C I V I L E N G I N E E R S • L A N D S U R V E Y O R S

Bruno Associates

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MEMORANDUM

To: Jay Gamble

From: Nicole Kesselring, PE NSK

Re: Mount Sunapee Resort West Bowl Expansion
Snowmelt Drainage and Watershed Analysis

Date: 5/27/04

In response to our meeting on May 3, 2004, regarding the above mentioned project, our office has performed a hydrologic study to examine the potential impact snowmaking operations could have on The Gunnison Brook, Lake Gunnison and Rand Pond.

During that meeting you conveyed the concerns of some Goshen Citizens regarding:

- Potential impact to the water quality and quantity of Lake Gunnison, also known as the Goshen Ocean,
- Potential impact to the water quality and quantity of Rand Pond, and
- The potential for flooding and washout along Brook Road.

As part of this study, we performed a field visit to each of the water bodies, and examining all culverts and bridges on the Gunnison Brook along Brook Rd. Further information was gathered through the use of USGS Maps, the FEMA Flood Insurance Study for Newport, NH (none is currently available for Goshen), FEMA Flood Insurance Maps for Goshen, and a phone conversation with Alan Hanscom of the NH DOT.

We feel that the following study will provide information which will demonstrate that the work proposed by Mt. Sunapee in the West Bowl Area will not adversely impact the Gunnison Brook Watershed.

Per our conversation, you stated that Mt. Sunapee proposes to make snow on 75 Ac of proposed trails in the West Bowl. 2 ½ feet of snow is typically made over each Ac, at a volume of 180,000 gallons per ac-ft of snow. This means that the entire volume of water proposed for snowmaking in this area will be approximately 33.75 million gallons of water.

The West Bowl area lies on the western slope of Mt. Sunapee within the Gunnison Brook Watershed. This watershed is comprised of 4,500 Ac to the point where the Gunnison Brook crosses under Rt. 10. The West Bowl area drains to an unnamed tributary on the eastern side of Brook Rd., which then discharges into the Gunnison Brook near the 90° corner in Brook Rd.(Merrill's corner). From this point the Gunnison Brook follows

JOHN BRUNO BRUCE BOEDTKER
Registered Engineer • Vermont, Connecticut, New Hampshire, New York, Massachusetts
Registered Land Surveyor • Vermont and New Hampshire

Brook Rd. its entire length, and crosses Rt. 10 prior to discharging into the South Branch of the Sugar River. See Exhibit 1.

Lake Gunnison: Lake Gunnison, also know as the Goshen Ocean, lies within the Sugar River Watershed area, on Blood Brook. The Blood Brook was dammed in this part of the valley to create the lake. Although Gunnison Brook and Lake Gunnison both lie within the Sugar River Watershed, Lake Gunnison is fed by Blood Brook, and is not hydraulically connected to Gunnison Brook. Chandler Hill and other mountain peaks create a drainage divide between the Gunnison Brook and Blood Brook, separating these two watersheds. Waters from these two brooks meet in Goshen, across Rt. 10 from Brook Rd., where the South Branch of the Sugar River begins.

Due to the hydraulic separation of the lake from Gunnison Brook, there is no potential for the lakes water level or water quality to be affected by snowmelt from the proposed trails within Mt. Sunapee Resort's West Bowl Area.

Rand Pond: Rand Pond lies within the Gunnison Brook Watershed. The pond's watershed area is approximately 270 Ac, and does not receive any runoff from the Mt. Sunapee West Bowl area. Rand Pond is fed by numerous tributaries, and it outflows drain into the Gunnison Brook. Due to the fact that the pond is located hydraulically upgradient of the Gunnison Brook, its inflows and water quality will not in any way be affected by snowmaking in the West Bowl area.

Bridges and Culverts along Brook Rd.: To assess the potential impact that snowmaking melt waters could have on the Gunnison Brook watershed a number of factors were examined.

First the snowmelt water quantity in relation to storm runoff from the entire watershed was examined. Based on The FEMA Flood Insurance Study for Newport, since none is available for Goshen, a discharge per square mile of watershed was calculated. This discharge was then applied to the Gunnison Brook Watershed area which is comprised of 7 Ac to arrive at stream flows for Gunnison Brook. These flows can be viewed in Table 1.

Table 1: Watershed Flow Data

S. Branch Sugar River @ Coon Brook Rd.				Gunnison Brook Watershed	
Storm Event (yr)	Stream Flow (cfs) *	Drainage Area (sq. miles)	Discharge per sq. mi (cfs)	Drainage Area (sq. miles)	Stream Flow (cfs) *
10	1,290	26.5	49	7	341
50	1,860	26.5	70	7	491
100	2,120	26.5	80	7	560

(Please note that due to the fact that peak flows for Gunnison Brook Watershed were calculated based on a much larger drainage area, that for a portion of the South Branch of the Sugar River, the actual peak flows out of the Gunnison Brook Watershed is most likely greater than the numbers represented in the table.)

Once the storm event streamflow for Gunnison Brook Watershed was calculated, we determined what percentage of total flow the snowmelt water from the West Bowl area will be. Snowmelt occurs at the end of the ski season as daily temperatures slowly rise. In any given year, snow can usually be seen left on the mountain in excess of 4 weeks after the mountain has closed. Taking into considering that when the mountain closes, melt has most likely already been occurring for up to 4 weeks, it would be reasonable assumed that snowmelt off the mountain actually occurs over an 8 week period of time. To be conservative, our calculations used a 7 day and 30 day melt period to determine what percentage of streamflow these quantities would represent. A 7 day melt time is unrealistic, but it puts into perspective the flow quantities we are dealing with.

As can be seen in Table 2, if melt were to occur over 7 days, snowmelt runoff would represent 2.2% of streamflow for a 10 year storm event and 1.3% of streamflow for a 100 year storm event. Similarly, runoff from a 30 day melt period would represent 0.5% to 0.3 % for a 10 and 100 year storm, respectively. As these calculations show, the snowmelt runoff, will represent such a small quantity of total flow, that it should not create an adverse impact.

Table 2: Snowmelt runoff as a % of Streamflow

Gunnison Brook Watershed		Snowmelt runoff as % of Streamflow	
Storm Event (yr)	Stream Flow (cfs) *	7 day melt (7.46cfs) (%)	30 day melt (1.74 cfs) (%)
10	341	2.2	0.5
50	491	1.5	0.4
100	560	1.3	0.3

Bridges and culverts along Brook Road were examined as part of this study. Our site visit revealed 4 driveway and class 4 road bridges, 2 culvert crossings, and 3 bridge crossings for Brook Rd. As Brook Rd. is a state road, bridges on this road are designed to the flood of record or the 50 year storm event, which ever is greater. All the bridges viewed appeared to be in good condition, with adequate clearance to pass large storm events. The two culverts under Cross Rd. appear to each be 68" diameter steel culverts, and appear to be in good condition. A single 60" culvert under a farm road, just east of the Province Rd./Brook Rd. intersection

was severely clogged with branches and debris, thereby decreasing its capacity. The area in which this culvert is located is shown as flood plain on the FEMA Flood Maps, so it is likely, that flooding occurs in this area in the spring time. It did not appear that the crossing is used for more than access to fields on the other side of the brook.

Alan Hanscom of the NH DOT was also contacted to determine if he was aware of any problems in this area. He stated that from time to time road shoulder maintenance is necessary due to washout out from some larger storm events, where the brook comes very close to the road. He was unaware of any bridge issues along Gunnison Brook.

Storm event runoff from the proposed trails is expected to be negligible in terms of the overall watershed area, since no impervious area will be created, and the infiltration characteristics of the land will remain substantially the same.

In summary, Lake Gunnison and Rand Pond will be completely unaffected by any increase in snowmelt from the West Bowl area because they are hydraulically disconnected. The increase in flow that will be realized by the Gunnison Brook during spring melt is a very small percentage of its storm event flow and is unlikely to create a noticeable impact at any bridges or culvert crossings. Based on the above discussion, it is my professional opinion that there will not be any adverse impact from the increase in snowmelt created by the proposed West Bowl area.

M:\03jobs\03022\03022-EX1.dwg, 5/27/2004 1:29:18 PM, JWK

BRUNO ASSOCIATES INC. P.C.
ENGINEERS, PLANNERS, SURVEYORS
PO BOX 387, THE MILL BUILDING
WOODSTOCK, VERMONT 05091
PHONE: (802) 457-3550 FAX: (802) 457-4853

GUNNISON BROOK WATERSHED AREA MAP
FOR
MOUNT SUNAPEE RESORT
IN
GOSHEN & SUNAPEE NEW HAMPSHIRE

NO	REVISIONS	DATE

PROJECT: 03022
DRAWN BY: JWK
CHECKED: BHB
DATE: 5/27/04
SURVEYED:
DESIGNED:

EX-1

WATERSHED AREA MAP

MOUNT SUNAPEE

West Bowl Area Fact Sheet

Gunnison Brook Watershed Area = **4,500 Ac**

Gunnison Brook has it headwaters at the top of Mt. Sunapee, and follows Brook Road down to Rt. 10. Shortly after it crosses under Rt. 10 it converges with the South Branch of the Sugar River.

Snowmelt in West Bowl Area
Proposed snowmaking trail area = **75 Ac**

Trail area = **1.67 % of Watershed**

Snow making snow quantity= **180,000 gal/ac-ft**

snow making snow depth = **2.5 ft**

Total snowmaking snow quantity = **33,750,000 gal = 4,512,032 cf**

Hypothetically, If entire snowmaking quantity melted over: **7 days**

runoff to Gunnison Brook would be: **7.46 cfs**

Hypothetically, If entire snowmaking quantity melted over: **30 days**

runoff to Gunnison Brook would be: **1.74 cfs**

In reality snow on mountain melts over a period of 4 - 6 weeks after Mt. Sunapee has closed. (runoff from melt begins prior to the mountain closing)

Gunnison Brook Watershed			Snowmelt runoff as % of Streamflow	
Storm Event (yr)	Drainage Area (sq. miles)	Stream Flow (cfs) *	7 day melt (7.46cfs) (%)	30 day melt (1.74 cfs) (%)
10	7	341	2.2	0.5
50	7	491	1.5	0.4
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FEMA, Flood Insurance Study, Newport, NH

S. Branch Sugar River @ Coon Brook Rd.				Gunnison Brook Watershed	
Storm Event (yr)	Stream Flow (cfs) *	Drainage Area (sq. miles)	Discharge per sq. mi	Drainage Area (sq. miles)	Stream Flow (cfs) *
10	1,290	26.5	49	7	341
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100	2,120	26.5	80	7	560

United States Department of Agriculture
NRCS Natural Resources Conservation Service

New Hampshi

New Hampshire County Rainfall Frequency Data

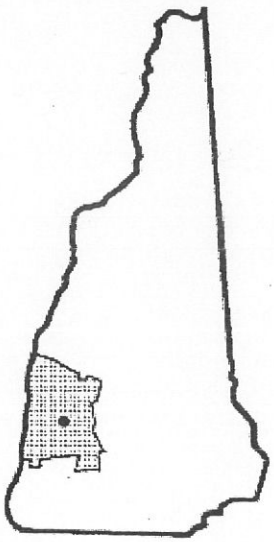
County or Area Rainfall Amounts in Inches by Frequency

County or Area	1 Year Inches	2 Years Inches	5 Years Inches	10 Years Inches	25 Years Inches	50 Years Inches	100 Years Inches
Belknap	2.4	2.8	3.7	4.1	5.0	5.5	6.1
Carroll - South	2.5	2.9	3.8	4.3	5.2	5.5	6.2
Carroll - North	3.0	3.3	4.3	5.0	5.7	6.2	6.6
Cheshire	2.4	2.8	3.7	4.2	5.0	5.6	6.3
Coos - South	3.0	3.5	4.1	4.8	5.6	6.2	6.8
Coos - North	2.4	3.0	3.5	4.2	4.9	5.3	6.1
Grafton	2.4	2.7	3.6	4.2	4.9	5.2	5.9
Hillsborough	2.5	2.9	3.8	4.3	5.1	5.7	6.3
Merrimack	2.4	2.8	3.7	4.2	5.0	5.6	6.2
Rockingham	2.5	3.0	3.8	4.3	5.2	5.7	6.4
Strafford	2.5	3.0	3.8	4.3	5.1	5.6	6.3
Sullivan	2.3	2.7	3.6	4.1	4.8	5.3	6.0

FLOOD INSURANCE STUDY

TOWN OF NEWPORT, NEW HAMPSHIRE

SULLIVAN COUNTY



APRIL 17, 1985

Federal Emergency Management Agency

COMMUNITY NUMBER - 330161

In the updated study, discharge-frequency relationships for the Sugar River were obtained from a hydrologic model of the Sugar River Basin using the HEC-1 Flood Hydrograph Package (Reference 4). This model did not include the area draining toward Lake Sunapee. It was determined that, with the high storage capacity of the lake, this area will not have a significant effect on the flooding downstream of the lake. To account for the lake dam outflows, 100 cubic feet per second (cfs) were added to HEC-1 discharges. This value was obtained from an integration of the curve of the average lake dam outflows for the past 20 years.

The discharges for the North Branch Sugar River and the South Branch Sugar River were determined using regional analyses of USGS gages in New Hampshire (Reference 5).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SUGAR RIVER					
Downstream of confluence of North Branch Sugar River	204.1[1]	7,252	10,417	13,028	18,200
At Belknap Avenue	121.7[1]	4,054	5,414	6,793	9,700
At State Route 10	76.0[1]	1,720	2,387	3,053	4,600
NORTH BRANCH SUGAR RIVER					
At Old Cornish Turnpike	80.8	2,070	2,980	3,410	4,390
SOUTH BRANCH SUGAR RIVER					
At Elm Street	45.7	1,810	2,610	2,980	3,840
At Coon Brook Road	26.5	1,290	1,860	2,120	2,730

[1]Includes area draining toward Lake Sunapee

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Sugar River (continued)								
AT	56,893[1]	85	798	3.8	846.9	846.9	847.2	0.3
AU	56,957[1]	59	639	4.8	847.4	847.4	847.7	0.3
AV	57,352[1]	111	415	7.4	847.8	847.8	848.1	0.3
AW	58,057[1]	212	957	3.2	851.8	851.8	852.6	0.8
North Branch Sugar River								
A	122[2]	80	304	11.2	773.3	765.8[3]	765.8	0.0
B	190[2]	80	646	5.3	773.3	768.0[3]	768.0	0.0
C	4,080[2]	135	759	4.5	773.3	772.5[3]	772.7	0.2
D	8,662[2]	130	989	3.4	776.1	776.1	777.1	1.0
E	9,552[2]	37	428	8.0	776.8	776.8	777.6	0.8
F	9,604[2]	56	631	5.4	777.4	777.4	778.1	0.7
G	10,134[2]	75	779	4.4	777.9	777.9	778.6	0.7
South Branch Sugar River								
A	242[2]	84	403	7.4	788.3	783.7[3]	784.0	0.3
B	309[2]	60	374	8.0	788.3	784.5[3]	784.5	0.0
C	5,754[2]	228	1,213	2.5	794.9	794.9	795.8	0.9
D	11,682[2]	138	449	6.6	803.1	803.1	803.4	0.3
E	11,751[2]	150	650	4.6	803.5	803.5	804.0	0.5

[1]Feet above corporate limits
[2]Feet above confluence with Sugar River
[3]Elevation computed without consideration of backwater from Sugar River

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NEWPORT, NH
(SULLIVAN CO.)

FLOODWAY DATA

SUGAR RIVER-NORTH BRANCH SUGAR RIVER-SOUTH BRANCH SUGAR RIVER

TABLE 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
South Branch Sugar River (continued)								
F	12,351	75	339	8.8	805.1	805.1	805.2	0.1
G	13,351	85	396	7.5	810.8	810.8	811.0	0.2
H	14,351	126	584	4.6	819.7	819.7	819.8	0.1
I	15,086	36	209	12.8	851.0	851.0	851.4	0.4
J	18,474	40	340	7.9	877.0	877.0	877.8	0.8
K	19,174	48	275	9.7	880.2	880.2	881.0	0.8
L	20,819	67	308	8.7	893.9	893.9	894.6	0.7
M	23,831	49	313	6.8	913.0	913.0	913.3	0.3
N	27,561	45	240	8.8	920.6	920.6	921.5	0.9
O	27,626	60	273	7.8	922.0	922.0	922.0	0.0
P	29,311	56	452	4.7	928.6	928.6	929.5	0.9

[1]Feet above confluence with Sugar River

TABLE 2

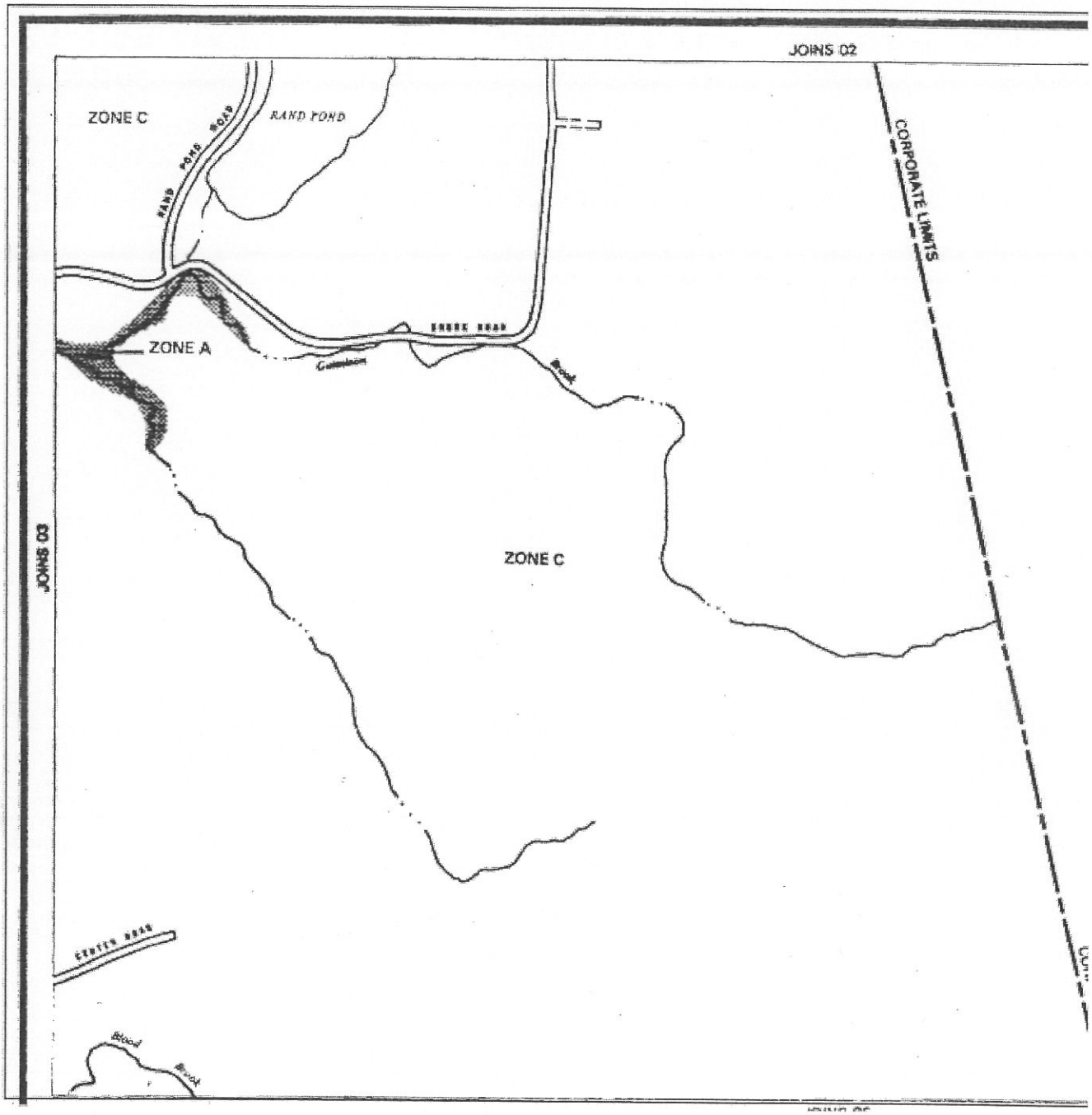
FEDERAL EMERGENCY MANAGEMENT AGENCY

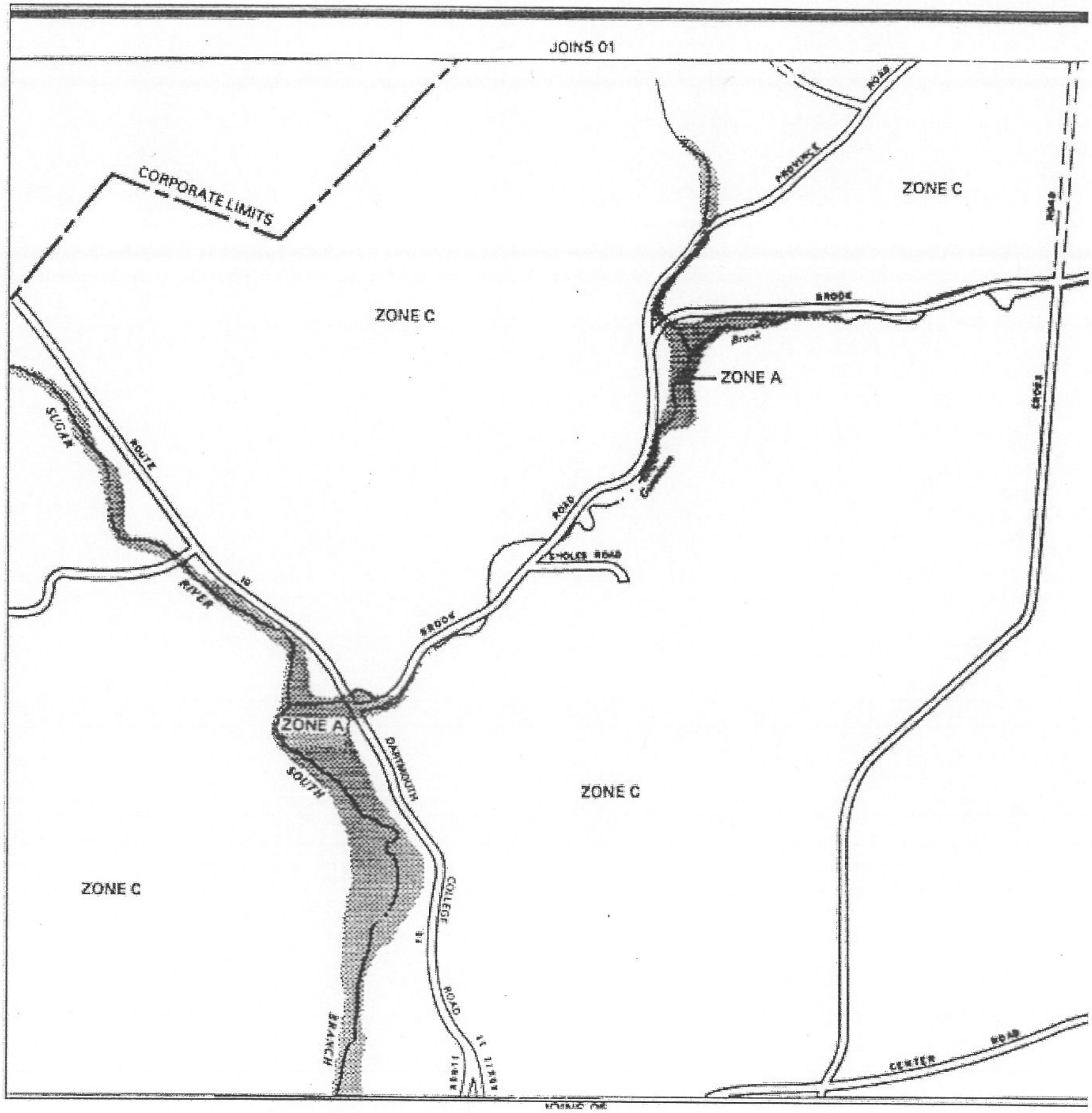
TOWN OF NEWPORT, NH

(SULLIVAN CO.)

