Traffic Analysis Of McDonald's Impact on the Intersection of Rockdale Avenue and Dartmouth Street

By

Walter Freeman Associates

May 18, 1990

Table of Contents

Project Description	1
Existing Conditions	1
Traffic Generated by McDonald's	2
Capacity and Level of Service Analysis	3
Figures	7
Appendix	13

Traffic Analysis Of McDonalds' Impact on the Intersection of Rockdale Avenue and Dartmouth Street

By

Walter Freeman Associates

PROJECT DESCRIPTION

A 5,000 square foot McDonald's Restaurant with a drive-thru service is proposed for the northwest corner of the Rockdale Avenue/Dartmouth Street intersection. There will be two drives on Rockdale Avenue on either side of the New Bedford Institution For Savings. North of the bank the drive will be one way in and south of the bank the drive will be one way out. There will be two one-way drives on Dartmouth Street. The exiting drive on Dartmouth Street will serve most of the exiting drive-thru service traffic. The Site surrounds an existing gas station at the corner. There will be a total of 68 parking spaces provided. This restaurant will replace an existing McDonald's Restaurant less than one half mile west of the site on Dartmouth Street.

EXISTING CONDITIONS

LANE USE, GEOMETRICS, AND LAND USE

Figure 1 shows the existing lane width and use at the intersection of Dartmouth Street and Rockdale Avenue. Rockdale Avenue runs north/south with its southbound approach having a 10.5 foot wide through and left turn lane and an 10.5 foot wide right turn lane. The total pavement width north of Dartmouth Street is 42 feet. The northbound approach has a 12 foot wide left turn lane and a 12 foot wide through and right turn lane. The total pavement width south of Dartmouth Street is 48 feet wide. Buses stop on either side of Rockdale Avenue north of Dartmouth Street, but cause very little traffic disruption. The east side of Rockdale Avenue has a 12 foot bus stop lane while the west side has none. The southbound buses stop approximately 180 feet from the intersection.

Dartmouth Street runs east/west with its eastbound approach 20 feet wide. Vehicles on this approach frequently form two lanes. The total width west of Rockdale Avenue is 38.5 feet. The westbound approach has an 18.5 foot wide left and through lane and a 12.5 foot wide right turn lane. The total pavement width east of Rockdale Avenue is 51 feet. There is a 12 foot parking aisle approximately 80 feet from the intersection on the westbound side.

A gas station occupies the northwest corner of the intersection. On the southwest corner there is another gas station and a convenient store adjacent to a "rent to own" video equipment store. The northeast corner is an empty lot. The southeast corner is occupied by an auto service facility with a used car lot. The immediate area on Rockdale Avenue south of the intersection is light commercial and/or small business. Traffic was observed to be moderate to heavy during the weekday peak hour period and traffic entering and leaving developments near the intersection did not significantly impede traffic flow.

TRAFFIC SIGNAL OPERATIONS

The intersection is controlled by a traffic signal having two vehicular phases with 26 seconds of green each within a 60 second cycle. While there are two pedestrian push button posts at the intersection, no pedestrian phases were called during our period of observation. Pedestrian activity was negligible.

TRAFFIC VOLUMES

Walter Freeman Associates staff video recorded, counted, and classified the existing traffic at the intersection on Friday, November 10, 1989 during the 4:00-6:00 PM weekday peak period. Traffic counts were summarized to determine the peak hour, peak 15 minutes within the peak hour, and the percentage of heavy vehicles. Lane use and widths, signal phasing and timing were also recorded. Figure 1 shows the 1989 peak hour traffic volumes and average weekday traffic (AWDT) at the intersection.

The peak hour from 4 to 6 PM was from 4:15 to 5:15 PM, with the peak 15 minute demand occuring from 4:45 to 5:00 PM. The peak hour on this particular Friday was 13 percent higher than the average of all counted weekday peak hours.

The traffic demand on Rockdale Avenue on this Friday was actually higher from 3 to 4 PM than from 4:15 to 5:15 PM - a situation not true during other weekdays. As a consequence of this higher early demand which exceeded the capacity of both the northbound and southbound approaches, long 20 vehicle queues southbound and northbound on Rockdale Avenue existed when we began our counts. These long queues slowly declined to predicted lengths of 7.5 to 8.5 vehicles at start of green by 4:30 PM.

In the eastbound direction the average queue length was slightly more than six vehicles at start of green, while in the westbound direction start of green queues were 5 vehicles in the left/through lane and one in the right turn lane.

The traffic was recorded from November 8-14, 1989, on Rockdale Avenue north of the intersection and on Dartmouth Street west of the intersection. The counts are shown plotted on Figures 2 and 3. The average weekday traffic for northbound vehicles on Rockdale Avenue is 8,031 while the southbound average weekday traffic is 8,331 vehicles. The average weekday traffic for eastbound vehicles on Dartmouth Street is 6,279 while the westbound traffic is 5,833 vehicles.

TRAFFIC GENERATED BY McDONALDS

There are two empirical studies of traffic generated by fast food restaurants with drive-through windows which we have used as references in this report plus 4:30 to 5:30 PM counts of the existing McDonald's on Dartmouth Street. One study by the Institute of Transportation Engineers (ITE) of over 30 such restaurants nationwide, including several McDonald's restaurants, is reported in Trip Generation, published in September 1987. Another study by Barton Aschman Associates of several McDonald's restaurants in the Chicago area was published in 1980.

Peak hour traffic generation rates cited by the ITE Study are generally lower than those cited by the McDonald's Study. Table 1 compares the traffic volumes predicted by each one of these studies for 5000 square foot restaurants as is proposed northwest of the intersection of Dartmouth Street and Rockdale Avenue. From 4:30 to 5:30 PM on Friday, November 10, 1989, we counted 200 vehicles entering and leaving the existing McDonald's restaurant on Dartmouth Steet - 100

entered and 100 left the site. This count ageed closely with the McDonald's study which predicts an average hourly volume of 202 vehicles entering and leaving McDonald's sites during the 4 to 6 PM weekday period.

For the purposes of our study we have analyzed two time periods:

1) The 12 noon to 1 PM Saturday peak hour, which generally has the greatest hourly site traffic (427), to estimate delays and queues likely to be experienced by traffic entering and leaving the site.

2) The 4 to 6 PM Friday peak hour, which generally has the greatest traffic on adjacent streets, to estimate the impact of the relocated facility on traffic operations at the intersection of Rockdale Avenue and Dartmouth Street. During this period, McDonald's typically has higher site traffic from 5 to 6 PM, but to be conservative, we have assumed that this is the highest estimated site traffic, 235 vehicles per hour, would occur during the peak hour of the intersection which is 4:15 to 5:15 PM.

Of the traffic entering the existing McDonalds site, 85 percent came from the east on Dartmouth Street and, therefore, passed through the intersection of Dartmouth Street and Rockdale Avenue. Of the traffic leaving the site, 66 percent went to the east on Dartmouth Street and, therefore, also passed through the intersection. There is an intersection Avoideble Shunt Street That passes from Rockdale to Dartmouth. Approx 1000' west of intersect.

Since the proposed restaurant will be a relocation rather than a facility completely new to the area, the traffic impact will be primarily to increase traffic entering and leaving driveways at the new location and to alter intersection turning movements at Rockdale Avenue and Dartmouth Street.

CAPACITY AND LEVEL OF SERVICE ANALYSIS

CAPACITY AND LEVEL OF SERVICE CRITERIA

The capacity of a signalized intersection is the maximum rate at which vehicles can normally pass through the intersection under prevailing roadway, vehicle mix, and traffic control conditions. According to the ***1985 Highway Capacity Manual,*** the level of service of a signalized intersection or any of its lane groups is related to the average stopped delay per vehicle. The table below gives the ranges of average stopped delay per vehicle associated with each level of service.

