

Assessment

To: Scott Leonard, One Buckland Center, PO Box 799, Rocky Hill, CT 06067

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Phone: (860) 550-2323

Date: December 30, 2019

Re: *Evaluation of Improved Access Provisions*

One Buckland Center

South Windsor, Connecticut

Update Request

At the request of the Town Planner, we have updated herein our last iteration of this assessment, dated July 24, 2018, to account for other developments that have been approved and/or developed since the peak hour traffic counts we conducted in this study area during the 2016 Christmas season for our initial assessment, dated March 29, 2017. This current update incorporates and evaluates the data contained in the traffic impact study that was prepared and submitted to, and approved by, the Town for the new Chase Bank in 2019 to be developed at the north end of this study area.

Description

We are pleased to submit herein our latest, updated evaluation of a possible provision to facilitate access to the subject One Buckland Center site from the northbound lanes of Buckland Road. This update includes the most current peak hour traffic volumes as provided by the Town Planner from the most recent development applications to date.

As it currently exists, the subject site has one site drive on the west side of Buckland Road that is only accessible by southbound right-turning traffic both inbound and outbound, with no easy way for northbound traffic to access the site without passing the site in the northbound direction and then negotiating a U-turn somewhere to the north of the site to approach the site in the southbound direction. It is understood and proposed that exiting traffic will continue to exit the site by making a right turn onto Buckland Road and heading south on Buckland Road to either continue south, or by negotiating a U-turn at the signalized intersection at the entrance to Buckland Mall, to head north on Buckland Road.

Please refer to Exhibit 1 of the Appendix which contains maps that locate this site with respect to the surrounding roadway network.

Option Considered

As the result of the concern raised over the illegal U-turns that currently occur at the northern end of the median separating the northbound and southbound lanes of Buckland Road, presumably to reach the subject site from points west, south and east of the site, we had conducted manual turning movement counts in June 2018 for 12 hours each on a typical Friday and Saturday, between the hours of 7:00 am and 7:00 pm, to measure northbound and southbound traffic volumes during this period, paying particular attention to how many vehicles each day made a U-turn at the north end of the median separating the northbound and southbound lanes to then head south, presumably to reach One Buckland Center.

Please refer to Table 1 on the next page which summarizes the results of these turning movement counts. A review of Table 1 shows that during these 12-hour periods, where a total of about 22,100 vehicles were counted on a Friday and a total of about 21,400 vehicles were counted on a Saturday traveling this section of Buckland Road, as many as from 17 to 19 vehicles made a U-turn to gain access to the southbound lanes.

Note that this U-turn is posted as an illegal maneuver and poses a potential hazard to those making the maneuver as well as to southbound traffic that may come into conflict with those making this maneuver.

Alternatively, please refer to Exhibit 2 of the Appendix which shows a viable manner to avoid this illegal U-turn maneuver and instead provide a safe alternative for those wishing to gain access to the subject site at One Buckland Road from the northbound lanes of Buckland Road safely and efficiently. This alternative involves making a median break between the northbound and southbound lanes in line with the site drive and providing a northbound left-turn lane for traffic entering the site from the south.

Supporting Information

In support of our recommendation, we have included herein the following information on the following four pages of this study:

- A. Table 1 which summarizes the results of the turning movement counts that were conducted on Buckland Road in the vicinity of One Buckland Center in June 2018 to assess the magnitude of the illegal U-turn maneuver.
- B. Table 2 which summarizes the estimated trip generation for One Buckland Center during the three selected peak periods for analysis (Friday am peak hour, Friday pm peak hour, and Saturday mid-day peak hour). As a worst-case, it has been assumed that there would be a total of 17,863 square feet of a combination of office and retail development. Given the different peaking characteristics of office and retail, the highest trip generation associated with each of these land uses was assumed as a "worst case"; i.e., all office for the weekday am peak, and all retail for the weekday pm and Saturday midday peaks. Trip distribution has been assumed to be distributed at 25 percent each to and from the north, east, south and west of the site.

Table 1
Summary of Buckland Road Traffic Volumes
Vicinity of One Buckland Center
South Windsor, Connecticut

Hour Begin	Friday, June 8, 2018				Saturday, June 9, 2018					
	NB Thru	NB U-Turn	NB Total	SB Total	TOTAL	NB Thru	NB U-Turn	NB Total	SB Total	TOTAL
7:00 AM	517	1	518	831	1349	274	0	274	281	555
8:00 AM	610	1	611	804	1415	512	0	512	463	975
9:00 AM	707	0	707	649	1356	806	2	808	618	1426
10:00 AM	797	2	799	717	1516	952	2	954	838	1792
11:00 AM	954	1	955	851	1806	1114	0	1114	1138	2252
12:00 AM	1012	0	1012	1008	2020	1122	0	1122	1181	2303
1:00 PM	935	3	938	1014	1952	1052	3	1055	1215	2270
2:00 PM	1032	2	1034	1119	2153	1043	2	1045	1096	2141
3:00 PM	1053	2	1055	973	2028	997	5	1002	1124	2126
4:00 PM	1203	4	1207	1108	2315	934	3	937	1103	2040
5:00 PM	1181	0	1181	1079	2260	851	0	851	1012	1863
6:00 PM	924	1	925	1006	1931	758	2	760	951	1711
Total:	10925	17	10942	11159	22101	10415	19	10434	11020	21454
Percent of Total:	49.43%	0.08%	49.51%	50.49%	100%	48.55%	0.09%	48.63%	51.37%	100%
Percent of NB Total:		0.16%					0.18%			

Bubaris Traffic Associates
July 2018

Table 2
Trip Generation and Trip Distribution Estimates
Proposed Retail Center
One Buckland Center
South Windsor, Connecticut

	<u>Trip Generation</u>			<u>Trip Distribution</u>			
	As Retail Use	As Office Use	Maximum for Design	To/From NORTH via Buckland Road 25%	To/From WEST via Pleasant Valley Road 25%	To/From SOUTH via Buckland Street 25%	To/From EAST via Buckland Hills Road 25%
<u>Friday AM Peak Hour</u>							
In	11	25	25	7	6	6	6
<u>Out</u>	<u>7</u>	<u>3</u>	<u>3</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>0</u>
Total	18	28	28	8	7	7	6
<u>Friday PM Peak Hour</u>							
In	32	5	32	8	8	8	8
<u>Out</u>	<u>34</u>	<u>22</u>	<u>34</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>8</u>
Total	66	27	66	16	17	17	16
<u>Saturday Midday Peak Hour</u>							
In	45	4	45	12	11	11	11
<u>Out</u>	<u>41</u>	<u>4</u>	<u>41</u>	<u>11</u>	<u>10</u>	<u>10</u>	<u>10</u>
Total	86	8	86	23	21	21	21

Bubaris Traffic Associates
July 2018

Table 3
Summary of Traffic Operations Analysis
Levels of Service
Proposed Retail Center
One Buckland Center
South Windsor, Connecticut

	<u>2020 Background</u>			<u>2020 Combined</u> <u>(Build with Improvements)</u>		
	<u>(No-Build)</u>					
	<u>AM Peak</u>	<u>PM Peak</u>	<u>Sat Peak</u>	<u>AM Peak</u>	<u>PM Peak</u>	<u>Sat Peak</u>
<u>Buckland Road at Evergreen Walk (Tamarack) and Lowe's Drive</u>						
Buckland Road northbound approach	B	E	E	B	E	D
Buckland Road southbound approach	B	D	D	B	D	E
Tamarack Road eastbound approach	B	C	E	B	C	C
Lowe's Site Drive westbound approach	C	D	F	C	D	E
Overall	-B-	-D-	-E-	-B-	-D-	-D-
Average Delay per Vehicle (sec.)	19.6	52.1	66.4	19.1	50.2	49.5
<u>Buckland Road at One Buckland Center Site Drive</u>						
Buckland Road northbound approach	-----	-----	-----	A	A	A
Buckland Road southbound approach	-----	-----	-----	A	B	B
Proposed Site Drive eastbound (outbound) right	-----	-----	-----	A	A	A
Overall	-----	-----	-----	-A-	-A-	-B-
Average Delay per Vehicle (sec.)	-----	-----	-----	2.3	4.6	11.6
<u>Buckland Street at Pleasant Valley Road and Buckland Hills Road</u>						
Buckland Street northbound approach	B	D	D	B	D	D
Buckland Street southbound approach	B	C	C	B	C	C
Pleasant Valley Road eastbound approach	C	D	D	C	C	D
Buckland Hills Drive westbound approach	D	E	D	D	D	D
Overall	-C-	-D-	-D-	-C-	-D-	-D-
Average Delay per Vehicle (sec.)	20.5	39.3	43.6	20.5	37.5	43.0

Table 4
Summary of Queuing Analyses
95th Percentile Queues
Proposed Retail Center
One Buckland Center
South Windsor, Connecticut