FLOODWAY DATA

SOUTH BRANCH SUGAR RIVER


JOHNS 02
ZONE C
RAND POND ROAD
RAND POND
CORPORATE LIMITS
ZONE A
Gammon
Brook
ZONE C
JOHNS 03
Blood
Brook


JOINS 01
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ZONE C
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ZONE C
ZONE A
ZONE C
ZONE C
PROVINCE
ROAD
BROOK
Brook
CROSS
ROAD
SUGAR
RIVER
ROUTE
10
BROOK
ROAD
DARTMOUTH
COLLEGE
ROAD
SOUTH
BRANCH
CENTER
ROAD

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Erosion factors		Organic matter
							K	T	
	In	Pct	G/cm³	In/hr	In/in	pH			Pct
MaB, MaC, MaD----- Marlow	0-8	3-10	1.00-1.30	0.6-2.0	0.10-0.23	3.6-6.0	0.24	3	2-8
	8-24	3-10	1.30-1.60	0.6-2.0	0.06-0.20	3.6-6.0	0.32		
	24-60	3-10	1.60-2.05	0.06-0.6	0.05-0.12	3.6-6.0	0.20		
MbB, MbC, MbD, MbE----- Marlow	0-4	3-10	1.00-1.30	0.6-2.0	0.10-0.23	3.6-6.0	0.20	3	---
	4-24	3-10	1.30-1.60	0.6-2.0	0.06-0.20	3.6-6.0	0.32		
	24-60	3-10	1.60-2.05	0.06-0.6	0.05-0.12	3.6-6.0	0.20		
McB, McC, McD---- Monadnock	0-8	1-8	0.80-1.20	0.6-2.0	0.15-0.21	3.6-6.0	0.28	3	3-8
	8-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
MfB, MfC, MfD---- Monadnock	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
MrC*, MrD*, MrE*: Monadnock-------	0-2	1-8	0.80-1.20	0.6-2.0	0.10-0.18	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Hermon----------	0-3	2-6	0.95-1.20	6.0-20	0.07-0.20	3.6-5.5	0.10	3	---
	3-17	2-7	1.00-1.30	6.0-20	0.05-0.17	3.6-6.0	0.10		
	17-60	1-4	1.50-1.70	6.0-20	0.03-0.10	5.1-6.0	0.10		
MuD*: Monadnock-------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.20	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Hermon----------	0-3	2-6	0.95-1.20	6.0-20	0.07-0.20	3.6-5.5	0.10	3	---
	3-17	2-7	1.00-1.30	6.0-20	0.05-0.17	3.6-6.0	0.10		
	17-60	1-4	1.50-1.70	6.0-20	0.03-0.10	5.1-6.0	0.10		
MvB*, MvC*, MvD*: Monadnock-------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Lyman-----------	0-2	2-10	0.75-1.20	2.0-6.0	0.13-0.24	3.6-6.0	0.20	2	---
	2-15	2-10	0.90-1.40	2.0-6.0	0.08-0.28	3.6-6.0	0.32		
	15	---	---	---	---	---	---		
MwB*, MwC*, MwD*: Monadnock-------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Lyman-----------	0-2	2-10	0.75-1.20	2.0-6.0	0.13-0.24	3.6-6.0	0.20	2	---
	2-15	2-10	0.90-1.40	2.0-6.0	0.08-0.28	3.6-6.0	0.32		
	15	---	---	---	---	---	---		
Rock outcrop.									
Na---------- Naumburg	0-7	1-5	1.20-1.50	2.0-6.0	0.05-0.09	3.6-5.5	0.17	5	3-7
	7-33	1-5	1.20-1.50	6.0-20	0.06-0.08	3.6-5.5	0.17		
	33-60	1-5	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	0.17		
NnA---------- Ninigret	0-9	3-7	1.00-1.25	2.0-6.0	0.13-0.25	4.5-6.0	0.28	3	2-8
	9-26	3-7	1.35-1.60	2.0-6.0	0.06-0.18	4.5-6.0	0.32		
	26-60	0-2	1.45-1.70	6.0-20	0.01-0.13	4.5-6.0	0.10		
Of---------- Ondawa	0-10	1-9	1.15-1.40	2.0-6.0	0.12-0.26	4.5-6.5	0.24	5	3-7
	10-36	1-9	1.15-1.45	2.0-6.0	0.12-0.22	4.5-6.5	0.37		
	36-60	0-3	1.30-1.50	2.0-20	0.04-0.13	4.5-6.5	0.20		

See footnote at end of table.

GRANITEHIGHWAYS.COM NBI

Place Name: Goshen (Town of)

NBI Structure Number: **009800850011700**
Longitude: **-72° 08' 51"**, Latitude: **43° 18' 5"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.05 MI NE OF JCT NH 10**

Year Built: **1940**, Reconstructed: **1998**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **8.9 m**
Bridge Roadway Width: **8.9 m**
Operating Rating: **56. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Slab**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Meets currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Superior to present desirable criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **97. %**

Return to National Bridge Inventory Database query form.

GRANITEHIGHWAYS.COM NBI

SEARCH
HOME
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MAIL
BRIDGE DATABASE
PHOTO SEARCH
LINKS
ABOUT
LEARN

Bridge Photos and Road Photos and Train Pictures For Sale Online

Place Name: Goshen (Town of)

NBI Structure Number: **009800870012000**
Longitude: **-72° 08' 39"**, Latitude: **43° 18' 14"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.32 MI NE OF JCT NH 10**

Year Built: **1940**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **9.8 m**
Bridge Roadway Width: **8.6 m**
Operating Rating: **25. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Steel**
Design Construction: **Stringer/Multi-beam or Girder**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**
Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Somewhat better than minimum adequacy to tolerate being left in place as is**
Water Adequacy Evaluation: **Equal to present minimum criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **74. %**

Return to National Bridge Inventory Database query form.

GRANITEHIGHWAYS.COM NBI

NORTH EAST NEW ENGLAND BRIDGE DATABASE PHOTO SEARCH LINKS ABOUT MAINE

Bridge Photos and Road Photos and Train Pictures For Sale Online

Place Name: Goshen (Town of)

NBI Structure Number: **009800900012300**
Longitude: **-72° 08' 30"**, Latitude: **43° 18' 20"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.47 MI N E OF JCT NH 10**

Year Built: **1945**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **7 m**
Bridge Roadway Width: **8 m**
Operating Rating: **48. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Slab**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Meets currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Equal to present desirable criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **95. %**

Return to National Bridge Inventory Database query form.

GRANITEHIGHWAYS.COM NBI

Place Name: Goshen (Town of)

NBI Structure Number: **009801050012900**
Longitude: **-72° 07' 32"**, Latitude: **43° 18' 45"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **CROSS ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **TOWN RD**

Year Built: **1940**

Owned and maintained by: **City or Municipal Highway Agency**

Functional Classification: **Rural Local**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **4.3 m**
Operating Rating: **9.1 Metric Tons**
Number of Spans in Main Unit: **2 Spans**
Material Design: **Aluminum, Wrought Iron or Cast Iron**
Design Construction: **Culvert (includes frame culverts)**

Scour: **Foundations determined to be stable for assessed scour conditions**
Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **November, 2000**

Structural Evaluation: **Basically intolerable requiring high priority of corrrective action**

Water Adequacy Evaluation: **Equal to present minimum criteria**

Average Daily Traffic: **110**
Year of Average Daily Traffic: **1987**
Sufficiency Rating: **40. %**

Return to National Bridge Inventory Database query form.

GHL GRANITEHIGHWAYS.COM NBI

HOME
NEW
STATE
BRIDGE DATABASE
PHOTO SEARCH
LINKS
ABOUT
LEGEND

Bridge Photos and Road Photos and Train Pictures For Sale Online

Place Name: Goshen (Town of)

NBI Structure Number: **009800810011700**
Longitude: **-72° 08' 55"**, Latitude: **43° 18' 5"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **NH 10**
Feature Intersected: **GUNNISON BROOK**
Location: **1.78 MI N LEMPSTER TL**

Year Built: **1975**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Major Collector**
Service On Bridge: **Highway-pedestrian**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **7.6 m**
Bridge Roadway Width: **9.8 m**
Operating Rating: **61. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Frame (except frame culverts)**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **July, 1999**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Superior to present desirable criteria**

Average Daily Traffic: **2600**
Year of Average Daily Traffic: **1993**
Sufficiency Rating: **91. %**

Return to National Bridge Inventory Database query form.

USGS

Water Resources

Data Category: Site Information | Geographic Area: New Hampshire | go

A scheduled power outage will affect access to **NWISWeb historical data**, updates for WaterWatch maps, and ftp services for water.usgs.gov. The outage could begin as early as Friday, May 21, 2004 at 10:30 pm EDT, and may continue as late as Monday May 24, 2004, 12:00 pm EDT. We are sorry for any inconvenience this may cause.

The following NWISWeb services will be affected:

- Discrete data **will not** be available during this time period (Water Quality Information, Ground-water levels, peaks, historical streamflow)
- Daily Streamflow Conditions maps **will not** be up-to-date.
- However, Real-time data **will** be available at http://waterdata.usgs.gov/nwis

Site Map for New Hampshire

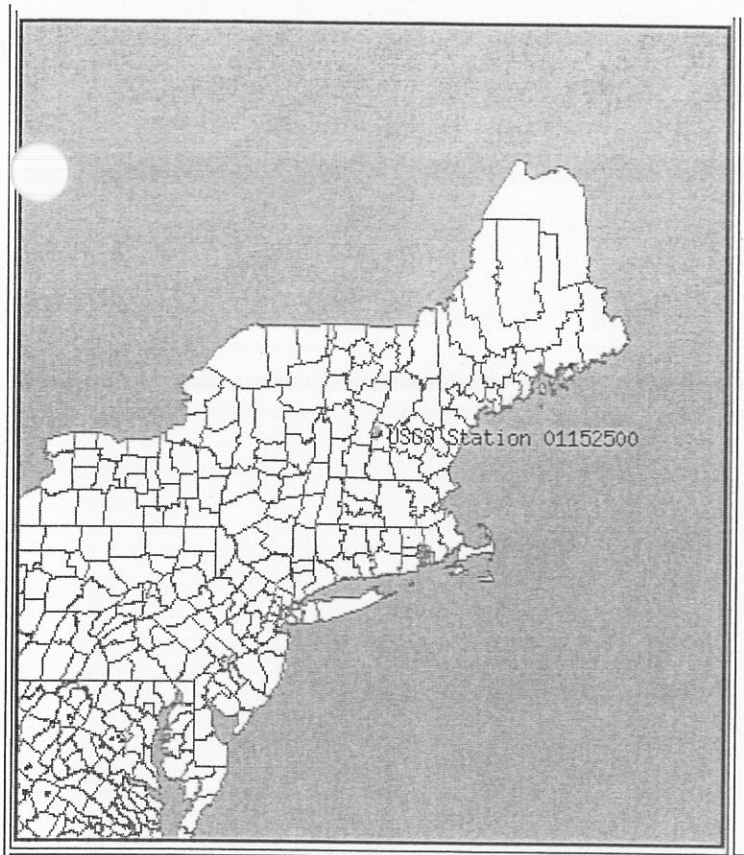
View real-time groundwater levels in Warner, NH. here

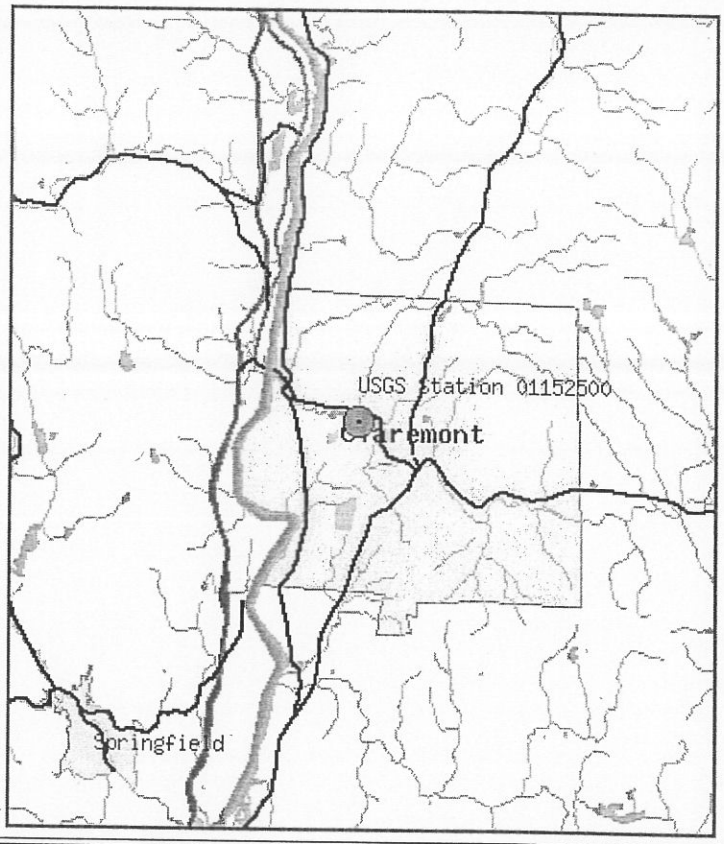
USGS 01152500 SUGAR RIVER AT WEST CLAREMONT, NH

Available data for this site: Station site map | GO

Sullivan County, New Hampshire
Hydrologic Unit Code 01080104
Latitude 43°23'15", Longitude 72°21'45" NAD27
Drainage area 269.00 square miles
Gage datum 358.78 feet above sea level NGVD29

Location of the site in New Hampshire.	Site map.





ZOOM IN 2X, 4X, 6X, 8X, or ZOOM OUT 2X, 4X. 6X. 8X.

Maps are generated by US Census Bureau TIGER Mapping Service.

Questions about data gs-w-nh_NWISWeb_Data_Inquiries@usgs.gov
Feedback on this website gs-w-nh_NWISWeb_Maintainer@usgs.gov

Top
Explanation of terms

NWIS Site Inventory for New Hampshire: Site Map
http://waterdata.usgs.gov/nh/nwis/nwismap?

Retrieved on 2004-05-24 09:45:31 EDT
Department of the Interior, U.S. Geological Survey
USGS Water Resources of New Hampshire
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TRAFFIC IMPACT AND SITE ACCESS STUDY

MOUNT SUNAPEE WEST BOWL EXPANSION

Newbury, New Hampshire
Goshen, New Hampshire
Sunapee, New Hampshire

June 2004

Prepared for
Mount Sunapee Resort

Stephen G. Pernaw
& Company

Stephen G. Pernaw & Company

47 Hall Street, Suite 3 • Concord, NH 03301
tel: (603) 228-5750 • fax: (603) 228-5886 • sgp@lr.net

Transportation: Engineering • Planning • Design

TRAFFIC IMPACT AND SITE ACCESS STUDY
MOUNT SUNAPEE - WEST BOWL EXPANSION
NEWBURY, GOSHEN and SUNAPEE, NEW HAMPSHIRE
JUNE 3, 2004

I. INTRODUCTION

The Mount Sunapee Resort is located on NH Route 103 (NH103) at the Mount Sunapee Traffic Circle in Newbury, New Hampshire. Access to the mountain is provided via one access road that extends in a southerly direction from the traffic circle. The existing ski facility has a comfortable carrying capacity (CCC) of approximately 5,220 skiers per day. Several previously planned on-mountain improvements and enhancements will bring the CCC up to approximately 5,650 skiers per day soon. Recognizing that existing skier demand exceeds the skier capacity on certain peak days, and that skier demand will increase in the years to come, the West Bowl Expansion project is intended to better serve the public by increasing the CCC by approximately 1,200 skiers per day, bringing the total to 6,850 skiers per day.

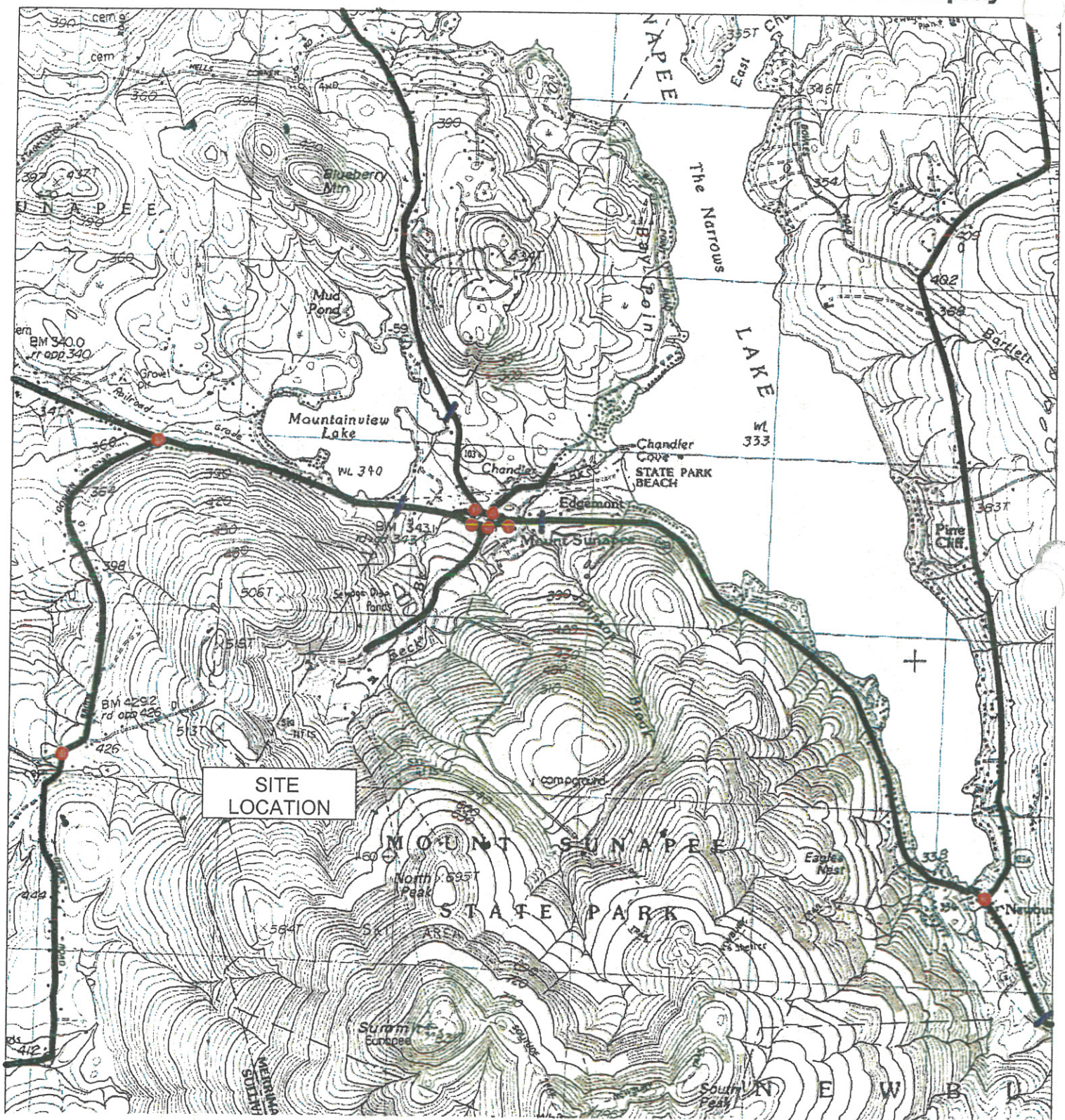
II. PROPOSED DEVELOPMENT

The West Bowl Expansion project involves a new ski lift and additional skiing terrain on the west side of the mountain. The expansion project includes the construction of 175 to 250 condominium units that will be located on private property that abuts the state lands. The condominium units will be comprised of hotel style units, two-story attached townhouses, and single-family detached dwellings, and many will be offered for sale on a "quarter share" basis.

Access to the West Bowl base lodge parking area, and the recreational homes is proposed via a new driveway on Brook Road in Goshen, New Hampshire. The proposed intersection is located approximately 2.1 miles south of the NH103/Brook Road intersection (in Sunapee, New Hampshire), and approximately 3.25 miles north of the NH10/Brook Road intersection (in Goshen, New Hampshire), and will intersect the east side of the roadway. The location of the subject site with respect to the area roadway network is shown on Figure 1.

