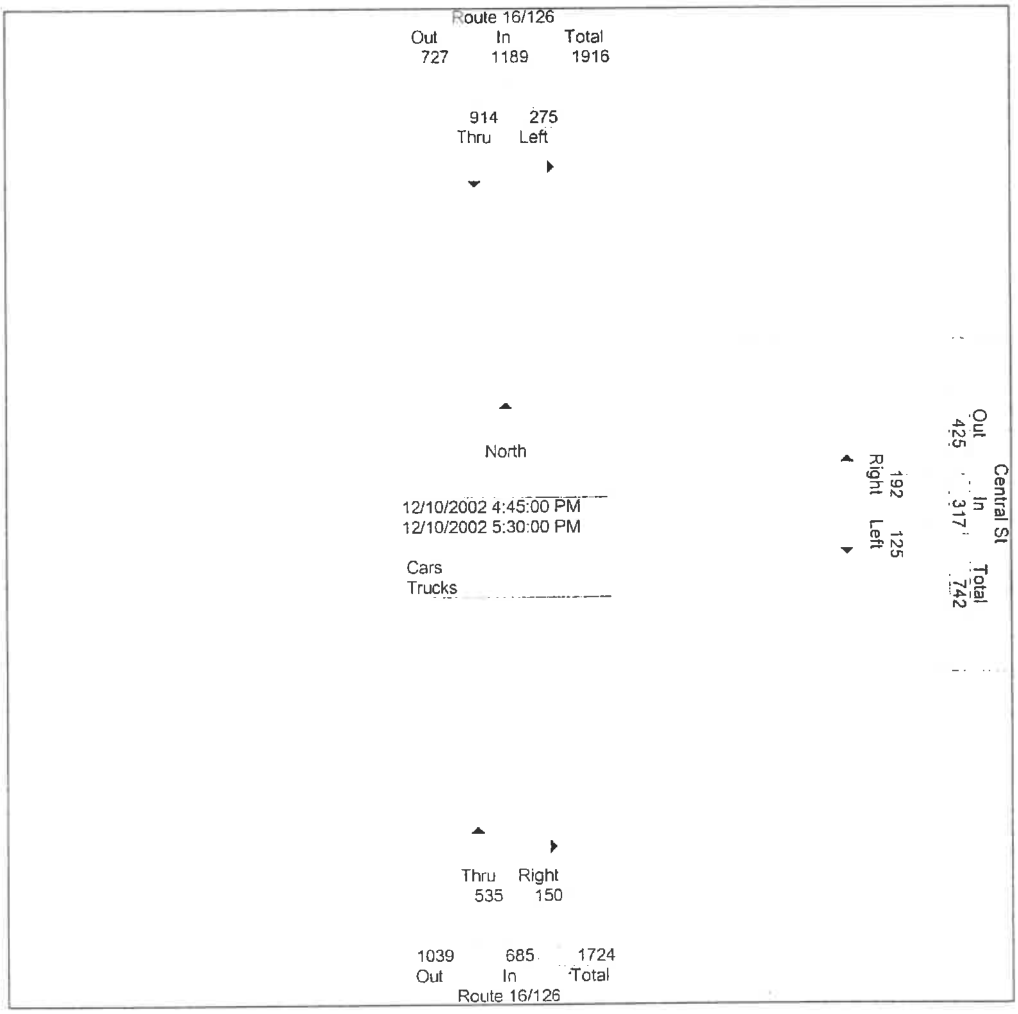
File Name : 20144010
Site Code : 20144010
Start Date : 12/10/2002
Page No : 1

	Route 16/126 From North			Central St From East			Route 16/126 From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection 16:45										
Volume	275	914	1189	125	192	317	535	150	685	2191
Percent	23.1	76.9		39.4	60.6		78.1	21.9		
Volume	275	914	1189	125	192	317	535	150	685	2191
Volume	70	221	291	32	44	76	163	44	207	574
Peak Factor										0.954
High Int.	17:30			17:00			17:15			
Volume	85	224	309	31	51	82	163	44	207	
Peak Factor			0.962			0.966			0.827	



S Street : Route 126 South
N Street : Route 16
y/State : Holliston, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144009
Site Code : 20144009
Start Date : 12/10/2002
Page No : 1

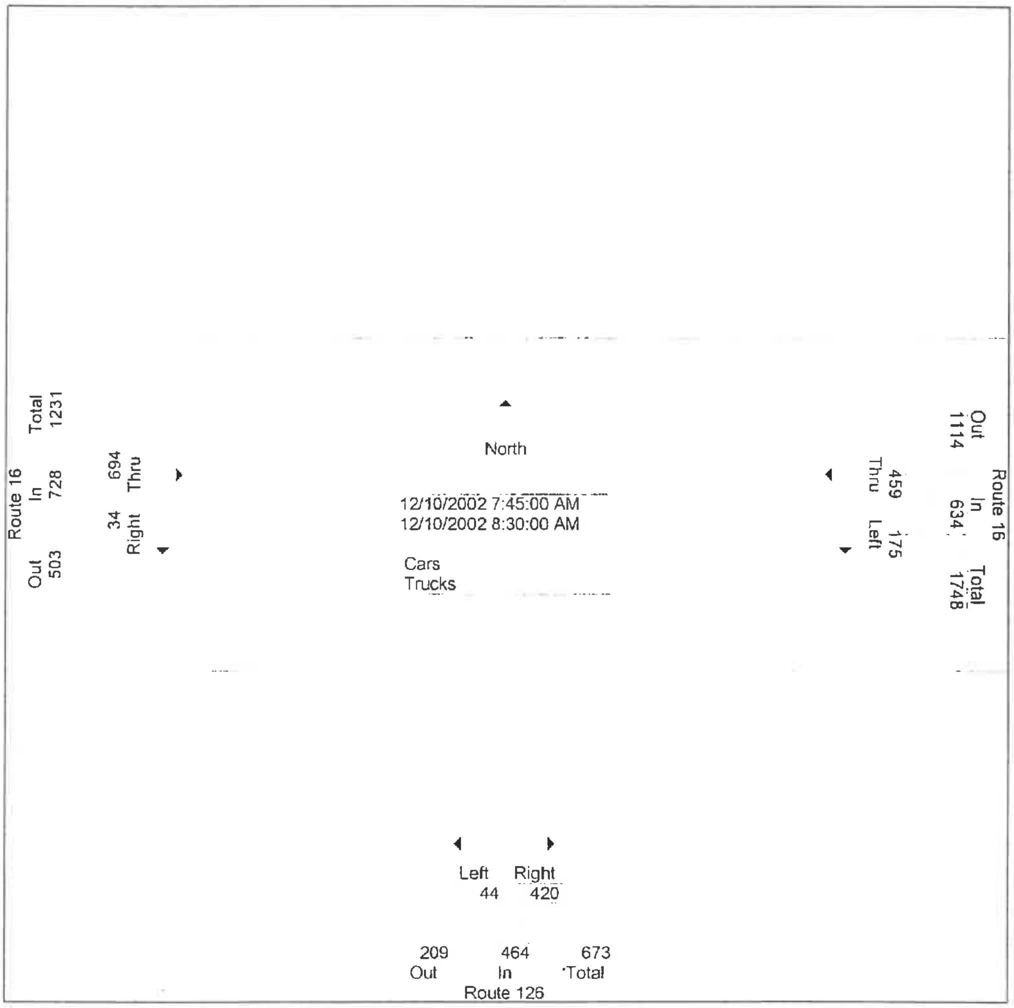
Groups Printed- Cars - Trucks

Start Time	Route 16 From East Left	Thru	Route 126 From South Left	Right	Route 16 From West Thru	Right	Int. Total
07:00	45	74	6	82	152	4	363
07:15	27	88	6	122	207	8	458
07:30	52	92	10	88	159	4	405
07:45	52	122	8	128	176	9	495
Total	176	376	30	420	694	25	1721
08:00	44	140	11	89	172	6	462
08:15	37	106	18	102	156	11	430
08:30	42	91	7	101	190	8	439
08:45	40	131	10	109	140	12	442
Total	163	468	46	401	658	37	1773
Grand Total	339	844	76	821	1352	62	3494
Apprch %	28.7	71.3	8.5	91.5	95.6	4.4	
Total %	9.7	24.2	2.2	23.5	38.7	1.8	

Start Time	Route 16 From East Left	Thru	App. Total	Route 126 From South Left	Right	App. Total	Route 16 From West Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection 07:45										
Volume	175	459	634	44	420	464	694	34	728	1826
Percent	27.6	72.4		9.5	90.5		95.3	4.7		
Volume	175	459	634	44	420	464	694	34	728	1826
Volume	52	122	174	8	128	136	176	9	185	495
Peak Factor										0.922
High Int. 08:00				07:45			08:30			
Volume	44	140	184	8	128	136	190	8	198	
Peak Factor			0.861			0.853			0.919	
ak Hour From 07:00 to 08:45 - Peak 1 of 1										
By Approach 07:30				07:45			07:15			
Volume	185	460	645	44	420	464	714	27	741	
Percent	28.7	71.3		9.5	90.5		96.4	3.6		
High Int. 08:00				07:45			07:15			
Volume	44	140	184	8	128	136	207	8	215	
Peak Factor			0.876			0.853			0.862	

N/S Street : Route 126 South	Accurate Counts	File Name	: 20144009
E/W Street : Route 16	978-664-2565	Site Code	: 20144009
City/State : Holliston, MA		Start Date	: 12/10/200
Weather : Clear		Page No	: 1

	Route 16 From East			Route 126 From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	07:45									
Volume	175	459	634	44	420	464	694	34	728	1826
Percent	27.6	72.4		9.5	90.5		95.3	4.7		
Volume	175	459	634	44	420	464	694	34	728	1826
Volume	52	122	174	8	128	136	176	9	185	495
Peak Factor										0.922
High Int.	08:00			07:45			08:30			
Volume	44	140	184	8	128	136	190	8	198	
Peak Factor			0.861			0.853			0.919	



|S Street : Route 126 South
|W Street : Route 16
ity/State : Holliston, MA
/eather : Clear

Accurate Counts
978-664-2565

File Name : 20144009
Site Code : 20144009
Start Date : 12/10/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 16 From East		Route 126 From South		Route 16 From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
16:00	113	183	15	62	122	12	507
16:15	110	179	13	59	120	19	500
16:30	146	189	15	60	118	21	549
16:45	136	156	30	59	110	22	513
Total	505	707	73	240	470	74	2069
17:00	102	178	13	63	138	16	510
17:15	134	189	27	66	125	15	556
17:30	126	183	18	73	126	20	546
17:45	109	171	15	59	116	11	481
Total	471	721	73	261	505	62	2093
Grand Total	976	1428	146	501	975	136	4162
Apprch %	40.6	59.4	22.6	77.4	87.8	12.2	
Total %	23.5	34.3	3.5	12.0	23.4	3.3	

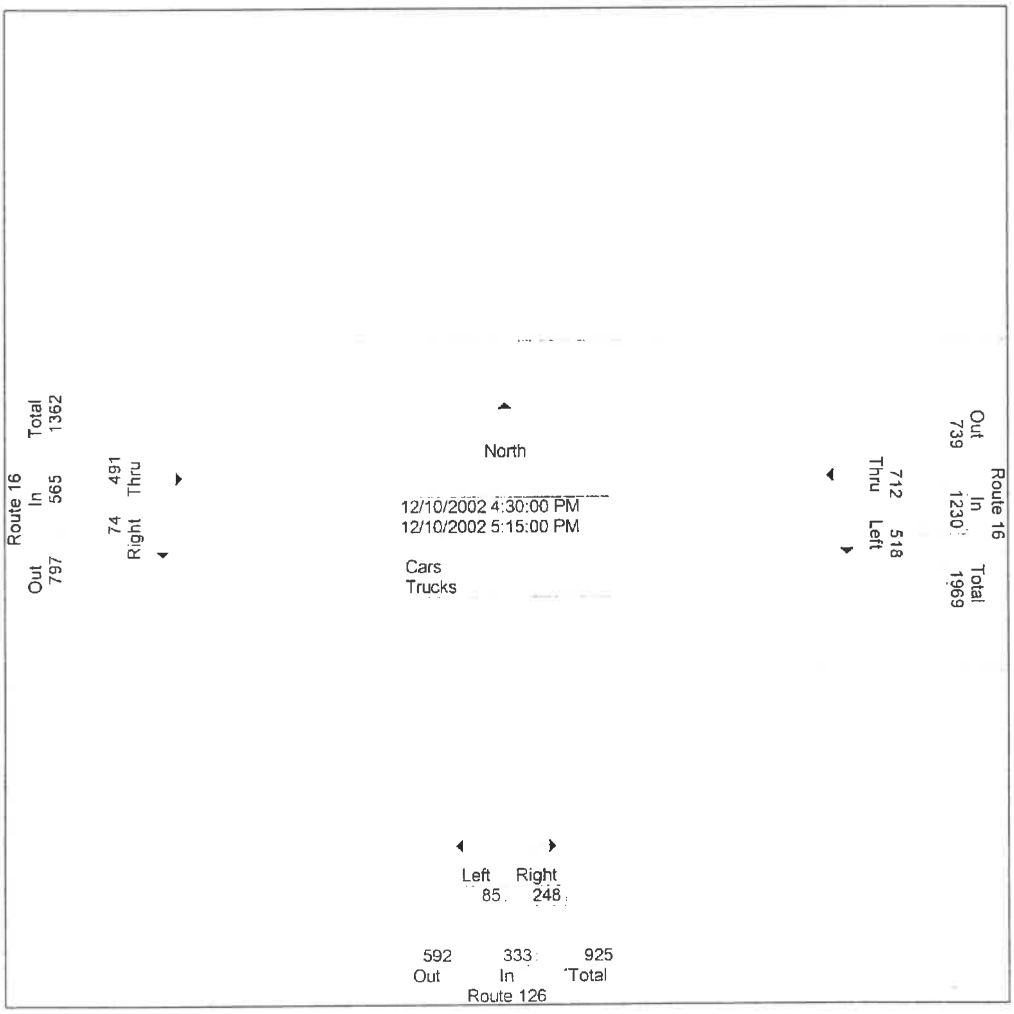
	Route 16 From East			Route 126 From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection	16:30									
Volume	518	712	1230	85	248	333	491	74	565	2128
Percent	42.1	57.9		25.5	74.5		86.9	13.1		
Volume	518	712	1230	85	248	333	491	74	565	2128
Volume	134	189	323	27	66	93	125	15	140	556
Peak Factor										0.957
High Int.	16:30		17:15			17:00				
Volume	146	189	335	27	66	93	138	16	154	
Peak Factor			0.918			0.895			0.917	
eak Hour From 16:00 to 17:45 - Peak 1 of 1										
By Approach	16:30		16:45			16:45				
Volume	518	712	1230	88	261	349	499	73	572	
Percent	42.1	57.9		25.2	74.8		87.2	12.8		
High Int.	16:30		17:15			17:00				
Volume	146	189	335	27	66	93	138	16	154	
Peak Factor			0.918			0.938			0.929	

N/S Street : Route 126 South
E/W Street : Route 16
City/State : Holliston, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144009
Site Code : 20144009
Start Date : 12/10/2002
Page No : 1

	Route 16 From East			Route 126 From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection 16:30										
Volume	518	712	1230	85	248	333	491	74	565	2128
Percent	42.1	57.9		25.5	74.5		86.9	13.1		
Volume	518	712	1230	85	248	333	491	74	565	2128
Volume	134	189	323	27	66	93	125	15	140	556
Peak Factor										0.957
High Int.	16:30			17:15			17:00			
Volume	146	189	335	27	66	93	138	16	154	
Peak Factor			0.918			0.895			0.917	



S Street : Hopping Brook Road
W Street : Route 16
ty/State : Milford, MA
eather : Clear

Accurate Counts
978-664-2565

File Name : 20144008
Site Code : 20144008
Start Date : 12/11/2002
Page No : 1

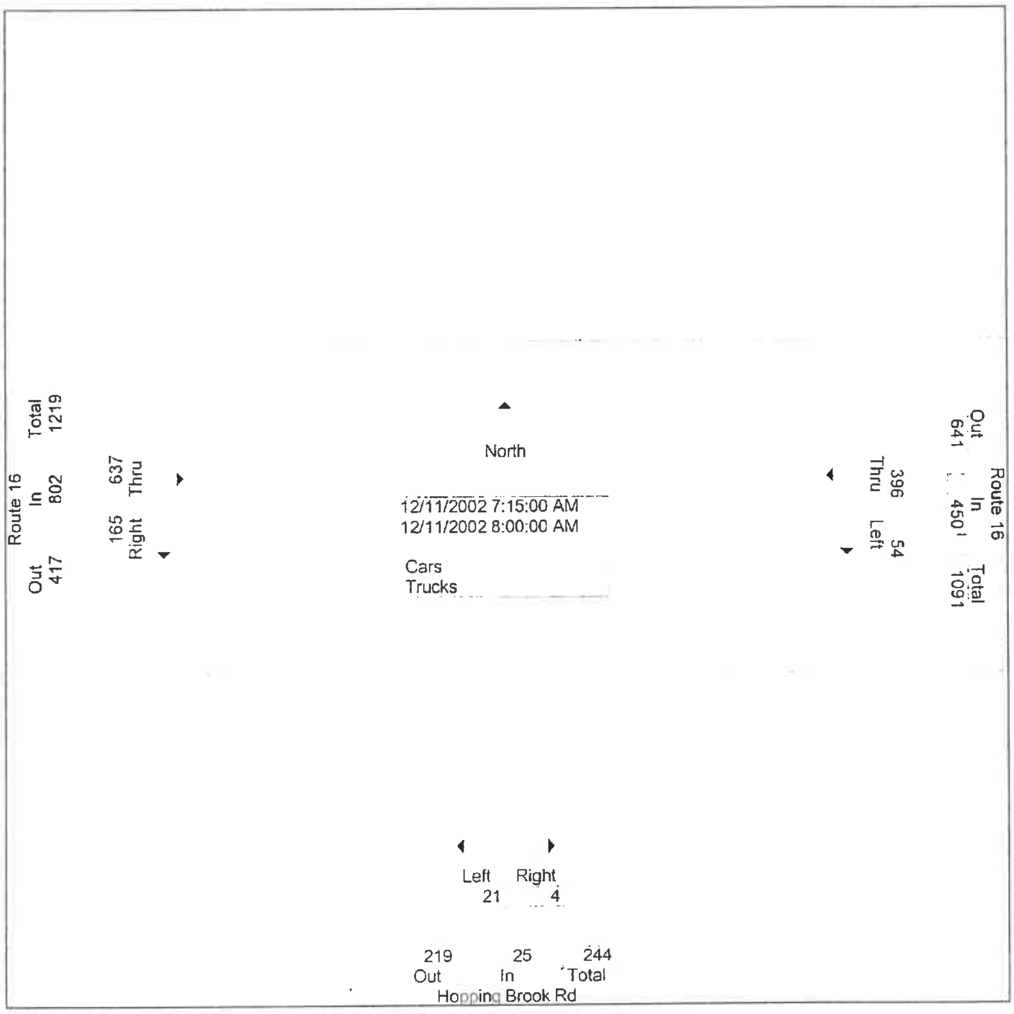
Groups Printed- Cars - Trucks

	Route 16 From East		Hopping Brook Rd From South		Route 16 From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
07:00	7	51	3	0	155	21	237
07:15	10	91	6	0	183	30	320
07:30	11	97	6	0	155	32	301
07:45	19	104	5	2	162	60	352
Total	47	343	20	2	655	143	1210
08:00	14	104	4	2	137	43	304
08:15	8	106	3	2	143	45	307
08:30	16	86	3	3	150	44	302
08:45	4	103	5	3	145	20	280
Total	42	399	15	10	575	152	1193
Grand Total	89	742	35	12	1230	295	2403
Apprch %	10.7	89.3	74.5	25.5	80.7	19.3	
Total %	3.7	30.9	1.5	0.5	51.2	12.3	

	Route 16 From East			Hopping Brook Rd From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
ak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	07:15									
Volume	54	396	450	21	4	25	637	165	802	1277
Percent	12.0	88.0		84.0	16.0		79.4	20.6		
Volume	54	396	450	21	4	25	637	165	802	1277
Volume	19	104	123	5	2	7	162	60	222	352
Peak Factor										0.907
High Int.	07:45			07:45			07:45			
Volume	19	104	123	5	2	7	162	60	222	
Peak Factor			0.915			0.893			0.903	
ak Hour From 07:00 to 08:45 - Peak 1 of 1										
By Approach	07:30			07:15			07:15			
Volume	52	411	463	21	4	25	637	165	802	
Percent	11.2	88.8		84.0	16.0		79.4	20.6		
High Int.	07:45			07:45			07:45			
Volume	19	104	123	5	2	7	162	60	222	
Peak Factor			0.941			0.893			0.903	

N/S Street : Hopping Brook Road	Accurate Counts	File Name	: 20144008
E/W Street : Route 16	978-664-2565	Site Code	: 20144008
City/State : Milford, MA		Start Date	: 12/11/2002
Weather : Clear		Page No	: 1

	Route 16 From East			Hopping Brook Rd From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour From 07:00 to 08:45 - Peak 1 of 1										
Intersection	07:15									
Volume	54	396	450	21	4	25	637	165	802	1277
Percent	12.0	88.0		84.0	16.0		79.4	20.6		
Volume	54	396	450	21	4	25	637	165	802	1277
Volume	19	104	123	5	2	7	162	60	222	352
Peak Factor										0.907
High Int.	07:45			07:45			07:45			
Volume	19	104	123	5	2	7	162	60	222	
Peak Factor			0.915			0.893			0.903	



Street : Hopping Brook Road
/ Street : Route 16
/State : Milford, MA
ather : Clear

Accurate Counts
978-664-2565

File Name : 20144008
Site Code : 20144008
Start Date : 12/11/2002
Page No : 1

Groups Printed- Cars - Trucks

	Route 16 From East		Hopping Brook Rd From South		Route 16 From West		
Start Time	Left	Thru	Left	Right	Thru	Right	Int. Total
16:00	2	171	25	13	100	6	317
16:15	8	156	14	4	124	9	315
16:30	5	165	40	13	83	6	312
16:45	1	178	17	9	109	1	315
Total	16	670	96	39	416	22	1259
17:00	4	175	64	29	113	4	389
17:15	3	175	41	20	136	3	378
17:30	3	204	31	15	128	3	384
17:45	1	166	20	9	118	2	316
Total	11	720	156	73	495	12	1467
Grand Total	27	1390	252	112	911	34	2726
Apprch %	1.9	98.1	69.2	30.8	96.4	3.6	
Total %	1.0	51.0	9.2	4.1	33.4	1.2	

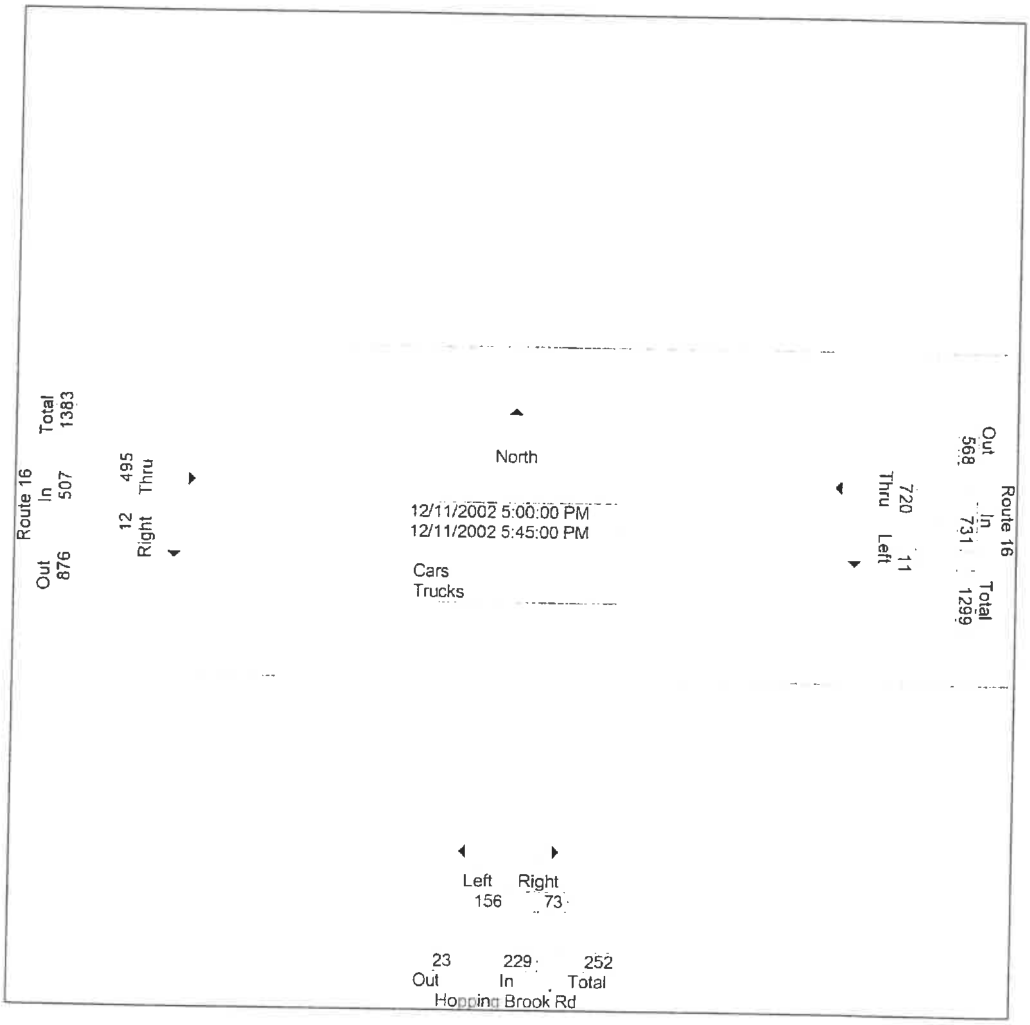
		Route 16 From East			Hopping Brook Rd From South			Route 16 From West		
Start Time		Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
ak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection	17:00									
Volume		11	720	731	156	73	229	495	12	507	1467
Percent		1.5	98.5		68.1	31.9		97.6	2.4		
Volume		11	720	731	156	73	229	495	12	507	1467
Volume		4	175	179	64	29	93	113	4	117	389
Peak Factor											0.943
High Int.	17:30				17:00			17:15			
Volume		3	204	207	64	29	93	136	3	139	
Peak Factor				0.883			0.616			0.912	
ak Hour From 16:00 to 17:45 - Peak 1 of 1										
By Approach	16:45				16:30			17:00			
Volume		11	732	743	162	71	233	495	12	507	
Percent		1.5	98.5		69.5	30.5		97.6	2.4		
High Int.	17:30				17:00			17:15			
Volume		3	204	207	64	29	93	136	3	139	
Peak Factor				0.897			0.626			0.912	

N/S Street : Hopping Brook Road
E/W Street : Route 16
City/State : Milford, MA
Weather : Clear

Accurate Counts
978-664-2565

File Name : 20144
Site Code : 20144
Start Date : 12/11/
Page No : 1

	Route 16 From East			Hopping Brook Rd From South			Route 16 From West			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. T
Peak Hour From 16:00 to 17:45 - Peak 1 of 1										
Intersection	17:00									
Volume	11	720	731	156	73	229	495	12	507	14
Percent	1.5	98.5		68.1	31.9		97.6	2.4		
Volume	11	720	731	156	73	229	495	12	507	14
Volume	4	175	179	64	29	93	113	4	117	3
Peak Factor										0.943
High Int.	17:30			17:00			17:15			
Volume	3	204	207	64	29	93	136	3	139	
Peak Factor			0.883			0.616			0.912	



Accident Data

Location	Year	Totals	Day of Week		Time of Day					Severity			Type of Accident					Lighting		Conditions			
			Weekday	Weekend	Am Peak	Midday	PM Peak	Night	Weekend	Property	Injury	Fatality	Angle	Head On	Rear End	Off-Road	Unknown	Daylight	Dark	Rain/Wet	Clear/Dry	Ice/Snow	Unknown
Route 109 @ Route 16																							
	98	13	8	5	--	1	3	4	5	9	4	--	6	--	5	--	2	4	9	4	8	1	--
	99	6	3	3	1	--	2	--	3	6	--	--	1	--	1	1	3	4	2	1	4	--	1
	00	4	3	1	1	1	1	--	1	3	1	--	4	--	--	--	--	4	--	--	4	--	--
Totals		23	14	9	2	2	6	4	9	18	5	0	11	0	6	1	5	12	11	5	16	1	1
Route 109 @ Beaver																							
	98	13	12	1	1	6	4	1	1	9	4	--	8	--	2	1	2	11	2	5	7	1	--
	99	12	10	2	1	4	4	1	2	8	4	--	8	1	2	--	1	9	3	2	10	--	--
	00	13	10	3	1	4	4	1	3	7	6	--	8	1	1	--	3	11	2	1	11	1	--
Totals		38	32	6	3	14	12	3	6	24	14	0	24	2	5	1	6	31	7	8	28	2	0
Route 109 @ Route 495																							
	98	19	18	1	3	4	5	6	1	15	3	--	3	--	9	5	1	13	5	4	13	1	--
	99	18	14	4	6	1	5	2	4	12	8	--	10	--	9	1	--	15	5	6	13	1	--
	00	33	26	7	9	9	6	2	7	21	11	--	13	--	13	4	2	25	7	7	25	--	--
Totals		70	58	12	18	14	16	10	12	48	22	0	26	0	31	10	3	53	17	17	51	2	0
Route 495 @ Route 85																							
	98	16	13	3	6	2	5	--	3	7	8	1	2	--	11	2	1	11	5	3	13	--	--
	99	16	12	4	3	4	1	4	4	11	4	--	4	--	7	3	2	10	6	3	13	--	--
	00	23	19	4	11	1	7	--	4	19	4	--	--	--	15	3	5	21	2	4	18	1	--
Totals		55	44	11	20	7	13	4	11	37	16	1	6	0	33	8	8	42	13	10	44	1	0
Route 85 @ Dilla/Fortune																							
	98	10	8	2	--	3	3	2	2	8	2	--	4	--	5	--	1	8	2	3	7	--	--
	99	7	6	1	1	2	3	--	1	5	2	--	5	--	--	--	2	5	2	2	5	--	--
	00	7	6	1	--	--	6	--	1	3	4	--	4	--	3	--	--	4	3	2	5	--	--
Totals		24	20	4	1	5	12	2	4	16	8	0	13	0	8	0	3	17	7	7	17	0	0
Route 16 @ Beaver/Fortune																							
	98	8	4	4	1		3		4	5	3		6	1	1	--	--	6	2	4	4	--	--
	99	10	10		2	2	3	3		7	3		6	1	1	--	2	5	4	3	7	--	--
	00	11	8	3	2	4	1	1	3	6	5		9	0	1	1	0	9	3	1	9	1	--
Totals		29	22	7	5	6	7	4	7	18	11		21	11	2	1	3	11	9	10	12	9	0

Location	Year	Totals	Day of Week		Time of Day					Severity			Type of Accident					Lighting		Conditions			
			Weekday	Weekend	Am Peak	Midday	PM Peak	Night	Weekend	Property	Injury	Fatality	Angle	Head On	Rear End	Off-Road	Unknown	Daylight	Dark	Rain/Wet	Clear/Dry	Ice/Snow	Unknown
Route 16/Washington St @ Route 126 Concord St/Nortl																							
	98	3	3	0	1	0	1	1	0	2	1	0	1	0	1	0	1	2	1	1	2	0	0
	99	4	3	1	1	1	0	2	0	1	3	0	2	0	1	1	0	3	1	2	2	0	0
	00	4	2	2	2	0	0	0	2	2	2	0	2	0	1	1	0	4	0	1	2	1	0
Totals		11	8	3	4	1	1	3	2	5	6	0	5	0	3	2	1	9	2	4	6	1	0
Summer Street/South																							
	98	7	5	2	3	1	2	0	1	5	2	0	1	0	4	1	1	4	3	2	5	0	0
	99	5	5	0	1	2	1	1	0	3	2	0	1	0	4	0	0	5	0	2	3	0	0
	00	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0
Totals		13	11	2	5	3	3	1	1	9	4	0	2	0	9	1	1	10	3	4	9	0	0
Not Designated																							
	98	4	4	0	1	2	0	1	0	4	0	0	1	0	2	0	1	4	0	0	4	0	0
	99	3	2	1	0	0	2	0	1	2	1	0	1	1	1	0	0	1	2	1	2	0	0
	00	4	3	1	2	0	0	1	1	4	0	0	0	0	2	1	1	3	1	2	2	0	0
Totals		11	9	2	3	2	2	2	2	10	1	0	2	1	5	1	2	8	3	3	8	0	0
Route 16/Washington St @ Central Street																							
	98	7	6	1	1	2	1	2	1	4	3	0	7	0	0	0	0	4	3	0	7	0	0
	99	5	5	0	0	4	1	0	0	4	1	0	4	0	0	0	1	5	0	0	5	0	0
	00	3	2	1	1	1	0	0	1	2	1	0	1	0	0	0	2	2	1	1	2	0	0
Totals		15	13	2	2	7	2	2	2	10	5	0	12	0	0	0	3	11	4	1	14	0	0
Route 16/Washington St @ Hopping Brook Rd																							
	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	00	2	2	0	0	2	0	0	0	1	1	0	2	0	0	0	0	2	0	1	1	0	0
Totals		2	2	0	0	2	0	0	0	1	1	0	2	0	0	0	0	2	0	1	1	0	0

Crash Rate Worksheet

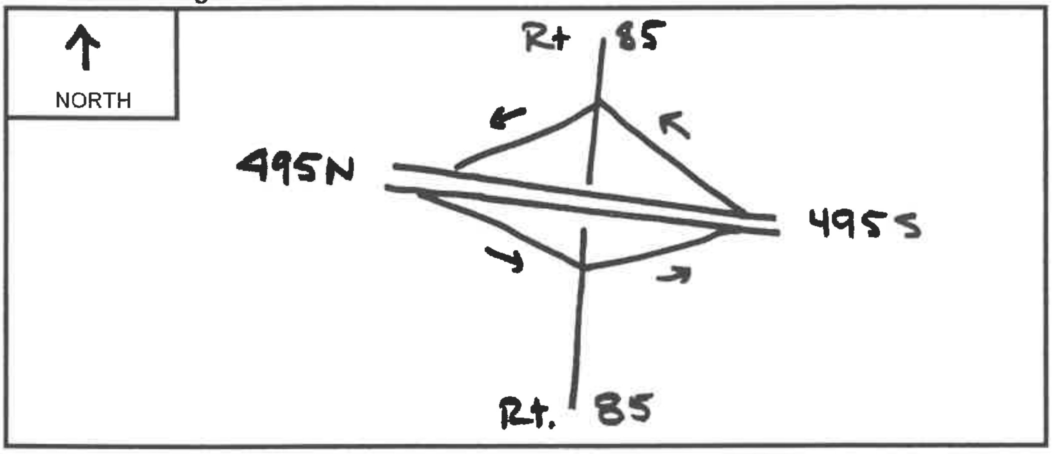
City/Town: Milford   MHD District: 3

Major Street: Route 85

Minor Street(s): Rt 495 Ramps – North + South

CONTROL: Signalized: ____ Unsignalized: X

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB	*	TOTAL
Volumes ([redacted]/PM):	757	460	917	697	1708	4539

"K" Factor: .09   Approach ADT: 50,433   ADT= Total Volume/"K" Factor

Total # of Accidents: 55   # of Years: 3   Average # of Accidents (A): 18.33

Crash Rate Calculation: 1.00

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

Signalization of the northbound ramps should help reduce accidents here

* this is the # of vehicles passing through both ramp intersections. This # needs to be included since the rate is for a pair of intersections

Crash Rate Worksheet

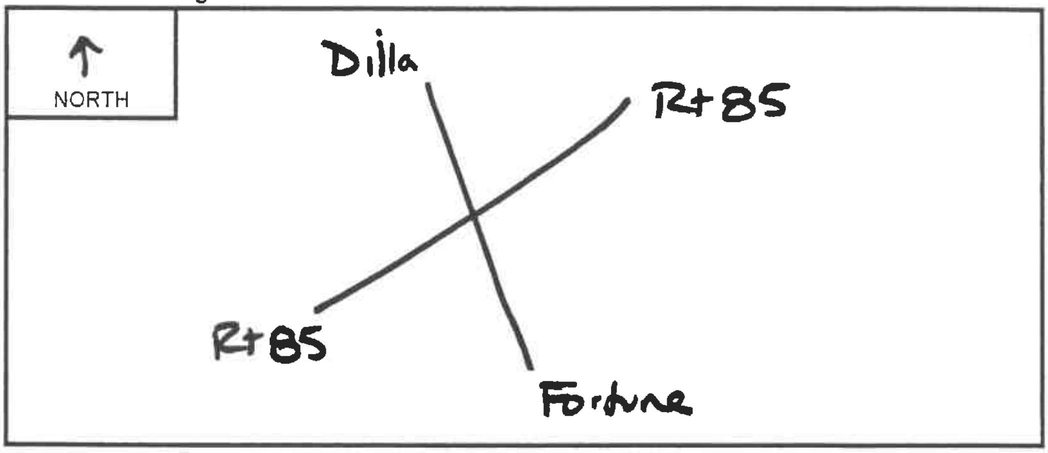
City/Town: Milford MHD District: 3

Major Street: Route 85

Minor Street(s): Dilla/Fortune

CONTROL: Signalized: X Unsignalized: ______

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	272	1464	868	640		3244

"K" Factor: .09 Approach ADT: 36,044 ADT= Total Volume/"K" Factor

Total # of Accidents: 24 # of Years: 3 Average # of Accidents (A): 8.0

Crash Rate Calculation: 0.61

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

this location is below state + district averages

Crash Rate Worksheet

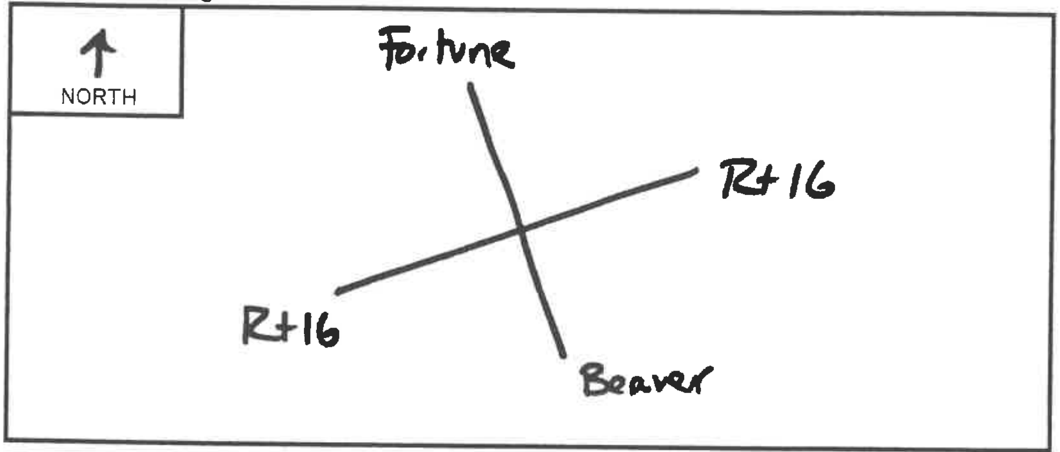
City/Town: Milford | MHD District: 3

Major Street: Rt 16

Minor Street(s): Fortune/Beaver

CONTROL: Signalized: X | Unsignalized:

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	355	795	583	494		2227

"K" Factor: .09 | Approach ADT: 24,744 | ADT= Total Volume/"K" Factor

Total # of Accidents: 29 | # of Years: 3 | Average # of Accidents (A): 9.67

rash Rate Calculation: 1.07

$$RATE = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

this intersection is being improved + will include protected phasing that can be expected to reduce accidents

Crash Rate Worksheet

City/Town: Milford

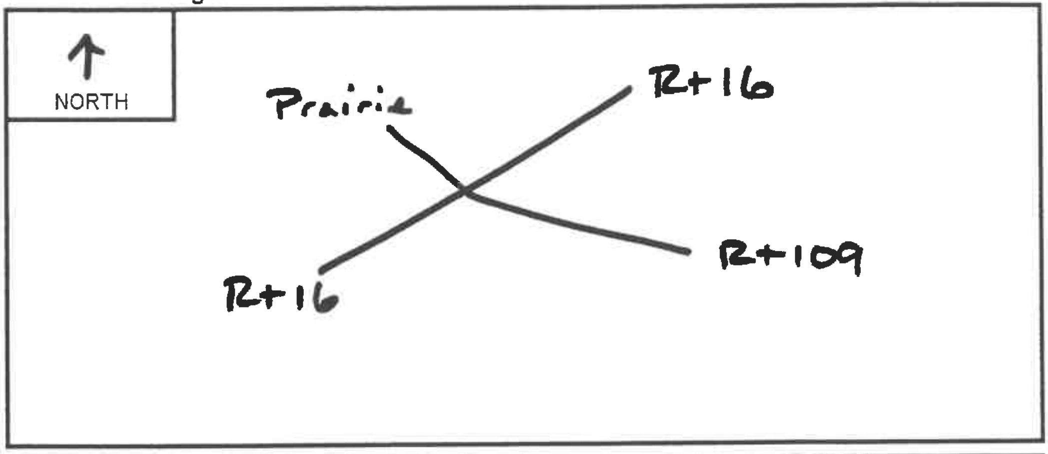
MHD District: 3

Major Street: Rt 109 @ Rt 16

Minor Street(s): Prairie St

CONTROL: Signalized: X Unsignalized:

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	788	581	529	19		1917

"K" Factor: .09

Approach ADT: 21,300

ADT= Total Volume/"K" Factor

Total # of Accidents: 23

# of Years: 3

Average # of Accidents (A): 7.67

Crash Rate Calculation: 0.99

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

Crash Rate Worksheet

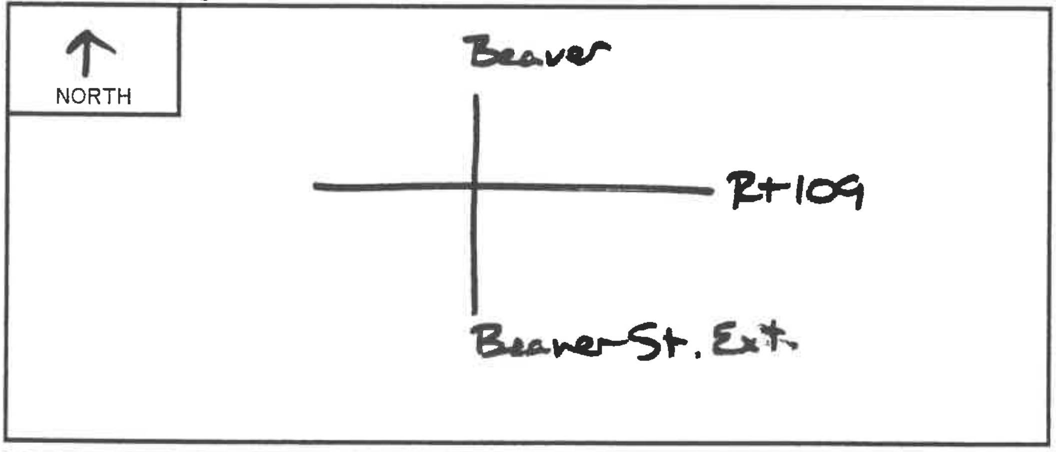
City/Town: Milford MHD District: 3

Major Street: Rt 109

Minor Street(s): Beaver/Beaver St Ext.

CONTROL: Signalized: X Unsignalized:

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	870	1120	643	750		3383

"K" Factor: .09 Approach ADT: 37,589 ADT= Total Volume/"K" Factor

Total # of Accidents: 38 # of Years: 3 Average # of Accidents (A): 12.67

rash Rate Calculation: 0.92

$$RATE = \frac{(A * 1,000,000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

Crash Rate Worksheet

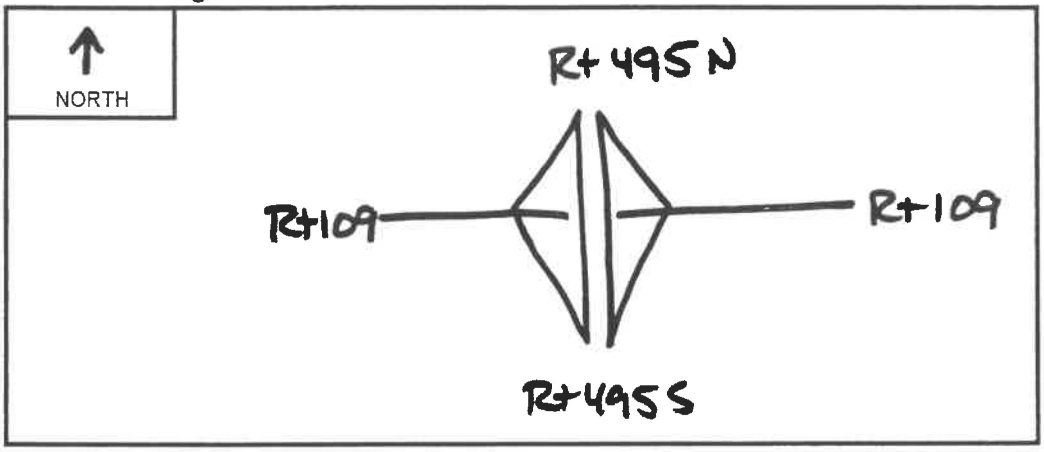
City/Town: ______________________ MHD District: 3

Major Street: ______________________

Minor Street(s): ______________________

CONTROL: Signalized: ______ Unsignalized: ______

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB	*	TOTAL
Volumes ([redacted]/PM):	1688	848	424	872	2164	5996

"K" Factor: .09 Approach ADT: 66,622 ADT= Total Volume/"K" Factor

Total # of Accidents: 70 # of Years: 3 Average # of Accidents (A): 23.33

Crash Rate Calculation: 096

$$RATE = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

the signalization here is expected to reduce accidents significantly.

* this is the # of vehicles passing through both ramp intersections. This # needs to be included since the rate is for a pair of intersections.

Crash Rate Worksheet

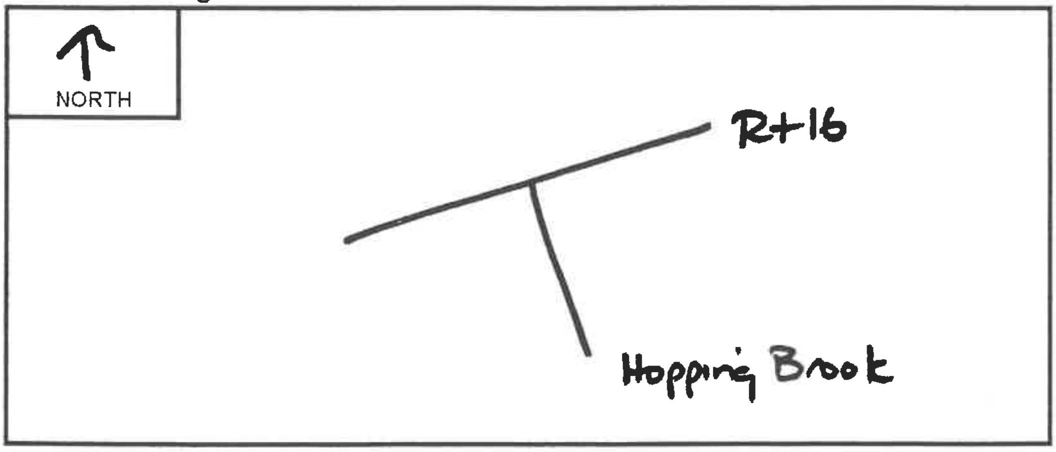
City/Town: Holliston   MHD District: 3

Major Street: Rt 16

Minor Street(s): Hopping Brook Road

CONTROL: Signalized: ____ Unsignalized: X

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	582	820	141			1543

"K" Factor: .09   Approach ADT: 17,144   ADT= Total Volume/"K" Factor

Total # of Accidents: 2   # of Years: 3   Average # of Accidents (A): .67

Crash Rate Calculation: 0.11

$$RATE = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

Crash Rate Worksheet

City/Town: Holliston

MHD District: 3

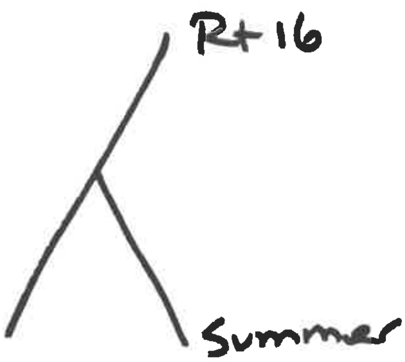
Major Street: Route 16

Minor Street(s): Rt 126/Summer St

CONTROL: Signalized: ______ Unsignalized: X

Intersection Diagram:

NORTH



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes [redacted]/PM):	581	1266	342			2189

"K" Factor: .09

Approach ADT: 24,322

ADT= Total Volume/"K" Factor

Total # of Accidents: 13

# of Years: 3

Average # of Accidents (A): 4.33

Crash Rate Calculation: 0.49

$$\text{RATE} = \frac{(A * 1{,}000{,}000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

* if <u>all</u> undesignated 16/126 accidents were assigned to this intersection the rate would be 0.90

Crash Rate Worksheet

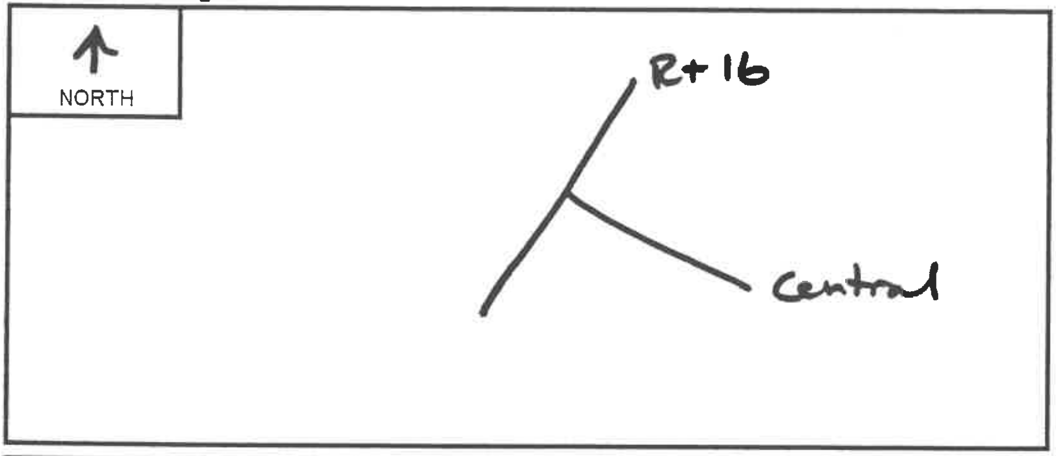
City/Town: Holliston MHD District: 3

Major Street: Route 16

Minor Street(s): Central St

CONTROL: Signalized: ____ Unsignalized: X

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes ([redacted]/PM):	705	1224	325			2254

"K" Factor: .09 Approach ADT: 25,044 ADT= Total Volume/"K" Factor

Total # of Accidents: 15 # of Years: 3 Average # of Accidents (A): 5.0

rash Rate Calculation: 0.55

$$RATE = \frac{(A * 1,000,000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

Crash Rate Worksheet

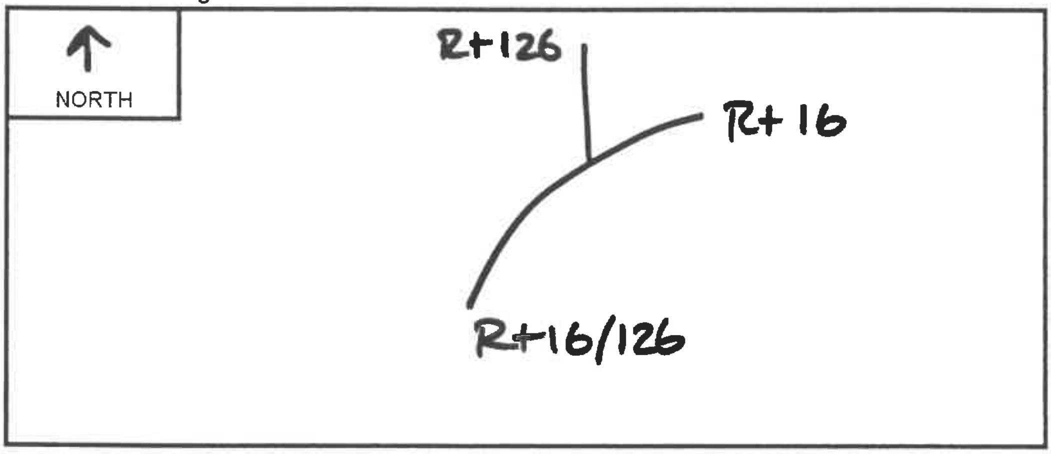
City/Town: Holliston — MHD District: 3

Major Street: Route 16

Minor Street(s): Route 126/Concord ST

CONTROL: Signalized: X — Unsignalized:

Intersection Diagram:



Approach:	1	2	3	4	5	
Direction:	EB	WB	NB	SB		TOTAL
Volumes (~~AM~~/PM):	556	652	•	452		1660

"K" Factor: .09 — Approach ADT: 18,444 — ADT= Total Volume/"K" Factor

Total # of Accidents: 11 — # of Years: 3 — Average # of Accidents (A): 3.67

Crash Rate Calculation: 0.55

$$RATE = \frac{(A * 1,000,000)}{(ADT * 365)}$$

Comments: State Average Rate = 0.66 for unsignalized intersections, 0.87 for signalized intersections

District 3 Average Rate = 0.78 for unsignalized intersections, 0.81 for signalized intersections

* if all undesignated 16/126 accidents are assigned to this intersection the rate would be 1.10/mev.

Memorandum on Trip Generation
Dated: March 28, 2002

TECHNICAL MEMORANDUM

From: Michael R. Abend

Date: March 28, 2002

SUBJECT: TRAFFIC UPDATE TO ACCOMPANY
NOTICE OF PROJECT CHANGE
HOPPING BROOK BUSINESS PARK
HOLLISTON, MASSACHUSETTS

INTRODUCTION

This memorandum has been prepared to accompany the Notice of Project Change for the Hopping Brook Business Park, along Route 16 (Washington Street) in Holliston, Massachusetts. The project change calls for the expansion of the park's area and changes to the roadway layout. No change is proposed regarding the overall building square footage of the development or the specific mix of land uses that would be included in the park. This memorandum discusses the traffic projections associated with the project as originally projected in 1982 and compares them with current estimates, based on various assumptions. The analysis includes updated traffic counts done at the site access along Route 16. It also considers the current mix of land uses within the park, including office, research and development, manufacturing, and warehouse space.

This comparison also considers the operating conditions at the site access intersection along Route 16. The original proposal called for three phases of the project, ultimately requiring the need to provide turning lanes in both directions along Route 16 and the installation of a traffic signal. This update confirms that the proposed mitigation will be adequate to accommodate the project based on updated trip generation estimates and updated intersection capacity analysis methodologies.

REVIEW OF 1982 FEIR ESTIMATES

The Final EIR was completed in 1982. The estimated traffic was based on an analysis of several similar parks in the area, and did not rely on the Institute of Transportation Engineers (ITE). publication **Trip Generation**. At the time, the ITE report was in its third edition. The estimated trips during the peak hours were based on calculations of the number of employees found in similar parks. At the time, there were expected to be 1,900 morning peak hour trips (in and out combined) and 2,750 evening peak hour trips (in and out combined). Although the FEIR did not include a specific estimate regarding daily volumes, a review of the ITE data suggests an estimate of 20,910 vehicles per day (half inbound and half outbound). This estimate is based on the current land use mix at the site and the ITE rates in effect in 1982. These were the volumes on which the proposed mitigation at the site entrance was based. The expected volumes along Route 16 past the site for a future Build year of 1987 were also evaluated in the FEIR.

At the time that those estimates were made, there were no specific assumptions regarding the mix of land uses within the business park. Instead, it was assumed that the mix would be similar to the parks from which the other data had been collected. This was, and still is, a reasonable basis for estimating a land use mix. The FEIR analysis projected that the volumes along Route 16 during the peak hours in 1987 for the Build conditions (unrelated to the project) would amount to 460 vehicles during the morning peak hour and 940 trips during the evening peak hour.

The original estimates in 1982 also expected that 45 percent of the traffic would be oriented to the west and 55 percent toward the east. Interestingly, at the time of that study, it was noted that the use of a relatively high general traffic growth rate of 2.6 was as high as it was because of growth along the Route 495 corridor. Nonetheless, the estimated distribution assumed that the orientation of trips would be more to the east than to the west.

CURRENT CONDITIONS

Currently the park has 558,000 square feet of space occupied, including approximately 30 percent office, 14 percent research and development, 17 percent manufacturing, and 38 percent warehouse. These percentages are expected to change slightly based on discussions with current businesses that indicate that they collectively plan to expand from 558,000 square feet to 750,000 square feet. Based on the type of expansion they currently expect, it is estimated that the land use mix at that point will be 35 percent office, 35 percent warehouse, 20 percent research and development, and 10 percent manufacturing. It is this mix that is used in estimating the trips for the overall business park for this traffic update.

A turning movement count was done at the access driveway at Route 16 during the peak hours in 2001. In addition, an automatic traffic recorder (ATR) count was done along the site access roadway, near Route 16, to capture the daily volumes. This information is summarized in Exhibit 1. [Note, that the counts done in 2001 were done before September 11th.]

The project currently has 558,000 square feet of occupied space; this is 19 percent of the full-build out. Comparing the existing volumes at the site to 19 percent of the original trip generation shows that the existing volumes are significantly below what was originally projected for the business park. The morning peak hour has approximately 47 percent less traffic than what would be expected, the evening peak hour has volumes 61 percent less than the expected volumes, and the daily estimate shows a volume of 39 percent less than the expected volumes. Based on these current volumes, it is reasonable to conclude that the original projections were high. However, to be conservative, this update considers more conservative (i.e., higher) traffic levels.

Since the original analysis was done in 1982, several things have changed that might effect the estimated trip generation of the project. First, the project is about twenty percent complete, which provides actual data at the site as well as information on the mix of tenants and land uses. Further, the Institute of Transportation Engineers has updated their **Trip Generation** report several times; the current version is the 6th edition, updated in 1997.

The existing information at the site provides data related to the distribution of traffic as well. With all this information it would be inappropriate to simply rely on the old trip generation projections for this update. There is more than one method of estimating traffic generation for this update. Three alternative methods are presented below:

1. **Current Trip Rates Only**
   The analysis above of existing volumes and existing square footage indicates that the project currently is generating traffic at rates that are significantly less than what was anticipated. Nonetheless, this is a legitimate basis for estimated future trips for a project. Therefore, this first alternative exclusively relies on the current trip rates at the site. The project will have a significantly lower impact than expected. Projecting the current low trip rates for the entire park would amount to 46 percent fewer trips during the morning peak hour, 61 percent fewer trips during the evening peak hour, and 39 percent fewer trips on a daily basis. These volumes were shown in Exhibit 2.

2. **Comparing Current ITE Projections to 1982 ITE Projections**
   As noted, the original analysis did not rely on the ITE report for its trip generation projections; it is not clear why this was the case. Nonetheless, those rates are relevant since they represent the most current information at the time. It is assumed that the breakdown of land uses is 35 percent for office, 35 percent for warehouse, 20 percent for research and development, and 10 percent for manufacturing. If that breakdown had

been known then, and if the ITE data had been used, a reasonable trip projection would have been calculated. A current estimate could then be compared to it based on that same information and the current ITE report. This information is shown in Exhibit 3. The purpose of this alternative is to compare the available information in 1982 to the available information in 2002.

This approach demonstrates that if the project had been evaluated using ITE data in 1982, then the current updated ITE information suggests that the peak hour and daily trips will be lower than expected. That is, the morning peak hour would have 35 percent few trips, the evening peak hour would have 46 percent fewer trips, and the daily volumes would be 14 percent lower than might have been originally projected based on ITE data and the assumed land use splits. The key point to this alternative comparison is that ITE projections are considered to be more accurate now than they were in 1982, since they now take into account the size of a development and not just each land use's overall trip rate. Reviewing agencies and traffic engineers/planners recognize that trip <u>rates</u> decrease as a development increases in size. Thus, with such a large project as this one, the decrease in the rate would be significant; thus, the lower overall projections. The original projections in the FEIR were overly conservative, even compared to the ITE analysis available at that time.

3. **<u>Existing Volumes for Current Uses and Add-On Trips Based on ITE Rates</u>**

The third alternative is to accept the trips to the existing building in the park and to add trips for the remaining 2,442,000 square feet based on current ITE data and assuming the land use mix for the rest of the park is consistent with the current mix. This information is shown in Exhibit 4. The results show that the expected volumes during the morning peak hour will be 22 percent higher than the original 1982 projections; evening peak hour volumes will be 17 percent below the original projections, and daily trips will be 16 percent below original projections.

It is noteworthy that this projection for the morning peak hour is still eight percent <u>less</u> than if the entire 3,000,000 square feet were estimated based on current ITE rates. Further, if the 1982 rates were considered, this projection would be 40 percent below those volumes. That is likely the result of a significant underestimate in the original projections for this peak hour.

Summary of Alternative Trip Projections

Each of the possible methods of estimating future trips suggests that traffic will be lower on a daily basis and during the evening peak hour. For the morning peak hour, two of the three methods also suggest lower volumes. The third alternative – relying on current ITE rates for the remainder of the project – is the most conservative estimate and suggests that morning peak hour volumes will be higher than originally estimated. Keep in mind that this does not mean that this method is the most accurate, it simply means it results in the highest estimated volumes. To be conservative, these numbers are used for this update. It is our opinion that these highest estimates are not the most accurate since the existing volumes should be relied on more significantly. It is also our opinion that the location is not a "high profile location" that will attract a high density of office uses. That is, it is expected that the overall land use mix within the park will tend toward the manufacturing and/or warehouse uses or other similar uses that are less employee intensive. Nonetheless, the highest projections are used in this update as a basis for confirming that this notice of project change does not require a full, updated review.

THE UPDATED ANALYSIS

In evaluating the adequacy of the proposed access to accommodate the project, the existing traffic counts along Route 16 are used along with an estimated growth rate to account for a five year build-out, as would normally be done in an EIR analysis. Thus, the 2001 volumes have been increase by 15 percent to reflect the MHD documented regional growth rate of 2.9 percent per year. This increase is applied to the Route 16 through traffic at the site driveway. These volumes are shown in Exhibit 5. To these volumes are added the site-related trips documented in Alternative 3 above and distributed inbound and outbound, to the east and to the west, based on the existing volumes at the site driveway. The updated Build volumes are shown in Exhibit 6.

The evaluation of the traffic operations at the site entrance has been done using ***Synchro5*** and following the methodology of the 2000 **Highway Capacity Manual**. The calculations are included in the appendix to the memorandum.

The original proposal for mitigation at the site entrance called for the installation of a traffic signal along with the construction of dedicated turn lanes along Route 16: this includes an eastbound right-turn lane and a westbound left-turn lane. Out of the site there is a wide enough roadway to allow for a left-turn lane and a right-turn lane out of the site. Based on these design assumptions, the morning peak hour is expected to operate at Level of Service *C* with an average delay of 33 seconds per vehicle. The only specific movement that would operate at less than Level of Service *D* would be the left turn out of the site which would operate with a delay of 56 seconds, Level of Service *E*.

In the evening the operations are expected to be at Level of Service *E* for the intersection as a whole, with an average delay of 62 seconds per vehicle. As with the morning peak hour, the only flow that would operate at worse than Level of Service *D* would be the left turns out of the site, at Level of Service *F*. This information is summarized in Exhibit 7.

Discussion

While Level of Service *D* is generally desirable, it is considered that the proposed project will have a generally sharp peak during the evening and that designing a larger intersection would require significant investment for little gain in capacity. An alternative would be to provide police officer control during the evening peak hour if the signal is unable to accommodate the volumes; a traffic control officer would be able to enhance operations modestly compared to a signal enough to bring the overall Level of Service to a *D*. Considering that a Level of Service *D* has an average delay of up to 55 seconds, the current estimate of 62 seconds per vehicle is not significantly worse particularly when only traffic leaving the site experiences Level of Service worse than *D*. It is likely that implementing reasonably aggressive Traffic Demand Management (TDM) measures within the park would have the effect of improving conditions enough to meet the Level of Service *D* criteria for the evening peak hour.

It is noteworthy that the evening peak hour volumes for the site are expected to be less than the original projections, yet this is the peak hour that shows an apparently worse operating condition than originally expected. The morning peak hour, even with 22 percent more traffic than originally expected, is still expected to operate at Level of Service *C*.

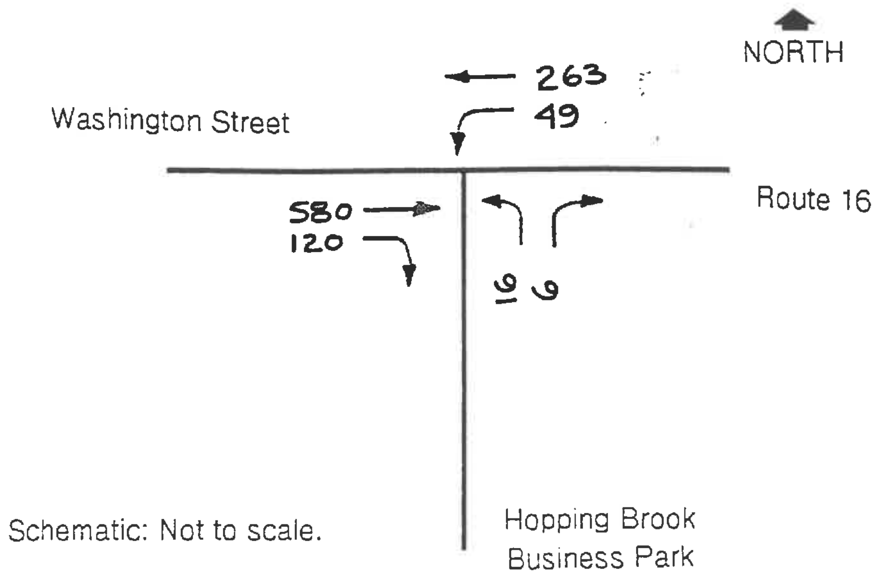
To some extent, it is beneficial that the project did not move forward as originally planned. It is likely that if it had been completed in five-to-ten years from its original approval, then the previously proposed traffic signal would not have been as sophisticated as current models are. A more sophisticated signal will more appropriately control traffic flows during both peak and off peak hours.

SUMMARY

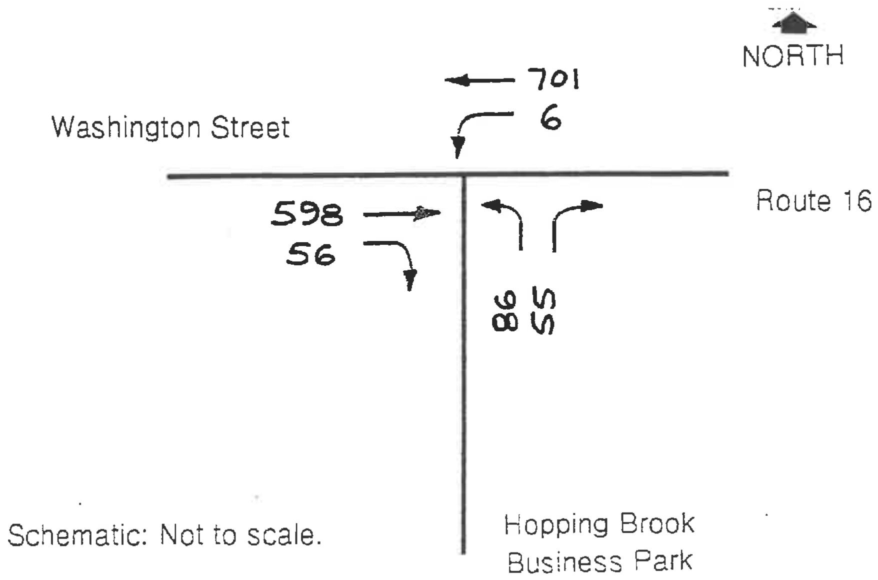
Based on this updated analysis, it is concluded that the proposed project change is not expected to result in a significant change to the traffic impact originally evaluated. The project change itself does not alter the square footage build-out of the project nor does it change the access proposal. There are several alternative ways to estimate the full build-out traffic generation of the site. Using the most conservative way, the operations at the site driveway are still expected to operate at a reasonable level. While it is possible that the evening peak hour will be slightly below Level of Service *D*, it is believed that the overall results will be similar to what would have been expected under the original proposal, possibly better. Therefore, no changes are proposed related to the traffic mitigation package.

20144-mem-npc

Morning Peak Hour



Evening Peak Hour



EXISTING VOLUMES	*Hopping Brook Business Park* *Holliston, Massachusetts*	Exhibit 1
	Abend Associates	

Current Volumes vs. Original Projections

	Peak Hour Trips Morning	Peak Hour Trips Evening	Daily Trips
Actual Counts (2001)	191	203	2,425
trips/ksf at 558,000 SF	0.34/ksf	0.36/ksf	4.35/ksf
Existing Trip Rate x 3,000,000 SF	1,027	1,091	13,038
vs. 1982 Projections	1,900	2,750	20,910
Difference: #	**- 873**	**- 1,659**	**- 7,870**
%	**- 46%**	**- 60%**	**- 38%**

Actual counts from 2001.
ksf = 1,000 square feet

PROJECTED VOLUMES
ALTERNATIVE 1

Hopping Brook Business Park
Holliston, Massachusetts

Exhibit 2

Abend Associates

ITE Rates in 1982 vs. ITE Rates in 2002

	Peak Hour Trips		Daily
	Morning	Evening	Trips
1982 ITE Rates @ 3,000,000 SF	3,870	4,620	20,910
2002 ITE Rates @ 3,000,000 SF	2,518	2,500	17,904

Difference:	#	**- 1,352**	**- 2,120**	**- 3,006**
	%	**- 35%**	**- 46%**	**- 14%**

Source: Trip Generation, 3rd edition 1982 and 6th edition 1997

Notes:

Trips include inbound and outbound combined.
Based on the following land use codes:
140, *Manufacturing,* (10%)
150, *Warehousing,* (35%)
710, *General Office,* (35%)
760, *Research and Development,* (20%)

PROJECTED VOLUMES
ALTERNATIVE 2

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 3

Combined Existing Volumes with ITE-Based Projections for Balance of Project

	Peak Hour Trips		Daily
	Morning	Evening	Trips
Existing Volumes [1] (558,000 SF)	191	203	2,425
ITE Based Volumes for Balance of Project [2] (2,442,000 SF)	2,126	2,085	15,110
Total Projected Site Trips	2,317	2,288	17,535
vs. 1982 Projections	1,900	2,750	20,910
Difference: #	**+ 471**	**- 462**	**- 3,375**
%	**+ 22%**	**- 17%**	**- 16%**

1 Existing volumes based on 2001 counts.
Balance of Park based on ITE rates and existing land use mix (see Exhibit 3).

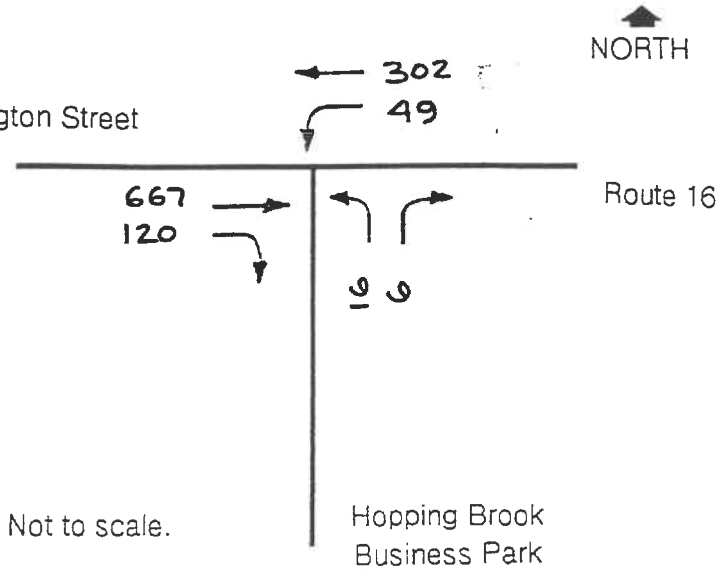
PROJECTED VOLUMES
ALTERNATIVE 3

Hopping Brook Business Park
Holliston, Massachusetts

Exhibit
4

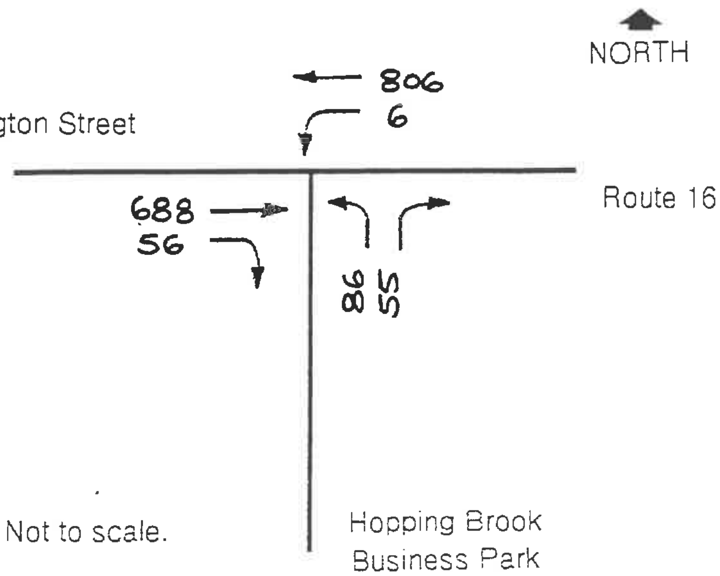
Abend Associates

Morning Peak Hour



Schematic: Not to scale.