<u>Approach</u>	<u>Segment</u>	<u>Available Storage (feet)</u>	<u><--- 2020 Combined (build) with Improvements ---></u>			<u>SAT Peak</u>	<u>STATUS</u>	<u>COMMENT</u>
Buckland Road southbound	<u>Between Tamarack Avenue and One Buckland Center:</u>							
	Southbound Through Lanes:	700 feet	19 feet	163 feet	563 feet	OK		
	Southbound Right-Turn Lane:	150 feet	0 feet	0 feet	0 feet	OK		
	<u>Between proposed site drive and Pleasant Valley Road:</u>							
Buckland Road northbound	Southbound Left-Turn Lanes:	550 feet	29 feet	183 feet	154 feet	OK		
	Southbound Through Lanes:	550 feet	160 feet	406 feet	426 feet	OK		
	Southbound Right-Turn Lane:	550 feet	111 feet	0 feet	0 feet	OK		
	<u>Between Buckland Hills Road and One Buckland Center:</u>							
Buckland Road northbound	Northbound left-turn lane:	150 feet	62 feet	81 feet	115 feet	-----		Provide minimum 150-foot long, full width left turn lane.
	Northbound through lanes:	600 feet	0 feet	0 feet	0 feet	OK		
	<u>Between One Buckland Center and Lowe's Site Drive:</u>							
	Northbound Left-Turn Lanes:	400 feet	108 feet	400 feet	389 feet	OK		
	Northbound Through Lanes:	700 feet	259 feet	698 feet	429 feet	OK		

- C. Table 3 which summarizes the updated traffic operations analyses during the three selected study peak periods based on projected 2020 background (no-build) and estimated 2020 combined (build) conditions. The two existing study intersections include the immediate intersection to the north at Evergreen Walk opposite the Lowe's site drive, and the immediate intersection to the south at Pleasant Valley Road opposite the Buckland Hills Mall entrance. The additional study intersection includes proposed signalization of the site drive and the proposed northbound left-turn lane. A review of Table 3 indicates that the proposed addition of One Buckland Center's traffic, with the proposed improvements in place, will continue to provide satisfactory levels of service.
- D. Table 4 which summarizes the estimated 95th percentile queues at the three study intersections with the proposed improvements in place. The results of these analyses indicate that the proposed additions and revisions can be accommodated satisfactorily without causing conditions where queued vehicles block key turn lanes and intersections.
- E. The attached Appendix which includes the following items:
 - Exhibit 1 - Location Maps showing subject site and its environs
 - Exhibit 2 - Proposed Northbound Left-Turn Lane with a possible configuration

The following represent graphical summaries of the projected 2020 peak hour traffic volumes utilizing the information contained in the approved Chase Bank traffic impact study provided to us by the Town Planner, but without the subject development in place (i.e., no-build conditions):

- Exhibit 3 - Background (no-build) 2020 Weekday AM Peak Hour
- Exhibit 4 - Background (no-build) 2020 Weekday PM Peak Hour
- Exhibit 5 - Background (no-build) 2020 Saturday Mid-Day Peak Hour

The following represent the site-generated traffic volumes and distributions for the subject development assuming the proposed turn-around in place allowing additional access from the south:

- Exhibit 6 - Trip Generation Calculations
 - A. ITE Land Use Code #820 – Shopping Center
 - B. ITE Land Use Code #710 – Office Space
- Exhibit 7 - Site-Generated (build) Trip Distributions
- Exhibit 8 - Site-Generated Weekday (build) AM Peak Hour Volumes
- Exhibit 9 - Site-Generated Weekday (build) PM Peak Hour Volumes
- Exhibit 10 - Site-Generated Saturday (build) Midday Peak Hour Volumes

The following represent graphical summaries of the projected peak hour traffic volumes when it is anticipated the subject development will be fully occupied and the proposed improvement will be in place:

Exhibit 11 - Combined (build) 2020 Weekday AM Peak Hour

Exhibit 12 - Combined (build) 2020 Weekday PM Peak Hour

Exhibit 13- Combined (build) 2020 Saturday Mid-Day Peak Hour

The following summarizes the definitions of levels of service under signalized conditions:

Exhibit 14 - Definitions of Levels of Service – Signalized Intersections

The following are the computer-generated worksheets for the background (no-build) conditions traffic operational analyses:

Exhibit 15 - Traffic Operations Analysis Worksheets
Background 2020 Weekday AM Peak Hour

Exhibit 16 - Traffic Operations Analysis Worksheets
Background 2020 Weekday PM Peak Hour

Exhibit 17 - Traffic Operations Analysis Worksheets
Background 2020 Saturday Mid-Day Peak Hour

The following are the computer-generated worksheets for the combined (build) conditions traffic operational analyses:

Exhibit 18 - Traffic Operations Analysis Worksheet
Combined 2020 Weekday AM Peak Hour

Exhibit 19 - Traffic Operations Analysis Worksheets
Combined 2020 Weekday PM Peak Hour

Exhibit 20 - Traffic Operations Analysis Worksheets
Combined 2020 Saturday Mid-Day Peak Hour

Recommendation

Our previous and updated findings indicate that the provision of a signalized left-turn lane in the Buckland Road northbound direction at the site drive serving One Buckland Center, which is located on the west side of the road, can be accommodated and would serve this site and area well with no apparent adverse impacts.

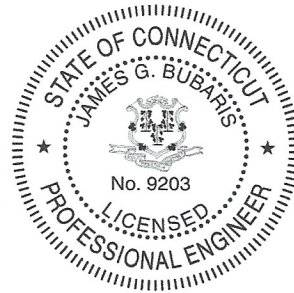
We recommend that a traffic signal be installed on Buckland Road at the subject site drive which only stops Buckland Road southbound traffic when there is either demand for a northbound vehicle to make a left-turn into the site, or for an exiting vehicle to make a right-turn out of the site. Left-turns OUT of the site will continue NOT to be allowed. This revision would also enable Buckland Road northbound traffic wishing to make a U-turn to head south to do so in protected fashion as well. Approaching northbound left-turning traffic should be provided a dedicated left-turn lane in the median area that is controlled by a left-turn signal which displays only upon demand at a designated point in the signal's cycle.

We further recommend that this signal be interconnected to the immediate traffic signal to the north at the intersection of Buckland Road at Tamarack Road (Evergreen Walk) and Lowe's site drive. Specifically, the left-turn phase at the proposed signal and turn lane should coincide with the northbound double-left turn phase at the Tamarack Road signal when Buckland Road southbound traffic is already stopped at that location to allow the left-turn movement into Evergreen Walk. Additionally, the outbound right-turn out of the subject site should coincide with the phase allocated for moving Lowe's traffic out of that site. Such should pose the least constraints to existing traffic operations while affording a substantial improvement.

Very truly yours,
Bubaris Traffic Associates



James G. Bubaris, P.E.
Conn. Reg. No. 9203
Principal



A P P E N D I X

**Site Traffic Evaluation Study
One Buckland Center
South Windsor, Connecticut**

Appendix

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Exhibit 4	Background (No-Build) 2020 Weekday PM Peak Hour
Exhibit 5	Background (No-Build) 2020 Saturday Mid-Day Peak Hour

Exhibit 6	Trip Generation Calculations Source: Trip Generation Manual, Institute of Transportation Engineers: A. ITE Land Use Code #820 – Shopping Center B. ITE Land Use Code #710 – Office Space
Exhibit 7	Site-Generated Trip Distributions
Exhibit 8	Site-Generated Weekday AM Peak Hour Volumes
Exhibit 9	Site-Generated Weekday PM Peak Hour Volumes
Exhibit 10	Site-Generated Saturday Midday Peak Hour Volumes

Exhibit 11	Combined (Build) Background 2020 Weekday AM Peak Hour
Exhibit 12	Combined (Build) 2020 Weekday PM Peak Hour
Exhibit 13	Combined (Build) 2020 Saturday Mid-Day Peak Hour

(continued)

Exhibit 14 Definitions of Levels of Service – Signalized Intersections

Exhibit 15 Traffic Operations Analysis Worksheets
 Background 2020 Weekday AM Peak Hour

Exhibit 16 Traffic Operations Analysis Worksheets
 Background 2020 Weekday PM Peak Hour

Exhibit 17 Traffic Operations Analysis Worksheets
 Background 2020 Saturday Mid-Day Peak Hour

Exhibit 18 Traffic Operations Analysis Worksheets
 Combined 2020 Weekday AM Peak Hour

Exhibit 19 Traffic Operations Analysis Worksheets
 Combined 2020 Weekday PM Peak Hour

Exhibit 20 Traffic Operations Analysis Worksheets
 Combined 2020 Saturday Mid-Day Peak Hour