In addition to traffic increases from local skiers, non-local day skiers, overnighters, and new residences, the expansion project will also result in approximately 108 additional employees on a typical weekend day. These additional employees will be affiliated with the skiing and the mountain, and others will be involved with the condominium/housing function. To put these statistics into perspective, Mount Sunapee reports that they currently utilize approximately 435-450 employees on a typical winter weekend.

Preliminary timetables indicate that project implementation would involve several years, and it is assumed for the purposes of this report that completion could occur by 2010. Accordingly, the traffic projections and analyses contained herein utilize 2010 as the base year, and 2020 as the ten-year planning horizon.



= AUTOMATIC TRAFFIC RECORDER LOCATION

= INTERSECTION TURNING MOVEMENT COUNT LOCATION

78601

Figure 1

Site Location

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

III. ACCESSIBILITY

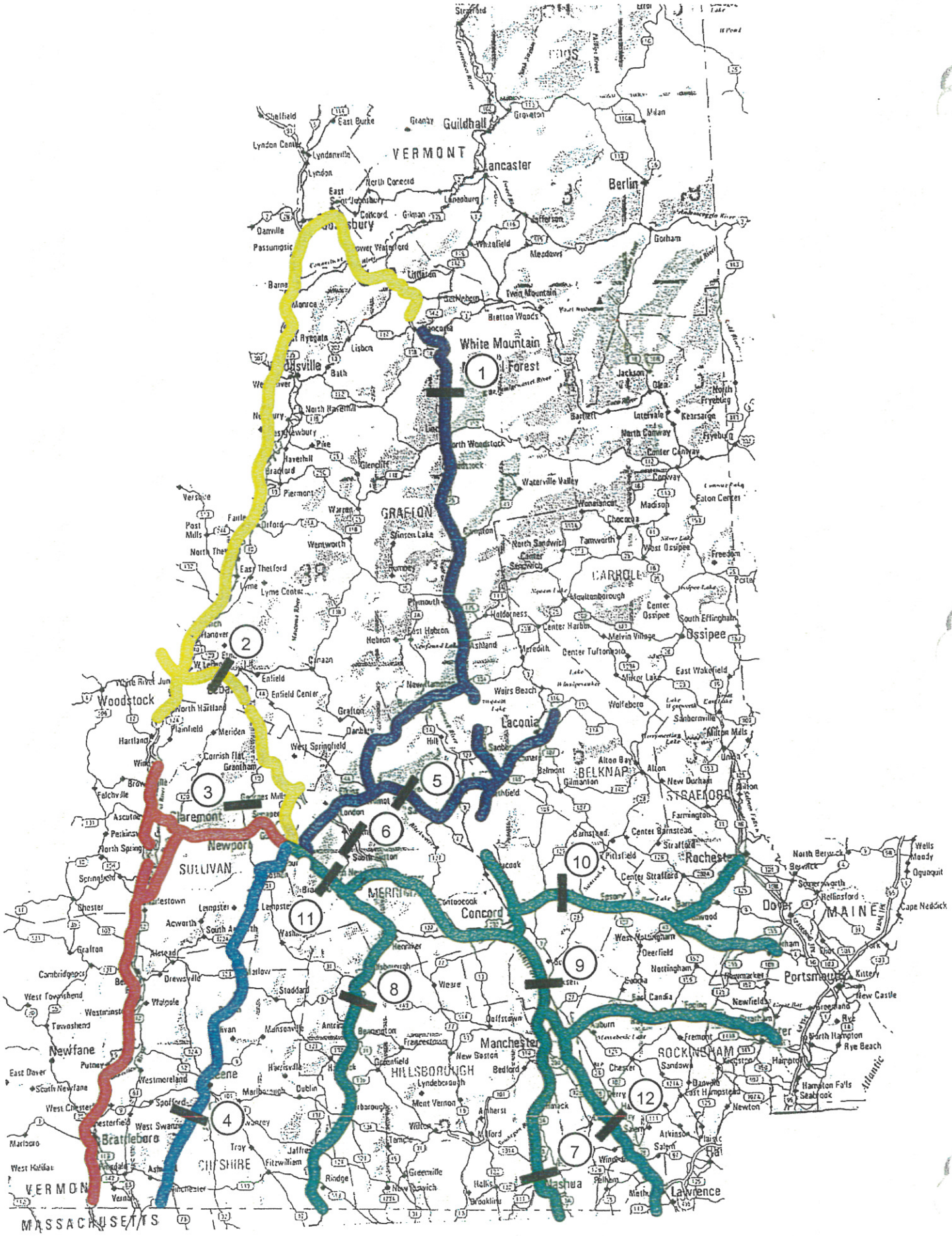
A. STATEWIDE – Mount Sunapee on NH103 is easily reached from Interstate Route 89 (I-89) via Exit 9 (and NH103) for northbound vehicles from Concord, Manchester, Nashua, and eastern Massachusetts, and via Exit 12-A (and NH11 to NH103-B) for southbound vehicles. From I-91 in central Vermont, most skiers take Exit 8 and travel east on NH103 through Claremont and Newport to reach the ski area. New Hampshire Routes 103-A and 103-B provide access between NH103 and I-89. Skiers from the southwest portion of the state utilize NH Route 10 (NH10) and Brook Road to reach NH103 and the traffic circle.

With the new point of access to the ski area and a new base lodge on Brook Road, those that currently utilize Brook Road to reach the mountain, will no longer need to travel to NH103 and enter the ski area via the traffic circle. Similarly, skiers arriving from points west via NH103 will have a choice between parking at the main mountain (via the traffic circle) or the new lodge (via Brook Road). Providing a secondary means of access to the ski area via the West Bowl area will reduce the number of existing vehicle-trips that utilize the traffic circle.

The diagram and table on Figure 2 show the primary access routes to Mount Sunapee from a statewide perspective and a summary of available traffic count data at several "checkpoints" throughout the State. In all cases, traffic demand on these principal access routes is lower during January and February (winter ski months) than during the peak summer months. With few exceptions, January and February travel is also below "average month" conditions (Annual Average Daily Traffic).

B. REGIONAL - The diagram and tables on Figure 3 show how the primary access routes to Mount Sunapee form four "gateways" that converge at the traffic circle, and several statistics from several nearby New Hampshire Department of Transportation (NHDOT) traffic recorder stations. The closest permanent traffic recorder station to the Mount Sunapee Ski Resort was located on NH103 in Newbury (east of Andrews Brook). This station was not so permanent in that the NHDOT discontinued its use in the spring of 2002. Nevertheless, from several years of historical data it is evident that traffic demand has been steadily increasing over the last decade (annual growth rate = 2.2%), and that the winter month travel is comparable to summer month travel due to the count station's proximity to the ski area.

The daily variations graph confirms that peak travel demand occurs on weekends. The hourly data suggests that on peak weekends, there are two separate and distinct peak hour periods. The morning peak hour period typically occurred from 8:00 to 9:00 AM and strongly reflects the ARRIVAL period for skiers. The afternoon peak hour period occurred from 4:00 to 5:00 PM and corresponds to the peak DEPARTURE period for the ski area. It is important to note that the hourly traffic demand falls off considerably before and after these periods. This means that periods with traffic congestion are of relatively short duration.


VERMONT
Guildhall
Lancaster
Berlin
White Mountain
Forest
GRAFTON
CARROLL
Woodstock
Laconia
BELKNAP
STRAFFORD
Ossipee
Claremont
Newport
SULLIVAN
Concord
Rochester
Dover
MAINE
Portsmouth
Manchester
HILLSBOROUGH
ROCKINGHAM
Nashua
Lawrence
Keene
Brattleboro
Newfane
CHESHIRE
MASSACHUSETTS
1
2
3
4
5
6
7
8
9
10
11
12

1. I-93 Lincoln (North of Exit 33)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

2. I-89 NH - VT State Line

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	39959	34883	32337
Peak Month	44549	39894	36873
Winter Month	36412	30972	27920

3. NH 10 Newport (1 Mi. S. of Croydon T/L)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	4122	3303	2698
Peak Month	4488	3861	3068
Winter Month	3776	2711	2320

4. NH 10 Swanzey (S. of Base Hill Road)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	11592	11009	8688
Peak Month	12425	12160	9647
Winter Month	10512	9464	7214

5. US 4 & NH 11 Andover (West of Junction)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	5423	5734	4688
Peak Month	6121	6346	6177
Winter Month	4831	5439	4179

6. I-89 Sutton - Warner Town Line

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

7. US 3 Nashua (Exit 5 -6 FEETurnpike)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

8. US 202 Antrim (South of Rest Area)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	5285	4660	3870
Peak Month	5851	5323	4656
Winter Month	4760	3828	2960

9. I-93 Hooksett (Toll Booth - Exit 11)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	67927	62273	63593
Peak Month	79705	78073	79668
Winter Month	63006	54593	55391

10. US 4 Chichester (East of Chichester Road)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	18224	16929	14814
Peak Month	21094	21324	18945
Winter Month	16185	13607	11298

11. NH 103 (East of Andrews Brook Bridge)*

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	4357	5187	4787
Peak Month	5328	6971	6377
Winter Month	4338	5514	6081

12. I-93 Windham (Derry Town Line)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	67927	62273	63593
Peak Month	79705	78073	79668
Winter Month	63006	54593	55391

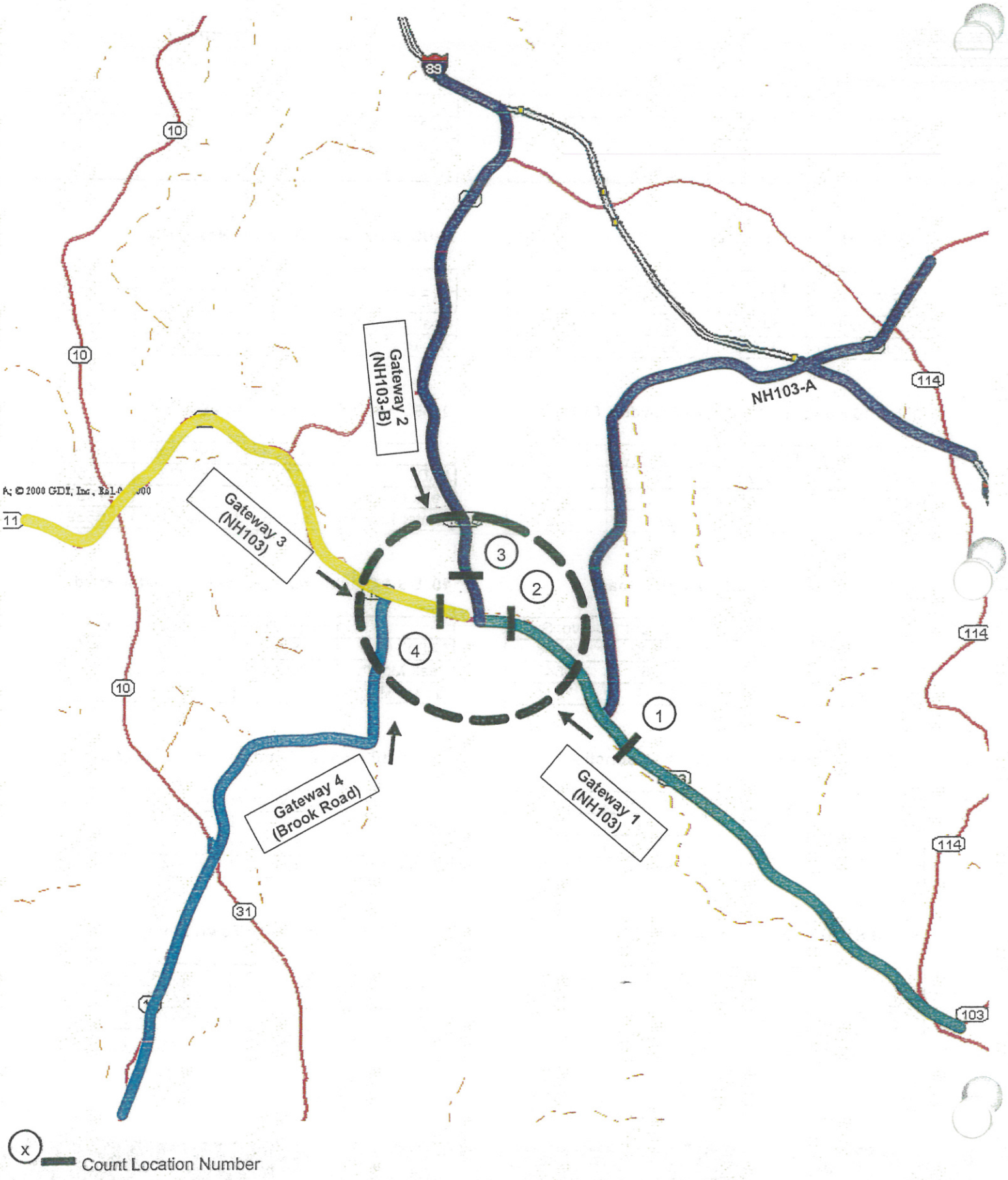
AADT - Annual Average Daily Traffic Volume
Peak Month = July or August
Winter Month = January or February
* 2001 Data (latest available)

01

Figure 2

Statewide Access Routes - 2003 Traffic Volumes

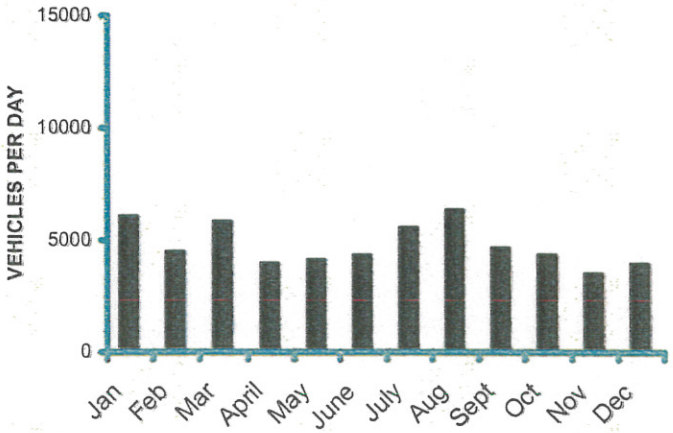
Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire


89
10
10
10
11
114
114
114
103
31
NH103-A
Gateway 2
(NH103-B)
Gateway 3
(NH103)
Gateway 4
(Brook Road)
Gateway 1
(NH103)
1
2
3
4
x
Count Location Number

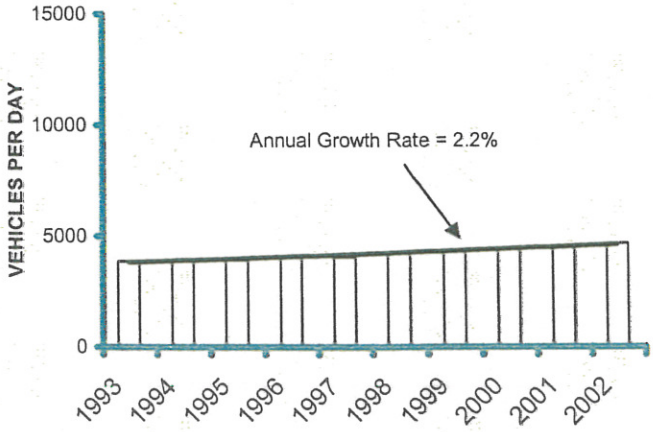
LOCATION 1: NH ROUTE 103 (East of Andrews Brook Bridge)

(NHDOT Permanent Recorder Location - 02321001)

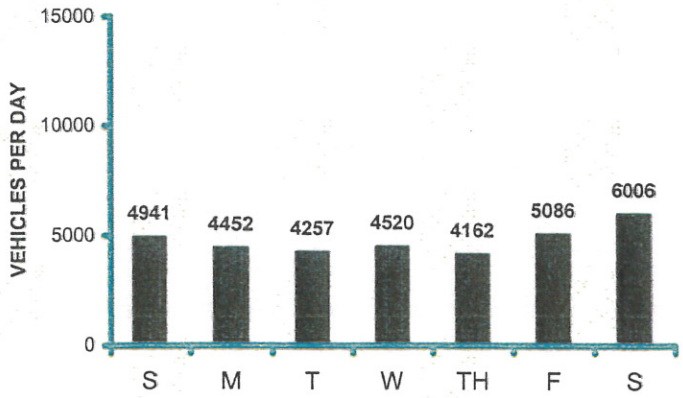
MONTHLY TRAFFIC VARIATIONS
(2001)



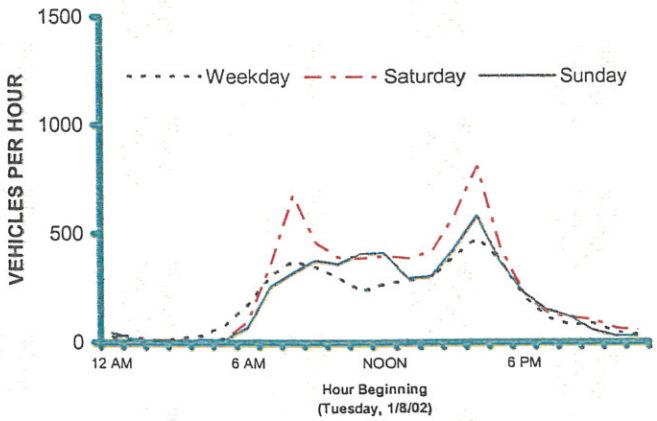
YEARLY TRAFFIC VARIATIONS



AVERAGE DAILY TRAFFIC VARIATIONS
(January, 2002)



HOURLY TRAFFIC VARIATIONS



1) NHDOT Permanent Recorder Station 02321001 was discontinued in Spring of 2002

78601

Figure 3

Regional Access Routes/Permanent Recorder Station - Temporal Variations

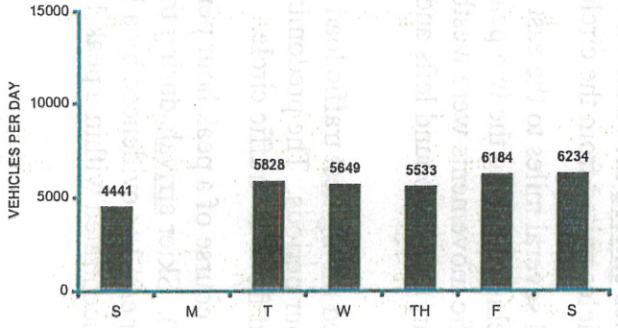
Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

The graphs on Figure 4 depict the results from the latest NHDOT traffic recorder counts on the three major legs of the traffic circle. These data are several years old and reflect summer (July and September) traffic demand. Nevertheless, this data illustrates that the peak hour volumes on the two NH103 stations ranged from 500 to 600 vehicles per hour (vph), and the NH103-B station exhibits the lowest volumes, which are on the order of 200 vph.

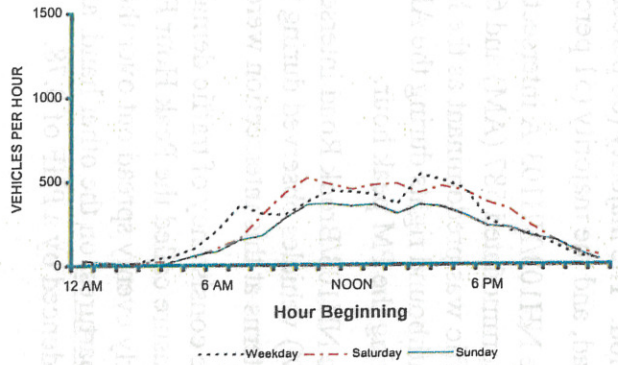
Pernaw & Company

LOCATION 2 - NH 103
(Over Johnson Brook)

DAILY TRAFFIC VARIATIONS
(September 2002)

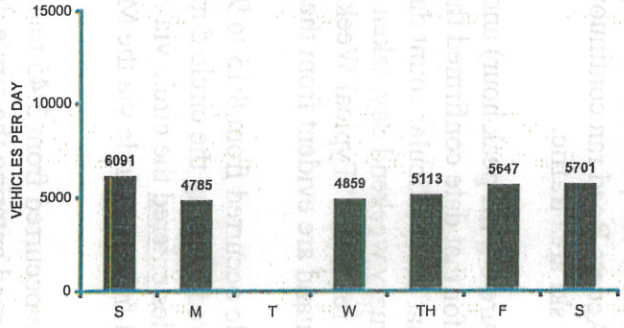


HOURLY TRAFFIC VARIATIONS

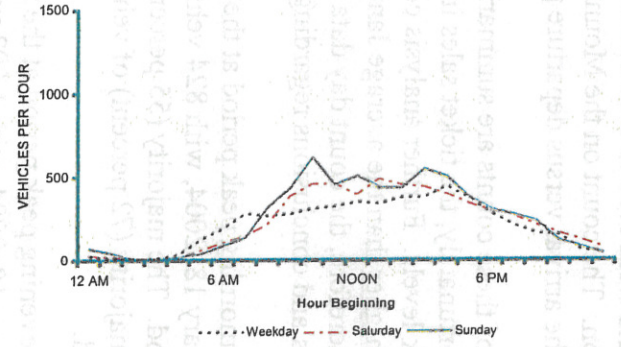


LOCATION 3 - NH 103
(Newbury - Sunapee Town Line)

DAILY TRAFFIC VARIATIONS
(July 2001)

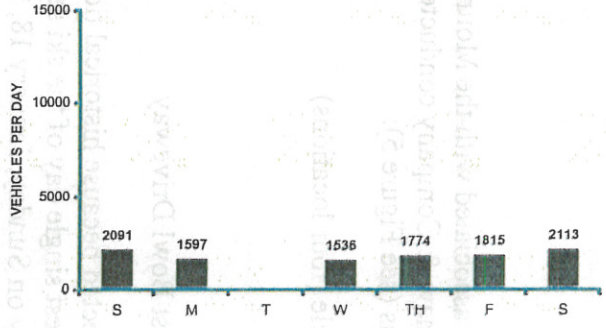


HOURLY TRAFFIC VARIATIONS

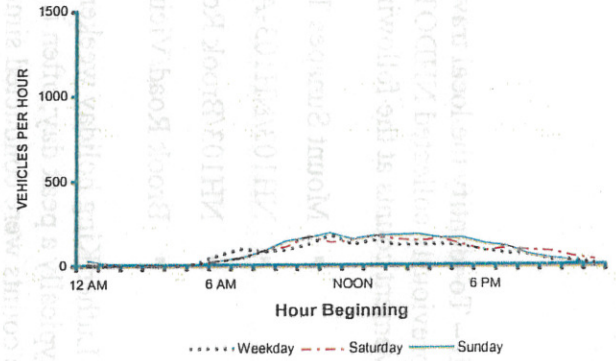


LOCATION 4 - NH 103B
(Newbury - Sunapee Town Line)

DAILY TRAFFIC VARIATIONS
(July 2001)



HOURLY TRAFFIC VARIATIONS



78601

* Data not available

Figure 4

Short-Term Recorder Stations - Temporal Variations

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

C. LOCAL – To identify the local travel patterns associated with the Mount Sunapee Resort, and update the previously collected NHDOT data, Pernaw & Company conducted detailed intersection turning movement counts at the following locations (see Figure 5):

- Mount Sunapee Traffic Circle (four locations)
- NH103/NH103-A
- NH103/Brook Road
- Brook Road/Vicinity of West Bowl Driveway

The Martin Luther King holiday weekend was selected because historical ticket sales data confirms that this is typically a peak day; often it is the busiest single day of the ski season. Consequently, these traffic counts were conducted simultaneously on Sunday, January 18, 2004, from 8:00 to 11:00 AM and from 3:00 to 5:00 PM in order to observe the peak one-hour period in the morning and afternoon. The count on the Mount Sunapee Access Road ran continuously throughout the day to tabulate the arrival versus departure patterns for ski area traffic.

