

CHAPTER 6 TRANSPORTATION

This Chapter of the Brookline Master Plan includes an inventory of the existing highway network in the town of Brookline, including highway classification, traffic volumes, roadway conditions and travel patterns. Issues related to transportation and mobility including highway policy, safety and capacity deficiencies, forecasts of future travel, and non-motorized and alternative modes are discussed. Recommendations to improve the highway network, and mobility in general, are also provided.

EXISTING HIGHWAY NETWORK

Highway Classification

There are a total of 48.1 miles of road in Brookline. Brookline's existing roadway network and the state's functional classification for roads are shown in Figure VI-1. Roads and highways are classified by the New Hampshire Department of Transportation (NH DOT) into different categories according to their functions and source of funding. The highways are classified by the NH DOT according to RSA 229:5.

Functional Classification

The following provides a description of the functional classification system characteristics of a road and highway network:

<u>Functional System</u>	<u>General Characteristics</u>
Principal Arterial	<ol style="list-style-type: none">1. Provides corridor movement suitable for substantial statewide or interstate travel and provides continuity for all rural arterials which intercept the urban area.2. Serves the major traffic movements within urbanized areas such as between central business districts and outlying residential areas, between major intercity communities, or between major suburban centers.3. Serves a major portion of the trips entering and leaving the urban area, as well as the majority of the through traffic desiring to bypass the central city.
Minor arterial	<ol style="list-style-type: none">1. Serves trips of moderate length at a somewhat lower level of travel mobility than principal arterials.2. Provides access to geographic areas smaller than those served by the higher system.3. Provides intracommunity continuity, but does not penetrate identifiable neighborhoods.
Major Collector	<ol style="list-style-type: none">1. Serve county seats not on arterial routes, serve larger towns not directly served by the higher systems, and other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, country parks and important mining and agricultural areas.2. Provides links with larger towns or cities, or with routes of higher classification.3. Serves the more important intracounty travel corridors.

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|-----------------|--|
| Minor Collector | <ol style="list-style-type: none"> 1. These routes accumulate traffic from local roads and bring all developed areas within reasonable distances of collector roads. 2. Provide service to the remainder smaller communities. 3. Link the locally important traffic generators with their rural hinterland. |
| Local | <ol style="list-style-type: none"> 1. Comprises all facilities not on higher systems. 2. Provides access to land and higher systems. 3. Through traffic usage discouraged. |

Table VI-1 provides a summary of the mileage for the classification of roads in the Town of Brookline. The table includes both the state functional classification and the state aid classification of roads. As shown in Table VI-1, there is a total of 48.1 miles of roads in the Town of Brookline.

About 14.5 percent of the road mileage is classified as non-public. NH 13 accounts for all the arterial mileage. NH 130 and Mason Road account for the major collector mileage. Pepperell Road, between NH 130 and the Hollis town line, is classified as a minor collector road.

*Table VI-1
State Aid Road Classification and Function (miles)*

State Classification	Principal Arterials, Interstate Highways	Minor Arterials	Major Collector	Minor Collector	Local Roads	Unimproved Roads	Total
Class I- Primary State Hwys		6.8					6.8
Class II- Secondary State Hwys			4.8	0.6	1.9		7.3
Class V- Town Roads			1.2		25.8		27.0
Class VI- Unimproved roads						7.0	7.0
Totals		6.8	6.0	0.6	27.7	7.0	48.1

Source: New Hampshire Department of Transportation, 1997

Note: The NHDOT is currently updating the town mileage, and there will be approximately 8 miles added to the Class V local roads classification.

**FIGURE VI-1
FUNCTIONAL CLASSIFICATION OF ROADS**

Funding Classification

State Aid

The State-aid classification system has been defined by RSA 229 to 231 to determine responsibility for construction, reconstruction and maintenance as well as eligibility for use of state aid funds. The following is a description of the state-aid system:

Class I, Primary State Highway System, consist of all existing or proposed highways on the primary state highway system, excepting all portions of such highways within the compact sections of towns and cities, provided that the portions of turnpikes and interstate highways within the compact sections of those cities are Class I highways.

Class II, Secondary State-Highway System, consist of all existing or proposed highways on the secondary state highway system, excepting portions of such highways within the compact sections of towns and cities.

All sections improved to the satisfaction of the Commissioner are maintained and reconstructed by the State. All unimproved sections, where no state and local funds have been expended, must be maintained by the town or city in which they are located until improved to the satisfaction of the highway commissioner.

All bridges improved to state standards with state-aid bridge funds are maintained by the State. All other bridges shall be maintained by the city or town until such improvement is made.

Class III, Recreational Roads, consist of all such roads leading to, and within state reservations designated by the Legislature. The NH DOT assumes full control of reconstruction and maintenance of such roads.

Class IV Highways, consist of all highways within the compact sections of cities and towns listed in RSA 229:5, V. The compact section of any such city or town shall be the territory within such city or town where the frontage on any highway, in the opinion of the Highway Commissioner, is mainly occupied by dwellings or buildings in which people live or business is conducted, throughout the year. No highway reclassification from Class I or II to Class IV shall take effect until all rehabilitation needed to return the highway surface to reputable condition has been completed by the State.

Class V, Rural Highway, consist of all other traveled highways which the town or city has the duty to maintain regularly.