Level of Service	Average Stopped Delay Per Vehicle (Seconds)
A	0 to 5
B	5 to 15
C	15 to 25
D	25 to 40
E	40 to 60
F	Over 60

Table 1. McDonald's Site Trip Generation

Trip Generation Comparisons - ITE and McDonald's Data
ITE land use code 834 = Fast Food Restaurants with a Drive-Through Window

Midday Peak Hour on Weekday

Time	Source	Size(SF)	TOTAL TRIPS	IN	OUT
n/a	ITE	5000	292	146	146
12 to 1 PM	McDonalds	5000	398	197	200

4-6 PM Peak Hours on Weekdays

Time	Source	Size(SF)	TOTAL TRIPS	IN	OUT
n/a	ITE	5000	164	84	81
5 to 6 PM	McDonalds	5000	235	118	118
4 to 5 PM	McDonalds	5000	168	84	84

Average Weekday

	Source	Size(SF)	TOTAL TRIPS	IN	OUT
	ITE	5000	2382	1191	1191
	McDonalds	5000	Not Available (n/a)		

Saturday Peak Hour

Time	Source	Size(SF)	TOTAL TRIPS	IN	OUT
n/a	ITE	5000	232	118	113
12 to 1 PM	McDonalds	5000	427	220	207

Notes:

n/a means not available.
ITE sample, while including McDonald's, explictly states that the restaurants studied had limited or no sit-down facilities.
The McDonald's Study includes several sites in the Chicago area and was copywritten in 1980. The study was conducted by Barton-Aschman Associates, Inc., of Evanston, Illinois.

EXISTING CONDITIONS

The long southbound Rockdale Avenue queue of vehicles waiting to go straight or turn left at Dartmouth Street during the PM peak will frequently extend back to and partially block the site driveway south of the New Bedford Institution for Saving. Occasionally this queue will also extend beyond both drives on Rockdale Avenue. Because of this blockage, most traffic entering the site during the peak hour from south on Rockdale Avenue and from the east on Dartmouth Street are likely to use the Dartmouth Street driveway. For the same reason, traffic leaving the site to go south on Rockdale Avenue or east on Dartmouth Street are likely to use the Dartmouth Street exit.

Traffic entering the site from the north on Rockdale Avenue will naturally use the Rockdale Avenue driveway adjacent to the bank. However, when these drivers go back north on Rockdale Avenue, those who used the drive-through window are likely to leave by the Dartmouth Street exit and turn left at the signal onto Rockdale Avenue.

Figure 4 shows our estimated weekday 4 to 6 PM peak hour and Saturday noon to 1 PM traffic entering and leaving the site if McDonald's is relocated to the proposed site.

The Rockdale Avenue/Dartmouth Street intersection traffic now experiences an average delay of over 30 seconds and a D Level of Service (LOS). The SB Rockdale Avenue critical left and through lane is oversaturated in the peak 15 minutes and its traffic has average delays of over a minute - a LOS F. The NB Rockdale Avenue approach left turn lane has delays of nearly 40 seconds with LOS D. The EB Dartmouth Street approach experiences a delay of 11 seconds and a B LOS. The left and through movements WB on Dartmouth Street have delays of 10 seconds with LOS C .

BUILD CONDITIONS

With the addition of McDonald's Restaurant there will be little net change in traffic using the intersection. However some critical movements will change during the peak hour:

southbound Rockdale Avenue through traffic will increase,
southbound Rockdale Avenue right turning traffic will decrease, and
eastbound Dartmouth Street left and right turning traffic will decrease.

Figure 5 shows our projected traffic volumes at the intersection of Rockdale Avenue and Dartmouth Street after the relocation of McDonalds.

These small changes in traffic volumes due to McDonald's relocation will increase delays on the southbound Rockdale Avenue approach by ten seconds at the most, will reduce the delays eastbound on Dartmouth Street, but will not change levels of service in the intersection or on any of its approaches. Average overall delays in the intersection will increase from 30.6 to 33.5 seconds per vehicle.

The most used site driveways will be those on Dartmouth Street. The busiest period for the site is expected to be from noon to one PM on Saturday. During this period delays to vehicles turning left into the site from Dartmouth Street will be approximately 5 seconds per vehicle. Delays to vehicles turning right from the site onto Dartmouth Street will also be slight - averaging less than 5 seconds per

vehicle. For vehicles leaving the site to go east on Dartmouth Street delays will vary from 15 seconds per vehicle to 19 seconds per vehicle, depending on how many use the site exit next to New Bedford Institution for Savings.

The average number of vehicles waiting to leave the site during the peak period from the Dartmouth Street driveway will be less than one.

POSSIBLE TRAFFIC MITIGATIONS

Improved Timing Existing timing at Rockdale Avenue and Dartmouth Street could be improved to reduce peak hour delays and queues. Changing the signal timing at the intersection by giving Rockdale Avenue more green time would both improve intersection capacity and Level of Service.

Holding the signal cycle length at 60 seconds, Phase 1 (N/S Rockdale Avenue) green time should be retimed to 34 seconds and Phase 2 (E/W Dartmouth Street) green time retimed to 20 seconds. Under these conditions, the average delay for the intersection would be reduced by 20 seconds per vehicle and the intersection would operate at a B Level of Service. This would be a significant improvement over the existing D Level of Service conditions.

The SB Rockdale Avenue approach delays would decrease from 77 seconds to 16 seconds and the NB Rockdale Avenue approach delays would decrease from 18 seconds to 9 seconds. The EB Dartmouth Street delay would increase from 11 seconds to 15 seconds and the WB Dartmoputh Street approach delays would increase from 10 seconds to 14 seconds, but overall operations would be better.

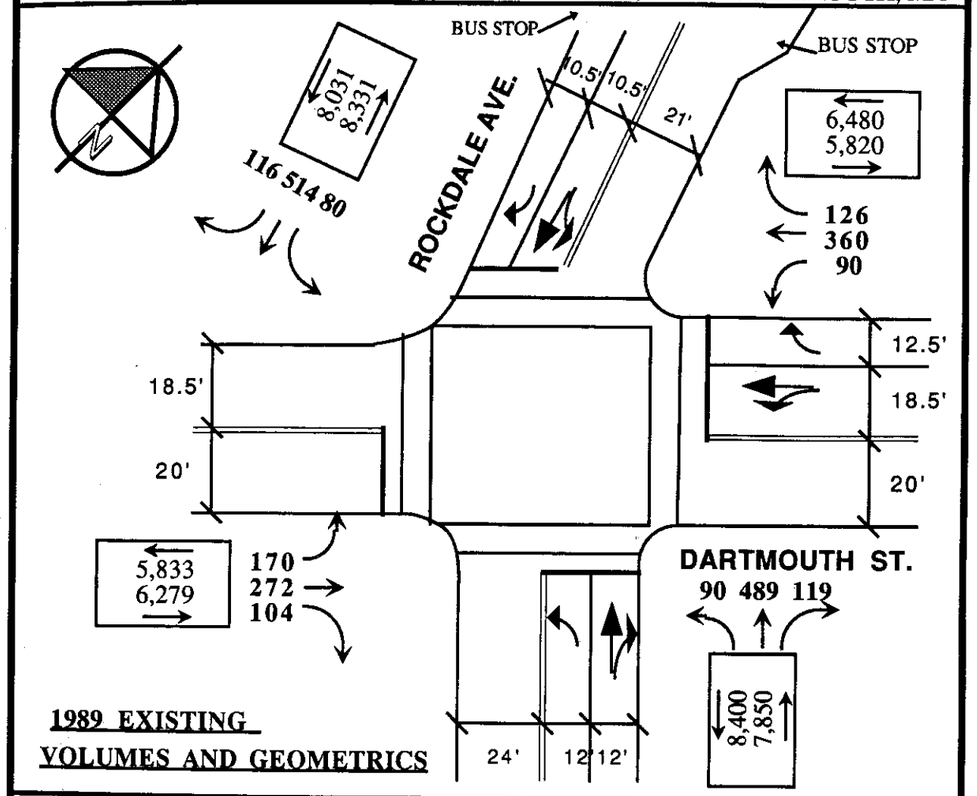
During the peak hour with this changed signal timing, the Rockdale Avenue southbound maximum queue lengths adjacent to the site would be reduced from 7.8 vehicles to 6.5 vehicles, while the eastbound queue length on Dartmouth Street would increase slightly from 6.8 vehicles to 7.2 vehicles.

Revised Lane Use Changing the lane use and signal timing to that shown on Figure 6 would further reduce queuing on Rockdale Avenue southbound to 6.1 vehicles and reduce queuing on dartmouth Street eastbound to 2.1 vehicles in the left turn lane and 4.9 in the curb lane.