The results of these counts are summarized on Figure 6 (AM peak hour) and Figure 7 (PM peak hour). Unfortunately, the ticket sales information for that date confirmed that it was well below historic peak levels. Further analysis confirmed that that particular count day was approximately ten percent higher than the average January – February weekend day, taken over the last four ski seasons. Therefore, the count day data reasonably reflects a "Typical Weekend Day" condition. Several facts and conclusions regarding traffic demand are evident from these data:

- The morning peak period at the traffic circle occurred from 8:15 to 9:15 AM on Sunday, January 18, 2004, with 824 vehicles observed entering the circle during that one-hour period. The majority (55 percent) of vehicles entered the circle via NH103 westbound, and the majority (72 percent) of vehicles exited from the circle via the Mount Sunapee Access Road.
- The evening peak period at the traffic circle occurred from 3:45 to 4:45 PM on Sunday, January 18, 2004, with 1,003 vehicles observed entering the circle during that one-hour period. The majority (66 percent) of vehicles entered the circle via Mount Sunapee Access Road, and the majority (51 percent) of vehicles exited from the circle via NH103 eastbound.
- The NH103/NH103-A intersection, located several miles to the east of the traffic circle, accommodated 587 (AM) and 608 (PM) vehicles during the two peak hour periods. Skier traffic was predominant as the heavier traffic movements were westbound through and southbound rights during the AM peak hour, and eastbound lefts and eastbound throughs during the PM peak hour.
- The NH103/Brook Road intersection carried the lightest traffic load with 239 (AM) and 376 (PM) vehicles observed during the peak hour periods. The predominant turning movement patterns at this intersection were also to and from the traffic circle.
- The consistency of traffic demand over the course of a peak hour period is quantified by a measure called the Peak Hour Factor (PHF). Skier arrivals during the AM peak hour were fairly evenly spread out over the one-hour period as evidenced by a PHF of 0.84. Skier departures, on the other hand, are more concentrated within a peak 15-minute interval as evidenced by a PHF of 0.78.

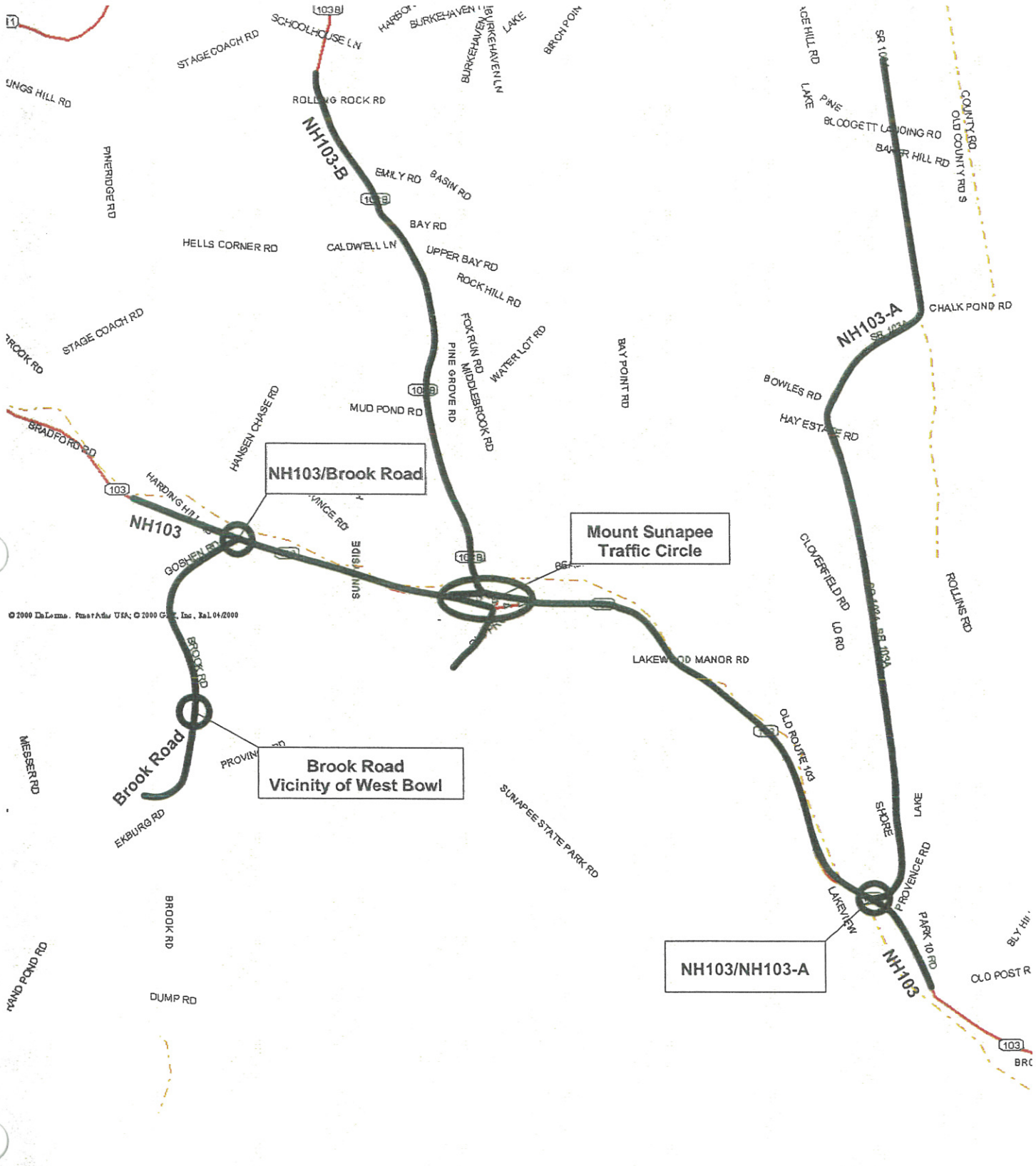


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Figure 5

Local Access Routes (with Intersection Turning Movement Count Locations)

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

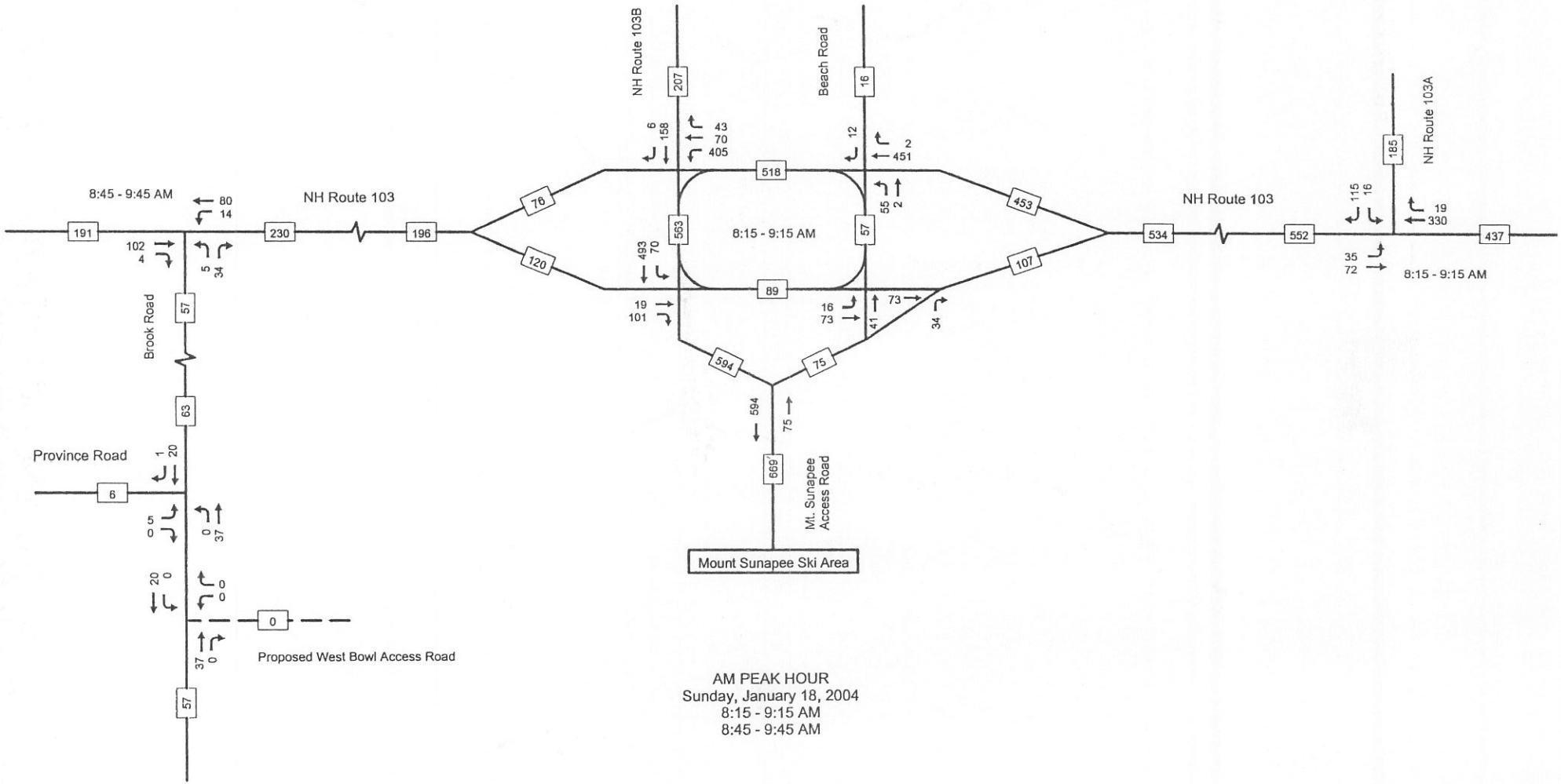

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Figure 6

2004 Existing Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed S[illegible] Expansion, Newbury, New Hampshire

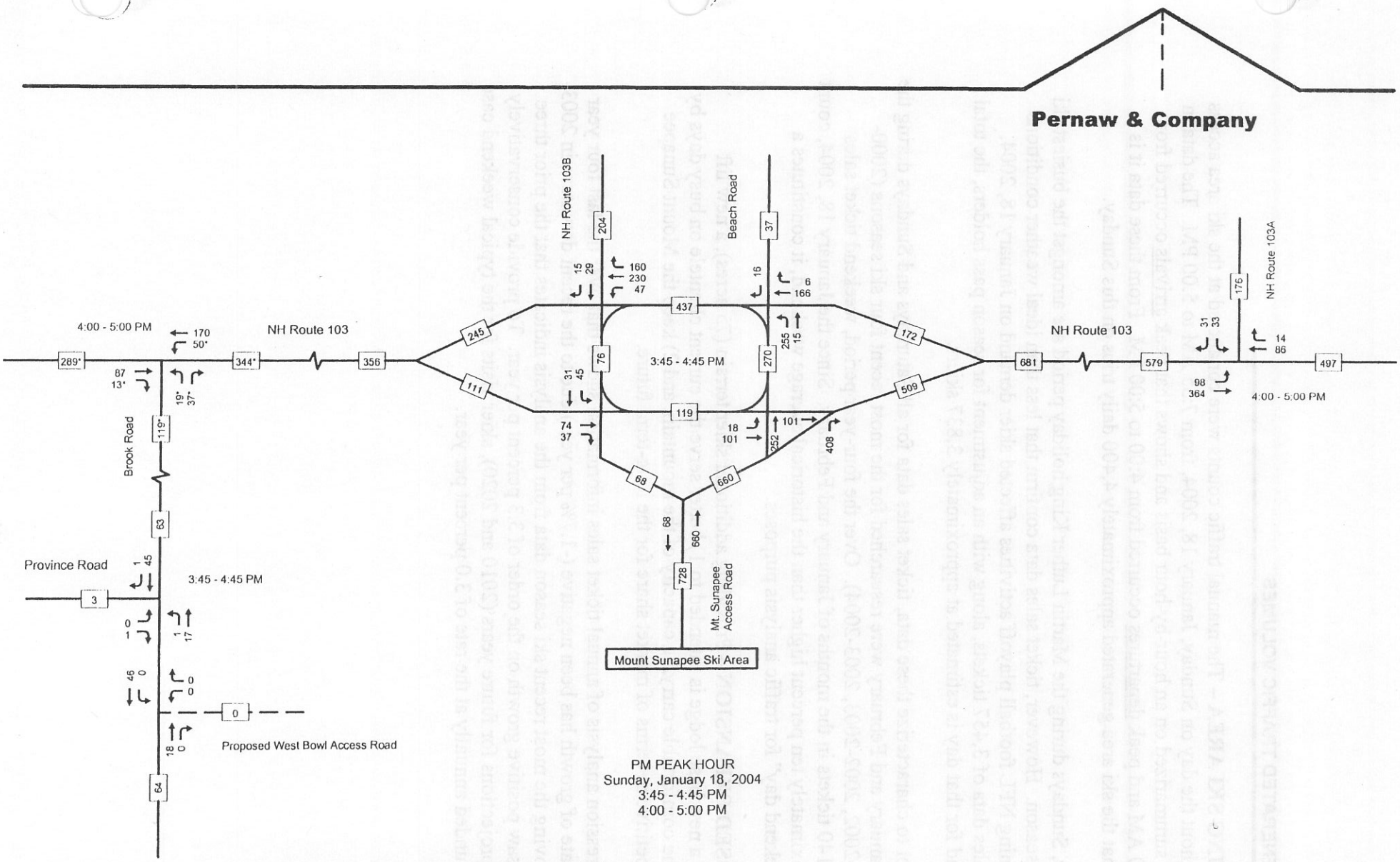

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Figure 7

2004 Existing Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

IV. SITE GENERATED TRAFFIC VOLUMES

A. EXISTING SKI AREA – The manual traffic counts were conducted at the ski area access road throughout the day on Sunday, January 18, 2004, from 7:35 AM to 5:00 PM. The data in Table 1 are summarized on an hour-by-hour basis and shows that peak arrivals occurred from 8:00 to 9:00 AM and peak departures occurred from 4:00 to 5:00 PM. From these data it is estimated that the ski area generated approximately 4,400 daily trips on this Sunday.

Historically, Sundays during the Martin Luther King holiday period are amongst the busiest ski days of the season. However, ticket sales data confirm that less than ideal weather conditions and the evening NFL football playoff activities affected skier demand on January 18, 2004. Based on sales data of 3,457 tickets, along with an adjustment for season pass holders, the total skier demand for that day is estimated at approximately 3,837 skiers.

In an attempt to characterize these data, ticket sales data for all Saturdays and Sundays during the months of January and February were researched for the most recent four ski seasons (2000-2001, 2001-2002, 2002-2003, 2003-2004). Over the four-year period, weekend ticket sales averaged 3,140 tickets in the months of January and February. Since the January 18, 2004, count day is approximately ten percent higher than the historical average weekend, it constitutes a "typical weekend day" for traffic analysis purposes.

B. PROPOSED EXPANSION – Providing additional skier terrain (75 acres), a new lift facility, and a new base lodge is intended to 1) better serve the current clientele on busy days by increasing the comfortable carrying capacity of the mountain, and 2) keep the Mount Sunapee Resort competitive in terms of market share for the long-term future.

A linear regression analysis of annual ticket sales information shows that over the last four year period, the rate of growth has been negative (-1.7% per year) due to the recent downturn in 2003-2004. Removing the most recent ski season data from the analysis indicates that the prior three year period saw positive growth on the order of 3.3 percent per year. To provide conservatively high traffic projections for future years (2010 and 2020), skier visits for the typical weekend case were compounded annually at the rate of 3.0 percent per year.

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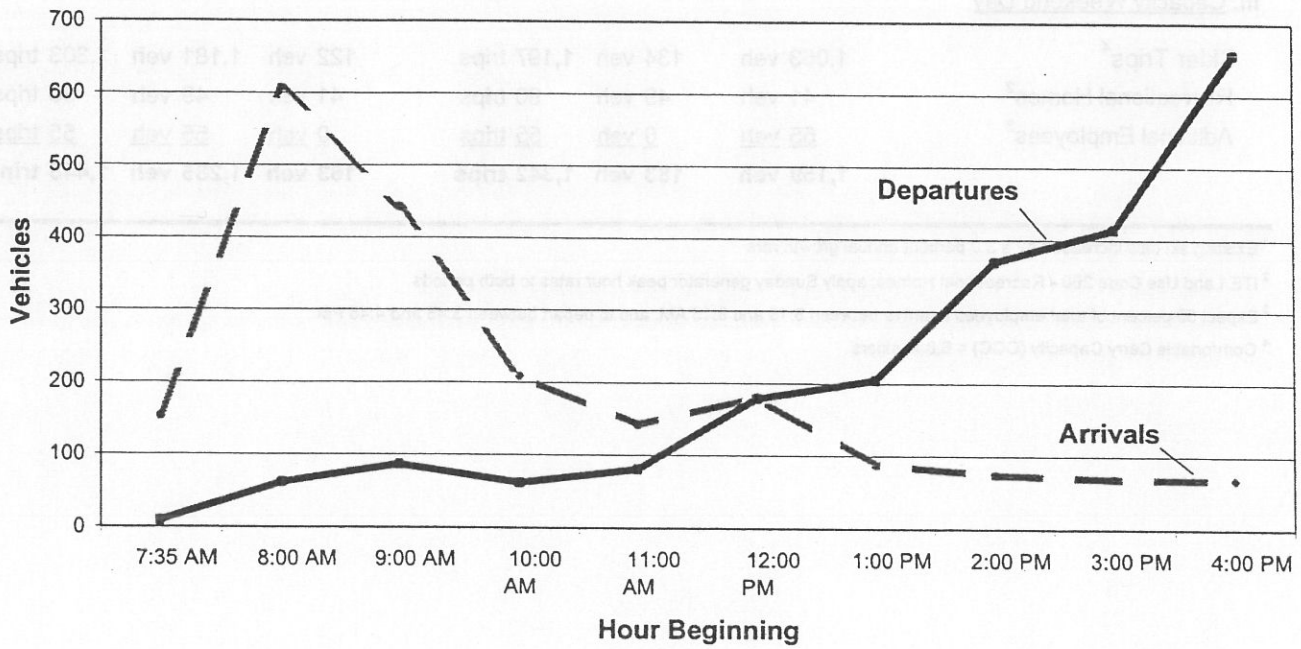
Table 1

Mount Sunapee Ski Area
Existing Site Generated Traffic Volumes

Sunday, January 18, 2004 (Martin Luther King Weekend)

	In		Out		Total	
7:35 - 8:00 AM*	218 veh	(10%)	14 veh	(1%)	232 trips	(5%)
8:00 - 9:00 AM	**607 veh**	**(29%)**	**62 veh**	**(3%)**	**669 trips**	**(16%)**
9:00 - 10:00 AM	443 veh	(21%)	87 veh	(4%)	530 trips	(13%)
10:00 - 11:00 AM	209 veh	(10%)	62 veh	(3%)	271 trips	(6%)
11:00 AM - 12:00 PM	142 veh	(7%)	81 veh	(4%)	223 trips	(5%)
12:00 - 1:00 PM	181 veh	(9%)	179 veh	(8%)	360 trips	(9%)
1:00 - 2:00 PM	88 veh	(4%)	205 veh	(10%)	293 trips	(7%)
2:00 - 3:00 PM	75 veh	(4%)	369 veh	(17%)	444 trips	(11%)
3:00 - 4:00 PM	69 veh	(3%)	414 veh	(19%)	483 trips	(11%)
4:00 - 5:00 PM	**68 veh**	**(3%)**	**657 veh**	**(31%)**	**725 trips**	**(17%)**
Sunday Total	2100 veh	(100%)	2130 veh	(100%)	4230 trips	(100%)

* Not a full hour



In addition to skiers, the West Bowl Expansion project will also generate traffic from the recreational homes (up to 250 condominium units), and additional employees (108 persons). Table 2 and Table 3 summarize the results of the trip generation analysis for the entire Mount Sunapee Resort.

Table 2 — Trip Generation Derivation

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
I. 2010 Typical Weekend Day						
Skier Trips[1]	707 veh	89 veh	796 trips	81 veh	785 veh	866 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	803 veh	**138 veh**	**941 trips**	**122 veh**	**889 veh**	**1,011 trips**
II. 2020 Typical Weekend Day						
Skier Trips[1]	956 veh	121 veh	1,077 trips	109 veh	1,063 veh	1,172 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	1,052 veh	**170 veh**	**1,222 trips**	**150 veh**	**1,167 veh**	**1,317 trips**
III. Capacity Weekend Day						
Skier Trips[4]	1,063 veh	134 veh	1,197 trips	122 veh	1,181 veh	1,303 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	1,159 veh	**183 veh**	**1,342 trips**	**163 veh**	**1,285 veh**	**1,448 trips**

[1] Existing ski trips increased by a 3.0 percent annual growth rate

[2] ITE Land Use Code 260 - Recreational Homes; apply Sunday generator peak hour rates to both periods

[3] Expect 50 percent of total employees to arrive between 8:15 and 9:15 AM, and to depart between 3:45 and 4:45 PM

[4] Comfortable Carry Capacity (CCC) = 6,850 skiers

C. TRIP DISTRIBUTION – Identifying the various travel routes that are used by skiers is an important consideration in preparing the future traffic projections for the West Bowl Expansion project. The annual "Guest Research Summary" reports prepared for the resort have consistently shown that approximately 65 percent of the visitors have trip origins from the following counties in southeast New Hampshire and eastern Massachusetts: Merrimack, Rockingham, Hillsborough, Essex, Middlesex, Suffolk, Norfolk, and Plymouth counties. The following travel patterns were derived from intersection turning movement count data and corroborate the finding from guest research information.