Exhibit 1
Location Maps
One Buckland Center
South Windsor, Connecticut

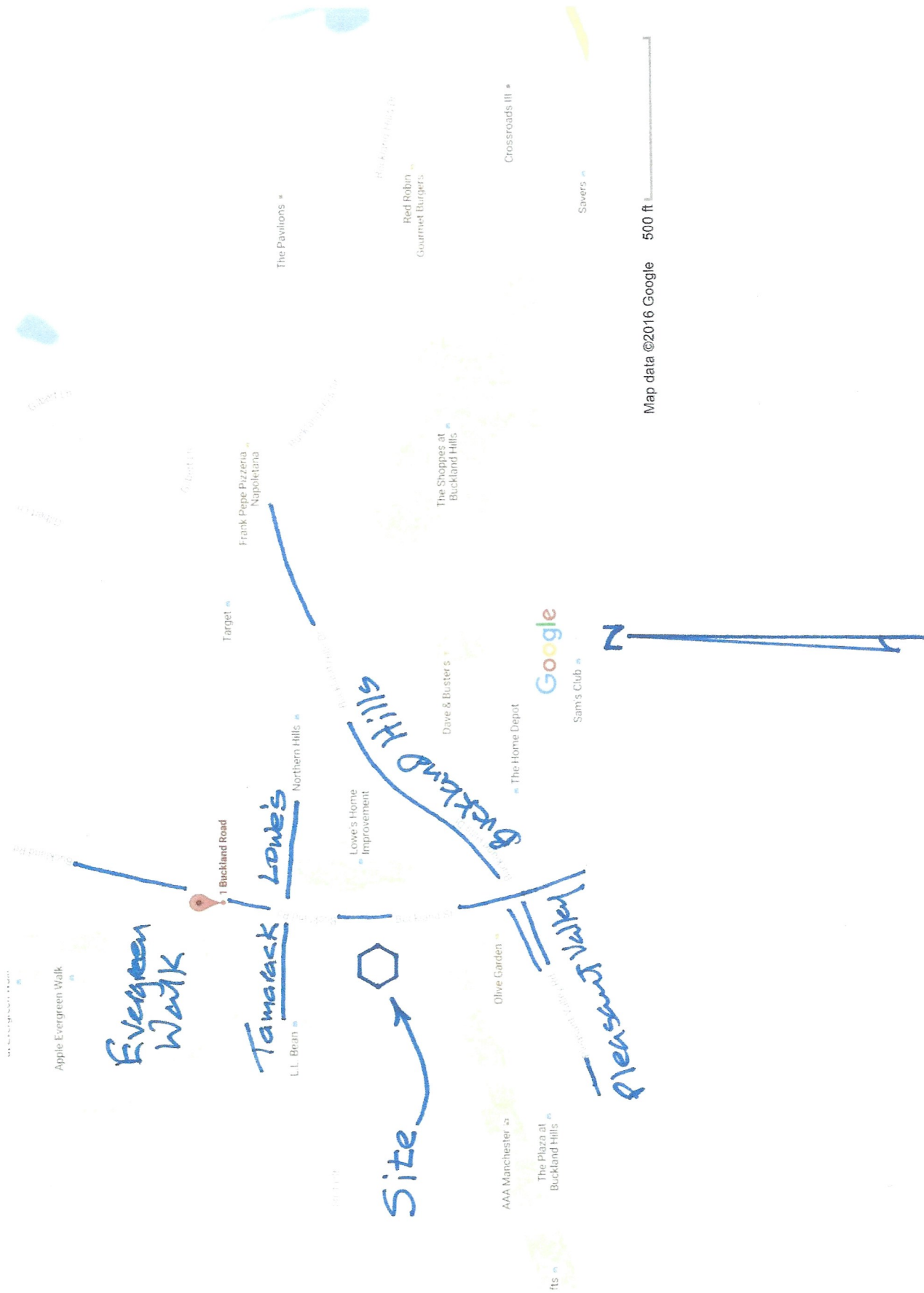
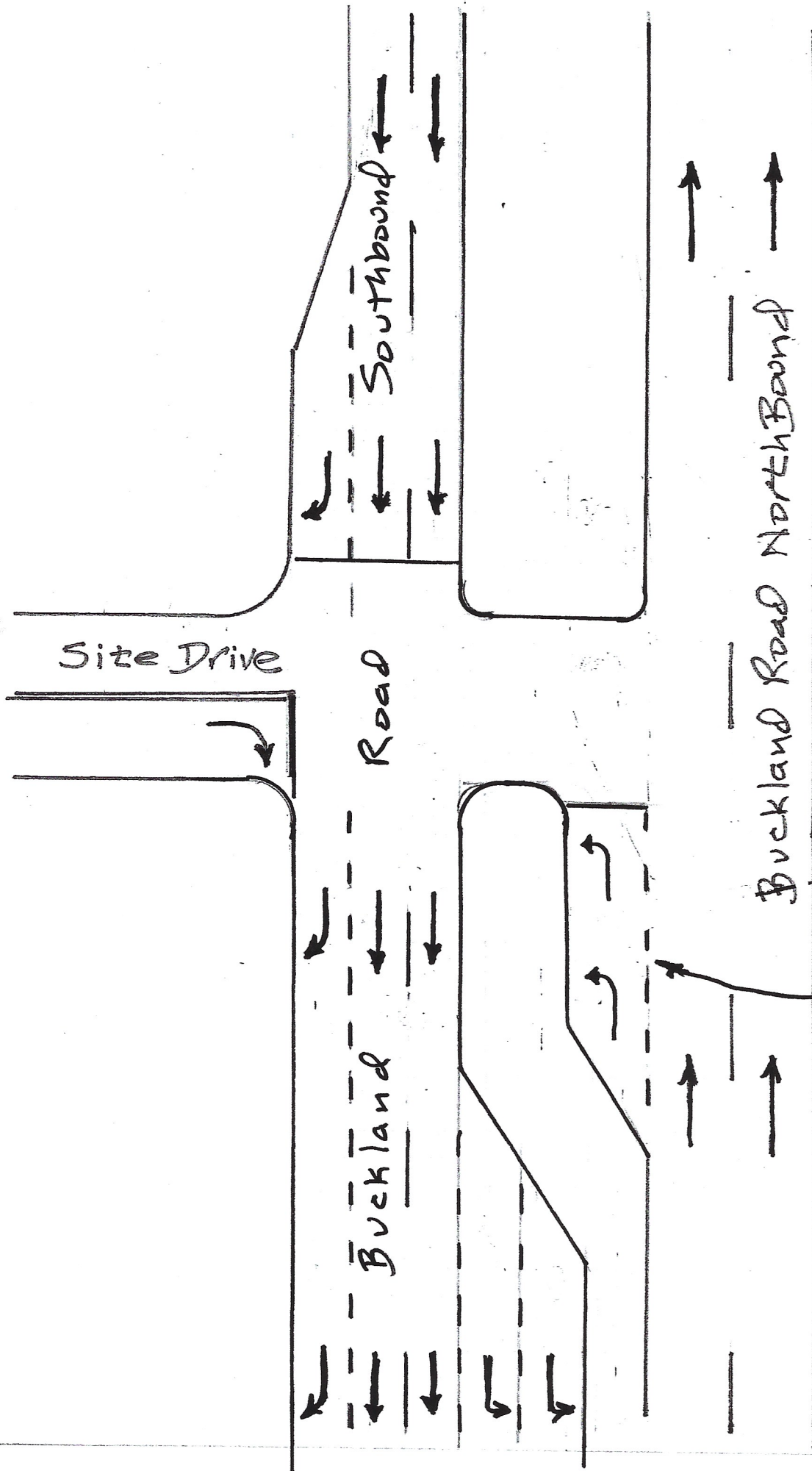




Exhibit 2
Proposed Northbound Left-Turn Lane
One Buckland Center
South Windsor, Connecticut



Proposed
Left-Turn
Lane

AD
ETC

[illegible]

DATE	REVISIONS
3/8/79	REVISED PROPOSED CURB CUT LOCATION
4/8/79	SIGN RELOCATION AREA SHOWN
8/26/79	TOWN AND SITE SIGNS MOVED PER CLIENT
10/21/79	TOWN AND SITE SIGNS MOVED PER CLIENT
12/26/79	REVISED PER CLIENT REQUEST

1 & 25 BUCKLAND ROAD
SOUTH WINDSOR, CT 06074

4.