Figures

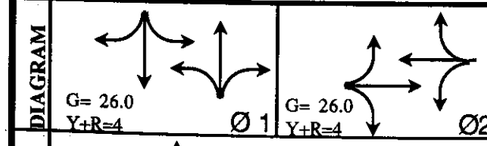
FIGURE 1

INTERSECTION: ROCKDALE AVE./DARTMOUTH ST.
ANALYST: W. FREEMAN **TIME PERIOD: 1989 PM PEAK**
PROJECT: McDONALD'S RESTAURANT CITY/STATE: DARTMOUTH, MA



1989 EXISTING VOLUMES AND GEOMETRICS

PHASING



NOTE: ALL TURNS MAY TURN RIGHT ON RED

1989 PM PEAK HOUR TRAFFIC VOLUMES

5,833
6,279
1989 AVERAGE WEEKDAY TRAFFIC VOLUMES

Approach	Grade %	%HV	Adj. Pkg. Lane Y/N	Nm	Buses Nb	PHF	Conf. Peds. (Peds/Hr)	Ped. Button Y/N	Min.time	Arr. Type
EB	0	1.1	N		0	·93		Y	17	3
WB	0	2.3	Y	10	0	·96		Y	12	3
NB	3	1.6	N		0	·88		Y	0	3
SB	-3	1.7	N		0	·93		Y	0	3

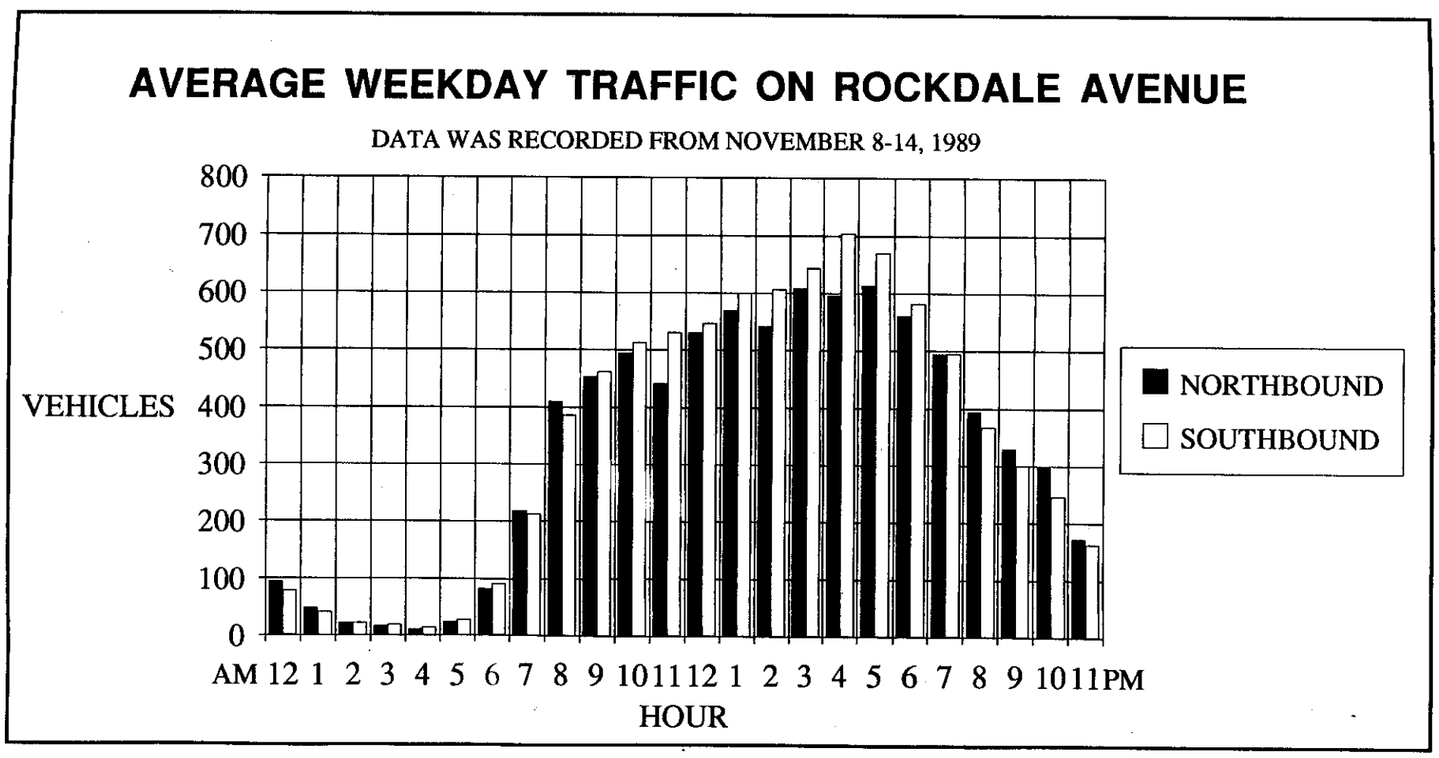

AVERAGE WEEKDAY TRAFFIC ON ROCKDALE AVENUE
DATA WAS RECORDED FROM NOVEMBER 8-14, 1989
VEHICLES
800
700
600
500
400
300
200
100
0
AM 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 PM
HOUR
NORTHBOUND
SOUTHBOUND

FIGURE 2

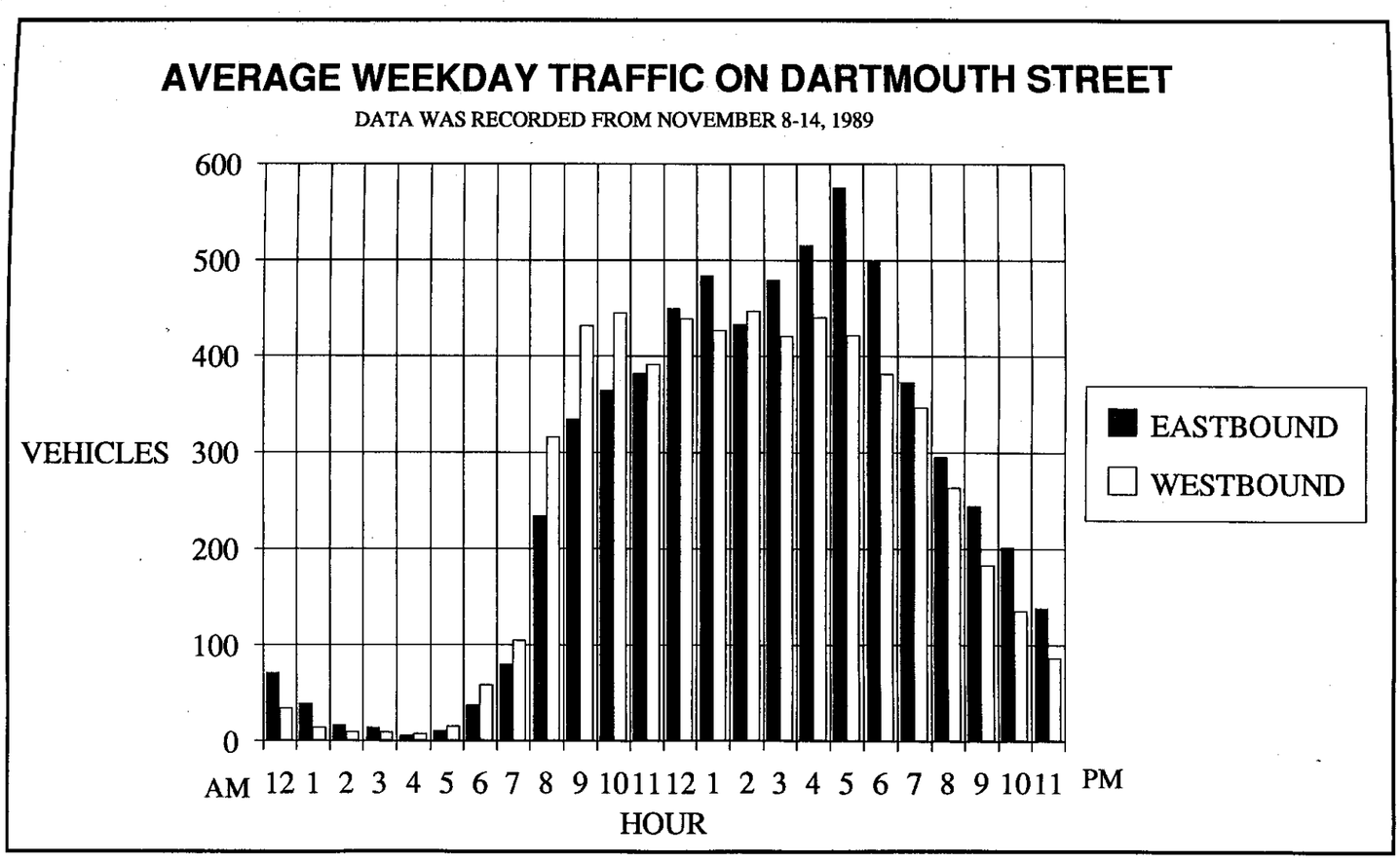

AVERAGE WEEKDAY TRAFFIC ON DARTMOUTH STREET
DATA WAS RECORDED FROM NOVEMBER 8-14, 1989
VEHICLES
600
500
400
300
200
100
0
AM 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 PM
HOUR
EASTBOUND
WESTBOUND