Gateway	Percentage
1. NH103 (east)	46%
2. NH103-A (north)	16%
3. NH103-B (north)	21%
4. NH103 (west)	12%
5. Brook Road (south)	5%
Total	100%

The distribution of vehicle trips associated with the future additional employees and the recreational homes are expected to be similar. It should be noted that the small percentage that utilizes Brook Road for access will likely utilize the West Bowl parking lot rather then continue up to NH103 and the traffic circle. Similarly, those traveling to/from points west on NH103 will likely use both points of access to the mountain. Such trip diversions to the new facility will translate into trip reductions on NH103 and the traffic circle, whereas the additional skiers, employees, and residents translate into traffic increases. The net changes to peak period traffic flows are presented in a later section.

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D. FUTURE TRAFFIC PROJECTIONS – Since full buildout of the West Bowl expansion project may occur by 2010, this year was selected as the base year for this study. Consistent with standard practice for conducting traffic impact studies in New Hampshire, a ten-year planning horizon (2020) was selected for analysis purposes.

These projections were prepared for the "Typical Weekend Day" case and for a "Capacity Weekend Day" for both the peak arrival period (AM) and the peak departure period (PM). The following table identifies the various cases and the corresponding traffic projection figures.

	2010 Base Year		2020 Horizon Year	
	Typical Weekend	Capacity Weekend	Typical Weekend	Capacity Weekend
AM Peak Hour (Arrival Period)	Figure 8	Figure 10	Figure 12	Figure 14
PM Peak Hour (Departure Period)	Figure 9	Figure 11	Figure 13	Figure 15

These traffic projections are all inclusive in that they reflect skier vehicles, service vehicles, shuttles, employee trips, and are predicated on full occupancy of all quarter-share units. For analysis purposes, the subsequent traffic projections are based on the upper limit of 250 condominium units.

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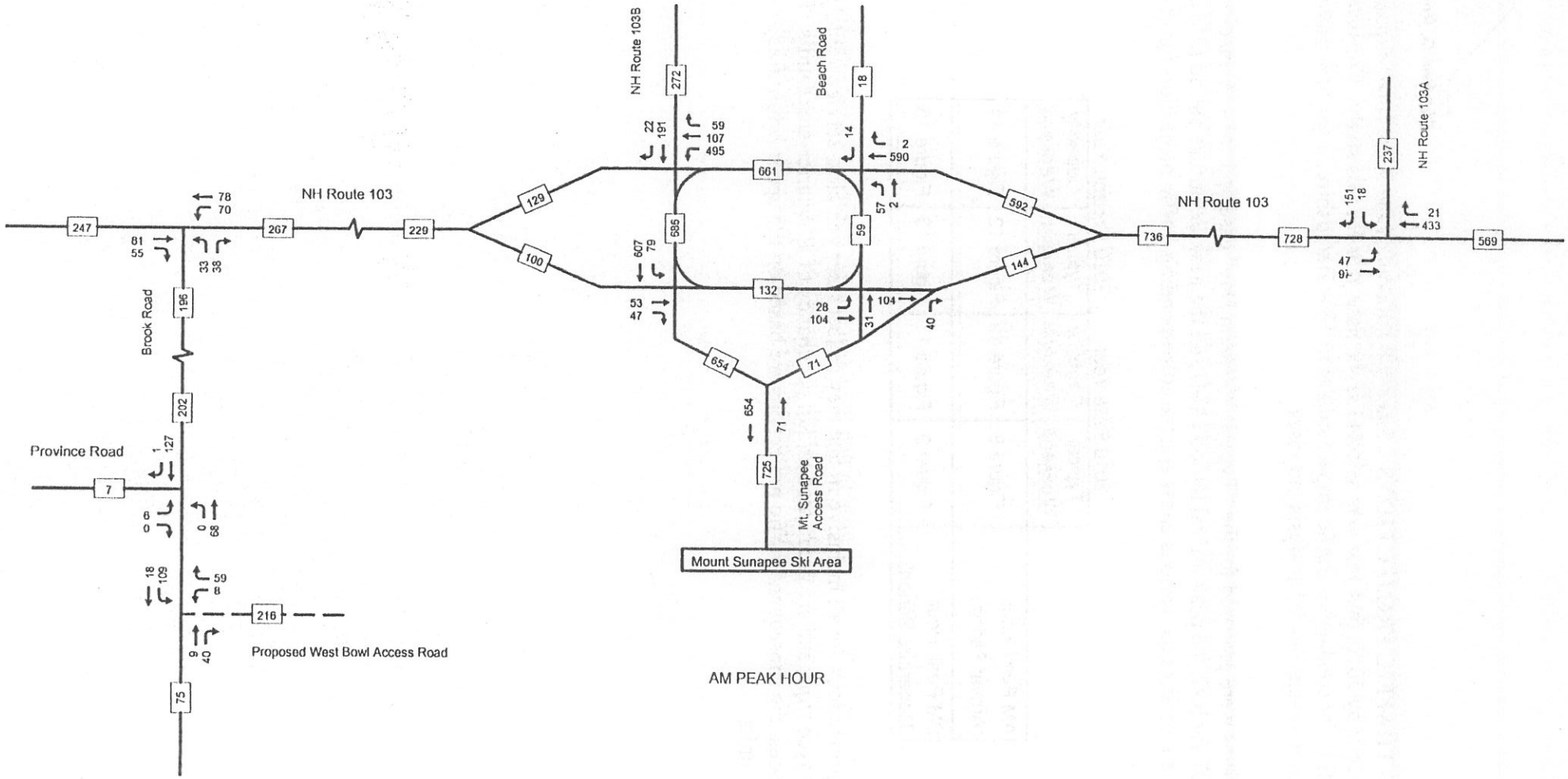

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Figure 8

2010 Typical Weekend Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

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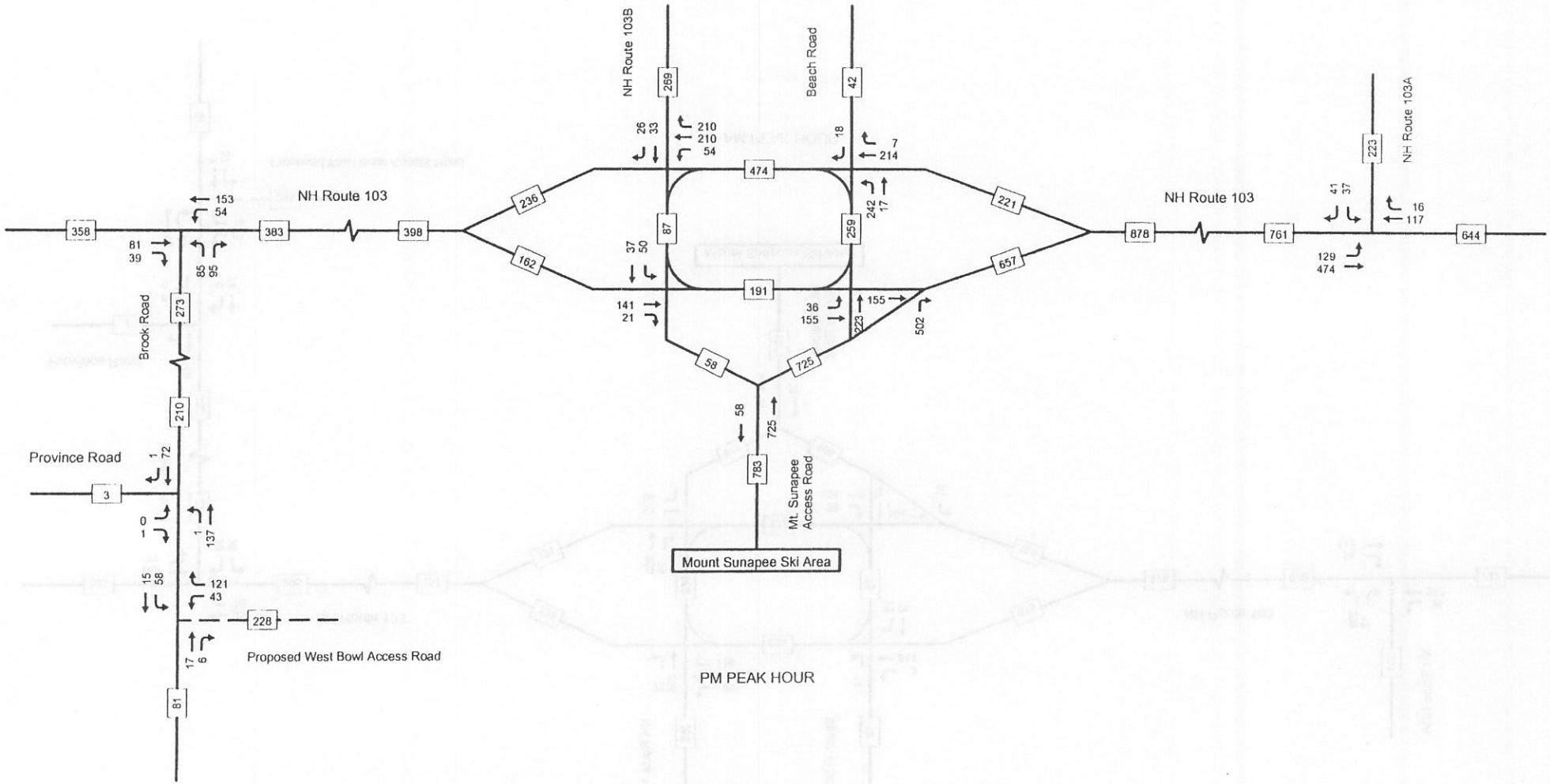

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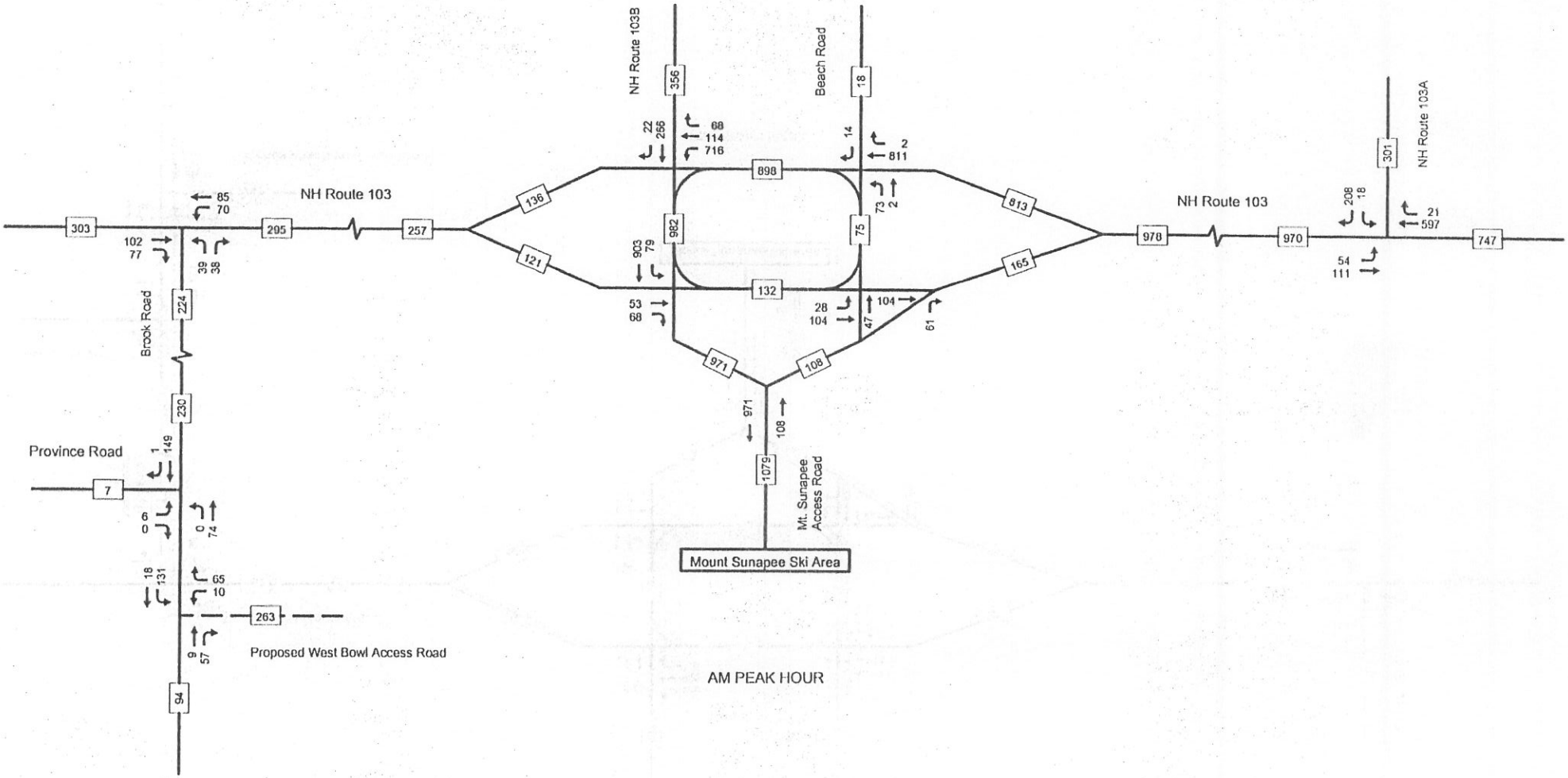
Figure 9

2010 Typical Weekend Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire



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NORTH

Figure 10

2010 Capacity Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

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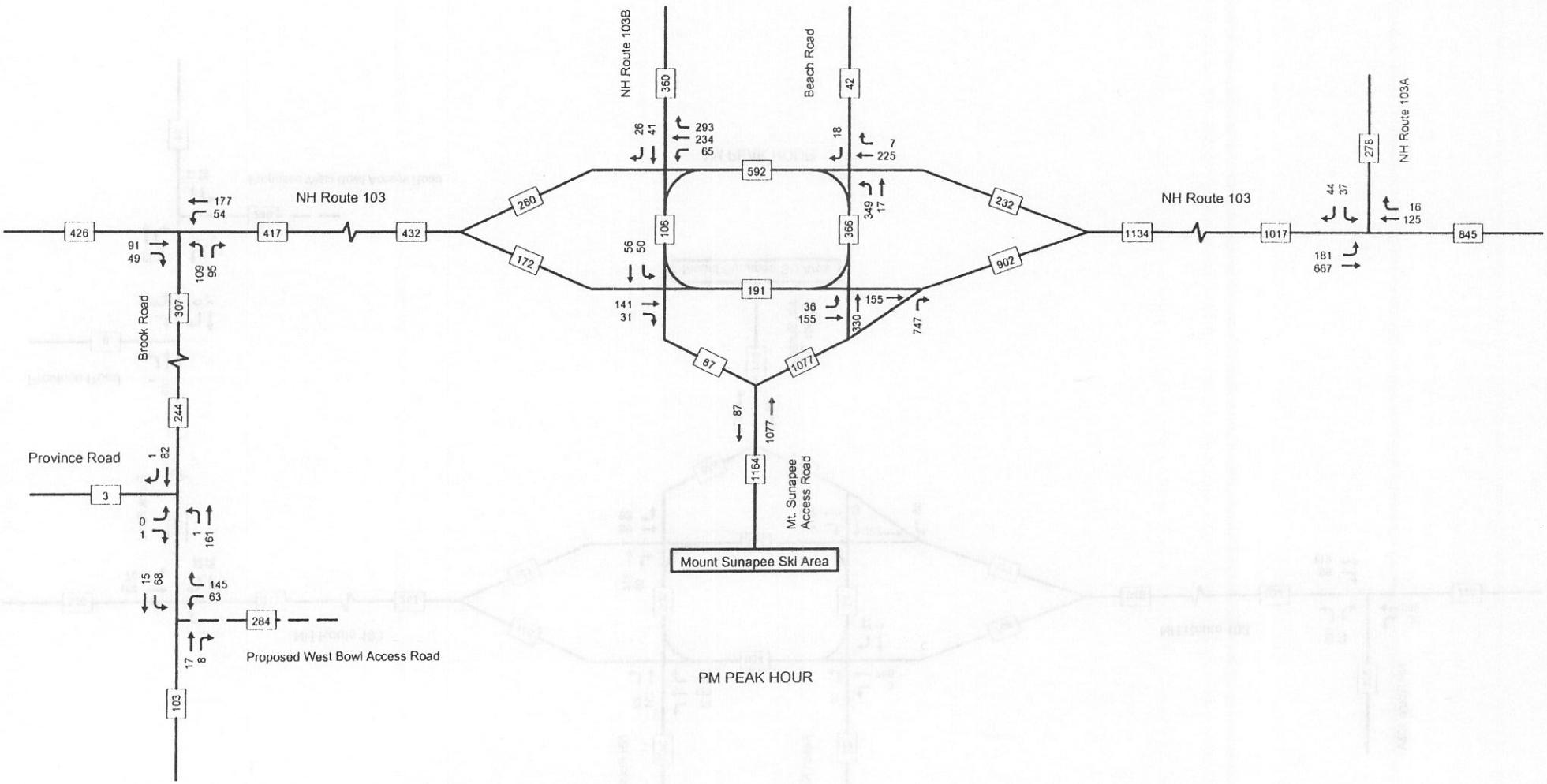