Class VI, Un-maintained Highways, consist of all other existing public ways, including highways subject to gates and bars, and highways not maintained in suitable condition for travel for five years or more.

Scenic Roads, are special town designations of Class IV, V, and VI roads where cutting or removal of a tree, or disturbance of a stone wall, must go through the hearing process and written approval of local officials (See RSA 231).

The state aid classification road mileage in Brookline is summarized in Table VI-1. As shown in Table VI-1, there are only Class I, II, V, and VI type roads in Brookline. There are no

Class III (recreational roads) or Class IV (urban compact roads) in Brookline. The major source of funding for maintenance of minor collector roads and local roads, which make up 28.2 miles, comes from the Town of Brookline and the New Hampshire state block grant for roads. Figure VI-2 shows the state's funding classification for Brookline.

Federal Aid

The Inter-modal Surface Transportation Efficiency Act of 1991 (ISTEA) replaced federal funding programs that date back to the Federal Interstate System of Highways under President Eisenhower. In addition to the restructuring of the federal funding programs, ISTEA also provides funding for conformance with the Clean Air Act Amendments of 1990. The Federal Interstate System had directed aid to four road system categories; Interstate, Primary, Secondary, and Urban. ISTEA creates two road systems; the National Highway System (NHS), and the Interstate System (which is a component of the NHS.) The NHS is intended to provide for interstate and inter-regional travel and to meet national defense requirements.

In addition to the NHS funding program, a new block grant type funding program called the Surface Transportation Program (STP), is available for all roads (including NHS roads) not functionally classified as a local road or rural minor collector. Transit capital projects are also eligible under this program. ISTEA also created the Congestion Mitigation and Air Quality Improvement Program (CMAQ) to help states implement their air quality plans and attain the national standards for carbon monoxide, ozone, and particulate matter. CMAQ funding is focused on air quality improvements and provides funds that expand or initiate transportation services or policies with air quality benefits. In addition, the Transportation Enhancements (TE) program provides funding for a variety of transportation-related projects such as pedestrian and bicycle facilities, preservation of abandoned railway corridors, and rehabilitation of historic transportation facilities,

There are no highways in Brookline designated as part of the National Highway System. There are approximately 12.8 miles of highway in Brookline eligible under the STP category. These include roads classified as Arterials and Major Collectors (NH 13 and NH 130).

**FIGURE VI-2
FUNDING CLASSIFICATION OF ROADS**

Traffic Volumes

Historic traffic volume data for the Town of Brookline is compiled from several sources. The New Hampshire Department of Transportation (NHDOT) collects traffic counts in accordance with federal guidelines under the Federal Highway Performance Monitoring Program (HPMS.) The HPMS guidelines describe federal procedures for sampling highway and road volumes. These procedures provide the Federal Highway Administration with highway volumes for design standards and meet the Environmental Protection Agency's requirements for estimating vehicular highway travel. In addition to the NHDOT's annual traffic counting program, the Nashua Regional Planning Commission maintains an ongoing traffic count program for validating the region's traffic mode. The NRPC also provides traffic counts for member communities upon request.

A State permanent traffic recorder is located on NH 13 just north of Old Milford Road near Melendy Pond. Historical traffic growth at this location is shown in Table VI-2 and illustrated in Figure VI-3.

As shown in Table VI-2, traffic on NH 13 grew at an annual rate of over ten percent between 1982 and 1985.. Average annual growth rates since 1986 have varied between 1 percent and 11 percent per year. Compared with the growth trends at other permanent counting stations in the area for the same period, this growth rate is similar to that of NH 101 in Amherst, and NH 101A in Milford.

Traffic count data collected at other locations in Brookline are compiled in Table VI-3. These counts represent an average weekday (24 hour period) and have not been adjusted by a seasonal factor.

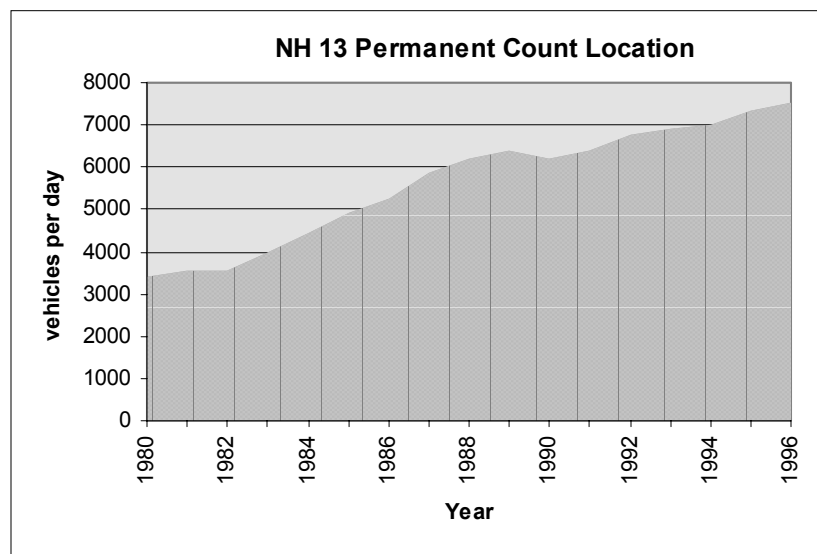
The most heavily traveled road in Brookline is NH 13 which runs north-south through the town from the Massachusetts state line to Milford. Route NH 130, which connects with NH 13 at the intersection of Quimby Road, provides access to Hollis and Nashua. In Brookline, Milford Street, Main Street, Pepperell Road (between Main St. and Proctor Hill Rd), and Proctor Hill Road make up Route NH 130. Mason Road which is classified as a major collector road, and Pepperell Rd. which is classified as a minor collector between the Hollis Town Line and Proctor Hill Road, both provide access to adjacent communities. Old Milford Road, Cleveland Hill Road, and Averill Road have played an increased role in collecting and distributing traffic in the town due to heavy increases in residential development. Cross Road and Bohanon Bridge Road also perform important collector functions by channeling traffic to and from NH 130.