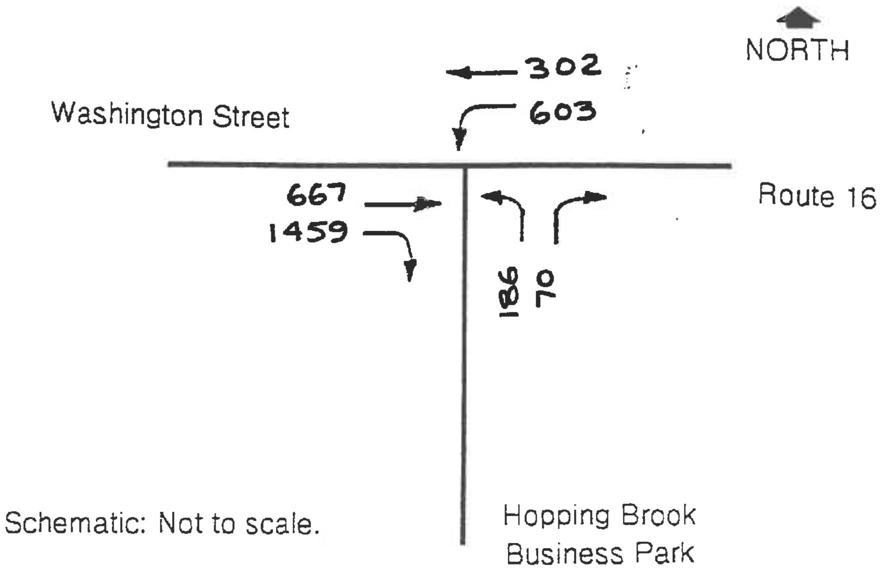
Evening Peak Hour



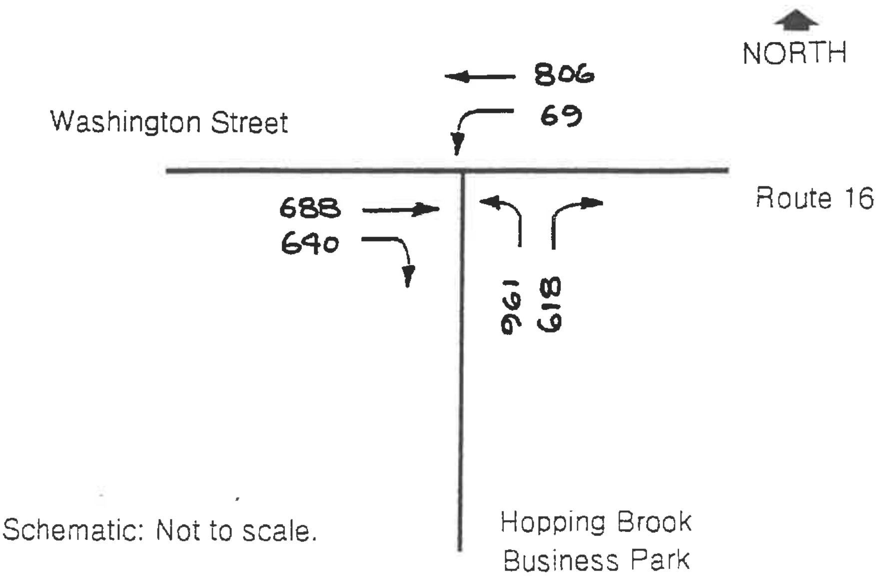
Schematic: Not to scale.

FUTURE NO BUILD VOLUMES	*Hopping Brook Business Park* *Holliston, Massachusetts*	Exhibit 5
	Abend Associates	

Morning Peak Hour



Evening Peak Hour



FUTURE BUILD VOLUMES	*Hopping Brook Business Park* *Holliston, Massachusetts*	Exhibit 6
	Abend Associates	

Future Build Conditions
Peak Hour Level of Service Summary

	Morning LOS	Morning Delay	Evening LOS	Evening Delay
Route 16 at Site Driveway				
Overall	C	33	E	66
Route 16 Eastbound				
thrus	D	50	D	46
rights	C	21	A	0
Route 16 Westbound				
lefts	E	56	D	48
thrus	A	3	D	45
Site Driveway				
lefts	D	45	F	154
rights	A	3	C	22

LEVEL OF SERVICE SUMMARY

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit 7

APPENDIX

Count Data

Traffic Counting Unlimited

e Code : 775-Van V.
Street: Hopping Brook Road
Street: Rt.16, Holliston, MA.
ther : Cloudy

PAGE: 1
FILE: hop4rt16

Sum of the Primary and Secondary

DATE: 8/27/01

e in	From North RT	THRU	LT	From East RT	THRU	LT	From South RT	THRU	LT	From West RT	THRU	LT	Vehicle Total
0 AM	0	0	0	0	52	9	1	0	3	20	146	0	231
15	0	0	0	0	74	12	3	0	4	33	158	0	284
30	0	0	0	0	69	12	1	0	3	29	165	0	279
45	0	0	0	0	68	16	1	0	6	38	111	0	240
TOTAL	0	0	0	0	263	49	6	0	16	120	580	0	1034
0 AM	0	0	0	0	46	17	0	0	2	33	79	0	177
15	0	0	0	0	46	13	2	0	4	41	72	0	178
30	0	0	0	0	57	8	2	0	7	27	70	0	171
45	0	0	0	0	83	7	7	0	8	26	102	0	233
TOTAL	0	0	0	0	232	45	11	0	21	127	323	0	759
TOTAL	0	0	0	0	495	94	17	0	37	247	903	0	1793

2 hour totals

94 (28%)

72% 247

37

69% | 31%

Traffic Counting Unlimited

Site Code : 775-Van V.
N-S Street: Hopping Brook Road
E-W Street: Rt.16, Holliston, MA.
Weather : Cloudy

PAGE: 1
FILE: hop4rt16

Sum of the Primary and Secondary

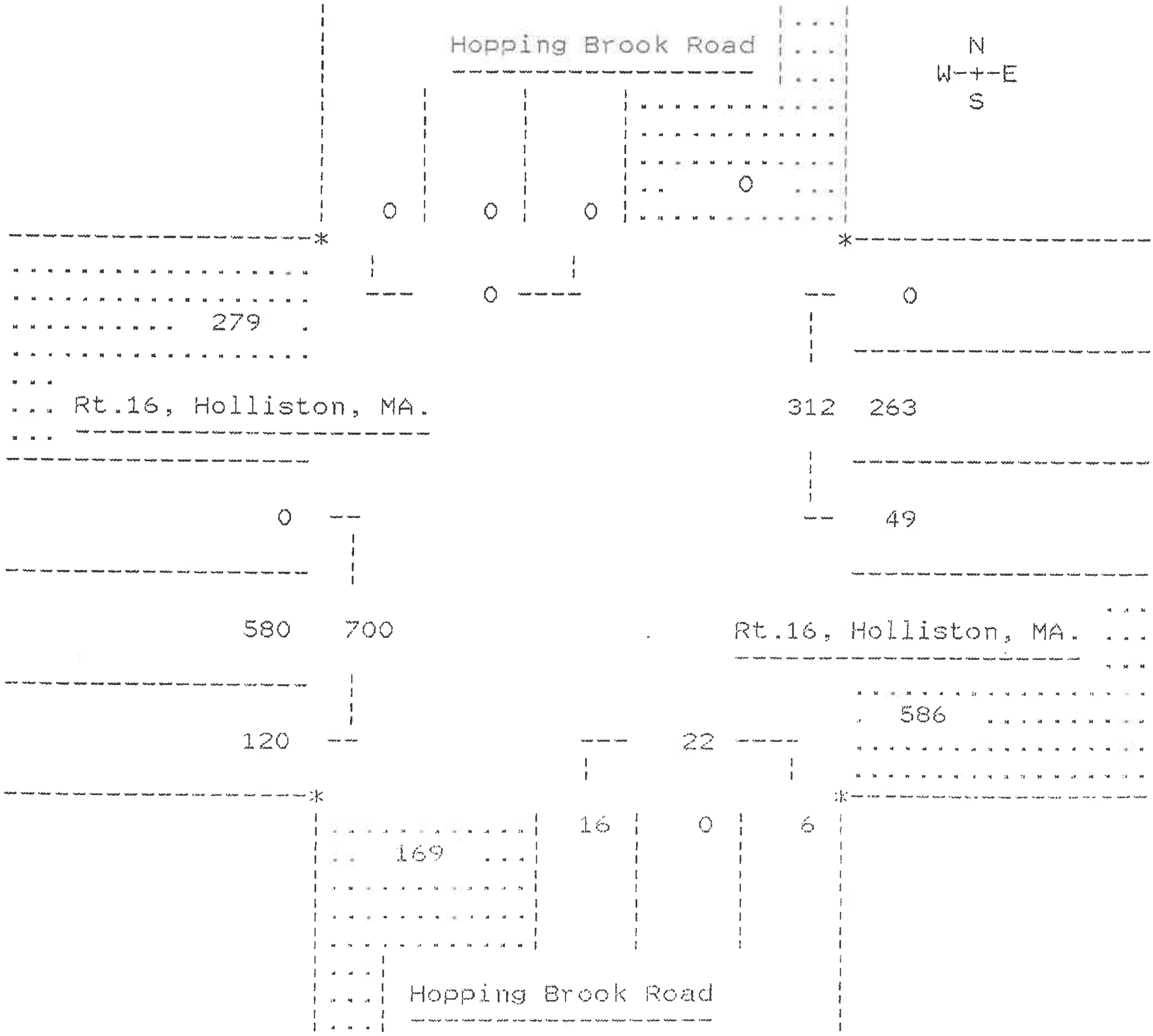
DATE: 8/27/01

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 9:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	7:00 AM	0.00	0	0	0	0	0	0	0
East	7:15 AM	0.91	0	257	57	314	0	82	18
South	8:00 AM	0.53	11	0	21	32	34	0	66
West	7:00 AM	0.90	120	580	0	700	17	83	0

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	7:00 AM	0.00	0	0	0	0	0	0	0
East		0.91	0	263	49	312	0	84	16
South		0.79	6	0	16	22	27	0	73
West		0.90	120	580	0	700	17	83	0



Traffic Counting Unlimited

te Code : 884-Roy L. PAGE: 1
Street: Hopping Brook Road FILE: rt16hop1
Street: Rt.16-Washington Street
ather : Sunny/Rain

Sum of the Primary and Secondary

DATE: 8/13/01

ne	From North			From East			From South			From West			Vehicle
gin	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	RT	THRU	LT	Total
:00 PM	0	0	0	0	127	1	14	0	40	2	77	0	261
:15	0	0	0	0	112	1	6	0	30	5	96	0	250
30	0	0	0	0	166	4	12	0	28	8	96	0	314
45	0	0	0	0	163	1	13	0	11	13	137	0	338
TOTAL	0	0	0	0	568	7	45	0	109	28	406	0	1163
00 PM	0	0	0	0	171	1	22	0	31	23	147	0	395
:15	0	0	0	0	188	2	9	0	21	10	161	0	391
30	0	0	0	0	179	2	11	0	23	10	153	0	378
45	0	0	0	0	163	3	11	0	19	0	89	0	285
TOTAL	0	0	0	0	701	8	53	0	94	43	550	0	1449
TOTAL	0	0	0	0	1269	15	98	0	203	71	956	0	2612

2 Lane 1.1 Ps

15 17%

83% 71 2 97

203 98

67% 33%

387

55

Traffic Counting Unlimited

Site Code : 884-Roy L.
N-S Street: Hopping Brook Road
E-W Street: Rt.16-Washington Street
Weather : Sunny/Rain

Sum of the Primary and Secondary

PAGE: 1
FILE: rt16hop1

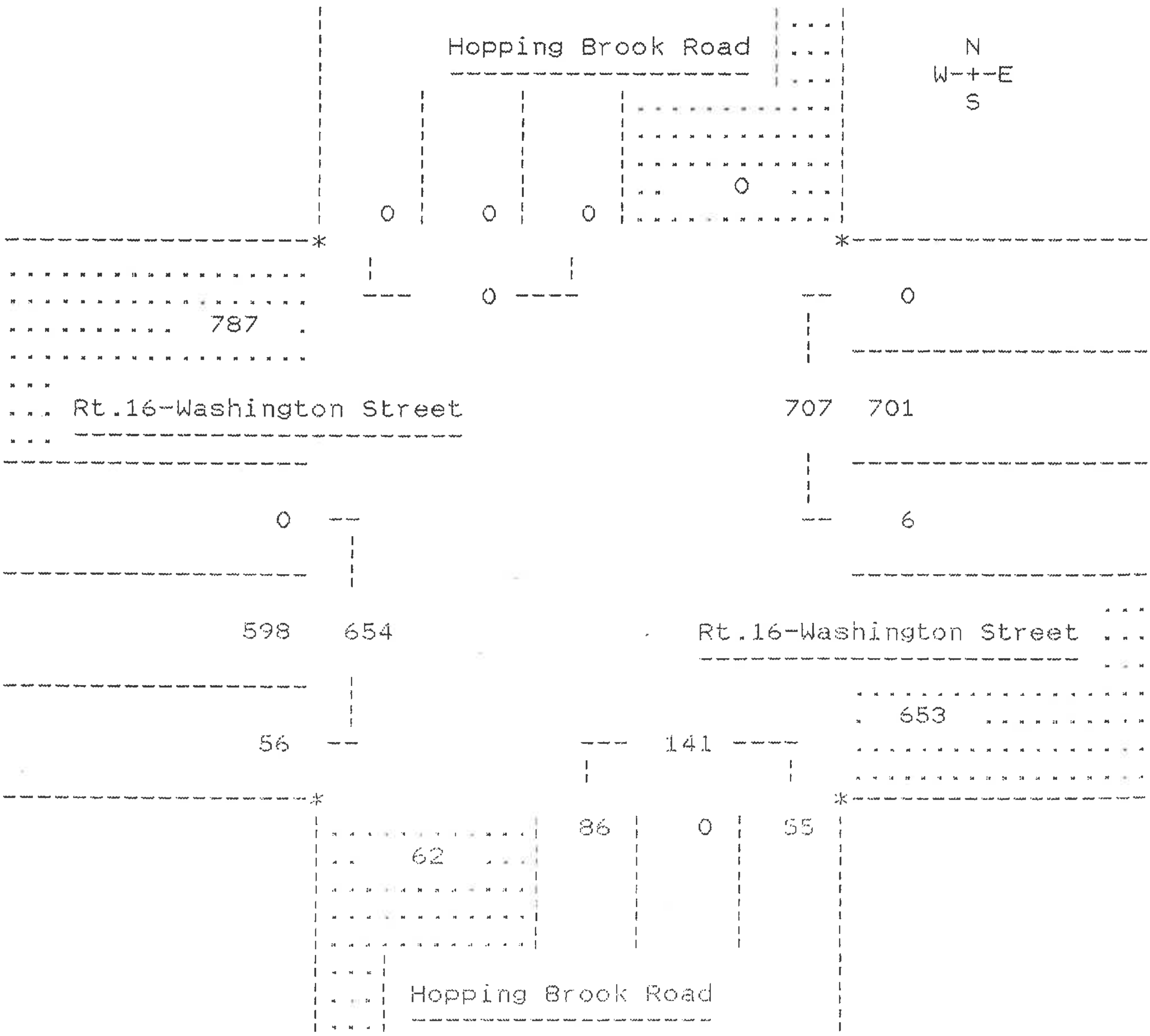
DATE: 8/13/01

PEAK PERIOD ANALYSIS FOR THE PERIOD: 4:00 PM - 6:00 PM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	4:45 PM	0.00	0	0	0	0	0	0	0
East	5:00 PM	0.93	0	701	8	709	0	99	1
South	4:00 PM	0.71	45	0	109	154	29	0	71
West	4:45 PM	0.96	56	598	0	654	9	91	0

Entire Intersection

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES Right	VOLUMES Thru	VOLUMES Left	VOLUMES Total	PERCENTS Right	PERCENTS Thru	PERCENTS Left
North	4:45 PM	0.00	0	0	0	0	0	0	0
East		0.93	0	701	6	707	0	99	1
South		0.67	55	0	86	141	39	0	61
West		0.96	56	598	0	654	9	91	0



Hopping Brook Road
Holliston, Massachusetts
Counted by Traffic Counting Unlimited
Box #734

JAMAR Technologies, Inc.
TAS for Windows
Copyright 1998

Site Code : 734
Start Date: 08/13/2001
File I.D. : C:\PROGRAM FI
Page : 1

Begin Time	Mon. SB	08/13 NB	Tues. SB	NB	Wed. SB	NB	Thur. SB	NB	Fri. SB	NB	Sat. SB	NB	Sun. SB	NB	Week Avg. SB	NB
12:00 am	*	*	0	8	0	5	*	*	*	*	*	*	*	*	0	6
01:00	*	*	0	2	1	6	*	*	*	*	*	*	*	*	0	4
02:00	*	*	1	1	0	2	*	*	*	*	*	*	*	*	0	2
03:00	*	*	2	2	1	0	*	*	*	*	*	*	*	*	2	1
04:00	*	*	3	0	4	2	*	*	*	*	*	*	*	*	4	1
05:00	*	*	26	3	23	2	*	*	*	*	*	*	*	*	24	2
06:00	*	*	141	24	121	13	*	*	*	*	*	*	*	*	131	18
07:00	*	*	166	56	189	34	*	*	*	*	*	*	*	*	178	45
08:00	*	*	197	39	184	50	*	*	*	*	*	*	*	*	190	44
09:00	*	*	114	60	60	33	*	*	*	*	*	*	*	*	87	46
10:00	*	*	68	65	55	38	*	*	*	*	*	*	*	*	62	52
11:00	65	75	56	70	50	76	*	*	*	*	*	*	*	*	57	74
12:00 pm	104	131	101	156	98	138	*	*	*	*	*	*	*	*	101	142
01:00	85	62	142	80	114	72	*	*	*	*	*	*	*	*	114	71
02:00	53	76	70	75	41	52	*	*	*	*	*	*	*	*	55	68
03:00	57	75	62	90	63	113	*	*	*	*	*	*	*	*	61	93
04:00	64	124	43	148	57	142	*	*	*	*	*	*	*	*	55	138
05:00	61	157	37	190	*	*	*	*	*	*	*	*	*	*	49	174
06:00	10	39	5	49	*	*	*	*	*	*	*	*	*	*	8	44
07:00	9	25	13	22	*	*	*	*	*	*	*	*	*	*	11	24
08:00	6	15	5	6	*	*	*	*	*	*	*	*	*	*	6	10
09:00	3	5	1	4	*	*	*	*	*	*	*	*	*	*	2	4
10:00	5	2	5	7	*	*	*	*	*	*	*	*	*	*	5	4
11:00	2	6	5	5	*	*	*	*	*	*	*	*	*	*	4	6
Totals	524	792	1263	1162	1061	778	0	0	0	0	0	0	0	0	1206	1073
	1316		2425		1839		0		0		0		0		2279	
Avg. Day	43.4%	73.8%	104.7%	108.2%	87.9%	72.5%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%		
AM Peaks	11:00	11:00	08:00	11:00	07:00	11:00									08:00	11:00
Volume	65	75	197	70	189	76									190	74
PM Peaks	12:00	05:00	01:00	05:00	01:00	04:00									01:00	05:00
Volume	104	157	142	190	114	142									114	174

ADTs

Relevant ITE Pages

TRIP GENERATION

6th Edition • Volume 2 of 3

TRIP GENERATION RATES, PLOTS, AND EQUATIONS

- Institutional (Land Uses 500-599)
- Medical (Land Uses 600-699)
- Office (Land Uses 700-799)
- Retail (Land Uses 800-899)
- Services (Land Uses 900-999)

ite

Institute of Transportation Engineers

58

Trip Generation, 6th Edition

An Informational Report of the
Institute of Transportation Engineers

Volume 2 of 3

The Institute of Transportation Engineers (ITE) is an international educational and scientific association of transportation and traffic engineers and other professionals who are responsible for meeting mobility and safety needs. The Institute facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of transportation by promoting professional development of members, supporting and encouraging education, stimulating research, developing public awareness, and exchanging professional information; and by maintaining of a central point of reference and action.

Founded in 1930, the Institute serves as a gateway to knowledge and advancement through meetings, seminars, and publications; and through our network of approximately 15,000 members working in some 80 countries. The Institute also has more than 70 local and regional chapters and more than 90 student chapters that provide additional opportunities for information exchange, participation and networking.

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Publication No. IR-016D
Second Printing
1000/AGS/1197

ISBN 0-935403-09-4
Printed in the United States of America

Land Use: 140
Manufacturing

Description

Manufacturing facilities are areas where the primary activity is the conversion of raw materials or parts into finished products. Size and type of activity may vary substantially from one facility to another. In addition to the actual production of goods, manufacturing facilities generally also have office, warehouse, research, and associated functions. General light industrial (land use 110), general heavy industrial (land use 120), and industrial park (land use 130) are related uses.

Additional Data

Average weekday transit trip ends
— 0.09 per employee
— 0.08 per 1,000 square feet gross floor area
— 1.25 per acre

Vehicle occupancy ranged from 1.2 to 1.3 persons per automobile on an average weekday.

The peak hour of the generator typically coincides with the peak hour of the adjacent street traffic. Facilities with employees on shift work may peak at other hours.

The sites were surveyed in the late 1960s, the early 1970s, the mid-1980s, and the 1990s throughout the United States.

Source Numbers

3, 7, 10, 15, 17, 74, 85, 88, 177, 184, 241, 357, 384, 418, 443

59

Manufacturing
(140)

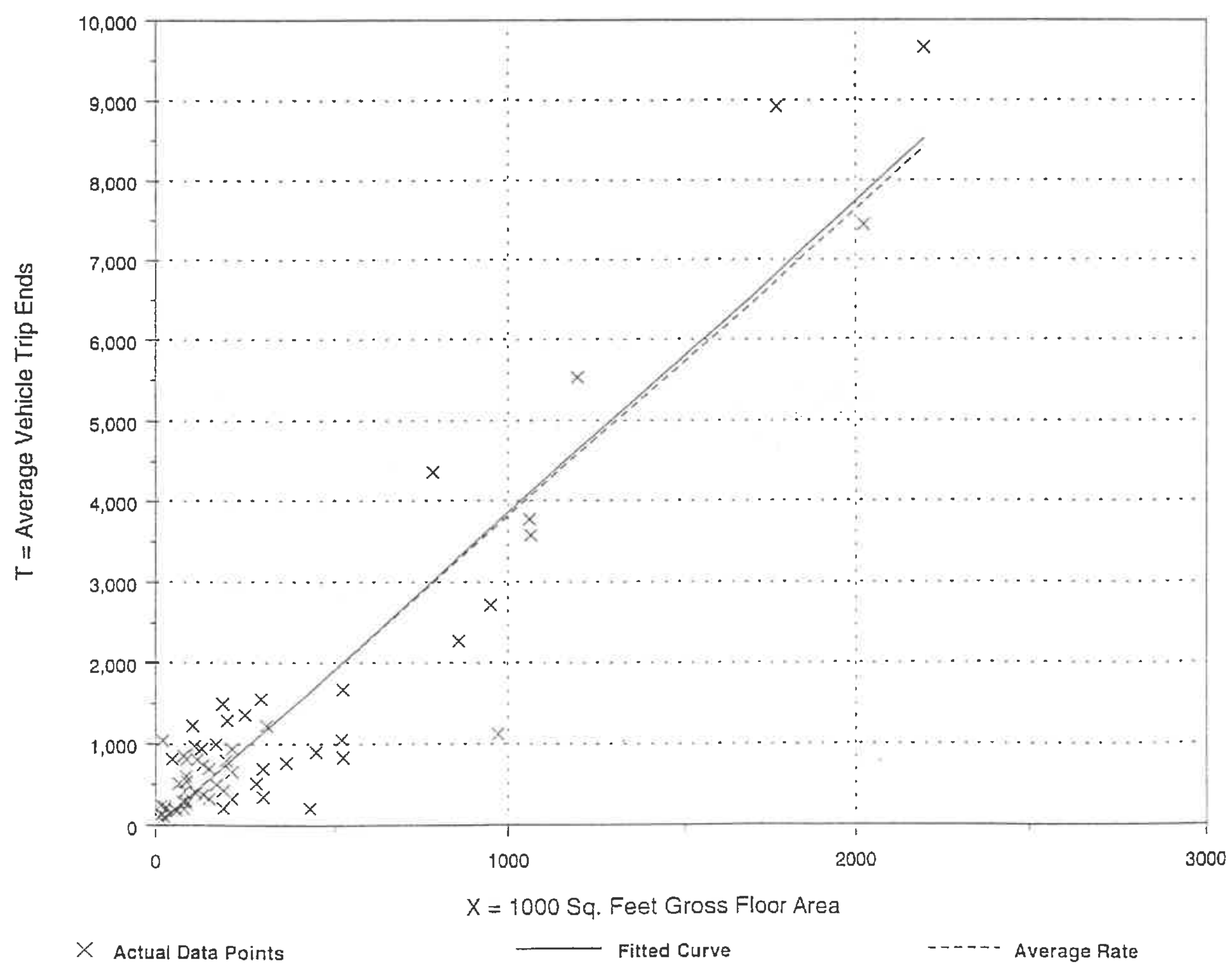
Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Weekday**

Number of Studies:	62
Average 1000 Sq. Feet GFA:	349
Directional Distribution:	50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
3.82	0.50 - 52.05	3.07

Data Plot and Equation



Fitted Curve Equation: $T = 3.881(X) - 20.702$ $R^2 = 0.87$

Manufacturing
(140)

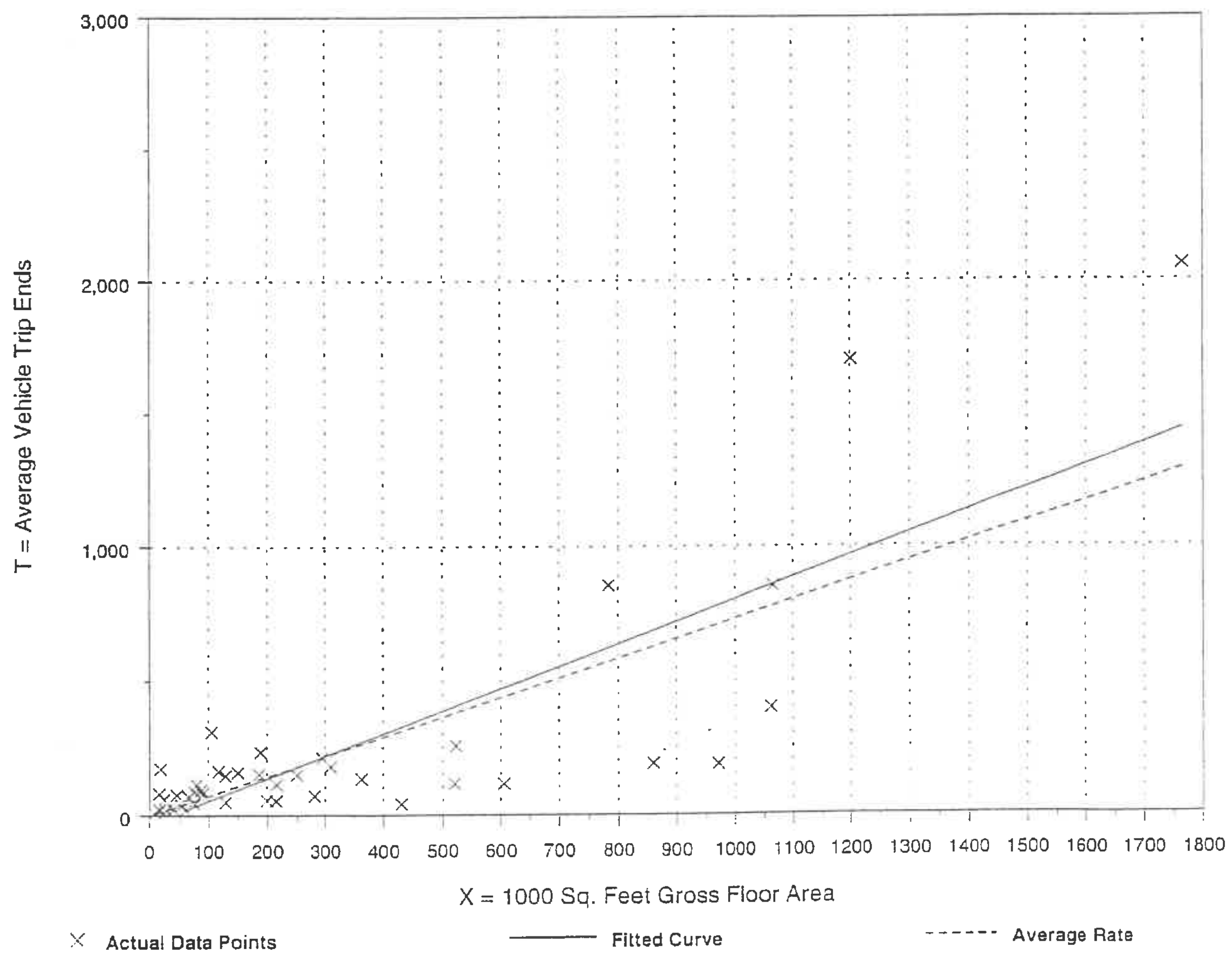
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 50
Average 1000 Sq. Feet GFA: 297
Directional Distribution: 77% entering, 23% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.73	0.10 - 8.75	1.04

Data Plot and Equation



Fitted Curve Equation: $T = 0.831(X) - 28.880$

$R^2 = 0.67$

60

Manufacturing
(140)

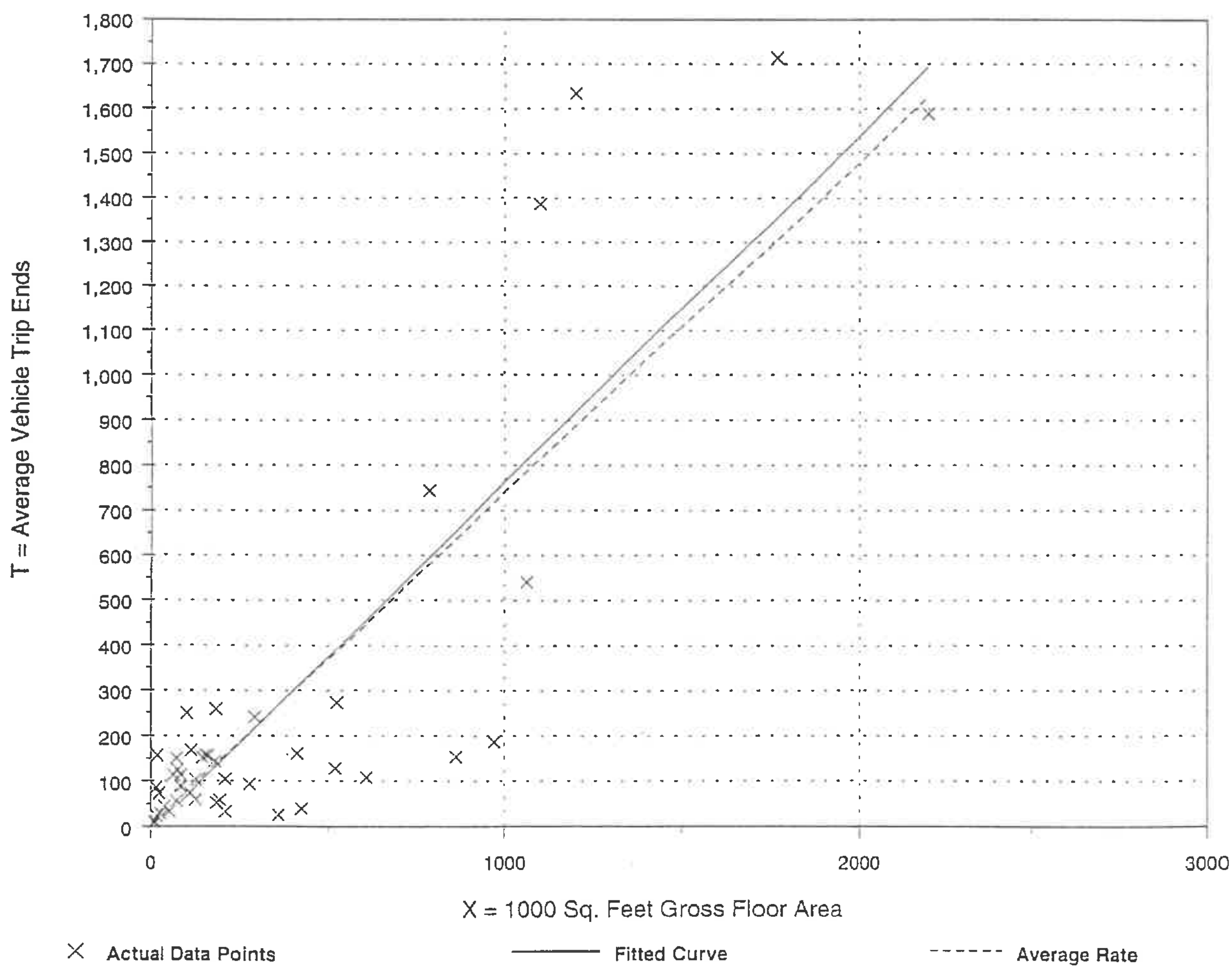
Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.**

Number of Studies:	54
Average 1000 Sq. Feet GFA:	325
Directional Distribution:	36% entering, 64% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.74	0.07 - 7.85	1.01

Data Plot and Equation



Fitted Curve Equation: $T = 0.776(X) - 12.885$ $R^2 = 0.75$

Land Use: 150
Warehousing

Description

Warehouses are primarily devoted to the storage of materials; they may also include office and maintenance areas. High-cube warehouse (land use 152) is a related use.

Additional Data

No vehicle occupancy data is available specifically for warehousing, but the average was approximately 1.3 persons per automobile for all industrial uses.

The peak hour of the generator typically coincides with the peak hour of the adjacent street traffic. Facilities with employees on shift work may peak at other hours.

The sites were surveyed from the late 1960s to the mid-1990s throughout the United States and Canada.

Source Numbers

6, 7, 12, 13, 15, 17, 74, 184, 192, 390, 406, 411, 436, 443

61

Warehousing
(150)

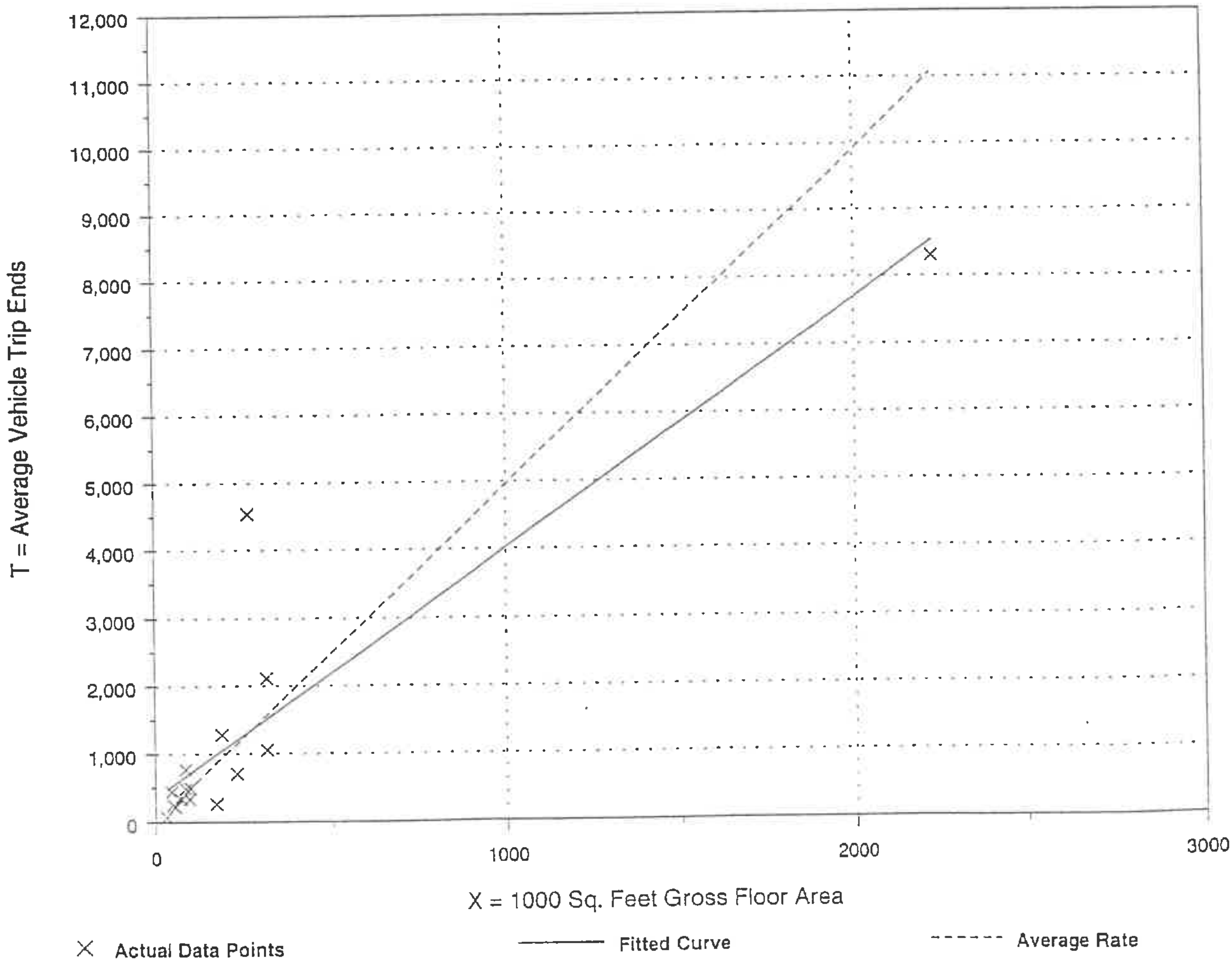
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 16
Average 1000 Sq. Feet GFA: 273
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
4.96	1.51 - 17.00	4.05

Data Plot and Equation



Fitted Curve Equation: $T = 3.676(X) + 350.266$

$R^2 = 0.82$

Warehousing
(150)

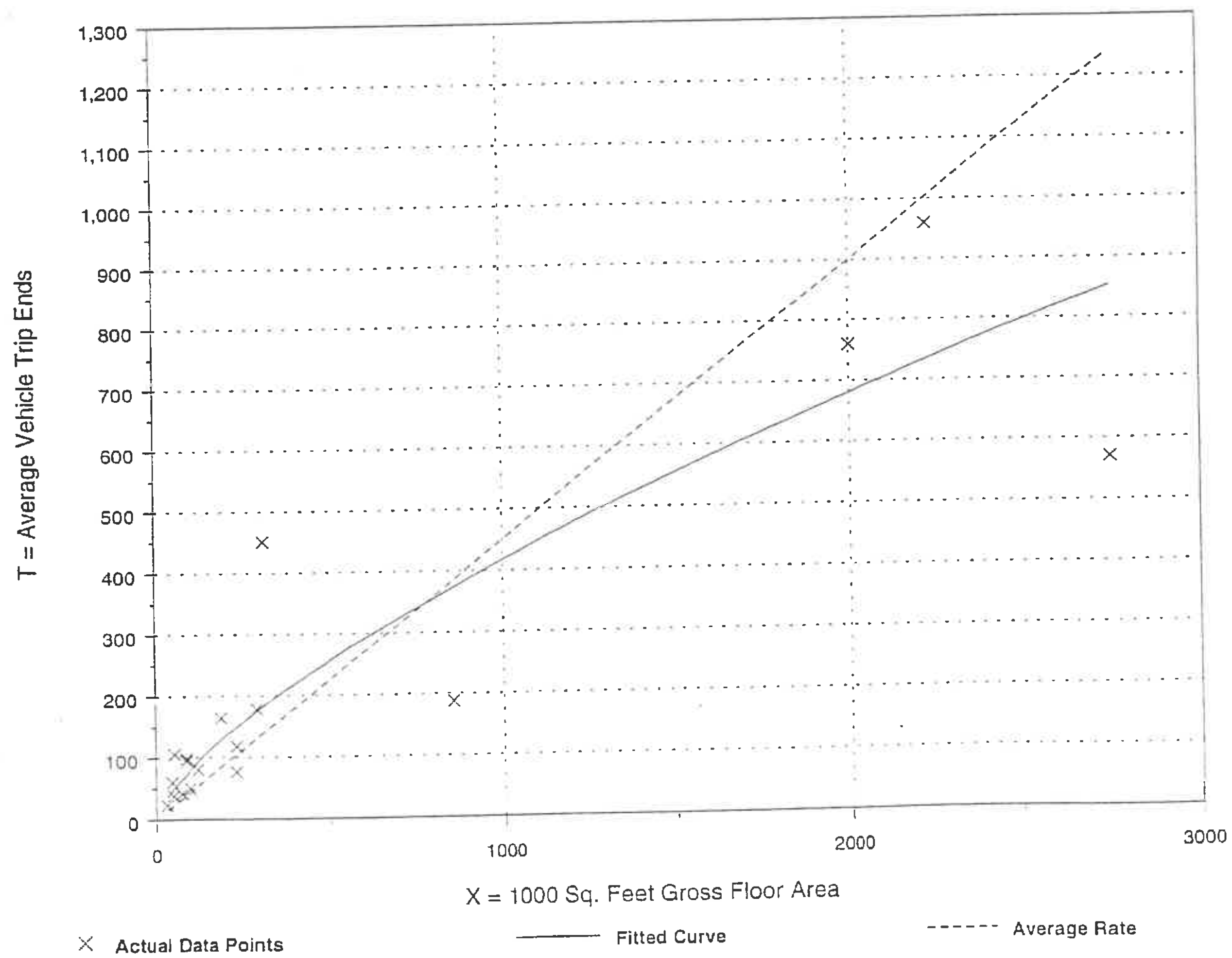
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Number of Studies: 19
Average 1000 Sq. Feet GFA: 531
Directional Distribution: 82% entering, 18% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.45	0.21 - 1.93	0.74

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.707\ Ln(X) + 1.148$ $R^2 = 0.79$

62

Warehousing
(150)

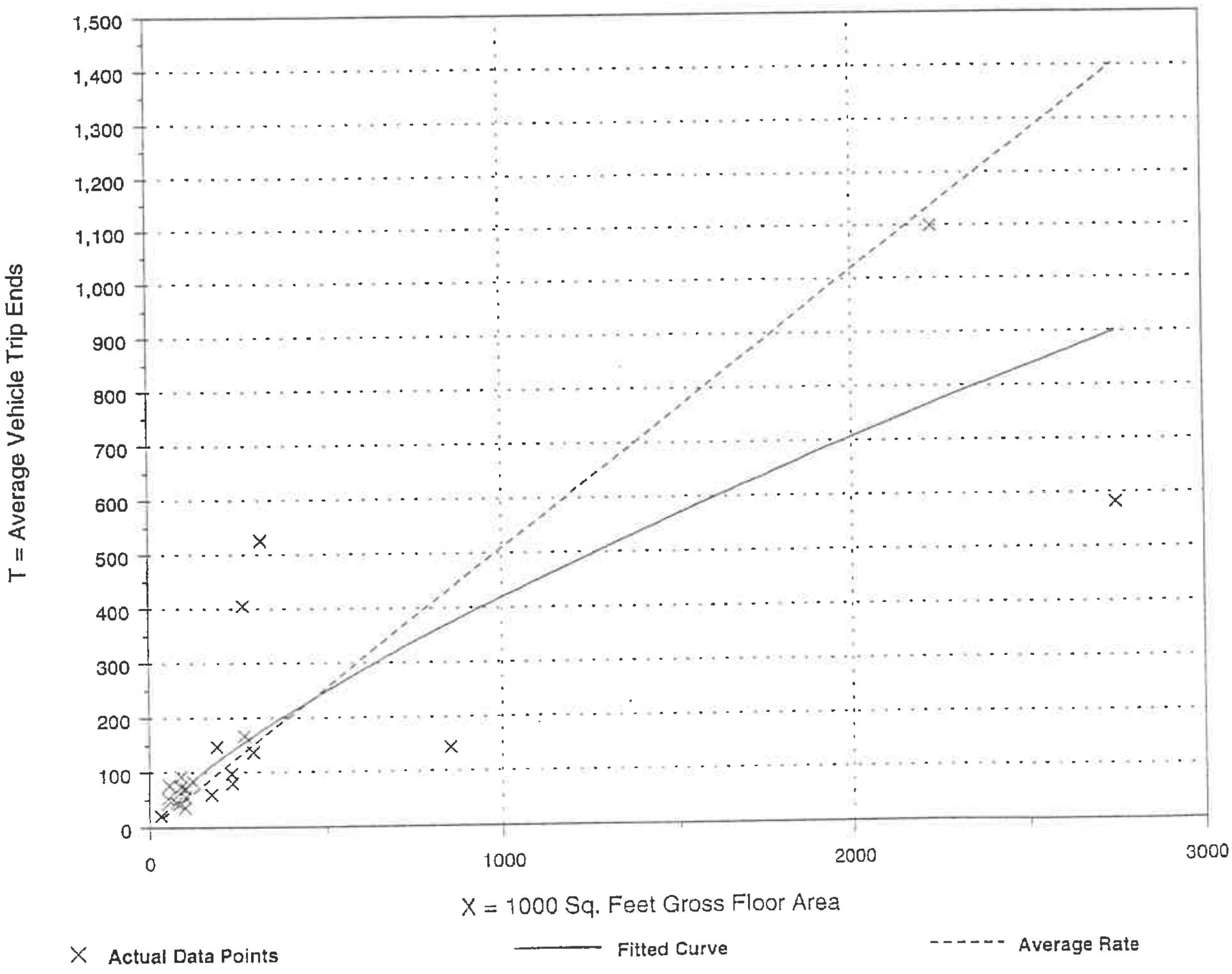
Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.**

Number of Studies:	22
Average 1000 Sq. Feet GFA:	406
Directional Distribution:	24% entering, 76% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
0.51	0.17 - 1.66	0.83

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.754 \; Ln(X) + 0.826$

$R^2 = 0.69$

Land Use: 710
General Office Building

Description

A general office building houses multiple tenants; it is a location where affairs of businesses, commercial or industrial organizations, or professional persons or firms are conducted. An office building or buildings may contain a mixture of tenants including professional services; insurance companies; investment brokers; and tenant services such as a bank or savings and loan institution, a restaurant or cafeteria, and service retail facilities. Nearly all of the buildings surveyed were in suburban locations. Corporate headquarters (land use 714), single tenant office building (land use 715), and office park (land use 750) are related uses.

If information is known about individual buildings, it is suggested that the general office building category be used rather than office parks when estimating trip generation for one or more office buildings in a single development. The office park category is more general, and it should be used when a breakdown of individual or different uses is not known. If the general office building category is used and if additional buildings, such as banks, restaurants, or retail stores are included in the development, then the development should be treated as a multiuse project. On the other hand, if the office park category is used, internal trip making is already reflected in the data and does not need to be considered.

When the buildings are interrelated (defined by shared parking facilities or the ability to easily walk between buildings) or house one tenant, it is suggested that the total area or employment of all the buildings be used for calculating the trip generation. When the individual buildings are isolated and not related to one another, it is suggested that the trip generation be calculated for each building separately and then summed.

Additional Data

Average weekday transit trip ends —

> Transit service was either nonexistent or negligible at the majority of the sites surveyed in this land use. Recent studies indicate increased use of transit, carpools, and other transportation demand management (TDM) strategies. Information has not been analyzed to document the impacts of TDM measures on the total site generation.

The average building occupancy varied considerably within the studies where occupancy data was provided. For buildings with occupancy rates reported, the average percent of occupied gross leasable area was 88 percent.

In some regions peaking may occur earlier or later and last somewhat longer than the traditional 7:00 A.M. to 9:00 A.M. and 4:00 P.M. to 6:00 P.M. peak period time frames.

The sites were surveyed from the 1960s to the 1990s throughout the United States.

63

Trip Characteristics

The trip generation for the A.M. and P.M. peak hours of the generator typically coincide with the peak hours of the adjacent street traffic; therefore, only one A.M. peak hour and one P.M. peak hour, which represent both the peak hour of the generator and the peak hour of the adjacent street traffic, are shown for general office buildings.

Source Numbers

2, 5, 20, 21, 51, 53, 54, 72, 88, 89, 92, 95, 98, 100, 159, 161, 172, 175, 178, 183, 184, 185, 189, 193, 207, 212, 217, 247, 253, 257, 260, 262, 279, 295, 297, 298, 300, 301, 302, 303, 304, 321, 322, 323, 324, 327, 404, 407, 408, 418, 419, 423

General Office Building
(710)

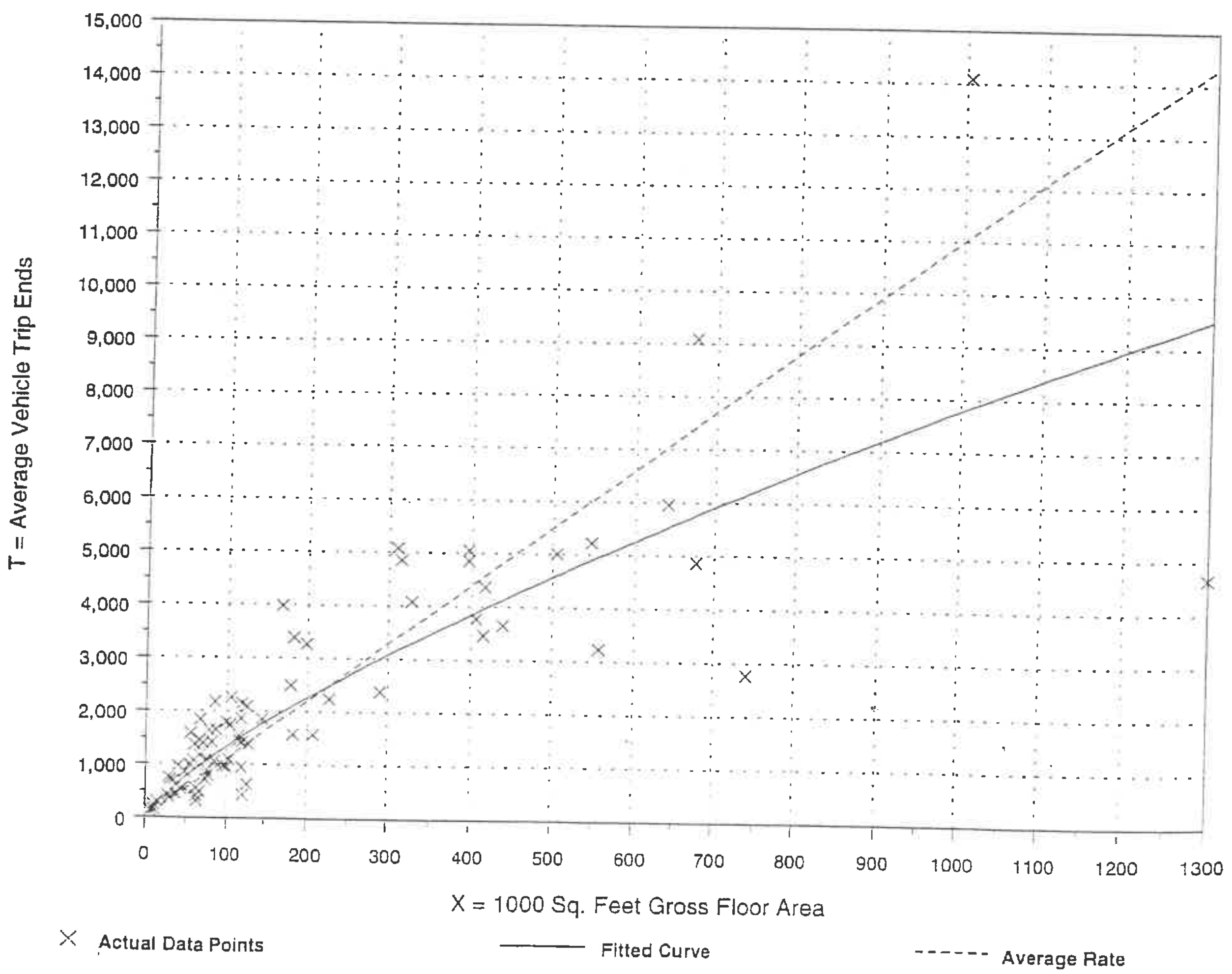
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 78
Average 1000 Sq. Feet GFA: 199
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
11.01	3.58 - 28.80	6.13

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.768\ Ln(X) + 3.654$ $R^2 = 0.80$

64

General Office Building
(710)

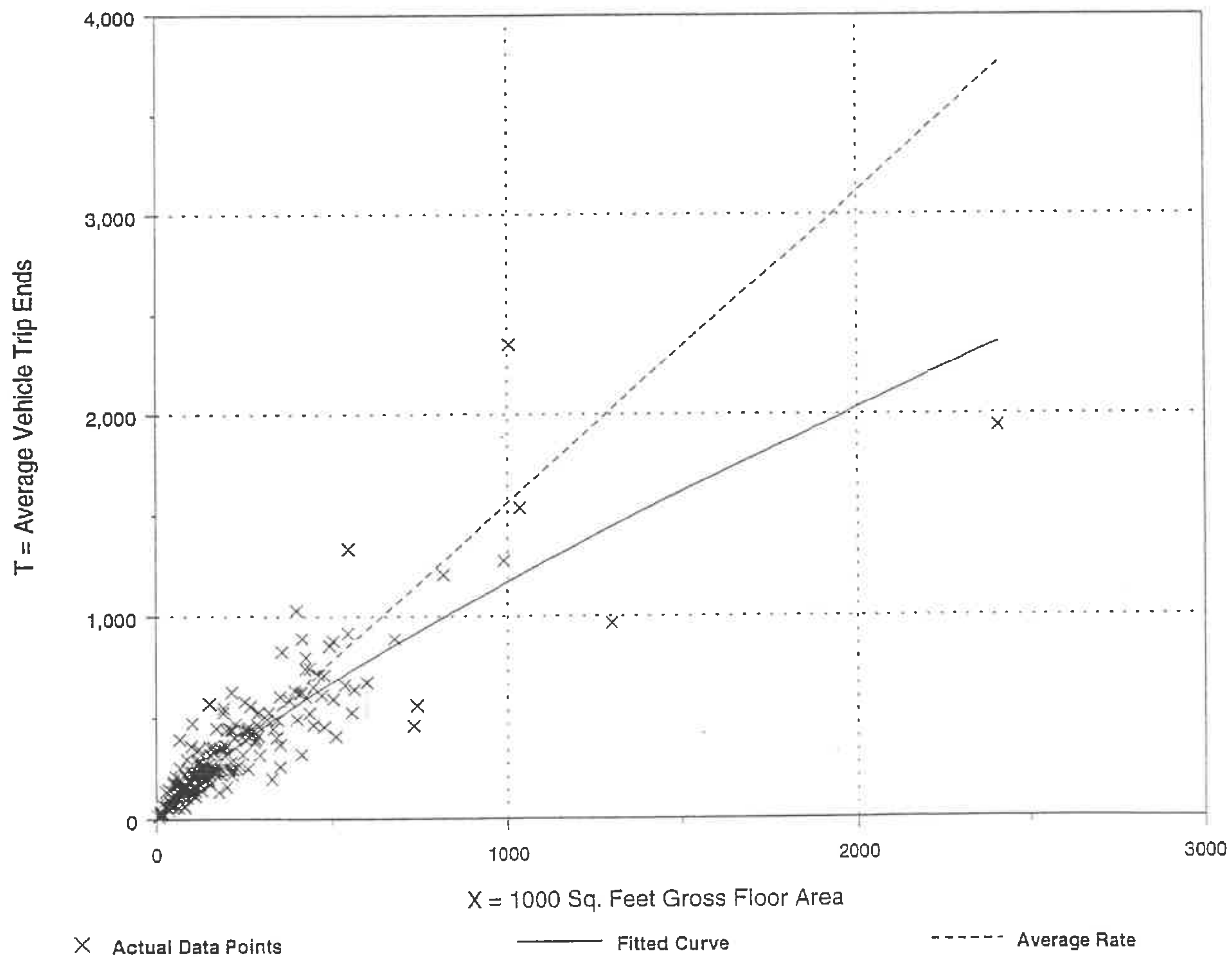
Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Weekday,**
	A.M. Peak Hour

Number of Studies:	216
Average 1000 Sq. Feet GFA:	223
Directional Distribution:	88% entering, 12% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.56	0.60 - 5.98	1.40

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.797\ Ln(X) + 1.558$

$R^2 = 0.83$

General Office Building
(710)

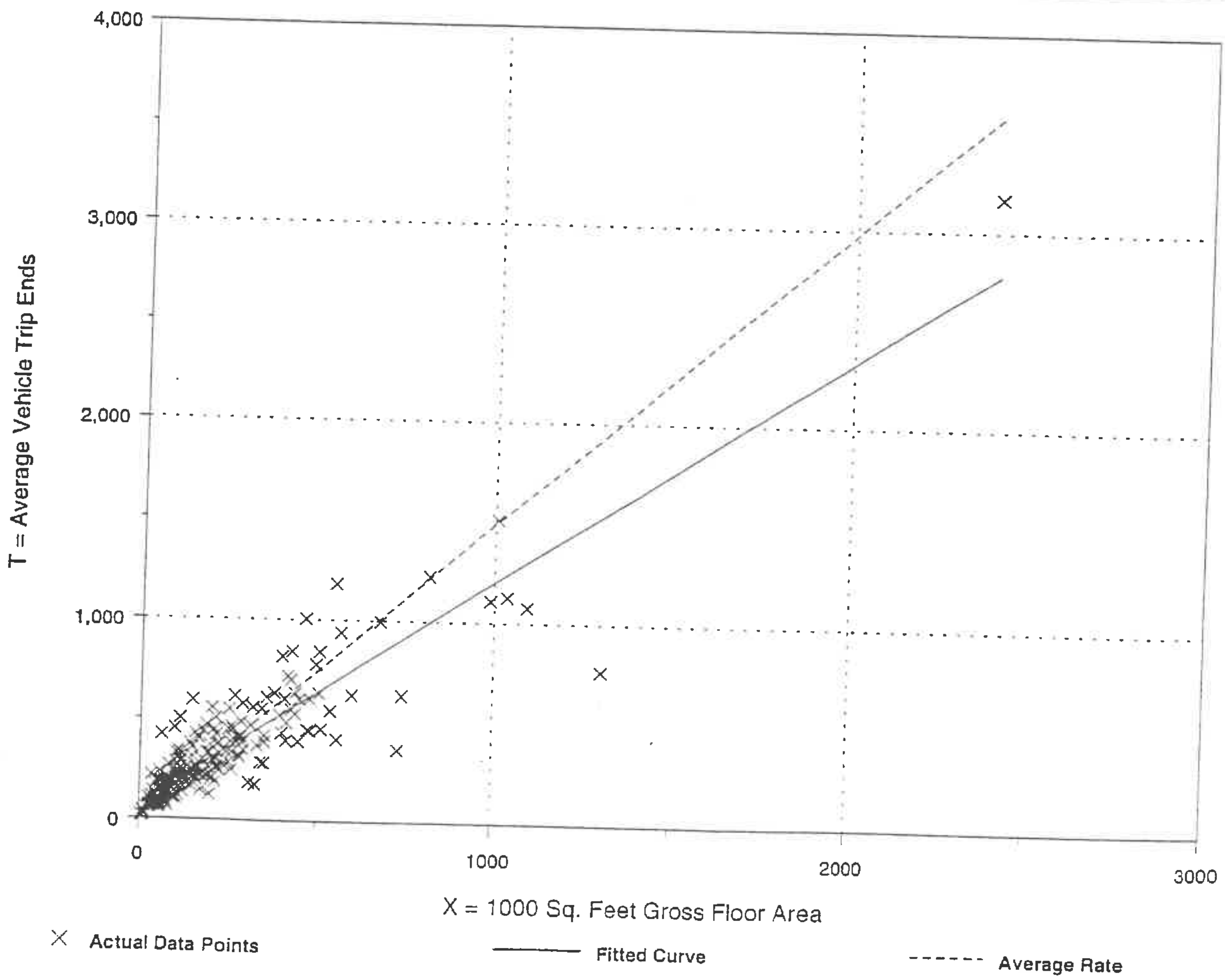
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
P.M. Peak Hour

Number of Studies: 234
Average 1000 Sq. Feet GFA: 216
Directional Distribution: 17% entering, 83% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.49	0.49 - 6.39	1.37

Data Plot and Equation



Fitted Curve Equation: $T = 1.121(X) + 79.295$ $R^2 = 0.82$

65

Land Use: 760
Research and Development Center

Description

Research and development centers are facilities or groups of facilities devoted almost exclusively to research and development activities. The range of specific types of businesses contained in this land use category varies significantly. Research and development centers may contain offices and light fabrication areas. General office building (land use 710), corporate headquarters building (land use 714), single tenant office building (land use 715), office park (land use 750), and business park (land use 770) are related uses.

Additional Data

Truck trips accounted for 1.84 percent of the weekday traffic at the research and development centers surveyed (range of 0.4 percent to 4.0 percent).

The average vehicle occupancy for the thirteen studies where information was submitted is approximately 1.19 persons per automobile. The range of vehicle occupancy rates is 1.10 to 1.33 persons per automobile.

The sites were surveyed from the 1960s to the 1990s throughout the United States, with many conducted in the Washington, D.C.; San Francisco; and San Diego metropolitan areas.

Trip Characteristics

The trip generation for the A.M. and P.M. peak hours of the generator typically coincide with the peak hours of the adjacent street traffic; therefore, only one A.M. peak hour and one P.M. peak hour, which represent both the peak hour of the generator and the peak hour of the adjacent street traffic, are shown for research and development centers.

Source Numbers

9, 105, 213, 218, 253, 332, 384, 423

66

Research and Development Center
(760)

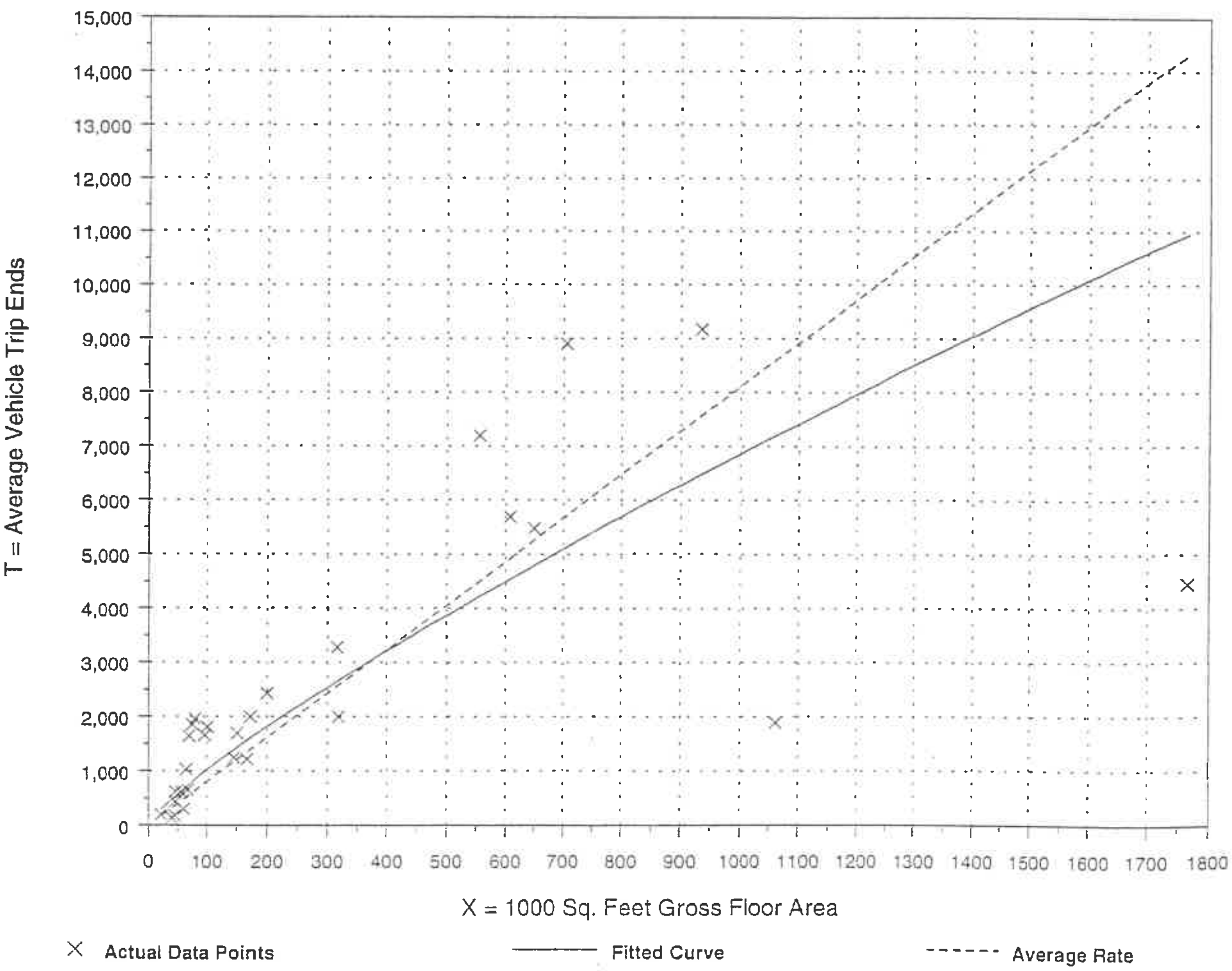
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday

Number of Studies: 28
Average 1000 Sq. Feet GFA: 308
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
8.11	1.78 - 24.95	5.85

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.824\ Ln(X) + 3.135$ $R^2 = 0.72$

Research and Development Center
(760)

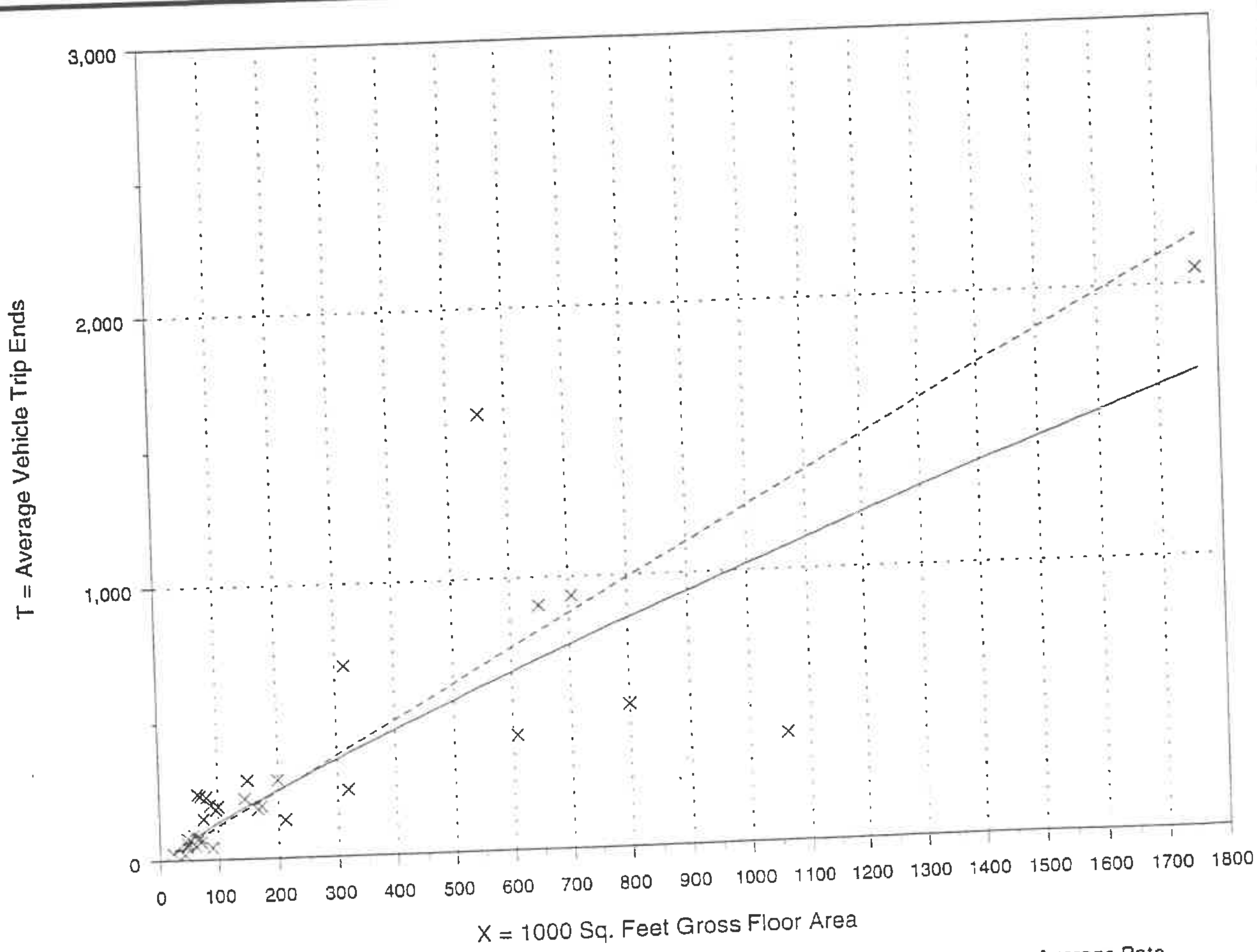
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
A.M. Peak Hour

Number of Studies: 32
Average 1000 Sq. Feet GFA: 279
Directional Distribution: 83% entering, 17% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.24	0.37 - 3.73	1.32

Data Plot and Equation



X Actual Data Points —— Fitted Curve ------ Average Rate

Fitted Curve Equation: $Ln(T) = 0.875 \, Ln(X) + 0.883$ $R^2 = 0.75$

67

Research and Development Center
(760)

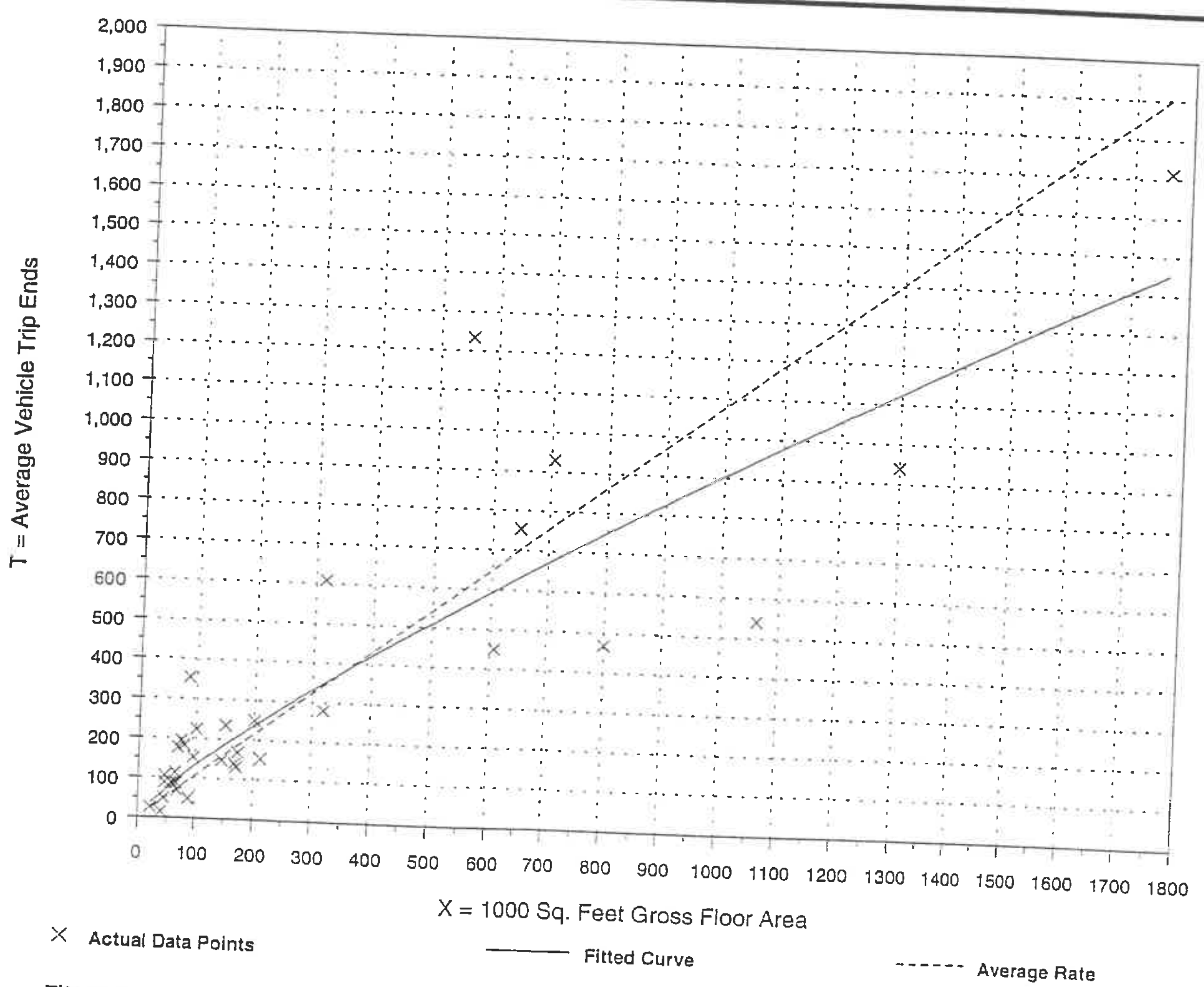
Average Vehicle Trip Ends vs: **1000 Sq. Feet Gross Floor Area**
On a: **Weekday,**
P.M. Peak Hour

Number of Studies: 34
Average 1000 Sq. Feet GFA: 306
Directional Distribution: 15% entering, 85% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
1.08	0.40 - 4.13	1.19

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.832\ Ln(X) + 1.060$

$R^2 = 0.78$

Level of Service Description

LOS

The average control delay per vehicle is estimated for each lane group and aggregated for each approach and for the intersection as a whole. LOS is directly related to the control delay value. The criteria are listed in Exhibit 16-2.