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Figure 11

2010 Capacity Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company

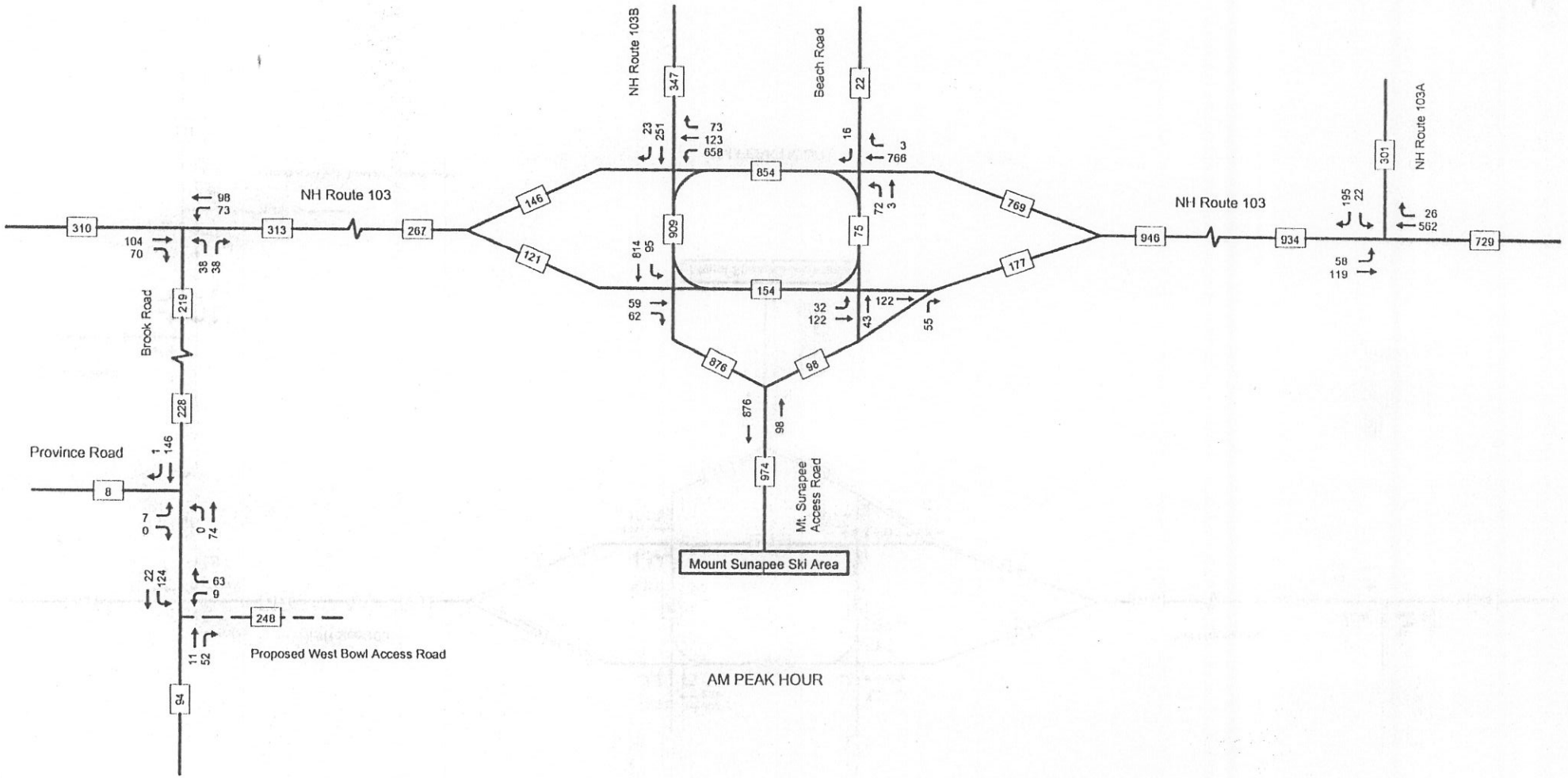

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Figure 12

2020 Typical Weekend Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

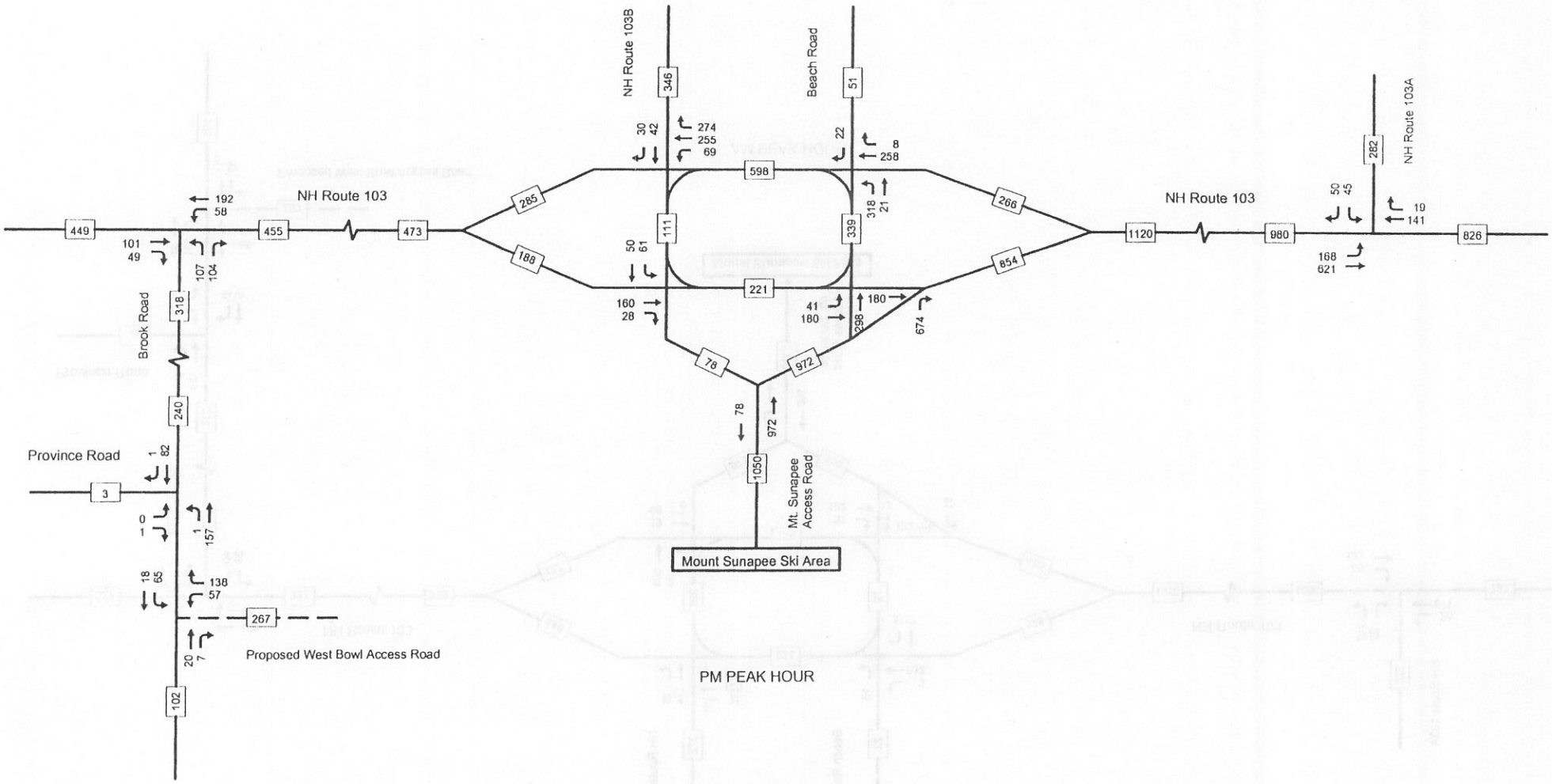

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Figure 13

2020 Typical Weekend Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company

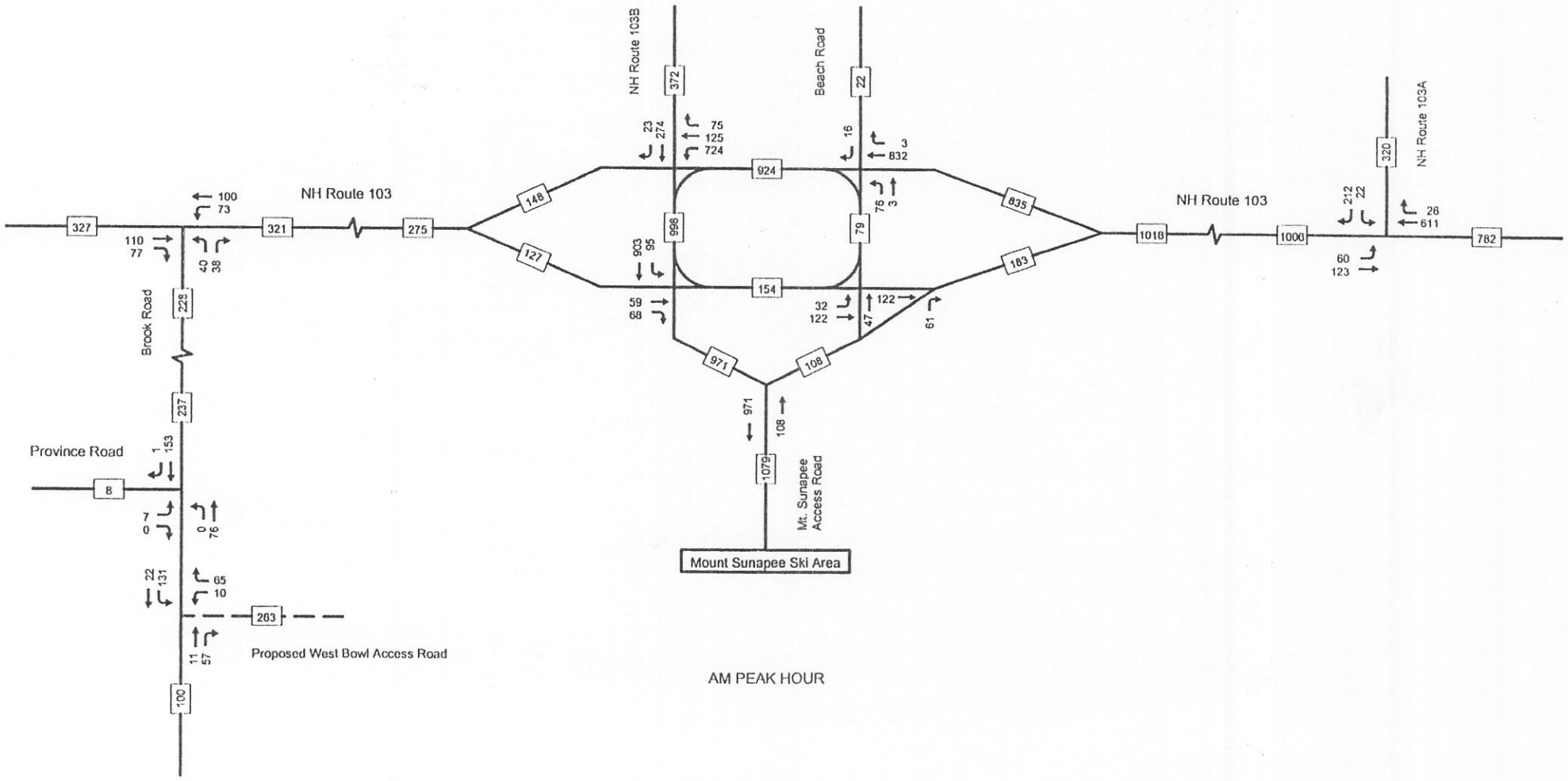

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Figure 14

2020 Capacity Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company

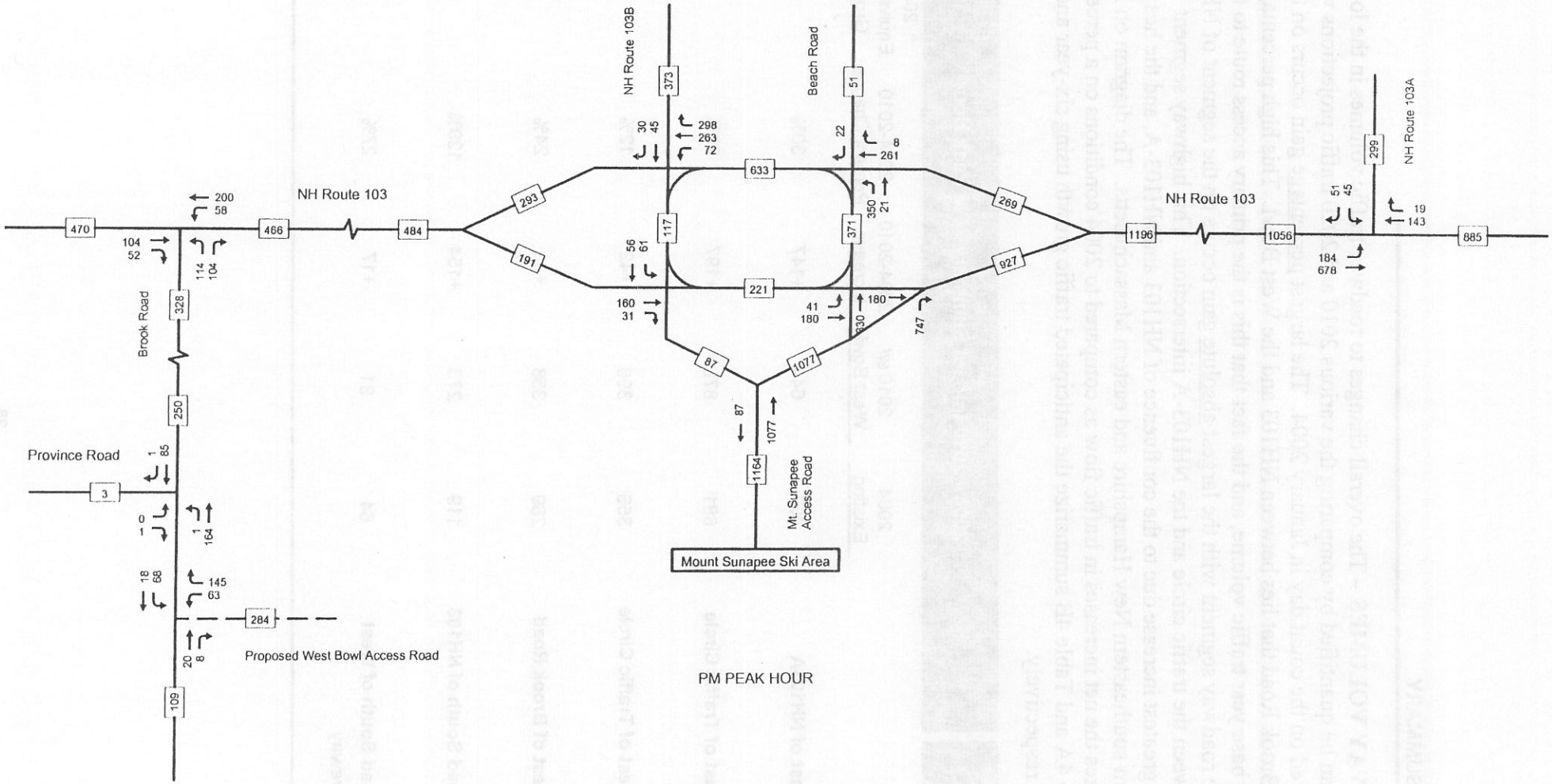

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Figure 15

2020 Capacity Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

V. IMPACT SUMMARY

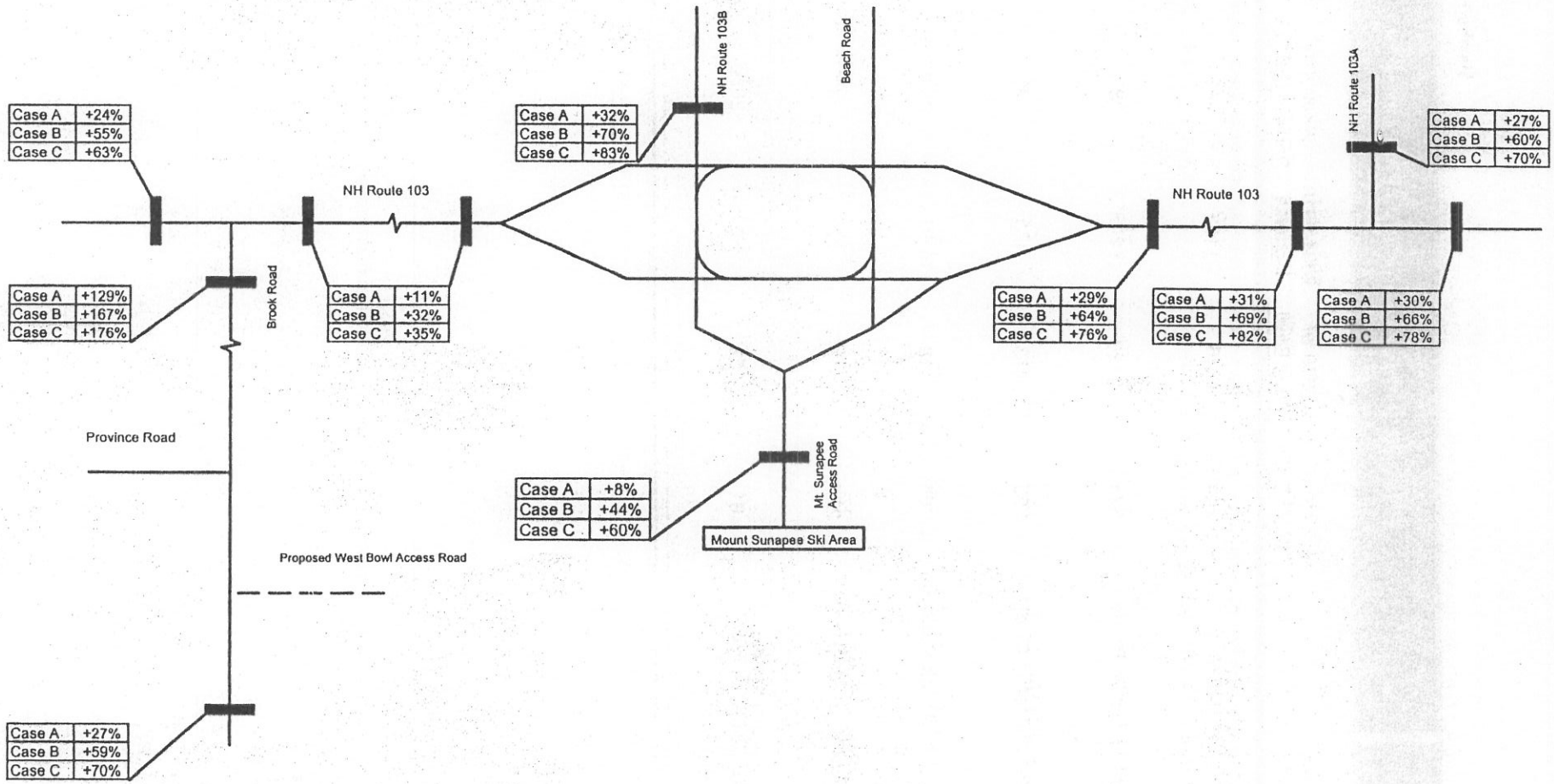
A. ROADWAY VOLUMES – The overall changes to roadway traffic volumes in the local study area can be quantified by comparing the various 2010 and 2020 traffic projections with those observed on the count day in January 2004. The largest percentage gain occurs on the segment of Brook Road that lies between NH103 and the West Bowl. This high percentage is due to a low base year traffic volume, and the fact that this is the primary access route to the new facility. The roadway segment with the largest absolute gain occurs on the segment of NH103 that lies between the traffic circle and the NH103-A intersection. This highway segment receives the greatest increase due to the confluence of NH103 and NH103-A, and the heavy draw of skiers from southeastern New Hampshire and eastern Massachusetts. The diagram on Figure 16 summarizes the net increases in traffic flow as compared to 2004 conditions on a percentage basis. Table 4A and Table 4B summarize the anticipated traffic growth using six-year and ten-year periods respectively.

Table 4A — **2004 - 2010 Impact Summary - PM Peak Hour**

Checkpoint	2004 Existing	2010 w/ West Bowl	2004-2010 Increase	2004-2010 Percent Change	2004-2010 Equivalent Annual Growth Rate
1. NH103 East of NH103A	497	644	+147	30%	4%
2. NH103 East of Traffic Circle	681	878	+197	29%	4%
3. NH103 West of Traffic Circle	356	398	+42	12%	2%
4, NH103 West of Brook Road	289	358	+69	24%	4%
5. Brook Road South of NH103	119	273	+154	129%	15%
6. Brook Road South of West Bowl Driveway	64	81	+17	27%	4%

Table 4B — **2010 - 2020 Impact Summary - PM Peak Hour**

Checkpoint	2010 w/ West Bowl	2020 w/ West Bowl	2004-2010 Increase	2004-2010 Percent Change	2004-2010 Equivalent Annual Growth Rate
1. NH103 East of NH103A	644	826	+182	28%	3%
2. NH103 East of Traffic Circle	878	1120	+242	28%	3%
3. NH103 West of Traffic Circle	398	473	+75	19%	2%
4, NH103 West of Brook Road	358	449	+91	25%	2%
5. Brook Road South of NH103	273	318	+45	16%	2%
6. Brook Road South of West Bowl Driveway	81	102	+21	26%	2%



Case A - 2004 Count Day versus 2010 Typical Weekend Day
Case B - 2004 Count Day versus 2020 Typical Weekend Day
Case C - 2004 Count Day versus 2020 Capacity Weekend Day

NORTH

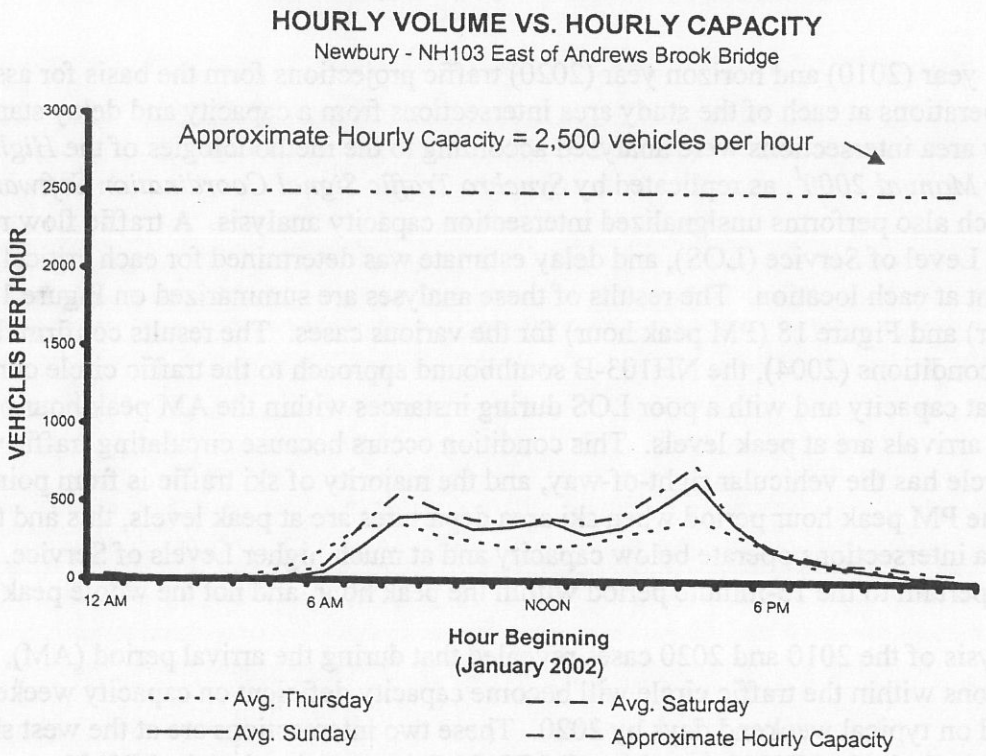
Figure 16

Traffic Volume Increases (2004 vs. Future Years) - PM Peak Hour Case

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

B. ROADWAY CAPACITY – The term "roadway capacity" in this case refers to the maximum sustained hourly flow rate at which vehicles can reasonably be expected to traverse a uniform two-lane section under a set of roadway and traffic conditions. The capacity of a two-lane highway is 1,700 passenger cars per hour in each direction, with a maximum of 3,200 for travel in both directions. Taking into account that NH103 follows a rolling terrain (is not level) and that it accommodates a mix of passenger cars and trucks, the hourly capacity is conservatively estimated at approximately 2,500 vph (total both directions).

The future traffic projections for 2020 on Figure 15 indicate that the two-way traffic volume on NH103 is less than 1,200 vph during worst-case conditions. Accordingly, this two-lane section of NH103 exhibits ample capacity to accommodate the future traffic volumes during the ski season. There is no need to widen NH103 to a four-lane highway as a result of future growth at Mount Sunapee. The following diagram compares the hourly traffic volumes on NH103 at the permanent recorder station (east of Andrews Brook Bridge) with the approximate capacity of the highway. This graph shows that roadway capacity is not a constraint.



C. INTERSECTION CAPACITY – In addition to roadway capacity, intersections themselves have separate capacities and in some cases they can affect the flow of traffic on a particular roadway segment. Capacity and Level of Service (LOS) calculations pertaining to unsignalized intersections with STOP and YIELD sign control address the quality of service for those vehicles turning into and out of intersecting side streets. The availability of adequate gaps in the traffic stream on the major street actually controls the potential capacity for vehicle movements to and

from the intersecting side streets and driveways. Levels of Service are simply letter grades (A-F) that categorize the vehicle delays associated with specific turning maneuvers. Table 5 describes the criteria used in this analysis.

Table 5 — Level-of-Service Criteria for Unsignalized Intersections

Level of Service	Control Delay (seconds/vehicle)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

Source: Transportation Research Board, Highway Capacity Manual 2000.