**TABLE VI-2
 HISTORICAL TRAFFIC GROWTH ON NH 13
 NEAR MELENDY POND IN BROOKLINE**

YEAR	Average Annual Daily Traffic(vehicles per day)	Annual Percent Change	Percent Change 1980-1996
1980	3,408		121 %
1981	3,573	4.84 %	
1982	3,545	- 0.78 %	
1983	3,983	12.36 %	
1984	4,451	11.75 %	
1985	4,941	11.01 %	
1986	5,262	6.50 %	
1987	5,879	11.73 %	
1988	6,192	5.32 %	
1989	6,392	3.23 %	
1990	6,224	- 2.63 %	
1991	6,385	2.59 %	
1992	6,785	6.26 %	
1993	6,934	2.20 %	
1994	7,013	1.14 %	
1995	7,355	4.88 %	
1996	7,529	2.37 %	
		5.00 %	

Source: New Hampshire Department of Transportation, 1980 - 1996

**FIGURE VI-3
 HISTORICAL GROWTH TRENDS ON NH 13**



**TABLE VI-3
 WEEKDAY TRAFFIC COUNTS IN BROOKLINE**

Street and Location	1993	1994	1995	1996
NH 13 at Mass State Line	6,372	nc	6,674	nc
NH 13 south of Milford St	5,000	nc	nc	nc
Peperell Rd. at Hollis T/L	nc	1,681	1,624	1,708
NH 130 east of Cross Rd.	5,194	nc	5,843	6,133
Milford St east. of NH 13	nc	2,218	nc	2,276
Mason Rd. west of NH 13	2,450	nc	2,407	2,500
Mason Rd. at Mason T/L	nc	959	947	nc
Old Milford Rd s. of NH 13	na	na	na	1,305
Old Milford Rd n of Steam Mill Hill	800	nc	1030	nc
Averill Rd west of NH 13	nc	nc	nc	539

Source: Nashua Regional Planning Commission, nc; not counted that year.

The average daily traffic volumes shown in Table VI-3 are illustrated on a map of Brookline in Figure VI-4.

Roadway Conditions

The pavement conditions of Brookline’s Class V roads (town owned roads) were surveyed by the Nashua Regional Planning Commission in 1995. The survey was performed using Road Surface Management System (RSMS) software which was developed by the University of New Hampshire for use by small towns. The software allows for an inventory of town roads to be compiled and also documents the condition of road surfaces. The software allows the user to prioritize repairs and will assign a recommended repair strategy for each road or road segment. The serviceability and the cost of maintenance for a road within the initial 75 percent of a pavement’s design life is less than one-fifth the cost of maintenance and reconstruction during the final 25 percent of the design life. The purpose of developing a pavement management system is to help the road agent determine when a road has reached that critical 75 percent point.

The reports resulting from the RSMS study are intended to provide assistance in assigning specific repair strategies and prioritizing repair needs. This software system is designed to be flexible and is not intended to take the place of the town road agent’s experience and judgment. The RSMS software allows the user to prioritize repairs based on three general weighing factors including traffic volume, roughness, and road conditions. This software recommends that traffic volume be allotted the most weight (50 to 60 %), roughness the second highest (25 to 30 %) and the road condition the lowest (15 to 25 %). Based on the pavement management study, Table VI-4 lists the top ten road segments prioritized by the RSMS software. It was not possible to confirm whether these segments have been improved since the study was conducted, since the Town Road Agent was not available to assist in this task.

**FIGURE VI-4
AVERAGE DAILY TRAFFIC VOLUMES**

TABLE VI-4
 RECOMMENDED REPAIR STRATEGIES FOR SELECTED ROAD SEGMENTS

<i>Road Segment</i>	<i>Recommended Repair and life span</i>
<i>Bond Rd segment 2, from NH 13 east to 0.1 miles</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill or Reclaimer Recycling)</i>
<i>North Mason Rd segment 3, 0.55 miles, near North Rd and Spaulding Brook Rd</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Old Milford Rd segment 1, 0.3 miles from Main to Steam Mill Hill Rd</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Old Milford Rd segment 2, 2.3 miles from Steam Mill Hill to Bear Hill Rd</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Steam Mill Hill Rd 0.15 miles</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Bohanon Bridge Rd 0.30 miles</i>	<i>Overlays 5 to 12 yrs (Shim Coat, or Thin Overlay, or Thick Overlay)</i>
<i>Cross Rd 0.15 miles</i>	<i>Overlays 5 to 12 yrs (Shim Coat, or Thin Overlay, or Thick Overlay)</i>
<i>North Mason Rd segment 1, from NH 13 west to 0.8 miles</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Springvale Ave 0.52 miles</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>
<i>Cleveland Hill Rd segment 1, 1.0 mile west from Averill Rd</i>	<i>Rebuild 5 to 12 yrs (Base Repair and Pavement Replace, or Hammermill, or Reclaimer Recycling)</i>