EXHIBIT 16-2. LOS CRITERIA FOR SIGNALIZED INTERSECTIONS

LOS	Control Delay per Vehicle (s/veh)
A	≤ 10
B	> 10–20
C	> 20–35
D	> 35–55
E	> 55–80
F	> 80

EXHIBIT 17-2. LEVEL-OF-SERVICE CRITERIA FOR TWSC INTERSECTIONS

Level of Service	Average Control Delay (s/veh)
A	0–10
B	> 10–15
C	> 15–25
D	> 25–35
E	> 35–50
F	> 50

Capacity Calculations

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
	→	↘	↙	←	↖	↗
Lane Configurations	↑	↱	↰	↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		300	300		0	0
Storage Lanes		1	1		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1863	1583	1770	1863	1770	1583
Flt Permitted			0.138		0.950	
Satd. Flow (perm)	1863	1583	257	1863	1770	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		586				76
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	2268			2404	1552	
Travel Time (s)	51.5			54.6	35.3	
Volume (vph)	667	1459	602	302	186	70
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	725	1586	654	328	202	76
Lane Group Flow (vph)	725	1586	654	328	202	76
Turn Type		Free	pm+pt			pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		Free	8			2
Detector Phases	4		3	8	2	3
Minimum Initial (s)	4.0		4.0	4.0	4.0	4.0
Minimum Split (s)	20.0		8.0	20.0	10.0	8.0
Total Split (s)	29.0	0.0	23.0	52.0	13.0	23.0
Total Split (%)	45%	0%	35%	80%	20%	35%
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	0.5		0.5	0.5	0.5	0.5
Lead/Lag	Lead		Lag			Lag
Lead-Lag Optimize?	Yes		Yes			Yes
Recall Mode	None		None	None	Min	None
Act Effct Green (s)	25.0	65.0	48.0	48.0	9.0	32.0
Actuated g/C Ratio	0.38	1.00	0.74	0.74	0.14	0.49
v/c Ratio	1.01	1.00	1.03	0.24	0.82	0.09
Uniform Delay, d1	20.0	0.0	18.6	2.7	27.2	0.0
Delay	50.2	20.9	56.2	2.8	45.1	2.7
LOS	D	C	E	A	D	A
Approach Delay	30.1			38.3	33.5	
Approach LOS	C			D	C	
Queue Length 50th (ft)	~286	~3	~235	30	79	0
Queue Length 95th (ft)	#502	#241	#269	52	#183	18
Internal Link Dist (ft)	2188			2324	1472	
50th Up Block Time (%)						

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
95th Up Block Time (%)						
Turn Bay Length (ft)		300	300			
50th Bay Block Time %	7%					
95th Bay Block Time %	41%		7%			
Queuing Penalty (veh)	378		12			

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.03
Intersection Signal Delay: 32.6 Intersection LOS: C
Intersection Capacity Utilization 95.6% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

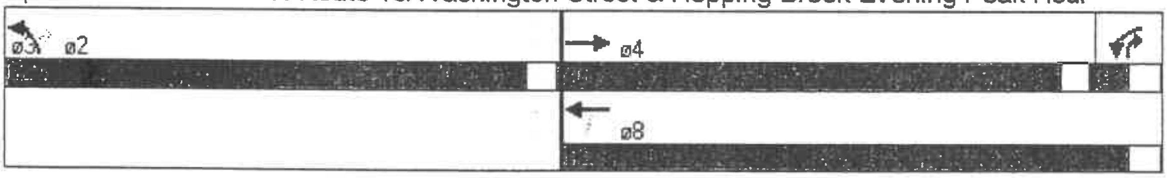
Splits and Phases: 5: Route 16/Washington Street & Hopping Brook Morning Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		300	300		0	0
Storage Lanes		1	1		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1863	1583	1770	1863	1770	1583
Flt Permitted			0.072		0.950	
Satd. Flow (perm)	1863	1583	134	1863	1770	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		335				110
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	2270			1858	1536	
Travel Time (s)	51.6			42.2	34.9	
Volume (vph)	688	640	69	806	961	618
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	748	696	75	876	1045	672
Lane Group Flow (vph)	748	696	75	876	1045	672
Turn Type		Free	pm+pt			pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		Free	8			2
Minimum Split (s)	20.0		8.0	20.0	20.0	8.0
Total Split (s)	60.0	0.0	8.0	68.0	62.0	8.0
Total Split (%)	46%	0%	6%	52%	48%	6%
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	0.5		0.5	0.5	0.5	0.5
Lead/Lag	Lead		Lag			Lag
Lead-Lag Optimize?	Yes		Yes			Yes
Act Effct Green (s)	56.0	130.0	64.0	64.0	58.0	66.0
Actuated g/C Ratio	0.43	1.00	0.49	0.49	0.45	0.51
v/c Ratio	0.93	0.44	0.65	0.96	1.32	0.78
Uniform Delay, d1	35.2	0.0	36.4	31.6	36.0	21.3
Delay	46.1	0.0	47.8	45.0	153.8	22.3
LOS	D	A	D	D	F	C
Approach Delay	23.9			45.2	102.4	
Approach LOS	C			D	F	
Queue Length 50th (ft)	590	0	33	689	~1138	385
Queue Length 95th (ft)	#850	0	#79	#981	#1397	562
Internal Link Dist (ft)	2190			1778	1456	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)		300	300			
50th Bay Block Time %	30%			31%		
95th Bay Block Time %	41%			39%		
Queuing Penalty (veh)	246			26		

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 130
Control Type: Pretimed
Maximum v/c Ratio: 1.32
Intersection Signal Delay: 61.6 Intersection LOS: E
Intersection Capacity Utilization 111.4% ICU Level of Service G
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Route 16/Washington Street & Hopping Brook Evening Peak Hour



Level of Service Description

LOS

The average control delay per vehicle is estimated for each lane group and aggregated for each approach and for the intersection as a whole. LOS is directly related to the control delay value. The criteria are listed in Exhibit 16-2.

EXHIBIT 16-2. LOS CRITERIA FOR SIGNALIZED INTERSECTIONS

LOS	Control Delay per Vehicle (s/veh)
A	≤ 10
B	> 10–20
C	> 20–35
D	> 35–55
E	> 55–80
F	> 80

EXHIBIT 17-2. LEVEL-OF-SERVICE CRITERIA FOR TWSC INTERSECTIONS

Level of Service	Average Control Delay (s/veh)
A	0–10
B	> 10–15
C	> 15–25
D	> 25–35
E	> 35–50
F	> 50

Capacity Calculations

HCM Unsignalized Intersection Capacity Analysis
1: Route 85 & Route 495 NB Ramps

3/12/2003

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑			↑	↱	↰		↱			
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	1006	375	0	0	235	17	153	0	224	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	1037	387	0	0	242	18	158	0	231	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	260			387			2703	2721	387	2934	2703	242
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	21			100			0	100	65	100	100	100
cM capacity (veh/h)	1311			1177			5	4	664	2	4	799

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	1037	387	242	18	158	231
Volume Left	1037	0	0	0	158	0
Volume Right	0	0	0	18	0	231
cSH	1311	1700	1700	1700	5	664
Volume to Capacity	0.79	0.23	0.14	0.01	32.72	0.35
Queue Length (ft)	225	0	0	0	Err	39
Control Delay (s)	17.2	0.0	0.0	0.0	Err	13.3
Lane LOS	C				F	B
Approach Delay (s)	12.5		0.0		4065.8	
Approach LOS					F	

Intersection Summary			
Average Delay	771.2		
Intersection Capacity Utilization	88.9%	ICU Level of Service	D

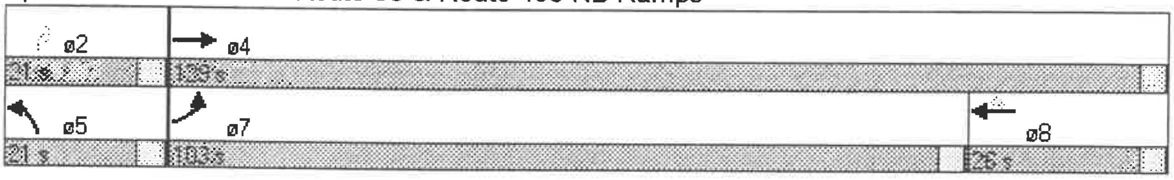
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50		50			
Trailing Detector (ft)	0	0			0	0	0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						20			266			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1705			1689			558			506	
Travel Time (s)		38.8			38.4			12.7			11.5	
Volume (vph)	1160	375	0	0	271	19	176	0	258	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	1196	387	0	0	279	20	181	0	266	0	0	0
Lane Group Flow (vph)	1196	387	0	0	279	20	181	0	266	0	0	0
Turn Type	Prot					Perm	custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases						8	5		2			
Detector Phases	7	4			8	8	5		2			
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0	20.0	8.0		20.0			
Total Split (s)	103.0	129.0	0.0	0.0	26.0	26.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	69%	86%	0%	0%	17%	17%	14%	0%	14%	0%	0%	0%
Maximum Green (s)	99.0	125.0			22.0	22.0	17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5		0.5			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			
Recall Mode	None	None			None	None	None		Min			
Walk Time (s)		5.0			5.0	5.0			5.0			
Flash Dont Walk (s)		11.0			11.0	11.0			11.0			
Pedestrian Calls (#/hr)		0			0	0			0			
Act Effct Green (s)	99.0	125.0			22.0	22.0	12.9		12.9			
Actuated g/C Ratio	0.68	0.86			0.15	0.15	0.09		0.09			
v/c Ratio	0.99	0.24			0.98	0.08	0.59		0.69			
Uniform Delay, d1	22.8	1.9			61.7	0.0	64.0		0.0			
Delay	42.5	2.1			100.3	20.4	63.9		6.9			
LOS	D	A			F	C	E		A			
Approach Delay		32.6			95.0							
Approach LOS		C			F							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	1029	51			268	0	86		0			
Queue Length 95th (ft)	#1492	86			#475	26	128		88			
Internal Link Dist (ft)		1625			1609			478			426	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 145.9
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.99
Intersection Signal Delay: 40.1 Intersection LOS: D
Intersection Capacity Utilization 96.1% ICU Level of Service E
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 85 & Route 495 NB Ramps



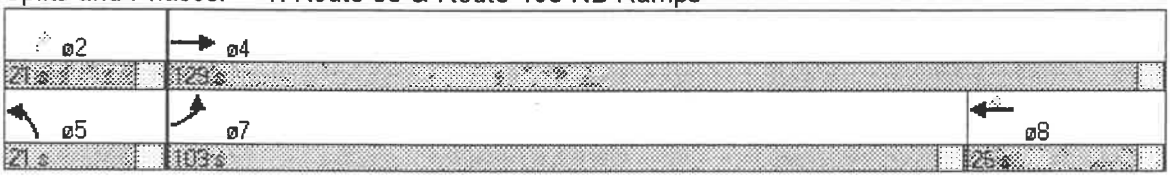
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑			↑	↱	↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50		50			
Trailing Detector (ft)	0	0			0	0	0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						20			266			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1705			1689			558			506	
Travel Time (s)		38.8			38.4			12.7			11.5	
Volume (vph)	1187	375	0	0	271	19	176	0	258	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	1224	387	0	0	279	20	181	0	266	0	0	0
Lane Group Flow (vph)	1224	387	0	0	279	20	181	0	266	0	0	0
Turn Type	Prot					Perm	custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases						8	5		2			
Detector Phases	7	4			8	8	5		2			
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0	20.0	8.0		20.0			
Total Split (s)	103.0	129.0	0.0	0.0	26.0	26.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	69%	86%	0%	0%	17%	17%	14%	0%	14%	0%	0%	0%
Maximum Green (s)	99.0	125.0			22.0	22.0	17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5		0.5			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			
Recall Mode	None	None			None	None	None		Min			
Walk Time (s)		5.0			5.0	5.0			5.0			
Flash Dont Walk (s)		11.0			11.0	11.0			11.0			
Pedestrian Calls (#/hr)		0			0	0			0			
Act Effct Green (s)	99.0	125.0			22.0	22.0	12.9		12.9			
Actuated g/C Ratio	0.68	0.86			0.15	0.15	0.09		0.09			
v/c Ratio	1.01	0.24			0.98	0.08	0.59		0.69			
Uniform Delay, d1	23.5	1.9			61.7	0.0	64.0		0.0			
Delay	49.0	2.1			100.3	20.4	63.9		6.9			
LOS	D	A			F	C	E		A			
Approach Delay		37.7			95.0							
Approach LOS		D			F							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~1139	51			268	0	86		0			
Queue Length 95th (ft)	#1547	86			#475	26	128		88			
Internal Link Dist (ft)		1625			1609			478			426	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 145.9
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.01
Intersection Signal Delay: 43.5 Intersection LOS: D
Intersection Capacity Utilization 97.7% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 85 & Route 495 NB Ramps



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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	507	207	0	0	679	18	312	0	148	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	523	213	0	0	700	19	322	0	153	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	719			213			1959	1977	213	2111	1959	700
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	41			100			0	100	82	100	100	100
cM capacity (veh/h)	887			1363			26	26	829	16	26	441

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	523	213	700	19	322	153
Volume Left	523	0	0	0	322	0
Volume Right	0	0	0	19	0	153
cSH	887	1700	1700	1700	26	829
Volume to Capacity	0.59	0.13	0.41	0.01	12.60	0.18
Queue Length (ft)	99	0	0	0	Err	17
Control Delay (s)	14.7	0.0	0.0	0.0	Err	10.3
Lane LOS	B				F	B
Approach Delay (s)	10.4		0.0		6785.3	
Approach LOS					F	

Intersection Summary			
Average Delay	1672.2		
Intersection Capacity Utilization	93.6%	ICU Level of Service	E

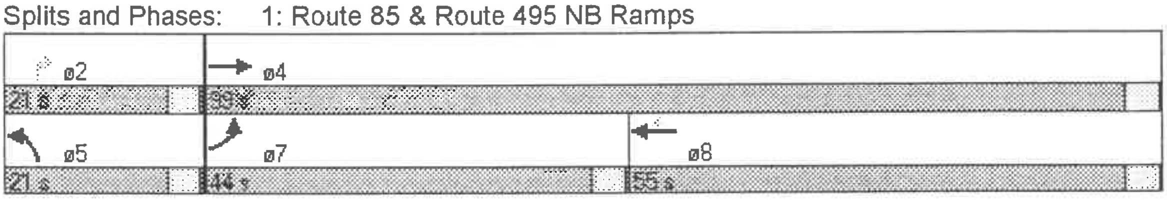
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑			↑	↱	↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50		50			
Trailing Detector (ft)	0	0			0	0	0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						15			175			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1705			1689			558			506	
Travel Time (s)		38.8			38.4			12.7			11.5	
Volume (vph)	585	238	0	0	783	20	360	0	170	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	603	245	0	0	807	21	371	0	175	0	0	0
Lane Group Flow (vph)	603	245	0	0	807	21	371	0	175	0	0	0
Turn Type	Prot					Perm	custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases						8	5		2			
Detector Phases	7	4			8	8	5		2			
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0	20.0	8.0		20.0			
Total Split (s)	44.0	99.0	0.0	0.0	55.0	55.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	37%	83%	0%	0%	46%	46%	18%	0%	18%	0%	0%	0%
Maximum Green (s)	40.0	95.0			51.0	51.0	17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5		0.5			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			
Recall Mode	None	None			None	None	None		Min			
Walk Time (s)		5.0			5.0	5.0			5.0			
Flash Dont Walk (s)		11.0			11.0	11.0			11.0			
Pedestrian Calls (#/hr)		0			0	0			0			
Act Effct Green (s)	40.0	95.1			51.0	51.0	16.1		16.1			
Actuated g/C Ratio	0.34	0.80			0.43	0.43	0.14		0.14			
v/c Ratio	1.00	0.16			1.00	0.03	0.79		0.48			
Uniform Delay, d1	39.5	2.8			34.0	5.6	49.9		0.0			
Delay	69.7	2.9			60.1	11.0	51.3		7.0			
LOS	E	A			E	B	D		A			
Approach Delay		50.4			58.9							
Approach LOS		D			E							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~477	37			~629	3	144		0			
Queue Length 95th (ft)	#716	56			#898	18	198		63			
Internal Link Dist (ft)		1625			1609			478			426	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 119.1
Natural Cycle: 120
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 50.3 Intersection LOS: D
Intersection Capacity Utilization 96.5% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 85 & Route 495 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑			↑	↱	↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50		50			
Trailing Detector (ft)	0	0			0	0	0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.91	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	1881	0	0	1881	1599	3467	0	1599	0	0	0
Flt Permitted	0.063						0.950					
Satd. Flow (perm)	119	1881	0	0	1881	1599	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						11			175			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1705			1689			558			506	
Travel Time (s)		38.8			38.4			12.7			11.5	
Volume (vph)	844	238	0	0	783	20	360	0	170	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	870	245	0	0	807	21	371	0	175	0	0	0
Lane Group Flow (vph)	870	245	0	0	807	21	371	0	175	0	0	0
Turn Type	pm+pt					Perm	custom		custom			
Protected Phases	7	4			8							
Permitted Phases	4					8	2		2			
Detector Phases	7	4			8	8	2		2			
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0	20.0	20.0		20.0			
Total Split (s)	66.0	129.0	0.0	0.0	63.0	63.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	44%	86%	0%	0%	42%	42%	14%	0%	14%	0%	0%	0%
Maximum Green (s)	62.0	125.0			59.0	59.0	17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5		0.5			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0		3.0			
Recall Mode	None	None			None	None	Min		Min			
Walk Time (s)		5.0			5.0	5.0	5.0		5.0			
Flash Dont Walk (s)		11.0			11.0	11.0	11.0		11.0			
Pedestrian Calls (#/hr)		0			0	0	0		0			
Act Effct Green (s)	125.0	125.0			59.0	59.0	17.0		17.0			
Actuated g/C Ratio	0.83	0.83			0.39	0.39	0.11		0.11			
v/c Ratio	1.10	0.16			1.09	0.03	0.94		0.52			
Uniform Delay, d1	38.5	2.4			45.5	13.2	66.0		0.0			
Delay	90.8	2.4			93.4	17.6	86.4		8.3			
LOS	F	A			F	B	F		A			
Approach Delay		71.4			91.5							
Approach LOS		E			F							

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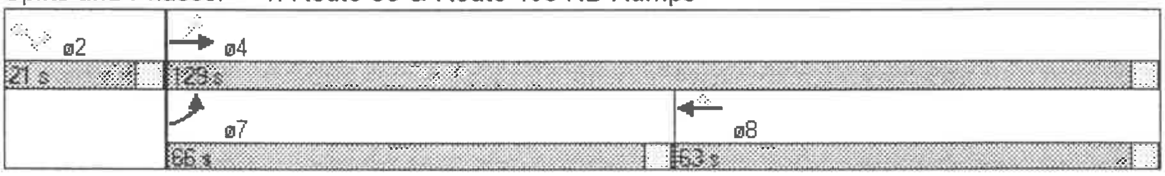
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~915	37			~887	6	189		0			
Queue Length 95th (ft)	#1176	53			#1140	25	#289		73			
Internal Link Dist (ft)		1625			1609			478			426	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.10
Intersection Signal Delay: 75.9 Intersection LOS: E
Intersection Capacity Utilization 111.3% ICU Level of Service G
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 85 & Route 495 NB Ramps



HCM Unsignalized Intersection Capacity Analysis
2: Route 85 & Route 495 SB Ramps

3/11/2003

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	1377	166	93	236	0	0	0	0	16	0	492
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	1420	171	96	243	0	0	0	0	16	0	507
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	243			1591			2362	1855	1420	1855	2026	243
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			77			100	100	100	65	100	36
cM capacity (veh/h)	1329			415			7	57	168	47	45	798

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	1420	171	96	243	16	507
Volume Left	0	0	96	0	16	0
Volume Right	0	171	0	0	0	507
cSH	1700	1700	415	1700	47	798
Volume to Capacity	0.84	0.10	0.23	0.14	0.35	0.64
Queue Length (ft)	0	0	22	0	31	116
Control Delay (s)	0.0	0.0	16.3	0.0	119.1	17.0
Lane LOS			C		F	C
Approach Delay (s)	0.0		4.6		20.3	
Approach LOS					C	

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	93.4%	ICU Level of Service	E

HCM Unsignalized Intersection Capacity Analysis
2: Route 85 & Route 495 SB Ramps

3/11/2003

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	1589	191	107	272	0	0	0	0	18	0	576
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	1638	197	110	280	0	0	0	0	19	0	594
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	280			1835			2733	2139	1638	2139	2336	280
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			67			100	100	100	30	100	22
cM capacity (veh/h)	1288			334			2	33	125	27	25	761

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	1638	197	110	280	19	594
Volume Left	0	0	110	0	19	0
Volume Right	0	197	0	0	0	594
cSH	1700	1700	334	1700	27	761
Volume to Capacity	0.96	0.12	0.33	0.16	0.70	0.78
Queue Length (ft)	0	0	35	0	55	194
Control Delay (s)	0.0	0.0	21.0	0.0	289.6	24.4
Lane LOS			C		F	C
Approach Delay (s)	0.0		5.9		32.4	
Approach LOS					D	

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	105.7%	ICU Level of Service	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	1616	191	107	272	0	0	0	0	18	0	804
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	1666	197	110	280	0	0	0	0	19	0	829
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	280			1863			2996	2167	1666	2167	2364	280
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			66			0	100	100	26	100	0
cM capacity (veh/h)	1288			326			0	31	120	25	23	761

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	1666	197	110	280	19	829
Volume Left	0	0	110	0	19	0
Volume Right	0	197	0	0	0	829
cSH	1700	1700	326	1700	25	761
Volume to Capacity	0.98	0.12	0.34	0.16	0.74	1.09
Queue Length (ft)	0	0	36	0	56	560
Control Delay (s)	0.0	0.0	21.6	0.0	314.6	82.0
Lane LOS			C		F	F
Approach Delay (s)	0.0		6.1		87.1	
Approach LOS					F	

Intersection Summary			
Average Delay	24.6		
Intersection Capacity Utilization	107.1%	ICU Level of Service	F

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	703	214	188	806	0	0	0	0	20	0	737
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	725	221	194	831	0	0	0	0	21	0	760
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	831			945			2703	1943	725	1943	2164	831
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			73			0	100	100	47	100	0
cM capacity (veh/h)	806			730			0	48	427	39	35	371

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	725	221	194	831	21	760
Volume Left	0	0	194	0	21	0
Volume Right	0	221	0	0	0	760
cSH	1700	1700	730	1700	39	371
Volume to Capacity	0.43	0.13	0.27	0.49	0.53	2.05
Queue Length (ft)	0	0	27	0	46	1347
Control Delay (s)	0.0	0.0	11.7	0.0	172.4	504.4
Lane LOS			B		F	F
Approach Delay (s)	0.0		2.2		495.6	
Approach LOS					F	

Intersection Summary			
Average Delay	141.4		
Intersection Capacity Utilization	97.4%	ICU Level of Service	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	811	246	216	930	0	0	0	0	23	0	850
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	836	254	223	959	0	0	0	0	24	0	876
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	959			1090			3116	2240	836	2240	2494	959
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			65			0	100	100	0	100	0
cM capacity (veh/h)	722			644			0	28	369	22	19	313

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	836	254	223	959	24	876
Volume Left	0	0	223	0	24	0
Volume Right	0	254	0	0	0	876
cSH	1700	1700	644	1700	22	313
Volume to Capacity	0.49	0.15	0.35	0.56	1.07	2.80
Queue Length (ft)	0	0	39	0	77	1870
Control Delay (s)	0.0	0.0	13.5	0.0	464.3	843.3
Lane LOS			B		F	F
Approach Delay (s)	0.0		2.5		833.3	
Approach LOS					F	

Intersection Summary			
Average Delay	237.4		
Intersection Capacity Utilization	111.4%	ICU Level of Service	G

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱	↰	↑					↰		↱
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	1070	246	216	930	0	0	0	0	23	0	869
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	0	1103	254	223	959	0	0	0	0	24	0	896
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
vC, conflicting volume	959			1357			3403	2507	1103	2507	2761	959
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			56			0	100	100	0	100	0
cM capacity (veh/h)	722			510			0	16	258	13	11	313

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	1103	254	223	959	24	896
Volume Left	0	0	223	0	24	0
Volume Right	0	254	0	0	0	896
cSH	1700	1700	510	1700	13	313
Volume to Capacity	0.65	0.15	0.44	0.56	1.85	2.86
Queue Length (ft)	0	0	55	0	94	1930
Control Delay (s)	0.0	0.0	17.4	0.0	1000.3	871.2
Lane LOS			C		F	F
Approach Delay (s)	0.0		3.3		874.6	
Approach LOS					F	

Intersection Summary			
Average Delay	233.7		
Intersection Capacity Utilization	112.6%	ICU Level of Service	G

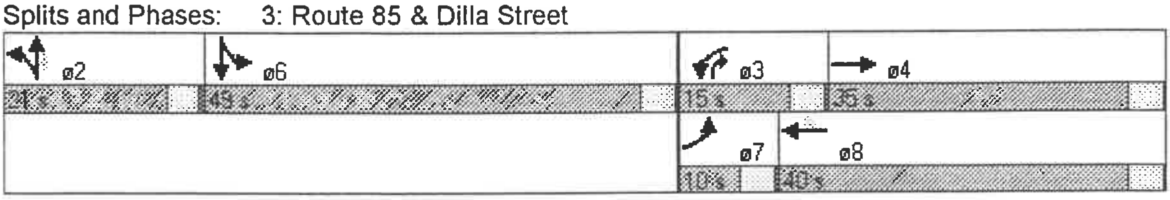
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.990				0.850			0.850		0.993	
Flt Protected	0.950			0.950				0.993		0.950	0.980	
Satd. Flow (prot)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1739	0
Flt Permitted	0.950			0.950				0.993		0.950	0.980	
Satd. Flow (perm)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1739	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3				264			68		2	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	28	441	32	321	231	256	15	94	243	881	342	31
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	29	455	33	331	238	264	15	97	251	908	353	32
Lane Group Flow (vph)	29	488	0	331	238	264	0	112	251	633	660	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	10.0	35.0	0.0	15.0	40.0	40.0	21.0	21.0	15.0	49.0	49.0	0.0
Total Split (%)	8%	29%	0%	13%	33%	33%	18%	18%	13%	41%	41%	0%
Maximum Green (s)	6.0	31.0		11.0	36.0	36.0	17.0	17.0	11.0	45.0	45.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	5.9	31.0		11.0	40.1	40.1		8.9	19.9	45.0	45.0	
Actuated g/C Ratio	0.05	0.28		0.10	0.36	0.36		0.08	0.18	0.40	0.40	
v/c Ratio	0.32	0.94		0.97	0.35	0.36		0.40	0.74	0.93	0.94	
Uniform Delay, d1	54.1	38.7		51.2	27.2	0.0		49.8	16.3	33.0	33.2	
Delay	52.6	58.3		81.0	28.4	3.6		48.9	17.1	45.3	47.6	
LOS	D	E		F	C	A		D	B	D	D	
Approach Delay		58.0			41.5			26.9			46.5	
Approach LOS		E			D			C			D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	20	342		124	132	0		41	68	449	352	
Queue Length 95th (ft)	53	#568		#223	210	59		70	118	#718	#690	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 111.9
Natural Cycle: 120
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 44.7 Intersection LOS: D
Intersection Capacity Utilization 87.4% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.990				0.850			0.850		0.993	
Flt Protected	0.950			0.950				0.993		0.950	0.981	
Satd. Flow (prot)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1741	0
Flt Permitted	0.950			0.950				0.993		0.950	0.981	
Satd. Flow (perm)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1741	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				304			55		2	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	32	508	38	370	266	295	18	117	304	1016	417	35
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	33	524	39	381	274	304	19	121	313	1047	430	36
Lane Group Flow (vph)	33	563	0	381	274	304	0	140	313	741	772	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	11.0	45.0	0.0	19.0	53.0	53.0	21.0	21.0	19.0	65.0	65.0	0.0
Total Split (%)	7%	30%	0%	13%	35%	35%	14%	14%	13%	43%	43%	0%
Maximum Green (s)	7.0	41.0		15.0	49.0	49.0	17.0	17.0	15.0	61.0	61.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	6.7	41.0		15.0	53.5	53.5		11.0	26.0	61.0	61.0	
Actuated g/C Ratio	0.05	0.28		0.10	0.37	0.37		0.08	0.18	0.42	0.42	
v/c Ratio	0.41	1.06		1.06	0.39	0.39		0.52	0.94	1.03	1.04	
Uniform Delay, d1	70.0	51.3		65.4	34.1	0.0		64.8	24.9	42.4	42.2	
Delay	68.4	97.5		113.9	35.3	3.6		63.9	32.4	77.0	80.8	
LOS	E	F		F	D	A		E	C	E	F	
Approach Delay		95.9			56.5			42.1			78.9	
Approach LOS		F			E			D			E	

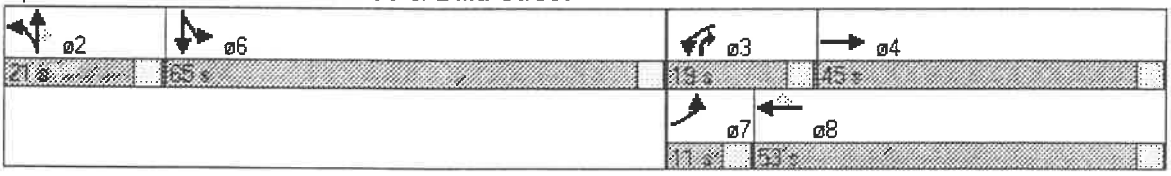
85

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	31	~578		~201	198	0		67	138	~781	~665	
Queue Length 95th (ft)	70	#839		#317	293	66		104	#257	#1076	#1128	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)										13%	15%	
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 144
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.06
Intersection Signal Delay: 71.0 Intersection LOS: E
Intersection Capacity Utilization 100.7% ICU Level of Service F
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.990				0.850			0.850		0.993	
Flt Protected	0.950			0.950				0.993		0.950	0.982	
Satd. Flow (prot)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1743	0
Flt Permitted	0.950			0.950				0.993		0.950	0.982	
Satd. Flow (perm)	1787	1862	0	3467	1881	1599	0	3549	1599	1698	1743	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				304			43		2	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	32	508	38	598	266	295	18	122	331	1016	463	35
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	33	524	39	616	274	304	19	126	341	1047	477	36
Lane Group Flow (vph)	33	563	0	616	274	304	0	145	341	763	797	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	11.0	42.0	0.0	26.0	57.0	57.0	21.0	21.0	26.0	61.0	61.0	0.0
Total Split (%)	7%	28%	0%	17%	38%	38%	14%	14%	17%	41%	41%	0%
Maximum Green (s)	7.0	38.0		22.0	53.0	53.0	17.0	17.0	22.0	57.0	57.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	6.7	38.0		22.0	57.5	57.5		11.2	33.2	57.0	57.0	
Actuated g/C Ratio	0.05	0.26		0.15	0.40	0.40		0.08	0.23	0.40	0.40	
v/c Ratio	0.41	1.14		1.16	0.37	0.37		0.53	0.85	1.14	1.16	
Uniform Delay, d1	70.1	52.9		62.0	31.3	0.0		64.8	24.3	44.4	44.3	
Delay	68.6	124.8		136.9	32.4	3.3		63.9	26.0	113.1	119.1	
LOS	E	F		F	C	A		E	C	F	F	
Approach Delay		121.7			78.9			37.3			116.2	
Approach LOS		F			E			D			F	

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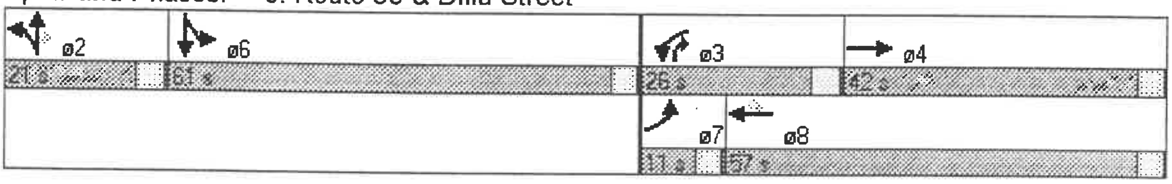
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	31	~618		~353	190	0		70	153	~876	~887	
Queue Length 95th (ft)	70	#879		#490	281	63		108	#262	#1175	#1235	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)										21%	28%	
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 144.2
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.16
Intersection Signal Delay: 95.5 Intersection LOS: F
Intersection Capacity Utilization 107.5% ICU Level of Service F
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lanes, Volumes, Timings
3: Route 85 & Dilla Street 3/10/2003

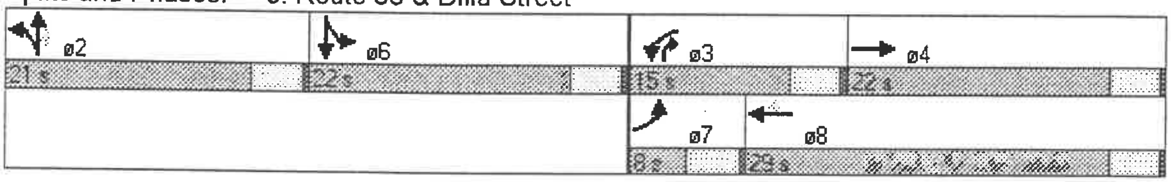
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.980				0.850			0.850		0.982	
Flt Protected	0.950			0.950				0.993		0.950	0.994	
Satd. Flow (prot)	1787	1844	0	3467	1881	1599	0	3549	1599	1698	1744	0
Flt Permitted	0.950			0.950				0.993		0.950	0.994	
Satd. Flow (perm)	1787	1844	0	3467	1881	1599	0	3549	1599	1698	1744	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		9				558			242		8	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	51	191	30	277	490	697	73	447	348	349	252	39
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	53	197	31	286	505	719	75	461	359	360	260	40
Lane Group Flow (vph)	53	228	0	286	505	719	0	536	359	322	338	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	8.0	22.0	0.0	15.0	29.0	29.0	21.0	21.0	15.0	22.0	22.0	0.0
Total Split (%)	10%	28%	0%	19%	36%	36%	26%	26%	19%	28%	28%	0%
Maximum Green (s)	4.0	18.0		11.0	25.0	25.0	17.0	17.0	11.0	18.0	18.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	4.1	15.5		10.1	23.8	23.8		14.9	25.0	16.4	16.4	
Actuated g/C Ratio	0.05	0.21		0.14	0.32	0.32		0.20	0.34	0.22	0.22	
v/c Ratio	0.55	0.58		0.60	0.83	0.80		0.74	0.51	0.85	0.85	
Uniform Delay, d1	35.1	24.1		30.2	23.3	4.5		27.8	2.9	27.7	27.1	
Delay	51.6	26.3		31.9	32.3	8.7		28.7	3.6	39.4	38.6	
LOS	D	C		C	C	A		C	A	D	D	
Approach Delay		31.1			21.0			18.6			39.0	
Approach LOS		C			C			B			D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	27	97		70	235	61		131	0	163	167	
Queue Length 95th (ft)	#80	167		109	#406	#287		185	40	#308	#318	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 73.5
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 24.8 Intersection LOS: C
Intersection Capacity Utilization 76.2% ICU Level of Service C
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.979				0.850			0.850		0.983	
Flt Protected	0.950			0.950				0.993		0.950	0.996	
Satd. Flow (prot)	1787	1842	0	3467	1881	1599	0	3549	1599	1698	1750	0
Flt Permitted	0.950			0.950				0.993		0.950	0.996	
Satd. Flow (perm)	1787	1842	0	3467	1881	1599	0	3549	1599	1698	1750	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		9				563			210		7	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	58	220	36	343	565	804	88	535	417	402	312	45
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	60	227	37	354	582	829	91	552	430	414	322	46
Lane Group Flow (vph)	60	264	0	354	582	829	0	643	430	382	400	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	8.0	25.0	0.0	16.0	33.0	33.0	23.0	23.0	16.0	26.0	26.0	0.0
Total Split (%)	9%	28%	0%	18%	37%	37%	26%	26%	18%	29%	29%	0%
Maximum Green (s)	4.0	21.0		12.0	29.0	29.0	19.0	19.0	12.0	22.0	22.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	4.0	18.7		11.4	28.1	28.1		17.8	29.2	20.8	20.8	
Actuated g/C Ratio	0.05	0.22		0.13	0.33	0.33		0.21	0.34	0.24	0.24	
v/c Ratio	0.72	0.64		0.76	0.94	0.92		0.87	0.63	0.92	0.92	
Uniform Delay, d1	41.2	28.5		35.9	28.0	8.3		32.8	5.7	31.7	31.1	
Delay	74.8	30.0		40.3	47.2	18.9		38.3	6.2	50.0	49.3	
LOS	E	C		D	D	B		D	A	D	D	
Approach Delay		38.3			32.5			25.4			49.6	
Approach LOS		D			C			C			D	

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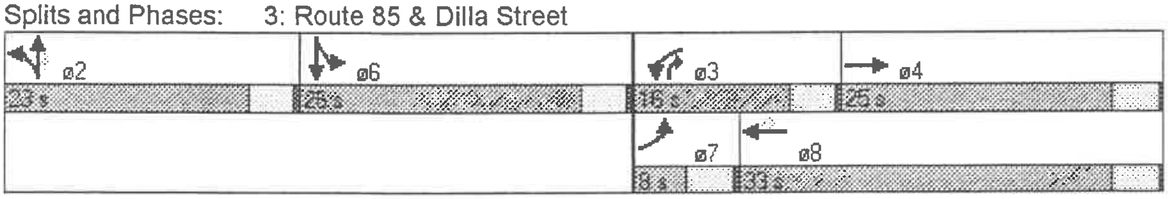
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	35	130		101	322	163		186	36	223	230	
Queue Length 95th (ft)	#104	211		#162	#534	#443		#277	69	#402	#318	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 85
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 34.5 Intersection LOS: C
Intersection Capacity Utilization 86.5% ICU Level of Service D
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



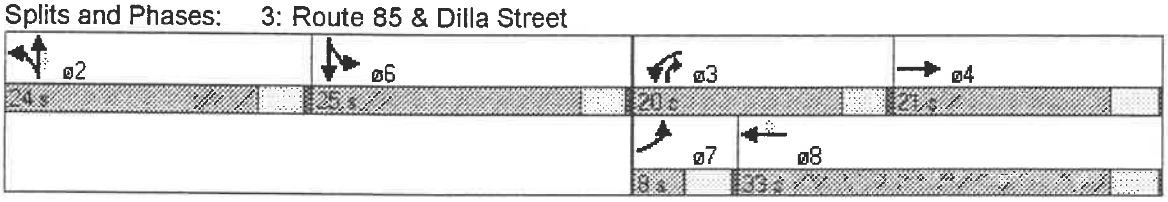
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt		0.979				0.850			0.850		0.983	
Flt Protected	0.950			0.950				0.994		0.950	0.997	
Satd. Flow (prot)	1787	1842	0	3467	1881	1599	0	3553	1599	1698	1751	0
Flt Permitted	0.950			0.950				0.994		0.950	0.997	
Satd. Flow (perm)	1787	1842	0	3467	1881	1599	0	3553	1599	1698	1751	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8				538			159		7	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	58	220	36	362	565	804	88	587	676	402	322	45
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	60	227	37	373	582	829	91	605	697	414	332	46
Lane Group Flow (vph)	60	264	0	373	582	829	0	696	697	387	405	0
Turn Type	Prot			Prot		Perm	Split		pm+ov	Split		
Protected Phases	7	4		3	8		2	2	3	6	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	2	2	3	6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	8.0	21.0	0.0	20.0	33.0	33.0	24.0	24.0	20.0	25.0	25.0	0.0
Total Split (%)	9%	23%	0%	22%	37%	37%	27%	27%	22%	28%	28%	0%
Maximum Green (s)	4.0	17.0		16.0	29.0	29.0	20.0	20.0	16.0	21.0	21.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag			Lead			
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes			Yes			
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	4.0	15.7		16.1	29.4	29.4		19.3	35.3	21.0	21.0	
Actuated g/C Ratio	0.04	0.18		0.18	0.33	0.33		0.22	0.40	0.24	0.24	
v/c Ratio	0.76	0.79		0.59	0.93	0.93		0.89	0.95	0.96	0.96	
Uniform Delay, d1	42.8	33.1		33.5	28.7	9.6		33.9	10.8	33.6	33.0	
Delay	77.1	38.4		33.9	48.8	22.8		39.7	27.8	63.9	62.7	
LOS	E	D		C	D	C		D	C	E	E	
Approach Delay		45.6			33.6			33.8			63.3	
Approach LOS		D			C			C			E	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	35	139		102	322	185		202	112	230	237	
Queue Length 95th (ft)	#104	#251		147	#534	#464		#301	#432	#421	#346	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 88.1
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 40.0 Intersection LOS: D
Intersection Capacity Utilization 89.0% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↑↱			↰↑↑	↱		↰↑↑↱			↰↑↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	1.00
Frt		0.976				0.850		0.943				0.850
Flt Protected		0.997			0.980			0.989			0.972	
Satd. Flow (prot)	0	3478	0	0	3503	1599	0	3333	0	0	3474	1599
Flt Permitted		0.926			0.673			0.798			0.634	
Satd. Flow (perm)	0	3230	0	0	2405	1599	0	2690	0	0	2266	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		60				152		162				60
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	31	355	73	143	203	147	94	161	157	209	147	58
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	32	366	75	147	209	152	97	166	162	215	152	60
Lane Group Flow (vph)	0	473	0	0	356	152	0	425	0	0	367	60
Turn Type	pm+pt			Perm		Perm	Perm			Perm		Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	8	2	2		6	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	8.0	28.0	0.0	20.0	20.0	20.0	22.0	22.0	0.0	22.0	22.0	22.0
Total Split (%)	16%	56%	0%	40%	40%	40%	44%	44%	0%	44%	44%	44%
Maximum Green (s)	4.0	24.0		16.0	16.0	16.0	18.0	18.0		18.0	18.0	18.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lag						
Lead-Lag Optimize?	Yes			Yes	Yes	Yes						
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		Min	Min	Min
Walk Time (s)		5.0		5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0	0	0	0		0	0	0
Act Effct Green (s)		14.0			9.9	9.9		10.0			10.0	10.0
Actuated g/C Ratio		0.39			0.35	0.35		0.35			0.35	0.35
v/c Ratio		0.36			0.42	0.23		0.40			0.46	0.10
Uniform Delay, d1		5.8			6.8	0.0		4.0			6.8	0.0
Delay		5.4			7.6	2.1		4.6			7.7	2.9
LOS		A			A	A		A			A	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		5.4			5.9			4.6			7.0	
Approach LOS		A			A			A			A	
Queue Length 50th (ft)		18			17	0		0			17	0
Queue Length 95th (ft)		54			51	22		35			53	0
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 28.3

Natural Cycle: 50

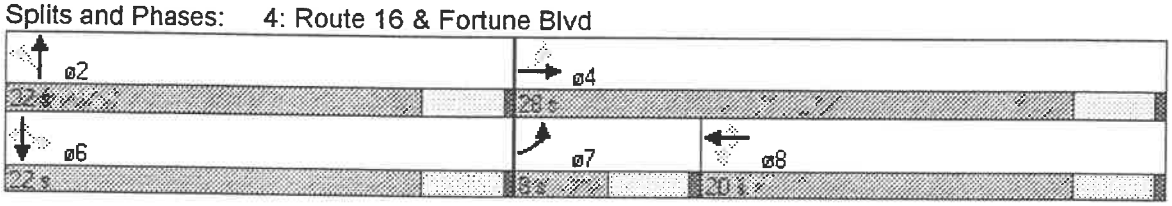
Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.46

Intersection Signal Delay: 5.8 Intersection LOS: A

Intersection Capacity Utilization 61.4% ICU Level of Service B

Splits and Phases: 4: Route 16 & Fortune Blvd



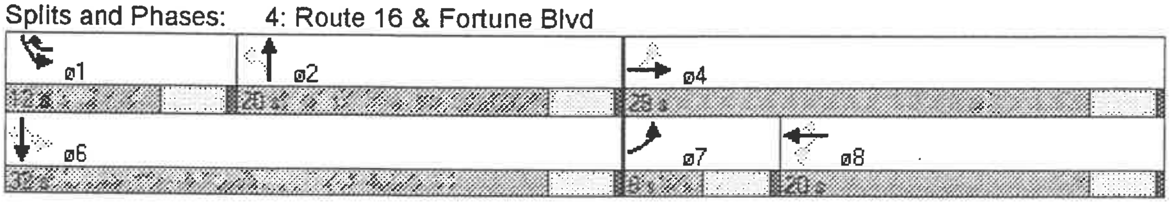
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱		↰↑↱		↰	↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Frt		0.971				0.850		0.947				0.850
Flt Protected		0.997			0.981			0.988		0.950		
Satd. Flow (prot)	0	3460	0	0	3506	1599	0	3344	0	1787	1881	1599
Flt Permitted		0.918			0.649			0.828		0.270		
Satd. Flow (perm)	0	3186	0	0	2320	1599	0	2803	0	508	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		57				223		165				68
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	35	425	109	165	253	216	120	214	181	278	181	66
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	36	438	112	170	261	223	124	221	187	287	187	68
Lane Group Flow (vph)	0	586	0	0	431	223	0	532	0	287	187	68
Turn Type	pm+pt			Perm		pm+ov	Perm			pm+pt		Perm
Protected Phases	7	4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	1	2	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	8.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	8.0	28.0	0.0	20.0	20.0	12.0	20.0	20.0	0.0	12.0	32.0	32.0
Total Split (%)	13%	47%	0%	33%	33%	20%	33%	33%	0%	20%	53%	53%
Maximum Green (s)	4.0	24.0		16.0	16.0	8.0	16.0	16.0		8.0	28.0	28.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes			Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		None	Min	Min
Walk Time (s)		5.0		5.0	5.0		5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0		0	0		0	0			0	0
Act Effct Green (s)		17.5			13.4	25.4		11.2		23.2	23.2	23.2
Actuated g/C Ratio		0.33			0.30	0.57		0.25		0.52	0.52	0.52
v/c Ratio		0.53			0.62	0.22		0.65		0.59	0.19	0.08
Uniform Delay, d1		11.9			13.4	0.0		9.9		6.1	5.7	0.0
Delay		11.6			14.2	1.1		10.8		9.2	6.8	2.4
LOS		B			B	A		B		A	A	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		11.6			9.8			10.8			7.5	
Approach LOS		B			A			B			A	
Queue Length 50th (ft)		57			48	0		37		37	22	0
Queue Length 95th (ft)		107			95	21		95		#105	62	0
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %												
95th Bay Block Time %											2%	
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 44.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 9.9 Intersection LOS: A
Intersection Capacity Utilization 73.8% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Route 16 & Fortune Blvd



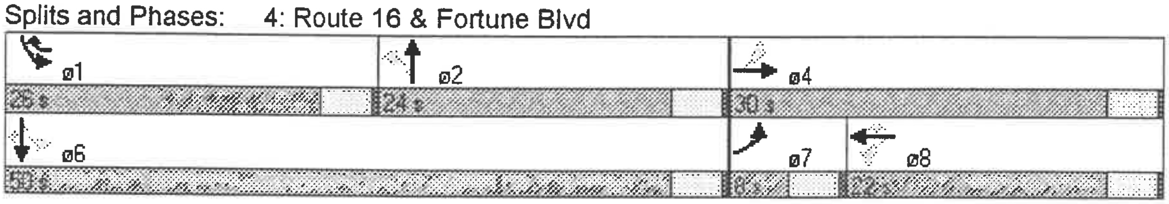
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑↑	↱		↰↑↱		↰	↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Frt		0.975				0.850		0.917				0.850
Flt Protected		0.997			0.979			0.992		0.950		
Satd. Flow (prot)	0	3474	0	0	3499	1599	0	3251	0	1787	1881	1599
Flt Permitted		0.883			0.602			0.857		0.167		
Satd. Flow (perm)	0	3077	0	0	2152	1599	0	2809	0	314	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		30				256		118				68
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	35	516	109	190	264	248	120	214	409	552	181	66
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	36	532	112	196	272	256	124	221	422	569	187	68
Lane Group Flow (vph)	0	680	0	0	468	256	0	767	0	569	187	68
Turn Type	pm+pt			Perm		pm+ov	Perm			pm+pt		Perm
Protected Phases	7	4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	1	2	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	8.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	8.0	30.0	0.0	22.0	22.0	26.0	24.0	24.0	0.0	26.0	50.0	50.0
Total Split (%)	10%	38%	0%	28%	28%	33%	30%	30%	0%	33%	63%	63%
Maximum Green (s)	4.0	26.0		18.0	18.0	22.0	20.0	20.0		22.0	46.0	46.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes			Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		None	Min	Min
Walk Time (s)		5.0		5.0	5.0		5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0		0	0		0	0			0	0
Act Effct Green (s)		25.6			21.6	47.2		19.9		45.6	45.6	45.6
Actuated g/C Ratio		0.31			0.29	0.63		0.26		0.61	0.61	0.61
v/c Ratio		0.69			1.01dl	0.23		0.92		0.93	0.16	0.07
Uniform Delay, d1		23.2			24.4	0.0		22.6		16.8	6.5	0.0
Delay		23.1			24.8	0.8		40.3		37.5	7.2	2.2
LOS		C			C	A		D		D	A	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		23.1			16.3			40.3			27.7	
Approach LOS		C			B			D			C	
Queue Length 50th (ft)		141			105	0		158		200	34	0
Queue Length 95th (ft)		196			158	22		#293		#434	71	0
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %												
95th Bay Block Time %											5%	
Queuing Penalty (veh)											2	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 75.2
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 27.1 Intersection LOS: C
Intersection Capacity Utilization 100.7% ICU Level of Service F
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 4: Route 16 & Fortune Blvd



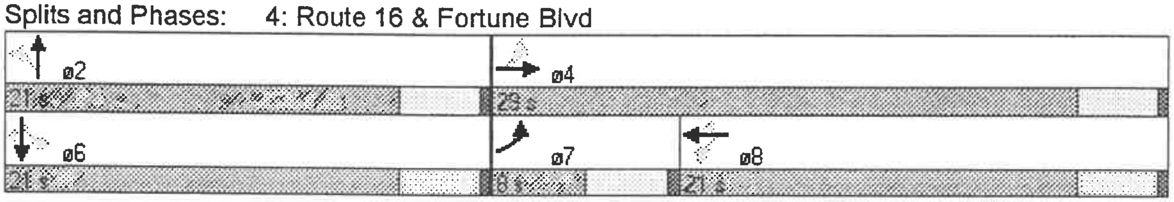
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱		↰↑↱			↰↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	1.00
Frt		0.944				0.850		0.951				0.850
Flt Protected		0.996			0.979			0.988			0.985	
Satd. Flow (prot)	0	3361	0	0	3499	1599	0	3358	0	0	3521	1599
Flt Permitted		0.905			0.695			0.720			0.637	
Satd. Flow (perm)	0	3054	0	0	2484	1599	0	2447	0	0	2277	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		137				261		176				42
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	31	191	133	238	304	253	138	256	189	134	319	41
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	32	197	137	245	313	261	142	264	195	138	329	42
Lane Group Flow (vph)	0	366	0	0	558	261	0	601	0	0	467	42
Turn Type	pm+pt			Perm		Perm	Perm			Perm		Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	8	2	2		6	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	8.0	29.0	0.0	21.0	21.0	21.0	21.0	21.0	0.0	21.0	21.0	21.0
Total Split (%)	16%	58%	0%	42%	42%	42%	42%	42%	0%	42%	42%	42%
Maximum Green (s)	4.0	25.0		17.0	17.0	17.0	17.0	17.0		17.0	17.0	17.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lag						
Lead-Lag Optimize?	Yes			Yes	Yes	Yes						
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		Min	Min	Min
Walk Time (s)		5.0		5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0	0	0	0		0	0	0
Act Effct Green (s)		17.0			12.9	12.9		12.0			12.0	12.0
Actuated g/C Ratio		0.41			0.39	0.39		0.36			0.36	0.36
v/c Ratio		0.27			0.58	0.33		0.61			0.57	0.07
Uniform Delay, d1		4.1			7.8	0.0		5.8			8.3	0.0
Delay		4.0			8.8	1.7		6.6			9.3	3.5
LOS		A			A	A		A			A	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		4.0			6.5			6.6			8.8	
Approach LOS		A			A			A			A	
Queue Length 50th (ft)		11			35	0		23			32	0
Queue Length 95th (ft)		50			85	29		60			72	0
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %												
95th Bay Block Time %											10%	
Queuing Penalty (veh)											2	

Intersection Summary

Area Type: Other
Cycle Length: 50
Actuated Cycle Length: 33.3
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 6.6 Intersection LOS: A
Intersection Capacity Utilization 70.7% ICU Level of Service C

Splits and Phases: 4: Route 16 & Fortune Blvd



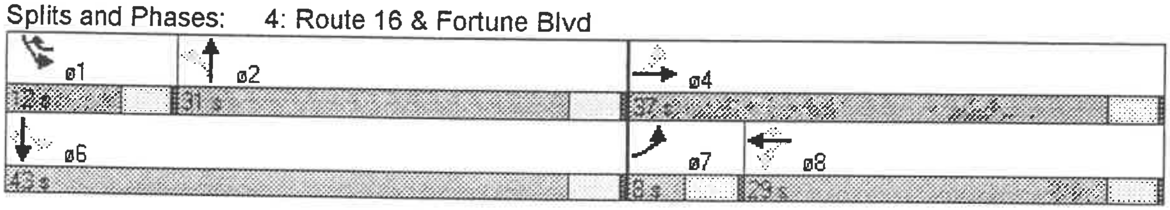
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱		↰↑↱		↰	↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Frt		0.944				0.850		0.955				0.850
Flt Protected		0.995			0.979			0.989		0.950		
Satd. Flow (prot)	0	3357	0	0	3499	1599	0	3376	0	1787	1881	1599
Flt Permitted		0.814			0.664			0.761		0.187		
Satd. Flow (perm)	0	2747	0	0	2373	1599	0	2598	0	352	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		166				355		88				56
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	44	228	161	274	359	363	166	351	218	241	392	62
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	45	235	166	282	370	374	171	362	225	248	404	64
Lane Group Flow (vph)	0	446	0	0	652	374	0	758	0	248	404	64
Turn Type	pm+pt			Perm		pm+ov	Perm			pm+pt		Perm
Protected Phases	7	4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	1	2	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	8.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	8.0	37.0	0.0	29.0	29.0	12.0	31.0	31.0	0.0	12.0	43.0	43.0
Total Split (%)	10%	46%	0%	36%	36%	15%	39%	39%	0%	15%	54%	54%
Maximum Green (s)	4.0	33.0		25.0	25.0	8.0	27.0	27.0		8.0	39.0	39.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes			Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		None	Min	Min
Walk Time (s)		5.0		5.0	5.0		5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0		0	0		0	0			0	0
Act Effct Green (s)		25.5			21.4	33.6		21.4		33.6	33.6	33.6
Actuated g/C Ratio		0.36			0.34	0.53		0.34		0.53	0.53	0.53
v/c Ratio		0.40			0.90dl	0.37		0.81		0.67	0.40	0.07
Uniform Delay, d1		9.7			18.9	0.4		16.4		8.0	8.7	0.9
Delay		9.7			22.1	1.6		17.2		12.9	9.6	3.1
LOS		A			C	A		B		B	A	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		9.7			14.6			17.2			10.2	
Approach LOS		A			B			B			B	
Queue Length 50th (ft)		42			126	4		132		54	97	0
Queue Length 95th (ft)		80			#220	42		123		#127	155	0
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %											17%	
95th Bay Block Time %											28%	
Queuing Penalty (veh)											14	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 63.3
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 13.4 Intersection LOS: B
Intersection Capacity Utilization 88.3% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 4: Route 16 & Fortune Blvd



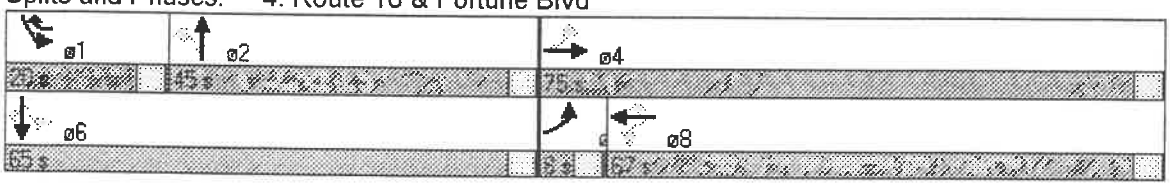
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↱			↰↑	↱		↰↑↱		↰	↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		75
Storage Lanes	0		0	0		1	0		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0		0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Frt		0.945				0.850		0.952				0.850
Flt Protected		0.995			0.974			0.989		0.950		
Satd. Flow (prot)	0	3361	0	0	3481	1599	0	3365	0	1787	1881	1599
Flt Permitted		0.693			0.623			0.758		0.124		
Satd. Flow (perm)	0	2341	0	0	2227	1599	0	2579	0	233	1881	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		117				280		56				29
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1422			697			1702			2591	
Travel Time (s)		32.3			15.8			38.7			58.9	
Volume (vph)	44	238	161	532	462	674	166	351	242	270	392	62
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	45	245	166	548	476	695	171	362	249	278	404	64
Lane Group Flow (vph)	0	456	0	0	1024	695	0	782	0	278	404	64
Turn Type	pm+pt			Perm		pm+ov	Perm			pm+pt		Perm
Protected Phases	7	4			8	1		2		1	6	
Permitted Phases	4			8		8	2			6		6
Detector Phases	7	4		8	8	1	2	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	8.0	20.0		20.0	20.0	8.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	8.0	75.0	0.0	67.0	67.0	20.0	45.0	45.0	0.0	20.0	65.0	65.0
Total Split (%)	6%	54%	0%	48%	48%	14%	32%	32%	0%	14%	46%	46%
Maximum Green (s)	4.0	71.0		63.0	63.0	16.0	41.0	41.0		16.0	61.0	61.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lead	Lag	Lag		Lead		
Lead-Lag Optimize?	Yes			Yes	Yes	Yes	Yes	Yes		Yes		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None	None	Min	Min		None	Min	Min
Walk Time (s)		5.0		5.0	5.0		5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0		0	0		0	0			0	0
Act Effct Green (s)		67.0			63.0	83.0		40.8		60.8	60.8	60.8
Actuated g/C Ratio		0.48			0.48	0.63		0.31		0.46	0.46	0.46
v/c Ratio		0.38			1.25dl	0.63		0.93		0.94	0.47	0.08
Uniform Delay, d1		15.7			33.2	7.9		40.9		28.5	24.3	10.7
Delay		15.5			46.0	8.4		50.4		55.2	24.8	12.1
LOS		B			D	A		D		E	C	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		15.5			30.8			50.4			35.0	
Approach LOS		B			C			D			D	
Queue Length 50th (ft)		87			436	198		236		165	232	0
Queue Length 95th (ft)		124			#596	317		#365		#340	323	42
Internal Link Dist (ft)		1342			617			1622			2511	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												75
50th Bay Block Time %											38%	
95th Bay Block Time %											42%	
Queuing Penalty (veh)											25	

Intersection Summary

Area Type: Other
Cycle Length: 140
Actuated Cycle Length: 131.8
Natural Cycle: 140
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 33.9 Intersection LOS: C
Intersection Capacity Utilization 101.4% ICU Level of Service F
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 4: Route 16 & Fortune Blvd



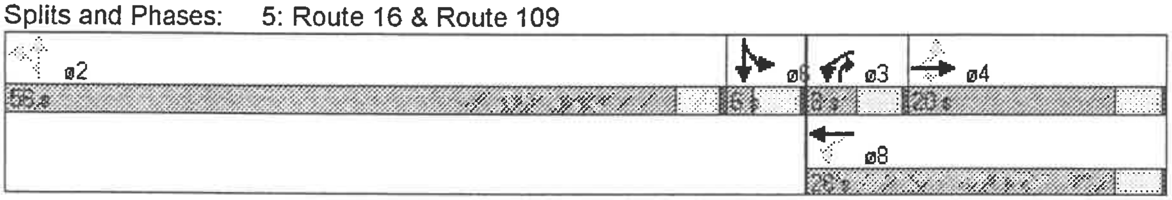
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱	↰	↱			↰	↱		↔	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.998				0.850		0.916	
Flt Protected		0.999		0.950				0.953			0.990	
Satd. Flow (prot)	0	3452	1599	1668	1877	0	0	1793	1599	0	1592	0
Flt Permitted		0.949		0.200				0.212			0.990	
Satd. Flow (perm)	0	3279	1599	351	1877	0	0	399	1599	0	1592	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			509		1				95		15	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	9	496	494	104	210	3	293	5	92	5	4	15
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	9	511	509	107	216	3	302	5	95	5	4	15
Lane Group Flow (vph)	0	520	509	107	219	0	0	307	95	0	24	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	56.0	56.0	8.0	6.0	6.0	0.0
Total Split (%)	22%	22%	22%	9%	31%	0%	62%	62%	9%	7%	7%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		52.0	52.0	4.0	2.0	2.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		16.0	16.0	24.0	24.0			52.0	4.0		2.0	
Actuated g/C Ratio		0.18	0.18	0.27	0.27			0.58	0.04		0.02	
v/c Ratio		0.89	0.72	0.70	0.44			1.33	0.59		0.48	
Uniform Delay, d1		36.1	0.0	26.0	27.2			19.1	0.0		16.2	
Delay		47.1	3.6	40.6	27.8			153.4	13.3		43.6	
LOS		D	A	D	C			F	B		D	
Approach Delay		25.6			32.0			120.3			43.6	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		C			C			F			D	
Queue Length 50th (ft)		153	0	48	103			~229	0		5	
Queue Length 95th (ft)		#245	95	#118	170			#388	#57		#42	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.33
Intersection Signal Delay: 48.4 Intersection LOS: D
Intersection Capacity Utilization 59.7% ICU Level of Service A
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



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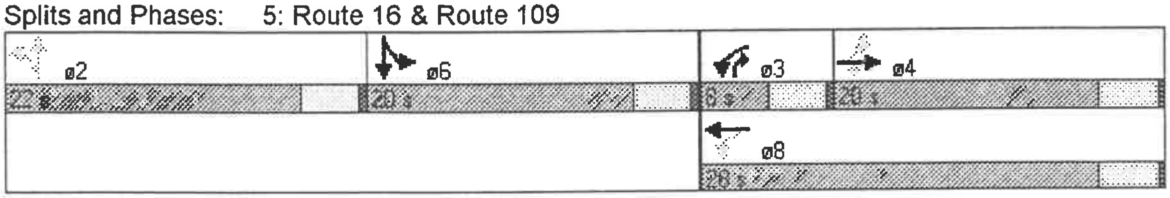
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱	↰	↑↱			↰	↱		✣	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.998				0.850		0.910	
Flt Protected		0.999		0.950				0.953			0.991	
Satd. Flow (prot)	0	3452	1599	1668	1877	0	0	1793	1599	0	1583	0
Flt Permitted		0.949		0.200				0.222			0.991	
Satd. Flow (perm)	0	3279	1599	351	1877	0	0	418	1599	0	1583	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			588		1				109		18	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	10	619	570	120	287	3	338	5	106	5	4	17
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	10	638	588	124	296	3	348	5	109	5	4	18
Lane Group Flow (vph)	0	648	588	124	299	0	0	353	109	0	27	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	22.0	22.0	8.0	20.0	20.0	0.0
Total Split (%)	29%	29%	29%	11%	40%	0%	31%	31%	11%	29%	29%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		18.0	18.0	4.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		15.2	15.2	23.3	21.4			18.2	4.0		6.2	
Actuated g/C Ratio		0.26	0.26	0.38	0.37			0.31	0.07		0.11	
v/c Ratio		0.75	0.69	0.56	0.43			2.69	0.52		0.15	
Uniform Delay, d1		20.1	0.0	12.2	13.3			20.3	0.0		7.9	
Delay		21.6	2.4	14.4	13.7			333.2	7.9		15.3	
LOS		C	A	B	B			F	A		B	
Approach Delay		12.5			13.9			256.4			15.3	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		B			B			F			B	
Queue Length 50th (ft)		111	0	28	73			~225	0		3	
Queue Length 95th (ft)		#177	71	#68	136			#376	#47		20	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 57.9
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 2.69
Intersection Signal Delay: 65.3 Intersection LOS: E
Intersection Capacity Utilization 69.9% ICU Level of Service B
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



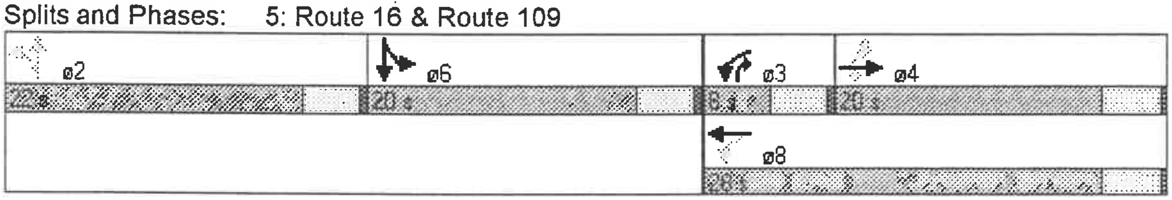
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.999				0.850		0.910	
Flt Protected		0.999		0.950				0.953			0.991	
Satd. Flow (prot)	0	3452	1599	1668	1879	0	0	1793	1599	0	1583	0
Flt Permitted		0.949		0.200				0.222			0.991	
Satd. Flow (perm)	0	3279	1599	351	1879	0	0	418	1599	0	1583	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			588		1				109		18	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	10	710	570	120	298	3	338	5	106	5	4	17
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	10	732	588	124	307	3	348	5	109	5	4	18
Lane Group Flow (vph)	0	742	588	124	310	0	0	353	109	0	27	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	22.0	22.0	8.0	20.0	20.0	0.0
Total Split (%)	29%	29%	29%	11%	40%	0%	31%	31%	11%	29%	29%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		18.0	18.0	4.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		16.1	16.1	24.0	22.3			18.1	4.0		6.2	
Actuated g/C Ratio		0.27	0.27	0.39	0.38			0.31	0.07		0.11	
v/c Ratio		0.83	0.68	0.56	0.43			2.74	0.52		0.15	
Uniform Delay, d1		20.4	0.0	12.0	13.2			20.7	0.0		8.0	
Delay		26.2	2.4	14.4	13.8			327.5	7.8		15.3	
LOS		C	A	B	B			F	A		B	
Approach Delay		15.7			13.9			252.1			15.3	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		B			B			F			B	
Queue Length 50th (ft)		132	0	28	77			~225	0		3	
Queue Length 95th (ft)		#232	71	#68	141			#376	#47		20	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 58.6
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 2.74
Intersection Signal Delay: 63.8 Intersection LOS: E
Intersection Capacity Utilization 73.1% ICU Level of Service C
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



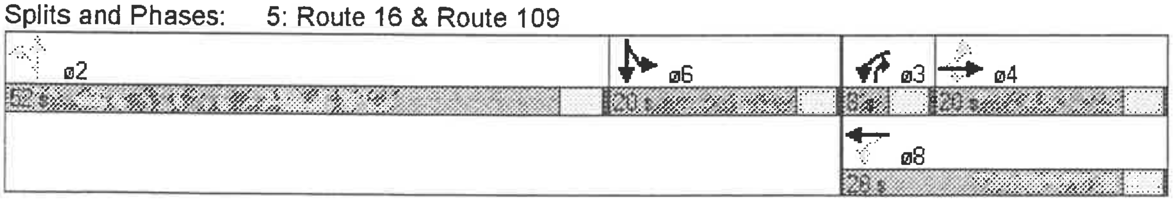
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↑	↱	↰	↑↱			↰↑	↱		↰↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.998				0.850		0.943	
Flt Protected		0.998		0.950				0.953			0.990	
Satd. Flow (prot)	0	3448	1599	1668	1877	0	0	1793	1599	0	1639	0
Flt Permitted		0.800		0.386				0.213			0.990	
Satd. Flow (perm)	0	2764	1599	678	1877	0	0	401	1599	0	1639	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			551		1				94		8	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	13	241	534	177	398	6	427	4	98	4	7	8
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	13	248	551	182	410	6	440	4	101	4	7	8
Lane Group Flow (vph)	0	261	551	182	416	0	0	444	101	0	19	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	52.0	52.0	8.0	20.0	20.0	0.0
Total Split (%)	20%	20%	20%	8%	28%	0%	52%	52%	8%	20%	20%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		48.0	48.0	4.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		15.0	15.0	23.0	23.0			48.0	4.0		6.3	
Actuated g/C Ratio		0.17	0.17	0.26	0.26			0.54	0.04		0.07	
v/c Ratio		0.56	0.76	0.83	0.86			2.07	0.63		0.15	
Uniform Delay, d1		34.1	0.0	29.2	31.5			20.7	2.8		22.5	
Delay		34.6	3.6	44.3	38.4			294.1	16.5		29.4	
LOS		C	A	D	D			F	B		C	
Approach Delay		13.6			40.2			242.6			29.4	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		B			D			F			C	
Queue Length 50th (ft)		71	0	85	222			~403	4		6	
Queue Length 95th (ft)		114	102	#199	#390			#600	#71		27	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 89.4
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 2.07
Intersection Signal Delay: 85.0 Intersection LOS: F
Intersection Capacity Utilization 70.5% ICU Level of Service C
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.998				0.850		0.939	
Flt Protected		0.998		0.950				0.953			0.990	
Satd. Flow (prot)	0	3448	1599	1668	1877	0	0	1793	1599	0	1632	0
Flt Permitted		0.854		0.361				0.218			0.990	
Satd. Flow (perm)	0	2951	1599	634	1877	0	0	410	1599	0	1632	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			635		1				116		9	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	15	324	616	204	510	6	492	4	113	4	7	9
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	15	334	635	210	526	6	507	4	116	4	7	9
Lane Group Flow (vph)	0	349	635	210	532	0	0	511	116	0	20	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	27.0	27.0	8.0	20.0	20.0	0.0
Total Split (%)	27%	27%	27%	11%	37%	0%	36%	36%	11%	27%	27%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		23.0	23.0	4.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		13.8	13.8	21.8	21.8			23.1	4.0		6.2	
Actuated g/C Ratio		0.22	0.22	0.35	0.35			0.37	0.06		0.10	
v/c Ratio		0.54	0.75	0.74	0.82			3.41	0.55		0.12	
Uniform Delay, d1		21.8	0.0	16.0	18.8			20.0	0.0		14.2	
Delay		21.9	2.6	23.5	22.0			367.9	9.4		20.5	
LOS		C	A	C	C			F	A		C	
Approach Delay		9.5			22.4			301.6			20.5	

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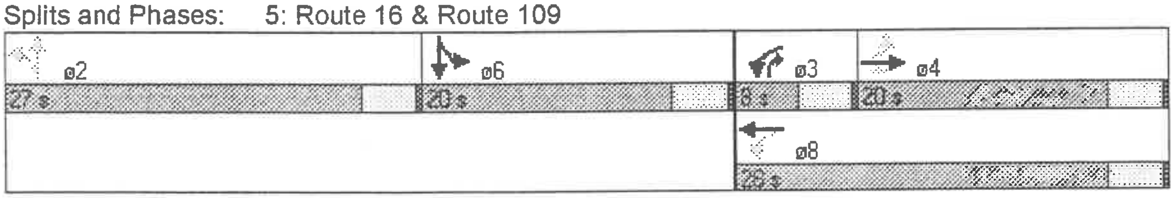
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		A			C			F			C	
Queue Length 50th (ft)		62	0	58	180			~371	0		4	
Queue Length 95th (ft)		102	83	#139	#341			#553	#53		20	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 63.1
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 3.41
Intersection Signal Delay: 90.8 Intersection LOS: F
Intersection Capacity Utilization 82.7% ICU Level of Service D
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑	↱	↰	↑↱			↰	↱		✣	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	12	10	12	12	12	12	12	10	10	10
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.999				0.850		0.924	
Flt Protected		0.998		0.950				0.953			0.988	
Satd. Flow (prot)	0	3448	1599	1668	1879	0	0	1793	1599	0	1603	0
Flt Permitted		0.751		0.367				0.272			0.988	
Satd. Flow (perm)	0	2595	1599	644	1879	0	0	512	1599	0	1603	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			635		1				116		9	
Headway Factor	1.04	1.04	1.00	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.09	1.09
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		811			1422			1775			576	
Travel Time (s)		18.4			32.3			40.3			13.1	
Volume (vph)	15	334	616	204	613	6	492	4	113	4	3	9
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	15	344	635	210	632	6	507	4	116	4	3	9
Lane Group Flow (vph)	0	359	635	210	638	0	0	511	116	0	16	0
Turn Type	Perm		Perm	pm+pt			custom		Over	Split		
Protected Phases		4		3	8				3	6	6	
Permitted Phases	4		4	8			2	2				
Detector Phases	4	4	4	3	8		2	2	3	6	6	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	8.0	20.0		20.0	20.0	8.0	20.0	20.0	
Total Split (s)	20.0	20.0	20.0	8.0	28.0	0.0	22.0	22.0	8.0	20.0	20.0	0.0
Total Split (%)	29%	29%	29%	11%	40%	0%	31%	31%	11%	29%	29%	0%
Maximum Green (s)	16.0	16.0	16.0	4.0	24.0		18.0	18.0	4.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lag	Lead					Lead			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes					Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		Min	Min	None	Min	Min	
Walk Time (s)	5.0	5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0	11.0		11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0	0		0		0	0		0	0	
Act Effct Green (s)		16.0	16.0	24.0	24.0			18.0	4.0		6.0	
Actuated g/C Ratio		0.27	0.27	0.40	0.40			0.30	0.07		0.10	
v/c Ratio		0.52	0.71	0.64	0.85			3.32	0.54		0.09	
Uniform Delay, d1		18.7	0.0	12.5	16.3			21.0	0.0		10.7	
Delay		19.3	2.3	17.1	23.1			355.7	8.1		18.1	
LOS		B	A	B	C			F	A		B	
Approach Delay		8.5			21.6			291.4			18.1	

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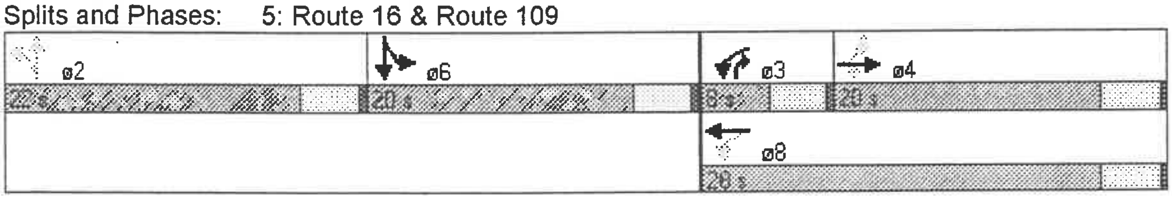
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		A			C			F			B	
Queue Length 50th (ft)		57	0	50	199			~336	0		2	
Queue Length 95th (ft)		96	74	#113	#393			#508	#50		16	
Internal Link Dist (ft)		731			1342			1695			496	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 60
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 3.32
Intersection Signal Delay: 84.4 Intersection LOS: F
Intersection Capacity Utilization 88.6% ICU Level of Service D
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 5: Route 16 & Route 109



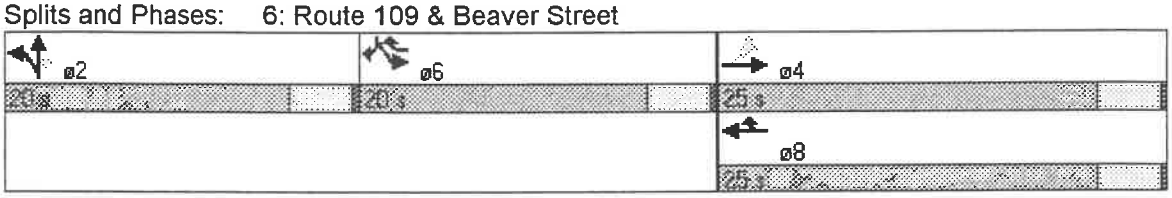
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50	50		50
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.592					0.950			0.950		
Satd. Flow (perm)	0	2116	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						409			126			160
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	60	369	0	0	1062	397	41	76	122	238	0	155
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	62	380	0	0	1095	409	42	78	126	245	0	160
Lane Group Flow (vph)	0	442	0	0	1095	409	42	78	126	245	0	160
Turn Type	Perm					custom	Split		Perm	custom		custom
Protected Phases		4			8	6 8	2	2		6		6
Permitted Phases	4					8			2	6		6
Detector Phases	4	4			8	6 8	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0		20.0	20.0	20.0	20.0		20.0
Total Split (s)	25.0	25.0	0.0	0.0	25.0	45.0	20.0	20.0	20.0	20.0	0.0	20.0
Total Split (%)	38%	38%	0%	0%	38%	69%	31%	31%	31%	31%	0%	31%
Maximum Green (s)	21.0	21.0			21.0		16.0	16.0	16.0	16.0		16.0
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None		Coord	Coord	Coord	Min		Min
Walk Time (s)	5.0	5.0			5.0		5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0		0	0	0	0		0
Act Effct Green (s)		21.0			21.0	36.1	20.9	20.9	20.9	11.1		11.1
Actuated g/C Ratio		0.32			0.32	0.56	0.32	0.32	0.32	0.17		0.17
v/c Ratio		0.65			0.95	0.38	0.07	0.13	0.21	0.41		0.39
Uniform Delay, d1		18.8			21.5	0.0	15.3	15.6	0.0	24.0		0.0
Delay		19.4			33.2	0.7	17.4	17.6	4.5	23.3		4.4
LOS		B			C	A	B	B	A	C		A
Approach Delay		19.4			24.4			10.9				
Approach LOS		B			C			B				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		77			219	0	11	21	0	45		0
Queue Length 95th (ft)		124			#344	25	35	55	34	68		37
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 20.9 Intersection LOS: C
Intersection Capacity Utilization 66.2% ICU Level of Service B
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Route 109 & Beaver Street