FIGURE 3

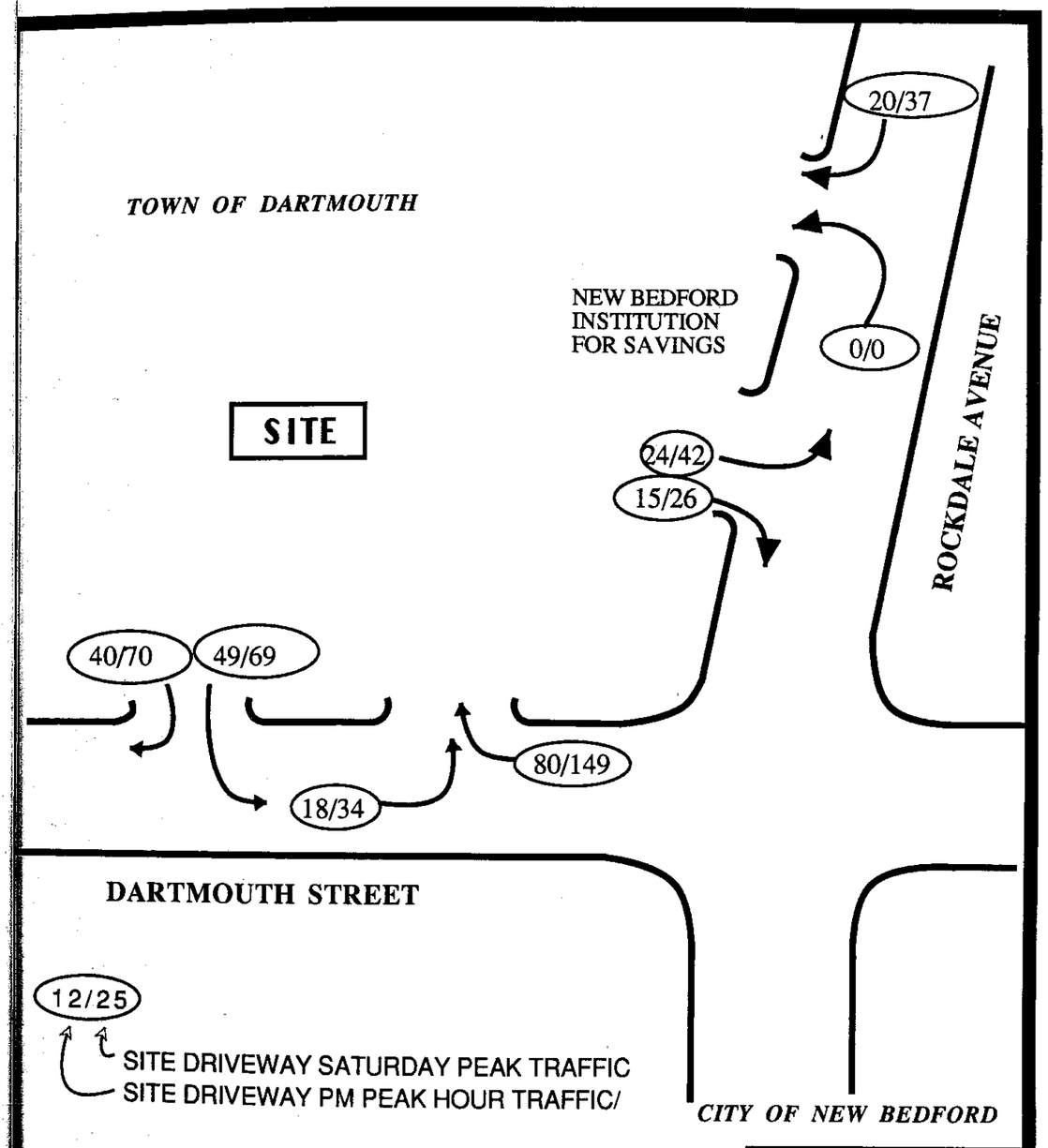


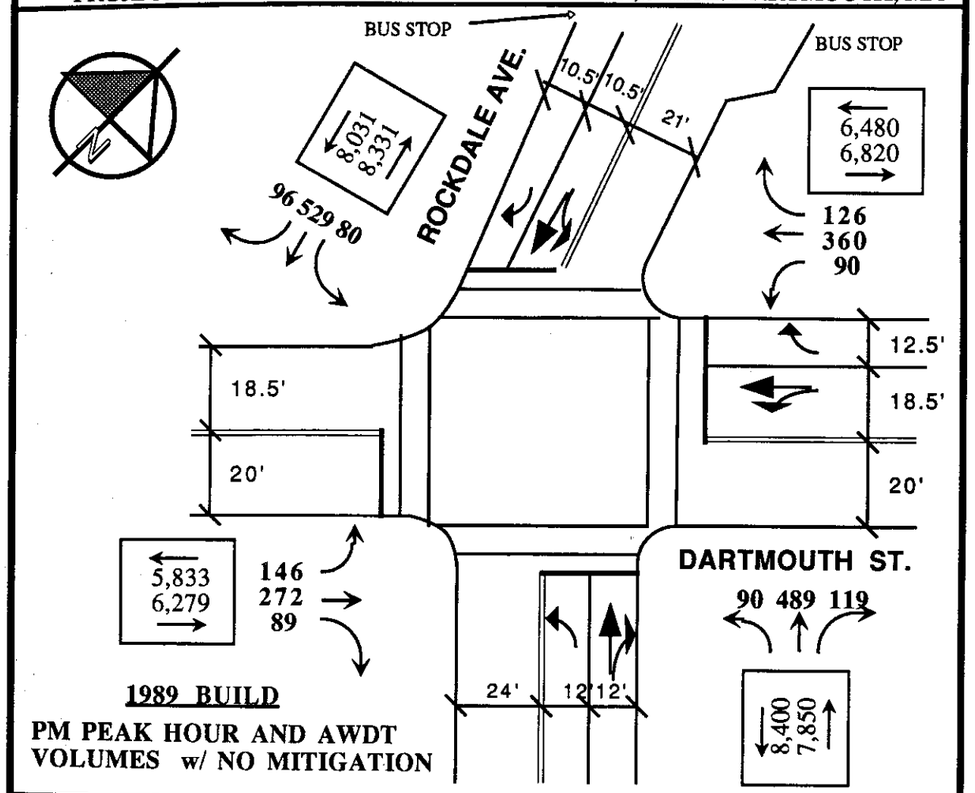
FIGURE 4

1989 McDonald's Site Drive's PM and Saturday Peak Hour Volumes

WALTER FREEMAN ASSOCIATES — McDONALD'S RESTAURANT

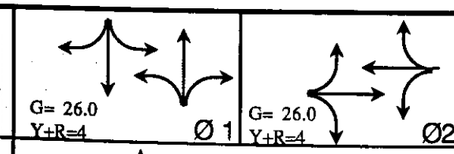
FIGURE 5

INTERSECTION: ROCKDALE AVE./DARTMOUTH ST.
ANALYST: W. FREEMAN **TIME PERIOD: 1989 PM PEAK BUILD**
PROJECT: McDONALD'S RESTAURANT CITY/STATE: DARTMOUTH, MA