Bridges

There are thirteen bridges in Brookline that are regularly inspected by the NH Department of Transportation. Five of the bridges are owned by the Town of Brookline. The remainder are owned by the State of New Hampshire. Three of the town's bridges are classified as either structurally deficient or functionally obsolete by the state. Bohanon Bridge over the Nissitissit River is closed for repairs. Two of the state's bridges, Mason Road over the Nissitissit and South Main Street over the Nissitissit, are classified as functionally obsolete. A list of the bridges and the status of weight restrictions is provided in Table VI-5.

TABLE VI-5
 BRIDGE CONDITION REPORT

Bridge	Owner	Status
North Mason Rd over Spaulding Brook	Town	Open no restrictions
Dupaw Gould Rd over Lancy Brook	Town	Open-Structurally Deficient
North Mason Rd over Scabbard Mill Brook	Town	Open-Functionally Obsolete "E-2" Load Restriction
Bond Street over the Nissitissit River	Town	Open-"E-2" Load Restriction
Bohanon Bridge Rd over the Nissitissit	Town	Structurally Deficient Bridge Closed
Mason Rd over the Nissitissit	State	Open-Functionally Obsolete "E-2" Load Restriction
NH 13 over the Nissitissit	State	Open no restrictions
NH 13 over Bela Brook	State	Open-"E-2" Load Restriction
NH 13 over Wallace Brook	State	Open no restrictions
NH 130 over Store Brook	State	Open-"E-2" Load Restriction
South Main Street over Wallace Brook	State	Open no restrictions
South Main Street over the Nissitissit	State	Open-"E-2" Load Restriction
Pepperell Rd over Rocky Pond Brook	State	Open no restrictions

"E-2" Load Restrictions prohibit crossing by any certified vehicle. Certified vehicles are those trucks that receive special state certification to exceed the load limit (up to a designated weight) set within their specified weight class.

Although the NH DOT inspects locally owned bridges as well as state bridges, the NH DOT only recommends a load restriction posting. The municipality bears the responsibility for installing signs for the posting of load restrictions, in accordance with NH DOT recommendations.

Commuting Travel Patterns of Brookline Residents

Information on origin and destination patterns for travel to workplace is available from the U.S. Census. Although the 1990 US Census data is now seven years old and total commuter trips have most likely changed since that time (due to residential growth and changes in employment), this information represents the latest available data on destination patterns for travel to work. The 1990 US Census data was compared to the data available from the 1980 US Census. The results are summarized in Table VI-6. The numbers in Table VI-6 indicate the number of persons commuting from one community to another, not the number of daily round trips made.

**TABLE VI-6
 COMMUTING PATTERNS FROM BROOKLINE**

Place of Work	1980 US Census Number of Brookline Commuters	Percent of Total Commuters	1990 US Census Number of Brookline Commuters	Percent of Total Commuters
Amherst	32	3.9 %	46	3.5 %
Brookline	134	16.1 %	190	14.7 %
Hollis	31	3.7 %	49	3.8 %
Merrimack	65	7.8 %	71	5.5 %
Milford	101	12.1 %	80	6.2 %
Nashua	213	25.6 %	355	27.4 %
Bedford	17	2.1 %	14	1.1 %
Manchester	15	1.8 %	57	4.4 %
Other New Hampshire	45	5.4 %	107	8.2 %
Massachusetts	179	21.5 %	325	25.2 %
Total	832	100 %	1,294	100 %

Table VI-6 shows that the amount of people who both live and work in the town has dropped from 16.1 percent in 1980 to 14.7 percent in 1990, even though the overall number has increased from 134 to 190. The percentage of commuters living in Brookline and working in Nashua, Manchester, and Massachusetts has increased while the percentage of Brookline residents working in Amherst, Merrimack, Milford, and Bedford, has decreased. The number of commuters overall has increased from 832 in 1980 to 1,294 in 1990. This represents an increase of 4.5 percent per year over the ten year span.

The vast majority of Brookline residents travel to work in a car by themselves, as shown in Table VI-7. Over 85 percent did so in 1990, representing an increase of 14 percent from 1980. The 1990 figure was slightly higher than the regional drive alone average of 82 percent. Nearly 10 percent of Brookliners carpool to work, just under the regional average of 11 percent, while 3 percent worked at home in 1990.

**TABLE VI-7
 COMMUTER MODE OF TRANSPORTATION, 1980 - 1990**

	1980	Percent	1990	Percent	Regional Average, 1990
Drive Alone	604	71.1%	1,099	85.2%	82.4%
Carpool	175	20.6%	123	9.5%	10.9%
Public Transportation	3	0.4%	2	0.2%	0.8%
Bicycle	n/a	n/a	4	0.3%	0.3%
Walk	25	2.9%	15	1.2%	2.1%
Other	11	1.3%	8	0.6%	2.8%
Work at Home	31	3.7%	39	3.0%	0.7%
Total Workers Age 16+	849	100.0%	1,290	100.0%	

Source: U.S. Census

Table VI-8 shows that Brookline residents are spending more time traveling to work, the result of increased traffic congestion or more distant work sites.