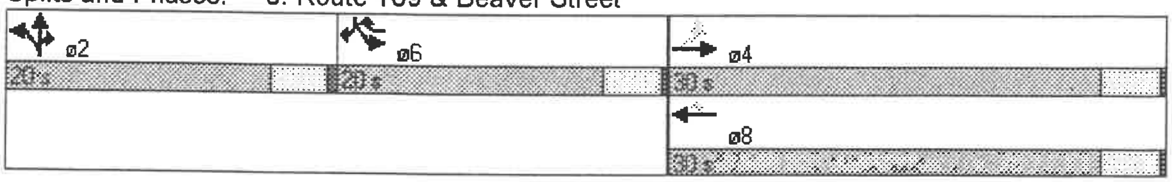
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50	50		50
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.569					0.950			0.950		
Satd. Flow (perm)	0	2034	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						472			144			184
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	69	425	0	0	1225	458	47	87	140	274	0	178
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	71	438	0	0	1263	472	48	90	144	282	0	184
Lane Group Flow (vph)	0	509	0	0	1263	472	48	90	144	282	0	184
Turn Type	Perm					pm+ov	Split		Prot	custom		custom
Protected Phases		4			8	6	2	2	2	6		6
Permitted Phases	4					8				6		6
Detector Phases	4	4			8	6	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0	20.0		20.0
Total Split (s)	30.0	30.0	0.0	0.0	30.0	20.0	20.0	20.0	20.0	20.0	0.0	20.0
Total Split (%)	43%	43%	0%	0%	43%	29%	29%	29%	29%	29%	0%	29%
Maximum Green (s)	26.0	26.0			26.0	16.0	16.0	16.0	16.0	16.0		16.0
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None	Min	Coord	Coord	Coord	Min		Min
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0	0		0
Act Effct Green (s)		26.0			26.0	42.3	19.7	19.7	19.7	12.3		12.3
Actuated g/C Ratio		0.37			0.37	0.60	0.28	0.28	0.28	0.18		0.18
v/c Ratio		0.67			0.95	0.41	0.10	0.17	0.26	0.46		0.42
Uniform Delay, d1		18.4			21.4	0.0	18.5	19.0	0.0	25.9		0.0
Delay		19.1			32.3	0.6	20.7	21.0	4.7	25.2		4.4
LOS		B			C	A	C	C	A	C		A
Approach Delay		19.1			23.6			12.6				
Approach LOS		B			C			B				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		94			271	0	15	29	0	56		0
Queue Length 95th (ft)		147			#410	26	42	67	38	85		43
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 20.8 Intersection LOS: C
Intersection Capacity Utilization 73.8% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Route 109 & Beaver Street



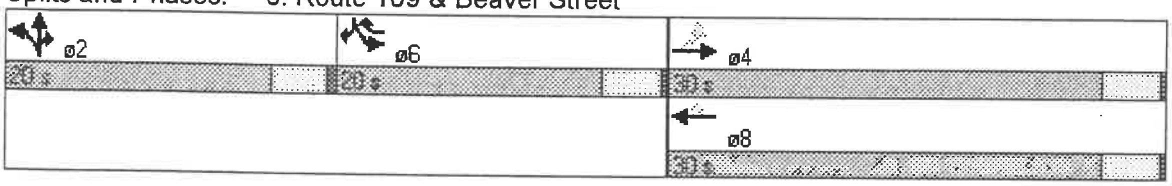
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50	50		50
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.569					0.950			0.950		
Satd. Flow (perm)	0	2034	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						659			144			184
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	69	425	0	0	1225	686	47	87	140	299	0	178
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	71	438	0	0	1263	707	48	90	144	308	0	184
Lane Group Flow (vph)	0	509	0	0	1263	707	48	90	144	308	0	184
Turn Type	Perm					pm+ov	Split		custom	custom		custom
Protected Phases		4			8	6	2	2	2	6		6
Permitted Phases	4					8			2	6		6
Detector Phases	4	4			8	6	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0	20.0		20.0
Total Split (s)	30.0	30.0	0.0	0.0	30.0	20.0	20.0	20.0	20.0	20.0	0.0	20.0
Total Split (%)	43%	43%	0%	0%	43%	29%	29%	29%	29%	29%	0%	29%
Maximum Green (s)	26.0	26.0			26.0	16.0	16.0	16.0	16.0	16.0		16.0
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None	Min	Coord	Coord	Coord	Min		Min
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0	0		0
Act Effct Green (s)		26.0			26.0	43.6	18.4	18.4	18.4	13.6		13.6
Actuated g/C Ratio		0.37			0.37	0.62	0.26	0.26	0.26	0.19		0.19
v/c Ratio		0.67			0.95	0.57	0.10	0.18	0.27	0.46		0.40
Uniform Delay, d1		18.4			21.4	0.4	19.5	19.9	0.0	24.9		0.0
Delay		19.1			32.3	0.8	21.4	21.8	4.8	24.4		4.3
LOS		B			C	A	C	C	A	C		A
Approach Delay		19.1			21.0			13.0				
Approach LOS		B			C			B				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		94			271	6	16	31	0	59		0
Queue Length 95th (ft)		147			#410	39	42	67	38	92		43
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 19.4 Intersection LOS: B
Intersection Capacity Utilization 74.5% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles

Splits and Phases: 6: Route 109 & Beaver Street



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50	50		50
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.632					0.950			0.950		
Satd. Flow (perm)	0	2259	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						399			68			196
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	125	745	0	0	733	387	61	131	451	560	0	190
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	129	768	0	0	756	399	63	135	465	577	0	196
Lane Group Flow (vph)	0	897	0	0	756	399	63	135	465	577	0	196
Turn Type	Perm					pm+ov	Split		Prot	custom		custom
Protected Phases		4			8	6	2	2	2	6		6
Permitted Phases	4					8				6		6
Detector Phases	4	4			8	6	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0	20.0		20.0
Total Split (s)	41.0	41.0	0.0	0.0	41.0	20.0	29.0	29.0	29.0	20.0	0.0	20.0
Total Split (%)	46%	46%	0%	0%	46%	22%	32%	32%	32%	22%	0%	22%
Maximum Green (s)	37.0	37.0			37.0	16.0	25.0	25.0	25.0	16.0		16.0
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None	Min	Coord	Coord	Coord	Min		Min
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0	0		0
Act Effct Green (s)		36.8			36.8	56.8	25.2	25.2	25.2	16.0		16.0
Actuated g/C Ratio		0.41			0.41	0.63	0.28	0.28	0.28	0.18		0.18
v/c Ratio		0.97			0.52	0.35	0.13	0.26	0.94	0.94		0.44
Uniform Delay, d1		26.1			19.9	0.0	24.2	25.1	26.9	36.5		0.0
Delay		43.4			20.2	0.8	24.8	25.7	48.6	53.4		5.3
LOS		D			C	A	C	C	D	D		A
Approach Delay		43.4			13.5			41.7				
Approach LOS		D			B			D				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		255			164	0	27	60	216	168		0
Queue Length 95th (ft)		#392			218	30	58	107	#420	#268		56
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 32.7 Intersection LOS: C
Intersection Capacity Utilization 82.8% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Route 109 & Beaver Street

ø2 23 s	ø6 20 s	ø4 41 s
		ø8 41 s

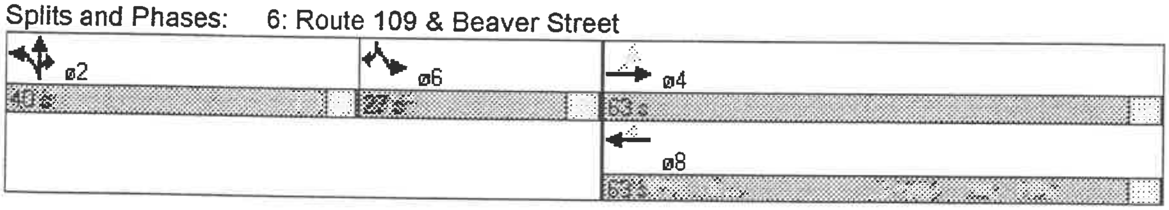
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50	50		50
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.577					0.950			0.950		
Satd. Flow (perm)	0	2062	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						460			60			226
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	144	859	0	0	845	446	70	151	520	646	0	219
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	148	886	0	0	871	460	72	156	536	666	0	226
Lane Group Flow (vph)	0	1034	0	0	871	460	72	156	536	666	0	226
Turn Type	Perm					Perm	Split		Prot	custom		custom
Protected Phases		4			8		2	2	2	6		6
Permitted Phases	4					8				6		6
Detector Phases	4	4			8	8	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0	20.0		20.0
Total Split (s)	63.0	63.0	0.0	0.0	63.0	63.0	40.0	40.0	40.0	27.0	0.0	27.0
Total Split (%)	48%	48%	0%	0%	48%	48%	31%	31%	31%	21%	0%	21%
Maximum Green (s)	59.0	59.0			59.0	59.0	36.0	36.0	36.0	23.0		23.0
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None	None	Min	Min	Min	Min		Min
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0	0		0
Act Effct Green (s)		59.0			59.0	59.0	36.0	36.0	36.0	23.0		23.0
Actuated g/C Ratio		0.45			0.45	0.45	0.28	0.28	0.28	0.18		0.18
v/c Ratio		1.10			0.54	0.47	0.15	0.30	1.10	1.09		0.48
Uniform Delay, d1		35.5			25.6	0.0	35.4	37.1	41.2	53.5		0.0
Delay		86.9			25.9	1.9	35.8	37.5	96.7	99.9		5.9
LOS		F			C	A	D	D	F	F		A
Approach Delay		86.9			17.6			78.9				
Approach LOS		F			B			E				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~521			273	0	46	104	~476	~324		0
Queue Length 95th (ft)		#656			335	59	86	167	#700	#445		71
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)												
95th Up Block Time (%)									38%			
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Natural Cycle: 130
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.10
Intersection Signal Delay: 60.0 Intersection LOS: E
Intersection Capacity Utilization 93.4% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Route 109 & Beaver Street



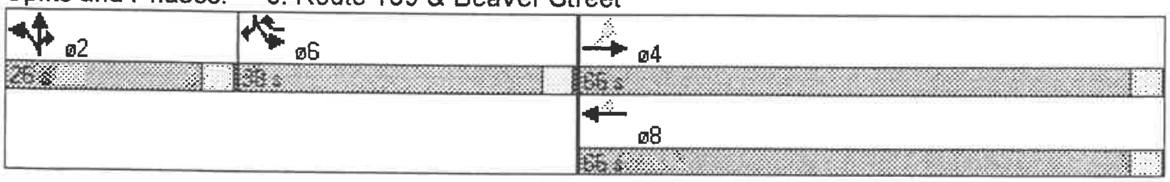
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰↑			↑↑	↱	↰	↑	↱	↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.(
Leading Detector (ft)	50	50			50	50	50	50	50	50		5(
Trailing Detector (ft)	0	0			0	0	0	0	0	0		0
Turning Speed (mph)	15		9	15		9	15		9	15		ε
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt						0.850			0.850			0.850
Flt Protected		0.993					0.950			0.950		
Satd. Flow (prot)	0	3549	0	0	3574	1599	1787	1881	1599	3467	0	1599
Flt Permitted		0.585					0.950			0.950		
Satd. Flow (perm)	0	2091	0	0	3574	1599	1787	1881	1599	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						330			63			194
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		850			1164			571			1702	
Travel Time (s)		19.3			26.5			13.0			38.7	
Volume (vph)	144	859	0	0	845	470	70	151	520	904	0	219
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	148	886	0	0	871	485	72	156	536	932	0	226
Lane Group Flow (vph)	0	1034	0	0	871	485	72	156	536	932	0	226
Turn Type	Perm					pm+ov	Split		Prot	custom		custom
Protected Phases		4			8	6	2	2	2	6		6
Permitted Phases	4					8				6		6
Detector Phases	4	4			8	6	2	2	2	6		6
Minimum Initial (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0		4.0
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0	20.0		20.0
Total Split (s)	66.0	66.0	0.0	0.0	66.0	38.0	26.0	26.0	26.0	38.0	0.0	38.0
Total Split (%)	51%	51%	0%	0%	51%	29%	20%	20%	20%	29%	0%	29%
Maximum Green (s)	62.0	62.0			62.0	34.0	22.0	22.0	22.0	34.0		34.0
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5		0.5
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0		3.0
Recall Mode	None	None			None	Min	Min	Min	Min	Min		Min
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0	11.0		11.0
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0	0		0
Act Effct Green (s)		62.0			62.0	100.0	22.0	22.0	22.0	34.1		34.1
Actuated g/C Ratio		0.48			0.48	0.77	0.17	0.17	0.17	0.26		0.26
v/c Ratio		1.04			0.51	0.37	0.24	0.49	1.66	1.03		0.40
Uniform Delay, d1		34.0			23.5	1.3	46.7	48.9	43.5	48.0		5.1
Delay		64.6			23.8	1.3	47.3	49.5	230.2	76.1		8.1
LOS		E			C	A	D	D	F	E		A
Approach Delay		64.6			15.7			176.0				
Approach LOS		E			B			F				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~493			261	28	53	121	~615	~431		18
Queue Length 95th (ft)		#628			320	56	100	193	#839	#561		88
Internal Link Dist (ft)		770			1084			491			1622	
50th Up Block Time (%)									28%			
95th Up Block Time (%)									48%			
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Natural Cycle: 130
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.66
Intersection Signal Delay: 68.5 Intersection LOS: E
Intersection Capacity Utilization 101.0% ICU Level of Service F
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6: Route 109 & Beaver Street



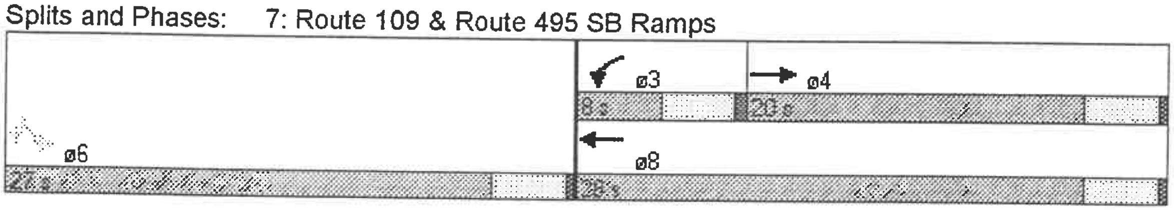
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												48
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	440	0	74	985	0	0	0	0	208	0	592
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	454	0	76	1015	0	0	0	0	214	0	610
Lane Group Flow (vph)	0	454	0	76	1015	0	0	0	0	214	0	610
Turn Type				Prot						custom		custom
Protected Phases		4		3	8					6		6
Permitted Phases												
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	20.0	0.0	8.0	28.0	0.0	0.0	0.0	0.0	27.0	0.0	27.0
Total Split (%)	0%	36%	0%	15%	51%	0%	0%	0%	0%	49%	0%	49%
Maximum Green (s)		16.0		4.0	24.0					23.0		23.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		13.9		4.0	20.3					26.7		26.7
Actuated g/C Ratio		0.25		0.07	0.37					0.49		0.49
v/c Ratio		0.50		0.58	0.77					0.13		0.76
Uniform Delay, d1		17.6		25.5	14.6					8.2		11.1
Delay		17.7		28.4	16.0					8.8		19.1
LOS		B		C	B					A		B
Approach Delay		17.7			16.9							
Approach LOS		B			B							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		68		20	185					18		139
Queue Length 95th (ft)		98		m#63	246					38		#346
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 16.9 Intersection LOS: B
Intersection Capacity Utilization 72.5% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



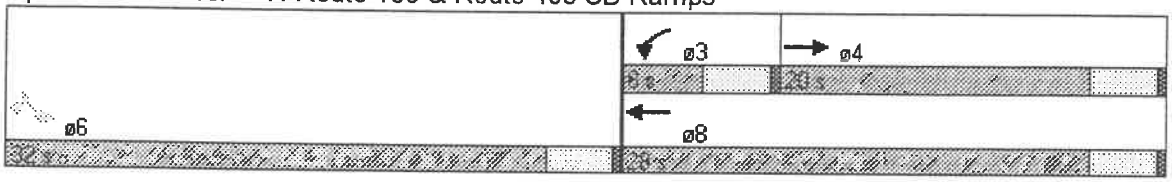
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												20
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	507	0	85	1136	0	0	0	0	240	0	683
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	523	0	88	1171	0	0	0	0	247	0	704
Lane Group Flow (vph)	0	523	0	88	1171	0	0	0	0	247	0	704
Turn Type				Prot						custom		custom
Protected Phases		4		3	8							
Permitted Phases										6		6
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	20.0	0.0	8.0	28.0	0.0	0.0	0.0	0.0	32.0	0.0	32.0
Total Split (%)	0%	33%	0%	13%	47%	0%	0%	0%	0%	53%	0%	53%
Maximum Green (s)		16.0		4.0	24.0					28.0		28.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		16.9		4.0	23.2					28.8		28.8
Actuated g/C Ratio		0.28		0.07	0.39					0.48		0.48
v/c Ratio		0.52		0.74	0.85					0.15		0.91
Uniform Delay, d1		18.2		28.3	16.1					9.2		14.6
Delay		18.9		52.4	18.5					9.2		28.1
LOS		B		D	B					A		C
Approach Delay		18.9			20.8							
Approach LOS		B			C							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		85		32	191					24		198
Queue Length 95th (ft)		128		#99	#271					42		#437
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												22%
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 21.3 Intersection LOS: C
Intersection Capacity Utilization 82.6% ICU Level of Service D
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



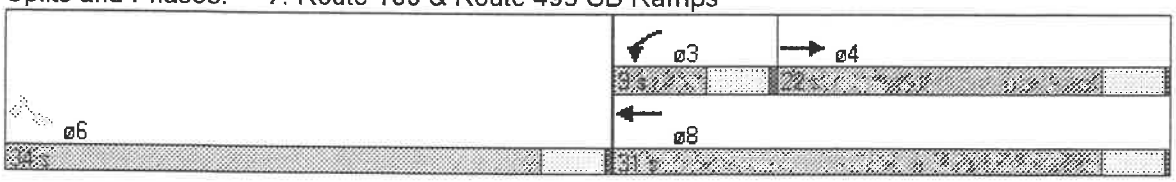
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												10
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	507	0	85	1364	0	0	0	0	240	0	683
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	523	0	88	1406	0	0	0	0	247	0	704
Lane Group Flow (vph)	0	523	0	88	1406	0	0	0	0	247	0	704
Turn Type				Prot						custom		custom
Protected Phases		4		3	8							
Permitted Phases										6		6
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	22.0	0.0	9.0	31.0	0.0	0.0	0.0	0.0	34.0	0.0	34.0
Total Split (%)	0%	34%	0%	14%	48%	0%	0%	0%	0%	52%	0%	52%
Maximum Green (s)		18.0		5.0	27.0					30.0		30.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		19.8		5.0	27.0					30.0		30.0
Actuated g/C Ratio		0.30		0.08	0.42					0.46		0.46
v/c Ratio		0.48		0.64	0.95					0.15		0.95
Uniform Delay, d1		18.4		30.1	17.5					10.6		17.2
Delay		19.5		42.0	27.8					10.3		33.5
LOS		B		D	C					B		C
Approach Delay		19.5			28.6							
Approach LOS		B			C							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		92		35	271					27		228
Queue Length 95th (ft)		135		#97	#417					46		#473
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												29%
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 26.6 Intersection LOS: C
Intersection Capacity Utilization 89.1% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



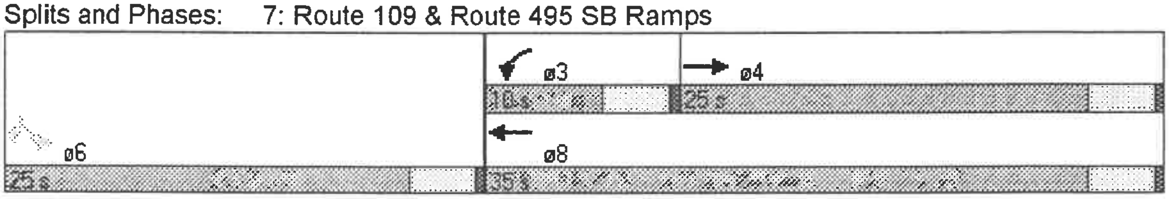
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												188
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	1068	0	140	673	0	0	0	0	286	0	586
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	1101	0	144	694	0	0	0	0	295	0	604
Lane Group Flow (vph)	0	1101	0	144	694	0	0	0	0	295	0	604
Turn Type				Prot						custom		custom
Protected Phases		4		3	8							
Permitted Phases										6		6
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	25.0	0.0	10.0	35.0	0.0	0.0	0.0	0.0	25.0	0.0	25.0
Total Split (%)	0%	42%	0%	17%	58%	0%	0%	0%	0%	42%	0%	42%
Maximum Green (s)		21.0		6.0	31.0					21.0		21.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		20.6		6.0	30.6					21.4		21.4
Actuated g/C Ratio		0.34		0.10	0.51					0.36		0.36
v/c Ratio		0.90		0.80	0.38					0.24		0.87
Uniform Delay, d1		18.7		26.4	8.9					13.5		12.1
Delay		23.5		33.6	12.0					13.9		22.8
LOS		C		C	B					B		C
Approach Delay		23.5			15.7							
Approach LOS		C			B							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		192		51	110					38		129
Queue Length 95th (ft)		#305		m#105	176					63		#333
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 20.1 Intersection LOS: C
Intersection Capacity Utilization 63.3% ICU Level of Service B
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



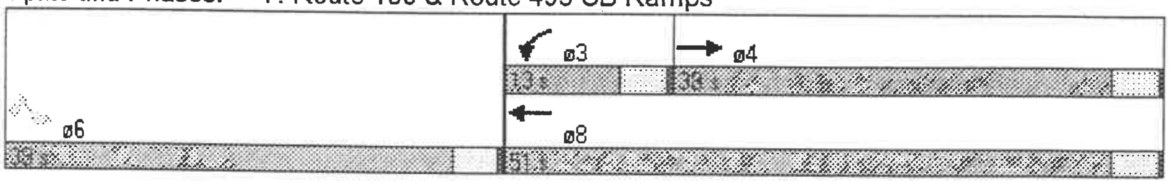
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												145
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	1232	0	161	776	0	0	0	0	330	0	676
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	1270	0	166	800	0	0	0	0	340	0	697
Lane Group Flow (vph)	0	1270	0	166	800	0	0	0	0	340	0	697
Turn Type				Prot						custom		custom
Protected Phases		4		3	8							
Permitted Phases										6		6
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	38.0	0.0	13.0	51.0	0.0	0.0	0.0	0.0	39.0	0.0	39.0
Total Split (%)	0%	42%	0%	14%	57%	0%	0%	0%	0%	43%	0%	43%
Maximum Green (s)		34.0		9.0	47.0					35.0		35.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		33.7		9.0	46.7					35.3		35.3
Actuated g/C Ratio		0.37		0.10	0.52					0.39		0.39
v/c Ratio		0.95		0.93	0.43					0.25		0.97
Uniform Delay, d1		27.3		40.1	13.4					18.4		21.2
Delay		36.1		80.6	13.5					18.7		45.3
LOS		D		F	B					B		D
Approach Delay		36.1			25.1							
Approach LOS		D			C							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		360		95	139					65		306
Queue Length 95th (ft)		#504		#216	184					97		#573
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												35%
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 33.0 Intersection LOS: C
Intersection Capacity Utilization 71.9% ICU Level of Service C
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



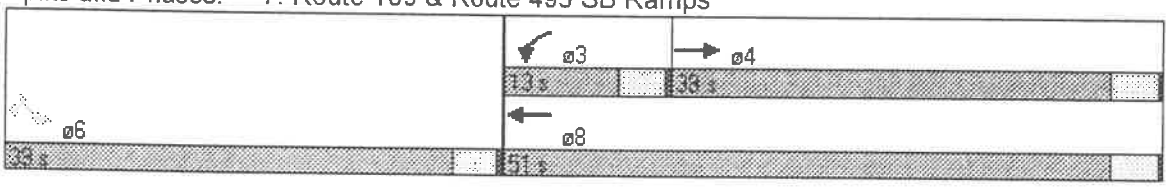
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑		↰	↑↑					↰↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50		50
Trailing Detector (ft)		0		0	0					0		0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	0.91	1.00
Frt												0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	3574	0	1787	3574	0	0	0	0	3467	0	1599
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												136
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1164			1273			553			471	
Travel Time (s)		26.5			28.9			12.6			10.7	
Volume (vph)	0	1232	0	161	800	0	0	0	0	330	0	676
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	0	1270	0	166	825	0	0	0	0	340	0	697
Lane Group Flow (vph)	0	1270	0	166	825	0	0	0	0	340	0	697
Turn Type				Prot						custom		custom
Protected Phases		4		3	8							
Permitted Phases										6		6
Detector Phases		4		3	8					6		6
Minimum Initial (s)		4.0		4.0	4.0					4.0		4.0
Minimum Split (s)		20.0		8.0	20.0					20.0		20.0
Total Split (s)	0.0	38.0	0.0	13.0	51.0	0.0	0.0	0.0	0.0	39.0	0.0	39.0
Total Split (%)	0%	42%	0%	14%	57%	0%	0%	0%	0%	43%	0%	43%
Maximum Green (s)		34.0		9.0	47.0					35.0		35.0
Yellow Time (s)		3.5		3.5	3.5					3.5		3.5
All-Red Time (s)		0.5		0.5	0.5					0.5		0.5
Lead/Lag		Lag		Lead								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0		3.0
Recall Mode		None		None	None					Coord		Coord
Walk Time (s)		5.0			5.0					5.0		5.0
Flash Dont Walk (s)		11.0			11.0					11.0		11.0
Pedestrian Calls (#/hr)		0			0					0		0
Act Effct Green (s)		33.7		9.0	46.7					35.3		35.3
Actuated g/C Ratio		0.37		0.10	0.52					0.39		0.39
v/c Ratio		0.95		0.93	0.44					0.25		0.98
Uniform Delay, d1		27.3		40.1	13.5					18.4		21.7
Delay		36.1		80.6	13.7					18.7		47.5
LOS		D		F	B					B		D
Approach Delay		36.1			24.9							
Approach LOS		D			C							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		360		95	145					65		311
Queue Length 95th (ft)		#504		#216	191					97		#580
Internal Link Dist (ft)		1084			1193			473			391	
50th Up Block Time (%)												
95th Up Block Time (%)												36%
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 33.3 Intersection LOS: C
Intersection Capacity Utilization 72.6% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Route 109 & Route 495 SB Ramps



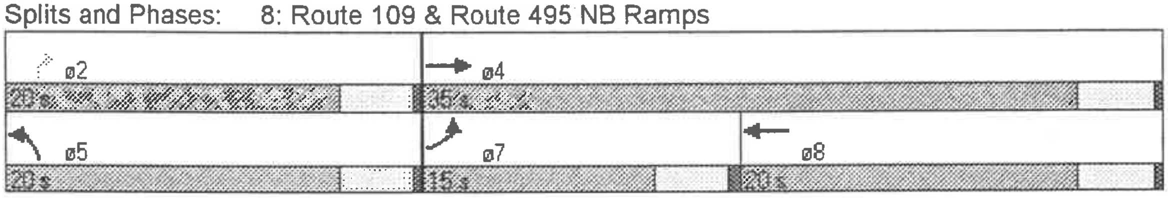
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									216			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	179	455	0	0	557	0	398	0	210	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	185	469	0	0	574	0	410	0	216	0	0	0
Lane Group Flow (vph)	185	469	0	0	574	0	410	0	216	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	15.0	35.0	0.0	0.0	20.0	0.0	20.0	0.0	20.0	0.0	0.0	0.0
Total Split (%)	27%	64%	0%	0%	36%	0%	36%	0%	36%	0%	0%	0%
Maximum Green (s)	11.0	31.0			16.0		16.0		16.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	9.5	24.8			13.5		22.2		22.2			
Actuated g/C Ratio	0.17	0.45			0.25		0.40		0.40			
v/c Ratio	0.60	0.29			0.66		0.29		0.28			
Uniform Delay, d1	22.2	9.0			18.6		11.7		0.0			
Delay	12.9	8.0			18.4		13.6		3.0			
LOS	B	A			B		B		A			
Approach Delay		9.4			18.4							
Approach LOS		A			B							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	55	63			88		48		0			
Queue Length 95th (ft)	107	86			125		87		36			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 12.4 Intersection LOS: B
Intersection Capacity Utilization 47.8% ICU Level of Service A

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									249			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	206	525	0	0	642	0	459	0	242	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	212	541	0	0	662	0	473	0	249	0	0	0
Lane Group Flow (vph)	212	541	0	0	662	0	473	0	249	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	15.0	35.0	0.0	0.0	20.0	0.0	20.0	0.0	20.0	0.0	0.0	0.0
Total Split (%)	27%	64%	0%	0%	36%	0%	36%	0%	36%	0%	0%	0%
Maximum Green (s)	11.0	31.0			16.0		16.0		16.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	10.0	28.3			14.4		18.7		18.7			
Actuated g/C Ratio	0.18	0.51			0.26		0.34		0.34			
v/c Ratio	0.65	0.29			0.71		0.40		0.35			
Uniform Delay, d1	20.9	7.6			18.4		13.9		0.0			
Delay	21.6	7.2			18.3		15.1		2.9			
LOS	C	A			B		B		A			
Approach Delay		11.3			18.3							
Approach LOS		B			B							

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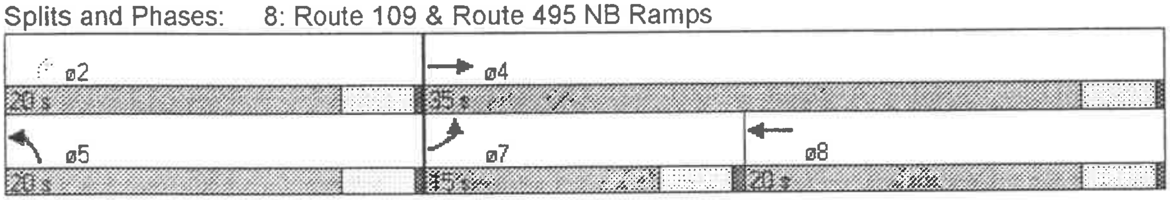
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	64	42			98		64		0			
Queue Length 95th (ft)	#124	64			146		101		39			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 13.3 Intersection LOS: B
Intersection Capacity Utilization 53.6% ICU Level of Service A
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



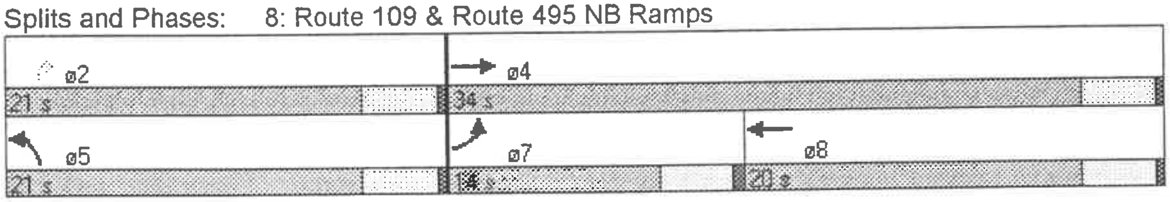
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									249			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	206	525	0	0	642	0	687	0	242	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	212	541	0	0	662	0	708	0	249	0	0	0
Lane Group Flow (vph)	212	541	0	0	662	0	708	0	249	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	14.0	34.0	0.0	0.0	20.0	0.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	25%	62%	0%	0%	36%	0%	38%	0%	38%	0%	0%	0%
Maximum Green (s)	10.0	30.0			16.0		17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	9.5	27.8			14.4		19.2		19.2			
Actuated g/C Ratio	0.17	0.51			0.26		0.35		0.35			
v/c Ratio	0.69	0.30			0.71		0.59		0.35			
Uniform Delay, d1	21.3	7.9			18.4		14.7		0.0			
Delay	25.3	7.6			18.3		15.8		2.7			
LOS	C	A			B		B		A			
Approach Delay		12.6			18.3							
Approach LOS		B			B							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	65	44			98		101		0			
Queue Length 95th (ft)	#144	67			146		151		38			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 14.1 Intersection LOS: B
Intersection Capacity Utilization 60.3% ICU Level of Service B
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									126			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	399	952	0	0	641	0	241	0	183	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	411	981	0	0	661	0	248	0	189	0	0	0
Lane Group Flow (vph)	411	981	0	0	661	0	248	0	189	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	20.0	40.0	0.0	0.0	20.0	0.0	20.0	0.0	20.0	0.0	0.0	0.0
Total Split (%)	33%	67%	0%	0%	33%	0%	33%	0%	33%	0%	0%	0%
Maximum Green (s)	16.0	36.0			16.0		16.0		16.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	15.6	34.4			14.7		17.7		17.7			
Actuated g/C Ratio	0.26	0.57			0.25		0.30		0.30			
v/c Ratio	0.88	0.48			0.75		0.24		0.34			
Uniform Delay, d1	21.3	7.5			20.9		16.1		5.2			
Delay	16.8	11.4			20.9		17.1		7.4			
LOS	B	B			C		B		A			
Approach Delay		13.0			20.9							
Approach LOS		B			C							

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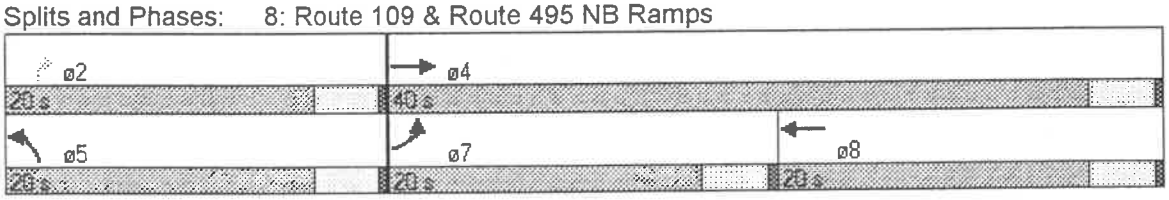
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	143	169			112		36		0			
Queue Length 95th (ft)	m#180	m199			164		62		57			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 15.1 Intersection LOS: B
Intersection Capacity Utilization 58.1% ICU Level of Service A
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



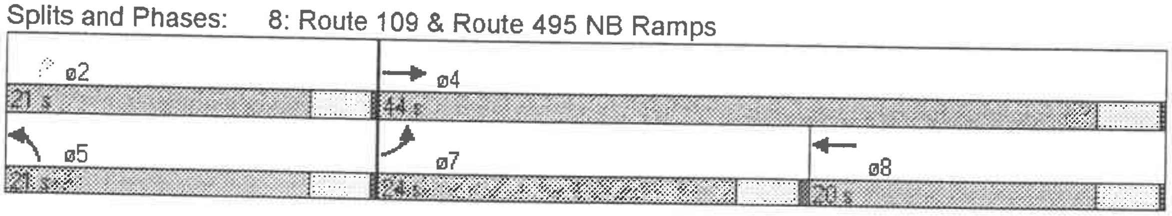
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									95			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	460	1098	0	0	739	0	278	0	211	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	474	1132	0	0	762	0	287	0	218	0	0	0
Lane Group Flow (vph)	474	1132	0	0	762	0	287	0	218	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	24.0	44.0	0.0	0.0	20.0	0.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	37%	68%	0%	0%	31%	0%	32%	0%	32%	0%	0%	0%
Maximum Green (s)	20.0	40.0			16.0		17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	19.2	39.0			15.8		18.0		18.0			
Actuated g/C Ratio	0.30	0.60			0.24		0.28		0.28			
v/c Ratio	0.90	0.53			0.88		0.30		0.43			
Uniform Delay, d1	21.9	7.6			23.7		18.5		10.4			
Delay	31.6	7.6			29.5		19.3		11.8			
LOS	C	A			C		B		B			
Approach Delay		14.7			29.5							
Approach LOS		B			C							

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	175	115			152		46		37			
Queue Length 95th (ft)	#332	158			#245		76		88			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 18.9 Intersection LOS: B
Intersection Capacity Utilization 65.5% ICU Level of Service B
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑			↑↑		↰↰		↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50		50			
Trailing Detector (ft)	0	0			0		0		0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1787	3574	0	0	3574	0	3467	0	1599	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									95			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1273			877			535			448	
Travel Time (s)		28.9			19.9			12.2			10.2	
Volume (vph)	460	1098	0	0	739	0	302	0	211	0	0	0
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	474	1132	0	0	762	0	311	0	218	0	0	0
Lane Group Flow (vph)	474	1132	0	0	762	0	311	0	218	0	0	0
Turn Type	Prot						custom		custom			
Protected Phases	7	4			8		5					
Permitted Phases							5		2			
Detector Phases	7	4			8		5		2			
Minimum Initial (s)	4.0	4.0			4.0		4.0		4.0			
Minimum Split (s)	8.0	20.0			20.0		8.0		20.0			
Total Split (s)	24.0	44.0	0.0	0.0	20.0	0.0	21.0	0.0	21.0	0.0	0.0	0.0
Total Split (%)	37%	68%	0%	0%	31%	0%	32%	0%	32%	0%	0%	0%
Maximum Green (s)	20.0	40.0			16.0		17.0		17.0			
Yellow Time (s)	3.5	3.5			3.5		3.5		3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5		0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			None		None		Coord			
Walk Time (s)		5.0			5.0				5.0			
Flash Dont Walk (s)		11.0			11.0				11.0			
Pedestrian Calls (#/hr)		0			0				0			
Act Effct Green (s)	19.2	39.0			15.8		18.0		18.0			
Actuated g/C Ratio	0.30	0.60			0.24		0.28		0.28			
v/c Ratio	0.90	0.53			0.88		0.32		0.43			
Uniform Delay, d1	21.9	7.6			23.7		18.7		10.4			
Delay	31.6	7.6			29.5		19.4		11.8			
LOS	C	A			C		B		B			
Approach Delay		14.7			29.5							
Approach LOS		B			C							

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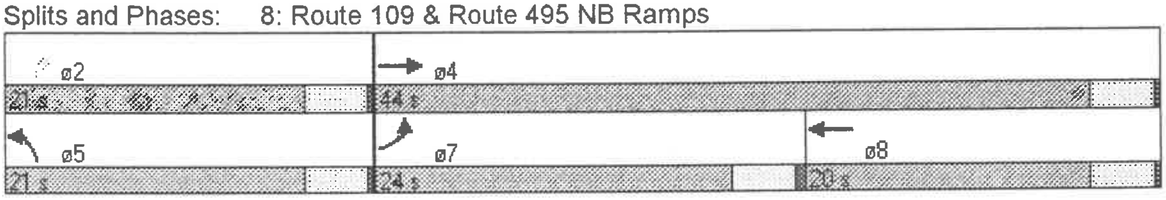
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	175	115			152		51		37			
Queue Length 95th (ft)	#332	158			#245		82		88			
Internal Link Dist (ft)		1193			797			455			368	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:NBR and 6:, Start of Green
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 18.9 Intersection LOS: B
Intersection Capacity Utilization 66.2% ICU Level of Service B
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: Route 109 & Route 495 NB Ramps



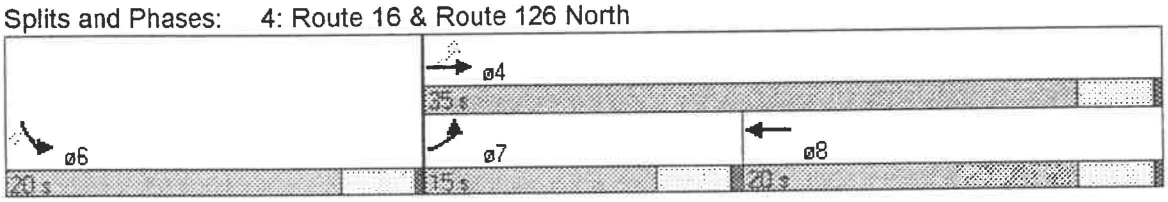
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.984			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1851	0	1668	1492
Flt Permitted	0.359				0.950	
Satd. Flow (perm)	630	1881	1851	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			12			264
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	332	674	252	33	42	256
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	342	695	260	34	43	264
Lane Group Flow (vph)	342	695	294	0	43	264
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	15.0	35.0	20.0	0.0	20.0	20.0
Total Split (%)	27%	64%	36%	0%	36%	36%
Maximum Green (s)	11.0	31.0	16.0		16.0	16.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	25.8	22.9	12.2		7.6	7.6
Actuated g/C Ratio	0.59	0.58	0.31		0.19	0.19
v/c Ratio	0.56	0.63	0.50		0.13	0.52
Uniform Delay, d1	3.9	4.9	10.7		13.3	0.0
Delay	4.6	5.6	12.9		15.5	3.3

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	A	A	B		B	A
Approach Delay		5.2	12.9		5.0	
Approach LOS		A	B		A	
Queue Length 50th (ft)	25	65	54		9	0
Queue Length 95th (ft)	79	192	127		30	42
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 55
Actuated Cycle Length: 39.2
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 6.6 Intersection LOS: A
Intersection Capacity Utilization 48.0% ICU Level of Service A

Splits and Phases: 4: Route 16 & Route 126 North



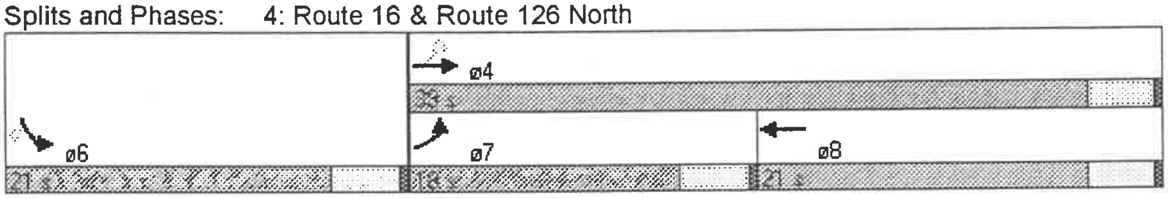
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.984			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1851	0	1668	1492
Flt Permitted	0.293				0.950	
Satd. Flow (perm)	514	1881	1851	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			11			304
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	383	777	290	38	48	295
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	395	801	299	39	49	304
Lane Group Flow (vph)	395	801	338	0	49	304
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	18.0	39.0	21.0	0.0	21.0	21.0
Total Split (%)	30%	65%	35%	0%	35%	35%
Maximum Green (s)	14.0	35.0	17.0		17.0	17.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	28.7	28.7	12.4		7.8	7.8
Actuated g/C Ratio	0.64	0.64	0.28		0.17	0.17
v/c Ratio	0.62	0.67	0.65		0.17	0.59
Uniform Delay, d1	3.7	4.9	13.5		15.6	0.0
Delay	5.0	5.9	15.0		17.5	3.3

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	A	A	B		B	A
Approach Delay		5.6	15.0		5.3	
Approach LOS		A	B		A	
Queue Length 50th (ft)	31	85	74		12	0
Queue Length 95th (ft)	116	259	165		35	48
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 44.8
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.67
Intersection Signal Delay: 7.2 Intersection LOS: A
Intersection Capacity Utilization 53.3% ICU Level of Service A

Splits and Phases: 4: Route 16 & Route 126 North



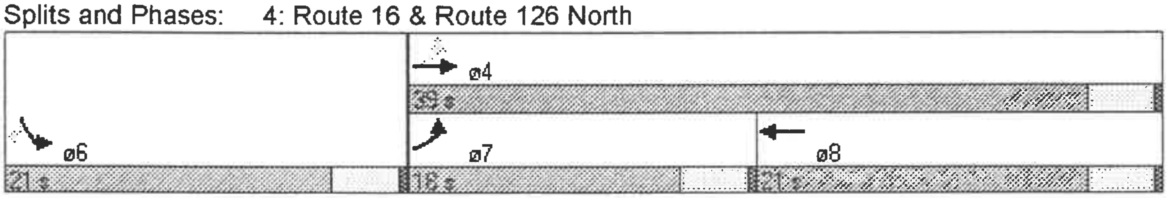
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.988			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1859	0	1668	1492
Flt Permitted	0.190				0.950	
Satd. Flow (perm)	334	1881	1859	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			8			352
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	389	787	381	38	48	341
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	401	811	393	39	49	352
Lane Group Flow (vph)	401	811	432	0	49	352
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	18.0	39.0	21.0	0.0	21.0	21.0
Total Split (%)	30%	65%	35%	0%	35%	35%
Maximum Green (s)	14.0	35.0	17.0		17.0	17.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	31.8	31.8	14.8		8.3	8.3
Actuated g/C Ratio	0.66	0.66	0.31		0.17	0.17
v/c Ratio	0.70	0.66	0.75		0.17	0.64
Uniform Delay, d1	5.7	4.8	14.6		17.0	0.0
Delay	12.6	6.2	20.3		17.9	3.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	B	A	C		B	A
Approach Delay		8.3	20.3		4.8	
Approach LOS		A	C		A	
Queue Length 50th (ft)	45	88	102		13	0
Queue Length 95th (ft)	#206	296	#271		35	50
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 48.3
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 10.1 Intersection LOS: B
Intersection Capacity Utilization 58.6% ICU Level of Service A
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Route 16 & Route 126 North



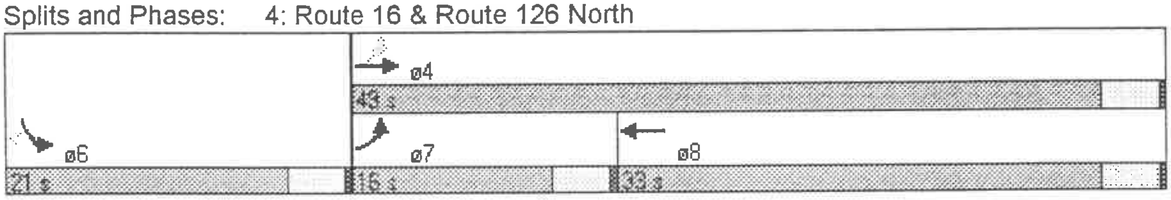
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑↱		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1870	0	1668	1492
Flt Permitted	0.121				0.950	
Satd. Flow (perm)	212	1881	1870	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			4			420
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	304	252	621	31	33	419
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	313	260	640	32	34	432
Lane Group Flow (vph)	313	260	672	0	34	432
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	16.0	49.0	33.0	0.0	21.0	21.0
Total Split (%)	23%	70%	47%	0%	30%	30%
Maximum Green (s)	12.0	45.0	29.0		17.0	17.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	39.6	39.6	23.9		8.8	8.8
Actuated g/C Ratio	0.70	0.70	0.42		0.16	0.16
v/c Ratio	0.70	0.20	0.85		0.13	0.74
Uniform Delay, d1	8.8	2.9	14.4		20.5	0.6
Delay	19.3	3.6	20.4		22.0	3.6

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	B	A	C		C	A
Approach Delay		12.2	20.4		5.0	
Approach LOS		B	C		A	
Queue Length 50th (ft)	50	18	178		11	0
Queue Length 95th (ft)	#208	68	#453		32	70
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 56.7
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 13.4 Intersection LOS: B
Intersection Capacity Utilization 69.0% ICU Level of Service B
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Route 16 & Route 126 North



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1870	0	1668	1492
Flt Permitted	0.089				0.950	
Satd. Flow (perm)	156	1881	1870	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			4			422
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	350	290	716	35	38	483
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	361	299	738	36	39	498
Lane Group Flow (vph)	361	299	774	0	39	498
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	22.0	67.0	45.0	0.0	23.0	23.0
Total Split (%)	24%	74%	50%	0%	26%	26%
Maximum Green (s)	18.0	63.0	41.0		19.0	19.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	55.8	55.8	34.5		11.8	11.8
Actuated g/C Ratio	0.73	0.73	0.45		0.16	0.16
v/c Ratio	0.80	0.22	0.91		0.15	0.85
Uniform Delay, d1	17.2	3.1	18.6		27.6	4.4
Delay	31.5	3.9	27.0		29.6	8.4

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	C	A	C		C	A
Approach Delay		19.0	27.0		10.0	
Approach LOS		B	C		A	
Queue Length 50th (ft)	126	34	326		18	35
Queue Length 95th (ft)	#309	82	#635		45	#162
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						8%
Queuing Penalty (veh)						1

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 76

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

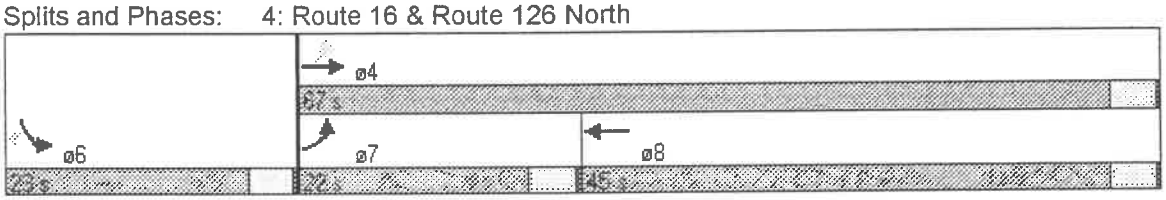
Maximum v/c Ratio: 0.91

Intersection Signal Delay: 19.7 Intersection LOS: B

Intersection Capacity Utilization 78.5% ICU Level of Service C

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Route 16 & Route 126 North



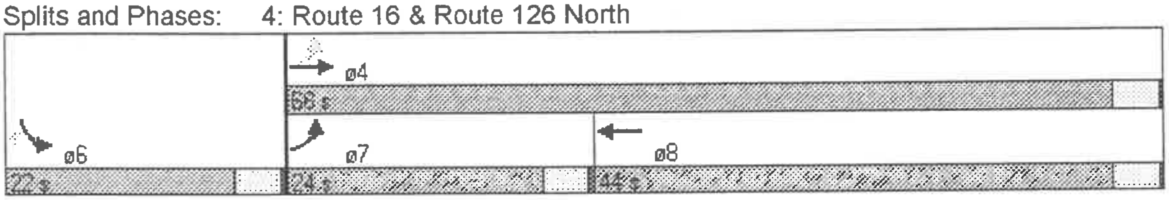
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	12	12	12	10	10
Storage Length (ft)	0			0	150	0
Storage Lanes	1			0	1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15			9	15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1668	1881	1870	0	1668	1492
Flt Permitted	0.091				0.950	
Satd. Flow (perm)	160	1881	1870	0	1668	1492
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			3			442
Headway Factor	1.09	1.00	1.00	1.00	1.09	1.09
Link Speed (mph)		30	30		30	
Link Distance (ft)		1841	804		855	
Travel Time (s)		41.8	18.3		19.4	
Volume (vph)	402	393	726	35	38	488
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	414	405	748	36	39	503
Lane Group Flow (vph)	414	405	784	0	39	503
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Detector Phases	7	4	8		6	6
Minimum Initial (s)	4.0	4.0	4.0		4.0	4.0
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0
Total Split (s)	24.0	68.0	44.0	0.0	22.0	22.0
Total Split (%)	27%	76%	49%	0%	24%	24%
Maximum Green (s)	20.0	64.0	40.0		18.0	18.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	None		Min	Min
Walk Time (s)		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0
Act Effct Green (s)	59.6	59.6	36.1		11.3	11.3
Actuated g/C Ratio	0.75	0.75	0.46		0.14	0.14
v/c Ratio	0.84	0.29	0.92		0.16	0.85
Uniform Delay, d1	18.7	3.0	19.8		29.6	3.7
Delay	36.4	3.8	31.2		30.7	7.9

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
LOS	D	A	C		C	A
Approach Delay		20.3	31.2		9.5	
Approach LOS		C	C		A	
Queue Length 50th (ft)	153	46	344		18	28
Queue Length 95th (ft)	#359	109	#662		46	#153
Internal Link Dist (ft)		1761	724		775	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)					150	
50th Bay Block Time %						
95th Bay Block Time %						7%
Queuing Penalty (veh)						1

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 79.2
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 21.5 Intersection LOS: C
Intersection Capacity Utilization 79.4% ICU Level of Service C
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 4: Route 16 & Route 126 North



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1093	230	189	464	64	243
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	1127	237	195	478	66	251
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1364		1995	1127
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			62		0	0
cM capacity (veh/h)			507		41	250

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1127	237	195	478	316
Volume Left	0	0	195	0	66
Volume Right	0	237	0	0	251
cSH	1700	1700	507	1700	121
Volume to Capacity	0.66	0.14	0.38	0.28	2.61
Queue Length (ft)	0	0	45	0	714
Control Delay (s)	0.0	0.0	16.5	0.0	803.3
Lane LOS			C		F
Approach Delay (s)	0.0		4.8		803.3
Approach LOS					F

Intersection Summary			
Average Delay	109.4		
Intersection Capacity Utilization	99.2%	ICU Level of Service	E

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1261	265	218	535	73	280
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	1300	273	225	552	75	289
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1573		2301	1300
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			47		0	0
cM capacity (veh/h)			422		20	198

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1300	273	225	552	364
Volume Left	0	0	225	0	75
Volume Right	0	273	0	0	289
cSH	1700	1700	422	1700	70
Volume to Capacity	0.76	0.16	0.53	0.32	5.22
Queue Length (ft)	0	0	76	0	Err
Control Delay (s)	0.0	0.0	22.9	0.0	Err
Lane LOS			C		F
Approach Delay (s)	0.0		6.6		Err
Approach LOS					F

Intersection Summary			
Average Delay	1342.9		
Intersection Capacity Utilization	112.8%	ICU Level of Service	G

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1277	270	218	672	119	280
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	1316	278	225	693	123	289
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1595		2459	1316
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			46		0	0
cM capacity (veh/h)			414		16	194

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1316	278	225	693	411
Volume Left	0	0	225	0	123
Volume Right	0	278	0	0	289
cSH	1700	1700	414	1700	44
Volume to Capacity	0.77	0.16	0.54	0.41	9.40
Queue Length (ft)	0	0	79	0	Err
Control Delay (s)	0.0	0.0	23.6	0.0	Err
Lane LOS			C		F
Approach Delay (s)	0.0		5.8		Err
Approach LOS					F

Intersection Summary			
Average Delay	1408.6		
Intersection Capacity Utilization	116.3%	ICU Level of Service	G

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	551	154	283	941	128	197
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	568	159	292	970	132	203
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			727		2122	568
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			67		0	61
cM capacity (veh/h)			881		37	524

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	568	159	292	970	335
Volume Left	0	0	292	0	132
Volume Right	0	159	0	0	203
cSH	1700	1700	881	1700	85
Volume to Capacity	0.33	0.09	0.33	0.57	3.94
Queue Length (ft)	0	0	36	0	Err
Control Delay (s)	0.0	0.0	11.1	0.0	Err
Lane LOS			B		F
Approach Delay (s)	0.0		2.6		Err
Approach LOS					F

Intersection Summary			
Average Delay	1443.1		
Intersection Capacity Utilization	77.5%	ICU Level of Service	C

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	635	177	326	1085	147	227
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	655	182	336	1119	152	234
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			837		2445	655
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			58		0	50
cM capacity (veh/h)			801		20	468

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	655	182	336	1119	386
Volume Left	0	0	336	0	152
Volume Right	0	182	0	0	234
cSH	1700	1700	801	1700	48
Volume to Capacity	0.39	0.11	0.42	0.66	8.04
Queue Length (ft)	0	0	52	0	Err
Control Delay (s)	0.0	0.0	12.7	0.0	Err
Lane LOS			B		F
Approach Delay (s)	0.0		2.9		Err
Approach LOS					F

Intersection Summary			
Average Delay	1441.6		
Intersection Capacity Utilization	88.3%	ICU Level of Service	D

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	Y	
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	790	229	326	1100	152	227
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	814	236	336	1134	157	234
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1051		2621	814
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			50		0	38
cM capacity (veh/h)			666		13	379

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	814	236	336	1134	391
Volume Left	0	0	336	0	157
Volume Right	0	236	0	0	234
cSH	1700	1700	666	1700	31
Volume to Capacity	0.48	0.14	0.50	0.67	12.44
Queue Length (ft)	0	0	71	0	Err
Control Delay (s)	0.0	0.0	15.8	0.0	Err
Lane LOS			C		F
Approach Delay (s)	0.0		3.6		Err
Approach LOS					F

Intersection Summary			
Average Delay	1343.8		
Intersection Capacity Utilization	94.5%	ICU Level of Service	E

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	714	35	180	472	45	432
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	736	36	186	487	46	445
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			772		1612	754
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			78		48	0
cM capacity (veh/h)			847		90	411

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	772	672	46	445
Volume Left	0	186	46	0
Volume Right	36	0	0	445
cSH	1700	847	90	411
Volume to Capacity	0.45	0.22	0.52	1.08
Queue Length (ft)	0	21	56	382
Control Delay (s)	0.0	5.2	81.5	101.0
Lane LOS		A	F	F
Approach Delay (s)	0.0	5.2	99.2	
Approach LOS			F	

Intersection Summary			
Average Delay	27.0		
Intersection Capacity Utilization	90.1%	ICU Level of Service	E

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	823	40	207	544	51	498
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	848	41	213	561	53	513
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			890		1857	869
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			72		10	0
cM capacity (veh/h)			766		59	353

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	890	774	53	513
Volume Left	0	213	53	0
Volume Right	41	0	0	513
cSH	1700	766	59	353
Volume to Capacity	0.52	0.28	0.90	1.46
Queue Length (ft)	0	29	102	680
Control Delay (s)	0.0	6.6	202.5	249.0
Lane LOS		A	F	F
Approach Delay (s)	0.0	6.6	244.7	
Approach LOS			F	

Intersection Summary			
Average Delay	64.4		
Intersection Capacity Utilization	101.8%	ICU Level of Service	F

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	849	51	207	773	142	498
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	875	53	213	797	146	513
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			928		2125	902
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			71		0	0
cM capacity (veh/h)			741		39	338

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	928	1010	146	513
Volume Left	0	213	146	0
Volume Right	53	0	0	513
cSH	1700	741	39	338
Volume to Capacity	0.55	0.29	3.73	1.52
Queue Length (ft)	0	30	Err	717
Control Delay (s)	0.0	7.5	Err	277.6
Lane LOS		A	F	F
Approach Delay (s)	0.0	7.5	2434.5	
Approach LOS			F	

Intersection Summary			
Average Delay	621.2		
Intersection Capacity Utilization	121.1%	ICU Level of Service	H

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	505	76	533	733	87	255
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	521	78	549	756	90	263
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			599		2414	560
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			44		0	50
cM capacity (veh/h)			983		16	530

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	599	1305	90	263
Volume Left	0	549	90	0
Volume Right	78	0	0	263
cSH	1700	983	16	530
Volume to Capacity	0.35	0.56	5.63	0.50
Queue Length (ft)	0	89	Err	68
Control Delay (s)	0.0	13.3	Err	18.3
Lane LOS		B	F	C
Approach Delay (s)	0.0	13.3	2557.3	
Approach LOS			F	

Intersection Summary			
Average Delay	407.2		
Intersection Capacity Utilization	117.3%	ICU Level of Service	G

Movement	EBT	EBR	WBL	WBT	NBL	NBR
	→	↘	↙	←	↖	↗
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	582	87	615	845	100	294
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	600	90	634	871	103	303
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			690		2784	645
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			30		0	36
cM capacity (veh/h)			910		6	474

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	690	1505	103	303
Volume Left	0	634	103	0
Volume Right	90	0	0	303
cSH	1700	910	6	474
Volume to Capacity	0.41	0.70	16.28	0.64
Queue Length (ft)	0	147	Err	110
Control Delay (s)	0.0	21.9	Err	25.1
Lane LOS		C	F	D
Approach Delay (s)	0.0	21.9	2556.6	
Approach LOS			F	

Intersection Summary			
Average Delay	411.9		
Intersection Capacity Utilization	133.7%	ICU Level of Service	H

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	2%			2%	2%	
Volume (veh/h)	841	190	615	869	110	294
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	867	196	634	896	113	303
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1063		3129	965
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			4		0	2
cM capacity (veh/h)			659		0	310

Direction, Lane #	EB 1	WB 1	NB 1	NB 2
Volume Total	1063	1530	113	303
Volume Left	0	634	113	0
Volume Right	196	0	0	303
cSH	1700	659	0	310
Volume to Capacity	0.63	0.96	237.72	0.98
Queue Length (ft)	0	348	Err	255
Control Delay (s)	0.0	82.2	Err	82.9
Lane LOS		F	F	F
Approach Delay (s)	0.0	82.2	2782.8	
Approach LOS			F	

Intersection Summary			
Average Delay	426.9		
Intersection Capacity Utilization	156.0%	ICU Level of Service	H

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱		↰↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	743	165	54	468	21	4
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	766	170	56	482	22	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			936		1360	766
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			92		85	99
cM capacity (veh/h)			700		145	390

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2
Volume Total	766	170	538	22	4
Volume Left	0	0	56	22	0
Volume Right	0	170	0	0	4
cSH	1700	1700	700	145	390
Volume to Capacity	0.45	0.10	0.08	0.15	0.01
Queue Length (ft)	0	0	6	13	1
Control Delay (s)	0.0	0.0	2.1	34.2	14.3
Lane LOS			A	D	B
Approach Delay (s)	0.0		2.1	31.0	
Approach LOS				D	

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	82.1%	ICU Level of Service	D

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	857	165	54	540	21	4
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	884	170	56	557	22	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			1054		1552	884
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			91		80	99
cM capacity (veh/h)			631		109	333

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2
Volume Total	884	170	612	22	4
Volume Left	0	0	56	22	0
Volume Right	0	170	0	0	4
cSH	1700	1700	631	109	333
Volume to Capacity	0.52	0.10	0.09	0.20	0.01
Queue Length (ft)	0	0	7	17	1
Control Delay (s)	0.0	0.0	2.4	46.0	15.9
Lane LOS			A	E	C
Approach Delay (s)	0.0		2.4	41.2	
Approach LOS				E	

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	92.2%	ICU Level of Service	E

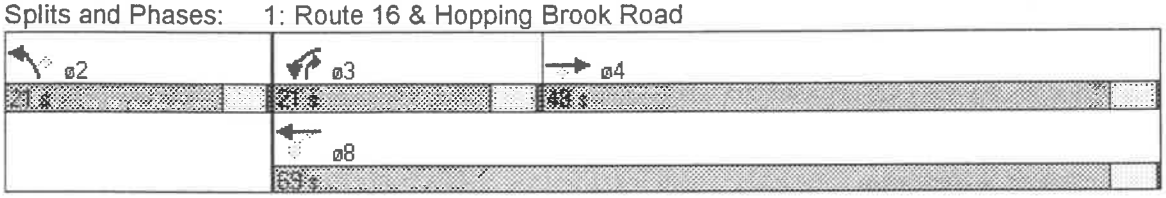
	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	10	12	15	12	12
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1881	1370	1641	2069	1641	1468
Flt Permitted			0.083		0.950	
Satd. Flow (perm)	1881	1370	143	2069	1641	1468
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		608				42
Headway Factor	1.00	1.09	1.00	0.88	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	698			1860	1054	
Travel Time (s)	15.9			42.3	24.0	
Volume (vph)	857	758	374	540	89	41
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	10%	10%	1%	10%	10%
Adj. Flow (vph)	884	781	386	557	92	42
Lane Group Flow (vph)	884	781	386	557	92	42
Turn Type		Perm	pm+pt			pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases		4	8			2
Detector Phases	4	4	3	8	2	3
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	8.0
Total Split (s)	48.0	48.0	21.0	69.0	21.0	21.0
Total Split (%)	53%	53%	23%	77%	23%	23%
Maximum Green (s)	44.0	44.0	17.0	65.0	17.0	17.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lag	Lag	Lead			Lead
Lead-Lag Optimize?	Yes	Yes	Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	Min	None
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	42.1	42.1	63.2	63.2	9.8	30.9
Actuated g/C Ratio	0.52	0.52	0.78	0.78	0.12	0.38
v/c Ratio	0.91	0.78	0.90	0.35	0.46	0.07
Uniform Delay, d1	17.6	2.7	20.8	2.7	33.1	0.0
Delay	26.5	4.6	45.8	3.1	34.0	5.5
LOS	C	A	D	A	C	A
Approach Delay	16.2			20.5	25.1	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach LOS	B			C	C	
Queue Length 50th (ft)	381	45	148	63	45	0
Queue Length 95th (ft)	#698	231	#344	126	91	0
Internal Link Dist (ft)	618			1780	974	
50th Up Block Time (%)						
95th Up Block Time (%)	18%					
Turn Bay Length (ft)						
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 81
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 18.1 Intersection LOS: B
Intersection Capacity Utilization 82.9% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 16 & Hopping Brook Road



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱		↰↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	526	12	11	814	156	73
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	542	12	11	839	161	75
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			555		1404	542
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			99		0	86
cM capacity (veh/h)			977		146	525

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2
Volume Total	542	12	851	161	75
Volume Left	0	0	11	161	0
Volume Right	0	12	0	0	75
cSH	1700	1700	977	146	525
Volume to Capacity	0.32	0.01	0.01	1.10	0.14
Queue Length (ft)	0	0	1	219	12
Control Delay (s)	0.0	0.0	0.3	165.5	13.0
Lane LOS			A	F	B
Approach Delay (s)	0.0		0.3	116.9	
Approach LOS				F	

Intersection Summary			
Average Delay	17.0		
Intersection Capacity Utilization	70.0%	ICU Level of Service	C

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱		↰↑	↰	↱
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	607	12	11	939	156	73
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (veh/h)	626	12	11	968	161	75
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
vC, conflicting volume			638		1616	626
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
tC, single (s)			4.2		6.5	6.3
tC, 2 stage (s)						
tF (s)			2.3		3.6	3.4
p0 queue free %			99		0	84
cM capacity (veh/h)			908		108	470

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2
Volume Total	626	12	979	161	75
Volume Left	0	0	11	161	0
Volume Right	0	12	0	0	75
cSH	1700	1700	908	108	470
Volume to Capacity	0.37	0.01	0.01	1.49	0.16
Queue Length (ft)	0	0	1	294	14
Control Delay (s)	0.0	0.0	0.4	335.9	14.1
Lane LOS			A	F	B
Approach Delay (s)	0.0		0.4	233.4	
Approach LOS				F	

Intersection Summary			
Average Delay	29.9		
Intersection Capacity Utilization	78.4%	ICU Level of Service	C

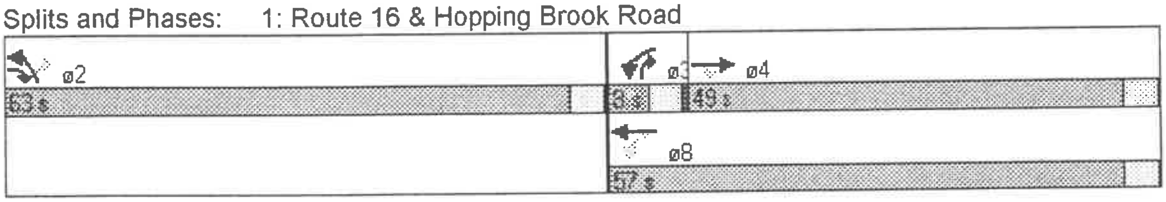
	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	10	12	15	12	12
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1881	1370	1641	2069	1641	1468
Flt Permitted			0.082		0.950	
Satd. Flow (perm)	1881	1370	142	2069	1641	1468
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		77				120
Headway Factor	1.00	1.09	1.00	0.88	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	698			1860	1054	
Travel Time (s)	15.9			42.3	24.0	
Volume (vph)	607	75	45	939	828	435
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	10%	10%	1%	10%	10%
Adj. Flow (vph)	626	77	46	968	854	448
Lane Group Flow (vph)	626	77	46	968	854	448
Turn Type		pm+ov	pm+pt			pm+ov
Protected Phases	4	2	3	8	2	3
Permitted Phases		4	8			2
Detector Phases	4	2	3	8	2	3
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	8.0
Total Split (s)	49.0	63.0	8.0	57.0	63.0	8.0
Total Split (%)	41%	53%	7%	48%	53%	7%
Maximum Green (s)	45.0	59.0	4.0	53.0	59.0	4.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lag		Lead			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	Min	None	None	Min	None
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	45.0	108.0	53.0	53.0	59.0	67.0
Actuated g/C Ratio	0.38	0.90	0.44	0.44	0.49	0.56
v/c Ratio	0.89	0.06	0.41	1.06	1.06	0.51
Uniform Delay, d1	35.1	0.0	19.2	33.5	30.5	11.3
Delay	42.2	0.1	19.5	72.5	70.9	11.8
LOS	D	A	B	E	E	B
Approach Delay	37.6			70.1	50.6	

Lane Group	→ EBT	↘ EBR	↙ WBL	← WBT	↖ NBL	↗ NBR
Approach LOS	D			E	D	
Queue Length 50th (ft)	450	0	20	~824	~726	139
Queue Length 95th (ft)	#666	3	43	#1074	#970	223
Internal Link Dist (ft)	618			1780	974	
50th Up Block Time (%)						
95th Up Block Time (%)	12%				5%	
Turn Bay Length (ft)						
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Natural Cycle: 120
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.06
Intersection Signal Delay: 54.1 Intersection LOS: D
Intersection Capacity Utilization 104.9% ICU Level of Service F
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Route 16 & Hopping Brook Road



Proposed & Recommended Improvements

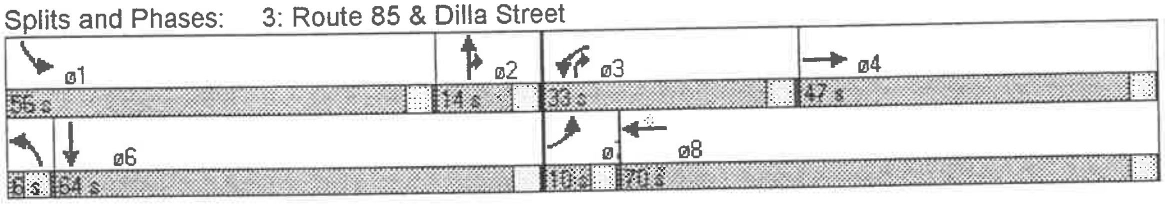
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt		0.990				0.850			0.850		0.989	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	1862	0	3467	1881	1599	1787	1881	1599	3467	1860	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1787	1862	0	3467	1881	1599	1787	1881	1599	3467	1860	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3				304			55		3	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	32	508	38	598	266	295	18	122	331	1016	463	35
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	33	524	39	616	274	304	19	126	341	1047	477	36
Lane Group Flow (vph)	33	563	0	616	274	304	19	126	341	1047	513	0
Turn Type	Prot			Prot		Perm	Prot		pt+ov	Prot		
Protected Phases	7	4		3	8		5	2	2 3	1	6	
Permitted Phases						8						
Detector Phases	7	4		3	8	8	5	2	2 3	1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0		20.0	20.0	
Total Split (s)	10.0	47.0	0.0	33.0	70.0	70.0	6.0	14.0	47.0	56.0	64.0	0.0
Total Split (%)	7%	31%	0%	22%	47%	47%	4%	9%	31%	37%	43%	0%
Maximum Green (s)	6.0	43.0		29.0	66.0	66.0	2.0	10.0		52.0	60.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min		Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	5.9	43.2		28.1	67.5	67.5	2.0	10.0	42.3	48.2	56.2	
Actuated g/C Ratio	0.04	0.30		0.19	0.46	0.46	0.01	0.07	0.29	0.33	0.39	
v/c Ratio	0.46	1.02		0.92	0.31	0.34	0.76	0.98	0.68	0.91	0.71	
Uniform Delay, d1	69.8	50.9		58.0	24.9	0.0	71.9	67.9	38.0	47.2	38.0	
Delay	70.8	91.0		67.4	26.2	2.6	163.1	126.6	39.1	48.4	38.0	
LOS	E	F		E	C	A	F	F	D	D	D	
Approach Delay		89.9			41.5			66.7			45.0	
Approach LOS		F			D			E			D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	32	~597		308	174	0	19	~126	252	494	369	
Queue Length 95th (ft)	71	#836		#417	246	56	#75	#266	371	586	492	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 145.5
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 53.6 Intersection LOS: D
Intersection Capacity Utilization 97.4% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



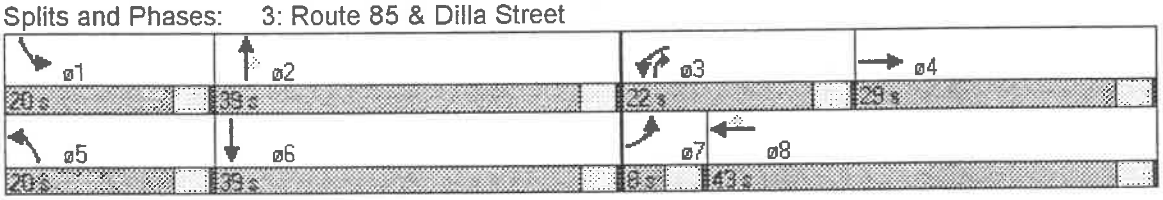
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰↰	↑	↱	↰	↑	↱	↰↰	↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50	50	50	50	50	50	50	
Trailing Detector (ft)	0	0		0	0	0	0	0	0	0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt		0.979				0.850			0.850		0.982	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	1842	0	3467	1881	1599	1787	1881	1599	3467	1847	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1787	1842	0	3467	1881	1599	1787	1881	1599	3467	1847	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7				382			191		7	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1359			1825			2591			1004	
Travel Time (s)		30.9			41.5			58.9			22.8	
Volume (vph)	58	220	36	362	565	804	88	587	676	402	322	45
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	60	227	37	373	582	829	91	605	697	414	332	46
Lane Group Flow (vph)	60	264	0	373	582	829	91	605	697	414	378	0
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases						8			2			
Detector Phases	7	4		3	8	8	5	2	3	1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	8.0	29.0	0.0	22.0	43.0	43.0	20.0	39.0	22.0	20.0	39.0	0.0
Total Split (%)	7%	26%	0%	20%	39%	39%	18%	35%	20%	18%	35%	0%
Maximum Green (s)	4.0	25.0		18.0	39.0	39.0	16.0	35.0	18.0	16.0	35.0	
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	Min	Min	None	Min	Min	
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	
Act Effct Green (s)	4.0	26.1		16.9	39.0	39.0	10.7	35.0	55.9	15.5	39.9	
Actuated g/C Ratio	0.04	0.24		0.15	0.36	0.36	0.10	0.32	0.51	0.14	0.36	
v/c Ratio	0.92	0.59		0.70	0.87	1.02	0.52	1.01	0.77	0.84	0.56	
Uniform Delay, d1	52.6	35.9		44.0	32.9	18.7	47.0	37.3	14.9	45.8	27.2	
Delay	124.6	37.2		44.0	39.6	49.4	46.4	68.6	15.6	50.6	28.6	
LOS	F	D		D	D	D	D	E	B	D	C	
Approach Delay		53.4			45.1			40.7			40.1	
Approach LOS		D			D			D			D	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	43	164		128	381	~434	62	~435	279	147	206	
Queue Length 95th (ft)	#129	253		179	#581	#676	111	#667	224	#222	323	
Internal Link Dist (ft)		1279			1745			2511			924	
50th Up Block Time (%)												
95th Up Block Time (%)												
Turn Bay Length (ft)												
50th Bay Block Time %												
95th Bay Block Time %												
Queuing Penalty (veh)												

Intersection Summary

Area Type: Other
Cycle Length: 110
Actuated Cycle Length: 109.6
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 43.4 Intersection LOS: D
Intersection Capacity Utilization 96.5% ICU Level of Service E
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 85 & Dilla Street