PHASING

DIAGRAM



NOTE: ALL TURNS
MAY TURN
RIGHT ON RED

LEGEND

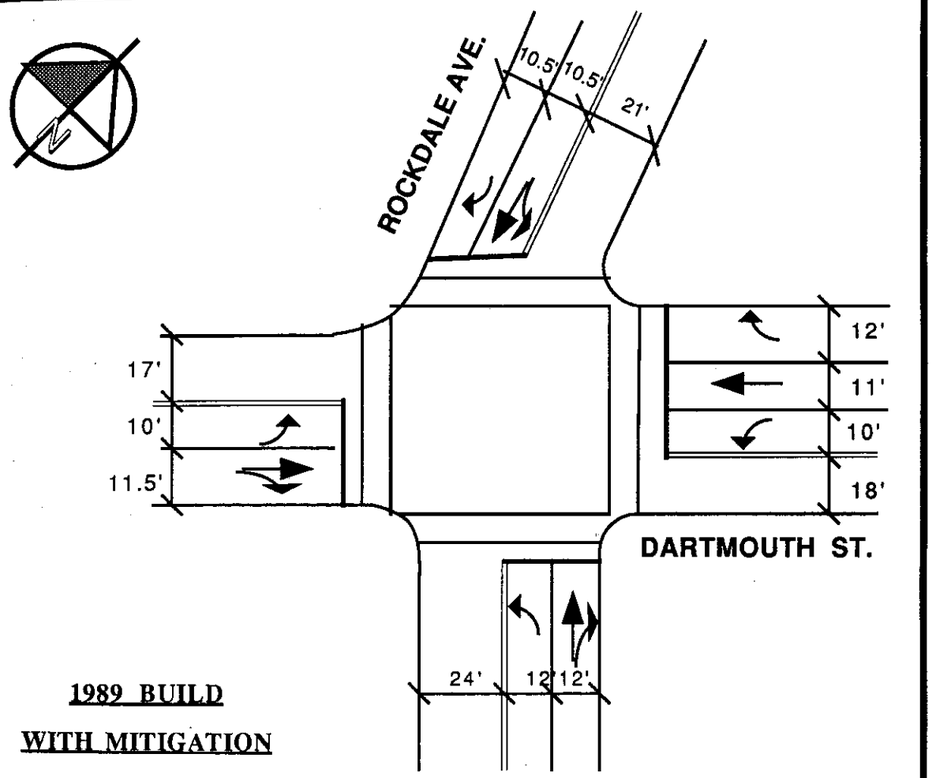
153
291
112
1989 BUILD PM PEAK HOUR TRAFFIC VOLUMES

5,833
6,279
1989 BUILD AVERAGE WEEKDAY TRAFFIC VOLUMES

Approach	Grade %	%HV	Adj. Pkg. Lane Y/N	Nm	Buses Nb	PHF	Conf. Peds. (Peds/Hr)	Ped. Button Y/N	Min.time	Arr. Type
EB	0	1.1	N		0	·93		Y	17	3
WB	0	2.3	Y	10	0	·96		Y	12	3
NB	3	1.6	N		0	·88		Y	0	3
SB	-3	1.7	N		0	·93		Y	0	3

FIGURE 6

INTERSECTION: ROCKDALE AVE./DARTMOUTH ST.
ANALYST: W. FREEMAN **TIME PERIOD: 1989 PM PEAK BUILD**
PROJECT: McDONALD'S RESTAURANT CITY/STATE: DARTMOUTH, MA

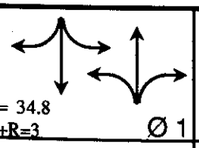


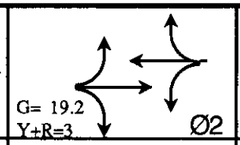
1989 BUILD

WITH MITIGATION

PHASING

DIAGRAM





NOTE: ALL TURNS MAY TURN RIGHT ON RED

Approach	Grade %	%HV	Adj. Pkg. Lane Y/N	Nm	Buses Nb	PHF	Conf. Peds. (Peds/Hr)	Ped. Button Y/N	Min.time	Arr. Type
EB	0	1.1	N		0	.93		Y	17	3
WB	0	2.3	Y	10	0	.96		Y	12	3
NB	-3	1.6	N		0	.88		Y	0	3
SB	3	1.7	N		0	.93		Y	0	3

Appendix

LOCATION:	ROCKDALE AVENUE N/S - SOUTH DARTMOUTH, MA															
DATES:	NOVEMBER 8 - 15, 1989															
HOUR BEGINS	MONDAY 13		TUESDAY 14		WEDNESDAY 8		THURSDAY 9		FRIDAY 10		SATURDAY 11		SUNDAY 12		WEEKDAY AVE.	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
12:00 AM	85	62	87	77	93	82	94	73	114	101	172	160	135	161	95	79
1	39	33	40	42	57	43	43	29	57	60	114	106	95	96	47	41
2	18	23	19	10	25	31	20	25	29	26	60	68	78	53	22	23
3	17	16	8	14	19	18	22	21	19	25	48	44	36	35	17	19
4	9	6	7	12	12	15	10	20	16	23	32	33	19	18	11	15
5	22	23	27	18	29	37	23	29	20	29	28	23	19	16	24	27
6	88	93	97	92	62		87	103	80	77	51	40	34	31	83	91
7	253	220	249	227	118		269	218	206	186	109	127	91	63	219	213
8	440	409	449	414			435	419	315	305	203	196	131	131	410	387
9	449	472	465	470			476	457	425	447	316	312	205	210	454	462
10	462	493	469	516			494	516	554	529	440	503	319	350	495	514
11	483	534	532	538	138	421	486	516	570	645	609	574	363	418	442	531
12:00 PM	517	544	521	546	494	523	484	515	641	604	635	665	437	441	531	546
1	580	584	591	612	524	556	523	594	628	652	639	697	560	610	569	600
2	531	590	534	587	536	578	521	550	587	732	639	689	552	657	542	607
3	623	641	593	637	610	612	568	594	648	737	707	674	583	620	608	644
4	587	720	613	726	597	680	571	677	611	715	663	672	577	625	596	704
5	674	691	638	687	579	651	561	657	614	667	633	629	679	546	613	671
6	558	564	552	541	566	534	573	579	558	694	574	613	528	407	561	582
7	475	523	518	414	458	491	466	479	558	572	500	547	372	393	495	496
8	371	341	411	270	370	346	388	388	435	496	408	355	273	253	395	368
9	309	296	363	180	308	383	303	269	371	375	300	303	230	234	331	301
10	281	223	274	170	276	225	302	315	356	304	268	255	179	191	298	247
11	186	140	135	135	132	151	178	176	234	217	217	183	137	95	173	164
TOTALS	8057	8241	8192	7935	6003	6377	7897	8219	8646	9218	8365	8468	6632	6654	8031	8331
COMBINED	16298		16127		12380		16116		17864		16833		13286		16362	

AVERAGE WEEKDAY COUNTS

LOCATION: DARTMOUTH STREET E/W- SOUTH DARTMOUTH, MA

DATES: NOVEMBER 8 - 15, 1989

HOUR BEGINS	MONDAY 13		TUESDAY 14		WEDNESDAY 8		THURSDAY 9		FRIDAY 10		SATURDAY 11		SUNDAY 12			WEEKDAY AVE.	
	E	W	E	W	E	W	E	W	E	W	E	W	E	W		E	W
12:00 AM	52		68				77	34	85		129		120		12	71	34
1	23		40				38	14	54		73		65		1	39	14
2	11		21				11	10	24		36		50		2	17	10
3	11		12				12	10	22		50		22		3	14	10
4	6		4				3	8	13		19		12		4	7	8
5	6		13				14	16	11		16		11		5	11	16
6	39		38				36	58	36		24		31		6	37	58
7	88		75				83	104	73		59		49		7	80	104
8	227		244				237	316	226		160		99		8	234	316
9	351		339				297	432	351		251		152		9	335	432
10	347		347				339	445	427		373		246		10	365	445
11	385		373		368	400	354	383	431		455		305		11	382	392
12:00 PM	447		433		421	439	398		550		528		315		12	450	439
1	505		488		455	427	442		527		480		420		1	483	427
2	404		451		377	447	405		531		432		352		2	434	447
3	481		482		441	421	485		510		464		414		3	480	421
4	511		519		471	440	523		551		498		401		4	515	440
5	610		565		517	422	590		594		463		427		5	575	422
6	476		478		450	382	526		563		425		386		6	499	382
7	365		350		335	347	365		450		363		249		7	373	347
8	287		258		295	264	307		330		278		246		8	295	264
9	199		255		261	183	234		275		220		176		9	245	183
10	177		197		193	135	214		227		182		154		10	202	135
11	130		135		112	87	164		151		162		76		11	138	87
TOTALS	6138	0	6185	0	4696	4394	6154	1830	7012	0	6140	0	4778	0		6279	5833
COMBINED TOTALS	6138		6185		9090		7984		7012		6140		4778			12111	