The base year (2010) and horizon year (2020) traffic projections form the basis for assessing traffic operations at each of the study area intersections from a capacity and delay standpoint. All study area intersections were analyzed according to the methodologies of the *Highway Capacity Manual 2000*[1], as replicated by *Synchro Traffic Signal Coordination Software (Version 6.0)*, which also performs unsignalized intersection capacity analysis. A traffic flow rate, capacity, Level of Service (LOS), and delay estimate was determined for each critical traffic movement at each location. The results of these analyses are summarized on Figure 17 (AM peak hour) and Figure 18 (PM peak hour) for the various cases. The results confirm that under existing conditions (2004), the NH103-B southbound approach to the traffic circle currently operates at capacity and with a poor LOS during instances within the AM peak hour period, when ski arrivals are at peak levels. This condition occurs because circulating traffic within the traffic circle has the vehicular right-of-way, and the majority of ski traffic is from points east. During the PM peak hour period when ski area departures are at peak levels, this and the other study area intersections operate below capacity and at much higher Levels of Service. These analyses pertain to the 15-minute period within the peak hour, and not the whole peak hour.

The analysis of the 2010 and 2020 cases revealed that during the arrival period (AM), two intersections within the traffic circle will become capacity deficient on capacity weekend days in 2010, and on typical weekend days by 2020. These two intersections are at the west side of the circle and include the NH103 (westbound)/NH103-B intersection and the NH103 (EB)/Circulating Ramp intersection. Analysis of the departure period (PM) indicates that the Mount Sunapee Access Road "slip ramp" to NH103 (eastbound) will experience congestion by 2020 on capacity days only. The remaining study area intersections will operate below capacity through the horizon year 2020, with the expanded ski area in full operation, and all quarter-share condominium units fully occupied.

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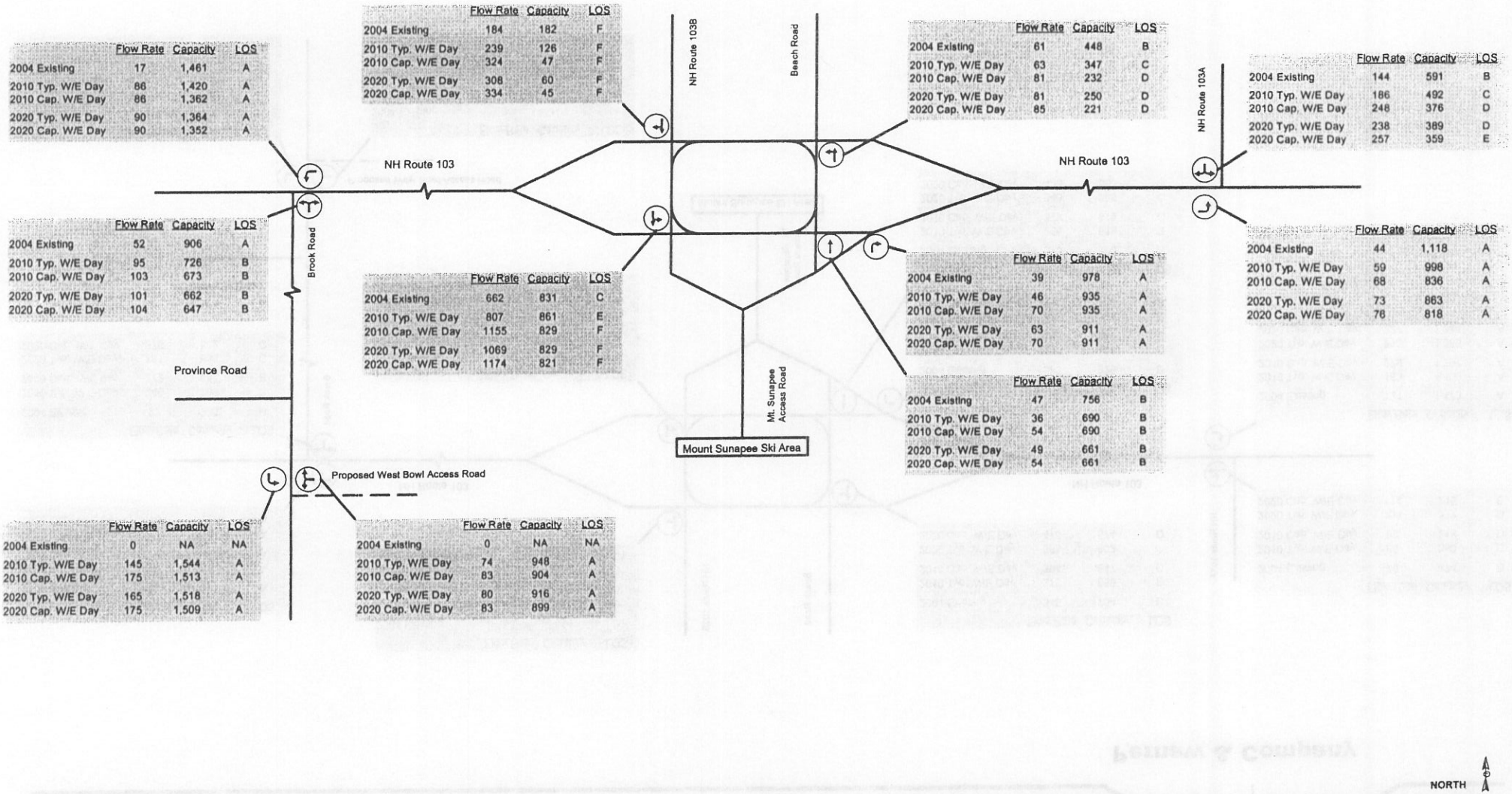
[1] Transportation Research Board, *Highway Capacity Manual* (Washington, D.C., 2000).



	Flow Rate	Capacity	LOS
2004 Existing	17	1,461	A
2010 Typ. W/E Day	86	1,420	A
2010 Cap. W/E Day	86	1,362	A
2020 Typ. W/E Day	90	1,364	A
2020 Cap. W/E Day	90	1,352	A

	Flow Rate	Capacity	LOS
2004 Existing	184	182	F
2010 Typ. W/E Day	239	126	F
2010 Cap. W/E Day	324	47	F
2020 Typ. W/E Day	308	60	F
2020 Cap. W/E Day	334	45	F

	Flow Rate	Capacity	LOS
2004 Existing	61	448	B
2010 Typ. W/E Day	63	347	C
2010 Cap. W/E Day	81	232	D
2020 Typ. W/E Day	81	250	D
2020 Cap. W/E Day	85	221	D

	Flow Rate	Capacity	LOS
2004 Existing	144	591	B
2010 Typ. W/E Day	186	492	C
2010 Cap. W/E Day	248	376	D
2020 Typ. W/E Day	238	389	D
2020 Cap. W/E Day	257	359	E

	Flow Rate	Capacity	LOS
2004 Existing	52	906	A
2010 Typ. W/E Day	95	726	B
2010 Cap. W/E Day	103	673	B
2020 Typ. W/E Day	101	662	B
2020 Cap. W/E Day	104	647	B

	Flow Rate	Capacity	LOS
2004 Existing	662	831	C
2010 Typ. W/E Day	807	861	E
2010 Cap. W/E Day	1155	829	F
2020 Typ. W/E Day	1069	829	F
2020 Cap. W/E Day	1174	821	F

	Flow Rate	Capacity	LOS
2004 Existing	39	978	A
2010 Typ. W/E Day	46	935	A
2010 Cap. W/E Day	70	935	A
2020 Typ. W/E Day	63	911	A
2020 Cap. W/E Day	70	911	A

	Flow Rate	Capacity	LOS
2004 Existing	44	1,118	A
2010 Typ. W/E Day	59	998	A
2010 Cap. W/E Day	68	836	A
2020 Typ. W/E Day	73	863	A
2020 Cap. W/E Day	76	818	A

	Flow Rate	Capacity	LOS
2004 Existing	47	756	B
2010 Typ. W/E Day	36	690	B
2010 Cap. W/E Day	54	690	B
2020 Typ. W/E Day	49	661	B
2020 Cap. W/E Day	54	661	B

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	145	1,544	A
2010 Cap. W/E Day	175	1,513	A
2020 Typ. W/E Day	165	1,518	A
2020 Cap. W/E Day	175	1,509	A

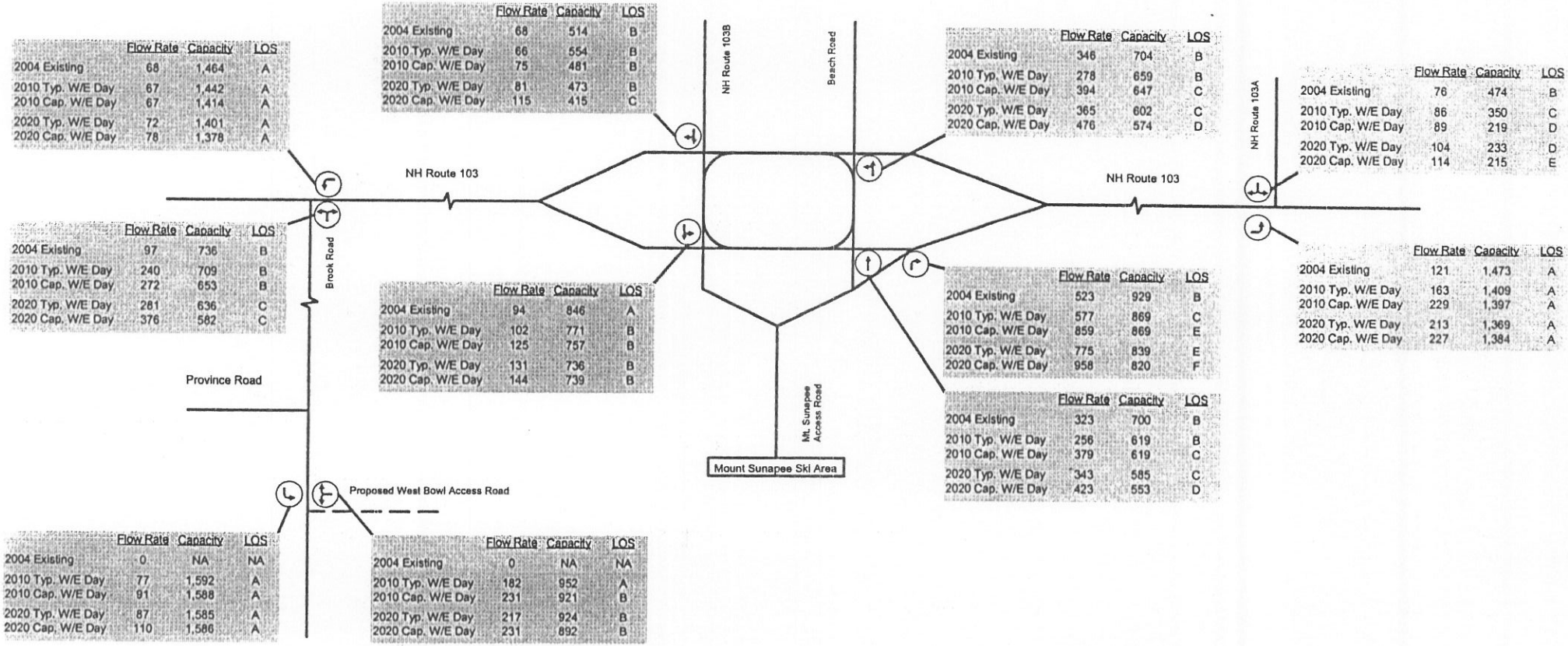
	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	74	948	A
2010 Cap. W/E Day	83	904	A
2020 Typ. W/E Day	80	916	A
2020 Cap. W/E Day	83	899	A

Figure 17

Stop & Yield Controlled Intersection Capacity Analysis Summary - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company



	Flow Rate	Capacity	LOS
2004 Existing	68	1,464	A
2010 Typ. W/E Day	67	1,442	A
2010 Cap. W/E Day	67	1,414	A
2020 Typ. W/E Day	72	1,401	A
2020 Cap. W/E Day	78	1,378	A

	Flow Rate	Capacity	LOS
2004 Existing	68	514	B
2010 Typ. W/E Day	66	554	B
2010 Cap. W/E Day	75	481	B
2020 Typ. W/E Day	81	473	B
2020 Cap. W/E Day	115	415	C

	Flow Rate	Capacity	LOS
2004 Existing	346	704	B
2010 Typ. W/E Day	278	659	B
2010 Cap. W/E Day	394	647	C
2020 Typ. W/E Day	365	602	C
2020 Cap. W/E Day	476	574	D

	Flow Rate	Capacity	LOS
2004 Existing	76	474	B
2010 Typ. W/E Day	86	350	C
2010 Cap. W/E Day	89	219	D
2020 Typ. W/E Day	104	233	D
2020 Cap. W/E Day	114	215	E

	Flow Rate	Capacity	LOS
2004 Existing	97	736	B
2010 Typ. W/E Day	240	709	B
2010 Cap. W/E Day	272	653	B
2020 Typ. W/E Day	281	636	C
2020 Cap. W/E Day	376	562	C

	Flow Rate	Capacity	LOS
2004 Existing	94	846	A
2010 Typ. W/E Day	102	771	B
2010 Cap. W/E Day	125	757	B
2020 Typ. W/E Day	131	736	B
2020 Cap. W/E Day	144	739	B

	Flow Rate	Capacity	LOS
2004 Existing	523	929	B
2010 Typ. W/E Day	577	869	C
2010 Cap. W/E Day	859	869	E
2020 Typ. W/E Day	775	839	E
2020 Cap. W/E Day	958	820	F

	Flow Rate	Capacity	LOS
2004 Existing	121	1,473	A
2010 Typ. W/E Day	163	1,409	A
2010 Cap. W/E Day	229	1,397	A
2020 Typ. W/E Day	213	1,369	A
2020 Cap. W/E Day	227	1,384	A

	Flow Rate	Capacity	LOS
2004 Existing	323	700	B
2010 Typ. W/E Day	256	619	B
2010 Cap. W/E Day	379	619	C
2020 Typ. W/E Day	343	585	C
2020 Cap. W/E Day	423	553	D

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	77	1,592	A
2010 Cap. W/E Day	91	1,588	A
2020 Typ. W/E Day	87	1,585	A
2020 Cap. W/E Day	110	1,586	A

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	182	952	A
2010 Cap. W/E Day	231	921	B
2020 Typ. W/E Day	217	924	B
2020 Cap. W/E Day	231	892	B

Figure 18

Stop & Yield Controlled Intersection Capacity Analysis Summary - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

To improve traffic operations at these temporary bottleneck locations, the following off-site mitigation is recommended.

- Widen the north side of the traffic circle between NH103-B and the Beach Access Road intersection to provide two westbound travel lanes; one shared lane for through movements (on NH103 westbound) and right-turns (onto NH103-B), and the other an exclusive lane for circulating traffic that is destined for the ski area.
- During the peak ARRIVAL period on weekends only, utilize police officer control from 8:15 to 9:15 AM at two locations within the traffic circle. The vehicular right-of-way needs to be controlled at the NH103 (westbound)/NH103-B intersection and the adjacent NH103 (eastbound)/Circulating Ramp intersection in order for approaching vehicles to traverse the traffic circle efficiently.
- During the peak DEPARTURE period on weekends only, utilize police officer control from 3:45 to 4:45 PM at one location within the traffic circle. Controlling the vehicular right-of-way at the NH103 (eastbound)/Access Road intersection will indirectly create adequate gaps in the traffic stream for skiers exiting onto NH103 (eastbound) via the nearby "slip ramp."

Use of police office control may delay the need for the physical modifications to the traffic circle; however, these should be completed prior to the horizon year 2020. The use of temporary police office control is expected to be needed on capacity days only in 2010, and on typical weekend days by 2020. Coordination between the Mount Sunapee Resort and the Newbury Police Department would ensure that police details are not used on weekend days with below normal skier demand (due to weather or other conditions).

Analysis of these intersections with the recommended traffic mitigation in place is summarized on Figure 19. With police officer control, traffic operations will be similar to traffic signal control. The following table summarizes the criteria used in this type of analysis. The analysis demonstrates that all traffic movements will operate below capacity and at reasonable Levels of Service on capacity weekend days through the horizon year 2020, with the West Bowl expansion project in full operation.

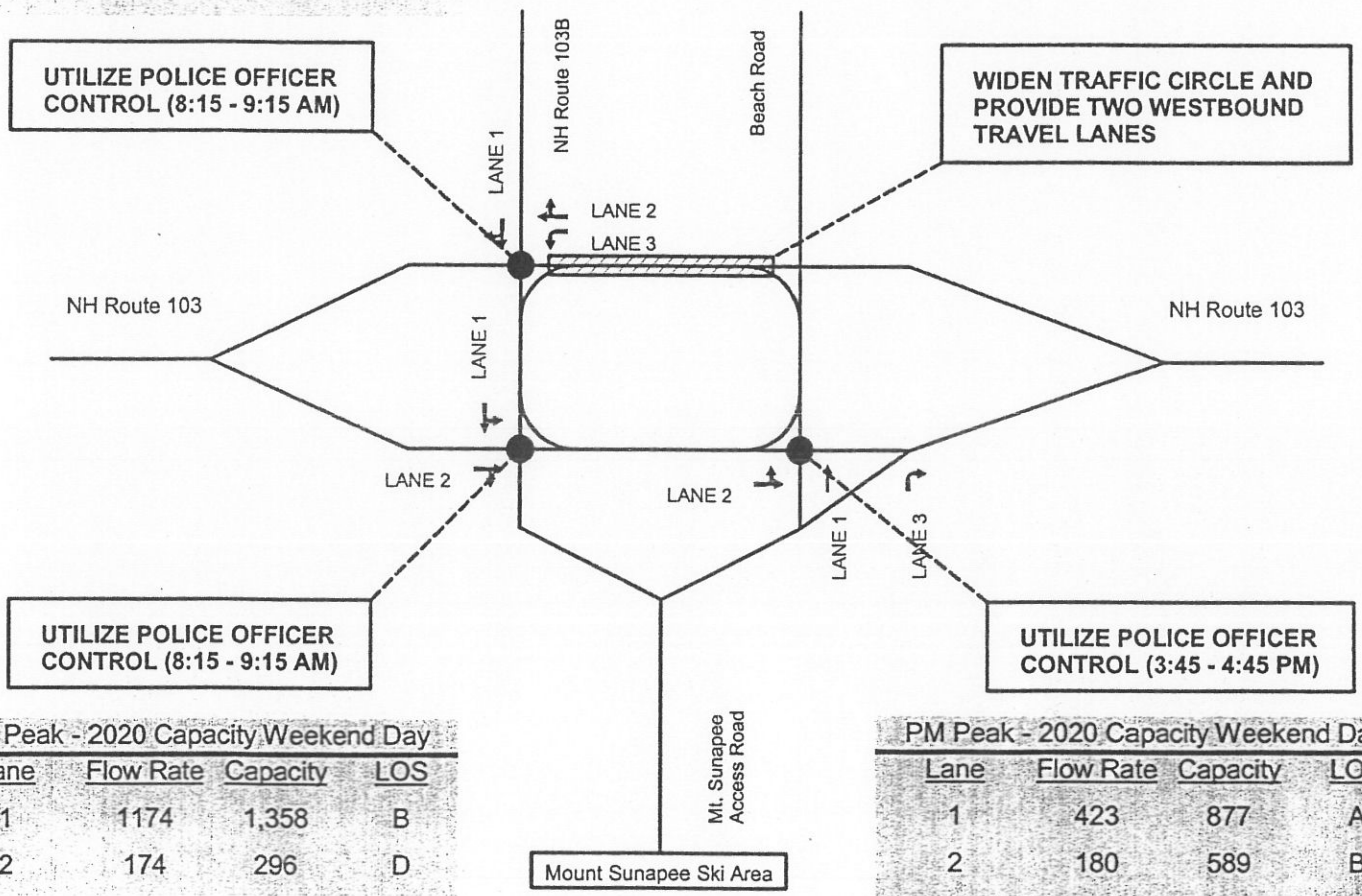
Table 6 — **Level-of-Service Criteria for Signalized Intersections (Police Officer Control)**

Level of Service	Control Delay (seconds/vehicle)
A	< 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

Source: Transportation Research Board, Highway Capacity Manual 2000.

AM Peak - 2020 Capacity Weekend Day

Lane	Flow Rate	Capacity	LOS
1	334	466	D
2	222	1,166	A
3	804	1,174	B



AM Peak - 2020 Capacity Weekend Day

Lane	Flow Rate	Capacity	LOS
1	1174	1,358	B
2	174	296	D

PM Peak - 2020 Capacity Weekend Day

Lane	Flow Rate	Capacity	LOS
1	423	877	A
2	180	589	B
3	958	969	C

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Figure 19

Intersection Capacity Analysis Summary With Mitigation

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

D. OTHER STREETS AND DRIVEWAYS – NH103 is punctuated with many residential driveways, commercial driveways, and local street intersections that operate in an uncontrolled fashion. The section of NH103 that extends between the traffic circle and the NH103-A intersection will receive the greatest increase due to the West Bowl expansion project for reasons stated earlier. For example, during the PM peak hour, the two-way traffic volume on this section of highway is expected to increase from 681 vehicles in 2004, to 878 vehicles in 2010, with the West Bowl in full operation. A generic intersection analysis, that is applicable to any intersecting street or driveway, shows that the increased delays for other vehicles (non-skiers) using these streets and driveways is nominal.

GENERALIZED DRIVEWAY DELAYS ON NH103 - PM Peak Hour Period

	2004 Existing	2010 w/West Bowl	Increased Control Delay
Typical Left-Turn Delay (from minor street)	14.4 sec	17.7 sec	+3.3 sec/veh
Typical Right-Turn Delay (from minor street)	11.8 sec	13.4 sec	+1.6 sec/veh
Typical Left-Turn Arrival Delay (to minor street from NH103)	0.1 sec	0.1 sec	neg

In all cases there is triple digit capacity for each of the critical turning movements at these other streets and driveways on NH103. It should be noted that the increase in delay is not a result of the West Bowl expansion project alone, but is also affected by normal background traffic growth by non-skiers.

E. BROOK ROAD – The width and condition of Brook Road is varied over its entire length between NH103 in Sunapee and NH10 in Goshen. The post development traffic projections for 2020 show that the section north of the West Bowl parking lot will accommodate a total of 250-330 vehicles during peak periods. The section immediately south of the West Bowl complex will accommodate approximately 110 vehicles on a peak hour basis.

Based on these anticipated traffic loads, and a design speed of 35 miles per hour, the minimum suggested pavement width for Brook Road is 24 feet (between NH103 and West Bowl), and 22 feet to the south of West Bowl. In all cases, graded shoulders are considered to be desirable.