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.905	
Flt Protected			0.950		0.985	
Satd. Flow (prot)	1881	1599	1787	1881	1677	0
Flt Permitted			0.060		0.985	
Satd. Flow (perm)	1881	1599	113	1881	1677	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		226			104	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	2040			1841	1269	
Travel Time (s)	46.4			41.8	28.8	
Volume (vph)	1277	270	218	672	119	280
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	1316	278	225	693	123	289
Lane Group Flow (vph)	1316	278	225	693	412	0
Turn Type		Perm	pm+pt			
Protected Phases	4		3	8	2	
Permitted Phases		4	8			
Detector Phases	4	4	3	8	2	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	67.0	67.0	10.0	77.0	23.0	0.0
Total Split (%)	67%	67%	10%	77%	23%	0%
Maximum Green (s)	63.0	63.0	6.0	73.0	19.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	Min	
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	63.0	63.0	73.0	73.0	19.0	
Actuated g/C Ratio	0.63	0.63	0.73	0.73	0.19	
v/c Ratio	1.11	0.25	1.23	0.50	1.02	
Uniform Delay, d1	18.5	1.3	20.7	5.8	30.1	
Delay	71.5	1.8	125.0	6.0	69.7	
LOS	E	A	F	A	E	
Approach Delay	59.4			35.2	69.7	
Approach LOS	E			D	E	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Queue Length 50th (ft)	~965	12	~127	161	~208	
Queue Length 95th (ft)	#1220	42	#278	230	#414	
Internal Link Dist (ft)	1960			1761	1189	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)						
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

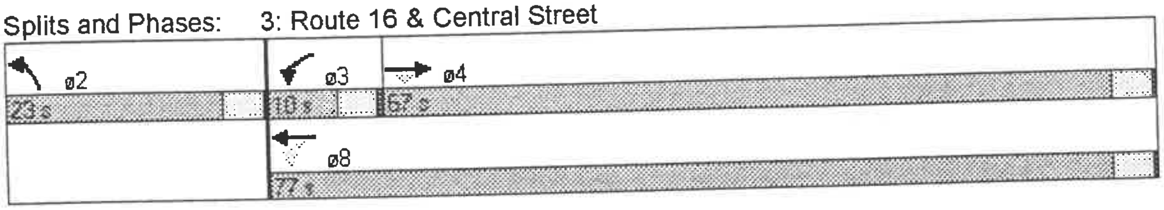
Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.23
Intersection Signal Delay: 53.2 — Intersection LOS: D
Intersection Capacity Utilization 116.3% — ICU Level of Service G

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 16 & Central Street



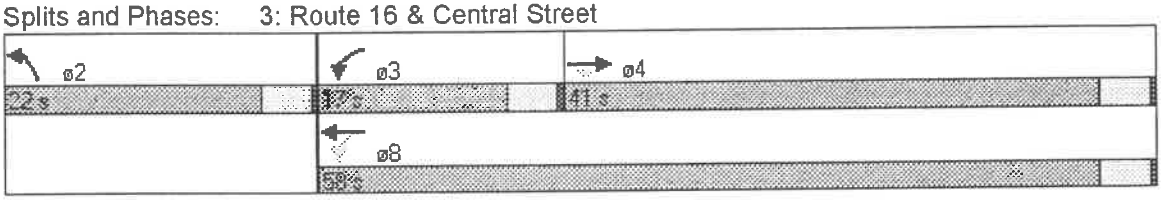
	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	Y	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	
Trailing Detector (ft)	0	0	0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.919	
Flt Protected			0.950		0.980	
Satd. Flow (prot)	1881	1599	1787	1881	1694	0
Flt Permitted			0.098		0.980	
Satd. Flow (perm)	1881	1599	184	1881	1694	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		236			87	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	2040			1841	1269	
Travel Time (s)	46.4			41.8	28.8	
Volume (vph)	790	229	326	1100	152	227
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	814	236	336	1134	157	234
Lane Group Flow (vph)	814	236	336	1134	391	0
Turn Type		Perm	pm+pt			
Protected Phases	4		3	8	2	
Permitted Phases		4	8			
Detector Phases	4	4	3	8	2	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	8.0	20.0	20.0	
Total Split (s)	41.0	41.0	17.0	58.0	22.0	0.0
Total Split (%)	51%	51%	21%	73%	28%	0%
Maximum Green (s)	37.0	37.0	13.0	54.0	18.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	
Lead/Lag	Lag	Lag	Lead			
Lead-Lag Optimize?	Yes	Yes	Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	Min	
Walk Time (s)	5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0	
Act Effct Green (s)	34.6	34.6	51.0	51.0	16.5	
Actuated g/C Ratio	0.46	0.46	0.67	0.67	0.22	
v/c Ratio	0.95	0.27	0.88	0.89	0.89	
Uniform Delay, d1	19.5	0.0	16.8	10.0	22.0	
Delay	32.2	2.0	33.2	15.6	34.0	
LOS	C	A	C	B	C	
Approach Delay	25.4			19.6	34.0	
Approach LOS	C			B	C	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Queue Length 50th (ft)	369	0	111	397	142	
Queue Length 95th (ft)	#614	36	#258	#761	#309	
Internal Link Dist (ft)	1960			1761	1189	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)						
50th Bay Block Time %						
95th Bay Block Time %						
Queuing Penalty (veh)						

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 75.6
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 23.6 Intersection LOS: C
Intersection Capacity Utilization 94.5% ICU Level of Service E
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Route 16 & Central Street



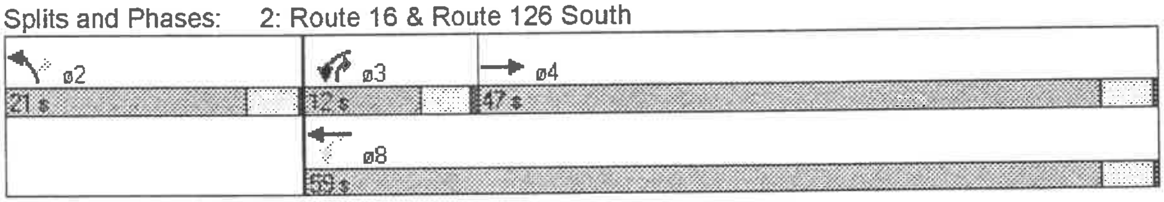
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
	→	↘	↙	←	↖	↗
Lane Configurations	↑↱		↰	↑	↰	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	2%			2%	2%	
Storage Length (ft)		0	150		50	0
Storage Lanes		0	1		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	50
Trailing Detector (ft)	0		0	0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.992					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1847	0	1769	1862	1769	1583
Flt Permitted			0.085		0.950	
Satd. Flow (perm)	1847	0	158	1862	1769	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	6					127
Headway Factor	1.01	1.01	1.01	1.01	1.01	1.01
Link Speed (mph)	30			30	30	
Link Distance (ft)	1860			2040	1126	
Travel Time (s)	42.3			46.4	25.6	
Volume (vph)	849	51	207	773	142	498
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	875	53	213	797	146	513
Lane Group Flow (vph)	928	0	213	797	146	513
Turn Type			pm+pt			pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases			8			2
Detector Phases	4		3	8	2	3
Minimum Initial (s)	4.0		4.0	4.0	4.0	4.0
Minimum Split (s)	20.0		8.0	20.0	20.0	8.0
Total Split (s)	47.0	0.0	12.0	59.0	21.0	12.0
Total Split (%)	59%	0%	15%	74%	26%	15%
Maximum Green (s)	43.0		8.0	55.0	17.0	8.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	0.5		0.5	0.5	0.5	0.5
Lead/Lag	Lag		Lead			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	None
Walk Time (s)	5.0			5.0	5.0	
Flash Dont Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	37.7		49.8	49.8	10.9	22.9
Actuated g/C Ratio	0.55		0.72	0.72	0.16	0.33
v/c Ratio	0.92		0.71	0.59	0.52	0.84
Uniform Delay, d1	13.7		9.7	4.5	26.5	15.7
Delay	21.7		22.8	5.4	28.5	20.2

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
LOS	C		C	A	C	C
Approach Delay	21.7			9.1	22.1	
Approach LOS	C			A	C	
Queue Length 50th (ft)	326		43	129	63	161
Queue Length 95th (ft)	#667		#161	273	116	#340
Internal Link Dist (ft)	1780			1960	1046	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)			150		50	
50th Bay Block Time %				5%	24%	46%
95th Bay Block Time %			14%	18%	48%	53%
Queuing Penalty (veh)			54	24	370	72

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 68.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.92
Intersection Signal Delay: 16.9 Intersection LOS: B
Intersection Capacity Utilization 87.7% ICU Level of Service D
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 16 & Route 126 South



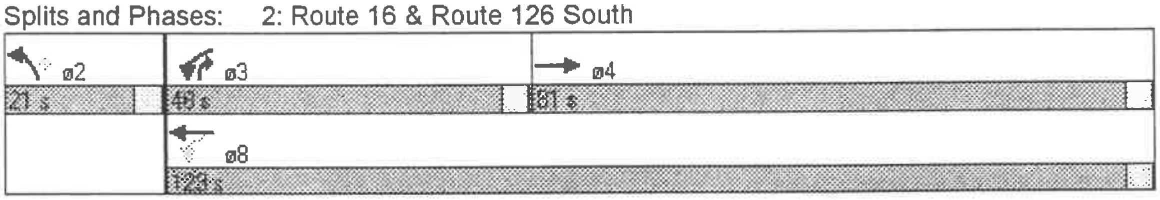
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	2%			2%	2%	
Storage Length (ft)		0	150		50	0
Storage Lanes		0	1		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	50
Trailing Detector (ft)	0		0	0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.975					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1816	0	1769	1862	1769	1583
Flt Permitted			0.049		0.950	
Satd. Flow (perm)	1816	0	91	1862	1769	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	11					117
Headway Factor	1.01	1.01	1.01	1.01	1.01	1.01
Link Speed (mph)	30			30	30	
Link Distance (ft)	1860			2040	1126	
Travel Time (s)	42.3			46.4	25.6	
Volume (vph)	841	190	615	869	110	294
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Adj. Flow (vph)	867	196	634	896	113	303
Lane Group Flow (vph)	1063	0	634	896	113	303
Turn Type			pm+pt			pm+ov
Protected Phases	4		3	8	2	3
Permitted Phases			8			2
Detector Phases	4		3	8	2	3
Minimum Initial (s)	4.0		4.0	4.0	4.0	4.0
Minimum Split (s)	20.0		8.0	20.0	20.0	8.0
Total Split (s)	81.0	0.0	48.0	129.0	21.0	48.0
Total Split (%)	54%	0%	32%	86%	14%	32%
Maximum Green (s)	77.0		44.0	125.0	17.0	44.0
Yellow Time (s)	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	0.5		0.5	0.5	0.5	0.5
Lead/Lag	Lag		Lead			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	None
Walk Time (s)	5.0			5.0	5.0	
Flash Dont Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	77.0		125.0	125.0	13.9	61.9
Actuated g/C Ratio	0.52		0.85	0.85	0.09	0.42
v/c Ratio	1.11		1.09	0.57	0.68	0.41
Uniform Delay, d1	34.6		44.2	3.1	64.3	17.3
Delay	96.2		102.5	3.5	64.5	17.6

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
LOS	F		F	A	E	B
Approach Delay	96.2			44.5	30.3	
Approach LOS	F			D	C	
Queue Length 50th (ft)	~1170		~640	201	106	116
Queue Length 95th (ft)	#1470		#905	300	176	194
Internal Link Dist (ft)	1780			1960	1046	
50th Up Block Time (%)						
95th Up Block Time (%)						
Turn Bay Length (ft)			150		50	
50th Bay Block Time %			56%	7%	50%	33%
95th Bay Block Time %			64%	10%	65%	41%
Queuing Penalty (veh)			539	55	346	41

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 147
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 60.8 Intersection LOS: E
Intersection Capacity Utilization 108.9% ICU Level of Service F
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 16 & Route 126 South



APPENDIX B

Hopping Brook Air Quality Mesoscale Analysis

Hopping Brook
Air Quality Mesoscale Analysis

Prepared for:
First Colony Development Co., Inc.
929 Boston Post Road East
Marlboro, MA 01752

Prepared by:
Epsilon Associates, Inc.
150 Main Street, P.O. Box 700
Maynard, MA 01754-0700

June 19, 2003

Table of Contents

AIR QUALITY

1.0 Introduction

A mesoscale analysis was performed for the Hopping Brook Industrial Park Project ("Project") based on the vehicle trips per day (tpd) generated will exceed the 3,000 tpd threshold for a mesoscale analysis. The analysis includes both an estimate of the volatile organic carbon (VOC) emissions associated with all project-related vehicle trips and a demonstration that the VOC emissions associated with the Build condition will be less than those from the Existing condition in both the short and long term. In the case where hydrocarbon emissions from the build condition are expected to be greater than the future No-Build, the analysis includes identification and review of all reasonable and feasible reduction/mitigation measures. Prior to proceeding with the analysis, consultation with the Massachusetts Department of Environmental Protection (MADEP) was conducted for guidance as well as confirmation of the study area

The Project consists of the expansion of the existing industrial park located on Route 16 in Holliston, Massachusetts. The expansion will result in an additional 15,000 new vehicle tpd. For a more detailed description of the Project, see Section 1.0 of the SEIR.

A mesoscale analysis was performed to assess the total volatile organic compounds (VOCs) emissions associated with motor vehicle emissions related to the Project. The modeling methodology for the mesoscale analysis was developed in accordance with the MADEP guidelines. A modeling protocol was submitted to MADEP on March 25, 2003 and approved by Keith Grillo, Regional Planner on April 3, 2003 (See Appendix A of this report). Travel demand management and other mitigation strategies to reduce air quality impacts are described in Section 4.0 and Appendix A of the SEIR.

1.2 Mesoscale Analysis

A mesoscale analysis was performed to assess the total VOCs associated with motor vehicle emissions from the project. A mesoscale analysis predicts the change in regional emissions due to the project. The total vehicle pollutant burden was estimated for the No Build and Build conditions for the future year 2008 based on the traffic analysis performed by Abend Associates(Abend).

For each condition modeled, the EPA MOBILE6 computer program was used to estimate motor vehicle emissions on the roadway network. Emission estimates derived from MOBILE6 for VOCs/NOx are based on summertime conditions.

Intersection Selection

Intersection selection criteria for a mesoscale analysis is typically based on a Level of Service (LOS) D where the project increases traffic volumes by 10 percent or greater, or if the intersection operates at LOS E or F and the project degrades the location.

Based on these criteria, eight intersections meet these thresholds for the mesoscale analysis. The intersections used in the analysis are as follows:

1. Route 16 at Hopping Brook Road;
2. Route 16 at Route 126 South;
3. Route 16 at Central Street;
4. Route 85 at Dilla/Fortune;
5. Route 85 at Route 495 northbound Ramps;
6. Route 85 at Route 495 southbound Ramps;
7. Route 109 at Beaver Street/Beaver Street Expansion; and
8. Route 16 at Route 109.

The traffic volumes and LOS calculations provided in Air Quality Appendix form the basis of the air quality study.

Emissions Calculations (MOBILE6)

For each case modeled, the EPA MOBILE6[1] computer program was used to estimate motor vehicle emissions on the roadway network. Emissions data calculated by the MOBILE6 model are based on motor vehicle operations typical of peak periods. The Commonwealth's statewide Annual Inspection and Maintenance (I&M) Program was included, as well as state specific vehicle age registration distribution. The MOBILE6 inputs are based on the latest guidance issued by DEP[2] regarding updated inputs to the model. MOBILE6 input parameters are listed in the modeling

---

[1] *MOBILE6 is an EPA computer model that calculates emission factors for hydrocarbons, carbon monoxide, and oxides of nitrogen form gasoline and diesel fueled highway motor vehicles*

[2] *MADEP: February 12, 2003 memorandum for MOBILE6 inputs for performing microscale and mesoscale analysis.*

protocol provided in the Air Quality Appendix. In addition, emission calculations are presented for the VOC Build and No-Build scenarios.

The mesoscale analysis predicts the change in regional emissions due to the project. This is accomplished by multiplying changes in traffic flow (in vehicle miles traveled[3]) by an emission factor (grams per vehicle mile traveled).

1.3 Conclusion

Results of the mesoscale analysis as presented in Table 1 show an increase in daily VOC emissions for the 2008 Build condition versus the No-Build condition. The 2008 Build condition results in an increase in AM and PM VOC emissions of 13% and 16%, respectively. The 2008 Build condition results in a decrease of VOC emissions when compared to the existing conditions due to cleaner more efficient vehicles. The decrease in the AM and PM VOC emissions are 28% and 22%, respectively versus the existing conditions.

Traffic mitigation measures designed to minimize the increase compared to the No-Build condition are discussed in the Traffic Appendix A of the SEIR.

[3] *Vehicle Miles Traveled (VMT) – the average daily traffic multiplied by the roadway link length.*

Table .1: Mesoscale Analysis Summary

Pollutant	Time	Units	Existing	Full Build	No-Build	BD-NB	% Difference (BD-NB)	BD-Existing	% Difference (BD-existing)
VOC	AM Peak	grams/hr	3,114.8	2,429.7	2,155.8	273.9	13%	-68511%	-28%
		tons/hr	0.00343	0.00268	0.00238	0.00030	13%		
		tons/day*	0.049	0.038	0.034	0.004	13%		
	PM Peak	grams/hr	3,338.5	2,736.8	2,369.5	367.3	16%	-60166%	-22%
		tons/hr	0.00368	0.00302	0.00261	0.00040	16%		
		tons/day*	0.041	0.034	0.029	0.004	16%		
NOx	AM Peak	grams/hr	6,916.5	5,172.6	4,589.6	583.1	13%	- 174384%	-34%
		tons/hr	0.00762	0.00570	0.00506	0.00064	13%		
		tons/day*	0.109	0.081	0.072	0.009	13%		
	PM Peak	grams/hr	7,413.1	5,826.5	5,044.6	781.9	16%	- 158666%	-27%
		tons/hr	0.00817	0.00642	0.00556	0.00086	16%		
		tons/day*	0.091	0.071	0.062	0.010	16%		

* Tons/day estimated by multiplying hourly peak value by TRB Factor

1.4 Mitigation Measures and Conclusions

As is required when the mesoscale results show an increase in emissions from the No-Build to Build conditions, the proponent has identified and reviewed all reasonable and feasible reduction/mitigation measures to compensate for the increase in emissions associated with the 2008 Build scenario. Please refer to Traffic Appendix for a complete list of proposed mitigation measures.

APPENDIX A

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

April 3, 2003

Mr. Philip DeVita
Epsilon Associates, Inc.
150 Main Street
P.O. Box 700
Maynard, MA 01754-0700

Dear Mr.DeVita:

The Department of Environmental Protection (DEP) has reviewed the modeling protocol submitted for the Hopping Brook Industrial Park in Holliston. The intersections chosen within the study area satisfy DEP's requirements for a mesoscale air quality analysis. In addition the mobile 6 inputs presented meet DEP requirements.

Please contact Keith Grillo at (617) 292-5773 if you have any questions.

Sincerely,

Keith Grillo

Keith Grillo
Regional Planner

EPSILON ASSOCIATES INC.
Engineers ■ Environmental Consultants

/air/aqprotcl.doc

March 25, 2003

Mr. Keith Grillo
Department of Environmental Protection
Division of Air Quality Control
One Winter Street
Eighth Floor
Boston, MA 02108

Subject: Air Quality Modeling Protocol for Hopping Brook Industrial Park Mesoscale Analysis

Dear Keith:

Epsilon Associates, Inc. (Epsilon) is submitting this modeling protocol for your review and approval for the proposed expansion to the existing Hopping Brook Industrial Park, in Holliston, Massachusetts. Epsilon is preparing the air quality analysis as part of the Supplemental EIR submittal.

As discussed, the Hopping Brook Industrial Park is an existing project located on Route 16. The proponent has acquired an adjacent 85 acre parcel which has been added to the site. The expansion will result in an additional 15,000 new vehicle trips per day. A mesoscale analysis is required since the vehicle trips per day are greater than the 3,000 vehicle trips per day threshold.

Intersection Selection

Abend Associates, Inc. (Abend) has analyzed project traffic data for approximately 13 intersections in the vicinity of the project. Intersections selection criteria for a mesoscale analysis typically are based on a Level of Service (LOS) D where the project increases traffic volumes by 10 percent or greater, or if the intersection operates at LOS E or F and the project degrades the location. Based on these criteria, Epsilon is proposing that 8 intersections be analyzed. The intersections proposed are as follows:

1. Route 16 at Hopping Brook Road;
2. Route 16 at Route 126 South;
3. Route 16 at Central Street;

150 Main Street • PO Box 700 • Maynard, Massachusetts 01754-0700 978•897•7100 Fax 978•897•0099
www.epsilonassociates.com

4. Route 85 at Dilla/Fortune

5. Route 85 at Route 495 northbound Ramps;

6. Route 85 at Route 495 southbound Ramps;

7. Route 109 at Beaver Street/Beaver Street Expansion; and

8. Route 16 at Route 109

Figure 1 depicts the intersections studied by Abbend which include the proposed intersections locations for the mesoscale analysis. The traffic calculations are in Attachment A for your review.

Emissions Calculations (MOBILE5ah)

MOBILE6 input parameters are listed in Attachment B as proposed for this analysis based on the recent February 12, 2003 memorandum from DEP regarding the use of MOBILE6 for determining emission factors for use in the indirect source air quality analysis. MOBILE6 replaces MOBILE5ah for generating emission rates.

MOBILE6 is an EPA-approved program used to estimate emission rates for highway motor vehicles under a range of conditions.

Moving emissions are calculated based on actual speeds at which free-flowing vehicles travel through the intersections.

Mesoscale Analysis

The mesoscale analysis predicts the change in regional emissions due to the project. This is done by multiplying changes in traffic flow (in vehicle miles traveled based on link lengths) by an emission factor (in grams per vehicle mile traveled).

The mesoscale analysis will be based on the one intersection discussed above and the links leading into the intersections. The calculated VMT will be estimated based on peak hour traffic volumes and average vehicle speeds in the links and multiplied by the MOBILE6 emission factors to determine maximum hourly emissions. These peak hour emissions will be scaled based on a Transportation Research Board factor to account for daily vehicle miles traveled from an hourly value. A comparison of total NO_x and VOC emissions for the Future Build versus No-Build scenarios will be evaluated.

As discussed above, emission factors will be calculated using the MOBILE6 model. Vehicle speeds input into MOBILE56 will be determined by dividing total VMT by total vehicle hours traveled (VHT).

If you have any questions or comments about this analysis, please contact me at 978-461-6233.

Sincerely,

EPSILON ASSOCIATES, Inc.

Philip M DeVita

Philip M. DeVita
Senior Environmental Scientist, CCM

Attachments: Figures
Attachment A
Attachment B

Attachment A

Traffic Calculations

	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 northbound Ramps									
Overall	F	*	--						
Rte 85 EB LT	B	15	0.59			SEE SIGNALIZED			
Rte 495 NB LT	F	*	*						
Rte 495 NB RT	B	10	0.18						
Route 85 at Route 495 southbound Ramps									
Overall	F	141	--	F	237	--	F	234	--
Rte 85 WB LT	B	12	0.27	B	14	0.35	C	17	0.44
Rte 495 SB LT	F	172	0.53	F	464	1.07	F	*	1.85
Rte 495 SB RT	F	504	2.05	F	843	2.80	F	871	2.86
Route 16 at Hopping Brook Road									
Overall	A	4	--	A	6	--	F	*	--
Rte 16 WB LT/TH	A	<1	0.01	A	<1	0.01	A	2	0.05
Hopping Brook Rd LT	F	60	0.60	F	112	0.81	F	*	*
Hopping Brook Rd RT	B	13	0.11	B	14	0.12	F	53	0.91
Route 16 at Route 126 South									
Overall	F	*	--	F	*	--	F	*	--
Rte 16 WB LT/TH	B	13	0.56	C	22	0.70	F	82	0.96
Rte 126 NB LT	F	*	*	F	*	*	F	*	*
Rte 126 NB RT	C	18	0.50	D	25	0.64	F	83	0.98
Route 16 at Central Street									
Overall	F	*	--	F	*	--	F	*	--
Rte 16 EB LT	B	11	0.33	B	13	0.42	C	16	0.50
Central St NB LT/RT	F	*	*	F	*	*	F	*	*

	Morning								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Route 495 northbound Ramps									
Overall	F	*	--						
Route 85 EB LT	C	17	0.79						
Route 495 NB LT	F	*	*			SEE SIGNALIZED			
Route 495 NB RT	B	13	0.35						
Route 85 at Route 495 southbound Ramps									
Overall	A	5	--	A	8	--	C	25	--
Route 85 WB LT	C	16	0.23	C	21	0.33	C	22	0.34
Route 495 SB LT	F	119	0.35	F	290	0.70	F	315	0.74
Route 495 SB RT	C	17	0.64	C	24	0.78	F	82	1.09
Route 16 at Hopping Brook Road									
Overall	A	1	--	A	1	--	F	358	
Route 16 WB LT/TH	A	2	0.07	A	2	0.08	F	102	0.95
Hopping Brook Rd LT	D	32	0.11	E	43	0.15	F	*	*
Hopping Brook Rd RT	B	14	0.02	C	16	0.02	D	28	0.22
Route 16 at Route 126 South									
Overall	D	27	--	F	64	--	F	621	--
Route 16 WB LT/TH	A	5	0.22	A	7	0.28	A	8	0.29
Route 126 NB LT	F	82	0.52	F	203	0.90	F	*	3.73
Route 126 NB RT	F	101	1.08	F	249	1.46	F	270	1.52
Route 16 at Central Street									
Overall	F	109	--	F	*	--	F	*	--
Route 16 EB LT	C	17	0.38	C	23	0.53	C	24	0.54
Central St NB LT/RT	F	803	2.61	F	*	*	F	*	*

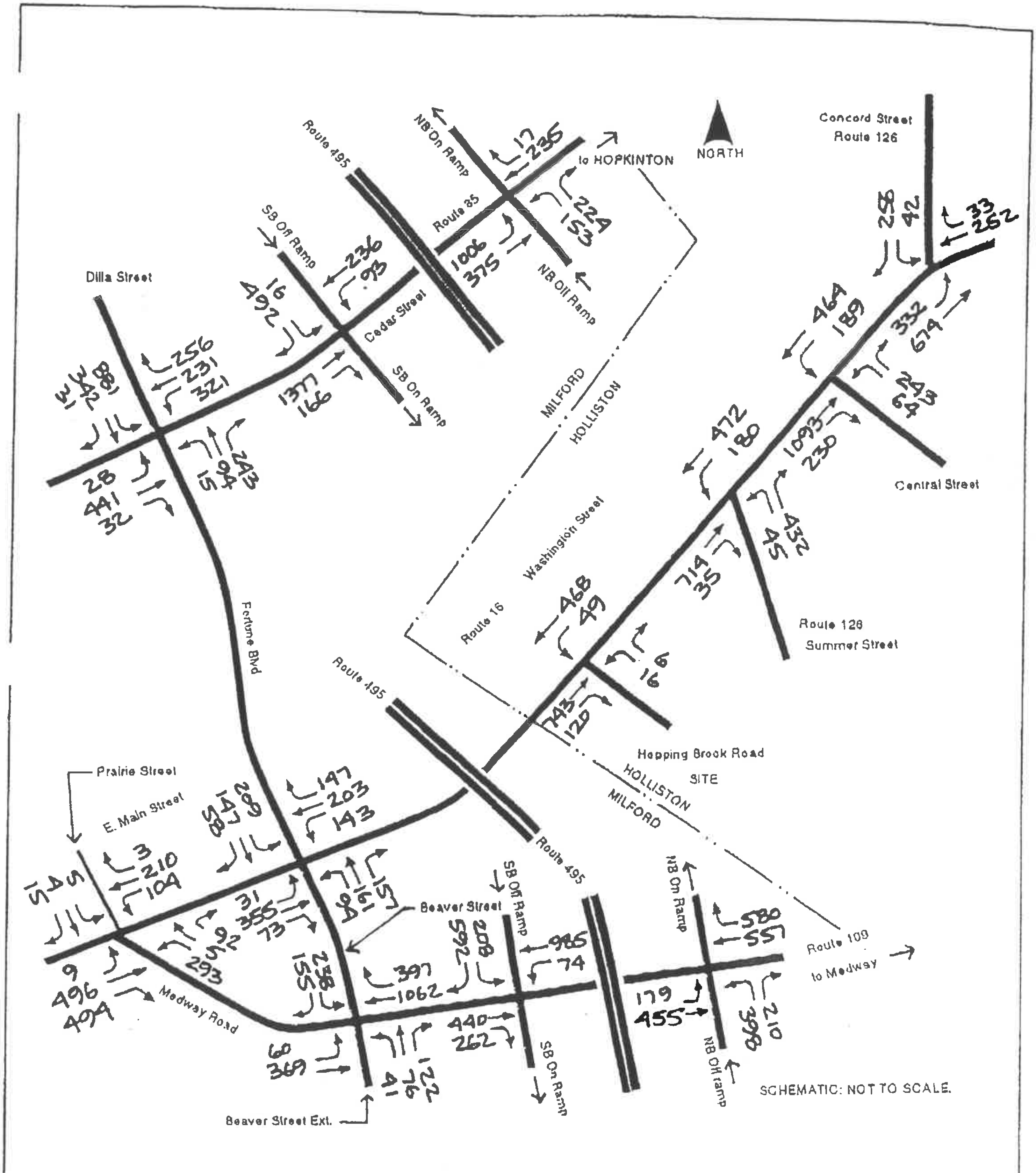
	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Dilla/Fortune									
Overall	**C**	**25**	--	**C**	**35**	--	**D**	**40**	--
Route 85 EB LT	D	52	0.55	E	75	0.72	E	77	0.76
Route 85 EB TH/RT	C	26	0.58	C	30	0.64	D	38	0.79
Route 85 WB LT	C	32	0.60	D	40	0.76	C	34	0.59
Route 85 WB TH	C	32	0.83	D	47	0.94	D	49	0.93
Route 85 WB RT	A	9	0.80	B	19	0.92	C	23	0.93
Fortune NB LT/TH	C	29	0.74	D	38	0.87	D	40	0.89
Fortune NB RT	A	4	0.51	A	6	0.63	C	28	0.95
Dilla SB LTR	D	39	0.85	D	50	0.92	E	64	0.96
Route 85 at Route 495 northbound Ramps									
Overall		**see**		**F**	**98**	—	**F**	**95**	--
Route 85 EB LT		unsignalized		C	22	0.88	F	121	1.19
Route 85 EB TH				A	4	0.18	A	2	0.16
Route 85 WB TH				F	234	1.65	F	121	1.17
Route 85 WB RT				C	23	0.05	B	19	0.04
Route 495 NB LT				C	34	0.6	F	86	0.94
Route 495 NB RT				A	6	0.41	A	8	0.52
Route 109 at Beaver Street/Beaver Street Extension									
Overall	**D**	**46**	--	**F**	**82**	—	**F**	**108**	--
Route 109 EB LT/TH	E	68	1.06	F	139	1.27	F	178	1.40
Route 109 WB TH	C	24	0.54	C	31	0.60	C	34	0.38
Route 109 WB RT	A	2	0.46	A	2	0.50	A	3	0.54
Beaver St Ext. NB LT	C	29	0.14	D	37	0.15	D	39	0.16
Beaver St Ext. NB TH	C	30	0.28	D	38	0.31	D	41	0.34
Beaver St Ext. NB RT	E	65	1.00	F	113	1.16	F	150	1.28
Beaver St SB LT	E	73	1.02	F	130	1.20	F	171	1.36
Beaver St SB RT	A	5	0.38	A	5	0.42	A	7	0.38
Route 109 at Route 495 southbound Ramps									
Overall	**C**	**20**	--	**C**	**33**	—	**C**	**33**	—
Route 109 EB LT	C	24	0.90	D	36	0.95	D	36	0.95
Route 109 WB TH	C	34	0.80	F	81	0.93	F	81	0.93
Route 109 WB TH	B	12	0.38	B	14	0.43	B	14	0.44
Route 495 SB LT	B	14	0.24	B	19	0.25	B	19	0.25
Route 495 SB RT	C	23	0.87	D	45	0.97	D	48	0.98

Morning

	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 85 at Dilla/Fortune									
Overall	**D**	**45**	—	**E**	**71**	—	**F**	**96**	—
Route 85 EB LT	D	53	0.32	E	68	0.41	E	68	0.41
Route 85 EB TH/RT	E	58	0.94	F	98	1.06	F	125	1.14
Route 85 WB LT	F	81	0.97	F	114	1.06	F	137	1.16
Route 85 WB TH	C	28	0.35	D	35	0.39	C	32	0.37
Route 85 WB RT	A	4	0.36	A	4	0.39	A	3	0.37
Fortune NB LT/TH	D	49	0.40	E	64	0.52	E	64	0.53
Fortune NB RT	B	17	0.74	C	32	0.94	C	26	0.85
Dilla SB LTR	D	48	0.94	E	79	1.04	F	119	1.16
Route 85 at Route 495 northbound Ramps									
Overall				**D**	**51**	—	**E**	**56**	—
Route 85 EB LT				E	61	1.05	E	69	1.07
Route 85 EB TH				A	2	0.24	A	2	0.24
Route 85 WB TH		see unsignalized		F	112	1.03	F	112	1.03
Route 85 WB RT				C	21	0.08	C	21	0.08
Route 495 NB LT				E	64	0.59	E	64	0.59
Route 495 NB RT				A	7	0.69	A	7	0.69
Route 109 at Beaver Street									
Overall	**C**	**21**	—	**C**	**21**	—	**B**	**20**	—
Route 109 EB LT/TH	B	19	0.65	B	19	0.67	B	19	0.67
Route 109 WB TH	C	33	0.95	C	32	0.95	C	32	0.95
Route 109 WB RT	A	2	0.52	A	2	0.53	A	2	0.68
Beaver St Ext. NB LT	B	17	0.07	C	21	0.10	C	21	0.10
Beaver St Ext. NB TH	B	18	0.13	C	21	0.17	C	22	0.18
Beaver St Ext. NB RT	A	5	0.21	A	5	0.26	A	5	0.27
Beaver St SB LT	C	24	0.55	C	26	0.62	C	26	0.64
Beaver St SB RT	A	4	0.39	A	4	0.42	A	4	0.41
Route 109 at Route 495 southbound Ramps									
Overall	**B**	**17**	—	**C**	**21**	—	**C**	**27**	—
Route 109 EB LT	B	18	0.50	B	19	0.52	B	20	0.48
Route 109 WB TH	C	28	0.58	D	52	0.74	D	42	0.64
Route 109 WB TH	B	16	0.77	B	19	0.85	C	28	0.95
Route 495 SB LT	A	9	0.13	A	9	0.15	B	10	0.15
Route 495 SB RT	B	19	0.76	C	28	0.91	C	34	0.95

	Morning								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 109 at Route 495 northbound Ramps									
Overall	**B**	**12**	--	**B**	**13**	--	**B**	**14**	--
Route 109 EB LT	B	13	0.60	C	22	0.65	C	25	0.69
Route 109 EB TH	A	8	0.29	A	7	0.29	A	8	0.30
Route 109 WB TH	B	18	0.66	B	18	0.71	B	18	0.71
Route 495 NB LT	B	14	0.29	B	15	0.40	B	16	0.59
Route 495 NB RT	A	3	0.28	A	3	0.35	A	3	0.35
Route 16 at Route 109									
Overall	**D**	**48**	--	**E**	**65**	--	**E**	**64**	--
Route 16/Route 109 EB LT/TH	D	47	0.89	C	22	0.75	C	26	0.83
Route 16/Route 109 EB RT	A	4	0.72	A	2	0.69	A	2	0.68
Route 16/Route 109 WB LT	D	41	0.70	B	14	0.56	B	14	0.56
Route 16/Route 109 WB TH/RT	C	28	0.44	B	14	0.43	B	14	0.43
Route 109 NB LT/TH	F	153	1.33	F	333	2.69	F	328	2.74
Route 109 NB RT	B	13	0.59	A	8	0.52	A	8	0.52
Prairies St SB LT/TH/RT	D	44	0.48	B	15	0.15	B	15	0.15
Route 16 at Fortune Blvd/Beaver Street									
Overall	**A**	**6**	--	**A**	**10**	--	**C**	**27**	--
Route 16 EB LT/TH/RT	A	5	0.36	B	12	0.53	C	23	0.69
Route 16 WB LT/TH	A	8	0.42	B	14	0.62	C	25	1.01
Route 16 WB RT	A	2	0.23	A	1	0.22	A	1	0.23
Beaver St NB LT/TH/RT	A	5	0.40	B	11	0.65	D	40	0.92
Fortune Blvd SB LT	A	8	0.46	A	9	0.59	D	38	0.93
Fortune Blvd SB TH	A	8	0.46	A	7	0.19	A	7	0.16
Fortune Blvd SB RT	A	3	0.10	A	2	0.08	A	2	0.07
Route 16 at Route 126 North									
Overall	**A**	**7**	--	**A**	**7**	--	**B**	**10**	--
Route 16/Route 126 EB LT	A	5	0.56	A	5	0.62	B	13	0.70
Route 16/Route 126 EB TH	A	6	0.63	A	6	0.67	A	6	0.66
Route 16 WB TH/RT	B	13	0.50	B	15	0.65	C	20	0.75
Route 126 SB LT	B	16	0.13	B	18	0.17	B	18	0.17
Route 126 SB RT	A	3	0.52	A	3	0.59	A	3	0.64

	Evening								
	2003 Existing			2008 No Build			2008 Build		
	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]	LOS[1]	Delay[2]	V/C[3]
Route 109 at Route 495 northbound Ramps									
Overall	**B**	**15**	--	**B**	**19**	--	**B**	**19**	--
Route 109 EB LT	B	17	0.88	C	32	0.90	C	32	0.90
Route 109 EB TH	B	11	0.48	A	8	0.53	A	8	0.53
Route 109 WB TH	C	21	0.75	C	30	0.88	C	30	0.88
Route 495 NB LT	B	17	0.24	B	19	0.30	B	19	0.32
Route 495 NB RT	A	7	0.34	B	12	0.43	B	12	0.43
Route 16 at Route 109									
Overall	**F**	**85**	--	**F**	**91**	--	**F**	**84**	--
Route 16/Route 109 EB LT/TH	C	35	0.56	C	22	0.54	B	19	0.52
Route 16/Route 109 EB RT	A	4	0.76	A	3	0.75	A	2	0.71
Route 16/Route 109 WB LT	D	44	0.83	C	24	0.74	B	17	0.64
Route 16/Route 109 WB TH/RT	D	38	0.86	C	22	0.82	C	23	0.85
Route 109 NB LT/TH	F	294	2.07	F	368	3.41	F	356	3.32
Route 109 NB RT	B	17	0.63	A	9	0.55	A	8	0.54
Prairies St SB LT/TH/RT	C	29	0.15	C	21	0.12	B	18	0.09
Route 16 at Fortune Boulevard/Beaver Street									
Overall	**A**	**7**	--	**B**	**13**	--	**C**	**34**	--
Route 16 EB LT/TH/RT	A	4	0.27	A	10	0.40	B	16	0.38
Route 16 WB LT/TH	A	9	0.58	C	22	0.90	D	46	1.25
Route 16 WB RT	A	2	0.33	A	2	0.37	A	8	0.63
Beaver St NB LT/TH/RT	A	7	0.61	B	17	0.81	D	50	0.93
Fortune Blvd SB LT	A	9	0.57	B	13	0.67	E	55	0.94
Fortune Blvd SB TH	n/a	n/a	n/a	A	10	0.40	C	25	0.47
Fortune Blvd SB RT	A	4	0.07	A	3	0.07	B	12	0.08
Route 16 at Route 126 North									
Overall	**B**	**13**	--	**B**	**20**	--	**C**	**22**	--
Route 16/Route 126 EB LT	B	19	0.70	C	32	0.80	D	36	0.84
Route 16/Route 126 EB TH	A	4	0.20	A	4	0.22	A	4	0.29
Route 16 WB TH/RT	C	20	0.85	C	27	0.91	C	31	0.92
Route 126 SB LT	C	22	0.13	C	30	0.15	C	31	0.16
Route 126 SB RT	A	4	0.74	A	8	0.85	A	8	0.85

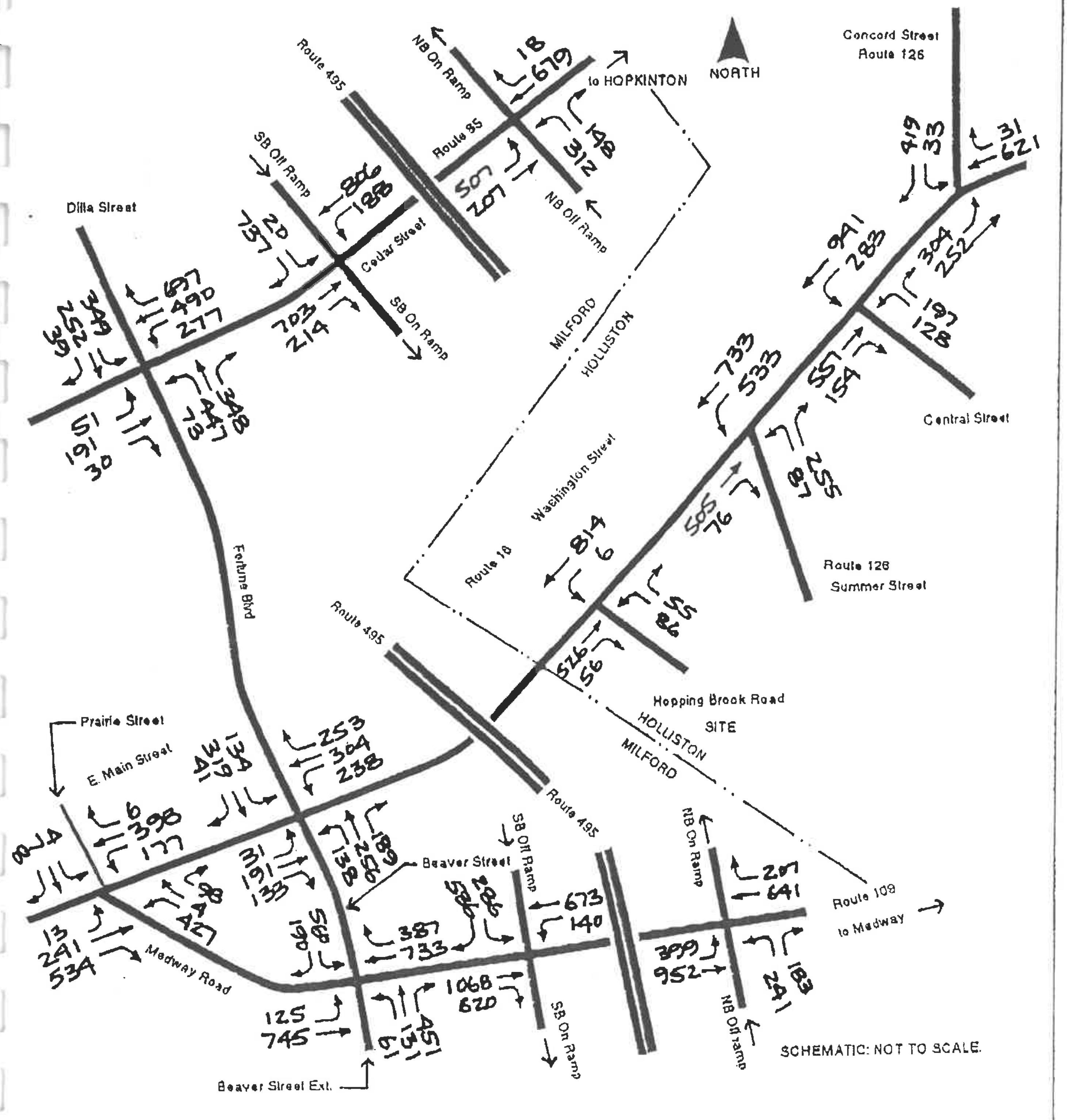


003 EXISTING VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Exhibit

Abend Associates



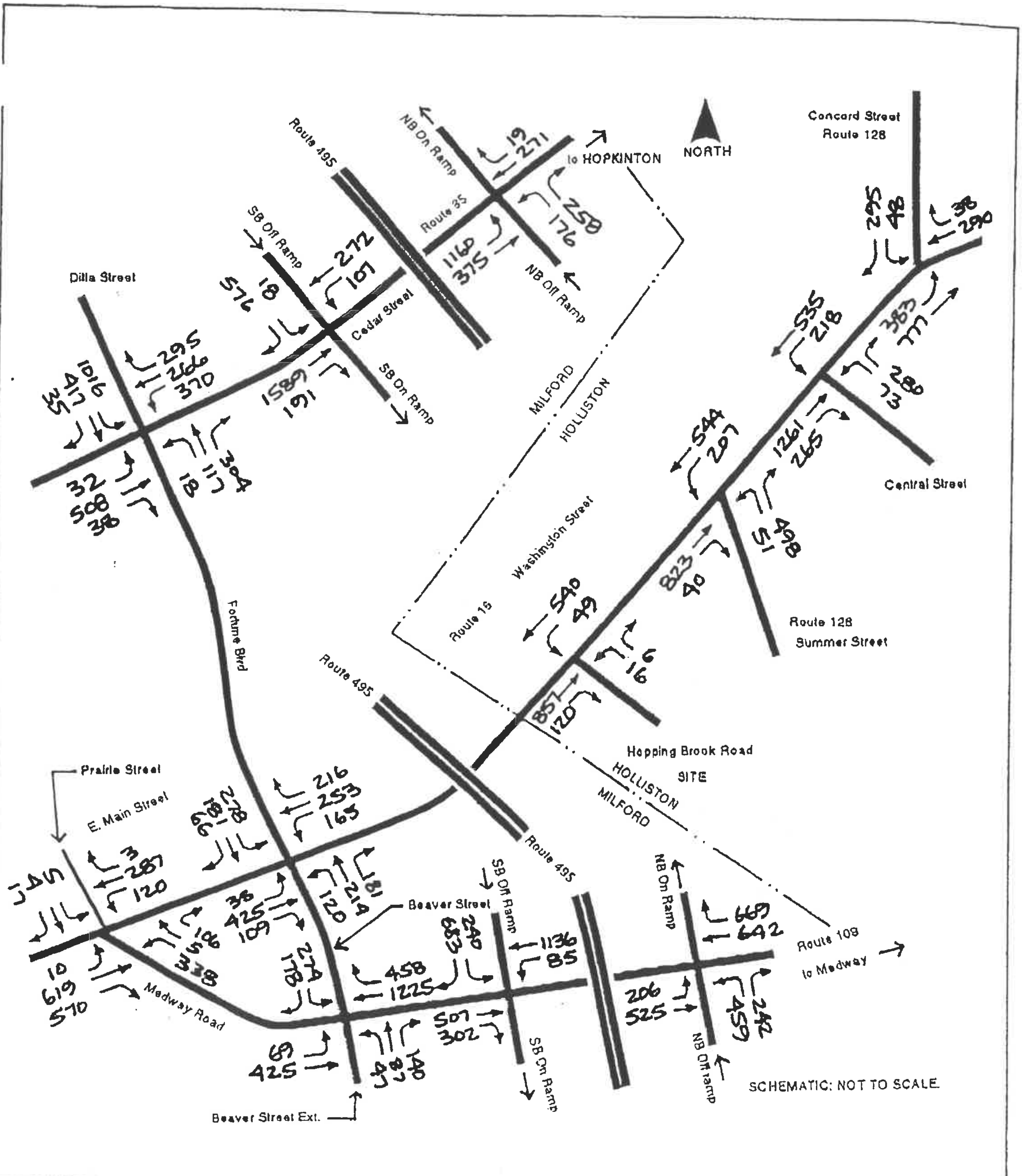
2003 EXISTING VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit

14



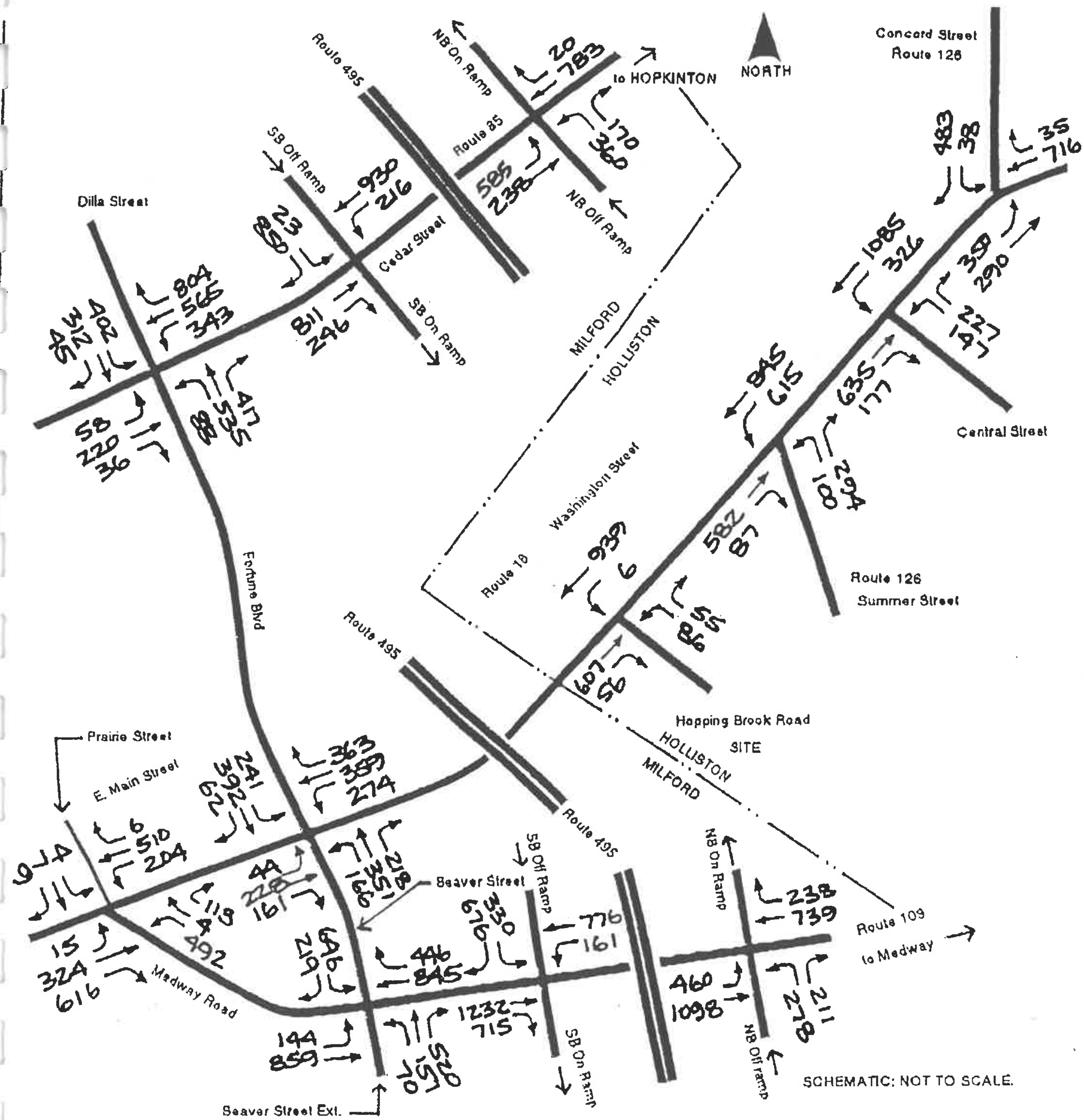
'008 NO BUILD VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit

15

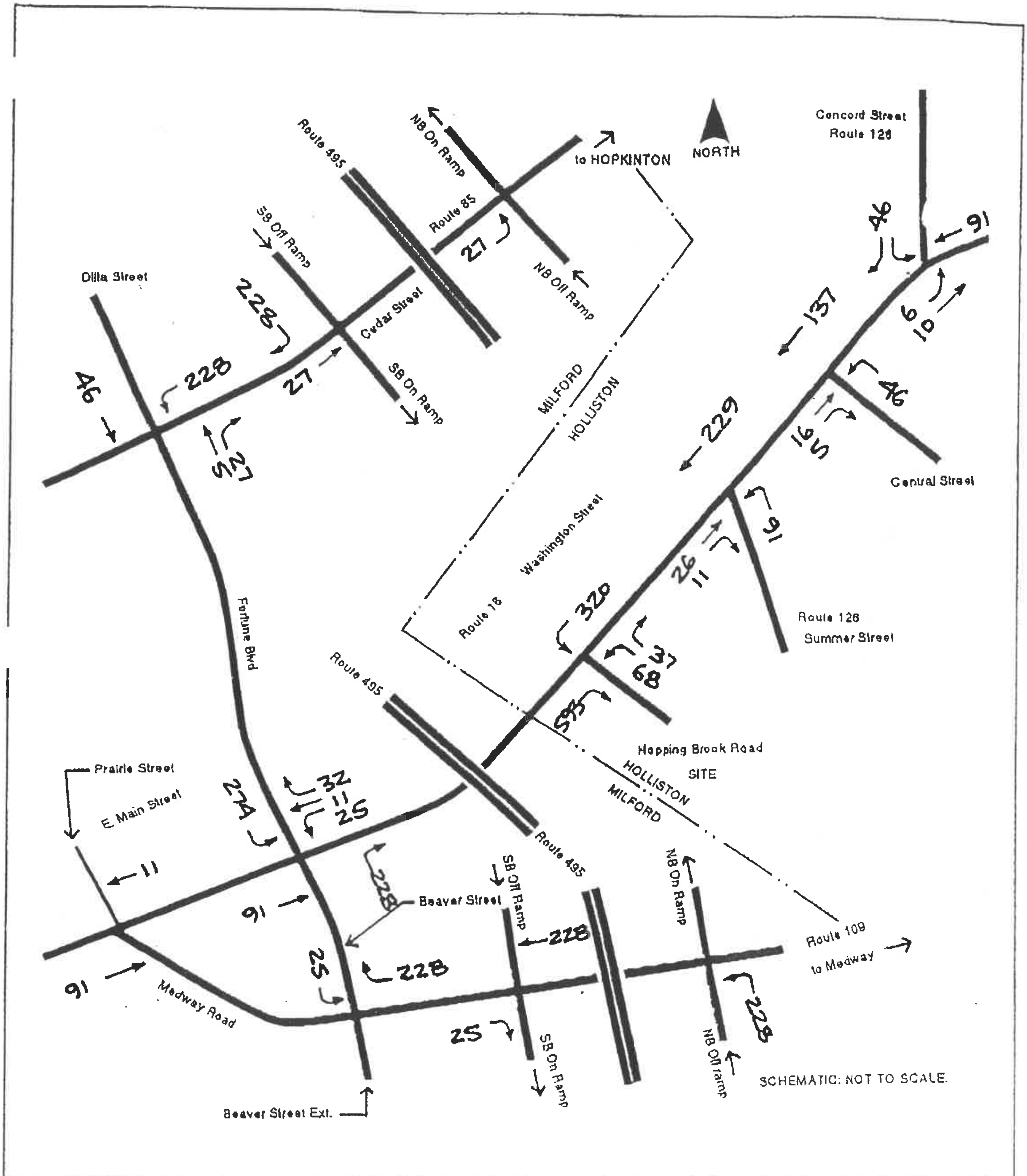


008 NO BUILD VOLUMES
EVENING PEAK HOUR

Hopping Brook
Business Park
Holliston, Massachusetts

Abend Associates

Exhibit



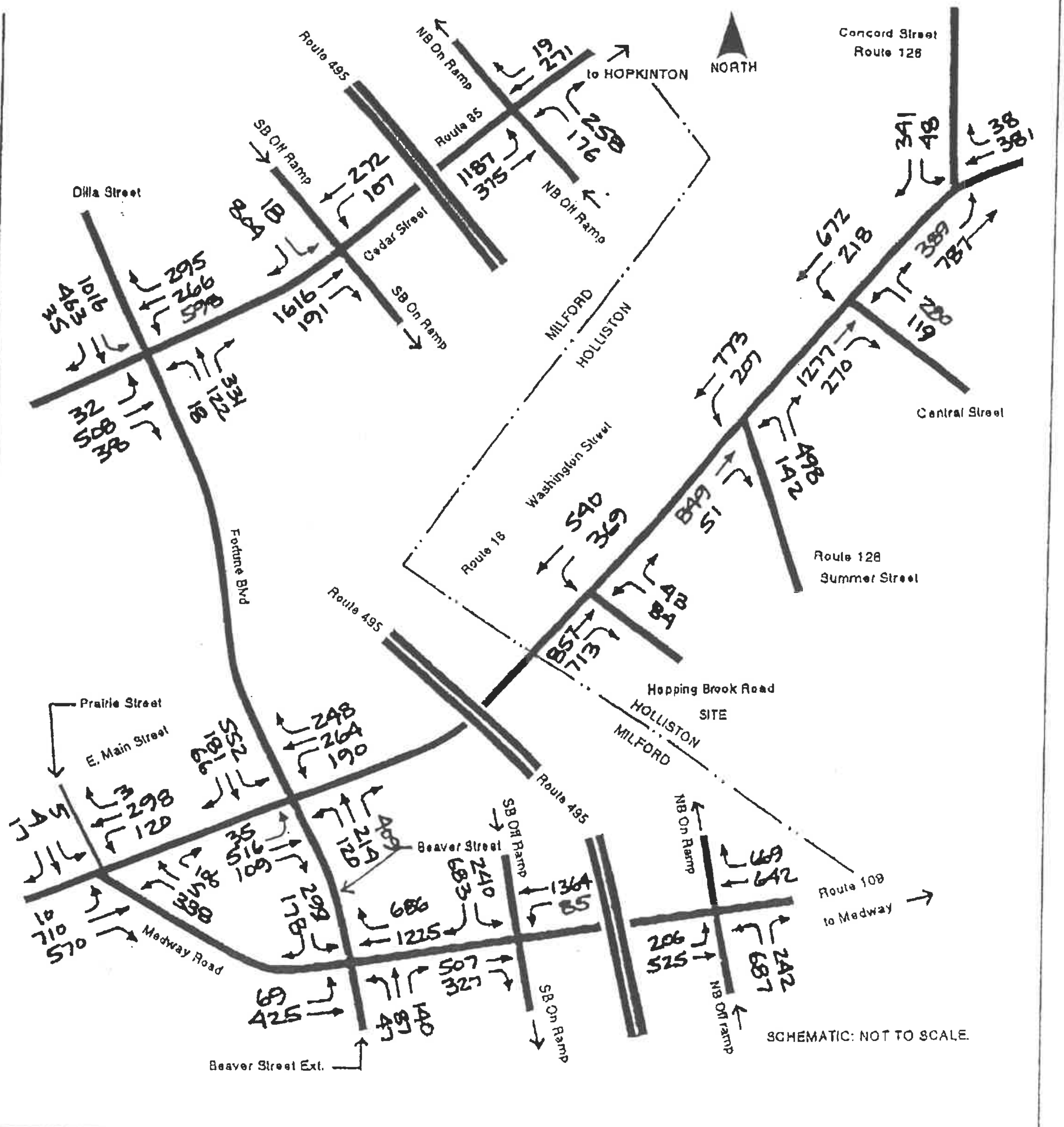
ROJECT–RELATED VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit

17

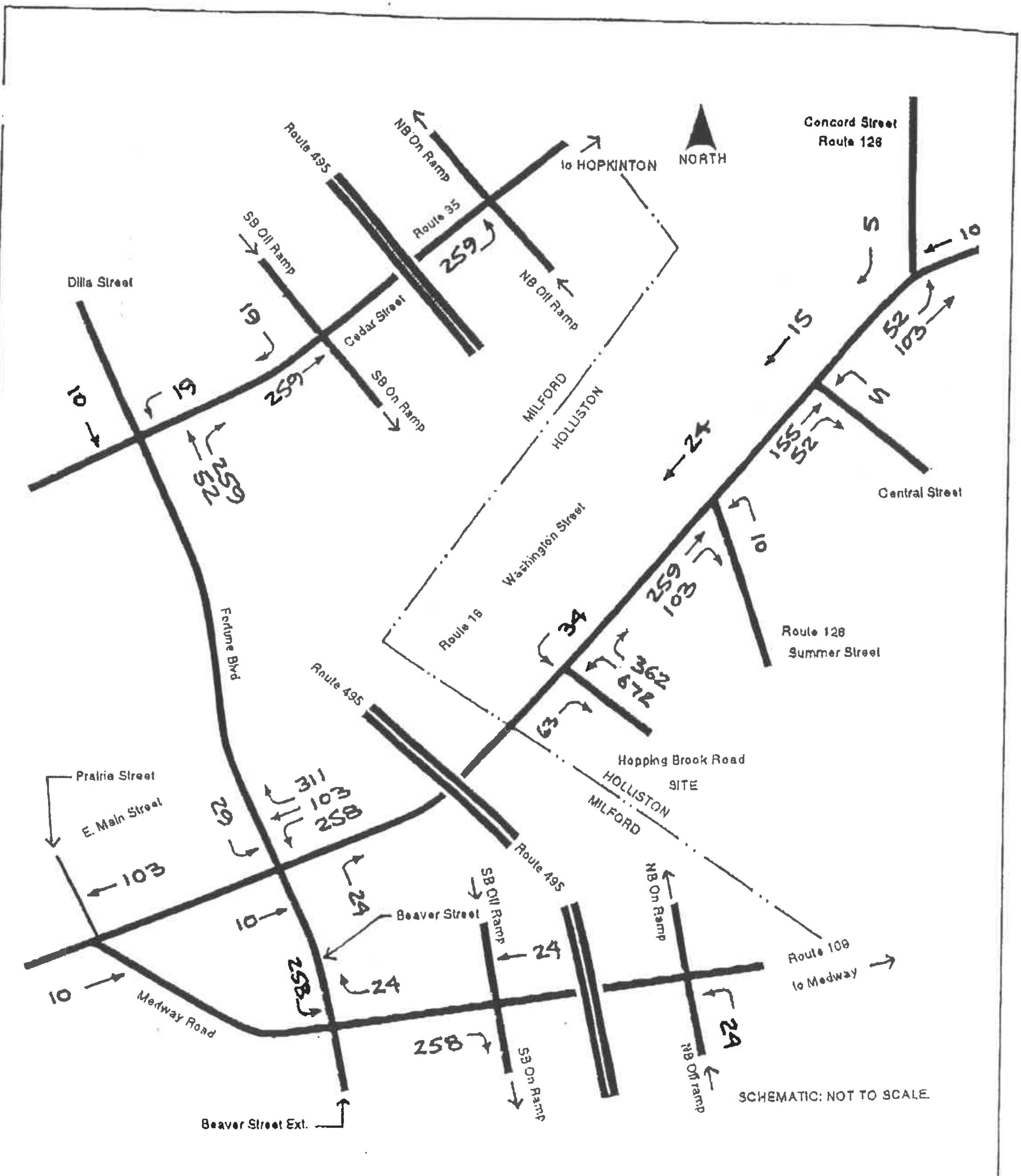


'008 BUILD VOLUMES
MORNING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Exhibit

Abend Associates



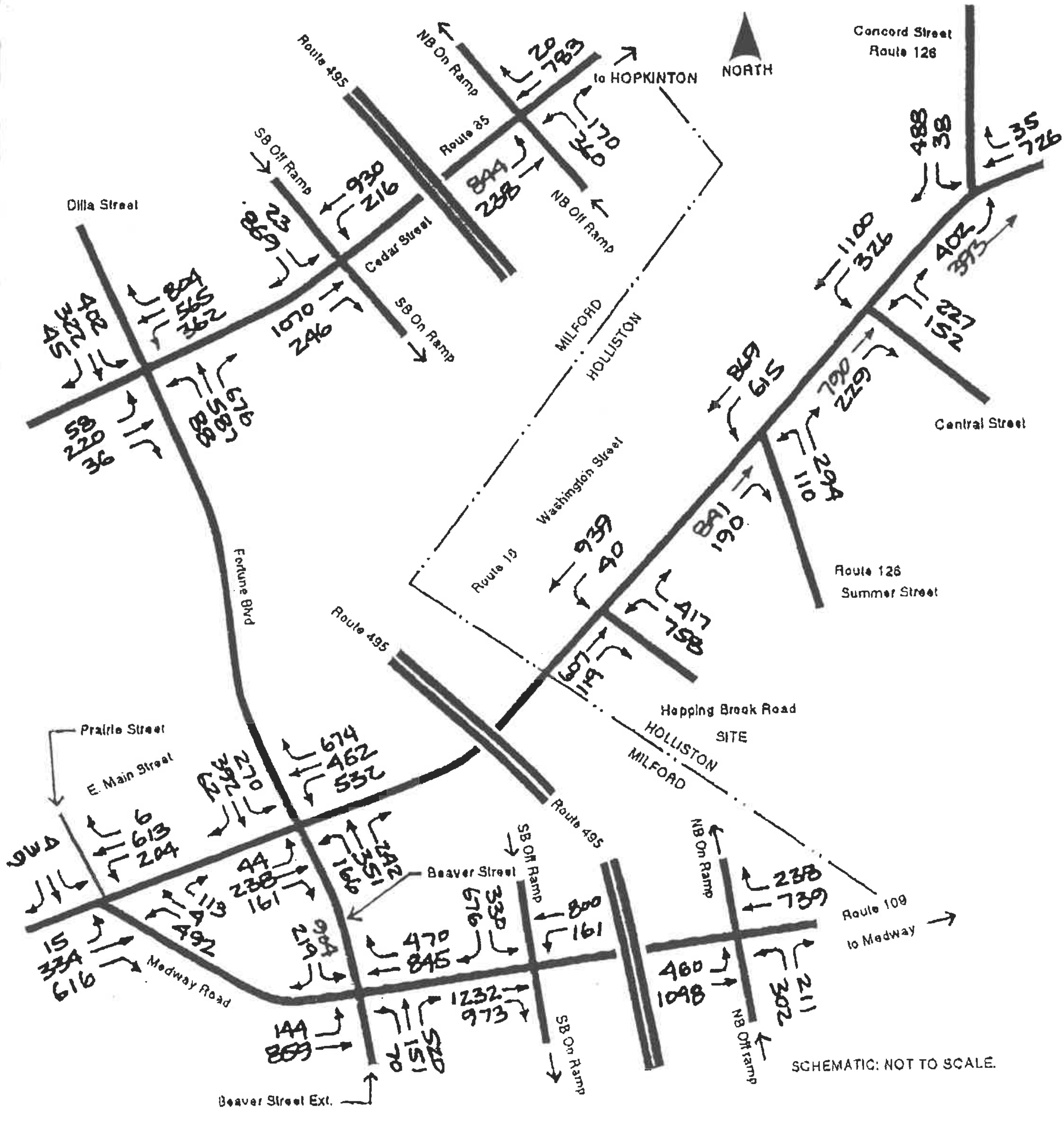
PROJECT-RELATED VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit

19



2008 BUILD VOLUMES
EVENING PEAK HOUR

Hopping Brook Business Park
Holliston, Massachusetts

Abend Associates

Exhibit

20

Attachment B

MOBILE6 Input Parameters and Assumptions

MOBILE6 will be used to estimate vehicle emissions using the following assumptions: (Note: All inputs are based on those given in the 2/12/2003 memo from DEP.)

```
* Generic Input File for Summer/Winter Ozone and CO Build/No-Build Analyses for Calendar Year 2000+
* Filename = MA_O3CO.inp
* File prepared by Craig Woleader, MADEP (617)-348-4046
*
***************    Header Section    ***************
MOBILE6 INPUT FILE

POLLUTANTS        : HC CO NOX
SPREADSHEET       :
REPORT FILE      : MAO3CO.txt REPLACE

RUN DATA

***************    Run Section #1    ****************

> ***************************************************
> ******************** WINTER **********************
> ***************************************************

* Pollutant output format
EXPRESS HC AS VOC  :

* Mass. specific user inputs – require external data file
REG DIST          : MA_REG.D
I/M DESC FILE      : MA_ENHIM.D
* Note: MA_ENHIM.D requires MA_CUTPT.D to run

STAGE II REFUELING :
91 3 84. 84.

* Inputs for LEV II
94+ LDG IMP        : MA_LEV2.D
T2 EXH PHASE-IN    : LEV2EXH.D
T2 EVAP PHASE-IN   : LEV2EVAP.D
T2 CERT           : LEV2CERT.D

* Meteorological inputs
MIN/MAX TEMP       : 35. 45.

* Fuel Inputs
FUEL RVP          : 13.5
FUEL PROGRAM       : 2 N


***************    Scenario Section #1    ***************

***************     Winter Freeway      ***************

SCENARIO RECORD    : MA Freeway 2.71 mph (= minimum allowed freeway speed)
CALENDAR YEAR      : 2000
EVALUATION MONTH   : 1
AVERAGE SPEED      : 2.71 Freeway 92.0 0.0 0.0 8.0
```

SCENARIO RECORD : MA Freeway 3.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 3.0 Freeway 92.0 0.0 0.0 8.0

SCENARIO RECORD : MA Freeway 4.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 4.0 Freeway 92.0 0.0 0.0 8.0

*
*
*

SCENARIO RECORD : MA Freeway 60.7 mph (= maximum allowed freeway speed)
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 60.7 Freeway 92.0 0.0 0.0 8.0

*************** Winter Arterial ***************

SCENARIO RECORD : MA Arterial 2.5 mph (= minimum allowed arterial speed)
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 2.5 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD : MA Arterial 3.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 3.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD : MA Arterial 4.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 4.0 Arterial 0.0 100.0 0.0 0.0

*
*
*

SCENARIO RECORD : MA Arterial 65.0 mph (= maximum allowed arterial speed)
CALENDAR YEAR : 2000
EVALUATION MONTH : 1
AVERAGE SPEED : 65.0 Arterial 0.0 100.0 0.0 0.0

*************** End of This Run ***************
END OF RUN

*************** Run Section #2 ***************

> **

```
> ******************** SUMMER **********************
> ***************************************************

 * Pollutant output format
 EXPRESS HC AS VOC  :

 * Mass. specific user inputs -- require external data file
 REG DIST          : MA_REG.D
 I/M DESC FILE     : MA_ENHIM.D
 * Note: MA_ENHIM.D requires MA_CUTPT.D to run

 STAGE II REFUELING :
 91 3 84. 84.

 * Inputs for LEV II
 94+ LDG IMP       : MA_LEV2.D
 T2 EXH PHASE-IN   : LEV2EXH.D
 T2 EVAP PHASE-IN  : LEV2EVAP.D
 T2 CERT           : LEV2CERT.D

 * Meteorological inputs
 MIN/MAX TEMP      : 68. 94.

 * Fuel Inputs
 FUEL RVP          : 8.6
 FUEL PROGRAM      : 2 N

***************    Scenario Section #2    ***************

***************    Summer Freeway    ***************

 SCENARIO RECORD   : MA Freeway 2.71 mph (= minimum allowed freeway speed)
 CALENDAR YEAR     : 2000
 EVALUATION MONTH  : 7
 AVERAGE SPEED     : 2.71 Freeway 92.0 0.0 0.0 8.0

 SCENARIO RECORD   : MA Freeway 3.0 mph
 CALENDAR YEAR     : 2000
 EVALUATION MONTH  : 7
 AVERAGE SPEED     : 3.0 Freeway 92.0 0.0 0.0 8.0

 SCENARIO RECORD   : MA Freeway 4.0 mph
 CALENDAR YEAR     : 2000
 EVALUATION MONTH  : 7
 AVERAGE SPEED     : 4.0 Freeway 92.0 0.0 0.0 8.0

*
*
*

SCENARIO RECORD   : MA Freeway 60.7 mph (= maximum allowed freeway speed)

CALENDAR YEAR     : 2000
```

EVALUATION MONTH : 7
AVERAGE SPEED : 60.7 Freeway 92.0 0.0 0.0 8.0

*************** Summer Arterial ***************

SCENARIO RECORD : MA Arterial 2.5 mph (= minimum allowed arterial speed)
CALENDAR YEAR : 2000
EVALUATION MONTH : 7
AVERAGE SPEED : 2.5 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD : MA Arterial 3.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 7
AVERAGE SPEED : 3.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD : MA Arterial 4.0 mph
CALENDAR YEAR : 2000
EVALUATION MONTH : 7
AVERAGE SPEED : 4.0 Arterial 0.0 100.0 0.0 0.0

*
*
*

SCENARIO RECORD : MA Arterial 65.0 mph (= maximum allowed arterial speed)
CALENDAR YEAR : 2000
EVALUATION MONTH : 7
AVERAGE SPEED : 65.0 Arterial 0.0 100.0 0.0 0.0

*************** End of This Run ***************
END OF RUN

FIGURES

MOBILE6 Input/Output Files

26A

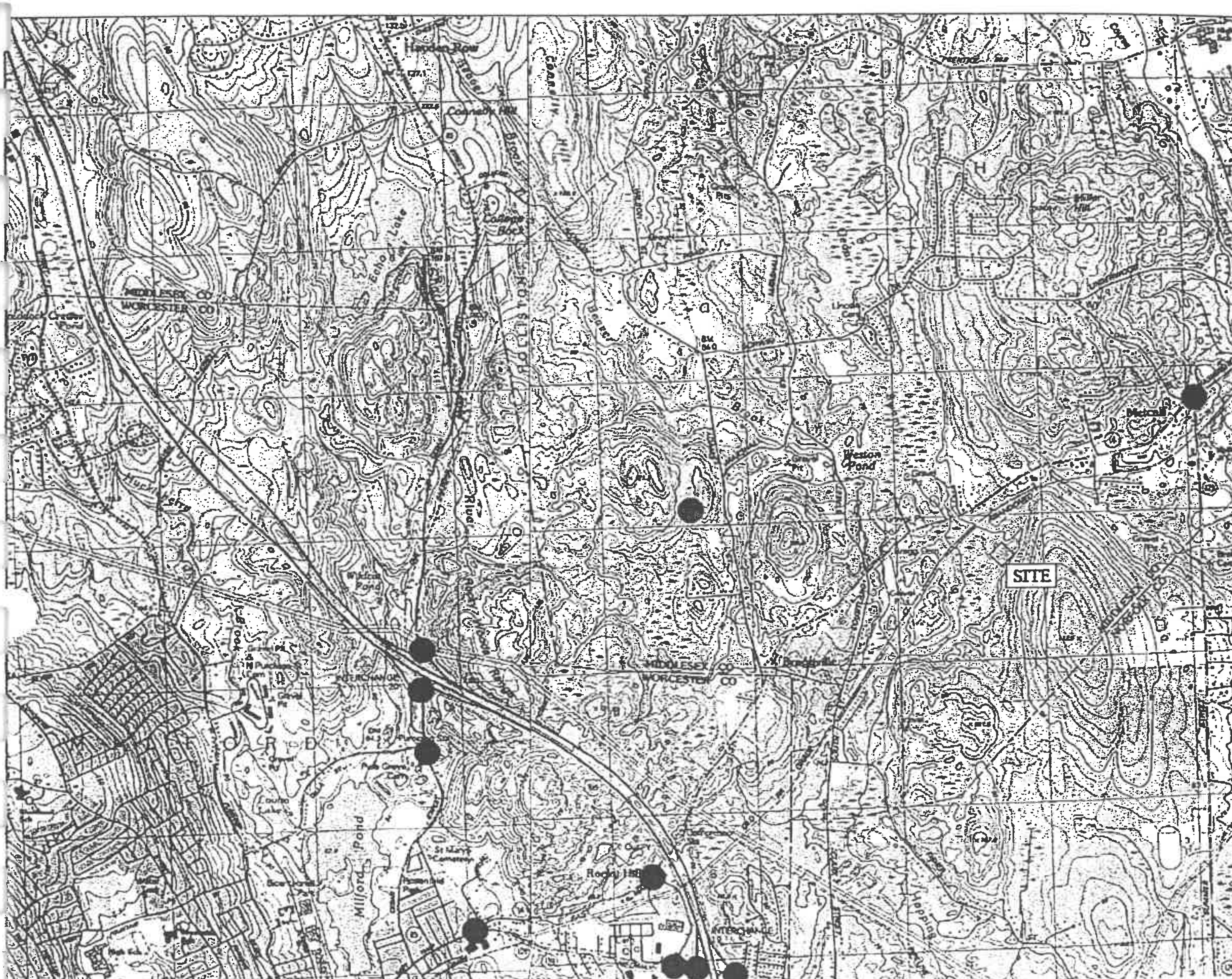


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Figure 1
Interesections Locations Studied

EPSILON ASSOCIATES INC.
Engineers ■ Environmental Consultants

```
*****************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                                *
* Input file: H2003A.INP (file 1, run 1).                                   *
*****************************************************************************
* ****************************************************
* ******************** WINTER **********************
* ****************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
  M 49 Warning:
                  0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                   1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                   1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                   1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                   1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                  0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                   1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: MA_ENHIM.D
* Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
* IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

* Reading non-default I/M CUTPOINTS from the following external
* data file: MA_CUTPT.D
* Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
* OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
* Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
* Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
* OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
* OBD Evap I/M program for MY 2004+
  M601 Comment:
               User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D

  Reading User Supplied Tier2 Exhaust bin phase-in fractions

     Data read from file: LEV2EXH.D


  Reading User Supplied Tier2 EVAP phase-in fractions

     Data read from file: LEV2EVAP.D


  Reading User Supplied Tier2 50K certification standards

     Data read from file: LEV2CERT.D

  M616 Comment:
               User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # # #
```

```
* MA Freeway 10.0 mph
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 10.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
              GVWR:              <6000    >6000    (All)
                       ------   ------   ------   ------   ------   ------   ------   ------   ------
------
   VMT Distribution:   0.4307   0.3221   0.1205            0.0340   0.0005   0.0018   0.0865   0.0039
1.0000
  ----------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :    1.565    1.288    1.809    1.430    3.449    1.161    1.040    1.204     6.40
1.556
     Composite CO  :    24.40    26.88    25.16    26.41    37.54    3.020    2.056    7.514    33.63
24.261
     Composite NOX :    1.221    1.368    1.773    1.478    4.000    1.521    1.618   17.958     1.37
2.879
  ----------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 20.0 mph
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 20.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
              GVWR:              <6000    >6000    (All)
```

```
                        ------     ------    ------     ------     ------     ------     ------     ------     ------
------
  VMT Distribution:   0.4307     0.3221    0.1205                0.0340     0.0005     0.0018     0.0865     0.0039
1.0000
  ---------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     1.110      0.920     1.303      1.024      1.882      0.887      0.756      0.812      4.71
1.086
     Composite CO   :    21.43      23.59     21.67      23.07      20.17      2.056      1.312      4.213      19.44
20.569
     Composite NOX :     0.993      1.101     1.448      1.195      4.341      1.200      1.268     14.825      1.44
2.395
  ---------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 25.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:     LDGV     LDGT12    LDGT34      LDGT       HDGV       LDDV       LDDT       HDDV        MC
All Veh
             GVWR:                <6000     >6000      (All)
                        ------    ------    ------     ------     ------     ------     ------     ------     ------
------
  VMT Distribution:   0.4307     0.3221    0.1205                0.0340     0.0005     0.0018     0.0865     0.0039
1.0000
  ---------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     1.046      0.873     1.239      0.972      1.507      0.798      0.663      0.685      4.39
1.010
     Composite CO   :    21.20      23.33     21.38      22.80      15.86      1.801      1.115      3.340      16.75
20.116
     Composite NOX :     1.007      1.117     1.462      1.211      4.518      1.113      1.174     13.981      1.51
2.341
  ---------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 30.0 mph
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 30.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
```

Month: Jan.
Altitude: Low
Minimum Temperature: 35.0 (F)
Maximum Temperature: 45.0 (F)
Absolute Humidity: 75. grains/lb
Fuel Sulfur Content: 120. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: No
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.004	0.842	1.197	0.938	1.259	0.730	0.593	0.588	4.15	0.959
Composite CO :	21.05	23.15	21.18	22.61	13.13	1.632	0.985	2.761	14.83	19.819
Composite NOX :	1.016	1.127	1.472	1.221	4.700	1.066	1.123	13.520	1.58	2.316

* #
* MA Arterial 10.0 mph
* File 1, Run 1, Scenario 5.
* #

M583 Warning:
The user supplied arterial average speed of 10.0 will be used for all hours of the day. 100% of VMT has been assigned to the arterial/collector roadway type for all hours of the day and all vehicle types.