TABLE VI-8
TRAVEL TIME FOR COMMUTER TRIPS, 1980 - 1990

Minutes	1980		1990	
	Number	Percent	Number	Percent
<10	90	10.8%	102	8.2%
10-19	149	17.8%	243	19.4%
20-29	257	30.7%	278	22.2%
30-44	209	25.0%	377	30.1%
45-59	65	7.8%	152	12.2%
60+	67	8.0%	99	7.9%
	837	100.0%	1,251	100.0%

Mean Travel Time 1980: 26.6 minutes

Mean Travel Time 1990: 29 minutes

Source: U.S. Census

Historical Residential Traffic Growth

An inventory of building permits issued by the town for new home construction over the past six years shows an overall annual growth rate in the Town of Brookline of 5.6 percent in housing units. The inventory of permits was performed in order to update the region's traffic model. The new single family homes built as a result of the issued permits are aggregated within 11 traffic analysis zones in Brookline. These zones are shown in Figure VI-5 and were created for traffic model analysis purposes. Table VI-9 shows the increases in single family homes in Brookline between 1990 and 1996.

TABLE VI-9
NEW SINGLE FAMILY HOMES

Traffic Analysis Zone (see Figure VI-5)	Total Housing Units 1990	New Homes 1990 to 1996	Total Housing Units 1997	Annual Growth Rate (Percentage)
320	123	29	152	3.6 %
321	59	0	59	0.0 %
322	79	10	89	2.0 %
323	52	6	58	1.8 %
324	39	1	40	0.4 %
325	31	21	52	9.0 %
326	129	91	220	9.3 %
327	105	21	126	3.1 %
328	53	13	66	3.7 %
329	107	9	116	1.4 %

330	104	143	247	15.5 %
Total	881	344	1225	5.6 %

FIGURE VI-5
BROOKLINE TRAFFIC ANALYSIS ZONES

The number of new vehicle trips on the town's roads and highways is dependent upon land use and development (residential, commercial, industrial, etc.) Based on the trip rate for a single family home published by the Institute of Transportation Engineers in their handbook, Trip Generation, the average single family home is likely to generate 10 vehicle trip ends on an average weekday (a trip end is described as a trip in or trip out, therefore, 10 vehicle trip ends equal five round trips.) Based on the ITE average trip rate of ten vehicle trip ends per house, the 344 single family homes constructed in Brookline since 1990, have probably added 3,440 new vehicle trips ends per day distributed throughout Brookline's road system.

Table VI-9 also indicates the fastest growing residential areas in Brookline. Traffic analysis zone 330, which is located in the northeast of the town, is growing at an annual rate of 15.5 percent per year (see Figure VI-4). The impact of vehicular traffic due to residential growth within this Traffic Analysis Zone (TAZ) will be focused on Old Milford Road which provides access to Route NH 13 to the north and Route NH 130 to the south. Traffic analysis zones 325 and 326, which are located in the town's southwest quadrant, are growing at an annual rate of 9.0 percent and 9.3 percent respectively. Traffic due to residential growth in these two zones will impact Cleveland Hill Road and Mason Road, which provide access to Route NH 13 to the north, and Averill Road which provides access to Route NH 13 and 130 to the south and east.

Future Traffic Growth

Future traffic volumes on Brookline's major highways and roads were projected using NRPC's computerized traffic model. The traffic model was developed on a region-wide basis as a tool to forecast future traffic and to determine future highway needs. The model utilizes land use development as the determinant for trip generation, and then distributes and assigns the traffic on the road network based on a mathematical gravity model. Land use determines the production and attraction of vehicle trips for each traffic analysis zone, while the gravity model determines the paths of least resistance between the zones when assigning traffic to specific roads. The model is validated utilizing field counts from automatic traffic recorders. Table VI-10 shows the model's forecasted traffic volumes to the year 2015 for Brookline's major highways.

**TABLE VI-10
 FUTURE TRAFFIC**

Highway Location	1994 Traffic	Year 2015 Estimate	Percent Change
NH 13 at Mass state line	6,350	8,650	36.2 %
NH 13 south of NH 130	5,150	6,450	25.2 %
NH 130 east of Cross Rd	5,200	7,750	49.0 %
Mason Road at Mason T/L	950	1,450	52.6 %
Pepperell Rd at Hollis T/L	1,700	1,900	11.8 %

Table VI-11 shows the operational characteristics of Brookline's major roads based on the volumes forecasted in Table VI-10. Table VI-11 provides the functional classification, the volume to capacity ratio (V/C), and the level of service ranking for each road segment.