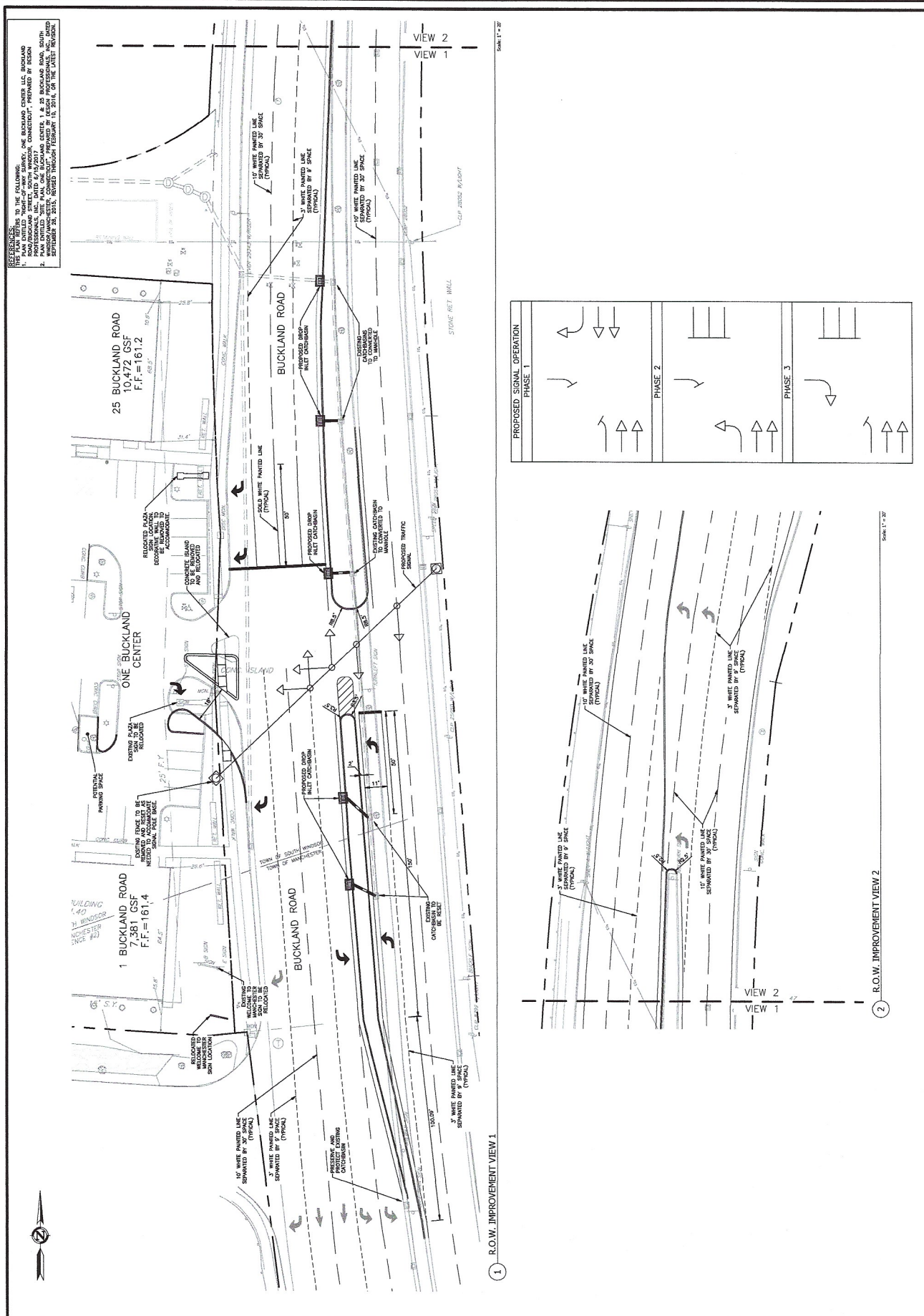
ONE BUCKLAND CENTER
1 & 25 BUCKLAND ROAD
SOUTH WINDSOR, CT 06074

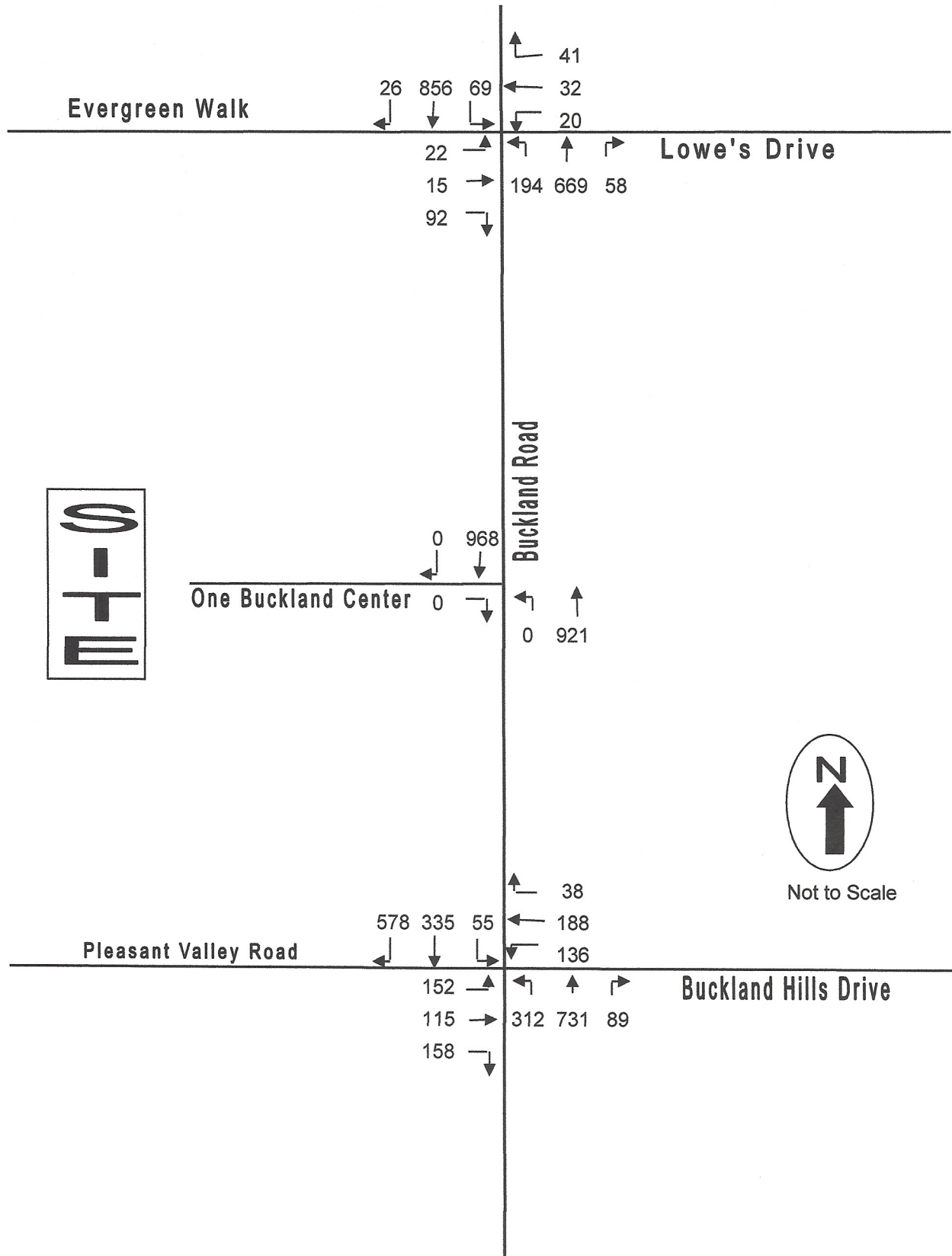
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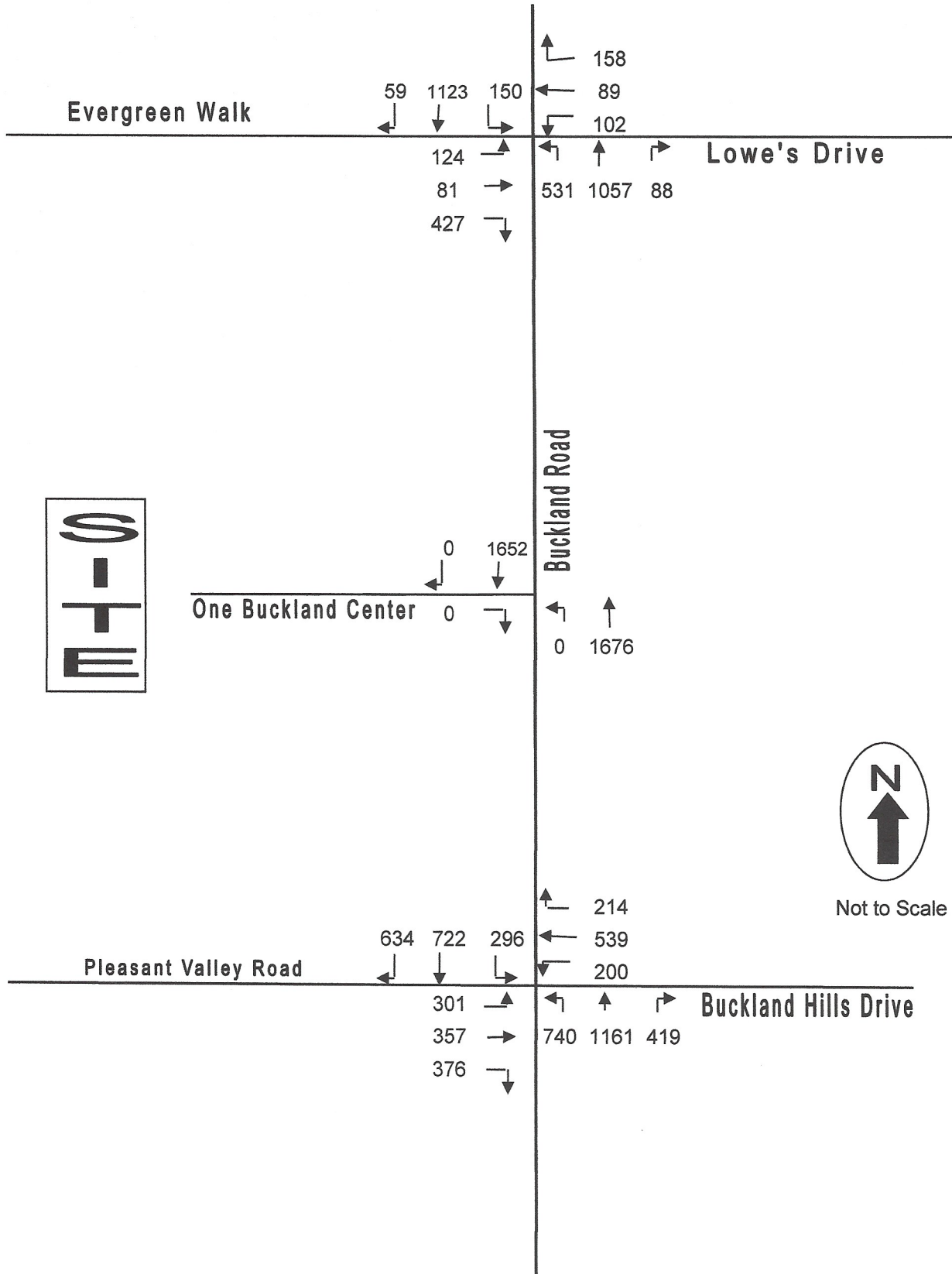
57

57

The following information was obtained from the records of the Department of the Interior, Bureau of Land Management, Washington, D. C., and is being furnished to you for your information.