LOCATION: ROCKDALE AVENUE @ DARTMOUTH STREET
DATE: 4:00 - 6:00 PM NOVEMBER 10, 1989 -FRIDAY

	ROCKDALE AVE. SB						ROCKDALE AVE NB						DARTMOUTH ST. EB						DARTMOUTH ST. WB					
	MOVE 1		MOVE 2		MOVE 3		MOVE 4		MOVE 5		MOVE 6		MOVE 7		MOVE 8		MOVE 9		MOVE 10		MOVE 11		MOVE 12	
STARTS	LEFTS		STRAIGHT		RIGHTS		LEFTS		STRAIGHT		RIGHTS		LEFTS		STRAIGHT		RIGHTS		LEFTS		STRAIGHT		RIGHTS	
AT	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV	CARS	HV
16:00																								
16:15	22		130	4	33		18		113		35		34		58		28	1	29		97	1	23	
16:30	17		135	1	24		21		124	2	23	2	45	1	68	2	19		24		86	1	25	1
16:45	22		124		41	4	17	2	114	1	27	1	46		65	1	28		15	1	88	4	44	
17:00	19		120		11	3	32		132	3	31		44		76	2	28		21		78	5	32	1
17:15	18		122	1	27		20		133		26		47	1	61	1	17	1	29	1	90	2	21	
17:30	14	1	113	2	16		24		112	2	19		38		67	2	26		38		75	1	15	1
17:45	21		112	1	34		27		130	1	33		39		68	1	26		30		64	3	25	
HOUR	61 LT		394 TH		102 RT		58 LT		354 TH		88 RT		126 LT		194 TH		76 RT		69 LT		277 TH		93 RT	
START @	0.69 PHF		0.72 PHF		0.57 PHF		0.69 PHF		0.70 PHF		0.63 PHF		0.68 PHF		0.69 PHF		0.66 PHF		0.59 PHF		0.71 PHF		0.53 PHF	
16:00		%HV	1.27	%HV	3.92	%HV	3.45	%HV	0.85	%HV	3.41	%HV	0.79	%HV	1.55	%HV	1.32	%HV	1.45	%HV	2.2	%HV	1.1	%HV
HOUR	80 LT		514 TH		116 RT		90 LT		489 TH		119 RT		170 LT		272 TH		104 RT		90 LT		360 TH		126 RT	
START @	0.91 PHF		0.94 PHF		0.64 PHF		0.70 PHF		0.91 PHF		0.85 PHF		0.92 PHF		0.87 PHF		0.90 PHF		0.78 PHF		0.92 PHF		0.72 PHF	
16:15		%HV	0.97	%HV	6.03	%HV	2.22	%HV	1.23	%HV	2.52	%HV	0.59	%HV	1.84	%HV	0.96	%HV	1.11	%HV	3.1	%HV	1.6	%HV
HOUR	76 LT		503 TH		110 RT		92 LT		509 TH		110 RT		184 LT		276 TH		93 RT		91 LT		354 TH		124 RT	
START @	0.86 PHF		0.92 PHF		0.61 PHF		0.72 PHF		0.94 PHF		0.89 PHF		0.96 PHF		0.88 PHF		0.83 PHF		0.76 PHF		0.96 PHF		0.70 PHF	
16:30		%HV	0.4	%HV	6.36	%HV	2.17	%HV	1.18	%HV	2.73	%HV	1.09	%HV	2.17	%HV	1.08	%HV	2.2	%HV	3.4	%HV	1.6	%HV
HOUR	74 LT		482 TH		102 RT		95 LT		497 TH		104 RT		176 LT		275 TH		100 RT		105 LT		343 TH		114 RT	
START @	0.84 PHF		0.97 PHF		0.57 PHF		0.74 PHF		0.92 PHF		0.84 PHF		0.92 PHF		0.88 PHF		0.89 PHF		0.69 PHF		0.93 PHF		0.65 PHF	
16:45	1.35	%HV	0.62	%HV	6.86	%HV	2.11	%HV	1.21	%HV	0.96	%HV	0.57	%HV	2.18	%HV	1	%HV	1.9	%HV	3.5	%HV	1.8	%HV
HOUR	73 LT		471 TH		91 RT		103 LT		513 TH		109 RT		169 LT		278 TH		98 RT		119 LT		318 TH		95 RT	
START @	0.87 PHF		0.96 PHF		0.67 PHF		0.80 PHF		0.95 PHF		0.83 PHF		0.88 PHF		0.89 PHF		0.88 PHF		0.78 PHF		0.86 PHF		0.72 PHF	
17:00	1.37	%HV	0.85	%HV	3.3	%HV		%HV	1.17	%HV		%HV	0.59	%HV	2.16	%HV	1.02	%HV	0.84	%HV	3.5	%HV	2.1	%HV

16:15 IS THE BEGINNING OF THE PEAK HOUR
2530 IS THE TOTAL ENTERING TRAFFIC IN THE PEAK HOUR

MOVEMENT NO. 1 IS ROCKDALE AVE. SB LEFT
MOVEMENT NO. 2 IS ROCKALE AVE. SB THRU
MOVEMENT NO. 3 IS ROCKDALE AVE. SB RIGHT
MOVEMENT NO. 4 IS ROCKDALE AVE. NB LEFT
MOVEMENT NO. 5 IS ROCKALE AVE. NB THRU
MOVEMENT NO. 6 IS ROCKDALE AVE. NB RIGHT
MOVEMENT NO. 7 IS DARTMOUTH ST. EB LEFT
MOVEMENT NO. 8 IS DARTMOUTH ST. EB THRU
MOVEMENT NO. 9 IS DARTMOUTH ST. EB RIGHT
MOVEMENT NO. 10 IS DARTMOUTH ST. WB LEFT
MOVEMENT NO. 11 IS DARTMOUTH ST. WB THRU
MOVEMENT NO. 12 IS DARTMOUTH ST. WB RIGHT

WALTER FREEMAN, TRAFFIC CONSULTANT

MCDONALD'S VOLUME BASE

Signalized Intersection Operations Analysis-Version 3.00-Resource Systems Group

Intersection: Rockdale Ave. at Dartmouth St.

Location: Dartmouth, MA

Traffic Period: 1989 Design Hour (PM Peak) - No-Build

Base Traffic Volumes

	Dartmouth EB	Dartmouth WB	Rockdale NB	Rockdale SB
TOTAL LT	170	90	90	80
TOTAL TH	272	360	489	514
TOTAL RT	104	126	119	116

Development Volumes

	Dartmouth EB	Dartmouth WB	Rockdale NB	Rockdale SB
TOTAL LT	-24			
TOTAL TH				15
TOTAL RT	-15			-20

Total Analysis Volumes

	Dartmouth EB	Dartmouth WB	Rockdale NB	Rockdale SB
TOTAL LT	170	90	90	80
TOTAL TH	272	360	489	514
TOTAL RT	104	126	119	116
Total	546	576	698	710

% RTOR

Dartmouth EB	Dartmouth WB	Rockdale NB	Rockdale SB
10%	25%		35%

Adjustments to Base Vol's

Base Year =	1989
Final Year =	1989
Growth/yr =	1.03
DHV adjust =	1.000
Total Growth =	1.000
Add dev Y/N =	n
Time of Day =	PM
Controller =	fixed time
CBD?	N

Traffic and Roadway Conditions

Approach	Grade %	%HV	Adj	Parking?	Nm Parking	Buses Nb
Dartmouth EB		1.1		n		
Dartmouth WB		2.3		y	10	
Rockdale NB	3	1.6		n		
Rockdale SB	-3	1.7		n		

	Conf Peds/hr	Ped. Button?	Min Time Butt	Arr Type	phf
Dartmouth EB		N		3	0.93
Dartmouth WB		N		3	0.96
Rockdale NB		N		3	0.88
Rockdale SB		N		3	0.93