M112 Warning:
Wintertime Reformulated Gasoline Rules Apply

M 48 Warning:
there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D
Calendar Year: 2003
Month: Jan.
Altitude: Low
Minimum Temperature: 35.0 (F)
Maximum Temperature: 45.0 (F)
Absolute Humidity: 75. grains/lb
Fuel Sulfur Content: 120. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: No
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.584	1.323	1.873	1.473	3.506	1.188	1.068	1.243	6.40	1.589
Composite CO :	24.17	26.78	25.22	26.35	38.59	3.087	2.108	7.742	33.55	24.194
Composite NOX :	1.383	1.560	1.998	1.679	3.936	1.543	1.642	16.039	1.35	2.869

* #
* MA Arterial 20.0 mph
* File 1, Run 1, Scenario 6.

```
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 20.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:              <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.4307    0.3221    0.1205              0.0340    0.0005    0.0018    0.0865    0.0039
1.0000
 ----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     1.128     0.944     1.345     1.053     1.882     0.891     0.760     0.818      4.72
1.107
    Composite CO  :     20.89     23.13     21.37     22.65     20.15     2.058     1.313     4.219     19.48
20.152
    Composite NOX :     1.101     1.230     1.597     1.330     4.316     1.197     1.265    12.667      1.43
2.314
 ----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 25.0 mph
* File 1, Run 1, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 25.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:              <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.4307    0.3221    0.1205              0.0340    0.0005    0.0018    0.0865    0.0039
1.0000
 ----------------------------------------------------------------------------------------------------------
------
```

```
 Composite Emission Factors (g/mi):
      Composite VOC :      1.044     0.871     1.242     0.972     1.506    0.799     0.664     0.686      4.40
1.009
      Composite CO  :      20.31     22.49     20.70     22.00     15.81    1.799     1.114     3.335     16.78
19.381
      Composite NOX :      1.045     1.164     1.516     1.260     4.506    1.110     1.170    11.818      1.51
2.192
 ---------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
          The user supplied arterial average speed of 30.0
          will be used for all hours of the day.  100% of VMT
          has been assigned to the arterial/collector roadway
          type for all hours of the day and all vehicle types.
  M112 Warning:
             Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

       Vehicle Type:      LDGV     LDGT12     LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                 <6000      >6000     (All)
                        ------     ------     ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:     0.4307    0.3221    0.1205              0.0340    0.0005    0.0018    0.0865    0.0039
1.0000
 ---------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
      Composite VOC :      0.992     0.830     1.185     0.927     1.259    0.730     0.593     0.588      4.15
0.949
      Composite CO  :      20.11     22.26     20.43     21.76     13.11    1.631     0.984     2.758     14.84
19.037
      Composite NOX :      1.007     1.120     1.463     1.214     4.696    1.064     1.121    11.372      1.58
2.123
 ---------------------------------------------------------------------------------------------------------------
------
****************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                               *
* Input file: H2003A.INP (file 1, run 2).                                  *
****************************************************************************
* ****************************************************
* ******************** SUMMER **********************
* ****************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
```

```
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.991      MYR sum not = 1. (will normalize)
   M 49 Warning:
                 0.998      MYR sum not = 1. (will normalize)
   M 49 Warning:
                  1.00      MYR sum not = 1. (will normalize)

 * Reading I/M program description records from the following external
 * data file: MA_ENHIM.D
 * Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
 * IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

 * Reading non-default I/M CUTPOINTS from the following external
 * data file: MA_CUTPT.D
 * Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
 * OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
 * Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
 * Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
 * OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
 * OBD Evap I/M program for MY 2004+
   M601 Comment:
                User has enabled STAGE II REFUELING.


 * Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
 * data file: MA_LEV2.D

   Reading User Supplied Tier2 Exhaust bin phase-in fractions

      Data read from file: LEV2EXH.D


   Reading User Supplied Tier2 EVAP phase-in fractions

      Data read from file: LEV2EVAP.D


   Reading User Supplied Tier2 50K certification standards

      Data read from file: LEV2CERT.D

   M616 Comment:
                User has supplied post-1999 sulfur levels.

 * # # # # # # # # # # # # # # # # # # # # # # # # #
 * MA Freeway 10.0 mph
 * File 1, Run 2, Scenario 1.
 * # # # # # # # # # # # # # # # # # # # # # # # # #
   M582 Warning:
            The user supplied freeway average speed of 10.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
 *** I/M credits for Tech1&2 vehicles were read from the following external
     data file: TECH12.D
   M 48 Warning:
              there are no sales for vehicle class HDGV8b

  LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  68.0 (F)
            Maximum Temperature:  94.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
```

```
                  ATP Program:  No
              Reformulated Gas:  Yes

        Vehicle Type:      LDGV     LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
               GVWR:               <6000     >6000     (All)
                          ------   ------    ------    ------    ------    ------    ------    ------     ------
------
   VMT Distribution:     0.4215    0.3244    0.1219               0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
  -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       1.450     1.147     1.523     1.250     3.020     1.137     1.040     1.154      6.59
1.409
     Composite CO  :      14.90     14.02     13.74     13.94     33.27     3.003     2.047     7.065     37.70
14.470
     Composite NOX :       1.215     1.220     1.563     1.314     3.658     1.478     1.615    16.328      1.03
2.717
  -----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 20.0 mph
* File 1, Run 2, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
          The user supplied freeway average speed of 20.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
  M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                Calendar Year:  2003
                        Month:  July
                     Altitude:  Low
         Minimum Temperature:  68.0 (F)
         Maximum Temperature:  94.0 (F)
           Absolute Humidity:   75. grains/lb
         Fuel Sulfur Content:  120. ppm

         Exhaust I/M Program:  Yes
            Evap I/M Program:  Yes
                 ATP Program:  No
            Reformulated Gas:  Yes

        Vehicle Type:      LDGV     LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
               GVWR:               <6000     >6000     (All)
                          ------   ------    ------    ------    ------    ------    ------    ------     ------
------
   VMT Distribution:     0.4215    0.3244    0.1219               0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
  -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       1.033     0.799     1.068     0.873     1.769     0.870     0.756     0.779      4.92
0.979
     Composite CO  :      12.54     12.21     11.79     12.09     17.88     2.047     1.306     3.962     20.77
11.756
     Composite NOX :       0.925     0.961     1.252     1.041     3.970     1.166     1.266    13.280      1.08
2.206
  -----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 2, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
          The user supplied freeway average speed of 25.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
  M 48 Warning:
            there are no sales for vehicle class HDGV8b
```

```
 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
               Reformulated Gas:   Yes

      Vehicle Type:     LDGV    LDGT12    LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC
All Veh
              GVWR:               <6000     >6000    (All)
                        ------   ------    ------   ------   ------   ------   ------   ------   ------
------
   VMT Distribution:   0.4215    0.3244    0.1219            0.0350   0.0005   0.0018   0.0908   0.0040
1.0000
 ------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.970    0.753     1.009    0.823    1.470    0.783    0.663    0.656     4.60
0.907
     Composite CO  :     12.47    12.25     11.80    12.13    14.05    1.794    1.110    3.140    17.56
11.522
     Composite NOX :     0.922    0.969     1.257    1.048    4.131    1.082    1.172   12.460     1.14
2.140
 ------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 30.0 mph
* File 1, Run 2, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 30.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
               Reformulated Gas:   Yes

      Vehicle Type:     LDGV    LDGT12    LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC
All Veh
              GVWR:               <6000     >6000    (All)
                        ------   ------    ------   ------   ------   ------   ------   ------   ------
------
   VMT Distribution:   0.4215    0.3244    0.1219            0.0350   0.0005   0.0018   0.0908   0.0040
1.0000
 ------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.927    0.723     0.969    0.790    1.271    0.717    0.593    0.564     4.36
0.858
     Composite CO  :     12.48    12.38     11.88    12.24    11.64    1.626    0.981    2.596    15.27
11.432
     Composite NOX :     0.918    0.973     1.259    1.051    4.297    1.036    1.121   12.011     1.19
2.104
 ------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 10.0 mph
```

```
* File 1, Run 2, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 10.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                    Calendar Year:  2003
                            Month:  July
                         Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12   LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:              <6000    >6000     (All)
                        ------   ------   ------   ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.4215    0.3244   0.1219             0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
 -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.459     1.171    1.569    1.279     3.060     1.163     1.068     1.191      6.59
1.430
     Composite CO  :     14.64     13.90    13.71    13.85     34.21      3.069     2.098     7.280     37.61
14.368
     Composite NOX :      1.396     1.397    1.764    1.497     3.599     1.499     1.639    14.752      1.01
2.730
 -----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 20.0 mph
* File 1, Run 2, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 20.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                    Calendar Year:  2003
                            Month:  July
                         Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12   LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:              <6000    >6000     (All)
                        ------   ------   ------   ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.4215    0.3244   0.1219             0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
 -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.047     0.816    1.099    0.893     1.770     0.874     0.760     0.784      4.92
0.995
```

```
     Composite CO  :      12.03      11.87      11.56      11.78      17.86      2.049      1.308      3.967      20.82
11.402
     Composite NOX :      1.042      1.079      1.384      1.162      3.947      1.164      1.263     11.472      1.07
2.145
 --------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 25.0 mph
* File 1, Run 2, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

       Vehicle Type:       LDGV     LDGT12     LDGT34       LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
               GVWR:                 <6000      >6000      (All)
                         ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:     0.4215     0.3244     0.1219                0.0350     0.0005     0.0018     0.0908     0.0040
1.0000
 --------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.968      0.752      1.011      0.823      1.469      0.784      0.664      0.658       4.60
0.907
     Composite CO  :      11.68      11.70      11.35      11.61      14.01      1.792      1.109      3.136      17.60
10.951
     Composite NOX :      0.968      1.013      1.306      1.093      4.120      1.079      1.169     10.645       1.13
2.014
 --------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 2, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 30.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

       Vehicle Type:       LDGV     LDGT12     LDGT34       LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
               GVWR:                 <6000      >6000      (All)
```

VMT Distribution:	0.4215	0.3244	0.1219		0.0350	0.0005	0.0018	0.0908	0.0040	1.0000

Composite Emission Factors (g/mi):

Composite VOC :	0.918	0.714	0.961	0.782	1.270	0.717	0.593	0.564	4.36	0.850
Composite CO :	11.66	11.80	11.39	11.69	11.62	1.625	0.980	2.594	15.28	10.838
Composite NOX :	0.917	0.969	1.253	1.047	4.294	1.035	1.119	10.212	1.19	1.938

```
****************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                               *
* Input file: H2003B.INP (file 1, run 1).                                  *
****************************************************************************
* *****************************************************
* ********************* WINTER *********************
* *****************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: MA_ENHIM.D
* Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
* IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

* Reading non-default I/M CUTPOINTS from the following external
* data file: MA_CUTPT.D
* Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
* OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
* Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
* Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
* OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
* OBD Evap I/M program for MY 2004+
  M601 Comment:
             User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D

  Reading User Supplied Tier2 Exhaust bin phase-in fractions   .

     Data read from file: LEV2EXH.D


  Reading User Supplied Tier2 EVAP phase-in fractions

     Data read from file: LEV2EVAP.D


  Reading User Supplied Tier2 50K certification standards

     Data read from file: LEV2CERT.D

  M616 Comment:
             User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # # #
```

```
* MA Freeway 35.0 mph
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 35.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  Jan.
                       Altitude:  Low
            Minimum Temperature:  35.0 (F)
            Maximum Temperature:  45.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes

        Vehicle Type:     LDGV    LDGT12    LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
                GVWR:              <6000     >6000    (All)
                         ------   ------    ------   ------   ------   ------   ------   ------   ------
------
    VMT Distribution:    0.4307   0.3221    0.1205            0.0340   0.0005   0.0018   0.0865   0.0039
1.0000
 -------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.969    0.813     1.154    0.906    1.093    0.679    0.541    0.515     3.96
0.917
     Composite CO  :      21.19    23.32     21.33    22.78    11.48    1.523    0.901    2.388    13.40
19.859
     Composite NOX :      1.017    1.129     1.473    1.222    4.886    1.055    1.111   13.416     1.64
2.315
 -------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 40.0 mph
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 40.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  Jan.
                       Altitude:  Low
            Minimum Temperature:  35.0 (F)
            Maximum Temperature:  45.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes

        Vehicle Type:     LDGV    LDGT12    LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
                GVWR:              <6000     >6000    (All)
```

```
                          ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:      0.4307     0.3221     0.1205                0.0340     0.0005     0.0018     0.0865     0.0039
1.0000
  ------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :        0.951      0.799      1.133      0.890      0.981      0.642      0.502      0.462      3.83
0.893
     Composite CO   :      21.91      24.13      22.08      23.57      10.67      1.459      0.852      2.171     12.41
20.467
     Composite NOX :        1.039      1.153      1.495      1.246      5.081      1.086      1.145     13.721      1.68
2.368
  ------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 25.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
            Minimum Temperature:  35.0 (F)
            Maximum Temperature:  45.0 (F)
              Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes

      Vehicle Type:        LDGV      LDGT12     LDGT34      LDGT       HDGV       LDDV       LDDT       HDDV        MC
All Veh
             GVWR:                   <6000      >6000      (All)
                          ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:      0.4307     0.3221     0.1205                0.0340     0.0005     0.0018     0.0865     0.0039
1.0000
  ------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :        1.046      0.873      1.239      0.972      1.507      0.798      0.663      0.685      4.39
1.010
     Composite CO   :      21.20      23.33      21.38      22.80      15.86      1.801      1.115      3.340     16.75
20.116
     Composite NOX :        1.007      1.117      1.462      1.211      4.518      1.113      1.174     13.981      1.51
2.341
  ------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 30.0 mph
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 30.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
```

Month: Jan.
Altitude: Low
Minimum Temperature: 35.0 (F)
Maximum Temperature: 45.0 (F)
Absolute Humidity: 75. grains/lb
Fuel Sulfur Content: 120. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: No
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.004	0.842	1.197	0.938	1.259	0.730	0.593	0.588	4.15	0.959
Composite CO :	21.05	23.15	21.18	22.61	13.13	1.632	0.985	2.761	14.83	19.819
Composite NOX :	1.016	1.127	1.472	1.221	4.700	1.066	1.123	13.520	1.58	2.316

* #
* MA Arterial 35.0 mph
* File 1, Run 1, Scenario 5.
* #

M583 Warning:
The user supplied arterial average speed of 35.0 will be used for all hours of the day. 100% of VMT has been assigned to the arterial/collector roadway type for all hours of the day and all vehicle types.

M112 Warning:
Wintertime Reformulated Gasoline Rules Apply

M 48 Warning:
there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D

Calendar Year: 2003
Month: Jan.
Altitude: Low
Minimum Temperature: 35.0 (F)
Maximum Temperature: 45.0 (F)
Absolute Humidity: 75. grains/lb
Fuel Sulfur Content: 120. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: No
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.954	0.799	1.139	0.891	1.092	0.679	0.541	0.515	3.96	0.904
Composite CO :	20.25	22.45	20.58	21.94	11.48	1.523	0.901	2.388	13.40	19.082
Composite NOX :	0.989	1.101	1.444	1.195	4.886	1.055	1.111	11.283	1.64	2.106

* #
* MA Arterial 40.0 mph
* File 1, Run 1, Scenario 6.

```
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M583 Warning:
           The user supplied arterial average speed of 40.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
 M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
 M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  Jan.
                       Altitude:  Low
            Minimum Temperature:  35.0 (F)
            Maximum Temperature:  45.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.935	0.784	1.118	0.875	0.979	0.642	0.502	0.462	3.83	0.879
Composite CO :	20.95	23.23	21.31	22.71	10.62	1.457	0.850	2.163	12.40	19.672
Composite NOX :	1.010	1.124	1.465	1.217	5.076	1.081	1.139	11.539	1.68	2.154

```
* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 25.0 mph
* File 1, Run 1, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M583 Warning:
           The user supplied arterial average speed of 25.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
 M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
 M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  Jan.
                       Altitude:  Low
            Minimum Temperature:  35.0 (F)
            Maximum Temperature:  45.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4307	0.3221	0.1205		0.0340	0.0005	0.0018	0.0865	0.0039	1.0000

```
 Composite Emission Factors (g/mi):
     Composite VOC :       1.044     0.871     1.242     0.972     1.506     0.799     0.664     0.686      4.40
1.009
     Composite CO  :      20.31     22.49     20.70     22.00     15.81      1.799     1.114     3.335     16.78
19.381
     Composite NOX :       1.045     1.164     1.516     1.260     4.506     1.110     1.170    11.818      1.51
2.192
  ----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 30.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:       LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV       MC
All Veh
             GVWR:                 <6000     >6000     (All)
                         ------    ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.4307    0.3221    0.1205              0.0340    0.0005    0.0018    0.0865    0.0039
1.0000
  ----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       0.992     0.830     1.185     0.927     1.259     0.730     0.593     0.588      4.15
0.949
     Composite CO  :      20.11     22.26     20.43     21.76     13.11      1.631     0.984     2.758     14.84
19.037
     Composite NOX :       1.007     1.120     1.463     1.214     4.696     1.064     1.121    11.372      1.58
2.123
  ----------------------------------------------------------------------------------------------------------
------
*************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                            *
* Input file: H2003B.INP (file 1, run 2).                               *
*************************************************************************
* ***************************************************
* ******************** SUMMER **********************
* ***************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
```

```
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 0.998     MYR sum not = 1. (will normalize)
 M 49 Warning:
                  1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: MA_ENHIM.D
* Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
* IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

* Reading non-default I/M CUTPOINTS from the following external
* data file: MA_CUTPT.D
* Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
* OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
* Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
* Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
* OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
* OBD Evap I/M program for MY 2004+
 M601 Comment:
             User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D

 Reading User Supplied Tier2 Exhaust bin phase-in fractions

    Data read from file: LEV2EXH.D


 Reading User Supplied Tier2 EVAP phase-in fractions

    Data read from file: LEV2EVAP.D


 Reading User Supplied Tier2 50K certification standards

    Data read from file: LEV2CERT.D

 M616 Comment:
             User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 35.0 mph
* File 1, Run 2, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M582 Warning:
          The user supplied freeway average speed of 35.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
*** I/M credits for Tech1&2 vehicles were read from the following external
   data file: TECH12.D
 M 48 Warning:
            there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
```

```
                    ATP Program:  No
               Reformulated Gas:  Yes

        Vehicle Type:         LDGV     LDGT12     LDGT34       LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
                GVWR:                   <6000      >6000      (All)
                            ------     ------     ------     -------    ------     ------     ------     ------     ------
------
   VMT Distribution:       0.4215     0.3244     0.1219                 0.0350     0.0005     0.0018     0.0908     0.0040
1.0000
 ------------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :         0.892      0.696      0.931      0.760      1.135      0.668      0.541      0.494       4.17
0.818
     Composite CO  :        12.76      12.74      12.18      12.59      10.18       1.518      0.897      2.245      13.55
11.611
     Composite NOX :         0.907      0.970      1.254      1.048      4.468      1.026      1.109     11.910       1.23
2.095
 ------------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 40.0 mph
* File 1, Run 2, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M582 Warning:
          The user supplied freeway average speed of 40.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
 M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  July
                       Altitude:  Low
           Minimum Temperature:  68.0 (F)
           Maximum Temperature:  94.0 (F)
             Absolute Humidity:   75. grains/lb
           Fuel Sulfur Content:  120. ppm

           Exhaust I/M Program:  Yes
              Evap I/M Program:  Yes
                   ATP Program:  No
              Reformulated Gas:  Yes

        Vehicle Type:         LDGV     LDGT12     LDGT34       LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
                GVWR:                   <6000      >6000      (All)
                            ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:       0.4215     0.3244     0.1219                 0.0350     0.0005     0.0018     0.0908     0.0040
1.0000
 ------------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :         0.871      0.680      0.911      0.743      1.042      0.632      0.502      0.443       4.04
0.793
     Composite CO  :        13.54      13.53      12.88      13.35       9.46       1.455      0.848      2.041      12.37
12.235
     Composite NOX :         0.917      0.988      1.268      1.064      4.646      1.056      1.143     12.206       1.26
2.140
 ------------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 2, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M582 Warning:
          The user supplied freeway average speed of 25.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
 M 48 Warning:
            there are no sales for vehicle class HDGV8b
```

LEV phase-in data read from file MA_LEV2.D

Calendar Year:	2003
Month:	July
Altitude:	Low
Minimum Temperature:	68.0 (F)
Maximum Temperature:	94.0 (F)
Absolute Humidity:	75. grains/lb
Fuel Sulfur Content:	120. ppm
Exhaust I/M Program:	Yes
Evap I/M Program:	Yes
ATP Program:	No
Reformulated Gas:	Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4215	0.3244	0.1219		0.0350	0.0005	0.0018	0.0908	0.0040	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.970	0.753	1.009	0.823	1.470	0.783	0.663	0.656	4.60	0.907
Composite CO :	12.47	12.25	11.80	12.13	14.05	1.794	1.110	3.140	17.56	11.522
Composite NOX :	0.922	0.969	1.257	1.048	4.131	1.082	1.172	12.460	1.14	2.140

* #
* MA Freeway 30.0 mph
* File 1, Run 2, Scenario 4.
* #

M582 Warning:
The user supplied freeway average speed of 30.0 will be used for all hours of the day. 100% of VMT has been assigned to a fixed combination of freeways and freeway ramps for all hours of the day and all vehicle types.

M 48 Warning:
there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D

Calendar Year:	2003
Month:	July
Altitude:	Low
Minimum Temperature:	68.0 (F)
Maximum Temperature:	94.0 (F)
Absolute Humidity:	75. grains/lb
Fuel Sulfur Content:	120. ppm
Exhaust I/M Program:	Yes
Evap I/M Program:	Yes
ATP Program:	No
Reformulated Gas:	Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4215	0.3244	0.1219		0.0350	0.0005	0.0018	0.0908	0.0040	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.927	0.723	0.969	0.790	1.271	0.717	0.593	0.564	4.36	0.858
Composite CO :	12.48	12.38	11.88	12.24	11.64	1.626	0.981	2.596	15.27	11.432
Composite NOX :	0.918	0.973	1.259	1.051	4.297	1.036	1.121	12.011	1.19	2.104

* #
* MA Arterial 35.0 mph

```
* File 1, Run 2, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 35.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                <6000     >6000     (All)
                         ------   ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.4215    0.3244    0.1219              0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
 ---------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.880     0.685     0.920     0.749     1.135     0.668     0.541     0.494      4.17
0.808
     Composite CO  :     11.94     12.17     11.71     12.05     10.17     1.518     0.897     2.245     13.56
11.026
     Composite NOX :     0.887     0.947     1.231     1.025     4.468     1.026     1.109    10.125      1.23
1.914
 ---------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 40.0 mph
* File 1, Run 2, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 40.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2003
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:  120. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                <6000     >6000     (All)
                         ------   ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.4215    0.3244    0.1219              0.0350    0.0005    0.0018    0.0908    0.0040
1.0000
 ---------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.859     0.669     0.900     0.732     1.041     0.631     0.502     0.443      4.04
0.783
```

```
     Composite CO  :     12.70      12.94      12.39      12.79       9.42      1.453      0.846      2.034      12.36
11.631
     Composite NOX :      0.896      0.964      1.244      1.040      4.641      1.051      1.138     10.375      1.26
1.954
 -------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 25.0 mph
* File 1, Run 2, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 25.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  68.0 (F)
            Maximum Temperature:  94.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes

       Vehicle Type:     LDGV     LDGT12     LDGT34      LDGT      HDGV       LDDV       LDDT       HDDV        MC
All Veh
               GVWR:               <6000      >6000      (All)
                        ------    ------     ------     ------    ------     ------     ------     ------     ------
------
    VMT Distribution:   0.4215    0.3244     0.1219       .       0.0350     0.0005     0.0018     0.0908     0.0040
1.0000
 -------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.968      0.752      1.011      0.823      1.469      0.784      0.664      0.658      4.60
0.907
     Composite CO  :     11.68      11.70      11.35      11.61      14.01      1.792      1.109      3.136      17.60
10.951
     Composite NOX :      0.968      1.013      1.306      1.093      4.120      1.079      1.169     10.645      1.13
2.014
 -------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 2, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 30.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                  Calendar Year:  2003
                          Month:  July
                       Altitude:  Low
            Minimum Temperature:  68.0 (F)
            Maximum Temperature:  94.0 (F)
              Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:  120. ppm

            Exhaust I/M Program:  Yes
               Evap I/M Program:  Yes
                    ATP Program:  No
               Reformulated Gas:  Yes

       Vehicle Type:     LDGV     LDGT12     LDGT34      LDGT      HDGV       LDDV       LDDT       HDDV        MC
All Veh
               GVWR:               <6000      >6000      (All)
```

```
                         ------   ------   ------   ------   ------   ------   ------   ------   ------
------
  VMT Distribution:     0.4215   0.3244   0.1219            0.0350   0.0005   0.0018   0.0908   0.0040
1.0000
 -----------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :       0.918    0.714    0.961    0.782    1.270    0.717    0.593    0.564     4.36
0.850
    Composite CO  :      11.66    11.80    11.39    11.69    11.62     1.625    0.980    2.594    15.28
10.838
    Composite NOX :       0.917    0.969    1.253    1.047    4.294    1.035    1.119   10.212     1.19
1.938
 -----------------------------------------------------------------------------------------------------
------
```

```
* Input File for Summer/Winter Ozone - Hopping Brook - 2008 - 10,20,25,30 mph
* Filename = H2003a.inp
* File prepared by Craig Woleader, MADEP (617)-348-4046 - edited by Rich
*
***************     Header Section     ***************
MOBILE6 INPUT FILE

POLLUTANTS          : HC CO NOX
SPREADSHEET         :
REPORT FILE         : H2008a.txt REPLACE

RUN DATA

***************     Run Section #1     ****************

> ***************************************************
> ********************* WINTER **********************
> ***************************************************

* Pollutant output format
EXPRESS HC AS VOC   :

* Mass. specific user inputs -- require external data file
REG DIST            : MA_REG.D
I/M DESC FILE       : MA_ENHIM.D
* Note: MA_ENHIM.D requires MA_CUTPT.D to run

STAGE II REFUELING :
91 3 84. 84.

* Inputs for LEV II
94+ LDG IMP         : MA_LEV2.D
T2 EXH PHASE-IN     : LEV2EXH.D
T2 EVAP PHASE-IN    : LEV2EVAP.D
T2 CERT             : LEV2CERT.D

* Meteorological inputs
MIN/MAX TEMP        : 35. 45.

* Fuel Inputs
FUEL RVP            : 13.5
FUEL PROGRAM        : 2 N


***************     Scenario Section #1     ***************

***************       Winter Freeway        ***************

SCENARIO RECORD     : MA Freeway 10.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 1
AVERAGE SPEED       : 10.0 Freeway 92.0 0.0 0.0 8.0

SCENARIO RECORD     : MA Freeway 20.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 1
AVERAGE SPEED       : 20.0 Freeway 92.0 0.0 0.0 8.0

SCENARIO RECORD     : MA Freeway 25.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 1
AVERAGE SPEED       : 25.0 Freeway 92.0 0.0 0.0 8.0

*
*
*

SCENARIO RECORD     : MA Freeway 30.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 1
AVERAGE SPEED       : 30.0 Freeway 92.0 0.0 0.0 8.0


***************      Winter Arterial       ***************

SCENARIO RECORD     : MA Arterial 10.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 1
AVERAGE SPEED       : 10.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD     : MA Arterial 20.0 mph
```

```
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 1
AVERAGE SPEED      : 20.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : MA Arterial 25.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 1
AVERAGE SPEED      : 25.0 Arterial 0.0 100.0 0.0 0.0

*
*
*

SCENARIO RECORD    : MA Arterial 30.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 1
AVERAGE SPEED      : 30.0 Arterial 0.0 100.0 0.0 0.0

***************     End of This Run     ***************
END OF RUN


***************     Run Section #2    ***************

> ****************************************************
> ******************** SUMMER *********************
> ****************************************************

* Pollutant output format
EXPRESS HC AS VOC  :

* Mass. specific user inputs -- require external data file
REG DIST           : MA_REG.D
I/M DESC FILE      : MA_ENHIM.D
* Note: MA_ENHIM.D requires MA_CUTPT.D to run

STAGE II REFUELING :
91 3 84. 84.

* Inputs for LEV II
94+ LDG IMP        : MA_LEV2.D
T2 EXH PHASE-IN    : LEV2EXH.D
T2 EVAP PHASE-IN   : LEV2EVAP.D
T2 CERT            : LEV2CERT.D

* Meteorological inputs
MIN/MAX TEMP       : 68. 94.

* Fuel Inputs
FUEL RVP           : 8.6
FUEL PROGRAM       : 2 N

***************     Scenario Section #2     ***************

***************      Summer Freeway     ***************

SCENARIO RECORD    : MA Freeway 10.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
AVERAGE SPEED      : 10.0 Freeway 92.0 0.0 0.0 8.0

SCENARIO RECORD    : MA Freeway 20.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
AVERAGE SPEED      : 20.0 Freeway 92.0 0.0 0.0 8.0

SCENARIO RECORD    : MA Freeway 25.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
AVERAGE SPEED      : 25.0 Freeway 92.0 0.0 0.0 8.0

*
*
*

SCENARIO RECORD    : MA Freeway 30.0 mph
CALENDAR YEAR      : 2008
EVALUATION MONTH   : 7
AVERAGE SPEED      : 30.0 Freeway 92.0 0.0 0.0 8.0
```

```
***************        Summer Arterial       ***************

SCENARIO RECORD     : MA Arterial 10.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7
AVERAGE SPEED       : 10.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD     : MA Arterial 20.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7
AVERAGE SPEED       : 20.0 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD     : MA Arterial 25.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7
AVERAGE SPEED       : 25.0 Arterial 0.0 100.0 0.0 0.0

*
*
*

SCENARIO RECORD     : MA Arterial 30.0 mph
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7
AVERAGE SPEED       : 30.0 Arterial 0.0 100.0 0.0 0.0

***************       End of This Run       ***************
END OF RUN
```

```
****************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                               *
* Input file: H2008B.INP (file 1, run 1).                                  *
****************************************************************************
* ***************************************************
* ******************** WINTER *********************
* ***************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: MA_ENHIM.D
* Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
* IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

* Reading non-default I/M CUTPOINTS from the following external
* data file: MA_CUTPT.D
* Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
* OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
* Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
* Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
* OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
* OBD Evap I/M program for MY 2004+
  M601 Comment:
             User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D

  Reading User Supplied Tier2 Exhaust bin phase-in fractions

     Data read from file: LEV2EXH.D


  Reading User Supplied Tier2 EVAP phase-in fractions

     Data read from file: LEV2EVAP.D


  Reading User Supplied Tier2 50K certification standards

     Data read from file: LEV2CERT.D

  M616 Comment:
             User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # # #
```

```
* MA Freeway 35.0 mph
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 35.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  Jan.
                        Altitude:  Low
              Minimum Temperature:  35.0 (F)
              Maximum Temperature:  45.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  No
                 Reformulated Gas:  Yes

     Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
            GVWR:              <6000    >6000     (All)
                      ------   ------   ------   ------   ------   ------   ------   ------   ------
------
   VMT Distribution:  0.3616   0.3718   0.1390            0.0336   0.0004   0.0021   0.0879   0.0036
1.0000
 ---------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :   0.509    0.435    0.687    0.504    0.744    0.245    0.336    0.370     3.55
0.513
     Composite CO  :   13.25    13.96    14.81    14.19     8.15    1.018    0.601    1.644    12.95
12.506
     Composite NOX :   0.491    0.600    0.981    0.704    3.116    0.490    0.574    7.431     1.66
1.302
 ---------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 40.0 mph
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
            The user supplied freeway average speed of 40.0
            will be used for all hours of the day. 100% of VMT
            has been assigned to a fixed combination of freeways
            and freeway ramps for all hours of the day and all
             vehicle types.
  M112 Warning:
               Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  Jan.
                        Altitude:  Low
              Minimum Temperature:  35.0 (F)
              Maximum Temperature:  45.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  No
                 Reformulated Gas:  Yes

     Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
            GVWR:              <6000    >6000     (All)
```

```
                         ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:     0.3616     0.3718     0.1390                0.0336     0.0004     0.0021     0.0879     0.0036
1.0000
 ---------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       0.497      0.429      0.674      0.495      0.676      0.231      0.312      0.332       3.43
0.498
     Composite CO  :       13.70      14.44      15.32      14.68       7.57      0.970      0.568      1.494      11.98
12.882
     Composite NOX :       0.504      0.613      0.996      0.717      3.241      0.505      0.592      7.630       1.70
1.336
 ---------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
           The user supplied freeway average speed of 25.0
           will be used for all hours of the day. 100% of VMT
           has been assigned to a fixed combination of freeways
           and freeway ramps for all hours of the day and all
            vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                    Calendar Year:  2008
                            Month:  Jan.
                         Altitude:  Low
              Minimum Temperature:  35.0 (F)
              Maximum Temperature:  45.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                      ATP Program:  No
                 Reformulated Gas:  Yes

      Vehicle Type:        LDGV      LDGT12     LDGT34      LDGT       HDGV       LDDV       LDDT       HDDV        MC
All Veh
              GVWR:                  <6000      >6000      (All)
                         ------     ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:     0.3616     0.3718     0.1390                0.0336     0.0004     0.0021     0.0879     0.0036
1.0000
 ---------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       0.552      0.466      0.737      0.540      0.994      0.290      0.412      0.492       3.92
0.567
     Composite CO  :       13.26      13.96      14.83      14.19      11.25      1.226      0.746      2.299      16.25
12.686
     Composite NOX :       0.485      0.594      0.973      0.697      2.882      0.517      0.607      7.802       1.53
1.321
 ---------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 30.0 mph
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
           The user supplied freeway average speed of 30.0
           will be used for all hours of the day. 100% of VMT
           has been assigned to a fixed combination of freeways
           and freeway ramps for all hours of the day and all
            vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                    Calendar Year:  2008
```

```
                      Month:  Jan.
                   Altitude:  Low
        Minimum Temperature:  35.0 (F)
        Maximum Temperature:  45.0 (F)
          Absolute Humidity:   75. grains/lb
         Fuel Sulfur Content:   30. ppm

         Exhaust I/M Program:  Yes
            Evap I/M Program:  Yes
                 ATP Program:  No
            Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:               <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.3616    0.3718    0.1390              0.0336    0.0004    0.0021    0.0879    0.0036
1.0000
 ------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.528     0.448     0.712     0.520     0.845     0.264     0.369     0.423      3.71
0.537
    Composite CO  :     13.16     13.85     14.70     14.09      9.31     1.100     0.658     1.901     14.36
12.488
    Composite NOX :     0.491     0.599     0.980     0.703     2.998     0.495     0.580     7.499      1.60
1.304
 ------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 35.0 mph
* File 1, Run 1, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 35.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M112 Warning:
              Wintertime Reformulated Gasoline Rules Apply
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                 Calendar Year:  2008
                         Month:  Jan.
                      Altitude:  Low
           Minimum Temperature:  35.0 (F)
           Maximum Temperature:  45.0 (F)
             Absolute Humidity:   75. grains/lb
            Fuel Sulfur Content:   30. ppm

           Exhaust I/M Program:  Yes
              Evap I/M Program:  Yes
                   ATP Program:  No
              Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:               <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
  VMT Distribution:    0.3616    0.3718    0.1390              0.0336    0.0004    0.0021    0.0879    0.0036
1.0000
 ------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.503     0.430     0.681     0.499     0.744     0.245     0.336     0.370      3.55
0.508
    Composite CO  :     12.86     13.62     14.48     13.86      8.14     1.018     0.601     1.644     12.95
12.196
    Composite NOX :     0.480     0.589     0.966     0.692     3.116     0.490     0.574     6.675      1.66
1.226
 ------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 40.0 mph
* File 1, Run 1, Scenario 6.
```

* #

M583 Warning:
The user supplied arterial average speed of 40.0
will be used for all hours of the day. 100% of VMT
has been assigned to the arterial/collector roadway
type for all hours of the day and all vehicle types.

M112 Warning:
Wintertime Reformulated Gasoline Rules Apply

M 48 Warning:
there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D

Calendar Year:	2008
Month:	Jan.
Altitude:	Low
Minimum Temperature:	35.0 (F)
Maximum Temperature:	45.0 (F)
Absolute Humidity:	75. grains/lb
Fuel Sulfur Content:	30. ppm
Exhaust I/M Program:	Yes
Evap I/M Program:	Yes
ATP Program:	No
Reformulated Gas:	Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.3616	0.3718	0.1390		0.0336	0.0004	0.0021	0.0879	0.0036	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.491	0.424	0.668	0.490	0.675	0.231	0.312	0.332	3.43	0.493
Composite CO :	13.30	14.10	14.98	14.34	7.54	0.969	0.567	1.489	11.97	12.560
Composite NOX :	0.491	0.602	0.980	0.705	3.237	0.502	0.589	6.843	1.70	1.256

* #
* MA Arterial 25.0 mph
* File 1, Run 1, Scenario 7.
* #

M583 Warning:
The user supplied arterial average speed of 25.0
will be used for all hours of the day. 100% of VMT
has been assigned to the arterial/collector roadway
type for all hours of the day and all vehicle types.