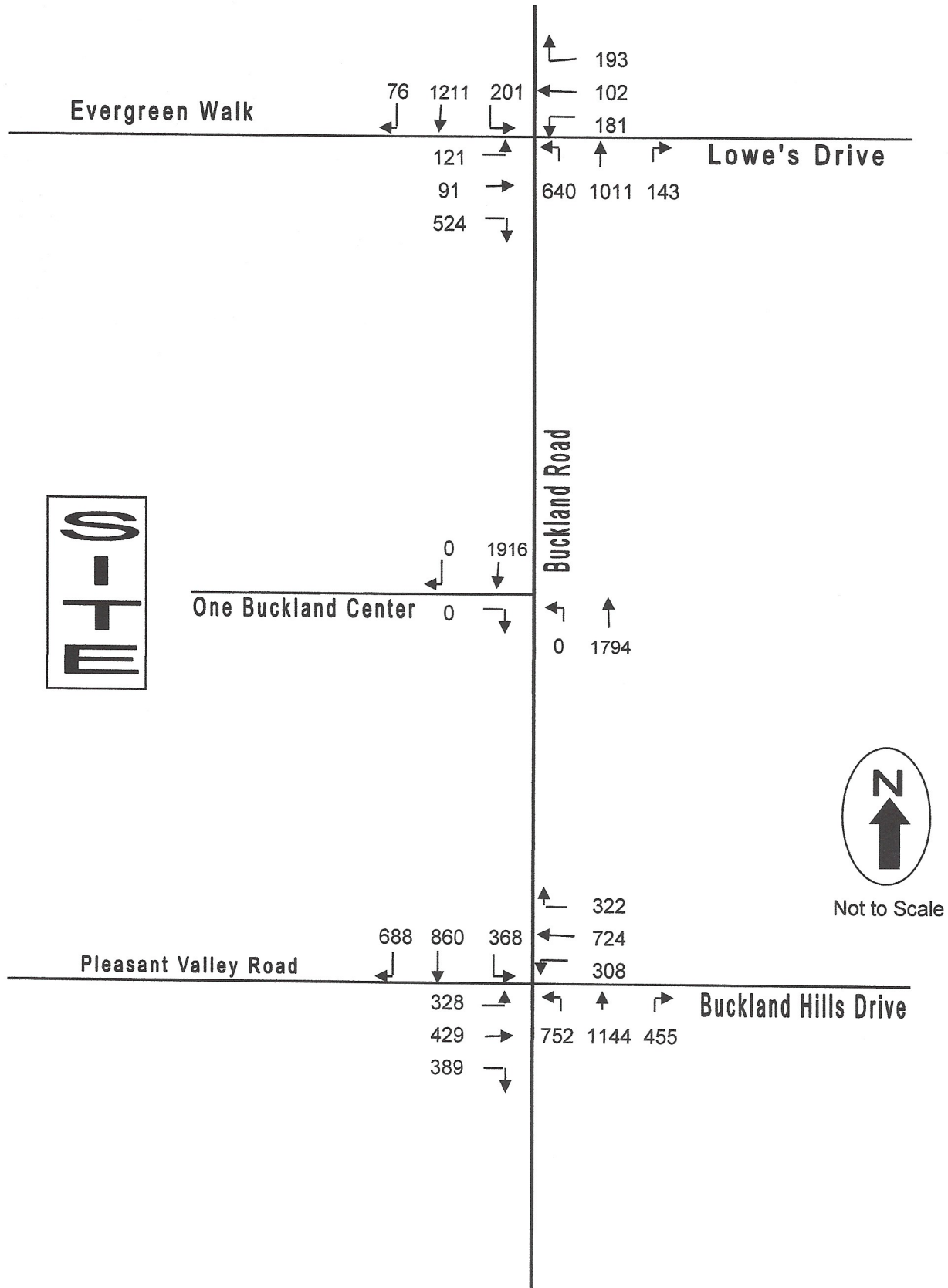


Exhibit 6

Trip Generation Calculations

Source: Trip Generation Manual, Institute of Transportation Engineers:

- A. ITE Land Use Code #820 – Shopping Center**
- B. ITE Land Use Code #710 – Office Space**

SHOPPING CENTER under 50,000 SF
(2012)
Based on Equations

Exhibit A

SUMMARY OF TRIP GENERATION CALCULATIONS

SOURCE: TRIP GENERATION REPORT, INSTITUTE OF TRANSPORTATION ENGINEERS, 9th EDITION, 2012

LAND USE: SHOPPING CENTER--CODE #820

PROJECT: Proposed Retail Use of One Buckland Center
South Windsor, Connecticut

NUMBER OF 1,000'S SQUARE FEET LEASABLE AREA: 17.863

<u>TIME PERIOD</u>	<u>ITE TRIP GENERATION EQUATION</u>	<u>TOTAL TRIPS</u>	<u>INBOUND</u>	<u>OUTBOUND</u>
AVERAGE WEEKDAY	$T = 42.70 (X)$ 50 % INBOUND * 50 % OUTBOUND	763	381	381
PEAK HOUR 7 TO 9 AM	$T = 0.96 (X)$ 62 % INBOUND * 38 % OUTBOUND	17	11	7
PEAK HOUR 4 TO 6 PM	$T = 3.71 (X)$ 48 % INBOUND * 52 % OUTBOUND	66	32	34
AVERAGE SATURDAY	$T = 49.77 (X)$ 50 % INBOUND * 50 % OUTBOUND	889	445	445
SATURDAY PEAK HOUR	$T = 4.82 (X)$ 52 % INBOUND * 48 % OUTBOUND	86	45	41
AVERAGE SUNDAY	$T = 25.24 (X)$ 50 % INBOUND * 50 % OUTBOUND	451	225	225
SUNDAY PEAK HOUR	$T = 3.12 (X)$ 49 % INBOUND * 51 % OUTBOUND	56	27	28

OFFICE BUILDING under 100,000 SF
(Based on Building Area)
(2012)

Exhibit B

SUMMARY OF TRIP GENERATION CALCULATIONS

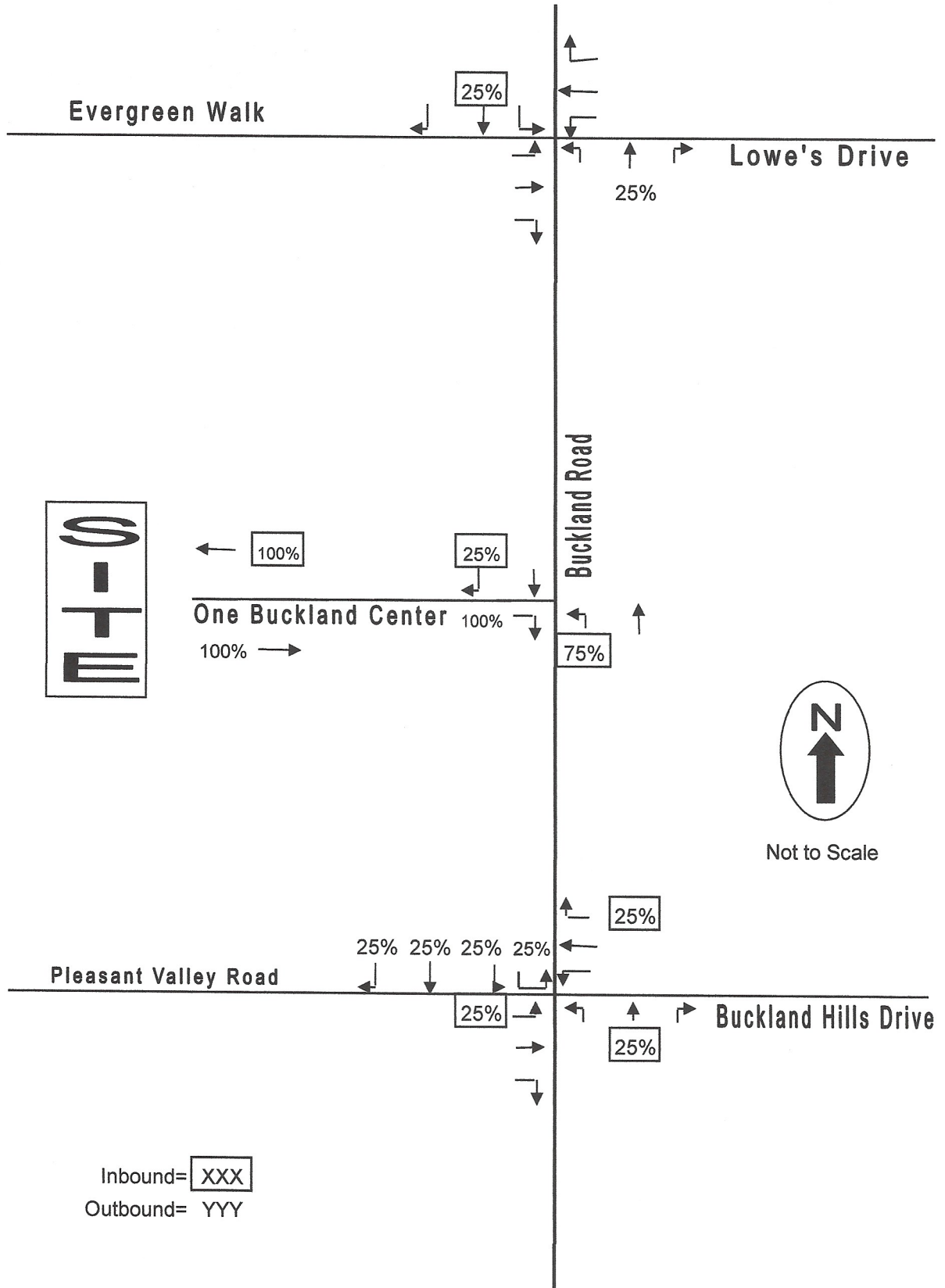
SOURCE: TRIP GENERATION REPORT, ITE, 9th EDITION, 2012