Lane Groupings

		# Lanes N	LT?	TH?	RT?	Lane Width	Left turn phase
Dartmouth EB	1	2	y	y	y	10	perm
EB	2						
	3						
Dartmouth WB							
	1	2	y	y	n	9	perm
WB	2	1	n	n	y	12.5	
	3						
Rockdale NB							
	1	1	y	n	n	12	perm
NB	2	1	n	y	y	12	
	3						
Rockdale SB							
	1	1	y	y	n	10.5	perm
SB	2	1	n	n	y	10.5	
	3						

Intersection: **Rockdale Ave. at Dartmouth St.**
Location: Dartmouth, MA
Traffic Period: 1989 Design Hour (PM Peak) - No-Build

Print Date 5/17/90
Print Time 8:20 AM

Computed By:
Checked By:

Phase Green Times

Phase 1	29.0
Phase 2	25.0
Phase 3	
Phase 4	
Phase 5	
Phase 6	
Phase 7	
Gr. Clear. - 8	
	Timing (sec.)
Total Green	54.0
Total Dead	6.0
Cycle Length	60.0

LEVEL OF SERVICE SUMMARY

Lane Group	Average Delay	Group LOS	Queue Length in Vehicles: At End of Red	Queue Length in Vehicles: Maximum	Appr. Delay	Approach LOS
Dartmouth EB					11.2	B
LTR	11.2	B	6.4	6.8		
Dartmouth WB					10.0	B
LT	10.4	B	5.1	5.4		
R	8.5	B	1.1	1.1		
Rockdale NB					18.1	C
L	39.7	D	1.0	1.1		
TR	15.0	B	6.7	7.6		
Rockdale SB					76.7	F
LT	87.9	F	6.6	7.8		
R	6.6	B	0.9	0.9		
			Average For Intersection		**30.6**	**D**

CAPACITY SUMMARY

Overall Xc = 0.89

Lane Group	Adjusted Vol.	Sat. Flow, s	V/c ratio, X	Critical Lane Groups	Moving Øs	Effective Green
Dartmouth EB						
LTR	610	2391	0.61	y	2	41.7%
Dartmouth WB						
LT	492	2252	0.52		2	41.7%
R	112	1287	0.21		2	41.7%
Rockdale NB						
L	102	246	0.86		1	48.3%
TR	691	1730	0.83		1	48.3%
Rockdale SB						
LT	639	1176	1.12	y	1	48.3%
R	102	1451	0.15		1	48.3%

Intersection: **Rockdale Ave. at Dartmouth St.**
Location: Dartmouth, MA
Traffic Period: 1989 Design Hour (PM Peak) - Build

Print Date 5/17/90
Print Time 8:22 AM

Computed By: WF
Checked By: AF

Phase Green Times

Phase 1	29.0
Phase 2	25.0
Phase 3	
Phase 4	
Phase 5	
Phase 6	
Phase 7	
Gr. Clear. - 8	
	Timing (sec.)
Total Green	54.0
Total Dead	6.0
Cycle Length	60.0

LEVEL OF SERVICE SUMMARY

Lane Group	Average Delay	Group LOS	Queue Length in Vehicles: At End of Red	Queue Length in Vehicles: Maximum	Appr. Delay	Approach LOS
Dartmouth EB					10.7	B
LTR	10.7	B	5.9	6.3		
Dartmouth WB					9.9	B
LT	10.2	B	5.1	5.4		
R	8.5	B	1.1	1.1		
Rockdale NB					18.1	C
L	39.7	D	1.0	1.1		
TR	15.0	B	6.7	7.6		
Rockdale SB					86.6	F
LT	97.0	F	6.8	8.1		
R	6.5	B	0.7	0.8		
			Average For Intersection		**33.5**	**D**

CAPACITY SUMMARY

Overall Xc = 0.87

Lane Group	Adjusted Vol.	Sat. Flow, s	V/c ratio, X	Critical Lane Groups	Moving Øs	Effective Green
Dartmouth EB						
LTR	567	2427	0.56	y	2	41.7%
Dartmouth WB						
LT	492	2329	0.51		2	41.7%
R	112	1287	0.21		2	41.7%
Rockdale NB						
L	102	246	0.86		1	48.3%
TR	691	1730	0.83		1	48.3%
Rockdale SB						
LT	655	1187	1.14	y	1	48.3%
R	85	1451	0.12		1	48.3%

Intersection: **Rockdale Ave. at Dartmouth St.**
Location: Dartmouth, MA
Traffic Period: 1989 Design Hour (PM Peak) - Build

Print Date 5/17/90
Print Time 8:28 AM

with improved timing

Computed By: WF
Checked By: AF

Phase Green Times

Phase 1	34.0
Phase 2	20.0
Phase 3	
Phase 4	
Phase 5	
Phase 6	
Phase 7	
Gr. Clear. - 8	
	Timing (sec.)
Total Green	54.0
Total Dead	6.0
Cycle Length	60.0

LEVEL OF SERVICE SUMMARY

Lane Group	Average Delay	Group LOS	Queue Length in Vehicles: At End of Red	Queue Length in Vehicles: Maximum	Appr. Delay	Approach LOS
Dartmouth EB					15.5	C
LTR	15.5	C	6.7	7.2		
Dartmouth WB					13.9	B
LT	14.5	B	5.8	6.2		
R	11.1	B	1.2	1.3		
Rockdale NB					8.6	B
L	7.3	B	0.8	0.9		
TR	8.8	B	5.6	6.3		
Rockdale SB					15.7	C
LT	17.2	C	5.5	6.5		
R	4.6	A	0.6	0.7		
			Average For Intersection		**13.1**	**B**

CAPACITY SUMMARY

Overall Xc = 0.82

Lane Group	Adjusted Vol.	Sat. Flow, s	V/c ratio, X	Critical Lane Groups	Moving Øs	Effective Green
Dartmouth EB						
LTR	566	2369	0.72	y	2	33.3%
Dartmouth WB						
LT	492	2247	0.66		2	33.3%
R	109	1287	0.25		2	33.3%
Rockdale NB						
L	102	371	0.49		1	56.7%
TR	691	1730	0.70		1	56.7%
Rockdale SB						
LT	655	1309	0.88	y	1	56.7%
R	88	1451	0.11		1	56.7%

Intersection: **Rockdale Ave. at Dartmouth St.**
Location: Dartmouth, MA
Traffic Period: 1989 Design Hour (PM Peak) - Build (WITH MITIGATION)

Print Date 6/5/90
Print Time 11:06 AM

Computed By: WF
Checked By: AE

WITH REVISED LANE USE

Phase Green Times

Phase 1	35.0
Phase 2	19.0
Phase 3	
Phase 4	
Phase 5	
Phase 6	
Phase 7	
Gr. Clear. - 8	
	Timing (sec.)
Total Green	54.0
Total Dead	6.0
Cycle Length	60.0

LEVEL OF SERVICE SUMMARY

Lane Group	Average Delay	Group LOS	Queue Length in Vehicles: At End of Red	Queue Length in Vehicles: Maximum	Appr. Delay	Approach LOS
Dartmouth EB					22.7	C
L	38.2	D	1.9	2.1		
TR	16.3	C	4.6	4.9		
Dartmouth WB					18.2	C
L	13.8	B	1.1	1.2		
T	21.2	C	4.6	4.9		
R	11.7	B	1.3	1.3		
Rockdale NB					7.7	B
L	6.2	B	0.8	0.8		
TR	8.0	B	5.4	6.1		
Rockdale SB					11.0	B
LT	11.9	B	5.3	6.1		
R	4.2	A	0.6	0.6		
			Average For Intersection		**14.0**	**B**

CAPACITY SUMMARY

Overall Xc = 0.83

Lane Group	Adjusted Vol.	Sat. Flow, s	V/c ratio, X	Critical Lane Groups	Moving Øs	Effective Green
Dartmouth EB						
L	157	568	0.87	Y	2	31.7%
TR	382	1737	0.69		2	31.7%
Dartmouth WB						
L	94	631	0.47		2	31.7%
T	375	1469	0.81		2	31.7%
R	109	1287	0.27		2	31.7%
Rockdale NB						
L	102	396	0.44		1	58.3%
TR	691	1730	0.68		1	58.3%
Rockdale SB						
LT	655	1386	0.81	Y	1	58.3%
R	88	1451	0.10		1	58.3%