M112 Warning:
Wintertime Reformulated Gasoline Rules Apply

M 48 Warning:
there are no sales for vehicle class HDGV8b

LEV phase-in data read from file MA_LEV2.D

Calendar Year:	2008
Month:	Jan.
Altitude:	Low
Minimum Temperature:	35.0 (F)
Maximum Temperature:	45.0 (F)
Absolute Humidity:	75. grains/lb
Fuel Sulfur Content:	30. ppm
Exhaust I/M Program:	Yes
Evap I/M Program:	Yes
ATP Program:	No
Reformulated Gas:	Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.3616	0.3718	0.1390		0.0336	0.0004	0.0021	0.0879	0.0036	1.0000

```
 Composite Emission Factors (g/mi):
     Composite VOC :       0.553     0.469     0.742     0.543     0.994    0.290     0.413     0.493      3.92
0.569
     Composite CO  :      12.90     13.65     14.53     13.89     11.22    1.225     0.745     2.296     16.28
12.400
     Composite NOX :       0.509     0.623     1.015     0.730     2.874    0.516     0.605     7.026      1.53
1.278
 -------------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M583 Warning:
          The user supplied arterial average speed of 30.0
          will be used for all hours of the day.  100% of VMT
          has been assigned to the arterial/collector roadway
          type for all hours of the day and all vehicle types.
 M112 Warning:
             Wintertime Reformulated Gasoline Rules Apply
 M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  Jan.
                        Altitude:  Low
             Minimum Temperature:  35.0 (F)
             Maximum Temperature:  45.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV     LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                <6000     >6000     (All)
                         ------    ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.3616    0.3718    0.1390              0.0336    0.0004    0.0021    0.0879    0.0036
1.0000
 -------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :       0.524     0.446     0.708     0.517     0.845    0.264     0.369     0.423      3.71
0.533
     Composite CO  :      12.77     13.52     14.37     13.75      9.30    1.099     0.657     1.899     14.37
12.174
     Composite NOX :       0.489     0.600     0.979     0.703     2.995    0.494     0.579     6.734      1.60
1.236
 -------------------------------------------------------------------------------------------------------------------
------
*******************************************************************************
* MOBILE6.2.01 (31-Oct-2002)                                                  *
* Input file: H2008B.INP (file 1, run 2).                                     *
*******************************************************************************
* *****************************************************
* ******************** SUMMER *********************
* *****************************************************

* Reading Registration Distributions from the following external
* data file: MA_REG.D
 M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
 M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
 M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
 M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
 M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
 M 49 Warning:
               0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
               0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
```

```
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.991     MYR sum not = 1. (will normalize)
 M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
 M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: MA_ENHIM.D
* Mass. Enhanced I/M program inputs for 2000+ calendar year, filename = MA_ENHIM.D
* IM240 Exhaust I/M program for Light Duty pre-1996 MY vehicles <=10,0000 lb GVWR

* Reading non-default I/M CUTPOINTS from the following external
* data file: MA_CUTPT.D
* Two-Speed Idle Exhaust I/M program for Heavy Duty vehicles >10,000 lb GVWR
* OBD Exhaust I/M program for Light Duty MY 1996+ vehicles <=10,000 lb GVWR
* Gas Cap Evap I/M program for Light Duty pre-1996 MY vehicles <=8,500 lb GVWR
* Gas Cap Evap I/M program for all MY Heavy Duty vehicles >8,500 lb GVWR
* OBD + Gas Cap Evap I/M program for MY 1996 - 2003 Light Duty vehicles <=8,500 lb GVWR
* OBD Evap I/M program for MY 2004+
 M601 Comment:
             User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D

 Reading User Supplied Tier2 Exhaust bin phase-in fractions

    Data read from file: LEV2EXH.D


 Reading User Supplied Tier2 EVAP phase-in fractions

    Data read from file: LEV2EVAP.D


 Reading User Supplied Tier2 50K certification standards

    Data read from file: LEV2CERT.D

 M616 Comment:
             User has supplied post-1999 sulfur levels.

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 35.0 mph
* File 1, Run 2, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M582 Warning:
          The user supplied freeway average speed of 35.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
*** I/M credits for Tech1&2 vehicles were read from the following external
   data file: TECH12.D
 M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
```

```
                 ATP Program:  No
          Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
              GVWR:              <6000    >6000    (All)
                       ------   ------   ------   ------   ------   ------   ------   ------   ------
------
  VMT Distribution:   0.3529   0.3738   0.1404            0.0347   0.0003   0.0021   0.0920   0.0037
1.0000
  ------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.507    0.411    0.584    0.458    0.735    0.239    0.322    0.345     3.84
0.487
    Composite CO  :     7.01     7.22     7.75     7.36     6.69     1.009    0.588    1.386    13.21
6.671
    Composite NOX :     0.453    0.522    0.818    0.603    2.528    0.470    0.535    6.528     1.25
1.164
  ------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 40.0 mph
* File 1, Run 2, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
          The user supplied freeway average speed of 40.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
  M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                Calendar Year:  2008
                        Month:  July
                     Altitude:  Low
          Minimum Temperature:  68.0 (F)
          Maximum Temperature:  94.0 (F)
            Absolute Humidity:   75. grains/lb
           Fuel Sulfur Content:   30. ppm

          Exhaust I/M Program:  Yes
             Evap I/M Program:  Yes
                  ATP Program:  No
             Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV      MC
All Veh
              GVWR:              <6000    >6000    (All)
                       ------   ------   ------   ------   ------   ------   ------   ------   ------
------
  VMT Distribution:   0.3529   0.3738   0.1404            0.0347   0.0003   0.0021   0.0920   0.0037
1.0000
  ------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.493    0.402    0.569    0.447    0.680    0.226    0.299    0.309     3.73
0.471
    Composite CO  :     7.42     7.62     8.16     7.76     6.22     0.962    0.556    1.260    12.05
6.990
    Composite NOX :     0.459    0.531    0.828    0.612    2.628    0.484    0.551    6.706     1.28
1.191
  ------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 25.0 mph
* File 1, Run 2, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M582 Warning:
          The user supplied freeway average speed of 25.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
  M 48 Warning:
            there are no sales for vehicle class HDGV8b
```

```
 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
               Reformulated Gas:   Yes

       Vehicle Type:      LDGV     LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                 <6000     >6000     (All)
                        ------    ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.3529    0.3738    0.1404              0.0347    0.0003    0.0021    0.0920    0.0037
1.0000
 -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.553     0.445     0.634     0.496     0.927     0.283     0.395     0.458      4.22
0.541
     Composite CO  :      6.93      7.12      7.66      7.27      9.24     1.215     0.729     1.938     17.17
6.748
     Composite NOX :     0.461     0.521     0.819     0.603     2.337     0.496     0.565     6.858      1.15
1.190
 -----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Freeway 30.0 mph
* File 1, Run 2, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M582 Warning:
          The user supplied freeway average speed of 30.0
          will be used for all hours of the day. 100% of VMT
          has been assigned to a fixed combination of freeways
          and freeway ramps for all hours of the day and all
           vehicle types.
 M 48 Warning:
            there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
               Reformulated Gas:   Yes

       Vehicle Type:      LDGV     LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:                 <6000     >6000     (All)
                        ------    ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.3529    0.3738    0.1404              0.0347    0.0003    0.0021    0.0920    0.0037
1.0000
 -----------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.527     0.426     0.608     0.476     0.813     0.258     0.353     0.393      4.01
0.511
     Composite CO  :      6.89      7.10      7.62      7.24      7.65     1.090     0.643     1.603     14.90
6.625
     Composite NOX :     0.458     0.524     0.821     0.605     2.431     0.475     0.540     6.589      1.20
1.169
 -----------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 35.0 mph
```

```
* File 1, Run 2, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 35.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:               <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.3529   0.3738    0.1404              0.0347    0.0003    0.0021    0.0920    0.0037
1.0000
 ------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.502    0.407     0.580     0.454     0.735     0.239     0.322     0.345      3.84
0.483
     Composite CO  :      6.69     7.00      7.53      7.14      6.69     1.009     0.588     1.386     13.22
6.446
     Composite NOX :     0.445    0.513     0.807     0.594     2.528     0.470     0.534     5.911      1.25
1.100
 ------------------------------------------------------------------------------------------------------------
------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 40.0 mph
* File 1, Run 2, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
            The user supplied arterial average speed of 40.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:      LDGV    LDGT12    LDGT34     LDGT      HDGV      LDDV      LDDT      HDDV        MC
All Veh
              GVWR:               <6000     >6000     (All)
                        ------   ------    ------    ------    ------    ------    ------    ------    ------
------
   VMT Distribution:    0.3529   0.3738    0.1404              0.0347    0.0003    0.0021    0.0920    0.0037
1.0000
 ------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.488    0.398     0.565     0.444     0.680     0.226     0.299     0.309      3.73
0.467
```

```
    Composite CO  :      7.09       7.38       7.93       7.53       6.19      0.961      0.554      1.256      12.04
6.754
    Composite NOX :      0.450      0.522      0.816      0.602      2.626     0.481      0.548      6.061       1.28
1.123
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* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 25.0 mph
* File 1, Run 2, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 25.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12     LDGT34      LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
             GVWR:               <6000      >6000      (All)
                       ------   ------     ------     ------     ------     ------     ------     ------     ------
------
   VMT Distribution:   0.3529   0.3738     0.1404                0.0347     0.0003     0.0021     0.0920     0.0037
1.0000
 -------------------------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.554     0.448     0.637     0.499      0.927     0.283      0.396      0.459       4.22
0.543
    Composite CO  :     6.63      6.91      7.46      7.06       9.21      1.214      0.728      1.936      17.20
6.537
    Composite NOX :     0.488     0.548     0.855     0.631      2.331     0.494      0.563      6.224       1.15
1.156
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* # # # # # # # # # # # # # # # # # # # # # # # # # #
* MA Arterial 30.0 mph
* File 1, Run 2, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
  M583 Warning:
           The user supplied arterial average speed of 30.0
           will be used for all hours of the day.  100% of VMT
           has been assigned to the arterial/collector roadway
           type for all hours of the day and all vehicle types.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
                   Calendar Year:  2008
                           Month:  July
                        Altitude:  Low
             Minimum Temperature:  68.0 (F)
             Maximum Temperature:  94.0 (F)
               Absolute Humidity:   75. grains/lb
             Fuel Sulfur Content:   30. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  Yes

      Vehicle Type:     LDGV    LDGT12     LDGT34      LDGT       HDGV       LDDV       LDDT       HDDV         MC
All Veh
             GVWR:               <6000      >6000      (All)
```

```
                       ------   ------   ------   ------   ------   ------   ------   ------   ------
------
   VMT Distribution:   0.3529   0.3738   0.1404            0.0347   0.0003   0.0021   0.0920   0.0037
1.0000
 -----------------------------------------------------------------------------------------------------
------
 Composite Emission Factors (g/mi):
     Composite VOC :     0.524    0.424    0.605    0.474    0.813    0.258    0.354    0.393     4.01
0.509
     Composite CO  :     6.57     6.87     7.40     7.02     7.64     1.089    0.643    1.601    14.92
6.396
     Composite NOX :     0.461    0.524    0.821    0.605    2.429    0.474    0.539    5.964     1.20
1.113
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APPENDIX B

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

ARGEO PAUL CELLUCCI
Governor

TRUDY COXE
Secretary

DAVID B. STRUHS
Commissioner

February 12, 2003

Dear Interested Party:

Effective immediately, the Department of Environmental Protection (DEP) will commence using the Mobile 6 emissions factor model for use in indirect source air quality analysis. This change became necessary since the DEP utilized the Mobile 6 model in developing the Massachusetts State Implementation Plan (SIP).

You can access the latest Mobile6 model on the internet at http://www.epa.gov/otaq/m6.htm. This site contains the inputs necessary for performing mesoscale and microscale air quality analyses.

You can reach me at (617) 292-5773 if you have any questions.

Sincerely,

Keith Grillo

Keith Grillo, Regional Planner
Transportation Unit
Bureau of Waste Prevention

Dav Cook

APPENDIX C

Order of Conditions

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40 and
Article XXX of the Town of Holliston Bylaws

DEP File Number:
185-553
Provided by DEP

COPY

A. General Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

From:
Holliston Conservation Commission
Conservation Commission

MDSX SO. DIST. DEEDS
DOCUMENT: 1167
DATE: 5.20.03
TIME: 2:57 pm

This issuance if for (check one):

☒ Order of Conditions

☐ Amended Order of Conditions

To: Applicant:
New Hopping Brook Realty Trust
Name
929 Boston Post Road
Mailing Address
Marlborough | MA | 01752
City/Town | State | Zip Code

Property Owner (if different from applicant):
Hopping Brook Trust, Jon Delli Priscoli Trustee, and Jon Delli Priscoli
Name
929 Boston Post Road East, Suite 2
Mailing Address
Marlborough | MA | 01752
City/Town | State | Zip Code

1. Project Location:
Hopping Brook Road — Street Address
Holliston — City/Town
4-6-18, 4-6-52, 1-1-51, 4-6-32 and 4-6-15.1 — Assessors Map/Plat Number
Parcel/Lot Number

2. Property recorded at the Registry of Deeds for:
Middlesex — County
Book 31501 (18, 52, 51) and 28716 (15.1) — Book
Page 0099 and 036 — Page
Certificate (if registered land)

3. Dates:
April 18, 2002 — Date Notice of Intent Filed
April 1, 2003 — Date Public Hearing Closed
April 30, 2003 — Date of Issuance

4. Final Approved Plans and Other Documents (attach additional plan references as needed):
See Appendix A — Title — Date
Title — Date
Title — Date

5. Final Plans and Documents Signed and Stamped by:
Robert D. McNeil III, PE # 39831
Name

6. Total Fee: $5725.00

(from Appendix B: Wetland Fee Transmittal Form)

B. Findings

Findings pursuant to the Massachusetts Wetlands Protection Act:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act. Check all that apply:

☒ Public Water Supply
☐ Land Containing Shellfish
☒ Prevention of Pollution
☒ Private Water Supply
☒ Fisheries
☒ Protection of Wildlife Habitat
☒ Groundwater Supply
☒ Storm Damage Prevention
☒ Flood Control

Furthermore, this Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

☒ the following conditions which are necessary, in accordance with the performance standards set forth in the wetlands regulations, to protect those interests checked above. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

Denied because:

☐ the proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations to protect those interests checked above. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect these interests, and a final Order of Conditions is issued.

☐ the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Act's interests, and a final Order of Conditions is issued. A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).

PROJECT FINDINGS PURSUANT TO THE MASSACHUSETTS WETLANDS PROTECTION ACT AND ARTICLE XXX

I. **PROJECT DESCRIPTION.** Environmental permitting for the Hopping Brook Industrial Park began in the mid-1970's with design and permit review and revisions continuing through 1985. The entire park site is divided into Phase I and II by the north-south NStar (formerly Boston Edison) power line alignment owned in fee by the utility. Phase I, to the west of the NStar corridor is largely constructed and is not the subject of this application. Wetland resource area boundaries and buffer zones were delineated, reviewed and approved under Abbreviated Notification of Resource Area Delineations under Massachusetts DEP File No. 185-524 (Jan. 16, 2001) and 185-538 (Sept. 4, 2001). The proposed project consists of the construction of a 1,500 foot access road, stormwater management system, utility installation and protection of and enhancement for rare and endangered species habitat. Also proposed in this submittal is the installation of underground utilities including horizontal boring beneath three existing sixty-inch concrete culverts on Hopping Brook and installation of a groundwater infiltration system. Wetland replacement of Bordering Vegetated Wetland and the impacted functions of Bank to be impacted by the roadway construction are also proposed. Construction of additional compensatory wetlands for anticipated future impacts to Holliston Freshwater Wetlands (a locally regulated isolated wetland), are combined with the replication for Bordering Vegetated Wetland (BVW) and Bank proposed herein. Future build-out of the park, primarily in upland area will be reviewed by the town boards at a later date. Site access will require a wetland impact of 3,236 square feet of BVW (310 CMR 10.55 and Holliston Regulations Section 3.1) and approximately 153 linear feet of Bank (310 CMR 10.54). These impacts have been minimized by the use of retaining walls. Indirect impacts to other wetland resource areas in the vicinity of the impacted wetland resource areas such as siltation or stormwater runoff will be avoided (see Site Plans including Construction Sequencing Plan. Detail Sheets (D1-D3), NOI Narrative Section: Soil Erosion / Sediment and Stormwater Control, Stormwater Management Report, Stormwater Runoff Study, and Stormwater pollution Prevention Plan). In addition to the aforementioned state wetland impact, there are two isolated, non-state, wetlands that will be altered (Wetland "J" and "E"). These wetlands do not meet the criteria for Isolated Land Subject to Flooding [310 CMR 10.57(1)(b)] because they contain virtually no standing water. However, these two wetlands do meet the criteria for Holliston Wetlands. Three certified vernal pools, CVP 2706, 2708, and 2709, are located in the northern portion of the site. Two state listed vertebrate species have been identified from the site and vicinity. These are the spotted turtle and four-toed salamander (both "Species of Special Concern" status). The project has been designed to avoid all impacts to wetlands habitat for both species. Further. nesting habitat enhancement is proposed for the spotted turtle, and completed and ongoing field study and land protection for both species has been designed in cooperation with the Massachusetts Natural Heritage and Endangered Species Program under a Conservation Permit to be issued pursuant to the Massachusetts Endangered Species Act (MESA) for the project.

II. **LIMITED PROJECT - 310 CMR 10.53 (e).** The Holliston Conservation Commission finds that the construction of the roadway crossing meets the requirements of a limited project set forth at 310 CMR 10.53(3)(e). The proposed roadway crossing has been designed and is proposed to be constructed in a manner that does not restrict the flow of water at the crossing. Mitigation for lost Bordering Vegetated Wetlands at a greater than 1:1 ratio is provided. Mitigation for lost Bank functions is also provided by the design. The intent of the Limited Project status being to prevent multiple wetland crossings, any future project to cross wetlands to gain access to certain portions of the property may or may not be qualified as a Limited Project roadway under 310 CMR 10.53 (3)(e).

III. **BANK 310 CMR 10.54 & LAND UNDER WATERWAYS 310 CMR 10.56.** The Holliston Conservation Commission finds that the alteration of 153 linear feet of Bank resulting from the roadway crossing complies with the performance standards in that the physical stability of the bank, ground water and surface water quality, capacity of the bank to provide important wildlife habitat, the carrying capacity of the existing channel within the bank, and the capacity of the bank to provide breeding habitat, escape cover, and food for fisheries is not impaired. Mitigation for work within Bank includes the installation of box culverts at the roadway crossing and the construction of a 130 linear foot rip-rap channel and a 140 linear foot water quality swale.

IV. **BORDERING VEGETATED WETLAND 310 CMR 10.55.** The Holliston Conservation Commission finds that the proposed road crossing will permanently alter approximately 3,236 SF of Bordering Vegetated Wetland and temporarily alter approximately 1,645 SF of Bordering Vegetated Wetland as a limited project pursuant to 310 CMR 10.53(3)(e). Mitigation for permanently lost Bordering Vegetated Wetland is provided at a greater than 1:1 ratio at the mitigation area. Mitigation for temporary Bordering Vegetated Wetlands impacts will occur in-situ following construction. The Holliston Conservation finds that the Bordering Vegetated Wetland impact and mitigation complies with the performance standards in that the design minimizes the loss of resource area, replacement area is proposed at a ratio of at least 1:1, the ground water and surface elevation of the replacement area is similar, and the replacement area has a unrestricted hydraulic connection to the same water body as the impacted wetland.

V. **FRESHWATER WETLANDS UNDER ARTICLE XXX.** The finding of the Holliston Conservation Commission relative to Bordering Vegetated Wetlands, which are also regulated as Freshwater Wetlands under Article XXX and its implementing regulations, is presented as Finding IV above. The proposed project will also impact a total of 26,122 SF at Freshwater Wetlands "E" and "J," which are subject to jurisdiction under Article XXX and its implementing regulations. The Holliston Conservation Commission finds that the mitigation suite offered by the Applicant, including wetland replication, vernal pool creation, rare species habitat enhancement, and four Conservation Restrictions totaling 30.87 acres will protect the interests of Article XXX and its implementing regulations.

VI. **BORDERING LAND SUBJECT TO FLOODING 310 CMR 10.57.** The Holliston Conservation Commission finds that the boundary of Bordering Land Subject to Flooding has been correctly determined by the Applicant and is correctly shown on the final plans referenced in this Order. Based upon these plans, no work is proposed within Bordering Land Subject to Flooding.

VII. **RIVERFRONT AREA 310 CMR 10.58.** The Holliston Conservation Commission finds that the utility installation in the Riverfront Area and other identified activities associated with the utility installation will not result in a significant adverse impact on the interests protected by the Riverfront Area in the proposed work zone. Work within the Riverfront Area has been minimized to the extent practicable, an extensive mitigation suite for work on the subject site has been offered, and the work has been designed such that the interests of rare species in the area will be protected.

VIII. **CERTIFIED VERNAL POOLS.** Certified Vernal Pools 2706, 2707 and 2708 are located on this site and are shown on the final plans referenced in this Order. Based upon these plans, no work is proposed within the Certified Vernal Pools or Vernal Pool Habitat as defined at 310 CMR 10.04. Under Article XXX and its implementing regulations, no work is proposed within the Certified Vernal Pools; however, work is proposed within Vernal Pool Habitat (i.e., areas within 100 feet of the pool boundary) and within the Vernal Pool Buffer Zone (i.e., areas between 100 and 200 feet of the pool boundary. The Holliston Conservation Commission finds that work proposed within the Vernal Pool Habitat and Vernal Pool Buffer Zone is required for the proposed project. The proposed mitigation suite offered by the Applicant includes features and components proposed to mitigate for work in these areas, including the creation of a new Vernal Pool and associated Vernal Pool Habitat and Vernal Pool Buffer Zone, four Conservation

Restrictions totaling 30.87 acres, and enhancements to the habitat of rare species on the project site. Lastly, the Holliston Conservation Commission hereby finds that the Vernal Pool Habitat and Vernal Pool Buffer Zone associated with the Vernal Pool to be created in the Wetland Replication Area will be limited to the subject property and will not extend onto the NStar property.

IX. **BUFFER ZONE TO BORDERING VEGETATED WETLANDS UNDER THE ACT.** The Holliston Conservation Commission finds that the proposed project includes provisions to protect adjacent wetland resource areas from alteration during construction, and an extensive mitigation suite, including four conservation restrictions totaling 30.87 acres, has been offered to protect the interests of the Act.

X. **ADJACENT UPLAND RESOURCE AREAS UNDER ARTICLE XXX.** The Holliston Conservation Commission finds that the proposed project includes provisions to minimize work to the extent practicable within the Adjacent Upland Resource Areas (i.e., areas within 100 feet of Bordering Vegetated Wetlands, other Freshwater Wetlands, Bank, and Bordering Land Subject to Flooding and areas within 200 feet of the Mean Annual High-Water Line of Hopping Brook) and provisions to protect the Adjacent Upland Resource Areas and adjacent wetland resources from unpermitted alteration during construction. The proposed mitigation suite offered by the Applicant includes four Conservation Restrictions totaling 30.87 acres which the Holliston Conservation Commission feels are critical to meeting the performance standards for work within the Adjacent Upland Resource Areas under Article XXX and its implementing regulations.

XI. **RARE SPECIES AND ENDANGERED SPECIES.** The proposed project has received a No Adverse Impact Letter from the Massachusetts Natural Heritage Program indicating that the proposed project, with the required conditions, will not result in a short- or long-term adverse impact to the wetland habitat of the local population of the subject rare species. In addition, the Applicant has negotiated a Conservation Permit pursuant to the Massachusetts Endangered Species Act (MESA) with the Massachusetts Natural Heritage and Endangered Species Program. The issuance of the Final Conservation Permit indicates that although the project may result in a taking of the subject rare species on the site, the proposed project, including mitigation, will result in a net benefit to the subject rare species. In this case, net benefits include enhancement of habitat, protection of habitat through Conservation Restrictions totaling 30.87 acres, and the monitoring of habitat use for up to five years.

XII. **NOTICE OF JURISDICTION UNDER THE MASSACHUSETTS WETLANDS PROTECTION ACT, M.G.L. Ch. 131, s. 40 AND ARTICLE XXX OF TOWN OF HOLLISTON BY-LAWS.** The Holliston Conservation Commission hereby finds that all or part of the property on which work is authorized by this Order is subject to jurisdiction under the Massachusetts Wetland Protection Act, M.G.L. Ch. 131, s. 40 and Article XXX of the Town of Holliston bylaws. The owner is hereby notified of his or her responsibility to comply with the provisions of these statutes. This condition shall remain in effect in perpetuity and shall survive the issuance of a Certificate of Compliance.

XIII. **RESOURCE AREA DELINEATION.** The Holliston Conservation Commission finds that the boundary of Bordering Vegetated Wetlands and two Isolated Vegetated Wetlands (Bylaw) on the site were previously established by an Order of Resource Area Delineation, DEP File # 185-524. No other resource areas were approved under that Order. The Holliston Conservation Commission also finds that additional Bordering Vegetated Wetlands boundaries and the Mean Annual High Water Line of Hopping Brook were previously established by an Order of Resource Area Delineation, DEP File # 185-538. The boundaries of Bordering Land Subject to Flooding and Vernal Pools Habitat were not determined by either Order.

General Conditions (only applicable to approved projects)

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.

2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.

3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.

4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. the work is a maintenance dredging project as provided for in the Act; or
   b. the time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.

5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order.

6. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

7. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

8. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to this Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

9. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words,

   "Massachusetts Department of Environmental Protection" [or, "MA DEP"]

   "File Number 185-553"

10. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before DEP.

11. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.

12. The work shall conform to the plans and special conditions referenced in this order.

13. Any change to the plans identified in Condition #12 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

14. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

15. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

16. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.

17. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

18. **WORK NOT AUTHORIZED.** Only work explicitly described in the above-referenced plans and Notice of Intent is authorized under this Order of Conditions. Installation of drains or sump pump effluents to any portion of the storm water drainage system that is tributary to a resource area is hereby prohibited, unless such work is explicitly depicted on the above plans, or subsequently approved plans.

19. **AUTHORIZED WORK.** This Order of Conditions applies only to work associated with the roadway, drainage system, utilities, and replication within Hopping Brook Phase II. Any work not covered by this Order: (i) within 100 feet of any mapped wetland as shown on the plans; (ii) within any area subject to the 100 year flood elevation; or (iii) within 200 feet of a perennial stream or river will require a separate filing. Any other activity relating to additional construction activities (e.g., lot grading, building construction, etc.) proposed within any area subject to jurisdiction by the Commission, shall require the filing of a Request for Determination of Applicability (RDA) and/or a new Notice of Intent and receipt of a valid Determination of Applicability or Order of Conditions, prior to the commencement of said activity. Any impacts on resource areas, associated with such areas, will take into consideration the cumulative impacts of all such activities, as well as those associated with this filing.

20. **PLAN CHANGES.** Any changes in the above-mentioned plans, Notice of Intent, or change resulting from the preceding conditions (including the submittal of additional information), must be submitted to the Holliston Conservation Commission for approval prior to implementation. A copy of such request shall at

the same time be sent to the Department of Environmental Protection. One of the following responses will be made by the Commission:

a. If the Commission finds, by majority vote, said changes to be insignificant to the interests of the Act, then the Commission will so notify the Applicant in writing.

b. If the Commission finds, by majority vote, said changes to be significant and / or deviate from the original plans, Notice of Intent, or this Order of Conditions, and that the interests of the Act would best be served by the issuance of additional conditions, the Commission will conduct another Public Hearing within 21 days, advertised at the Applicant's expense, in order to take testimony from all interested parties. Within 21 days of the close of the Public Hearing the Holliston Conservation Commission will issue an Amended Order of Conditions. No work shall be undertaken until the Amended Order of Conditions has been recorded in the Registry of Deeds or Land Court in the manner described in Condition #8 and with a marginal reference to the original Order of Conditions, and until all administrative appeal periods from the Amended Order of Conditions have elapsed.

c. If the Commission finds, by majority vote, said changes to be significant and would substantially change the nature, scope, purpose, or impact of the project, then the Commission will direct the Applicant to file a new Notice of Intent.

21. **TRANSFER OF OWNERSHIP.** Within ten (10) calendar days inclusive of the transfer of ownership of the subject property in whole or in part, including lots or buildings conveyed under individual deeds, the Conservation Commission shall be notified in writing of the name and address of the new owner. Within ten (10) calendar days inclusive of such transfer, a sworn affidavit shall be filed with the Holliston Conservation Commission by the new owner that he or she has read and understood the Order of Conditions and terms applicable to the project site and intends to comply with all provisions of the Order.

22. **RIGHT TO INSPECT.** Members and Agents of the Commission and the Department of Environmental Protection reserve the right to enter and inspect the property at all reasonable times, until a Certificate of Compliance is issued, to evaluate compliance with the conditions stated in this Order of Conditions, the *Massachusetts Wetlands Protection Act* (M.G.L. Ch. 131, Sec. 40) as amended, 310 CMR 10.00, and the Holliston by-law (Article XXX) and its implementing Regulations. The Commission may acquire any information, measurements, photographs, observations, and/or materials, or may require the submittal of any data or information deemed necessary by the Commission for that evaluation. Visitors shall check in at the field office.

23. **APPEAL PERIODS.** No work shall commence on-site until all appeal periods have elapsed and an Order of Conditions has been recorded with the Registry of Deeds, and proof of such recording has been submitted in writing to the Holliston Conservation Commission.

24. **COORDINATION WITH OTHER REQUIRED PERMITS.** No regulated work shall commence until all permits for this project have been received, which may include but are not limited to, NPDES permit, 401 Water Quality Certification from the Department of Environmental Protection, and a final Certificate pursuant to the Massachusetts Environmental Protection Act. The applicant shall provide copies of all additional permits to the Holliston Conservation Commission prior to the start of construction activities.

25. **CONTRACTOR NOTIFICATION.** The provisions of the Order of Conditions shall apply to, and be binding upon the Applicant, his employees, agents, independent contractors, and all successors and assigns in interest and control. The Applicant shall assure that a complete copy of this Order and Permit, including

its drawings, Special Conditions, and any amendments shall be maintained at the work site whenever work is being performed. The permittee shall assure that all contractors, subcontractors, and other personnel performing the permitted work, are fully aware of the permit's terms and conditions.

26. **ENFORCEABILITY.** Conditions set forth in this Order of Conditions are incorporated herein by reference and any breach of said conditions shall also be deemed to be a breach of the conditions of this permit and shall be enforceable to the fullest extent authorized by the Massachusetts Wetlands Protection Act (M.G.L., c.131, §40), its implementing Regulations (310 CMR 10.00), and Town of Holliston Wetlands Protection By-Law (Article XXX) and its implementing Regulations. The Commission orders that all work shall be performed in accordance with conditions set forth in this Order of Conditions, and with the Notice of Intent, plans and referenced documents.

27. **CONSERVATION RESTRICTIONS.** A Conservation Restriction, in perpetuity, pursuant to M.G.L., c.184, §26(c) shall be placed on four areas totaling 30.87 acres of the 205.56 acre parcel as shown on the referenced Conservation Restriction Plan. The Restriction shall be submitted to the Secretary of Environmental Affairs for approval prior to the commencement of any activities subject to this Order. The Conservation Restriction must be fully approved by the Secretary of Environmental Affairs prior to the issuance of a Full or Partial Certificate of Compliance. The content of the Conservation Restriction shall be reviewed and approved in writing by the Conservation Commission prior to submission of the documents to the Commonwealth. The Conservation Restriction shall follow the guidelines set forth in "*The Massachusetts Conservation Restriction Handbook*", Executive Office of Environmental Affairs, Division of Conservation Services.

PRE-CONSTRUCTION

All requests for site inspections and compliance reviews must be scheduled with the Conservation Commission office at least 7 days in advance.

28. **PRE-CONSTRUCTION MEETING.** Prior to the commencement of construction, the applicant shall submit the names and contact information of the Project Managers to the Commission. Additionally, prior to the commencement of any activities associated with this Order, the applicant, Project Managers, Compliance Inspector (See Condition 32: Compliance Inspection) and Conservation Agent or Commission representative shall meet at the site to review the Conditions of this Order. All wetland resource areas shall be clearly marked prior to this on-site project review.

29. **EROSION CONTROL INSTALLATION.** Prior to the commencement of work under this Order of Conditions, all erosion control measures (e.g., erosion control barriers and check dams, etc.), shall be installed. The Commission, or its agent, shall be notified when the protective measures have been installed for inspection and verification. No other work shall be undertaken until written approval is received from the Commission or its agent. Erosion control barriers shall be installed with siltation fencing backed by staked-in-place haybales. Haybales shall be entrenched three inches. Said siltation fencing shall be entrenched 6 inches and installed on the upland side of the haybale. Where haybales cannot be entrenched because of paved or compacted surfaces, loose hay shall be stuffed between and under bales to ensure that water is properly filtered.

30. **NOTIFICATION OF COMMENCEMENT OF WORK.** The Applicant shall notify the Conservation Commission, in writing, 48 hours before any activity commences on the project site and shall advise the Conservation Commission of the name(s) and telephone number(s) of the person(s) on site responsible for compliance with this Order. This list shall be resubmitted if any changes are made to it.

31. **NSTAR ACCESS AGREEMENT.** Prior to the start of construction, the Holliston Conservation Commission shall be provided with a copy of the access agreement between the Applicant and Nstar relative to the construction of the proposed Wetland Replication Area for the project.

32. **WETLAND PROTECTION.** No work or activity, including the cutting of vegetation, shall take place in a wetland area other than provided for in this Order of Conditions. No vegetation shall be removed from areas that are outside of the Limit of Work shown on the final site plans.

CONSTRUCTION

33. **WETLAND CROSSING.** The box culverts to be used at the wetland crossing shall consists of one 4' by 6' culvert and one 4' by 11' culvert, not two 4' by 6' culverts as shown on the site plan. The inverts of the culverts shall be those shown on the site plan.

34. **TEMPORARY FILL AT WETLAND CROSSING.** The temporary wetland crossing shall be constructed of two 36" RCP pipes, and temporary fill shall consist of gravel/stone borrow without fines, washed and obtained off-site.

35. **VERNAL POOL HYDROLOGY.** Prior to the start of construction, the Applicant shall submit to the Holliston Conservation Commission for its review and approval information relative to the maintenance of the existing hydrology of Certified Vernal Pool 2808 during construction and post construction periods of the proposed project. This information shall include any narrative, drainage calculations, and plans required to demonstrate that the hydrology of the pool will not be adversely affected by the proposed project.

36. **COMPLIANCE INSPECTION.** The applicant shall retain the services of a qualified professional (hereafter referred to as the "Compliance Inspector") with demonstrated experience in wetland protection, wetland management, endangered species, endangered species habitat, endangered species monitoring programs, to oversee all aspects of construction relating to wetland alteration and replication activities. The résumé of this individual shall be submitted to and approved by the Commission. The Compliance Inspector shall be hired by the Conservation Commission and shall represent the rights and interests of the Conservation Commission, funding for whom shall be provided by the applicant. The Compliance Inspector shall inspect all work within the resource areas, buffer zones, replication activities on a weekly basis. Compliance Inspections shall occur twice weekly when activities include wetland replication, the construction of the roadway crossing, bank restoration, and areas within 200 feet of the Certified Vernal Pools or within the watershed of the Certified Vernal Pools. The applicant or its representative shall create a plan that shows all of the above listed areas and provide a copy of this plan to the Commission, the Compliance Inspector(s), and all contractors responsible for the project prior to the start of construction. The Conservation Commission reserves the right to increase or decrease the number of visits by the Compliance Inspector based on the level of construction activity, the environmental complexity and/or sensitivity of construction activities, unforeseen conditions, and climatalogical factors. The applicant may choose to select more than one individual or a firm to conduct the Compliance Inspection if the minimum qualifications stated above are not met by one individual or company. The Compliance Inspector shall be available for Conservation Commission meetings when required. The Compliance Inspector shall also be responsible for identifying an acceptable alternate should the Compliance Inspector be unable to conduct the required inspections.

37. **PERIODIC INSPECTION REPORTS.** A brief monthly report shall be submitted by the Compliance Inspector to the Commission, detailing the extent of compliance with this Order of Conditions, status of erosion control measures, including dates and times of inspections, work which has been completed to date, any problems or difficulties encountered, and recommendations for remediation. The Compliance Inspector's reports shall be submitted weekly during periods in which activity is occurring in wetland areas, bank restoration activities, construction of the roadway crossing, endangered species habitat and monitoring, replication areas, within 200 feet of the vernal pool area or within any watershed area that will contribute runoff into the Certified Vernal Pools. The condition of the detention basins shall be inspected and reported after each storm event of greater that 0.5 (1/2) inch or greater in a 24-hour period until vegetation is fully established, and thereafter at intervals per the schedule provided in Attachment H of the referenced Notice of Intent. Monitoring reports detailing the percent vegetative cover and percent of wetland plant species, type of species, and relative vigor of the plants growing in the replication area. Recommendations for the replacement of dead or dying vegetation shall be made, and implemented. The reports are to include a discussion of the progress of construction to date, adherence to the referenced Construction Sequence Plans, provide an update of the work scheduled for the next period, state the effectiveness and condition of erosion control measures, and state whether the project is in compliance with the terms of this Order. The period of inspections shall begin at the time siltation controls are installed. Inspections shall continue as described in the "Multi-Year Project Components", Attachment H, of the Notice of Intent every 3 (three) months once construction activities are complete. A final Certificate of Compliance shall not be issued until all monitoring activity cycles described in Attachment H of the Notice of Intent have been completed. The weekly logs/reports shall be submitted on a monthly basis to the Conservation Commission, the Building Department and the Planning Board. The Conservation Commission reserves the right to require submission of such reports on a more frequent interval. Approval for temporary cessation of reports must be requested in writing by the Applicant or his authorized representative. Failure to submit satisfactory reports shall be deemed sufficient cause for the issuance of an Enforcement Order pursuant to the Act and Bylaw. Continued submission of incomplete or inadequate reports shall be deemed sufficient cause for revocation of this permit.

38. **HABITAT AND ENDANGERED SPECIES MONITORING.** The Compliance Inspector shall monitor the temperature of the constructed nesting area, with oversight from the Conservation Commission or the Conservation Agent. The temperature will be monitored at 0.5 (1/2) hour intervals in the center of the nesting area using a HOBO type data logging sensor at depths of 1, 4, 10 and 18 inches from April 1st until July 31st of each year for five years. All data thus generated shall be reported to the Conservation Commission at intervals specified in the Periodic Inspection Reports. The applicant shall be required to modify and implement design modifications for the nesting habitat if the temperatures are not within the nominal range required for nesting (i.e., a persistent soil temperature in the depth of potential nests of 45 C or greater or a lower temperature value if supported by the scientific literature).

39. **MONTHLY CONSTRUCTION MEETINGS.** During the period of construction a monthly meeting shall occur between the Conservation Commission or the Conservation Agent, the Compliance Inspector and the Project Manager and Project Engineers to discuss all activities associated with this Order.

40. **LIMIT OF WORK.** The erosion control barrier shall be the Limit of Construction (unless otherwise specified on the approved plans) beyond which no vegetation clearing or earth-disturbing activity shall occur or heavy equipment shall be allowed. At no time during or after construction shall fill or other materials be placed, slump or fall beyond the limit of grading as shown on the plans. The Applicant shall be responsible for inspecting and maintaining all slopes and embankments and shall immediately inform the Commission if slumping or erosion occurs. In addition, Orange Snow Fence will be required to be

installed at the erosion control barrier to more clearly mark the Limit of Work at the Bordering Vegetated Wetlands/Bank crossing. The Orange Snow Fence will be installed and maintained from 30 feet prior to the crossing to 30 feet after the crossing on both sides of the proposed roadway.

41. **ANTI TRACKING PAD DETAIL.** Prior to the start of construction, the Applicant shall submit a detail for the Anti Tracking Pad proposed at the northern and southern access routes to the site. The Anti Tracking Pad shall be a minimum of 100 feet in length, rather than 50 feet.

42. **EROSION CONTROL MAINTENANCE AND STOCKPILE.** Prior to any soil disturbance, removal, or stockpiling, the Applicant shall have on the site, an adequate quantity of supplemental haybales, silt fence, and stakes to be used for control of emergency erosion problems. All erosion control measures are to be inspected weekly and after each storm event of 0.5 (1/2) inch or greater in a 24-hour period, to ensure the proper functioning of said measures in preventing the introduction of silt in the wetland. Erosion controls must be inspected, cleaned of accumulated material, and repaired as needed. Material collected from the siltation barrier shall be removed as necessary and disposed in an upland area. All erosion control and sedimentation prevention measures shall remain in place and be maintained for the purpose for which they are installed (proper maintenance may require periodic replacement) until the area upgradient is permanently stabilized and a Certificate of Compliance has been issued. In the event that an uncontrollable emergency occurs, such as a heavy rainstorm, causing erosion and sedimentation breakout, the Applicant shall replace such barriers to the standards required by the Order and the satisfaction of the Commission.

43. **ADDITIONAL EROSION CONTROL.** The installation of haybales or other erosion control and sediment control measures may be required in places not shown on the plan or mentioned in the Order of Conditions. Erosion control barriers may be required by the Conservation Commission in those locations, in order to prevent or rectify damage to resource areas. Said erosion control barriers shall be in place within forty-eight (48) hours of said request. Any interim, partially constructed drainage structure outfalls shall have erosion control and sedimentation prevention. Any unstabilized drainage ways will have erosion controls placed across the flow path at least every 50 feet intervals.

44. **STABILIZATION.** All disturbed surfaces shall be permanently stabilized with vegetation within five (5) days of final grading except in non-growing seasons where temporary stabilization (as described in Special Condition, 45) shall be employed. Under no circumstances shall soil be left unstabilized for periods over one month. Preventative controls such as temporary seeding/ bonded fiber matrix or jute covering shall be employed to prevent such an occurrence.

45. **SLOPES.** All slopes 3:1 to a maximum of 2:1 shall be stabilized with American Excelsior Co. Curlex blankets, "Soil Guard" or other method approved by the Commission. The proposed grading shall be constructed as shown on the enclosed plan. No deviations shall be made to the limit of work or the steepness of the slopes shown. No increase in slope, retaining walls, boulder walls, or rip rap slopes shall be constructed without prior approval by the Conservation Commission.

46. **DEWATERING.** There shall be no dewatering on site that will result in the direct discharge of water to any wetland resource area. Any dewatering discharge within 100 feet of a resource area, within 200 feet of a vernal pool or nesting habitat, or functional drainage way will be equipped with a filter bag designed for that purpose. All suction hoses will be kept at the surface of the water to reduce to a minimum the suspension and pumping of silt.

47. **DUST CONTROL.** Oil, sodium chloride, and/or calcium chloride shall not be used during or after construction for the control of dust. Only water shall be used for dust control, and water shall be applied as required to adequately control dust generated by site activities.

48. **SPILL PREVENTION.** All equipment shall be stored outside the resource area and the 100-foot buffer zone and in such a manner so as not to introduce any pollutants into any wetlands, and in no event shall there be any discharge or spillage of fuel, oil or other pollutants into any resource area. Servicing of equipment (e.g., fueling, changing, adding or applying lubricants or hydraulic fluids, or washing/rinsing of concrete transports) must be done outside resource areas and the 100-foot buffer zone, with the exception of refueling of immobile equipment. Immobile equipment includes, but is not limited to, operating pumps, where removal of the pump would cause unreasonable damage to the resource area or delay to the construction effort. During and after work on this project, the Applicant shall take all reasonable precautions to prevent the discharge or spillage of fuel, oil other pollutants by ignorance, accident or vandalism. Storage of petroleum products for use during construction (motor oil, gasoline, or diesel fuel) shall not be allowed in buffer zones or resource areas at any time.

49. **SPILL PREVENTION EQUIPMENT.** Before construction measures and equipment will be provided on site sufficient to prevent discharged fluids from reaching wetlands or water bodies, and be readily available for use. These will include some combination of the following:

- dikes, berms or retaining walls sufficiently impervious to contain spilled oil;
- sorbent and barrier materials in quantities determined by the contractor to be sufficient to capture the largest reasonably foreseeable spill;
- disposable drums or containers suitable for holding and transporting contaminated materials;
- any immobile equipment operation within a resource area or the buffer zone and any other equipment which, for any reason, is refueled within the resource area of the buffer zone will have sorbent pad under it at all times it is operation and during any refueling.

50. **DETENTION FACILITIES.** Detention basins designed to mitigate the runoff from the proposed roadway construction shall be completely constructed and verified as functional by the Compliance Inspector prior to the start of earth moving activities on other portions of the project which generate runoff to each basin unless otherwise permitted in writing by the Commission. Specifically, a binder course with a Cape Cod berm shall be installed prior to any further construction. All outlets from all detention basins shall be installed with temporary outlet riser pipes and filter materials or other such device approved by the Commission prior to installation to allow the basins to function as sedimentation basins. These structures shall remain in place throughout construction until the site is fully stabilized and the Commission gives approval for their removal.

51. **STOCKPILING.** All debris, fill and excavated material, construction material, and building material shall be stockpiled at least 100 feet away from any wetland, be located outside of any floodplain and be located to prevent sediment from surface runoff entering the wetlands. At no time shall any debris or other material be buried or disposed of within the line marked on the plan as a wetland. All stockpiles shall be properly stabilized to prevent erosion and siltation. Preventative control such as temporary seeding/ bonded fiber matrix or jute covering shall be employed to prevent such an occurrence.

52. **FILL MATERIAL.** All fill brought on to the site for use in this project within the 100-foot buffer zone shall be in accordance with General Condition Number 6. Additionally, the material shall be free from, organic matter, large stones, masonry, stumps, tree branches, and waste materials. In addition to the specific

exclusion of certain materials as fill used in connection with this project the following shall be prohibited: chemically contaminated material; concrete and asphalt rubble; stumps; "bulky waste", "garbage", "rubbish", "refuse", "special waste" and "waste" as defined in 310 CMR 19.01, DISPOSAL OF SOLID WASTE BY SANITARY LANDFILL.

53. **CONSTRUCTION DEBRIS REMOVAL.** All debris generated during construction from any aspect of this project shall be removed from the site and properly disposed. All stumps, brush, waste and debris shall be removed from the construction site or recycled into usable chips and shall be distributed promptly and in a legal manner. Records as to the destination of all materials to be removed from the site, including, stumps, brush, excess fill, loam, shall be kept and provided to the Commission upon request.

54. **TIMING OF CONSTRUCTION.** No work permitted under this Order of Conditions shall be performed within 200 feet of Certified Vernal Pools 2806, 2807 and 2808 or within watershed areas contributing to these Certified Vernal Pools between March 1st and May 15th of any year in which construction activities occur unless approval in advance is obtained in writing from the Conservation Commission. Additional time-frame limitations set forth in Attachment G of the Notice of Intent shall also be followed. Lastly, once the erosion control barriers have been established at the southern crossing and prior to the start of earth-moving activities, the area between the erosion control barriers shall be inspected by a qualified biologist for the presence of the subject rare species. Specimens shall be removed from the work zone by a qualified biologist. If this work is conducted outside of the active period of the subject rare species, the Holliston Conservation Commission shall be in advance notified in writing, and this inspection will not be required.

55. **WETLAND REPLICATION AREA.** All work concerning the proposed wetland replication shall conform to the above referenced plans and supporting documents, unless otherwise specified in this Order. As discussed by Oxbow Associates, the Wetland Replication Area shall be constructed, graded, and seeded during year one, and the woody vegetation shall be established during year two. The Compliance Inspector shall evaluate and report the condition and growth of the wetland replication area at intervals required in Attachment H of the Notice of Intent. The Compliance Inspector's final report shall be a portion of the documentation necessary to obtain a Certificate of Compliance for the wetland replication work. A Certificate of Compliance for the replicated wetland shall require that at least 75% of the surface of the replacement area be reestablished with indigenous wetland plant species within two growing seasons following completion of the area [310 CMR 10.55(4)(b)7].

56. **WORK STOPPAGE.** The Applicant or his representative shall notify the Commission, in writing, at least one week prior to the commencement of construction. In the event that work ceases on the site for a period of time greater than fifteen (15) business days, and before the inspections required by the Order have stopped, the Applicant shall notify the Commission. The Applicant will notify the Commission as to what steps will be taken for long-term maintenance of the site during the stoppage of work. The Applicant shall re-notify the Commission prior to the re-commencement of work.

57. **TIMELY RESPONSE TO EROSION PROBLEMS.** The Applicant shall move swiftly to control any erosion problems that occur on the site. The Holliston Conservation Commission reserves the right to require additional erosion and/or damage prevention controls it may deem necessary.

58. **CONTROL OF CONSTRUCTION DEBRIS.** No construction debris (paper, wood, metal, concrete, etc.) may be allowed to enter the resource area at any time. Windblown material shall be promptly removed from wetland resource areas.

59. **DAMAGE TO RESOURCE AREAS.** Any damage caused as a direct result of this project to any wetland resource areas, beyond that authorized by the Order, is the responsibility of the Applicant to repair, restore or replace. Sedimentation or erosion into these areas shall be considered damage to wetland resource areas. The Conservation Commission shall be promptly notified of any damage to wetland resource areas. Following notification, the Applicant must submit a plan for abatement of the problem and restoration. This plan must be approved by the Conservation Commission prior to its implementation.

60. **SURPLUS EARTH MATERIALS.** It shall be the responsibility of the Applicant to ensure that any and all surplus materials which are not needed for use on the project are lawfully disposed of outside any area subject to protection under M.G.L. c 131, s. 40 and Article XXX, unless such disposal area and activity are regulated under either a valid Order of Conditions or Determination of Applicability.

61. **STREET LIGHTING.** In order to facilitate the migration of vernal pool species within the wildlife corridor there shall be no street lights installed within 100 feet of any vernal pool area.

POST CONSTRUCTION

62. **CERTIFICATE OF COMPLIANCE.** Not more than thirty days following completion of the project, the Applicant shall submit with their request for a Certificate of Compliance, an affidavit prepared by a professional engineer or land surveyor registered in the Commonwealth of Massachusetts, stating that the site has been developed in accordance with the requirements of this Order of Conditions, based upon an on-site inspection and the referenced site plan(s).

63. **AS BUILT.** Upon completion of the project, the Applicant shall submit with their request for a Certificate of Compliance, an As-Built plan for all work within the jurisdiction of the Wetlands Protection Act and Article XXX. If a project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect or land surveyor. a written statement by such a professional person certifying substantial compliance with the plans and setting forth what deviations, if any, exists from the plans approved in the Order shall accompany the request for a Certificate of Compliance.

64. **FERTILIZERS.** Fertilizers utilized for landscaping and lawn care shall be low phosphate content variety, and shall be used in moderation. Pesticides and herbicides shall not be used within 100 feet of a wetland resource area.

65. **DRAINAGE SYSTEM MAINTENANCE.** Prior to issuance of a Certificate of Compliance all drainage structures shall be cleaned of accumulated sediment and debris. Following issuance of a Certificate of Compliance, all catch basins and other storm drainage structures shall be inspected and cleaned annually of all accumulated sediments. Catch basins with hoods or water quality inlets shall be inspected semiannually to check for oil build-up and outlet obstructions. A licensed contractor shall dispose of material removed from catch basins. Records of such cleaning shall be maintained for a minimum of the previous three (3) years and shall be made available for inspection upon request by the Commission. The Applicant shall submit a summary of these reports annually to the Commission. This condition shall survive the Order of Conditions and shall run with the title of the property.

66. **NON-ROADWAY DISCHARGE.** For the purposes of this project site, the term non-roadway discharge shall not include stormwater that is derived from any paved surfaces on the site, including, but not limited to roadways and parking lots. This condition shall survive this Order of Conditions, and shall run with the title of the property.

67. **UNDERGROUND STORAGE TANKS.** No underground storage of fuel oils or hazardous substances or hazardous wastes shall be allowed within the 100-foot buffer zone or within 200 feet of any Certified Vernal Pool or nesting habitat. This condition shall survive this Order of Conditions, and shall run with the title of the property.

68. **SNOW REMOVAL AND STORAGE.** No snow storage areas shall be located within the 100 foot Wetland Buffer Zone. At no time shall snow removal operations result in the direct discharge of snow into wetlands, nesting habitat, vernal pool areas or drainage channels. Sodium chloride shall not be used for de-icing on any portion of the site covered by this Order of Conditions. These conditions shall remain in force in perpetuity beyond the issuance of a Certificate of Compliance.

69. **OPERATION AND MAINTENANCE PLAN.** The Applicant shall provide an Operation and Maintenance Plan for the stormwater drainage system to the Commission prior to its release of the Order of Conditions. The owner and party responsible for maintenance of the system must be clearly identified in the plan. The drainage system shall be maintained according to the plan. The annual roadway sweeping plan shall be implemented to include two annual sweep operations; the first by April 30th and a second by November 1st of each year. This condition shall remain in force in perpetuity beyond the issuance of a Certificate of Compliance.

70. **GROUNDWATER INFILTRATION AREA THERMAL MITIGATION PLAN.** Prior to the discharge of any roof water to the groundwater infiltration area beneath the turtle nesting area, the Applicant shall provide to the Holliston Conservation Commission for their approval details regarding the method or methods to be used to detain the first inch of runoff. Only roof runoff may be discharge through the groundwater infiltration area located beneath the turtle nesting area. This condition shall remain in force in perpetuity beyond the issuance of a Certificate of Compliance.

71. **VERNAL POOL CERTIFICATION.** The Applicant shall have a qualified biologist conduct the fieldwork and complete and submit the necessary paperwork to the Massachusetts Natural Heritage and Endangered Species Program to certify the Vernal Pool proposed to be created within the Wetland Replication Area. This work shall be completed by the end of the three-year Wetland Replication Area monitoring period, and a copy of all paperwork shall be submitted to the Holliston Conservation Commission in a timely manner.

72. **RARE SPECIES MONITORING REPORTS.** The Holliston Conservation Commission shall be notified in writing by certified mail, return receipt requested of the availability of Rare Species Monitoring Reports. The Holliston Conservation Commission shall be notified of the availability of the reports within 14 days of submittal of the reports to the Massachusetts Natural Heritage and Endangered Species Program.

73. **MULTI-YEAR PROJECT COMPONENTS.** Following construction activities the Compliance Inspector shall continue to submit reports every 3 months related to Nesting Habitat Maintenance, Nesting Habitat Monitoring, Drift Fence, Turtle Monitoring (South), Wetland Replication and the Stormwater Management System as specified in the Notice of Intent. These reports shall continue for the time periods specified for each activity in Attachment H of the Notice of Intent or for five years, whichever is less.

Findings as to municipal bylaw or ordinance

Furthermore, the Holliston Conservation Commission (Conservation Commission) hereby finds (check one that applies):

☐ that the proposed work cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw specifically:

Municipal Ordinance or Bylaw ______ Citation ______

Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order of Conditions is issued.

☐ that the following additional conditions are necessary to comply with a municipal ordinance or bylaw, specifically:

Municipal Ordinance or Bylaw ______ Citation ______

The Commission orders that all work shall be performed in accordance with the said additional conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

B. Findings (cont.)

Additional conditions relating to municipal ordinance or bylaw:

1. All of the Conditions listed above pursuant to the Massachusetts Wetlands Protection Act and its implementing regulations are hereby made part of the Order of Conditions under Article XXX and its implementing regulations. No additional conditions beyond those required to protect the specified interests under the Massachusetts Wetlands Protection Act are required for this project pursuant to Article XXX.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40 and
Article XXX of the Town of Holliston Bylaws

DEP File Number:

185-553

Provided by DEP

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

april 29, 2003
Date

This Order must be signed by a majority of the Conservation Commission. The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office (see Appendix A) and the property owner (if different from applicant).

Signatures:

Joel Carlson, Chairman	Dennis Ferriera
Geoffrey Zeamer	Elizabeth A. Brousseau Elizabeth Brousseau
Peter Rosati	Lisa Todd Lisa Todd
Michael Lotti	

On 29th Day Of april 2003 Month and Year

before me personally appeared

The above named signatories

to me known to be the person described in and who executed the foregoing instrument and acknowledged that he/she executed the same as his/her free act and deed.

Jane Sears Pierce
Notary Public

2/20/09
My Commission Expires

This Order is issued to the applicant as follows:

☐ by hand delivery on

Date

☐ by certified mail, return receipt requested, on

Date

C. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate DEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Appendix E: Request of Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act, (M.G.L. c. 131, § 40) and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

D. Recording Information

This Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on Page 7 of Form 5 shall be submitted to the Conservation Commission listed below.

Conservation Commission

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40 and
Article XXX of the Town of Holliston Bylaws

DEP File Number:

185-553

Provided by DEP

D. Recording Information (cont.)

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Holliston Conservation Commission
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Hopping Brook Park, Phase II — 185-553
Project Location — DEP File Number

Has been recorded at the Registry of Deeds of:

Middlesex
County — Book — Page

for:

New Hopping Brook Realty Trust
Property Owner

and has been noted in the chain of title of the affected property in:

Book 31501, page 99 and Book 28716, page 36
Book — Page

In accordance with the Order of Conditions issued on:

April 30, 2003
Date

If recorded land, the instrument number identifying this transaction is:

Instrument No. 1167 on May 20, 2003 at 2:57 p.m.
Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant
Michael P. Healy, as attorney for Applicant

APPENDIX A

A. PLANS:

Hopping Brook Road & Utility Extension For The Hopping Brook Business Park, Holliston MA, Bruce Saluk & Associates:

Sheet	Description	Date	Revision
EX	Existing Conditions – Index Sheet	01/21/2003	
E1	Existing Conditions and Resource Plan	01/21/2003	
E2	Existing Conditions and Resource Plan	01/21/2003	
E3	Existing Conditions and Resource Plan	01/21/2003	
IN	Proposed Conditions – Index Sheet	03/04/2002	03/21/2003
C1	Road Alignment Plan	03/04/2002	
C2	Road Alignment Plan	03/04/2002	
C3	Road Alignment Plan	03/04/2002	
C4	Drainage, Utility and Grading Plan	03/04/2002	03/21/2003
C5	Drainage, Utility and Grading Plan	03/04/2002	03/21/2003
C6	Drainage, Utility and Grading Plan	03/04/2002	03/21/2003
C7	Roadway Profile	03/04/2002	03/21/2003
C8	Roadway Profile	03/04/2002	03/21/2003
CR	Conservation Restriction Plan	01/24/2003	
WR	Wetland Replacement Plan	01/21/2003	03/21/2003
CS	Construction Index Plan	03/21/2003	03/21/2003
CS1	Construction Sequence Plan	03/21/2003	
CS2	Construction Sequence Plan	03/04/2002	01/21/2003
CS3	Construction Sequence Plan	03/21/2003	
CS4	Construction Sequence Plan	03/21/2003	
CS5	Construction Activity Schedule	03/21/2003	
D1	Detail Sheet	03/04/2002	03/21/2003
D2	Detail Sheet	03/04/2002	03/21/2003
D3	Detail Sheet	10/04/2002	03/21/2003
	Mylar Existing Conditions Plans		
EX	Existing Conditions – Index Sheets	1/21/2003	
E1	Existing Conditions & Resource Plans	1/21/2003	
E2	Existing Conditions & Resource Plans	1/21/2003	

B. DOCUMENTS:

Document	Proponent	Date	Revised
Notice of Intent, Hopping Brook Realty Trust (Phase II)	Oxbow Associates	04/18/2002	03/13/2003
Stormwater Runoff Study, Hopping Brook, File # 2044	Bruce Saluk & Assoc.	02/2002	03/23/2003
Stormwater Management Report, Hopping Brook, #2044	Bruce Saluk & Assoc.	04/2002	03/21/2003
Storm Water Pollution Prevention Plan (SWPPP) - Road & Utility Extension for the Hopping Brook Business Park	Bruce Saluk & Assoc.	03/21/2003	
Hopping Brook Park, Holliston, MA, Conservation Commission Topics for Discussion	Bruce Saluk & Assoc.	12/10/2002	01/29/2003
Order of Resource Area Delineation, DEP File # 185-524	First Colony Development	01/16/2001	

Order of Resource Area Delineation, DEP File # 185-538	First Colony Development	09/04/2001
Letter, "Predicted Temperature Effect of Roofwater Infiltration on Soil Temperature in Underground Infiltration Systems	Norse Environmental	By facsimile: 1/17/03
Letter, First Colony Development Company, Inc.	Norse Environmental	03/17/2003
Letter, Response to February 19, 2003 Eco Tec, Inc., Review	Oxbow Associates, Inc.	03/20/2003
Letter, First Colony Development Co., Inc.	Healy & Johnson, LLC	03/19/2003
Letter, Response to Comments on Notice of Intent – DEP file 185-553, Hopping Brook Business Park	Bruce Saluk & Assoc.	03/21/2003
Letter, Access road and stormwater structures for commercial development (Hopping Brook Park), NHESP File # 01-8977	Natural Heritage (NHESP), Pat Huckery	04/01/2003

APPENDIX D

Revised Stormwater Management Report

STORMWATER MANAGEMENT REPORT

FOR

Hopping Brook – Phase II
BSA File #2044

Prepared For:

New Hopping Brook Trust
929 Boston Post Road, East
Suite 2
Marlborough, MA 01752

Prepared By:

Bruce Saluk & Associates, Inc.
Civil Engineers and Land Surveyors
576 Boston Post Road
Marlborough, MA 01752

Prepared On:

April 2002
Revised: August 6, 2002
Revised: November 1, 2002
Revised: December 10, 2002
Revised: January 22, 2003
Revised: March 21, 2003

LIST OF TABLES

SECTION 1: Existing and Proposed Conditions

SECTION 1: Existing and Proposed Conditions

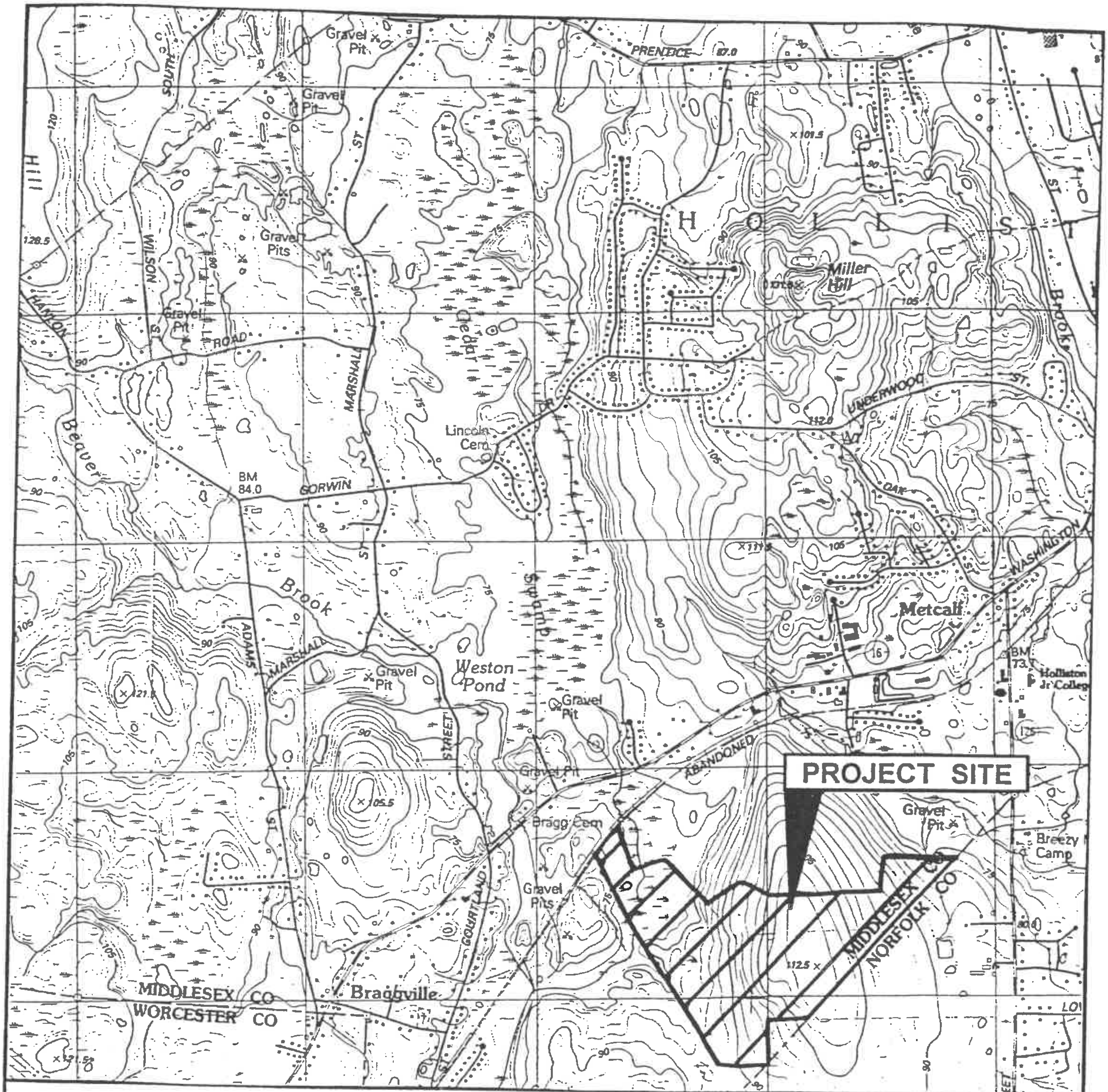
The project site as illustrated on Figure 1-1, is located at Hopping Brook Industrial Park, Washington Street in Holliston, MA. This property is located within the Industrial zoning district.

The Natural Resource Service Soil Survey indicates that the site soil is comprised of hydrological groups "A" through "C."

The land is currently undeveloped, predominantly forested, and includes a rare species inhabited wetland system (four-toed salamander & spotted turtle). Most runoff leaves the site in a westerly direction through the local depression that discharges into an existing triple 60-inch diameter RCP culvert located along a partially constructed road crossing at the East Branch of Hopping Brook.

Although the entire property is ±205 Acres, this stage of the project only includes a 1,500-foot access road. A separate application will be made in the future, as the market allows, for the site development.

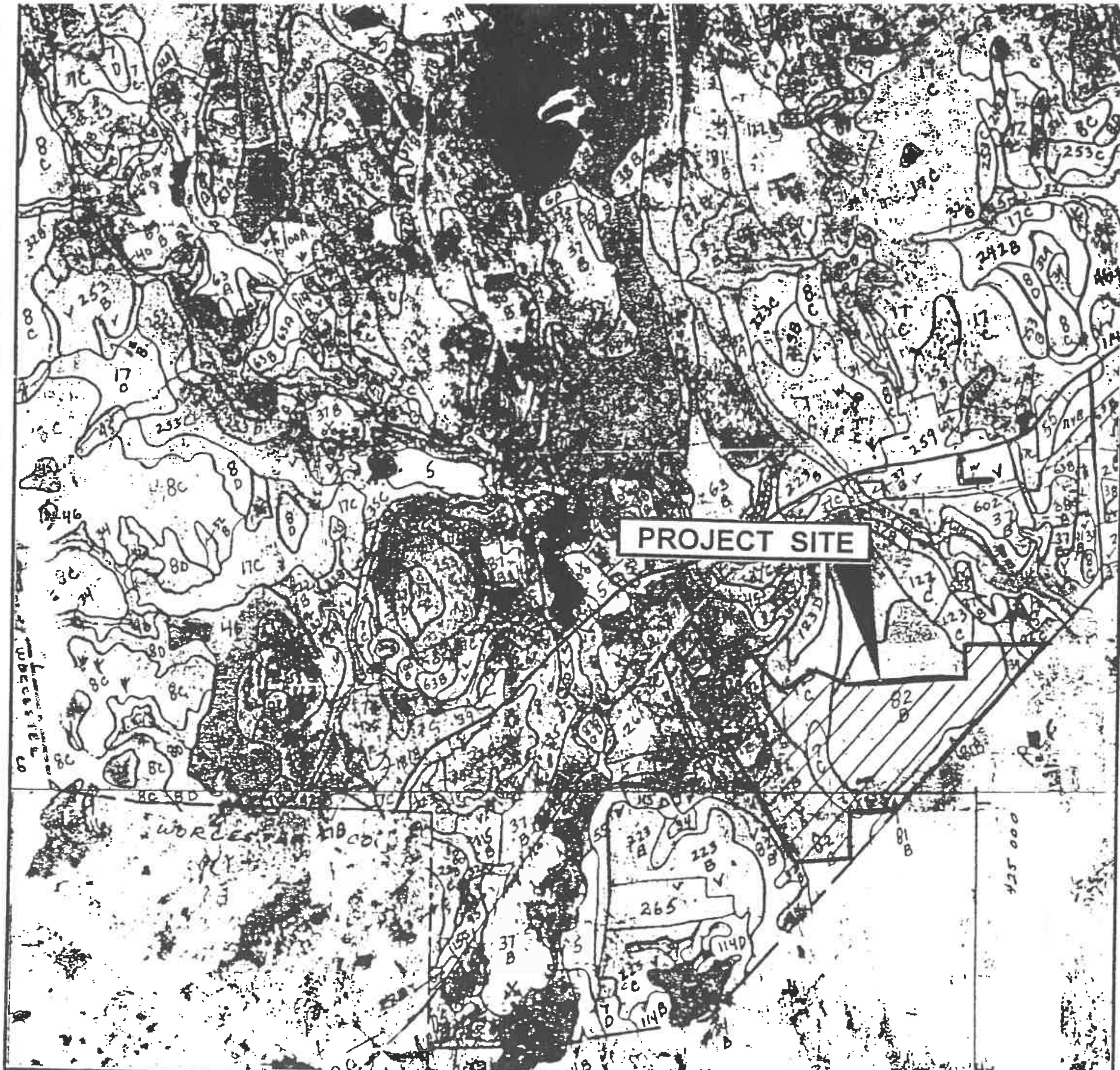
The proposed site access roadway, is an extension of the existing Hopping Brook Road. The completed portion of this road consists of a varying width pavement that includes drainage, water, electric & telephone, and sewer infrastructure associated with the future build-out of the site. The proposed roadway results in a net increase in impervious area of approximately 77,500 SF. The proposed roadway will incorporate a drainage collection system that will convey flow through a stormwater treatment system including deep-sump catch basins, extended detention basins and a water quality swale as shown on the plan.



SCALE: 1"=2083'

FIGURE 1-1
LOCUS PLAN

BRUCE SALUK & ASSOCIATES, INC.
Civil Engineers & Land Surveyors
576 Boston Post Road
Marlborough, MA 01752



SCALE: 1"=2083'

FIGURE A-3
NRSC SOILS MAP

BRUCE SALUK & ASSOCIATES, INC.
Civil Engineers & Land Surveyors
576 Boston Post Road
Marlborough, MA 01752

SECTION 2: Design Rationale

SECTION 2: Design Rationale

The stormwater system was designed to meet standards of the DEP Stormwater Management Policy (November 1996 with revisions of March 1997) and the Holliston Wetlands Administration Bylaw Regulations (September 2001), as well as the Holliston Board of Health Stormwater and Runoff Regulations (February 1999 with revisions of August 2000). As a requirement, 80% of Total Suspended Solids (TSS) must be removed from the average annual load. There will be no direct discharge of untreated stormwater into the wetlands. Additional design criteria include a net reduction in both peak rate and volume of runoff leaving the site. In fact, a significant reduction in peak rate of runoff has been achieved and will reduce erosion along Hopping Brook.

Runoff rates were calculated by developing a HydroCAD computer model using the Holliston Board of Health Stormwater and Runoff Regulations (February 1999 with revisions of August 2000) and TR-55 & TR-20 methodologies for both existing and proposed conditions. HydoCAD software combines the benefits of TR-55's Time of Concentration methodology with the benefits of TR-20's stormwater routing methodology. Refer to Section 4 of the report, which summarizes the runoff rates and volumes for existing and proposed conditions.

Some of the structural means to achieve the aforementioned performance standards include the following:

- All catch basins will include 48-inch deep sumps with oil traps.
- All three extended detention basins will include a forebay and separate infiltration area.
- A water quality swale will treat a small portion of the proposed road runoff.
- Provisions for future maintenance of the stormwater system are provided in Appendix B.

Table 3-1 provides the watershed characteristics that were used in developing the computer model (HydroCAD) for runoff calculations under existing and proposed conditions.

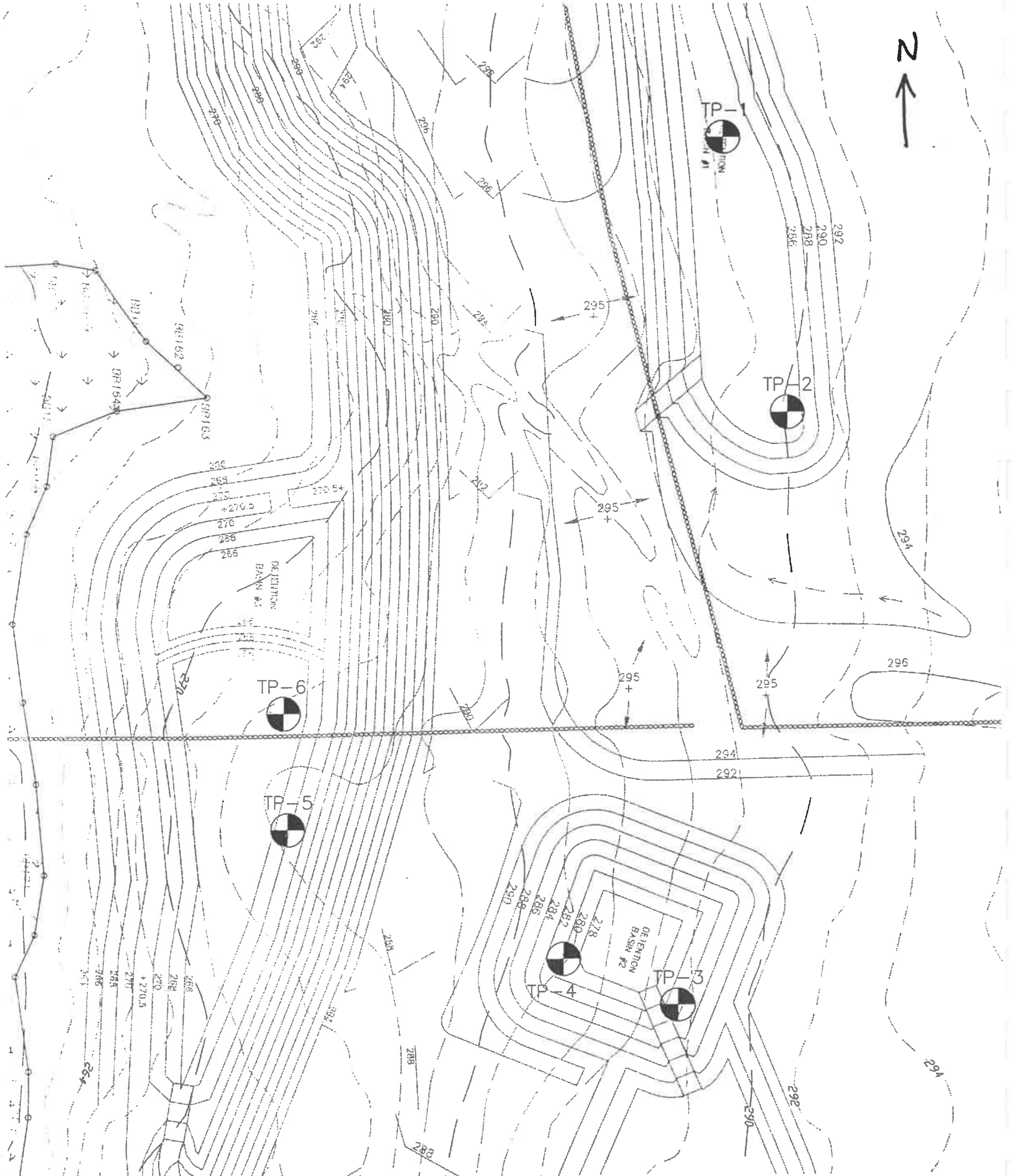
To further protect the water quality, a Construction Stormwater Maintenance schedule is provided on the plan (see Index sheet), and a Post Construction Stormwater Maintenance Plan is included (see Appendix "B").

BSA, Inc. designed the proposed extended detention basins to filter runoff from the proposed roadway and other site runoff. All forebays are designed to treat the 1-inch water quality runoff volume. The purpose of the forebay is to settle suspended solids, pretreat debris, sediment and pollutants. Treated runoff leaving the forebay then enters the main detention area that includes groundwater recharge and finally discharges onto the existing upland. Detention basin #1 will discharge treated runoff from the undisturbed hillside to Certified Vernal Pool (CVP) 2808. This is designed as a discharge to a Critical Area under DEP Stormwater Standards.

In-situ Soil Testing Information

1. In-situ soil evaluation in the location of all proposed Detention Basins revealed loamy-sand material with an average seasonal high groundwater elevation at about two-feet below the surface. Soil testing logs are attached.

N.T.S.
2-26-03
Soil Testing Locations



1(

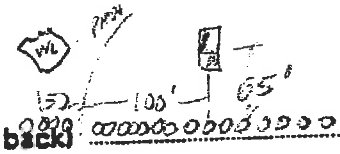
On-site Review

Deep Hole Number TP 1 Date: Feb 26, 2003 Time: AM Weather clear cold

Location (identify on site plan) DBASIN # 1

Land Use ________ Slope (%) 1% Surface Stones walls

Vegetation



Landform

Position on landscape (sketch on the back)

Distances from:

Open Water Body ____ feet Drainageway ____ feet

Possible Wet Area ____ feet Property Line ____ feet

Drinking Water Well ____ feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 – 6"	A	FSL	10YR 3/3	NO	Friable
6" – 24"	Bw	SL	10YR 5/6	NO	Friable
24" – 94"	C	LS	2.5Y 5/1	75% 7.5YR 5/8 @ 24"	Many rounded stones & cobbles, mixed w/ coarse sandy grael, few silt coated stones.

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 46" Weeping from Pit Face: 43"

Estimated Seasonal High Ground Water: 24"

On-site Review

Deep Hole Number TP-2 Date: 2-26-03 Time: AM Weather

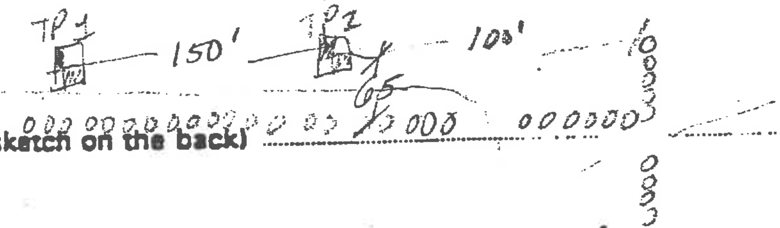
Location (identify on site plan) D-BASIN #1

Land Use Slope (%) ∅ Surface Stones walls

Vegetation

Landform

Position on landscape (sketch on the back)



Distances from:

Open Water Body feet Drainageway feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0"-6"	A	FSL	10 YR 3/3	NO	Friable
6"-32"	Bw	SL	10 YR 5/6	>5% @26" 7.5YR 5/8	Friable
32"-120"	C	LS	2.5Y 5/1		Fine sand mixed Few Rock Fragments Few Boulders

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 100" Weeping from Pit Face: 33"

Estimated Seasonal High Ground Water: 26"

On-site Review

Deep Hole Number TP 3 Date: 2-26-03 Time: AM Weather Clear Cold

Location (identify on site plan) D-BASIN 2

Land Use Slope (%) 1% Surface Stones WAlls

Vegetation

Landform

Position on landscape (sketch on the back)

Distances from:

Open Water Body feet Drainageway feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0"-6"	A	FSL	10YR 3/3	NO	Friable
6"-36"	Bw	SL	10YR 5/6	>5% @21" 7.5YR 5/8	Friable
36"-120"	C	LS	2.5Y 5/1	↓	Friable Fine Sand Few Rock Fragments Few Cobbles

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 100" Weeping from Pit Face: 24"

Collapse Estimated Seasonal High Ground Water: 21"

On-site Review

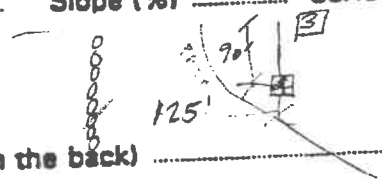
Deep Hole Number TP 4 Date: 2-26-03 Time: AM Weather Clear cold

Location (identify on site plan) D-Basin #2

Land Use .... Slope (%) .... Surface Stones walls

Vegetation

Landform



Position on landscape (sketch on the back) ....

Distances from:

Open Water Body .... feet Drainageway .... feet