Brook Road is a State maintained facility. Accordingly, a driveway permit from the NHDOT, District 2 will be required to construct the proposed driveway on Brook Road for the West Bowl area. Analysis of the traffic projections contained herein demonstrates that a single shared approach lane is sufficient on each leg of the Brook Road/West Bowl driveway intersection. Intersection sight distances at the proposed driveway will need to be evaluated at the driveway permit stage.

F. TECHNICAL APPENDIX – A separate technical appendix includes traffic data, growth rate calculations, and capacity analyses that were performed in the course of this study.

VI. SUMMARY OF FINDINGS AND CONCLUSIONS

The Mount Sunapee Ski Resort in Newbury, New Hampshire currently offers 62 slopes and trails on 230 skiable acres that are serviced by ten ski lifts. Vehicular access to the mountain is provided by a single access road that intersects NH Route 103 at the Mount Sunapee traffic circle. The West Bowl expansion project includes adding approximately 75 acres of terrain that is skiable from the main summit, a new lift facility, a new base lodge, and 175 to 250 quarter-share condominium units. These improvements will increase the comfortable carrying capacity of the ski area to approximately 6,850 skiers, and is intended to better serve existing skier demand and maintain market share for the long-term future. Vehicular access to the new West Bowl facility is proposed via a two-way driveway that will intersect the east side of Brook Road in Goshen, at a point approximately 2.1 miles south of NH103 in Sunapee, New Hampshire.

The traffic counts that were collected at the traffic circle on Sunday, January 18, 2004 (Martin Luther King holiday weekend) revealed that the ski area generated 669 vehicle-trips (594 in, 75 out) during the peak ARRIVAL period from 8:15 to 9:15 AM, and 728 vehicle-trips (68 in, 660 out) during the peak DEPARTURE period from 3:45 to 4:45 PM. Due to weather and other conditions, this particular count is representative of a typical weekend day.

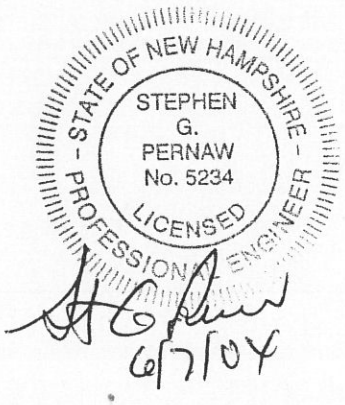
Future traffic projections were prepared for 2010 (base year = project completion) and 2020 (horizon year) for the entire study area, and reflect both typical weekend day and capacity weekend day conditions. By 2020, the Mount Sunapee Resort is expected to generate a total of 1,222 (AM) and 1,317 (PM) peak hour trips on a typical weekend day with the condominium units completely occupied. Under this scenario, the West Bowl driveway will accommodate approximately 248 (AM) and 267 (PM) trips. This translates into approximately 20 percent of the total trips utilizing the new access point on Brook Road, and the remaining 80 percent utilizing the existing access road at the traffic circle.

An intersection capacity and Level of Service analysis of all study area intersections using the 2020 traffic projections revealed that traffic operations and capacity deficiencies will occur at two locations within the traffic circle during the arrival period, and at one location during the departure period. To mitigate these situations, a combination of roadway widening along a portion of the traffic circle is necessary, along with police officer control from 8:15 to 9:15 AM (two persons) and 3:45 to 4:45 PM (one person) on typical winter weekends. For the base year case (2010), the need for police officer control will likely be limited to capacity weekend days only. In terms of roadway capacity, the two lane section of NH103 was found to be appropriate, and it will operate well below capacity on winter weekend days through 2020 and beyond, with the West Bowl Expansion project in full operation.

At the multitude of intersecting streets and driveways along the NH103 corridor (east of Mount Sunapee), the net increase in through traffic (due to ski area expansion and normal background growth) will result in longer delays for those using these various points of access during peak arrival and departure periods. Analysis of a generic case shows that increase in such delays will be limited, and on the order of an additional 2-4 seconds of delay per side-street vehicle, when comparing 2004 existing conditions with 2010 (full expansion). In the case of Brook Road,

capacity conditions do not govern; however, the minimum roadway width should be 24 feet on the section between NH103 and the West Bowl driveway, and 22 feet south of the driveway, based on the anticipated traffic volumes and a thirty-five mile per hour design speed.

With implementation of the basic measures and recommendations contained herein, vehicular access to and from the Mount Sunapee Resort as proposed, will be reasonably safe and efficient from a traffic engineering and operations standpoint. Both the recommended modifications to the traffic circle and the proposed driveway on Brook Road will require the review and approval of the New Hampshire Department of Transportation – District 2 through the Driveway Permit system.



WM. D. COUNTRYMAN
Environmental Assessment and Planning
868 Winch Hill Road
Northfield, Vermont 05663
(802) 485-8421
wdcenv@together.net

Preliminary Wildlife and Wildlife Habitat Assessment Mount Sunapee Resort -- West Bowl Expansion

General

Field work to determine the presence of wildlife and the potential for significant habitats was undertaken on 4 and 13 May 2004. In both instances, investigations began at the summit, the first day concentrating on the area proposed for the ski lift, the second day concentrating on areas to the south and west. On both occasions, observations were made during a 'wander search', with objectives to note any wildlife or wildlife sign, and to characterize the vegetative cover and potential wildlife habitat.

On 4 May, snow cover from a storm the night before extended from the summit to about 750 meters elevation. The day was cool but with increasing sunshine and light wind. The second day, 13 May, was warm and sunny with light wind. Between the two dates, the season had advanced significantly, with development of leaves and spring flora much more evident by 13 May.

Land Use

There is little evidence of past human activity on the upper slopes, with the exception of the hiking trail. Although apparently undisturbed for many years, the number of large trees is small. At ca. 600 meter elevation, a few scattered yellow birch (Betula alleghaniensis) measuring as much as 87 cm. diameter (34.25 inches) were noted, but most trees are of modest height and diameter. The coniferous forest on a rocky shoulder near the state park boundary contains a few large red spruce (Picea rubens) but such trees are uncommon on the project site.

Uniformity of cover type found at higher elevations is missing below ca. 550 meters where recent cutting has taken place, and evidence of old logging roads and fencelines is found. The southern edge of the study area is bounded by a stone wall, indicating that one side or both was once cleared land. Clearings have grown to brush (primarily brambles, pin cherry and aspen), and the general aspect is of a diverse but broken canopy. The base area is a combination of broken woodlots, old field association and remnant orchards typical of once-settled farmland.

Old growth, as described in Neid, et al. (2003) was not observed on the study area. Isolated large trees were exceptionally uncommon, as noted above. The forest cover above 550 meters was generally uniform in height and apparent age, with a sparse shrub understory. There are few downed logs or dead snags in this forest, indicating a relatively even-aged forest that has developed since logging occurred prior to 1924.

Vegetative Cover

From summit to base, the dominant forest changes in distinct bands from coniferous growth at the summit, northern hardwoods between ca 780 and 480 meters elevation, and mixed growth below 480 meters. The summit forest is primarily spruce-fir (*Picea rubens* and *Abies balsamea*) with numerous birches (*Betula papyrifera*). The northern hardwood community includes beech (*Fagus grandifolia*), paper birch (*Betula papyrifera*), yellow birch (*B. alleghaniensis*) and black cherry (*Prunus serotina*), with sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), hophornbeam (*Ostrya virginiana*) and aspen (*Populus tremuloides*) increasingly common at lower elevations. Below 510 meters, stands of hemlock (*Tsuga canadensis*) and scattered red oak (*Quercus rubra*) appear, and in the vicinity of the proposed base facilities, white pine (*Pinus Strobus*) is common.

The high elevation coniferous woods has an understory of small trees of overstory species along with hobblebush (*Viburnum alnifolium*) mountain maple (*Acer spicatum*), red maple (*Acer rubrum*) and mountain ash (*Sorbus americana*) and a mossy ground cover which includes wood sorrel (*Oxalis montana*), Canada mayflower (*Maianthemum canadensis*), blue-bead lily (*Clintonia borealis*), wild sarsaparilla (*Aralia nudicaulis*) and goldthread (*Coptis groenlandica*).

The northern hardwood forest is open, with little in the way of saplings or understory shrubs except for striped maple (*Acer pensylvanicum*) and scattered hobblebush. Typical spring flowers such as Canada mayflower, false Solomon's-seal (*Smilacina racemosa*), Indian-cucumber (*Medeola virginiana*), purple trillium (*Trillium erectum*), painted trillium (*T. undluatum*), twisted-stalk (*Streptopus roseus*), bellwort (*Uvularia sessilifolia*) and yellow violet (*Viola rotundifolia*) occur sporadically in these woods, with blue-bead lily becoming uncommon at lower elevations. Ferns (*Osmunda claytoniana, O. regalis, O. cinnamomea, Thelypteris noveboracensis* and *Polystichum acrostichoides*) occur in the hardwood forests, as do clubmosses (*Huperzia lucidula, Diphasiastrum digitatum, Lycopodium obscurum* and *L. annotinum*).

The lower section of northern hardwood forest has been logged in the past, and regeneration includes sprouts and saplings of the trees listed above, along with shadbush (*Amelanchier* spp.) and pin cherry (*Prunus pensylvanica*). Hayscented fern (*Dennstaedtia punctilobula*) and bracken (*Pteridium aquilinum*) are common in logged forests and clearings.

Lower elevation forests contain a greater diversity of species. All the higher-elevation species are present, with the addition sweet birch (*Betula lenta*), apple (*Malus pumila*), cottonwood (*Populus deltoides*) and basswood (*Tilia americana*). Several shrub species absent on upper slopes are common at lower elevations, including meadowsweet (*Spiraea latifolia*), steeplebush (*S. tomentosa*), brambles (*Rubus idaeus*, R. *alleghaniensis* and *R. occidentalis*), willows (*Salix* spp.), choke cherry (*Prunus virginiana*) and hawthorn (*Crataegus* sp.). Weedy non-native species are common at the base.

One species listed on the New Hampshire Natural Heritage Bureau proposed list of Endangered, Threatened, Watch, Extirpated and Intermediate Plant Species was noted during field work. A single butternut tree (*Juglans cinerea*) occurs on the north side of the existing access road off Brook Road. The area appears to have been an old house site, and there are likely to be additional butternuts nearby. Butternut is of concern because of the threat posed by canker dieback (*Melanconis juglandis*), a widespread fungus disease that weakens and then kills the tree. The tree noted at Brook Road can likely be avoided and therefore not be affected by the project.

Wildlife Observations

The greatest concentration of wildlife sign was observed in the area where logging operations have recently taken place. While occasional evidence of moose (primarily scat) was noted as high on the mountain as 700 meters, such sign is abundant in the upper area of the cut. In addition, there are localize areas of concentrated bark stripping (mostly on red and striped maple) and browsing on maples, ash, aspen and elm. Evidence of deer was sporadic, consisting of widely scattered pellet groups and occasional browsing.

Pine and hemlock stands at lower elevations were investigated specifically to determine whether there was evidence of use by overwintering deer. The stands tend to be small and fragmented, and the overstory does not appear to be dense enough to prevent deep snows from accumulating or to shield the interior from winter winds. Hemlock foliage, within reach of deer, remained unbrowsed. No deer sign was noted in these stands.

No trees scarred by bears were noted during field work, and potential denning sites appear to be limited to areas with ledges and tumbled stone at higher elevations. Such an area was observed on a small spruce-covered promontory at ca. 700 meters near the southern edge of the project area. Talus-like rocks on the west side of this area could provide shelter for hibernating bears, although no indication of such use was seen (Photo 1). This area is south of the southernmost proposed ski trail, and would not be affected by the project as I understand it.

Bird life at Mount Sunapee is typical of deep forest environments at this latitude. Because field work was conducted in early to mid-May, much of the spring migration had not occurred, however, and most birds observed were resident species (hairy and downy woodpeckers (*Picoides villosus* and *P. pubescens*), chickadees (*Parus atricapillus*), blue jays (*Cyanocitta cristata*), ruffed grouse (*Bonasa umbellus*). Ovenbirds (*Seiurus aurocapillus*) are common in the northern hardwood forests. The extensive hardwood forests can be expected to provide habitat for numerous migratory and resident species.

Two partial twig nests were noted in tops of beech trees near the hiking trail at ca. 660 meters (Photo 2). There was no evidence of recent use (fresh twigs, feathers or droppings near the nests, so it was assumed that they were built last year. Being incomplete, the nests were not identifiable as to species. The fact that there were two nests, in trees that

did not stand appreciably above the general canopy, would tend to eliminate raptors as the builders, and I conclude that they were most likely built by great blue herons (*Ardea herodias*).

Miscellaneous observations included evidence of porcupine (*Erethizon dorsatum*) in a small hovel beside a tote road, and a red-bellied snake (*Storeria occipitomaculata*) at ca. 480 meter elevation.

Summary

With the exception of a few scattered large trees, the area appears to have a history of timber operations: prior to 1924 on state park lands, and within the past 20 years on remaining properties. No areas answering to the description of old growth forests as used in Neid, et al. (2003) were observed.

One plant species of concern to the New Hampshire Natural Heritage Bureau was noted next to Brook Road. A single butternut tree occurs at an old house site north of the existing access road, but it appears to be far enough from the road not to be affected by improvements that might take place on the existing footprint. Before work is done, the tree (and any others nearby) should be flagged and a suitable protective buffer established.

The most significant wildlife observation was the two twig nests, possibly built by great blue herons, in tree tops at ca. 660 meters near the Summit Hiking Trail. Neither nest appeared to be finished or under active construction, but their presence indicates potential use of these woods for nesting by such birds. If the nests were active, a large buffer zone would be recommended within which no human activity should take place. Here, however, the birds who built these nests were acclimated to an active hiking trail lies a few yards away.

Wildlife on this parcel is typical of large wooded tracts in the state. Moose are the most obvious large animal, and the species is having impacts on woody plant succession where there is concentrated activity. A broad zone at ca. 540 meters (the upper edge of areas that have seen logging operations) is heavily used by moose, and ash, maples, elms, yellow birches and hophornbeams are especially affected by browsing. Bark stripping on striped maple and red maple is locally common.

Deer sign is light across most of the site, with pellet groups and evidence of browsing uncommon. Areas used by deer as overwintering habitat was not observed on the project area. Pine and hemlock stands occur at the lowest elevations, but they are fragmented and have relatively open canopies. In most instances where hemlocks, a favored browse species, occurs, foliage at heights available to deer showed only sporadic evidence of browsing.

Conclusions

The principal impact of the proposed ski trail development on wildlife will be the fragmentation of a relatively uniform forest. Certain deep-woods species of birds may be affected, depending on the width of the trails, but the number of species is likely to be increased as extensive "edge" habitat is created on both sides of all trails. In addition, the trails themselves will offer openland habitat that is currently not available.

Edge habitat will also provide ample browse for deer and moose, and both species can be expected to increase in numbers. There should be minimal impact on other species of resident mammals.

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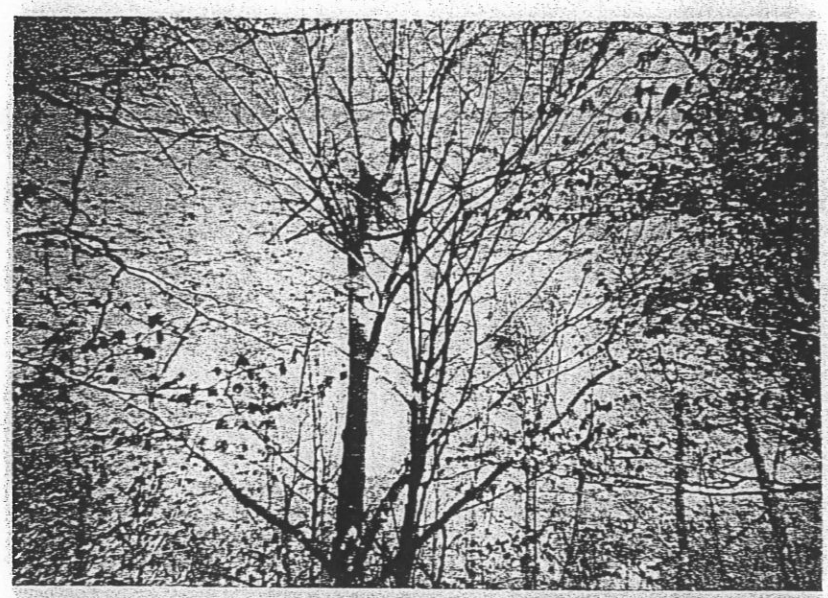

Photo 1. Partial twig nests in beech trees, near Summit Hiking Trail at ca. 660 meters.

Isolated rock at ca. 675 meters, midway between proposed lift line and park boundary. With the exception of a rocky promontory at ca. 700 meters near the southern edge of the project area, such rock was rare, but could offer denning sites for black bear.

Characteristic Plant Species
Mount Sunapee West Bowl Expansion

TREES

Eastern white pine	*Pinus strobus*	Scattered mid-slope, in stands at base
Eastern hemlock	*Tsuga canadensis*	Scattered mid-slope and below, occasionally in small stands
Balsam fir	*Abies balsamea*	Co-dominant at higher elevations
Red spruce	*Picea rubens*	Co-dominant at higher elevations, scattered individuals at mid-slope
Trembling aspen	*Populus tremuloides*	Minor component at lower elevations
Bigtooth aspen	*Populus grandidentata*	Scattered
Butternut	*Juglans cinerea*	One tree near Goshen Road entrance
Hophornbeam	*Ostrya virginiana*	Minor component at lower elevations
Black birch	*Betula lenta*	Uncommon
Yellow birch	*Betula alleghaniensis*	Co-dominant in mid to upper level deciduous woods
Paper birch	*Betula papyrifera*	Co-dominant at high elevations, common at mid-slope
Gray birch	*Betula populifolia*	Lower elevations
Beech	*Fagus grandifolia*	Common, often dominant, component of northern hardwood stands
Red oak	*Quercus rubra*	Minor component in NHW stands
American elm	*Ulmus americana*	Minor component, lower elevations
Mountain ash	*Sorbus americana*	Common at higher elevations
Shadbush	*Amelanchier* sp.	Occasional
Black cherry	*Prunus serotina*	Common species, lower mid-slopes and above
Hawthorn	*Crataegus* sp.	Uncommon; lower elevations
Apple	*Malus pumila*	Lower elevations (old farm sites)
Striped maple	*Acer pensylvanicum*	Common species lower mid-slopes and above
Sugar maple	*Acer saccharum*	Common below conifer belt
Red maple	*Acer rubrum*	Common
Basswood	*Tilia americana*	Uncommon, below mid-slope
White ash	*Fraxinus americana*	Common on bottom 2/3 of mountain

SHRUBS

Willows	*Salix* spp.	Occasional, along watercourses
Beaked hazelnut	*Corylus cornuta*	Common mid-slope and below
Currant	*Ribes* sp.	Occasional
Meadowsweet	*Spiraea latifolia*	Frequent, mid-slope and below
Steeplebush	*Spiraea tomentosa*	Uncommon, lower slopes
Shadbush	*Amelanchier* sp.	Occasional, lower 2/3 of mountain
Blackberry	*Rubus alleghaniensis*	Frequent
Black raspberry	*Rubus occidentalis*	Lower elevations
Raspberry	*Rubus idaeus*	Lower elevations
Dewberry	*Rubus hispidus*	Lower elevations
Choke cherry	*Prunus virginiana*	Near base
Pin cherry	*Prunus pensylvanica*	Common from mid-slope & below

Mountain maple	*Acer spicatum*	Common understory tree
Low sweet blueberry	*Vaccinium angustifolium*	Clearings at lower elevations
Elderberry	*Sambucus* sp.	Scattered
Hobblebush	*Viburnum alnifolium*	Abundant at higher elevations
Mtn fly honeysuckle	*Diervilla lonicera*	Occasional

HERBACEOUS

Shining clubmoss	*Huperzia lucidula*	Common at higher elevations
Ground-cedar	*Diphasiastrum digitatum*	Occasional at lower elevations
Princess-pine	*Lycopodium obscurum*	Occasional at lower elevations
Bristly clubmoss	*Lycopodium annotinum*	Occasional
Long beech-fern	*Phegopteris conectilis*	Occasional
Cinnamon fern	*Osmunda cinnamomea*	Common
Interrupted fern	*Osmunda Claytoniana*	Common
Hay-scented fern	*Dennstaedtia punctilobula*	Common in cutover areas
Sensitive fern	*Onoclea sensibilis*	Common at lower elevations
Bracken	*Pteridium aquilinum*	Common in clearings & edges
Canada mayflower	*Maianthemum canadense*	Common
False hellebore	*Veratrum viride*	Occasional in wet sites
Blue-bead lily	*Clintonia borealis*	Common, esp. at upper elevations
Purple trillium	*Trillium erectum*	Occasional
Painted trillium	*Trillium undulatum*	Uncommon
Indian-cucumber	*Medeola virginiana*	Common
Twisted-stalk	*Streptopus roseus*	Occasional in hardwood forests
Bellwort	*Uvularia sessilifolia*	Common
False Solomon's seal	*Smilacina racemosa*	Common
Goldthread	*Coptis groenlandica*	Common
Buttercup	*Ranunculus acris*	Common at lower elevations
Partridgeberry	*Mitchella repens*	Occasional
Blue-eyed grass	*Sisyrinchium montanum*	Occasional
Starflower	*Trientalis borealis*	Common
Mountain sorrel	*Oxalis montana*	Common at higher elevations
Sarsaparilla	*Aralia nudicaulis*	Common
Cinquefoil	*Potentilla simplex*	Common at lower elevations
Strawberry	*Fragaria virginiana*	Common at lower elevations
Yellow violet	*Viola rotundifolia*	Common at higher elevations
White violet	*Viola blanda*	Occasional, damp openings
Blue violet	*Viola* sp.	Occasional
St. John's-wort	*Hypericum perfoliatum*	Occasional
Beechdrops	*Epifagus virginiana*	Occasional under *Fagus*
Bunchberry	*Cornus canadensis*	Occasional
Indian-pipe	*Monotropa uniflora*	Occasional
Speedwell	*Veronica officinalis*	Disturbed areas at lower elevations
Rough goldenrod	*Solidago rugosa*	Common at lower elevations
Ox-eye daisy	*Chrysanthemum leucanthemum*	Common, lower elevations