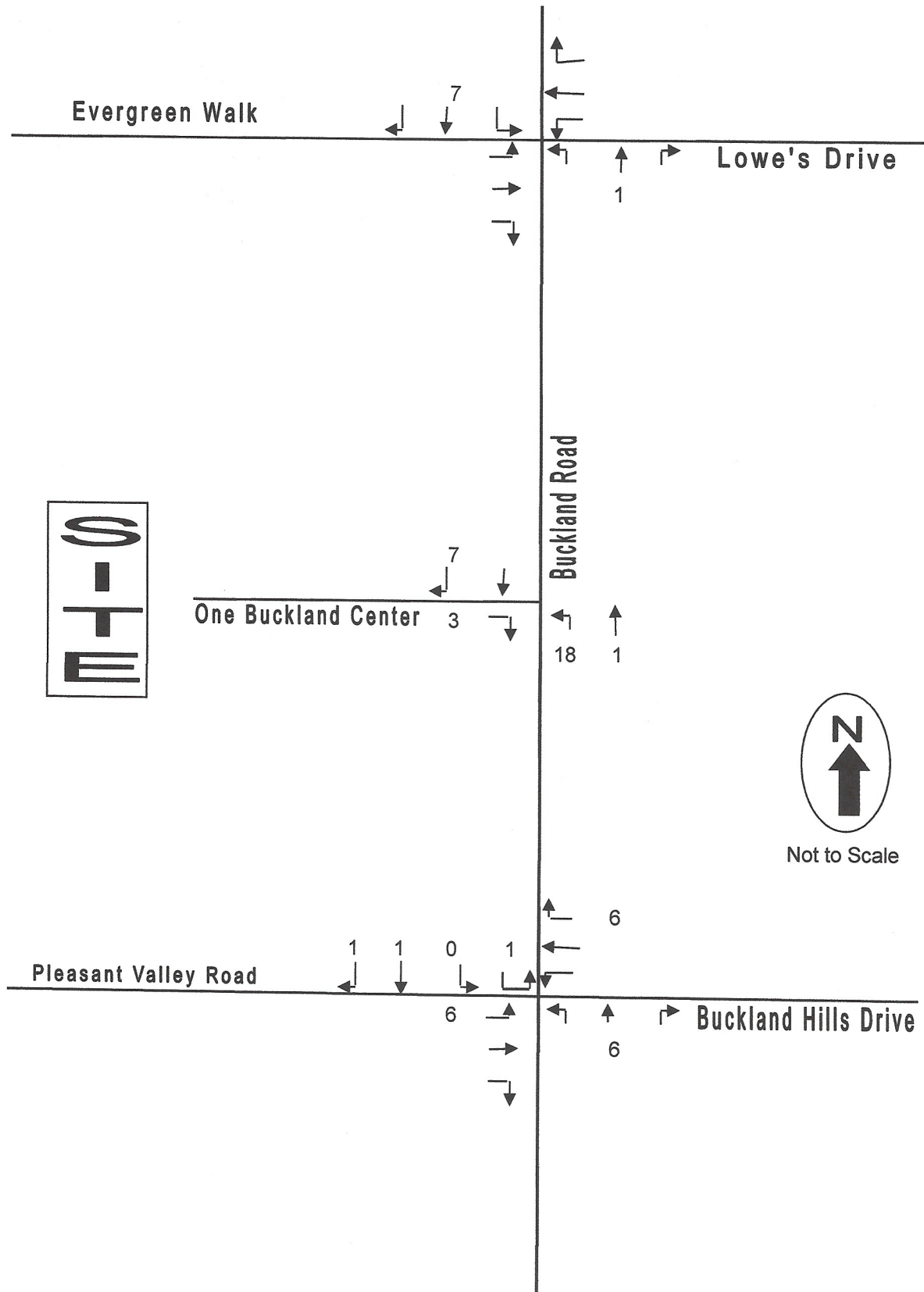
LAND USE: GENERAL OFFICE BUILDINGS - CODE #710

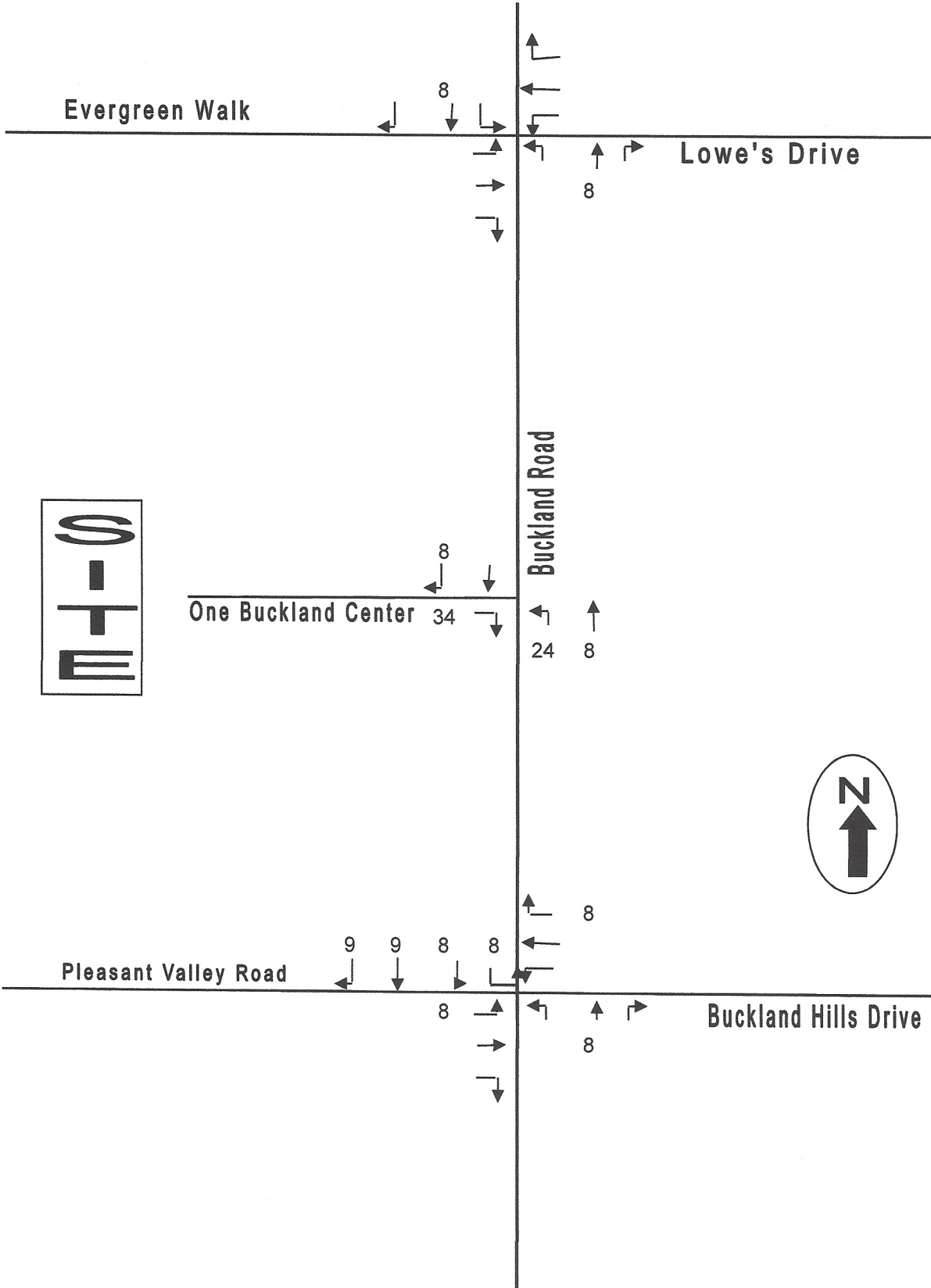
PROJECT: **Proposed Office Use of One Buckland Center**
South Windsor, Connecticut