Possible Wet Area .... feet Property Line .... feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0"-6"	A	FSL	10YR 3/3	NO	Friable
6"-32"	Bw	SL	10YR 5/6	>5% @22" 7.5YR 5/8	Friable
32"-120"	C	LS	2.5Y 5/1	↓	Rounded stones Fine sand Few rock frags.

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 100" Weeping from Pit Face: 24"

collapse Estimated Seasonal High Ground Water: 22"

On-site Review

Deep Hole Number TP5 Date: 2-26-03 Time: PM Weather Clear Cold

Location (identify on site plan) O-BASIN 3

Land Use Slope (%) 1% Surface Stones walls

Vegetation 8-50 — 1
120'

Landform BB-170

Position on landscape (sketch on the back)

Distances from:

Open Water Body feet Drainageway feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0"-6"	A	FSL	10YR 3/3	No	Friable
6"-36"	Bw	SL	10YR 5/6	>5% @ 24" 7.5YR 5/8	Friable
36"-120"	C	LS	2.5Y 5/1		med-coarse sand mix w/ few cobbles & gravel

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 115" Weeping from Pit Face: 36"

Estimated Seasonal High Ground Water: 24"

On-site Review

Deep Hole Number TP 6 Date: 2-26-03 Time: PM Weather Clear Cold

Location (identify on site plan)

Land Use Slope (%) 1% Surface Stones walls

Vegetation 10' [illegible]

Landform

Position on landscape (sketch on the back)

Distances from:

Open Water Body feet Drainageway feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0"-6"	A	FSL	10YR 3/3	NO	Friable
6"-35"	Bw	SL	10YR 5/6	>5% @ 24" 7.5YR 5/8	Friable
35"-120"	C	LS	2.5Y 5/1		Friable Few rounded stones Fine - med. sand

Parent Material (geologic) Ablation till Depth to Bedrock: Below pit

Depth to Groundwater: Standing Water in the Hole: 105" Weeping from Pit Face: 32"

Estimated Seasonal High Ground Water: 24"

SECTION 3: Hydrologic Design Criteria

SECTION 3: Hydrologic Design Criteria

1. **DESIGN STORMS:** Both the existing and proposed conditions were analyzed for the 1, 2, 5, 10, 25, 50, and 100-year storm frequencies. The rainfalls used for the above storms were 2.6, 3.25, 4.1, 4.9, 6.1, 7.3 and 8.5 inches, respectively. The rainfall distribution used for each of the storms was a SCS type III, 24-hour rainfall distribution. The rainfall depths used are from the Holliston Board of Health Stormwater and Runoff Regulations (February 1999 with revisions of August 2000) and are based on the "Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada, by Cornell University, September 1993."

2. **METHODOLOGY:** HydroCAD was used to develop hydrologic calculations. HydroCAD uses TR-55 methodology to develop time of concentrations, and TR-20 methodology for stormwater routing. The Natural Resources Conservation Service (NRCS) developed these methods.

3. **HYDROLOGIC SOIL GROUP:** Soil mapping was used to define the Soil Hydrologic Group classifications for the onsite, that were determined to be from a Hydrologic Group "A" through "C" soil for the site under existing and proposed conditions. A conservative application of a "C" soil was used for modeling purposes.

4. **RUNOFF:** The quantity of rainfall that was calculated as runoff was based on (1) soil types and associated hydrologic soil classification, (2) the area of existing and proposed impervious and pervious surfaces; i.e. buildings, driveways, and man-made and natural surface slopes.

TABLE 3-1: Hydrologic Design Criteria

ITEM	EXISTING CONDITIONS	PROPOSED CONDITIONS
DRAINAGE AREA (Ac.)		
EX-A1	20.18	---
PR-A1a	---	15.48
PR-A1b	---	3.78
PR-A1c	---	0.48
EX-A2	34.21	---
PR-A2a	---	22.26
PR-A2b	---	10.41
PR-A2c	---	0.99
PR-A2d	---	0.79
EX-A3	0.32	---
PR-A3	---	0.52
TOTAL	**54.71 Ac.**	**54.71 Ac.**
TIME OF CONC.		
EX-A1	38.7 mins	---
PR-A1a	---	36.1 mins
PR-A1b	---	8.0 mins
PR-A1c	---	5.0 mins
EX-A2	40.8 mins	---
PR-A2a	---	36.8 mins
PR-A2b	---	33.9 mins
PR-A2c	---	5.0 mins
PR-A2d	---	5.0 mins
EX-A3	5.0 mins	---
PR-A3	---	5.0 mins

RAINFALL CURVE NUMBER (CN)

EX-A1	70.00	---
PR-A1a	---	74.00
PR-A1b	---	72.00
PR-A1c	---	98.00
EX-A2	70.00	---
PR-A2a	---	70.00
PR-A2b	---	71.00
PR-A2c	---	81.00
PR-A2d	---	98.00
EX-A3	70.00	---
PR-A3	---	98.00

STORM FREQUENCY/ INCHES OF RAINFALL

1 Yr	2.60 in/24 Hr	2.60 in/24 Hr
2 Yr	3.25 in/24 Hr	3.25 in/24 Hr
5 Yr	4.10 in/24 Hr	4.10 in/24 Hr
10 Yr	4.90 in/24 Hr	4.90 in/24 Hr
25 Yr	6.10 in/24 Hr	6.10 in/24 Hr
50 Yr	7.30 in/24 Hr	7.30 in/24 Hr
100 Yr	8.50 in/24 Hr	8.50 in/24 Hr

ANTECEDENT MOISTURE CONDITIONS:

	2	2

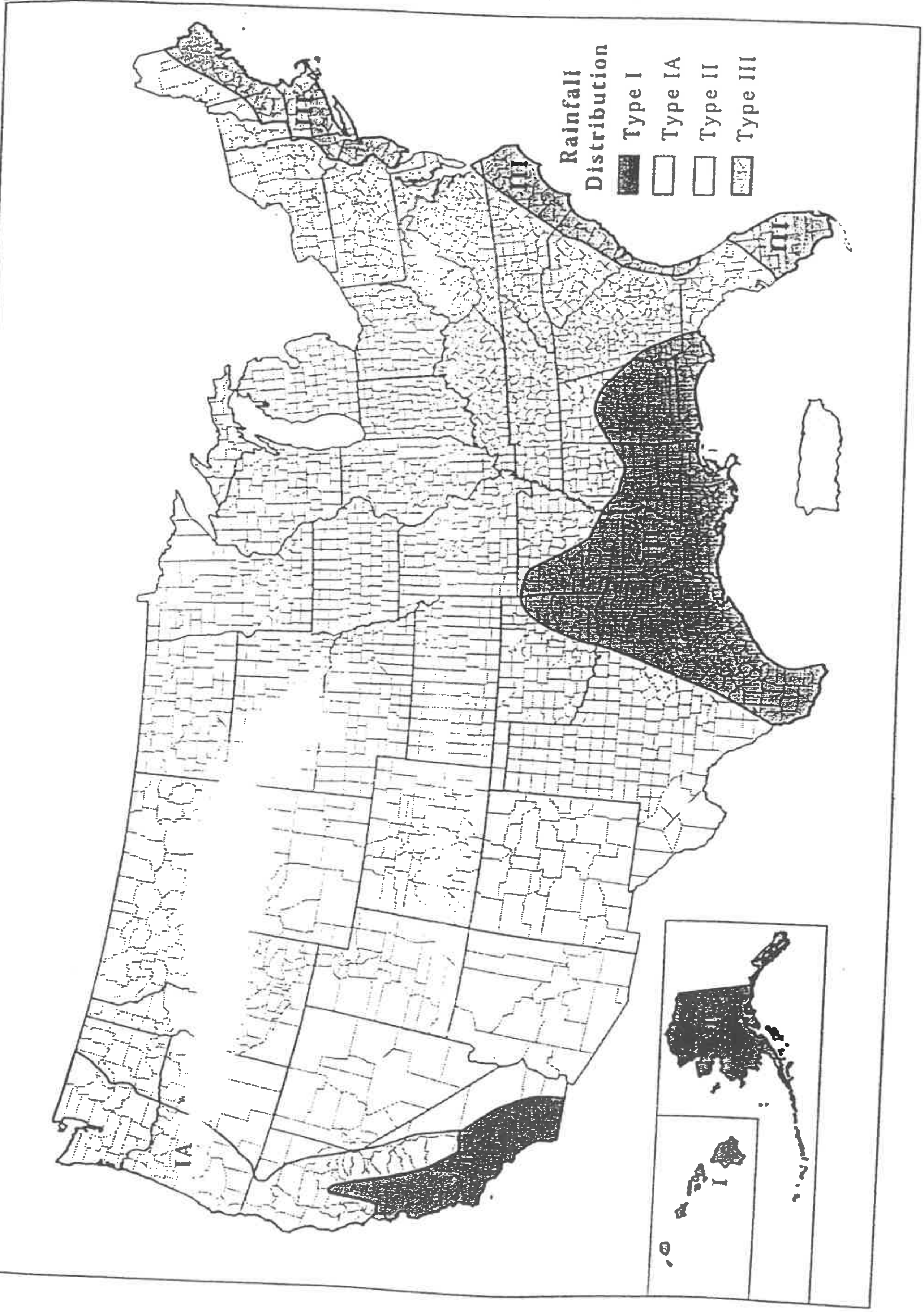
Footnotes:

A1 is the onsite area that is tributary to the CVP 2808 & wetlands under **Existing** conditions and **Proposed** conditions. 0.58 acres of impervious will be diverted to detention basin #2.

A2 is the onsite and offsite area that is tributary to the wetlands under **Existing** conditions and **Proposed** conditions.

A3 is the onsite and offsite area that is tributary to the wetlands at the south entrance under **Existing** conditions and **Proposed** conditions. Proposed stormwater will flow to the proposed Water Quality Swale.

Figure B-2 Approxomate geographic boundaries for NRCS (SCS) rainfall distribitions

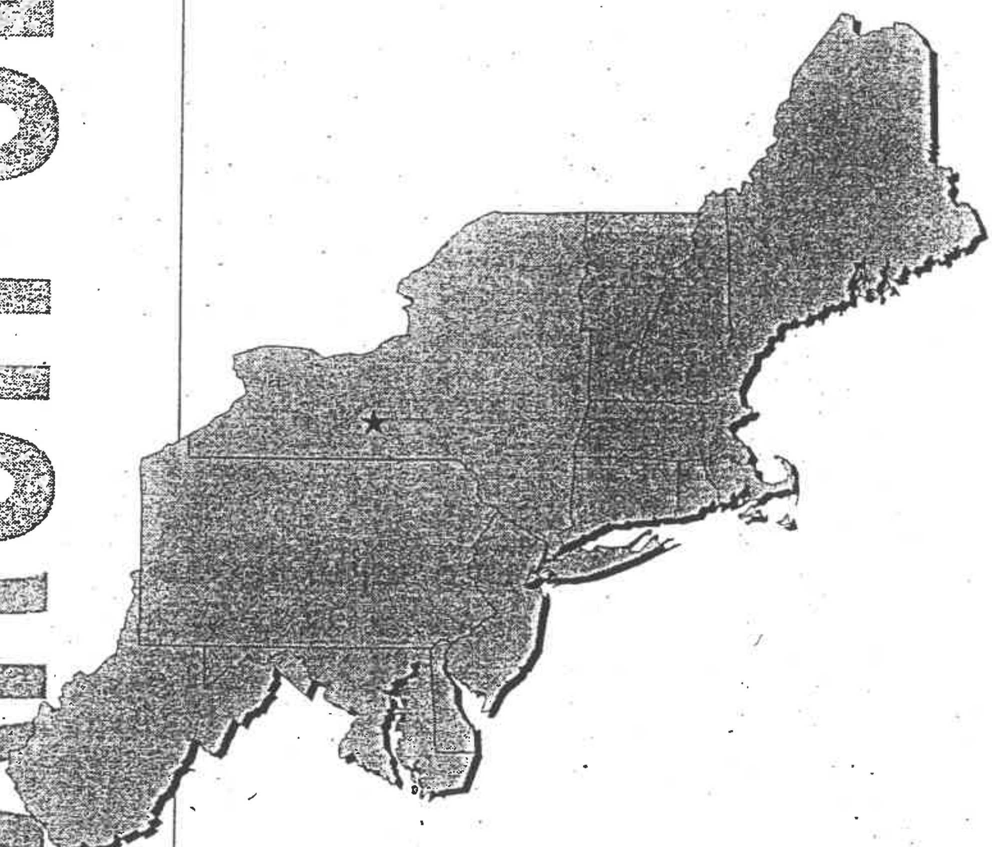


RESEARCH SERIES

NORTHEAST REGIONAL CLIMATE CENTER

Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada

Daniel S. Wilks
Richard P. Cember



Cornell University
Ithaca, New York
Publication No. RR 93-5
September 1993

24 HOUR RAINFALL

Prepared By William R. Domey, P.E.

An updated Atlas of Precipitation has been published by the Northeast Regional Climate Center at Cornell University that provides more accurate data for the 24 Hour Rainfall and precipitation of other storm events than the National Weather Service TP40 - *Rainfall Frequency of the United States* (Hershfield 1961) which has been used widely to calculate stormwater runoff rates and volumes in Massachusetts. The updated atlas should be used instead since it is scientifically sound and up to date. Otherwise, structures for stormwater infiltration, retention, detention, and other BMP's may be incorrectly and/or undersized for real storm events.

The new Atlas:

Utilizes the advances in statistics methodology and computing power since 1961.

Provides results determined from data of stations having an average length of record of 51.3 years as compared to the data of TP40, which had an average length of record of 22.6 years.

Recognizes that the frequency of heavy rain events has increased since 1961. TP40 encompasses a relatively dry period compared to the past 40 years.

Provides empirical adjustment factors to transform precipitation amounts pertaining to calendar day observations to maximum precipitation regardless of time of observation.

Analysis of the 1993 Northeast Regional Climate Center Atlas for Southwest Middlesex and Western Norfolk Counties, corrected for the 24-Hour Storm, results in the following rainfall values.

24-Hour Storm	Rainfall (inches)
1	2.6
2	3.25
5	4.1
10	4.9
25	6.1
50	7.3
100	8.5

The title of the new atlas is *Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada*, Cornell University, Ithaca, New York, Publication No. RR 93-5, September 1993. Telephone (607) 255-1751. A second publication entitled *Atlas of Short-Duration Precipitation Extremes for the Northeastern United States and Southwestern Canada*, Publication No. RR 95-1, March 1995, is also available.

February 7, 1999
Revised August 17, 2000

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]	77	86	91	94	
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and I_a, = 0.2S.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

EXAMPLE
= 25 YRS
i = 6.6 in/hr
@ 5 mins

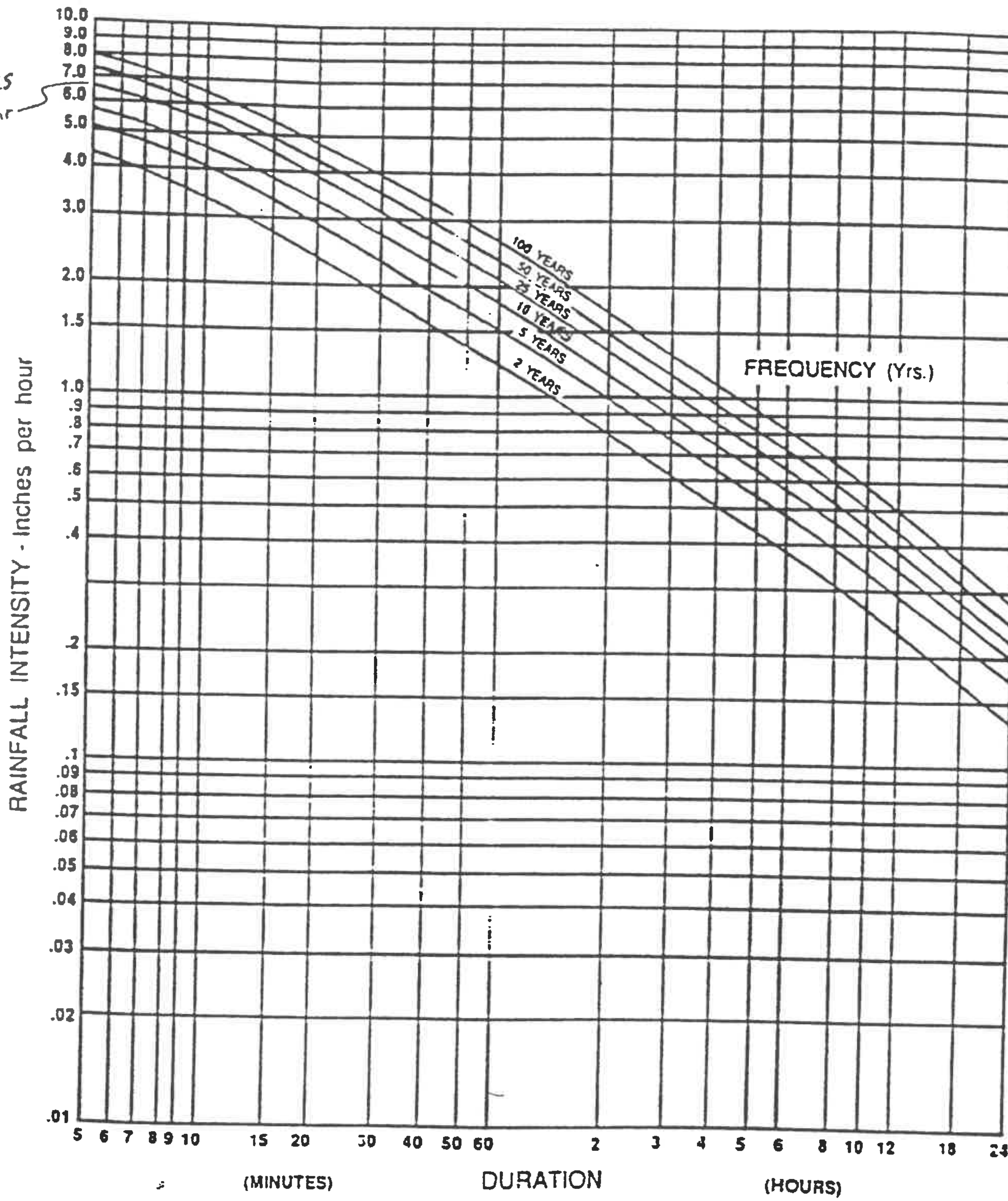


Figure 10-6. Intensity — Duration — Frequency Curve for Worcester, MA

Table 19-10.—Range of seepage rates in unlined canals (data taken from Wilson et al. [1980] after Kraatz [1977])

Effective hydraulic conductivity	Description of materials[1]
in/hr	
0.12–0.18	Clay-loam, described as "impervious"
0.25–0.38	Ordinary clay loam
0.38–0.50	Sandy loam or gravelly clay-loam with sand and clay
0.50–0.75	Sandy loam
0.75–0.88	Loose sandy soil
1.0–1.25	Gravelly sandy soils
1.5–3.0	Very gravelly soils

[1] Does not reflect the flashy, sediment-laden character of many ephemeral streams.

* Taken from the National Engineering Handbook, Section 4

Velocity Factors

The TR-55 Shallow Concentrated Flow procedure and the NEH-4 Upland Method are both published as a chart of velocity vs. slope for various surfaces. Both charts are based on the same equation and make use of a velocity factor, Kv, determined by the surface type. HydroCAD provides the following predefined surface types for use with this equation.

The first two surfaces (paved and unpaved) are the basis for TR-55 Figure 3-1, and the factors are taken from TR-55, Appendix F. The remaining surfaces are taken from NEH-4 Figure 15.2 with the factors derived from that chart. (Some descriptions have been abbreviated.) For other surfaces or conditions, HydroCAD also allows the direct entry of Kv values.

Surface Description	Kv (fps)	Kv (m/s)
Paved	20.3	6.20
Unpaved	16.1	4.92
Grassed Waterway	15.0	4.57
Nearly Bare & Untilled	10.0	3.05
Cultivated Straight Rows	9.0	2.74
Short Grass Pasture	7.0	2.13
Woodland	5.0	1.52
Forest w/Heavy Litter	2.5	0.76

SECTION 4: Summary and Conclusions

SECTION 4: Summary & Conclusion

The proposed stormwater system meets the design objectives, summarized as follows:

- DEP stormwater management guidelines for treatment of stormwater and removal of 80% total suspended solids has been achieved by various construction means as outlined in Appendix "C".

- Construction and post construction erosion control, operation and maintenance are included with the development as outlined in Appendix "B".

- The proposed stormwater treatment detention basin has attenuated the peak rates & volumes of runoff. Runoff rates were calculated by developing computer models in HydroCAD and the Holliston Board of Health Stormwater and Runoff Regulations (February 1999 with revisions of August 2000) for both existing and proposed conditions. There will be various reductions to the total runoff under proposed conditions for each Year Storm shown below.

Condition **Flow (cfs) vs. Year Storm**

	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Existing	12.80	24.22	41.86	60.23	90.10	121.58	154.06
Proposed	7.26	13.32	23.72	36.16	57.21	84.55	112.61
Flow Reduction	43%	45%	43%	40%	37%	30%	27%

Condition **Volume (acre-ft) vs. Year Storm**

	1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Existing	2.30	3.91	6.37	8.95	13.15	17.64	22.33
Proposed	1.66	3.35	5.92	8.59	12.91	17.50	22.26
Flow Reduction	28%	14%	7%	4%	2%	1%	0%

Tables 4-1 and 4-2 summarize the computer output for both existing and proposed conditions.

Table 4-1: Existing Conditions
Storm Flows vs. Year Storm

	Area (Ac)	Elevations	Peak Discharge (cfs)
1 Yr Storm (2.60 in/24 hr)			
Ex-A1	20.18	---	4.83
Ex-A2	34.21	---	7.96
Ex-A3	0.32	---	0.16
TOTAL	**54.71**	---	**12.80**
2 Yr Storm (3.25 in/24 hr)			
Ex-A1	20.18	---	9.15
Ex-A2	34.21	---	15.08
Ex-A3	0.32	---	0.30
TOTAL	**54.71**	---	**24.22**
5 Yr Storm (4.10 in/24 hr)			
Ex-A1	20.18	---	15.76
Ex-A2	34.21	---	26.01
Ex-A3	0.32	---	0.52
TOTAL	**54.71**	---	**41.86**
10 Yr Storm (4.90 in/24 hr)			
Ex-A1	20.18	---	22.69
Ex-A2	34.21	---	37.46
Ex-A3	0.32	---	0.75
TOTAL	**54.71**	---	**60.23**
25 Yr Storm (6.10 in/24 hr)			
Ex-A1	20.18	---	33.90
Ex-A2	34.21	---	56.06
Ex-A3	0.32	---	1.11
TOTAL	**54.71**	---	**90.10**
50 Yr Storm (7.30 in/24 hr)			
Ex-A1	20.18	---	45.78
Ex-A2	34.21	---	75.68
Ex-A3	0.32	---	1.50
TOTAL	**54.71**	---	**121. 58**
100 Yr Storm (8.5 in/24 hr)			
Ex-A1	20.18	---	58.04
Ex-A2	34.21	---	95.93
Ex-A3	0.32	---	1.90
TOTAL	**54.71**	---	**154.06**

Table 4-2: Proposed Conditions
Storm Flows vs. Year Storm

	Area (Ac)	Elevations	Peak Discharge (cfs)
1 Yr Storm (2.60 in/24 hr)			
PR-A1a (in/out D-basin #1)	15.48	290.63	5.59 / 0.26
PR-A1b	3.78	---	2.03
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	287.38	3.13 / 0.95
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	273.22	3.23 / 1.21
PR-A2a	22.26	---	5.46
PR-A3 (in/out WQ swale)	0.52	274.18	1.35 / 1.26
TOTAL	**54.71**	---	**7.26**
2 Yr Storm (3.25 in/24 hr)			
PR-A1a (in/out D-basin #1)	15.48	290.84	9.54 / 0.91
PR-A1b	3.78	---	3.67
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	287.70	5.68 / 2.92
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	273.48	4.37 / 3.01
PR-A2a	22.26	---	10.34
PR-A3 (in/out WQ swale)	0.52	274.22	1.69 / 1.61
TOTAL	**54.71**	---	**13.32**
5 Yr Storm (4.10 in/24 hr)			
PR-A1a (in/out D-basin #1)	15.48	291.07	15.36 / 2.31
PR-A1b	3.78	---	6.13
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	288.09	9.55 / 6.35
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	273.88	6.88 / 6.50
PR-A2a	22.26	---	17.86
PR-A3 (in/out WQ swale)	0.52	274.25	2.15 / 2.05
TOTAL	**54.71**	---	**23.72**

10 Yr Storm (4.90 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	291.30	21.29 / 4.23
PR-A1b	3.78	---	8.65
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	288.41	13.54 / 9.66
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	274.16	10.37 / 9.68
PR-A2a	22.26	---	25.68
PR-A3 (in/out WQ swale)	0.52	274.29	2.57 / 2.46
TOTAL	**54.71**	---	**36.16**

25 Yr Storm (6.10 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	291.66	30.68 / 8.27
PR-A1b	3.78	---	19.34
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	288.82	19.97 / 16.24
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	274.53	16.72 / 15.57
PR-A2a	22.26	---	38.34
PR-A3 (in/out WQ swale)	0.52	274.33	3.21 / 3.09
TOTAL	**54.71**	---	**57.21**

50 Yr Storm (7.3 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	292.02	40.49 / 13.20
PR-A1b	3.78	---	16.87
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	289.05	26.70 / 23.97
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	274.77	21.01 / 19.95
PR-A2a	22.26	---	51.71
PR-A3 (in/out WQ swale)	0.52	274.38	3.85 / 3.72
TOTAL	**54.71**	---	**84.55**

100 Yr Storm (8.5 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	292.32	50.47 / 17.66
PR-A1b	3.78	---	21.17
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	289.21	33.63 / 31.06
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	274.92	24.63 / 23.92
PR-A2a	22.26	---	65.52
PR-A3 (in/out WQ swale)	0.52	274.42	4.48 / 4.35
TOTAL	**54.71**	---	**112.61**

Table 4-3: Existing Conditions
Storm Volumes vs. Year Storm

	Area (Ac)	Peak Volume (acre-ft)
1 Yr Storm (2.6 in/24 hr)		
Ex-A1	20.18	0.85
Ex-A2	34.21	1.44
Ex-A3	0.32	0.01
TOTAL	**54.71**	**2.30**
2 Yr Storm (3.25 in/24 hr)		
Ex-A1	20.18	1.44
Ex-A2	34.21	2.44
Ex-A3	0.32	0.02
TOTAL	**54.71**	**3.91**
5 Yr Storm (4.10 in/24 hr)		
Ex-A1	20.18	2.35
Ex-A2	34.21	3.98
Ex-A3	0.32	0.04
TOTAL	**54.71**	**6.37**
10 Yr Storm (4.90 in/24 hr)		
Ex-A1	20.18	3.30
Ex-A2	34.21	5.60
Ex-A3	0.32	0.05
TOTAL	**54.71**	**8.95**
25 Yr Storm (6.10 in/24 hr)		
Ex-A1	20.18	4.85
Ex-A2	34.21	8.22
Ex-A3	0.32	0.08
TOTAL	**54.71**	**13.15**
50 Yr Storm (7.3 in/24 hr)		
Ex-A1	20.18	6.51
Ex-A2	34.21	11.03
Ex-A3	0.32	0.10
TOTAL	**54.71**	**17.64**
100 Yr Storm (8.5 in/24 hr)		
Ex-A1	20.18	8.24
Ex-A2	34.21	13.96
Ex-A3	0.32	0.13
TOTAL	**54.71**	**22.33**

Table 4-4: Proposed Conditions
Storm Volumes vs. Year Storm

	Area (Ac)	Peak Volume (acre-ft)
1 Yr Storm (2.60 in/24 hr)		
PR-A1a (in/out D-basin #1)	15.48	0.86 / 0.29
PR-A1b	3.78	0.18
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	0.57 / 0.46
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	0.54 / 0.54
PR-A2a	22.26	0.94
PR-A3 (in/out WQ swale)	0.52	0.10 / 0.07
TOTAL	**54.71**	**1.66**
2 Yr Storm (3.25 in/24 hr)		
PR-A1a (in/out D-basin #1)	15.48	1.38 / 0.77
PR-A1b	3.78	0.30
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	0.91 / 0.80
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	0.96 / 0.95
PR-A2a	22.26	1.59
PR-A3 (in/out WQ swale)	0.52	0.13 / 0.10
TOTAL	**54.71**	**3.35**
5 Yr Storm (4.10 in/24 hr)		
PR-A1a (in/out D-basin #1)	15.48	2.15 / 1.52
PR-A1b	3.78	0.48
PR-A1c & PR-A2b (in/out D-basin #2)	10.89	1.42 / 1.31
PR-A2c, PR-A2d & D-basin #2 Discharge (in/out D-basin #3)	1.78	1.58 / 1.57
PR-A2a	22.26	2.59
PR-A3 (in/out WQ swale)	0.52	0.17 / 0.13
TOTAL	**54.71**	**5.92**

10 Yr Storm (4.90 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	2.95 / 2.30
PR-A1b	3.78	0.67
PR-A1c & PR-A2b		
(in/out D-basin #2)	10.89	1.96 / 1.84
PR-A2c, PR-A2d & D-basin #2		
Discharge (in/out D-basin #3)	1.78	2.22 / 2.20
PR-A2a	22.26	3.64
PR-A3 (in/out WQ swale)	0.52	0.20 / 0.17
TOTAL	**54.71**	**8.59**

25 Yr Storm (6.10 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	4.22 / 3.56
PR-A1b	3.78	0.97
PR-A1c & PR-A2b		
(in/out D-basin #2)	10.89	2.82 / 2.70
PR-A2c, PR-A2d & D-basin #2		
Discharge (in/out D-basin #3)	1.78	3.23 / 3.21
PR-A2a	22.26	5.35
PR-A3 (in/out WQ swale)	0.52	0.25 / 0.22
TOTAL	**54.71**	**12.91**

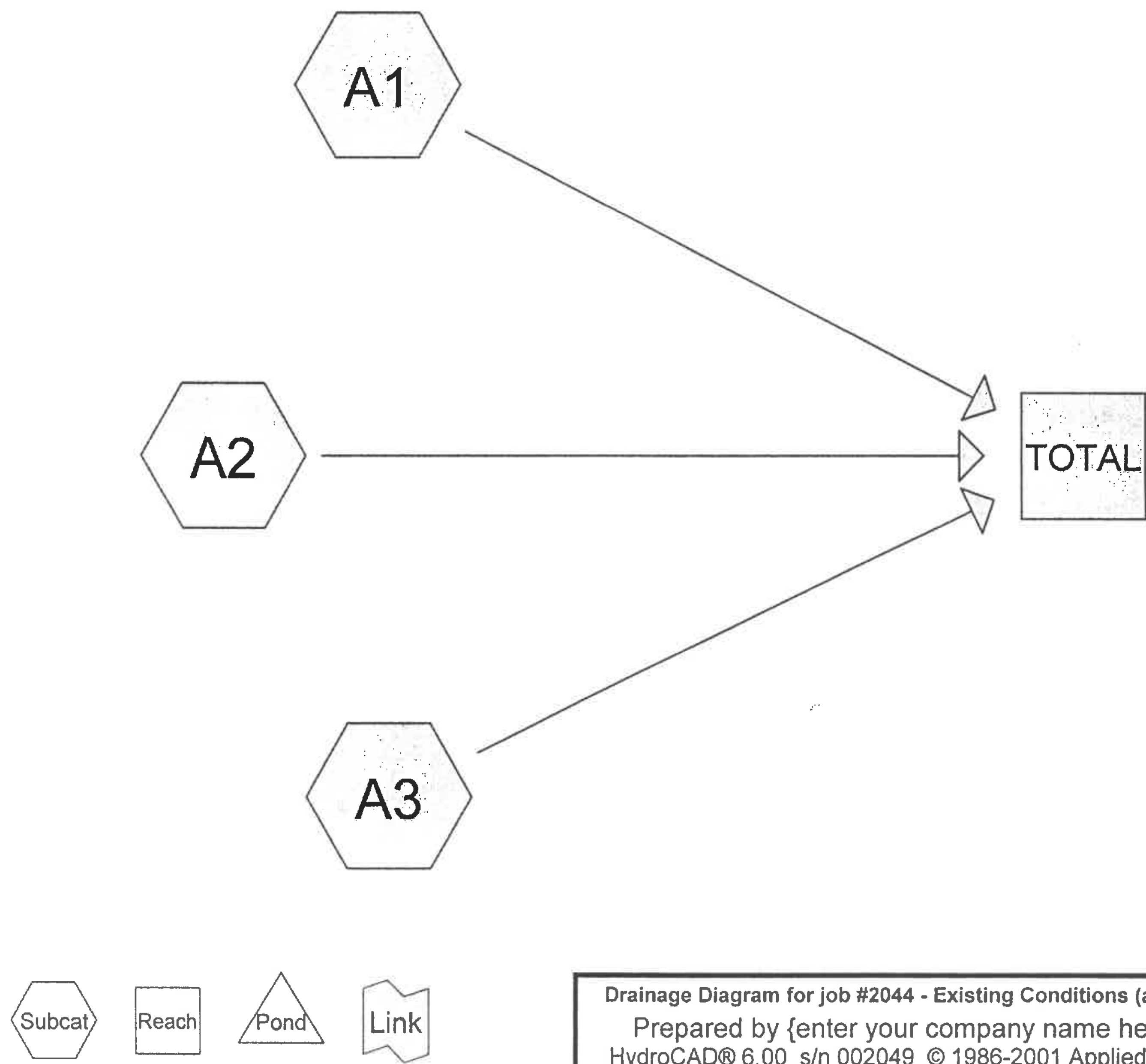
50 Yr Storm (7.3 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	5.55 / 4.88
PR-A1b	3.78	1.29
PR-A1c & PR-A2b		
(in/out D-basin #2)	10.89	3.73 / 3.61
PR-A2c, PR-A2d & D-basin #2		
Discharge (in/out D-basin #3)	1.78	4.18 / 4.16
PR-A2a	22.26	7.18
PR-A3 (in/out WQ swale)	0.52	0.31 / 0.27
TOTAL	**54.71**	**17.50**

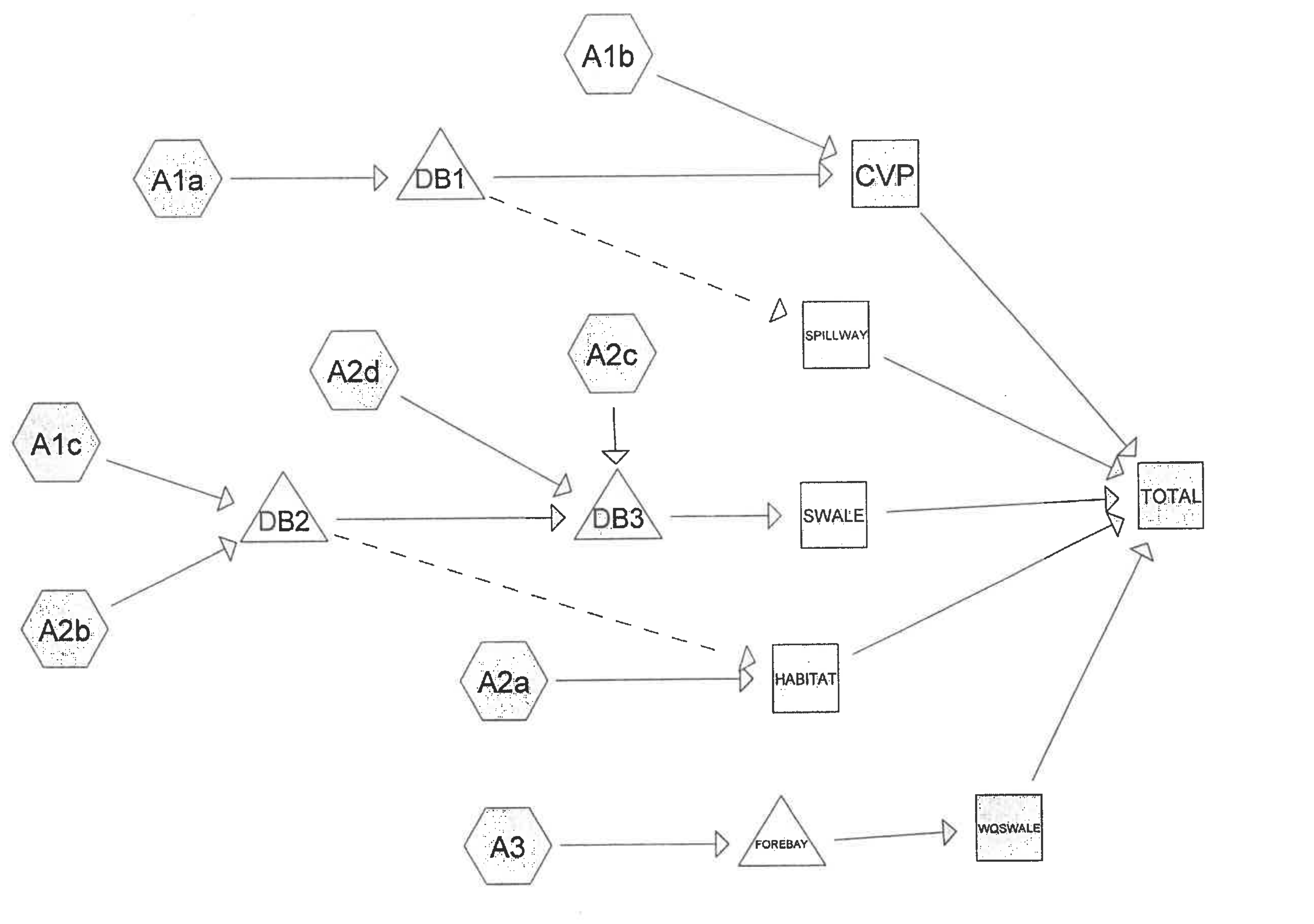
100 Yr Storm (8.5 in/24 hr)

PR-A1a (in/out D-basin #1)	15.48	6.93 / 6.26
PR-A1b	3.78	1.62
PR-A1c & PR-A2b		
(in/out D-basin #2)	10.89	4.68 / 4.56
PR-A2c, PR-A2d & D-basin #2		
Discharge (in/out D-basin #3)	1.78	5.11 / 5.09
PR-A2a	22.26	9.08
PR-A3 (in/out WQ swale)	0.52	0.36 / 0.33
TOTAL	**54.71**	**22.26**

APPENDIX A: Hydrology Calculations



Drainage Diagram for job #2044 - Existing Conditions (access road)-REV 03-04-03
Prepared by {enter your company name here} 03/04/2003



Drainage Diagram for job #2044 - Proposed Conditions (access road) - REV 02-28-03
Prepared by {enter your company name here} 03/03/2003
HydroCAD® 6.00 s/n 002049 © 1986-2001 Applied Microcomputer Systems

APPENDIX B: Construction and Post Construction Stormwater Maintenance Plan

APPENDIX B: Construction and Post Construction Stormwater Maintenance Plan

Construction Operation Maintenance Plan

Refer to plans, Notice of Intent and Order of Conditions.

Post Construction Maintenance Plan

The following items are intended as a guideline for continued maintenance of the storm drain system. There may be other measures that should be applied to certain drainage appurtenances not mentioned herein. Therefore, the **New Hopping Brook Trust** should be updating this plan on an as needed basis.

1.) All catch basin/sumps shall be inspected monthly and those basins that have debris within 2 ft. of the pipe invert shall be cleaned.

2.) The culverts, swales, and pipe ends shall be inspected after large storms and/or on a yearly basis for evidence of scour. Degraded areas shall be lined with rip-rap or with other appropriately engineered solutions.

3.) Similarly, the detention basin outlets shall be inspected for scour holes in high velocity areas. Any sign of erosion shall be remedied as in item 2.

4.) Significant erosion along slopes shall be protected with engineered soil reinforcement, jute mesh and/or erosion control, as approved.

5.) Forebay filters shall be inspected monthly and cleaned of sediment and other debris retained on the filter media a minimum of four times per year. Removal shall be by hand rake or other appropriate means. Filter media shall be replaced on an as needed basis.

The above recommendations are applicable to project completion with 100% established vegetative cover, and are not intended for construction progress measures. Construction stage measures shall be in accordance with the Construction Sequencing Plans, the Notice of Intent and the Holliston Conservation Commission Order of Conditions.

APPENDIX C: DEP Stormwater Management Calculations

APPENDIX C: DEP Stormwater Management Calculations

Standard #1 – Untreated Stormwater

The project was designed to not discharge untreated contaminated stormwater into, or cause erosion to wetlands or water bodies.

Standard #2 – Post –Development Peak Discharge Rates

All performance standards for this standard have been met. Refer to Section 4 in report where runoff volumes & flows for both existing and proposed conditions are given.

Standard #3 – Recharge to Groundwater

The soil types were groundwater recharge is proposed (forebay in D-Basin #3) are assumed to be hydrologic soil group "C". Total onsite impervious area over hydrologic group "C" soils tributary to recharge area (areas following the forebay filter in DB #2 & DB #3, and inside the forebay filter for the Water Quality Swale) follows:

Ic1(to Water Quality Swale)=0.52 acre
Ic2(to Dbasin #2)=0.35 acre
Ic3(to Dbasin #3)=0.56 acre

Required recharge volume for hydrologic group C soils, ReVc=Ic * 0.10

ReVc1 = ((0.52 acres) * (0.10 in))/(12 in/ft) = 0.004 ac-ft
ReVc2 = ((0.35 acres) * (0.10 in))/(12 in/ft) = 0.003 ac-ft
ReVc3 = ((0.56 acres) * (0.10 in))/(12 in/ft) = 0.005 ac-ft
Total ReVc = ReVc1 + ReVc2 + ReVc3 = **0.012 ac-ft**

Recharge Volume Provided

Forebay to the Water Quality Swale

Elev	Area (sf)	Volume (ac-ft)
272	477	0.000
273	718	0.014
274	960	0.033

D-Basin #1

Elev	Area (sf)	Volume (ac-ft)
290	36,996	0.000
290.5	40,575	0.445

D-Basin #2

Elev	Area (sf)	Volume (ac-ft)
286	3,840	0.000
287	7,587	0.131

D-Basin #3

Elev	Area (sf)	Volume (ac-ft)
272	1,326	0.000
273	2,963	0.049

Total Recharge Volume Provided = 0.033 + 0.445 + 0.131 + 0.049 = **0.658 Ac-ft**

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TSS Removal Calculation Worksheet

Name: Hopping Brook - Phase II

Location: Holliston, MA

Proj. No.: 2044
Date: 3/10/2003
Computed by: R. McNeil
Checked by: B. Saluk

TSS SUMMARY SHEET

$$\textbf{Weighted Average TSS Removal \%} = \frac{[(15.48\text{ ac})\times(0.78) + (12.67\text{ ac})\times(0.85) + (0.52\text{ ac})\times(0.85)]}{(28.67\text{ ac})} = \underline{81\%}$$

4.

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TSS Removal Calculation Worksheet

Name: Hopping Brook - Phase II
Location: Holliston, MA

Proj. No.: 2044
Date: 3/10/2003
Computed by: R. McNeil
Checked by: B. Saluk

Subarea A1 (15.48 ac)	A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
	Forebay Filter	25	1.00	0.25	0.75
	Extended Detention Basin	70	0.75	0.53	0.23

Total TSS Removal= 78%

Notes:
*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

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TSS Removal Calculation Worksheet

Name: Hopping Brook - Phase II

Location: Holliston, MA

Proj. No.: 2044
Date: 3/10/2003
Computed by: R. McNeil
Checked by: B. Saluk

Subarea A2 (12.67 ac)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Parking Lot Sweeping	10	1.00	0.1	0.90
Deep Sump Catch Basins	25	0.90	0.23	0.68
Forebay Filter	25	0.68	0.17	0.51
Extended Detention Basin	70	0.51	0.35	0.15

Total TSS Removal= 85%

Notes:
*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

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TSS Removal Calculation Worksheet

Name: Hopping Brook - Phase II

Location: Holliston, MA

Proj. No.: 2044
Date: 3/10/2003
Computed by: R. McNeil
Checked by: B. Saluk

Subarea A3 (0.52 ac)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Parking Lot Sweeping	10	1.00	0.1	0.90
Deep Sump Catch Basins	25	0.90	0.23	0.68
Forebay Filter	25	0.68	0.17	0.51
Water Quality Swale	70	0.51	0.35	0.15

Total TSS Removal= 85%

Notes:

*Starting TSS Load for first BMP= 1.00. TSS load for subsequent BMP's is equal to the Remaining Load (E) from the previous BMP.

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SUBJECT Hopping Brook
JOB NO. 2044

SHEET NO. 1 OF
DATE 03-10-03
COMPUTED R. McNeil
CHECKED B. Saluk

Stormwater Runoff Volume to be Treated for Water Quality

Total proposed impervious area = 1.43 AC

From Ic1(0.52 AC) + Ic2(0.35 AC) + Ic3(0.56 AC) = 1.43

Req'd. water quality depth = 1.0 inches of runoff
*(Critical area is CVP 2808. The only discharge to this area is from DBasin #1 that collects runoff from undisturbed upland only. All other proposed stormwater discharges are to non-critical areas.)

$$\text{WQ Volume} = \frac{1\text{ IN}}{12\ \frac{\text{IN}}{\text{FT}}} \times 1.43\text{ AC} = \underline{0.119}\text{ AC-FT}$$

From Standard # 3 - Recharge volume

$$ReVc = 0.658\text{ AC-FT} > 0.119\text{ AC-FT}\ \checkmark$$

APPENDIX D: Drainage Collection System Design

Table 10.7
RECOMMENDED RUNOFF COEFFICIENTS (C) FOR RATIONAL METHOD (For Surface Type)

Character of Surface	Runoff Coefficients
Pavement	
Asphaltic and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, Sandy Soil	
Flat, 2 Percent	0.05 to 0.10
Average, 2 to 7 Percent	0.10 to 0.15
Steep, 7 Percent	0.15 to 0.20
Lawns, Heavy Soil	
Flat, 2 Percent	0.13 to 0.17
Average, 2 to 7 Percent	0.18 to 0.22
Steep, 7 Percent	0.25 to 0.35

0.90 used

0.20 used

Table 10.8
RECOMMENDED Ca VALUES (Rational Method) (Greater than 10-Year Design Runoff)

Recurrence Interval (Years)	C_a
2 to 10	1.0
25	1.1
50	1.2
100	1.25

Note: The product of C × C_a should not exceed 1.

Reference: WPCF Manual of Practice No. 9, *Design and Construction of Sanitary and Storm Sewers.*

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Subject:	Hopping Brook
Job No.	2044
Computed By:	RDM3
Checked By:	BS
Date:	01/21/2003

Table #1

Drainage Subareas & Runoff Coefficients

SUBAREA (system component)	Pervious Area, As (C=0.20)	Impervious Area, Ap (C=0.90)	(Asx0.20)+ (Apx0.90)	Total Tributary Area (acres)	WEIGHTED "C"
CB#1	0.04	0.08	0.08	0.12	0.67
CB#2	0.05	0.05	0.06	0.10	0.55
CB#3	0.19	0.13	0.16	0.32	0.48
CB#4	0.03	0.09	0.09	0.12	0.73
CB#5	0.15	0.18	0.19	0.33	0.58
CB#6	0.04	0.10	0.10	0.14	0.70
CB#7	0.02	0.17	0.16	0.19	0.83
CB#8	0.04	0.10	0.10	0.14	0.70
CB#9	0.00	0.15	0.14	0.15	0.90
CB#10	0.00	0.11	0.10	0.11	0.90
CB#11	0.23	0.10	0.14	0.33	0.41
CB#12	0.05	0.16	0.15	0.21	0.73
EXCB#1	0.23	0.25	0.27	0.48	0.56
EXCB#2	0.00	0.05	0.04	0.05	0.90
EXCB#3	0.00	0.18	0.16	0.18	0.90
EXCB#4	0.25	0.11	0.15	0.36	0.41
EXCB#5	0.34	0.09	0.15	0.44	0.35
EXCB#6	0.08	0.16	0.16	0.24	0.67
EXCB#7	1.03	0.44	0.60	1.47	0.41
EXCB#8	0.04	0.20	0.19	0.24	0.78

Printed: 03/10/2003

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Civil Engineers & Land Surveyors
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Storm Drainage Computations

Name: Hopping Brook Phase II
Location: Holliston, MA

Proj. No.: 2044
Date: 03/10/2003
Computed by: RDM3
Checked by: BS

Design Parameters:
25 Year Storm*
n = 0.013

RUNOFF										DESIGN									
LOCATION		AREA	C	C x A	SUM	FLOW TIME (MIN)		i	Q	PIPE DESIGN			CAPACITY				PROFILE		
FROM	TO	(AC.)			C x A	PIPE	CONC TIME		cfs	PIPE TYPE	PIPE SIZE	SLOPE (ft/ft)	Q full cfs	V full ft/s	LENGTH	FALL	RIM UPPER	INV UPPER	INV LOWER
CB 1	DMH 1	0.12	0.67	0.08	0.08	0.00	5.00	6.1	0.5	RCP	12	0.0400	7.1	9.1	9	0.36	297.70	293.70	293.34
CB 2	DMH 1	0.10	0.55	0.06	0.06	0.00	5.00	6.1	0.3	RCP	12	0.0400	7.1	9.1	17	0.68	297.70	293.70	293.02
DMH 1	DMH 2	0.00	0.00	0.00	0.14	0.00	5.00	6.1	0.8	RCP	12	0.0240	5.5	7.0	262	6.29	297.65	293.02	286.73
CB 3	DMH 2	0.32	0.48	0.16	0.16	0.00	5.00	6.1	0.9	RCP	12	0.0200	5.0	6.4	9	0.18	290.91	286.91	286.73
CB 4	DMH 2	0.12	0.73	0.09	0.09	0.00	5.00	6.1	0.5	RCP	12	0.0115	3.8	4.9	16	0.18	290.91	286.91	286.73
DMH 2	FES 1	0.00	0.00	0.00	0.38	0.00	5.00	6.1	2.3	RCP	12	0.0065	2.9	3.7	112	0.73	290.73	286.73	286.00
CB 7	DMH 4	0.19	0.83	0.16	0.16	0.00	5.00	6.1	1.0	RCP	12	0.0050	2.5	3.2	9	0.05	282.00	278.00	277.96
CB 8	DMH 4	0.14	0.70	0.10	0.10	0.00	5.00	6.1	0.6	RCP	12	0.0050	2.5	3.2	17	0.09	282.00	278.00	277.92
DMH 4	DMH 3a	0.00	0.00	0.00	0.26	0.00	5.00	6.1	1.6	RCP	12	0.0028	1.9	2.4	298	0.83	282.45	277.92	277.09
CB 5	DMH 3a	0.33	0.58	0.19	0.63	0.00	5.00	6.1	3.9	RCP	12	0.0150	4.4	5.6	17	0.26	287.00	283.00	282.75
CB 6	DMH 3a	0.14	0.70	0.10	0.10	0.00	5.00	6.1	0.6	RCP	12	0.0050	2.5	3.2	16	0.08	286.60	282.60	282.52
DMH 3a	DMH 3	0.00	0.00	0.00	0.99	0.00	5.00	6.1	6.0	RCP	18	0.0050	7.4	4.2	94	0.47	287.25	276.59	276.12
DB 2	DMH 3	0.00	0.00	0.00	1.90	0.00	5.00	6.1	11.6	RCP	30	0.0140	48.5	9.9	75	1.05	290.00	276.17	275.12
DMH 3	BYPASS DMH	0.00	0.00	0.00	2.89	0.00	5.00	6.1	17.6	RCP	30	0.0096	40.1	8.2	222	2.12	288.35	275.12	273.00
BYPASS DMH	FES 4	0.00	0.00	0.00	2.89	0.00	5.00	6.1	17.6	RCP	30	0.0140	48.5	9.9	38	0.53	278.50	267.03	266.50
DMH 3	FES 2	0.00	0.00	0.00	2.89	0.00	5.00	6.1	17.6	RCP	30	0.0020	18.3	3.7	58	0.12	288.35	275.12	275.00
DB 3	FES 3	0.00	0.00	0.00	1.92	0.00	5.00	6.1	11.7	RCP	30	0.0050	29.0	5.9	60	0.30	275.50	266.80	266.50
CB 9	DMH 5	0.15	0.90	0.14	0.14	0.00	5.00	6.1	0.8	RCP	12	0.0050	2.5	3.2	21	0.11	278.97	274.97	274.87
CB 10	DMH 5	0.11	0.90	0.10	0.10	0.00	5.00	6.1	0.6	RCP	12	0.0050	2.5	3.2	24	0.12	278.97	274.97	274.85
DMH 5	DMH 7	0.00	0.00	0.00	0.23	0.00	5.00	6.1	1.4	RCP	12	0.0149	4.3	5.5	134	2.00	278.99	274.85	272.85
CB 11	DMH 7	0.33	0.41	0.14	0.14	0.00	5.00	6.1	0.8	RCP	12	0.0050	2.5	3.2	13	0.07	277.00	273.00	272.94
CB 12	DMH 7	0.21	0.73	0.15	0.15	0.00	5.00	6.1	0.9	RCP	12	0.0050	2.5	3.2	30	0.15	277.00	273.00	272.85
DMH 7	HW 1	0.00	0.00	0.00	0.52	0.00	5.00	6.1	3.2	RCP	15	0.0056	4.8	3.9	9	0.05	277.55	272.60	272.55
DMH 4E	DMH 6	0.00	0.00	0.00	1.73	0.00	5.00	6.1	10.6	RCP	30	0.0068	33.7	6.9	90	0.61	280.80	274.10	273.49
DMH 6	HW 2	0.00	0.00	0.00	1.73	0.00	5.00	6.1	10.6	RCP	30	0.0020	18.3	3.7	80	0.16	277.90	272.40	272.24

*Rainfall Intensity provided in the Town of Holliston BOH Stormwater and Runoff Regulations, Revised August 17, 2000

\\dwg\2044\ssheets\DRAINCALCS-25-yr REV 030303.xls

Printed: 03/10/2003

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Storm Drainage Computations

Name: Hopping Brook Phase II
Location: Holliston, MA

Proj. No.: 2044
Date: 03/10/2003
Computed by: RDM3
Checked by: BS

Design Parameters:
25 Year Storm*
n = 0.013

RUNOFF										DESIGN									
LOCATION		AREA	C	C x A	SUM	FLOW TIME (MIN)		i	Q	PIPE DESIGN			CAPACITY		PROFILE				
FROM	TO	(AC.)			C x A	PIPE	CONC TIME		cfs	PIPE TYPE	PIPE SIZE	SLOPE (ft/ft)	Q full cfs	V full ft/s	LENGTH	FALL	RIM UPPER	INV UPPER	INV LOWER
DB 1	DMH 8	0.00	0.00	0.00	0.43	0.00	5.00	6.1	2.6	RCP	30	0.0190	56.5	11.5	164	3.12	295.00	281.12	278.00
DMH 8	FES 7	0.00	0.00	0.00	0.43	0.00	5.00	6.1	2.6	RCP	30	0.0190	56.5	11.5	58	1.10	283.00	272.10	271.00
FES 5	FES 6	0.00	0.00	0.00	0.43	0.00	5.00	6.1	2.6	RCP	24	0.0417	46.2	14.7	48	2.00	N/A	290.00	288.00
EXCB 1	DMH 1E	0.48	0.56	0.27	0.27	0.00	5.00	6.10	1.6	RCP	12	0.005	2.6	3.4	18.25	0.10	306.90	303.60	303.50
EXCB 2	DMH 1E	0.05	0.90	0.04	0.04	0.00	5.00	6.10	0.3	RCP	12	0.004	2.2	2.8	26	0.10	306.90	303.60	303.50
DMH 1E	DMH 2E	0.00	0.00	0.00	0.31	0.00	5.00	6.10	1.9	RCP	12	0.005	2.6	3.3	225	1.20	306.30	303.30	302.10
EXCB 3	DMH 2E	0.18	0.90	0.16	0.16	0.00	5.00	6.10	1.0	RCP	12	0.004	2.3	3.0	70	0.30	299.40	296.40	296.10
EXCB 4	DMH 2E	0.36	0.41	0.15	0.15	0.00	5.00	6.10	0.9	RCP	12	0.004	2.3	2.9	50	0.20	296.10	293.10	292.90
DMH 2E	DMH 3E	0.00	0.00	0.00	0.62	0.00	5.00	6.10	3.8	RCP	24	0.023	34.5	11.0	146	3.40	297.80	294.80	291.40
EXCB 5	DMH 3E	0.44	0.35	0.15	0.15	0.00	5.00	6.10	0.9	RCP	18	0.033	19.2	10.9	15	0.50	293.20	290.00	289.50
EXCB 6	DMH 3E	0.24	0.67	0.16	0.16	0.00	5.00	6.10	1.0	RCP	12	0.009	3.4	4.3	22	0.20	293.20	290.00	289.80
DMH 3E	DMH 4E	0.00	0.00	0.00	0.94	0.00	5.00	6.10	5.7	RCP	24	0.005	16.4	5.2	400	2.10	293.40	290.00	287.90
EXCB 7	DMH 4E	1.47	0.41	0.60	0.60	0.00	5.00	6.10	3.7	RCP	12	0.038	7.0	8.9	13	0.50	280.60	277.00	276.50
EXCB 8	DMH 4E	0.24	0.78	0.19	0.19	0.00	5.00	6.10	1.2	RCP	12	0.027	5.9	7.5	22	0.60	280.60	277.00	276.40
DMH 4E	DMH 6	0.00	0.00	0.00	1.73	0.00	5.00	6.10	10.6	RCP	30	0.007	33.7	6.9	90	0.61	280.80	274.10	273.49

APPENDIX E: Stormwater Cooling to Protect Hopping Brook

APPENDIX E: Stormwater Cooling to Protect Hopping Brook

OBJECTIVE

Although this portion of Hopping Brook is not listed as a Cold Water Fishery, it is the goal of the stormwater design plan is to meet the Massachusetts Department of Environmental Protection Class B Cold Water criteria (314 CMR 4.00), specifically the thermal and chemical requirements for cold water fisheries discussed in 314 CMR 4.05. In section 4.05 (3)(b), "these waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Where designated, they shall be suitable as a source of public water supply with appropriate treatment, suitable for irrigation and other agricultural uses, suitable for compatible industrial cooling and process uses, and shall have consistently good aesthetic value. Dissolved oxygen levels shall not be less than 6.0 mg/l in cold water fisheries, unless background conditions are lower and shall not be below 75% of saturation in cold water fisheries due to discharge. Temperature shall not exceed 68° F (20° C) in cold water fisheries and the rise in temperature due to discharge shall not exceed 3° F (1.7° C) in rivers and streams designated as cold water fisheries.

BEST MANAGEMENT PRACTICES – STORMWATER DRAINAGE DESIGN

The stormwater drainage system for Hopping Brook Industrial Park's Phase II Access Road includes several structural Best Management Practices (BMP's) including three extended detention basins with forebays, and a water quality swale with a forebay. In each case the forebay has been designed with sufficient volume to store and filter the 1-inch rainfall event.

Three primary discharges are proposed. The first discharge is the combination of a small wooded upland and the outflow from Detention Basin #1 that collects stormwater from a large wooded upland. The design intent of this discharge is to bypass existing overland flow under the proposed access road to maintain flow to Certified Vernal Pool (CVP) # 2808. This outflow travels approximately 900 feet from CVP# 2808 through existing heavily canopied wetlands to Hopping Brook.

The second discharge is a combination of a large wooded upland and the majority of the proposed access road catch basin system. These combined flows are conveyed either directly to the forebay of Detention Basin #3 or first to Detention Basin #2 and then under the access road into the forebay of Detention Basin #3. This outflow travels approximately 500 feet overland from Detention Basin #3 to the south of CVP # 2808, then continues for another 700 feet through existing heavily canopied wetlands to Hopping Brook.

The third discharge includes two distinct systems. First, a portion of the Hopping Brook Road and Boynton Road stormwater collection system currently discharges via a 30" RCP near the entrance of the proposed access road. Under the proposed design this flow is redirected to a headwall discharge to a riprap channel North of the proposed access road. Second, the remainder of the proposed access road catch basin system is routed to a headwall discharge to a Water Quality Swale with a forebay South of the proposed access road. A proposed 4'x6' box culvert conveys this flow under the proposed access road, and then continues for another 1,700 feet through existing heavily canopied wetlands to Hopping Brook.

Although only Detention Basin #1's discharge is regulated by DEP as a discharge to a Critical Area (ie. CVP 2808), all proposed forebays are designed to hold and filter the 1-inch water quality volume.

The HydroCAD computer model for the 1-inch storm event reports a total of 0.02 cfs to be discharged from the proposed development site.

The stormwater discharge will thoroughly mix with water in the wetland. Shading will further reduce the temperature so the heated runoff will return to ambient temperature.

CONCLUSION

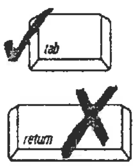
Although not required, the stormwater drainage system for the proposed access road will meet the Massachusetts DEP standards for cold water fisheries found in 314 CMR 4.05 (3)(b) and will not thermally impact Hopping Brook. Additionally, the proposed stormwater discharge to CVP 2808 will meet the DEP standards for discharge to Critical Areas.

WPA Appendix C – Stormwater Management Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

A. Property Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Note: This February 2000 version of the Stormwater Management Form supersedes earlier versions including those contained in DEP's Stormwater Handbooks.

1. The proposed project is: Hopping Brook Industrial Park – Phase II, Holliston, MA

New development ☒ Yes ☐ No

Redevelopment ☐ Yes ☒ No

Combination ☐ Yes ☒ No (If yes, distinguish redevelopment components from new development components on plans).

2. Stormwater runoff to be treated for water quality are based on which of the following calculations:

☒ 1 inch of runoff x total impervious area of post-development site for discharge to **critical areas** (Outstanding Resource Waters, recharge areas of public water supplies, shellfish growing areas, swimming beaches, cold water fisheries).

☐ 0.5 inches of runoff x total impervious area of post-development site for other resource areas.

3. List all plans and documents (e.g. calculations and additional narratives) submitted with this form:

Stormwater Report including Drainage Area Plans; DA-1, DA-2, DA-3

Proposed Site Access Roadway Plans

B. Stormwater Management Standards

DEP's Stormwater Management Policy (March 1997) includes nine standards that are listed on the following pages. Check the appropriate boxes for each standard and provide documentation and additional information when applicable.

Standard #1: Untreated stormwater

☒ The project is designed so that new stormwater point discharges do not discharge untreated stormwater into, or cause erosion to, wetlands and waters.

B. Stormwater Management Standards (cont.)

Standard #2: Post-development peak discharges rates

☐ Not applicable – project site contains waters subject to tidal action.

Post-development peak discharge do not exceed pre-development rates on the site at the point of discharge or downgradient property boundary for the 2-yr and 100-yr, 24-hr storms.

☐ without stormwater controls

☒ with stormwater controls designed for the 24-hr, 1-yr, 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr storms.

☒ The project's stormwater design will not increase off-site flooding impacts from the 100-yr, 24-hr storm.

Standard #3: Recharge to groundwater

Amount of impervious area (sq. ft.) to be infiltrated: 62,300 sf

Volume to be recharged is based on:

☒ The following Natural Resources Conservation Service hydrologic soils groups (e.g. A, B, C, D, or UA) or any combination of groups:

(% of impervious area)	(Hydrologic soil group)	(% of impervious area)	(Hydrologic soil group)
100	C		

☐ Site specific pre-development conditions: ______ Recharge rate ______ Volume

Describe how there calculations were determined:

TR-20 calculations using hydrologic soil group "C" designation

List each BMP or nonstructural measure used to meet Standard #3. (e.g. dry well, infiltration trench).

Forebay filter followed by recharge basin areas in Dbasin 1, 2, & 3. Forebay filter to Water Quality Swale.

The annual groundwater recharge for the post-development site approximates the annual recharge from existing site conditions.

☒ Yes

☐ No

B. Stormwater Management Standards (cont.)

Standard #4: 80% TSS Removal

☒ The proposed stormwater management system will remove 80% of the post-development site's average annual Total Suspended Solids (TSS) load.

Identify the BMP's proposed for the project and describe how the 80% TSS removal will be achieved.

Deep sump & hooded catch basins, Forebay filter, extended detention basin, water quality swale

(see attached calculations)

If the project is redevelopment, explain how much TSS will be removed and briefly explain why 80% removal cannot be achieved.

Standard #5: Higher potential pollutant loads

Does the project site contain land uses with higher potential pollutant loads (See Stormwater Policy Handbook – Vol. I, page I-23, for land uses of high pollutant loading).

☐ Yes If yes, describe land uses:

☒ No

Identify the BMPs selected to treat stormwater runoff. If infiltration measures are proposed, describe the pretreatment. (Note: If the area of higher potential pollutant loading is upgradient of a critical area, infiltration is not allowed.

Pretreatment includes deep sump & hooded catch basins & forebay filters.

Standard #6: Protection of critical areas

Will the project discharge to or affect a critical area? (See Stormwater Policy Handbook – Vol. I, page I - 25, for critical areas).

☒ Yes If yes, describe areas: Dbasin #1 discharges to CVP 2808

☐ No

Identify the BMPs selected for stormwater discharges in these areas and describe how BMPs meet restrictions listed on pages I-27 and I-28 of the Stormwater Policy Handbook – Vol. I:

Forebay filter, extended detention basin (Dbasin #1 conveys undisturbed upland flow only)

B. Stormwater Management Standards (cont.)

Note: components of redevelopment projects which plan to develop previously undeveloped areas do not fall under the scope of Standard 7.

Standard #7: Redevelopment projects

Is the proposed activity a redevelopment project?

☐ Yes   If yes, the following stormwater management standards have been met:

____

____

☒ No

The following stormwater standards have not been met for the following reasons:

____

____

☐ The proposed project will reduce the annual pollutant load on the site with new or improved stormwater control.

Standard #8: Erosion/sediment control

☒ Erosion and sediment controls are incorporated into the project design to prevent erosion, control sediments, and stabilize exposed soils during construction or land disturbance.

Standard #9: Operation/maintenance plan

☒ An operation and maintenance plan for the post-development stormwater controls have been developed. The plan includes ownership of the stormwater BMPs, parties responsible for operation and maintenance, schedule for inspection and maintenance, routine and long-term maintenance responsibilities, and provision for appropriate access and maintenance easements extending from a public right-of-way to the stormwater controls.

Plan/Title	Date
Stormwater Report – Appendix B	March 2003

C. Submittal Requirements

DEP recommends that applicants submit this form, as well as, supporting documentation and plans, with the Notice of Intent to provide stormwater management information for Commission review consistent with the wetland regulations (310 CMR 10.05 (6)(b)) and DEP's Stormwater Management Policy (March 1997). If a particular stormwater management standard cannot be met, information should be provided to demonstrate how equivalent water quality and water quantity protection will be provided. DEP encourages engineers to use this form to certify that the project meets the stormwater management standards as well as acceptable engineering standards. For more information, consult the Stormwater Management Policy.

D. Signatures

New Hopping Brook Trust	March 21, 2003
Applicant	Date
Signature	
Bruce Saluk & Associates, Inc.	March 21, 2003
Representative	Date
Robert D. McNeil III	
Signature	

COMMONWEALTH OF MASSACHUSETTS
ROBERT
D.
McNEIL III
CIVIL
No. 39831
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX E

Stormwater Water Pollution Prevention Plan

Storm Water Pollution Prevention Plan (SWPPP)

Road & Utility Extension for the Hopping Brook Business Park Holliston, MA

Prepared By: Bruce Saluk & Associates, Inc.
576 Boston Post Road
Marlborough, MA 01752
(508) 485-1662

Prepared For: New Hopping Brook Trust
929 Boston Post Road
Suite 2
Marlborough, MA 01752

March 21, 2003

Construction Pollution Prevention Plan
for the
Road & Utility Extension of Hopping Brook Business Park

Project Name and Location: Hopping Brook Road & Utility Extension
Hopping Brook Business Park
Route 16
Holliston, MA 01746
Middlesex County Latitude: 421004
Longitude: -712743

Owner Name and Address: New Hopping Brook Trust
929 Boston Post Road, Suite 2
Marlborough, MA 01752
(508) 481-6095

Description: (Purpose and Types of Soil Disturbing Activities)

This project will consist of a 1,500-lf site access roadway. This is an extension of the existing Hopping Brook Road and will include drainage, water, electric & telephone, and sewer infrastructure.

Soil disturbing activities will include: clearing & grubbing; installing stabilized construction entrances, perimeter, and other erosion and sediment controls; grading; excavation for the detention basins, drainage system, utilities, wetland crossing, and wetland replacement area; construction of retaining walls, curb and gutter, roadway, and sidewalk areas, and preparation for final planting and seeding.

Runoff Coefficient:

The proposed roadway extension results in a net increase in impervious area of approximately 62,300 SF. The proposed roadway will incorporate a drainage collection system that will convey flow through a stormwater treatment system including deep-sump catch basins, extended detention basins and a water quality swale as shown on the plan.

Site Area:

The site is approximately 205 Acres of which 13 acres will be disturbed by construction activities.

Sequence of Major Activities:

The order of activities will be as follows:

1. Mobilization to the site
2. Install stabilized construction entrances anti-tracking pads
   (Activity at North & South access areas)
3. Clear & grub wetland replacement area, incl. equipment & material storage area
4. Pile and stabilize topsoil
5. Construct and plant wetland replacement area & equipment and storage area
6. Construct rip-rap channel at HW #2 and DMH #6 for existing drain diversion
7. Clear & grub wetland crossing area
8. Pile and stabilize wetland spoils
9. Install temporary wetland crossing
10. Clear & grub roadway up to STA 52+50 incl. equipment & material storage areas
11. Clear & grub for earth dike and sedimentation basin (Dbasin #3)
12. Pile and stabilize topsoil
13. Install earth dike with borrow from roadway and equipment & material storage areas
14. Construct sedimentation basin (Dbasin #3)
15. Construct channel to sedimentation basin along NW side of roadway embankment
16. Install permanent wetland crossing including retaining walls and box culverts
    (Activity area from STA 41+00 to STA 49+00)
17. Construct Water Quality Swale with forebay
18. Clear & grub for haul road up to Wetland E location
19. Pile and stabilize topsoil
20. Install RAP haul road up to Wetland E location
21. Clear & grub for earth dike for haul road temporary sedimentation basin(Wetland E)
22. Pile and stabilize topsoil
23. Install earth dike
24. Construct sedimentation basin channel (leave existing vegetation)
25. Clear & grub for Temporary Diversion Channel A
26. Pile and stabilize topsoil
27. Construct Temporary Diversion Channel A
28. Continue clearing and grubbing haul road up to borrow pit location
29. Pile and stabilize topsoil
30. Install RAP haul road with cross culverts up to borrow pit location
31. Clear & grub for earth dike for borrow pit sedimentation basin
32. Pile and stabilize topsoil
33. Install earth dike
34. Construct sedimentation basin for borrow pit
35. Clear & grub borrow pit area
36. Pile and stabilize topsoil
37. Begin borrow pit operations
38. Begin filling roadway embankment at wetland crossing area
    (Activity area from STA 41+00 to STA 49+00)
39. Install drainage system in this activity area
40. Continue filling roadway embankment
    (Activity area from STA 49+00 to STA 52+50)
41. Install drainage system in this activity area including Dbasin #3 bypass

42. Bring Dbasin #3 bypass online
43. Remove accumulated sediment from sedimentation basin (Dbasin #3)
44. Construct final Dbasin #3 configuration including forebay and outlet control structure
45. Clear & grub for earth dike and emergency spillway for Detention Basin #2
46. Pile and stabilize topsoil
47. Fill to adjust haul road embankment and equipment & material storage areas
48. Construct Detention Basin #2
49. Bring Dbasin #3 bypass offline, bring Dbasin #3 online
50. Clear & grub for Temporary Diversion Channel B
51. Pile and stabilize topsoil
52. Construct Temporary Diversion Channel B
53. Clear & grub roadway to end STA 56+50 incl. equipment & material storage areas.
54. Pile and stabilize topsoil
55. Continue filling roadway embankment
    (Activity from STA 52+50 to STA 56+50)
56. Install drainage & sewer system in activity area
57. Clear & grub for earth dike and emergency spillway for Detention Basin #1
58. Pile and stabilize topsoil
59. Fill to adjust haul road embankment and equipment & material storage areas
60. Construct Detention Basin #1
61. Clear & grub for utility corridor/maintenance road and Dbasin #1 outfall
    (Activity from intersection with roadway down to limit of grading)
62. Pile and stabilize topsoil
63. Fill maintenance road embankment – ALL FILLING COMPLETE
64. Stabilize borrow pit
65. Complete grading and install permanent seeding and plantings
66. Remove anti-tracking pad at the South Entrance
67. Complete final paving
68. Install utilities in activity area from intersection down to limit of grading
69. Construct Dbasin #1 outfall with level spreader
70. Remove accumulated sediment from Dbasin #2
71. Bring Temporary diversion channel A offline, bring Dbasin #2 online
72. Remove accumulated sediment from Dbasin #1
73. Bring Temporary diversion channel B offline, bring Dbasin #1 online
74. Begin utility corridor work at North Entrance
75. Clear & grub jacking & receiving pit area
76. Pile and stabilize topsoil
77. Construct jacking & receiving pits
78. Install utilities in activity area
79. Clear & grub utility corridor
    (Activity from receiving pit up to the limit of grading)
80. Install utilities in activity area
81. Construct gravel maintenance road
82. Clear & grub for recharge / nesting area
83. Install recharge system including emergency outfall
84. Construct nesting area
85. Remove anti-tracking pad at the North Entrance
86. Restore gravel access at the North Entrance
87. Demobilization

Name of Receiving Waters:

The entire construction activity zone will drain into Hopping Brook that varies in distance from proposed discharge locations from 700 to 1,700 lf.

Controls

Erosion and Sedimentation Controls:

Structural Practices

Haybale / Siltation Fencing – Siltation fencing with double-staked haybales shall be installed to protect the adjacent resources prior to the commencement of each work activity and maintained throughout the course of construction until vegetation is fully established. In the area of the wetland crossing, one or more temporary or permanent culverts will be in place. The erosion control perimeter will be maintained as a continuous barrier in these areas. The contractor shall have additional haybales and siltation fencing available to address washouts and other emergencies.

Exposed Slopes – On exposed slopes, mechanical cultivation of soils shall include grooves created by dozer treads set perpendicular to the slope direction. On long slopes, runoff shall be directed via swales to temporary sedimentation traps where directed by the construction manager.

Clearing and grubbing – soil stripping shall be done in stages in order to minimize the amount of exposed soil for the project. Soil stabilization measures shall be implemented immediately after finish grading. Loam and seed shall be applied as soon as reasonably possible as work progresses.

Earth Dike – will be constructed along the Eastern side of the wetlands. A portion of the dike will divert runoff around the construction site. The remaining portion of the dike will collect runoff from the disturbed areas and direct the runoff to the sedimentation basin.

Sedimentation Basin – will be constructed at the location of Dbasin #3. Constructing an embankment and excavating a storage pond with a volume of 0.39 acre-feet will form the basin. The basin will drain though a temporary standpipe and outlet pipe to a rip-rap outlet and channel. Once construction activities are nearly complete, the accumulated sediment will be removed from the basin.

Temporary Sedimentation Traps – will be constructed as needed. These traps are small basins intended for short-term use (overnight to several weeks). Typical dimensions might be 5ft x 10ft and 3-5 ft in height. Many temporary sedimentation traps might be used at various locations to control erosion and sediment. It can remain in place until it obstructs construction operations or fills up with deposit, when it can be replaced with another trap. Temporary sedimentation traps can be produced by a natural depression, excavation, or with an impoundment berm. Typical locations in natural drainageways include the bottoms of embankments, the lower end of waste or borrow areas, or at the downgrade area of a cut section. Temporary sediment traps may include a standpipe filter to provide additional removal of excess sediment where applicable.

Drainage swales – will be constructed at various locations throughout the site during construction to route runoff to sedimentation traps or basins.

Stabilization Practices

Temporary Stabilization – Topsoil stockpiles and disturbed portions of the site where construction activity temporarily ceases for at least 21 days will be stabilized with temporary seed and mulch no later than 7 days from the last construction activity in that area. The temporary seed shall be as follows:

<u>New England Erosion Control / Restoration Mix</u>
Application Rate: 35 lbs/acre 1,245 sq. ft./lb
The New England Erosion Control/Restoration Mix contains a selection of native grasses and wildflowers designed to colonize generally moist, recently disturbed sites where quick growth of vegetation is desired to stabilize the soil surface. This mix is particularly appropriate for detention basins that do not normally hold standing water. The plants in this mix can tolerate infrequent inundation, but no constant flooding. In New England, the best results are obtained with a spring or early fall seeding. Summer and fall seeding can be successful with a light mulching of weed-free straw to conserved moisture. Late fall and winter dormant seeding require a slight increase in the seeding rate. Fertilization is not required unless the soils are particularly infertile. Species include: Swithgrass (*Panicum virgatum*), Creeping Red Fescue (*Festuca rubra*), Virginia Wild Rye (*Elymus vierinicus*), Fox Sedge (*Carex vulpinoidea*), Creeping Bentgrass (*Agrostis stolonifera*), Silky Wild Rye (*Elymus villosus*), Nodding Bur-marigold (*Bidens cernua*), Soft Rush (*Juncus effuses*), Grass-leaved Goldenrod (*Solidago graminifolia*), Sensitive fern (*Onoclea sensibilis*), Joe-Pye Weed (*Eupatorium maculatum*), boneset (*Eupatorium perfoliatum*), Flat-top Aster (*Aster umbellatus*), New York Aster (*Aster novi-belgii*), and Blue Vervain (*Verbena hastate*).

Areas of the site that are to be paved will be temporarily stabilized by applying geotextile and stone sub-base until bituminous pavement can be applied.

Permanent Stabilization – Disturbed portions of the site where construction activities permanently ceases shall be stabilized with permanent seed no later than 14 days after the last construction activity. A specific permanent stabilization schedule follows:

> Wetland Replication Area - Place imported clean topsoil or topsoil compost mix to 6-12 inches deep. Place logs within the replication area (one dozen logs, 4-10 feet in length, 8 inches or greater in diameter. Plant shrub and tree specimens (1-gallon pots or larger stock for shrubs). Seed entire replication area with native herbaceous seed mix at two times the recommended planting rate. Monitor annually and report for two growing seasons with photo-documentation.

Wetland Replication Area Planting Scheme

Species	Estimated Number of Plantings	Estimated Spacing	Size of Specimens	Notes
Shrub Species *				
Buttonbush (*Cephalanthanus occidentalis*)	40	Approx. 7 ft.	18"-24"	To be planted in a ring near the 253 foot contour line
Common winterberry (*Ilex verticillata*)	12	Approx. 7 ft.	18"-24"	To be planted within the 253-255 foot contour lines
Highbush blueberry (*Vaccinum corymbosum*)	12	Approx. 7 ft.	18"-24"	To be planted within the 253-255 foot contour lines
Northern arrowwood (*Viburnum recognitum*)	12	Approx. 7 ft.	18"-24"	To be planted within the 253-255 foot contour lines
Highbush cranberry (*V. trilobum*)	12	Approx. 7 ft.	18"-24"	To be planted within the 253-255 foot contour lines
Maleberry (*Lyonia ligustrina*)	12	Approx. 7 ft.	18"-24"	To be planted within the 253-255 foot contour lines
Tree Species *				
Red maple (*Acer rubrum*) Atlantic white cedar (*Chamaecyperis thyoides*) Swamp white oak (*Quercus bicolor*) Green ash (*Fraxinus pennsylvanicum*)	25 total plantings	25 ft.	1" caliper	To be planted near the upland wetland interface
** Northeast Wetland Shrub and Herb Mix from Southern Tier Consulting or Equivalent Mix Approved by the Commission	1 lb/10,890 sq. ft. (2x the Recommend Rate)			The entire basin will be seeded in the first year.

* Shrub and tree species will be planted after at least one season of observed water levels in the wetland replication area.

* Southern Tier Consulting Northeast Wetland Shrub and Herb Mix includes species such as: highbush blueberry (*Vaccinum corymbosum*), northern arrowwood (*Viburnum recognitum*), silky dogwood (*Cornus amomum*), blue vervain (*Verbena hastata*), Joe pye weed (*Eupatroium maculatum*), many leaved bulrush (*Scirpus polyphyllus*), fringed sedge (*Carex crinita*), nodding bur-marigold (*Bidens cernua*), swamp milkweed (*Ascelpias incarnata*), blue iris (*Iris versicolor*), flat-topped white aster (*Aster umbellatus*), and bladder sedge (*Carex intumescens*).

Wetland Replication Area (Adjacent Equipment & Material Staging Area) - Upon conclusion of work in the wetland replication area, the adjacent staging area will be planted with saplings of northern red oak (*Quercus rubra*), black birch (*Betula lenta*), and white pine (*Pinus strobus*). Plantings will be approximately twenty feet on center individually, or in clumps of up to two. This will require approximately 25 saplings/shrubs (approx. 5,000 sq. ft. staging area) and will include specimens 2'-3' or 3'-5' in height. Finally the area will be mulched with native material and allowed to succeed to forest. The Holliston Conservation Commission shall approve any necessary deviations from this planting scheme (including size and species).

Wetland Replication Area - Adjacent Staging Area Planting Scheme

Tree Species	Estimated Number of Plantings	Estimated Spacing	Size of Specimens *	Notes
Northern red oak (*Quercus rubra*)	8	25 ft.	2' – 5'	Various sizes
Black birch (*Betula lenta*)	10	25 ft.	2' – 5'	Various sizes
White pine (*Pinus strobes*)	7	25 ft.	2' – 5'	Various sizes

Wetland Crossing Area - Temporary disturbance to BVW is proposed in the following locations; Area adjacent to Flag BB237.5, Area F1, Area, F2, and Area. Temporary disturbance is associated with the installation of bases and footings for proposed retaining walls and associated erosion control (haybale/siltfence line). Once construction is complete, these areas will be restored to grade and seeded with Northeast Wetland Shrub and Herb Mix from Southern Tier Consulting or an equivalent mix approved by the Commission. This seed mix shall be applied at two times the recommended application rate to ensure a dense establishment of non-invasive and desirable shrubs.

Bank Replication - The proposed rip-rap channel from HW#2 will be approximately 130 linear feet and will contain at least 24 inches of rip-rap (slope of 1:2). The top of the channel bank will extend at least 18" above the top of the rip-rap. Annual rye grass or other means will be used to stabilize exposed bank soils in the rip-rap channel as needed. The proposed water quality swale with forebay from HW#1 will be approximately 140 linear feet and at least 48 inches wide at a slope of 1:3. At least 4 inches of sandy loam consisting of 10-20% organic matter and less than 20% silt will comprise the base of the swale. The swale will be planted will a native perennial upland grass mix such as Northeast Upland Native/Naturalized Wildflower mix from Southern Tier Consulting or other mix approved by the Commission. This mix includes upland and wetland species such as annual ryegrass (*Lolium multiflorum*), wild rye (*Elymus canadensis*), sheep fescue (*Festuca ovina*), switchgrass (*Panicum virgatum*), common yarrow (*Achillea millefolium*), black eyed susan (*rudbeckia hirta*), ox-eye daisy (*Chrysanthemum leucanthem*), blue vervain (*Verbena hastate*), and chicory (*Cichorium intybus*). This mix will be applied at the recommended rate of 100 lbs/acre. Staked haybale check dams will be installed at a minimum of 50-foot intervals during construction and will be removed once the bank has become fully stabilized.

Detention Basin Seeding – Recommend seeding of the Detention Basins includes a Southern Tier Consulting Northeast Wetland Hummock Mix or New England Erosion Control/Restoration Mix from New England Wetland Plants, Inc. or another mix approved by the Holliston Conservation Commission.

<u>Southern Tier Consulting Northeast Wetland Hummock Mix</u>
1 pound will cover 13,400 sq. ft @ 200 seeds per sq. ft.
This mix is to seed drawdown areas, the edges of wetlands, and adjacent uplands in constructed and restored wetlands. The mix is produced from hand collected seed and only limited quantities are available. The seeds in this mix will not generally germinate under water. We recommend a seeding rate of 3.25 pounds per acre and interplanting with bare root transplants on a three or four foot interval. Species include: Green Bulrush (*Scirpus atrovirens*), Soft Rush (*Juncus effuses*), Fox Sedge (*Carex vulpinoidea*), Rice Cut Grass (*Leersia oryzoides*), Bearded Sedge (*Carex comosa*), Fringed Sedge (*Carex crinita*), Shallow Sedge (*Carex lurida*), and Hop Sedge (*Carex lupulina*)

OR

New England Erosion Control / Restoration Mix

Application Rate: 35 lbs/acre 1,245 sq. ft./lb

The New England Erosion Control/Restoration Mix contains a selection of native grasses and wildflowers designed to colonize generally moist, recently disturbed sites where quick growth of vegetation is desired to stabilize the soil surface. This mix is particularly appropriate for detention basins that do not normally hold standing water. The plants in this mix can tolerate infrequent inundation, but no constant flooding. In New England, the best results are obtained with a spring or early fall seeding. Summer and fall seeding can be successful with a light mulching of weed-free straw to conserved moisture. Late fall and winter dormant seeding require a slight increase in the seeding rate. Fertilization is not required unless the soils are particularly infertile. Species include: Swithgrass (*Panicum virgatum*), Creeping Red Fescue (*Festuca rubra*), Virginia Wild Rye (*Elymus vierinicus*), Fox Sedge (*Carex vulpinoidea*), Creeping Bentgrass (*Agrostis stolonifera*), Silky Wild Rye (*Elymus villosus*), Nodding Bur-marigold (*Bidens cernua*), Soft Rush (*Juncus effuses*), Grass-leaved Goldenrod (*Solidago graminifolia*), Sensitive fern (*Onoclea sensibilis*), Joe-Pye Weed (*Eupatorium maculatum*), boneset (*Eupatorium perfoliatum*), Flat-top Aster (*Aster umbellatus*), New York Aster (*Aster novi-belgii*), and Blue Vervain (*Verbena hastate*).

Groundwater Recharge / Nesting Area – Following the installation of the subsurface recharge system, suitable inorganic soil (high sand, low silt content) will be placed over the system. Once the final grades have been established, the area will be planted with native bunch grass (*Schizachrium scoparius* or another native species). These plantings will be on roughly thirty-foot centers. Exposed side slopes will be loamed and seeded as necessary for stabilization. See the Notice of Intent narrative, Proposed Mitigation Section for further clarification.

Utility Corridor Turnout Areas - Two 20' x 30' turnouts for construction vehicles are proposed along the proposed utility corridor. These two areas total approximately 1,200 sq. ft. and will be cleared during construction. Upon conclusion of work in this area these two areas will be planted with saplings of northern red oak (*Quercus rubra*), black birch (*Betula lenta*), and white pine (*Pinus strobus*) and/or any other tree species salvaged from the construction site. Plantings will be approximately twenty feet on center individually, or in clumps of up to two. This will require a total of at least 12 saplings (6 per turnout) and will include specimens 2'-3' or 3'-5' in height. Finally these areas will be mulched with native material and allowed to succeed to forest. Any necessary deviations from this planting scheme (including size and species) shall be approved by the HCC.

Turnout Areas Adjacent to the Utility Installation Planting Scheme

Tree Species	Estimated Number of Plantings	Estimated Spacing	Size of Specimens *	Notes
Northern red oak (*Quercus rubra*)	2	20 ft.	2' – 5'	Various sizes
Black birch (*Betula lenta*)	2	20 ft.	2' – 5'	Various sizes
White pine (*Pinus strobes*)	2	20 ft.	2' – 5'	Various sizes
* Mature trees may be salvaged from the construction site if possible and planted in these areas.				

Stormwater Management

Stormwater drainage will be provide by a curb and gutter storm drain system, utilizing deep-sump and hooded catch basins, forebay filters, and extended detention basins as well as a water quality swale. Approximately 192 acres of the site will remain undisturbed and in its natural state. When construction is complete all stabilized areas will drain through the stormwater management system mentioned above. When upslope areas are stabilized, the accumulated sediment from the detention basins will be removed, and the basins will be planted with permanent vegetation. All detention basins are designed to slowly drain dry. It is expected that this stormwater management system will result in more than 80% removal of total suspended solids from the site's runoff. The stormwater system has been designed by a professional engineer to keep peak flow rates and volumes from the 1, 2, 5, 10, 25, 50, and 100-year 24-hour storms at their pre-development rates and volumes. All discharge outlets from the stormwater management system will be stabilized by rip-rap aprons and/or channels.

Other Controls

Wildlife Movement

Critter Gaps

Haybale/siltfencing with critter gaps, to allow wildlife movement, will provide effective erosion and sedimentation control when placed in reasonable locations. Gaps will not be placed in areas that are prone to accumulation of sediment (i.e. Low spots at the base of steep slopes). Critter gaps will be placed approximately 50-75 feet apart.

Waste Disposal

Waste Materials

All waste materials will be collected and stored in metal dumpsters rented from a licensed solid waste management company. The dumpsters will meet all local Holliston and state solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpsters. All dumpsters will be emptied a minimum of twice per week or more often in necessary. No construction waste will be buried or burned onsite. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer and the construction site superintendent will be responsible for seeing that these procedures are followed.

Hazardous Waste

All hazardous waste materials will be disposed of in the manner specified by local and state regulation or by the manufacturer. Site personnel will be instructed in these practices and the construction site superintendent will be responsible for seeing that these procedures are followed.

Sanitary Waste

All sanitary waste will be collected from the portable units a minimum of three times per week by a licensed sanitary waste management company, as required by local and state regulation.

Offsite Vehicle Tracking

A stabilized construction entrance (anti-tracking pad) has been provided at both North and South construction access points to help reduce vehicle tracking of sediments.

Roadway Sweeping

The existing Hopping Brook road will be swept using a mechanical street sweeper on an as needed basis. Additionally, after the roadway extension is paved, it too will be swept using a mechanical street sweeper on an as needed basis.

Timing of Controls / Measures

General

As indicated in the Sequence of Major Activities, the stabilized construction entrances and the Wetland Replication Area will be constructed prior to the clearing or grading of any other portion of the site. Areas where construction activity temporarily ceases for more than 21 days will be stabilized with a temporary seed and mulch within 7 days of the last disturbance. Once construction activity cease permanently in an area, that area will be permanently stabilized as stated in section Controls – Stabilization Practices, above.

Construction Timing (Time-Frame Limitations):

Construction time-frame limitations, installation of critter gaps, and on-site construction monitoring are proposed for the construction of the turtle nesting area / groundwater infiltration system and installation of the utilities only. In order to avoid temporal overlap with nesting, incubation or emergence, work associated with the aforementioned activities should proceed between **October 1 through March 15** without the need for a qualified field biologist on site. If work is to be performed with air temperatures greater than 60 F° or outside of this time-frame, a qualified field biologist is required to be on-site to inspect the critter gaps, monitor the work area, and inform the construction crew how to minimize the possibility of any turtles entering the work area and/or how to relocate animals outside of the work area. Furthermore, any nests located in or near the work area will be marked or relocated by a qualified field biologist.

No construction time-frame limits or use of critter gaps are proposed at any other locations on the site including the southern access vicinity. These areas do not have a demonstrated migratory value for rare and endangered species. The Massachusetts Natural Heritage & Endangered Species Program (NHESP) has not suggested or required special construction measures for any other areas onsite besides the limitations mentioned above. In the area of the wetland crossing, one or more temporary or permanent culverts will be in place. The erosion control perimeter will be maintained as a continuous barrier in these areas.

Certification of Compliance with Federal, State, and Local Regulations

This Stormwater Pollution Prevention Plan (SWPPP) reflects Holliston requirements for stormwater management and erosion & sediment control, as established in the local by-laws. To ensure compliance, this plan was prepared in accordance with the United States Environmental Protection Agency NPDES Stormwater Program, Massachusetts Department of Environmental Protection (DEP) Stormwater Management Policy and Guidelines, and Holliston Town By-Laws. No other applicable State or Federal requirements for sediment and erosion site plans (or permits), or stormwater management site plans (or permits) exist.

Maintenance / Inspection Procedures

Erosion and Sediment Control Inspection and Maintenance Practices

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report
- Accumulated sediment will be removed from silt fence when it has reached one-third the height of the fence.
- Silt fence will be inspected for depth of sediment, tears, too see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.
- All sedimentation basins will be inspected for depth of sediment, and accumulated sediment will be removed when it reaches 10% of the design capacity or at the end of the job. Temporary sediment traps can be allowed to fill with sediment, and either excavated and re-used or stabilized and abandoned.
- All diversion dikes and channels will be inspected and any breaches promptly repaired.
- Temporary and permanent seeding and plantings will be inspected for bare spots, washouts, and healthy growth.
- A Construction Stormwater Maintenance Inspection Report will be submitted after each inspection. A copy of the report form to be completed by the inspector is attached.
- The site superintendent will select three individuals who will be responsible for inspections, maintenance and repair activities, and filling out the inspection and maintenance report.
- Personnel selected for inspection and maintenance responsibilities will receive training from the site superintendent. They will be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.

Non-Storm Water Discharges

It is expected that the following non-stormwater discharges will occur from the site during the construction period:

- Water from water line flushings

- Pavement wash waters (where no spills or leaks of toxic or hazardous materials have occurred).
- Uncontaminated groundwater (from dewatering excavation)

All non-stormwater discharges will be directed to the sedimentation basin (Dbasin #3) prior to discharge. All uncontaminated groundwater from dewatering operations related to the utility corridor and jacking and receiving pit area will be directed to a temporary sedimentation basin.

Spill Prevention

Material Management Practices

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping – The following good housekeeping practices will be followed onsite during the construction project:

- An effort will be made to store only enough product required to do the job
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers and if possible under a roof or other enclosure
- Products will be kept in their original containers with the manufacturer's label affixed
- Substances will not be mixed with one another unless recommended by the manufacturer
- Whenever possible, all of a product will be used up before disposing of the container
- Manufacturer's recommendations for proper use and disposal will be followed
- The site superintendent will inspect daily to ensure proper use and disposal of materials

Hazardous Products – These practices are used to reduce the risks associated with hazardous materials.

- Products will be kept in original containers unless they are not resealable
- Original labels and material safety data will be retained; they contain important product information
- If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

Product Specific Practices

Petroleum Products

All onsite vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.

Fertilizers

Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

Paints

All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the stormwater system but will be properly disposed of according to manufacturer's instructions or State and local regulations.

Concrete Trucks

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

<u>Spill Control Practices</u>

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material will be reported to the appropriate State or local government agency, regardless of the size.
- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures will also be included.

- The site superintendent will be the spill prevention and cleanup coordinator. This individual will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage areas and in the office trailer onsite.


PREPARED BY:
BRUCE SALUK & ASSOC., INC.
CIVIL ENGINEERS & LAND SURVEYORS
576 BOSTON POST ROAD
MARLBOROUGH, MA 01752
CONSTRUCTION
INDEX SHEET
HOLLISTON, MA
PREPARED FOR:
NEW HOPPING BROOK TRUST
828 BOSTON POST ROAD
MARLBOROUGH, MA 01752
DATE: MARCH 21, 2002

Pollution Prevention Plan Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signed:________________________________

John Q. Quality
President
Environmental Site Monitor

Date: ________________________________

Contractor's Certification

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the stormwater discharges associated with industrial activity from the construction site identified as part of this certification.

Signature	For	Responsible for
____________________ Joe Contractor, President Date: ________________	Construction Company Address Line 1 Address Line 2 Telephone number	General Contractor
____________________ Joe Planter, President Date: ________________	Erosion Control Company Address Line 1 Address Line 2 Telephone number	Temporary and Permanent Stabilization
____________________ Jane Digger, President Date: ________________	Dirt Movers Address Line 1 Address Line 2 Telephone number	Stabilized entrances, Earth Dikes, Sedimentation Basins

INSPECTION AND MAINTENANCE REPORT FORM

for

Road & Utility Extension of Hopping Brook Business Park

<u>TO BE COMPLETED EVERY 7 DAYS AND WITHIN 24-HOURS OF A RAINFALL EVENT OF 0.5 INCHES OR MORE.</u>

INSPECTOR: ______________________ DATE: ______________

INSPECTOR'S QUALIFICATIONS: ____

DAYS SINCE LAST RAINFALL: ________ AMOUNT OF LAST RAINFALL: ________ INCHES

STABILIZATION MEASURES

AREA	DATE SINCE LAST DISTURBED	DATE OF NEXT DISTURBANCE	STABILIZED? (Y/N)	STABILIZED WITH	CONDITION
North tracking pad					
South tracking pad					
Wetland replication					
Wetland crossing					
Sed.Basin - DB3					
Haul Road					
Sed.Basin – DB2					
Div.channel A					
Borrow Pit					
Div.channel B					
Roadway Ext.					
Sed.Basin – DB1					
Maint. Road					
Jacking Pits					
Utility Corridor					
Recharge/Nesting					

STABILIZATION REQUIRED: ____

TO BE PERFORMED BY: ______________________ ON OR BEFORE: ______________

INSPECTION AND MAINTENANCE REPORT FORM

for

Road & Utility Extension of Hopping Brook Business Park

STRUCTURAL CONTROLS

DATE: ____________________

Haybale / Siltfencing:

FROM	TO	IS LINE STABILIZED?	WASHOUT OR OVERTOPPING?

MAINTENANCE REQUIRED FOR HAYBALE/SILTFENCE LINE: ____

____

____

TO BE PERFORMED BY: ____________________ ON OR BEFORE: ____________________

____

EARTH DIKES

FROM	TO	IS DIKE STABILIZED?	WASHOUT OR OVERTOPPING?

MAINTENANCE REQUIRED FOR EARTH DIKES:________________________________

TO BE PERFORMED BY:____________________ ON OR BEFORE:____________________

SEDIMENTATION BASINS / TRAPS

LOCATION	DEPTH OF SEDIMENT	IS BASIN/TRAP STABILIZED?	FILLED OR OVERTOPPING ?	CONDITION OF OUTFALL/OUTLET DEVICE

MAINTENANCE REQUIRED FOR SEDIMENTATION BASINS/TRAPS:______________________________

TO BE PERFORMED BY:____________________ ON OR BEFORE:________________

ANTI-TRACKING PADS

LOCATION	SEDIMENT ON ROAD?	IS THE GRAVEL FOULED?	DOES ALL TRAFFIC USE THE PAD?	CONDITION OF DRAINAGE DIVERTS
NORTH				
SOUTH				

MAINTENANCE REQUIRED FOR ANTI-TRACKING PADS:______________________________________

TO BE PERFORMED BY:____________________ ON OR BEFORE:____________________

INSPECTION AND MAINTENANCE REPORT FORM

for

Road & Utility Extension of Hopping Brook Business Park

CHANGES REQUIRED TO THE POLLUTION PREVENTION PLAN:

REASONS FOR CHANGES:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

Signed:________________________________ Date: __________________

APPENDIX F

Correspondence with the Division of Fisheries and Wildlife

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

Garrett M. Tunision
Fisheries Biologist
Sanford Ecological Services, Inc.
30 Turnpike Road
Southborough, MA 01772

July 29, 2002

Re: Hopping Brook Park Project in Holliston, MA, EOEA # 4411

Dear Mr. Tunision:

Thank you for contacting the Fisheries Section of MassWildlife relative to the above-mentioned project. Hopping Brook, Holliston, is considered a cold water resource due to its ability to holdover trout through the warmer months. As a result, any discharge into the brook must not exceed the thresholds established under the Massachusetts Department of Environmental Protection's Class B Cold Water criteria (314 CMR 4.00). Specifically, 4.05: Classes and Criteria. For dissolved oxygen and temperature: dissolved oxygen shall not be less than 6.0mg/L in cold water fisheries, unless background conditions are lower…levels shall not be lowered below 75% of saturation due to a discharge. Temperature shall not exceed 68°F (20°C) in coldwater fisheries…and the rise in temperature due to a discharge shall not exceed 3°F (1.7°C) in rivers and streams designated as cold water fisheries. A qualified engineer will be able to design a stormwater drainage system, which will be capable of handling summer storm events so as to meet the above temperature, and dissolved oxygen requirements. At that time, we will be happy to review the plans.

In the meantime, if you should have any questions or require further information relative to the resource, please do not hesitate to contact me directly at (508) 792-7270 ext. 132.

Sincerely,

Richard A. Hartley
Aquatic Biologist

Cc. Chuck Bell, Northeast District Supervisor

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

Garrett M. Tunison
Sanford Ecological Services, Inc.
30 Turnpike Road
Southborough, MA 01772

October 2, 2002

Re: Stormwater Management Plan for Hopping Brook Park, Holliston, Massachusetts

Dear Mr. Tunison:

I have reviewed your Stormwater Management Plan for the proposed Hopping Brook Park in Holliston. Avoiding direct discharge into Hopping Brook and the use of extended detention basins will help minimize potential impacts to the fisheries resource. We feel that the Stormwater Management Plan, as proposed, does not constitute a significant risk to the fisheries resources associated with Hopping Brook.

Thank you for allowing us to comment on this proposal. Should you have any questions or require further information, please do not hesitate to contact me directly at (508) 792-7270 ext. 132.

Sincerely,

Richard A. Hartley
Aquatic Biologist

Cc. Charles Bell, MDFW Northeast District Supervisor

APPENDIX G

Approval of Amendment to the Town of Holliston Zoning By-law

THE COMMONWEALTH OF MASSACHUSETTS
OFFICE OF THE ATTORNEY GENERAL
WESTERN MASSACHUSETTS DIVISION
1350 MAIN STREET
SPRINGFIELD, MASSACHUSETTS 01103-1629

TOM REILLY
ATTORNEY GENERAL

(413) 784-1240
www.ago.state.ma.us

February 3, 2003

Jacqueline S. Dellicker, Town Clerk
100 Linden Street
Holliston, MA 01746

RE: **Holliston Special Town Meeting of December 17, 2002 — Case # 2372**
Warrant Article # 2 (Zoning)

Dear Ms. Dellicker:

Article 2 - I return with the approval of this Office the amendments to the town by-laws adopted under this Article on the warrant for the Holliston town meeting that convened on December 17, 2002.

Very truly yours,

THOMAS F. REILLY
ATTORNEY GENERAL
Kelli Lawrence
by: Kelli E. Lawrence, Assistant Attorney General
By-law Coordinator, Municipal Law Unit
1350 Main Street, 4th Floor
Springfield, MA 01103-1629
(413) 784-1240, x 117

enc.
pc:

Town Counsel

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TOWN OF HOLLISTON
OFFICE OF THE TOWN CLERK

100 Linden Street
Holliston, MA 01746

TELEPHONE (508) 429-0601 FAX (508) 429-0684
OFFICE HOURS; MONDAY – FRIDAY 8:30 AM – 4:30 PM

Jacqueline S. Dellicker
Town Clerk

Board of Selectmen
Town Offices
100 Linden Street
Holliston, MA 01746

This is to certify that at the Special Town Meeting of December 17, 2002, Article 2 received favorable voting action as follows:

ARTICLE 2. To see if the Town will vote to amend the Town of Holliston Zoning By-law by adding the following new sub-paragraph f to Section I-D PROHIBITED USES, subsection 3:

f. Private sewage disposal systems or treatment plants shall be allowed in Industrial Districts in conjunction with commercial or industrial development and further pursuant to the requirements of a Special Permit issued by the Permit Granting Authority, and provided, however, no discharge or leaching areas shall be located in a Zone I or Zone II as determined by the Massachusetts Department of Environmental Protection Aquifer Protection Areas.; or take any action relative thereto. **(Board of Selectmen)**

MOTION: Moved that the Zoning By-law of the Town of Holliston be amended as stated in the Article.

VOTE: Unanimously passed by two-thirds (2/3) hand vote to accept Article 2 as stated in the motion. The vote was Yes – 320, No – 63.

A true record, Attest:

Jacqueline S Dellicker

Jacqueline S. Dellicker
Town Clerk

cc: Planning Board, Zoning Board of Appeals, Michael Healy

A true copy of record
Attest: Jacqueline S. Dellicker
Town Clerk
Holliston, MA 01746

Jacqueline S Dellicker