Functional classifications were described earlier in this chapter. Volume to capacity ratio is a formula expressed as the amount of existing traffic on a road divided by the maximum carrying capacity of that road. Level of service (LOS) is a qualitative measure of operating conditions that occur on a road or facility within a given period of time. Level of service analysis is a qualitative

and quantitative measure of the effects of a number of operational factors including roadway geometrics, travel delay, freedom to maneuver, and safety. The level of service (LOS) ranking categories range from LOS "A" to LOS "F" and are described as follows:

- Level of Service "A" - Represents free flow operating conditions. Individual users are virtually unaffected by others.
- Level of Service "B" - Represents stable flow conditions with other traffic in the stream becoming noticeable. The freedom to select desired speeds is still unaffected.
- Level of Service "C" - Represents stable flow but marks the beginning of increases in the formation of platoons of vehicles.
- Level of Service "D" - Represents high density but stable flow. Freedom to maneuver and speeds are highly restricted.
- Level of Service "E" - Represents operating conditions at or near capacity. Congestion level and delays are high.
- Level of Service "F" - Is representative of forced flow conditions with lengthy queues and very long delays.

**TABLE VI-11
OPERATIONAL CHARACTERISTICS**

Highway Location	Year 2015 Estimate	Functional Classification	Theoretical Capacity	Vol/Cap	LOS
NH 13 at Mass state line	8,650	MN ART	26,500	0.33	C
NH 13 south of NH 130	6,450	MN ART	26,500	0.24	B
NH 130 east of Cross Rd	7,750	MJ COLL	23,800	0.33	C
Mason Road at Mason T/L	1,450	MJ COLL	23,800	0.06	A
Pepperell Rd at Hollis T/L	1,900	MN COLL	21,400	0.09	A

Alternative Transportation

The rapid rate of growth within Town has resulted in greater demands being placed on Town roads, since the majority of Brookliners choose vehicular travel for most travel purposes. To accommodate this increased demand and to preserve the rural environment which residents favor, steps should be taken to provide citizens with the opportunity to use a variety of travel modes for work and non-work travel. In particular, walking and bicycling are viable options for a rural community such as Brookline. Alternative travel options may particularly benefit those who are not able or willing to drive, such as children, the elderly, and the disabled.

In 1995 the Town of Brookline, as part of the region's Metropolitan Planning Organization, endorsed the NRPC Region Bicycle & Pedestrian Plan (RBPP) which was created to develop and implement a comprehensive bicycle and pedestrian system within the region. The primary goals of the plan are to insure the incidence of bicycling and walking by establishing a continuous, coordinated nonmotorized transportation network and by creating a traveling environment in which bicycling and walking are attractive alternatives. The RBPP recommendations for physical and institutional improvements as well as a nonmotorized network comprised of local and state roads on which bicycle and pedestrian improvements should be focused.

The key recommendations of the RBPP are to:

- Use the existing and planned street system to the maximum extent possible, consistent with safety considerations, for bicycle travel. The preferable facility for bicycle travel is a four-foot paved shoulder on existing roads, separated from motorized travel lanes by a 6 to 8 inch painted white stripe. Paved shoulders will serve the needs of all nonmotorized users and minimize acquisition and construction costs, and are especially appropriate for the rural roads located in Brookline. Shared roadways, with appropriate signage and safety improvements, are recommended where paved shoulders and bicycle lanes are not possible. "Bike Route" signage is recommended for all nonmotorized road segments.
- Install five-foot sidewalks on both sides of arterial roads where possible. These facilities are desirable on high-volume corridors to improve walking safety. Sidewalks are also desirable on at least one side of collector roads. For rural and low-volume routes, paved shoulders may be used by both pedestrians and bicyclists.
- Provide pedestrian crossings at high-volume intersections on all arterial roads.
- Establish a regular nonmotorized facility maintenance program. This program would include regular inspection of facilities to identify hazardous conditions, road shoulder sweeping, and maintenance of facilities based on safety considerations.
- Adopt land use strategies which facilitate nonmotorized travel. Strategies such as encouraging mixed-use development, programming nonmotorized improvements into the local Capital Improvements Program, requiring nonmotorized improvements as a part of development approval, and adopting bicycle- and pedestrian-friendly design standards would result in a more attractive traveling environment for nonmotorized modes.
- Implement nonmotorized educational programs in schools. This program would teach children basic principles for safely sharing roadways with vehicles and would ideally incorporate on- and off-road training time. A key component of this program is teaching the importance of wearing bicycle helmets.

The Brookline nonmotorized network adopted by Town officials is shown in Figure VI-6, and includes Route 13, Route 130, Main Street, Milford Street and Mason Road. These routes were selected to provide for regional nonmotorized travel; additional roads may be suitable to provide for local travel.

As part of the study, an inventory was conducted from July to September 1994 to assess the suitability of each road for bicycle and pedestrian travel. The results of this survey are shown in Table VI-12. The major north-south link, Route 13, and east-west link, Route 130 are both in excellent condition for nonmotorized travel, but safety improvements are warranted due to high vehicular travel speeds and located here and the only sidewalks in town are both located on this street. Mason Road is suitable for nonmotorized travel, but is constrained by a lack of available room for improvements.