DARTMOUTH ST. AT McDonald's

SATURDAY PEAK

GENERAL CHARACTERISTICS

POPULATION OVER 250,000 [Y]
CONTROLS: STOP OR YIELD (S/Y) [Y]
PREVAILING SPEED (MPH): [30]
MAIN ST: **Dartmouth St.WB Dartmouth St.EB**
NUMBER OF LANES [2]
Approach A: Exclusive Right Turn Lane?(Y/N) [n]

SIGHT DISTANCE RESTRICTIONS (SEC)

APPROACH A	THROUGHS	
Dartmouth St.WB	RIGHTS	
APPROACH B	LEFTS	
Dartmouth St.EB	THROUGHS	
APPROACH C	LEFTS	
Driveway SB	RIGHTS	

Dartmouth St.EB
Dartmouth St.WB
Driveway SB

MINOR STREET LANES

APPROACH C: Driveway SB
EXCLUSIVE LEFT TURN LANE? (Y/N) [y]
EXCLUSIVE RIGHT TURN LANE? (Y/N) [y]
LARGE TURN RADII ?(Y/N) [n]
APPROACH ANGLE < 60 DEGREES?(Y/N) [n]
RIGHT TURN ACCELERATION LANE?(Y/N) [y]

	Dartmouth St.WB APPROACH A		Dartmouth St.EB APPROACH B		Driveway SB APPROACH C	
MOVEMENT	TH	RT	LT	TH	LT	RT
VOLUME	367		34	460	89	70
PHF	0.9	0.9	0.9	0.9	0.90	0.9
V, ADJUSTED VOLUMES(VPH)	406		38	511	99	78
GRADE %						
CYCLES%						
LIGHT TRUCKS & RVs %					2	2
COMBINATION VEHICLES %	2	2	2	2		
PASS. CAR EQUIVALENTS/HR			39		100	79
Vc, CONFLICTING FLOW(VPH)			408		957	408
Tc, CRITICAL GAP (SEC)			5		6	4
Ts, FOLLOW UP GAP (SEC)			3		3	3
Cp, POTENTIAL CAPACITY			790		348	1034
% Cp UTILIZED			5%		0	8%
IMPEDENCE FACTOR			0.97		1	0.95
Cm, ACTUAL CAPACITY			790		337	1034

SUMMARY OF CAPACITY AND LEVEL OF SERVICE BY MOVEMENT

Dartmouth St.EB

MOVEMENT	DEMAND	Cm			RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	38	790			752	A	5	0.1 VEH.
Driveway SB			SHARED LANE					
MOVEMENT	DEMAND	Cm	CAPACITY	VOL.	RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	100	337			237	C	15	0.4 VEH.
RIGHT	79	1034			955	A	4	0.1 VEH.

DARTMOUTH ST. AT McDonald's

SATURDAY PEAK

GENERAL CHARACTERISTICS

POPULATION OVER 250,000 [Y]

CONTROLS: STOP OR YIELD (S/Y) [Y]

PREVAILING SPEED (MPH): [30]

MAIN ST: **Dartmouth St.WB Dartmouth St.EB**

NUMBER OF LANES [2]

Approach A: Exclusive Right Turn Lane?(Y/N) [n]

MINOR STREET LANES

APPROACH C: Driveway SB

EXCLUSIVE LEFT TURN LANE? (Y/N) [Y]

EXCLUSIVE RIGHT TURN LANE? (Y/N) [Y]

LARGE TURN RADII ?(Y/N) [n]

APPROACH ANGLE < 60 DEGREES?(Y/N) [n]

RIGHT TURN ACCELERATION LANE?(Y/N) [Y]

SIGHT DISTANCE RESTRICTIONS (SEC)

APPROACH A	THROUGHS	
Dartmouth St.WB	RIGHTS	
APPROACH B	LEFTS	
Dartmouth St.EB	THROUGHS	
APPROACH C	LEFTS	
Driveway SB	RIGHTS	

Approach B
Dartmouth St.EB

Dartmouth St.WB
Approach A

Approach C
Driveway SB

	Dartmouth St.WB APPROACH A		Dartmouth St.EB APPROACH B		Driveway SB APPROACH C	
MOVEMENT	TH	RT	LT	TH	LT	RT
VOLUME	367		34	460	137	70
PHF	0.9	0.9	0.9	0.9	0.90	0.9
V, ADJUSTED VOLUMES(VPH)	408		38	511	152	78
GRADE %						
CYCLES%						
LIGHT TRUCKS & RVs %					2	2
COMBINATION VEHICLES %	2	2	2	2		
PASS. CAR EQUIVALENTS/HR			39		154	79
Vc, CONFLICTING FLOW(VPH)			408		957	408
Tc, CRITICAL GAP (SEC)			5		6	4
Ts, FOLLOW UP GAP (SEC)			3		3	3
Cp, POTENTIAL CAPACITY			790		348	1034
% Cp UTILIZED			5%		44%	8%
IMPEDENCE FACTOR			0.97		1	0.95
Cm, ACTUAL CAPACITY			790		337	1034

SUMMARY OF CAPACITY AND LEVEL OF SERVICE BY MOVEMENT

Dartmouth St.EB

MOVEMENT	DEMAND	Cm	RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	38	790	752	A	5	0.1 VEH.

Driveway SB — SHARED LANE

MOVEMENT	DEMAND	Cm	CAPACITY	VOL.	RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	154	337			183	D	19	0.8 VEH.
RIGHT	79	1034			955	A	4	0.1 VEH.

With no McDonald's traffic exiting onto Rockdale Ave.

DARTMOUTH ST. AT McDonald's

SATURDAY PEAK

GENERAL CHARACTERISTICS

POPULATION OVER 250,000: Y

CONTROLS: STOP OR YIELD (S/Y): Y

PREVAILING SPEED (MPH): 30

MAIN ST: **Dartmouth St.WB Dartmouth St.EB**

NUMBER OF LANES: 2

Approach A: Exclusive Right Turn Lane?(Y/N): n

MINOR STREET LANES

APPROACH C: Driveway SB

EXCLUSIVE LEFT TURN LANE? (Y/N): n

EXCLUSIVE RIGHT TURN LANE? (Y/N): n

LARGE TURN RADII ?(Y/N): n

APPROACH ANGLE < 60 DEGREES?(Y/N): n

RIGHT TURN ACCELERATION LANE?(Y/N): n

SIGHT DISTANCE RESTRICTIONS (SEC)

APPROACH A	THROUGHS	
Dartmouth St.WB	RIGHTS	
APPROACH B	LEFTS	
Dartmouth St.EB	THROUGHS	
APPROACH C	LEFTS	
Driveway SB	RIGHTS	

Approach B
Dartmouth St.EB

Dartmouth St.WB
Approach A

Approach C
Driveway SB

	Dartmouth St.WB APPROACH A		Dartmouth St.EB APPROACH B		Driveway SB APPROACH C	
MOVEMENT	TH	RT	LT	TH	LT	RT
VOLUME	367		34	460	137	70
PHF	0.9	0.9	0.9	0.9	0.90	0.9
V, ADJUSTED VOLUMES(VPH)	408		38	511	152	78
GRADE%						
CYCLES%						
LIGHT TRUCKS & RVs %					2	2
COMBINATION VEHICLES %	2	2	2	2		
PASS. CAR EQUIVALENTS/HR			39		154	79
Vc, CONFLICTING FLOW(VPH)			408		957	408
Tc, CRITICAL GAP (SEC)			5		6	5
Ts, FOLLOW UP GAP (SEC)			3		3	3
Cp, POTENTIAL CAPACITY			790		348	900
% Cp UTILIZED			5%		44%	9%
IMPEDENCE FACTOR			0.97		1	0.94
Cm, ACTUAL CAPACITY			790		337	899.9

SUMMARY OF CAPACITY AND LEVEL OF SERVICE BY MOVEMENT

Dartmouth St.EB

MOVEMENT	DEMAND	Cm	RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	38	790	752	A	5	0.1 VEH.

Driveway SB — SHARED LANE

MOVEMENT	DEMAND	Cm	CAPACITY	VOL.	RES.	LOS	AVG DELAY(SEC)	AVG QUEUE
LEFT	154	337	428	232	195	D	18	1.1 VEH.
RIGHT	79	900						