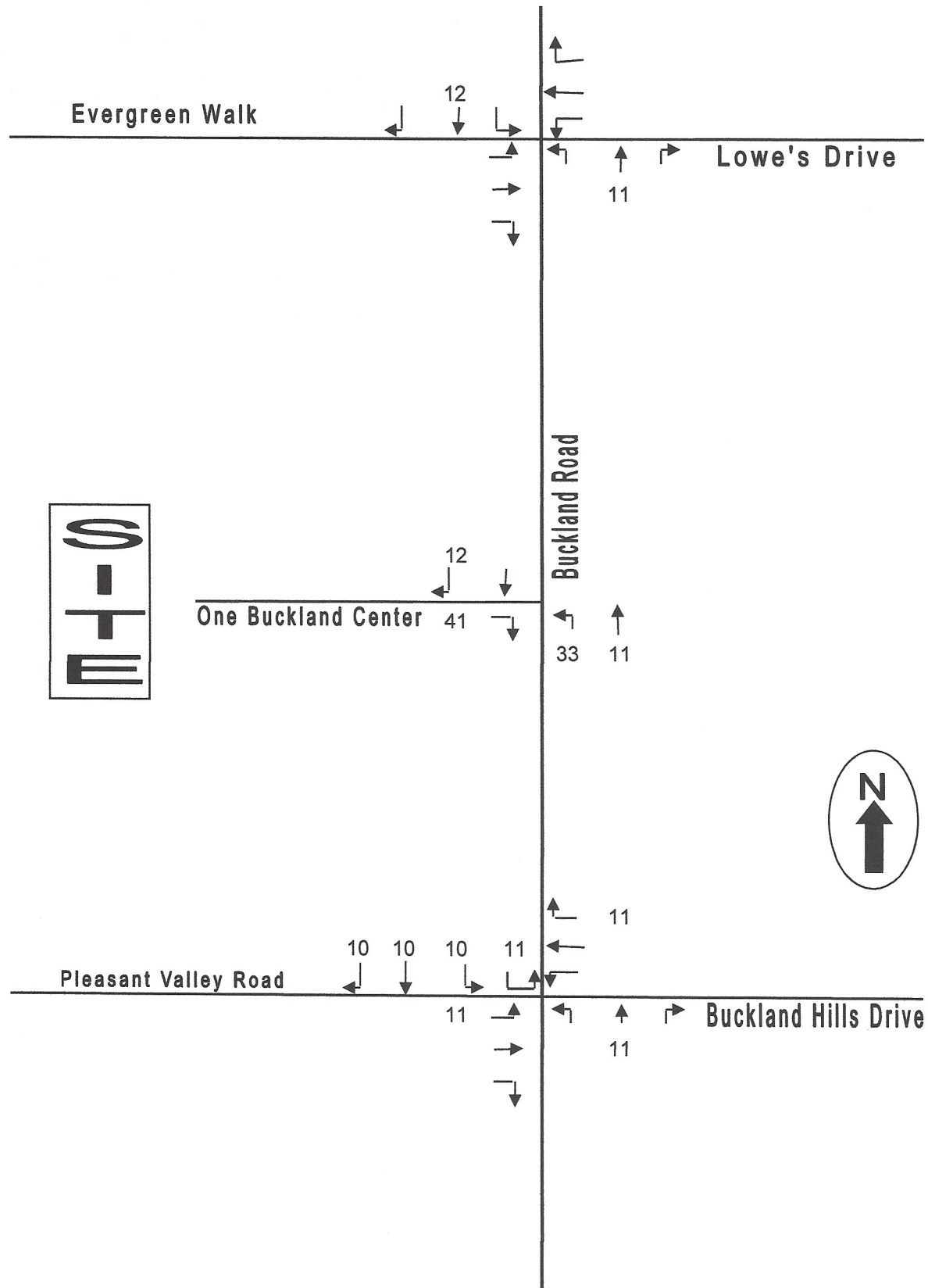
GROSS FLOOR AREA IN 1,000'S SQUARE FEET: **17.863**

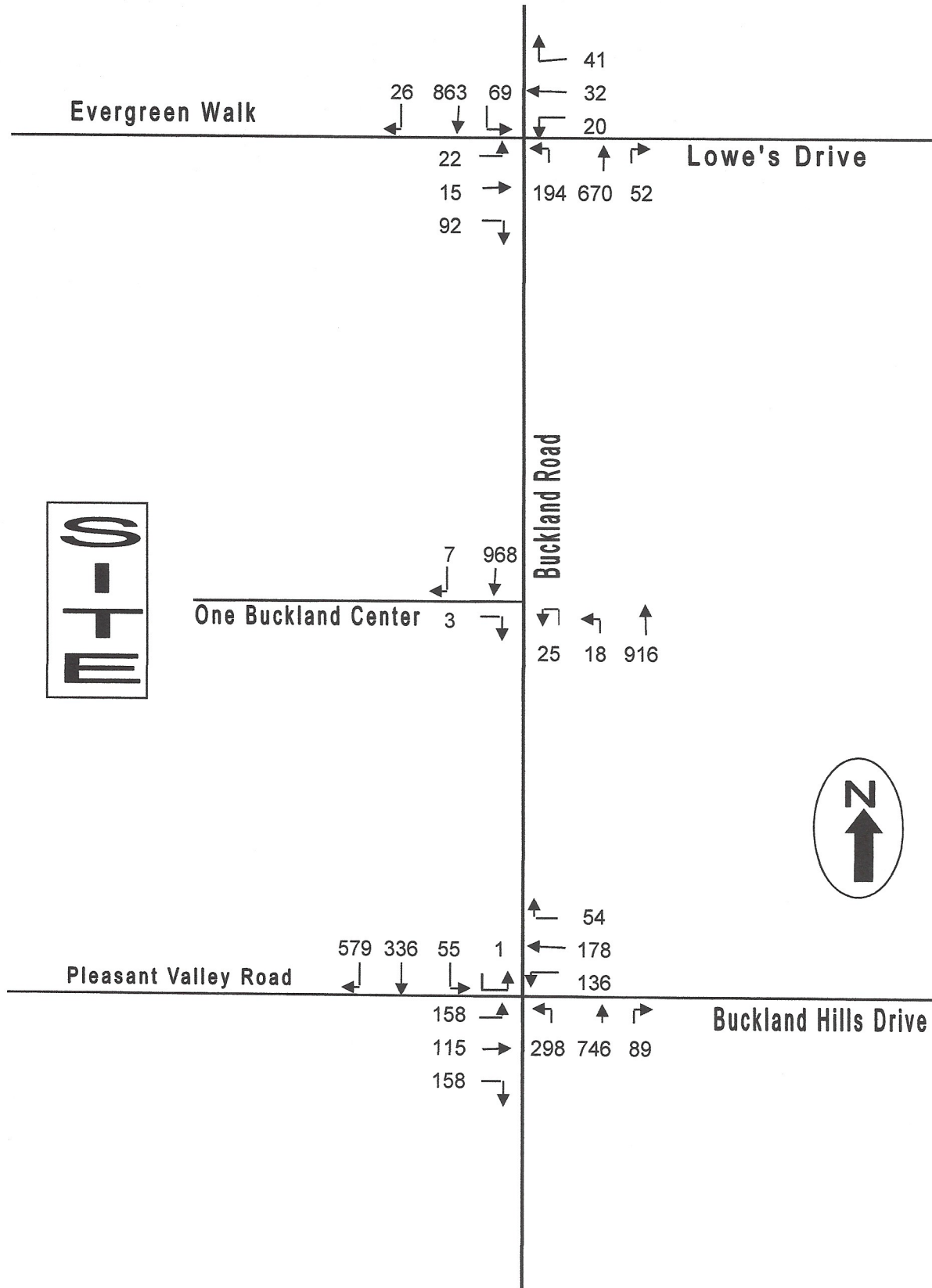
<u>TIME PERIOD</u>	<u>ITE TRIP GENERATION EQUATION</u>	<u>TOTAL TRIPS</u>	<u>INBOUND</u>	<u>OUTBOUND</u>
AVERAGE WEEKDAY	T = 11.03 (X) 50 % INBOUND * 50 % OUTBOUND	197	99	99
PEAK HOUR 7 TO 9 AM	T = 1.56 (X) 88 % INBOUND * 12 % OUTBOUND	28	25	3
PEAK HOUR 4 TO 6 PM	T = 1.49 (X) 17 % INBOUND * 83 % OUTBOUND	27	5	22
AVERAGE SATURDAY	T = 2.46 (X) 50 % INBOUND * 50 % OUTBOUND	44	22	22
SATURDAY PEAK HOUR	T = 0.43 (X) 54 % INBOUND * 46 % OUTBOUND	8	4	4
AVERAGE SUNDAY	T = 1.05 (X) 50 % INBOUND * 50 % OUTBOUND	19	9	9
SUNDAY PEAK HOUR	T = 0.16 (X) 58 % INBOUND * 42 % OUTBOUND	3	2	1