**TABLE VI-12
INVENTORY OF NONMOTORIZED NETWORK**

Road Section	Road Type (1)	Speed Limit	ADT (2)	Pavement Condition (3)	Grades (4)	Right of Way (5)
NH 130 - Hollis Line to NH 13	2LU	35/30	4,546	F	M	A
NH 13 - Mass. Line to Milford Line	2LU	50	6,183	G	M	E
Mason Road	2LU	30	1,855	G	S	L
Milford Street	2LU	30	1,773	F	S	A

(1) Type of Road

2L = 2 Lanes

U = Undivided

(2) ADT

Average

Daily

Traffic

(3) Pavement

G = Good

F = Fair

P = Poor

(4) Grades

F = Flat

S = Slight

M =
Moderate

E = Extreme

(5) ROW

E =

Extensive

A =

Adequate

L = Limited

FIGURE VI-6
BROOKLINE NONMOTORIZED NETWORK

KEY TRANSPORTATION ISSUES

Developing Alternative Road Corridors

Table VI-6, which showed the commuting patterns of Brookline residents, indicated that the majority of traffic generated in Brookline is going to and returning from points north via NH 13, points east and southeast via NH 130 and Pepperell Rd, and points south via NH 13. These commuting patterns are reflected in the average daily traffic on Brookline's major roads (see Table VI-3). These patterns were also reiterated in a 1993 NRPC questionnaire that was distributed to Brookline residents on Rocky Pond Rd., Old Milford Rd., and side streets off of Old Milford Rd. Residents were asked to document the roads on all vehicle trips to and from their homes. The largest amount of trips were made using Route NH 13 to and from the north and Route NH 130 to and from the east. Based on this questionnaire and the census data on commuting patterns, several potential road corridors were developed. The development of these corridors is described in detail in a traffic study completed for the Town of Brookline by the Nashua Regional Planning Commission in 1996.

The potential new roads corridors are described as follows:

- **Hood Road.** Improve Hood Road from NH 13 in Brookline to Milford. This road corridor will allow a connection to Route NH 101A and NH 122 via Foster Road and Ponemah Hill Rd. in Milford and Federal Hill Rd. in Hollis.
- **New Road.** A new road running east/west from Overlook *Lane* in Brookline to Adams Rd. in Milford just north of the Hollis town line. This road will facilitate east west access to Route NH 122 from one of the fastest growing residential areas in Brookline.
- **Rocky Pond Road.** The improvement of Rocky Pond Road will allow eastbound and westbound traffic to be routed around the Cross Rd./NH 130 intersection and the NH 130/Pepperell Rd. intersection.
- **Wood Road.** Improve Wood Road from Rocky Pond road to NH 130. Improvements to this road, running north/south from Rocky Pond to NH 133, will provide an alternative route to the Main St.-Pepperell Rd (NH 130) corridor. An alternative corridor which was conceptually proposed as part of the Gavin subdivision on lot F-18 would be from Dunbar Drive or Hollis Lane to Perkins Road.
- **New Road.** A new road running east/west from Old Milford Road to Milford Street (Route NH 130), or the continuation of Bear Hill Road to NH 13.
- The extension of Cross Road over the Nissitissit River to NH 13.

The improvements to all the above mentioned roads includes widening, improving the drainage system, improvements to the horizontal and vertical alignments (grading and curves), and a paving with a bituminous concrete surface. All of the alternative road corridors were proposed to provide a more direct route to the regional highway system including NH 122, NH 101A, and NH 130. These alternative routes will provide a by-pass around the most heavily traveled intersections and highways in Brookline such as NH 13, Pepperell Road (NH 130), Cross Rd., Main Street, and Old Milford Road.

Development Impacts On Highways

Communities face the problem of having to upgrade the local road network as new development occurs. To the extent that new development projects create a need for improvements, developers should be required to pay their proportion of the cost to implement these improvements. The amount of developer contributions should bear a rational connection to the needs created by and the benefits conferred upon the subdivision. The administrative costs of a formal impact fee system are too great for the Town at this time. As such, it is recommended that the current system of off-site improvement negotiations by the Selectmen in consultation with the Planning Board be continued.

Scenic Road Designation

As New Hampshire's residential, commercial and industrial development has grown, so has the need to improve the road system, thereby reducing the number of country roads that constitute an important asset to the State. To prevent the elimination of scenic roads, communities are enabled by State legislation to designate roads other than state highways as Scenic Roads. This Law protects such roads from repair or maintenance which would involve the cutting or removal of medium and large-sized trees, except with the written consent of an official body. The law is an important tool in protecting the scenic qualities of roads. The large trees and stone walls that line many rural roads are irreplaceable and contribute heavily to the New England character of the region's towns.

In Brookline, North Mason and Averill Roads have been designated as Scenic Roads. The Town should continue to utilize the N.H. Scenic Road Law as a method of preserving the town's rural character, in particular those roads currently classified as Class VI, such as Townsend Hill, Hutchinson Hill, and Dupaw Gould Roads.

Development Policy for Class VI Roads

The Town should form a policy to control and guide future developments along Class VI roads. The Planning Board should consider the effect which proposed subdivisions may have on the roads and require the developer to upgrade the roads as a condition for subdivision approval. Even if the new road in a subdivision meets the Town's specifications, the other roads (especially Class VI roads) in the area may not be adequate to accommodate the increased traffic resulting from the new development. In this case the developer should pay his proportion of the cost to upgrade these off-site roads. Development on Class VI roads should not be allowed until those roads are improved to Class V or better.

Cul-De-Sacs and Turnarounds

Cul-De-Sacs can be an integral part of an efficient road network if properly designed. If improperly designed, cul-de-sacs can lead to an inefficient road system and level of service problems on collector roads. One of the many issues raised when reviewing plans with cul-de-sacs is whether the road should extend to the property boundary. The following should be used as a guide to both the planning board and developers in building roads in Town.

The Planning Board should encourage cul-de-sacs to the property boundary in the following situations:

- Extending cul-de-sacs to the property edge to have less curb cuts off Route 13. For example, Rock Ramond Road can service a lot which also has access from Route 13, thereby discouraging a curb cut on Route 13, and close to a major intersection.
- Where a future possible connection may be appropriate for establishing an efficient road network in Town. For example, by including a stub road off of Talbot Road, future access to other lots and possibly Route 13 may exist, thereby establishing another possible east-west road from Cleveland Hill to Route 13, possibly reducing traffic along Mason Road and Averill Road.

The Planning Board should discourage cul-de-sacs in the following situations:

- Where the cul-de-sac would be between two zones. For example, a through road leading from a solely residential zone to a solely commercial zone may not be appropriate. A through road may encourage truck traffic and patrons to drive through a residential neighborhood to get to the commercial area. However, at this time, there is no zone in town which is zoned for only commercial use.
- Where extending it would produce a dangerous intersection.
- Where it is coming off of an existing cul-de-sac. This may produce long cul-de-sacs, when an option of building a proper road network exists.
- Where an extension of the cul-de-sac to abutting property would *not* be feasible due to steep slopes, major wetland areas or other natural features of the land.
- Where an extension would lead to property which would be better serviced from another road.

The Planning Board should also ensure that both hammerhead and cul-de-sac turnarounds should be designed with enough space to accommodate emergency vehicles such as fire trucks and ambulances. The Board should undertake a review of the cul-de-sac design standards currently in place.

Development Control on NH 13

The only industrial/commercial zones in Brookline are 1000 feet wide along NH 13; south of Mason Road to the State Line in the South, and between 500 feet South of Milford Street and North Mason Road to the North. The Town should have a well planned and consistent way of dealing with future development plans along NH 13 so that it will not become another highway that is characterized by numerous traffic lights and curb cuts causing severe traffic tie-ups and delays (NH 101A in Nashua is an example). In preparing such a policy for development control along NH 13, the Planning Board should consider the following:

- Future developments should provide safe and convenient access to NH 13. The safest possible location for access shall be selected and all access points should meet the minimum safe sight distance standard published by the American Association of State Highway and

Transportation Officials in the publication entitled A Policy on the Geometric Design of Highway and Streets.

- The existing frontage requirement of 200 feet in the Residential-Agricultural District and 150 feet in the Industrial-Commercial District, as well as the 30-foot front setback requirement in the zoning ordinance will also maintain the rural characteristics of NH 13. Buffers in the front of the lots will also serve this purpose. Good examples of front yard buffering along NH 13 are Grant Plastics and Bingham Lumber.

Alternative Travel Modes

As discussed earlier, a critical component of the quality of life within Town is a balanced transportation system providing a variety of travel options. Steps should be taken to facilitate the use of alternative travel modes, such as:

- Integrating four-foot paved shoulders on Main Street, Mason Road, and Milford Street when those roads are improved. In addition, improvements should be focused on Old Milford Road, Cleveland Hill Road, Averill Road, and North Mason Road to provide for local nonmotorized travel.
- Install "Bike Route" signage on nonmotorized routes.
- Explore the potential to convert the abandoned railway corridor running north-south through Town into an off-road nonmotorized facility.
- Install five-foot sidewalks on both sides of Route 13, Route 130, and Main Street, and on one side of Mason Road and Milford Street, where physically possible, and within one mile of any school.
- Provide pedestrian crossings at the intersections of all nonmotorized routes.
- Establish a regular nonmotorized facility maintenance program. The Road Department should regularly inspect road shoulders and sidewalks for hazardous conditions and program maintenance to address the most critical needs.
- Adopt land use strategies which facilitate nonmotorized travel. The Planning Board should pursue strategies such as mixed-use development, consider pedestrian and bicyclist travel as a part of every development approval, and adopt bicycle- and pedestrian-friendly road design standards.
- Identify key nonmotorized facility improvement needs and program them into the Capital Improvements Program.
- Implement nonmotorized educational programs in schools. Teachers in the local school system should be encouraged to adopt an educational program available from many bicycle and pedestrian organizations, or to create one of their own. Information is available on these programs from the Nashua Regional Planning Commission.

GENERAL RECOMMENDATIONS

1. Frontage roads parallel with NH Route 13 within the subdivision(s) should be encouraged in order to limit the number of curb cuts on NH Route 13.
2. Access drives to developments on either side of NH Route 13 should be aligned to form a four-way intersection.
3. Encourage land use patterns which will facilitate the use of a variety of transportation modes, especially walking and bicycling, for residents of all ages.
4. As a long term strategy, the town should explore the feasibility of establishing a transit feeder route to Milford and/or Nashua to serve residents and workers.
5. The Town should assess the impact of traffic on the Town's road network which may occur as a result of the Manchester Airport expansion.
6. The Town should contact the New Hampshire Department of Transportation to investigate the possibility of no-salt or reduced salt on all state roads.

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