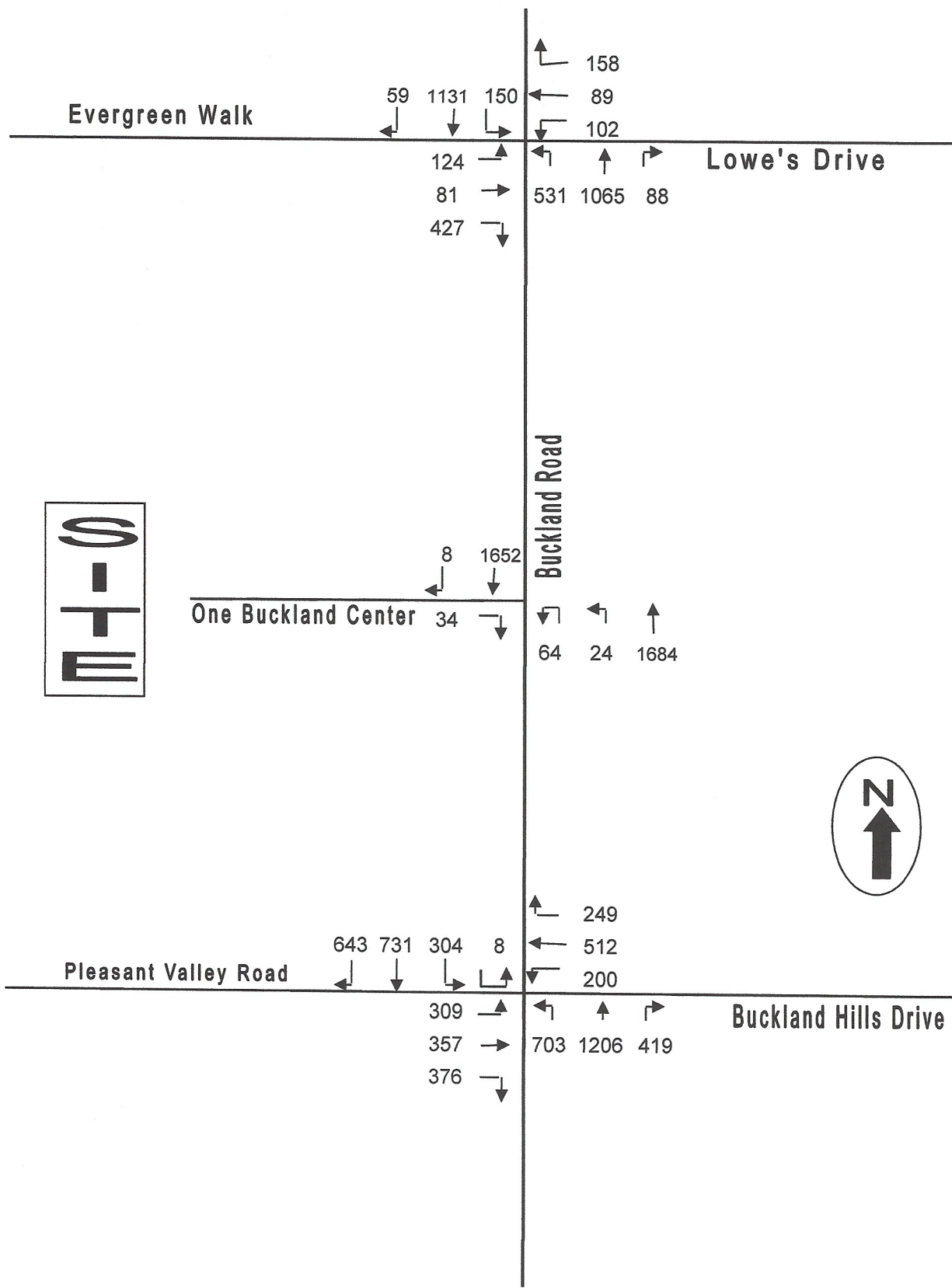












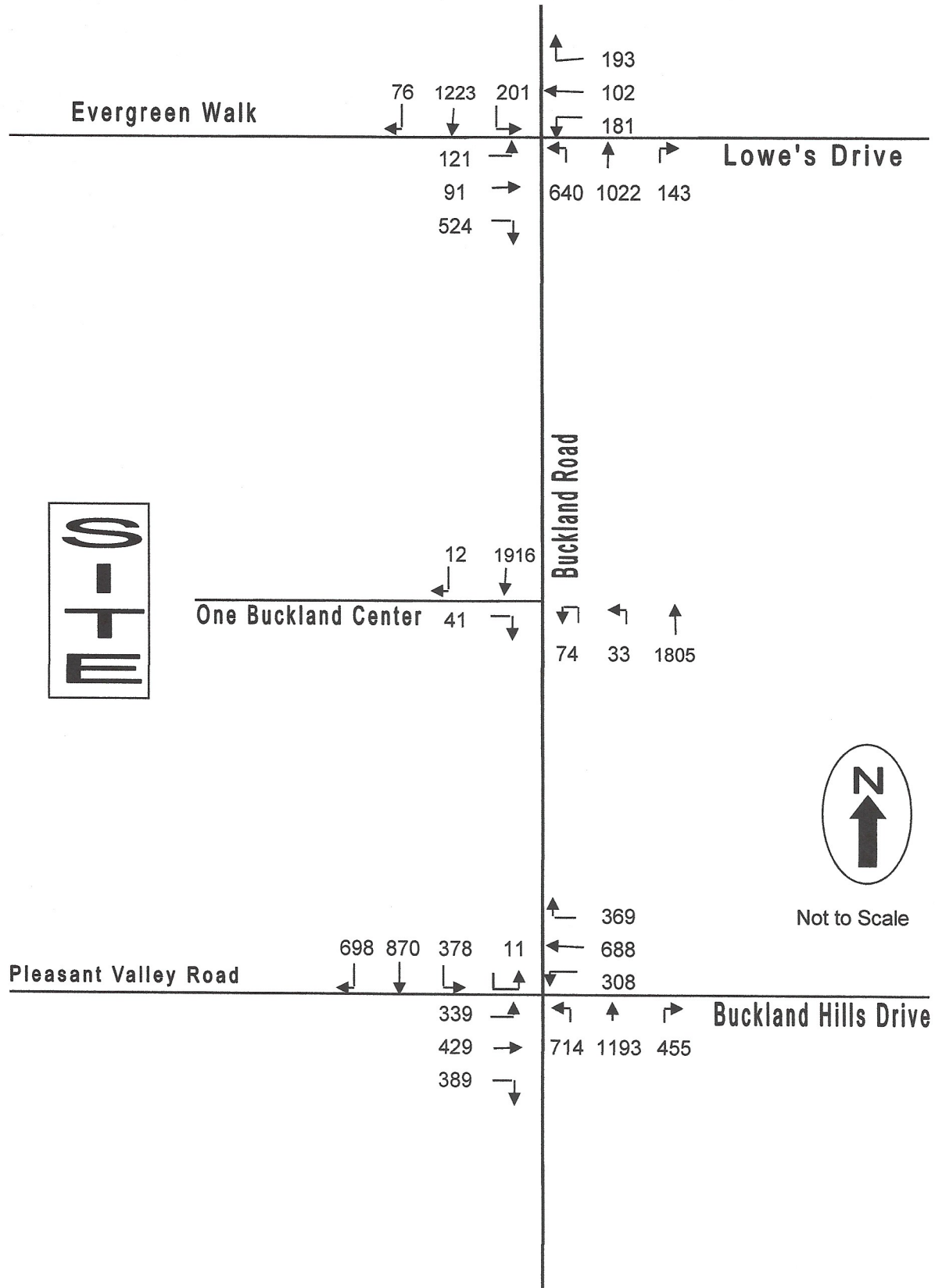


EXHIBIT 14
LEVEL OF SERVICE CRITERIA
SIGNALIZED INTERSECTIONS

SOURCE: HIGHWAY CAPACITY MANUAL (HCM), 2010
TRANSPORTATION RESEARCH BOARD (1)

Level of Service for **signalized intersections** is defined in terms of control delay, which is a measure of driver discomfort, frustration, increased fuel consumption, and lost travel time. The delay experienced by a motorist is comprised of a number of factors that relate to control, geometric, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions in the absence of traffic control, geometric delay, any incidents, and any other vehicles. Specifically, LOS criteria for traffic signals are stated in terms of the average control delay per vehicle, typically for a 15-minute analysis period. Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the green ratio, and the volume-to-capacity (v/c) ratio for the lane group.

In the case of **signalized intersections**, the Level of Service for each approach is computed, and an overall Level of Service for the entire intersection is determined.

Levels of Service (LOS) for **signalized intersections** are defined as follows:

LEVEL OF SERVICE	CONTROL DELAY PER VEHICLE (SECONDS)	CONDITION
LOS A	≤ 10	LOW DELAY
LOS B	> 10 TO 20	SHORT DELAY
LOS C	> 20 TO 35	AVERAGE DELAY
LOS D	> 35 TO 55	CONGESTION NOTICEABLE
LOS E	> 55 TO 80	LIMIT OF ACCEPTABLE DELAY
LOS F	> 80	UNACCEPTABLE

In today's environment, Levels of Service C to D are considered acceptable, and Levels of Service A to B are seldomly achieved at signalized intersections.

(1) **HCM**, Exhibit 16-2.

Exhibit 15
Traffic Operations Analysis Worksheets
Background 2020 Weekday AM Peak Hour

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕	↗	↖	↕	↗	↖↖	↕↕		↖	↕↕	
Traffic Volume (vph)	22	15	92	20	32	41	194	669	58	69	856	26
Future Volume (vph)	22	15	92	20	32	41	194	669	58	69	856	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.988			0.996	
Flt Protected		0.971		0.950			0.950			0.950		
Satd. Flow (prot)	0	3437	1583	1770	1863	1583	3433	3497	0	1770	3525	0
Flt Permitted		0.971		0.950			0.950			0.950		
Satd. Flow (perm)	0	3437	1583	1770	1863	1583	3433	3497	0	1770	3525	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			145			145		10			3	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	16	100	22	35	45	211	727	63	75	930	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	40	100	22	35	45	211	790	0	75	958	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	custom	NA	custom	custom	NA	custom	Prot	NA		Prot	NA	
Protected Phases	8	8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8	8	4	4	4		2			6	

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	31.0		12.0	31.0	
Total Split (%)	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%	34.4%		13.3%	34.4%	
Maximum Green (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	27.0		8.0	27.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		8.0	8.0	8.0	8.0	8.0	8.0	53.4		8.0	50.2	
Actuated g/C Ratio		0.09	0.09	0.09	0.09	0.09	0.09	0.59		0.09	0.56	
v/c Ratio		0.13	0.37	0.14	0.21	0.17	0.69	0.38		0.48	0.49	
Control Delay		39.0	6.6	40.1	41.5	1.3	49.7	11.8		49.8	17.3	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		39.0	6.6	40.1	41.5	1.3	49.7	11.8		49.8	17.3	
LOS		D	A	D	D	A	D	B		D	B	
Approach Delay		15.8			23.5			19.8			19.6	
Approach LOS		B			C			B			B	
Queue Length 50th (ft)		11	0	12	19	0	57	106		41	163	
Queue Length 95th (ft)		27	21	35	48	0	#111	143		86	#392	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		305	272	157	165	272	305	2079		157	1967	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.13	0.37	0.14	0.21	0.17	0.69	0.38		0.48	0.49	

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 19.6

Intersection LOS: B

Intersection Capacity Utilization 49.0%

ICU Level of Service A

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	26%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	13.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Queue shown is maximum after two cycles.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes

 Ø1	 Ø2 (R)	 Ø3	 Ø4	 Ø8
12 s	31 s	23 s	12 s	12 s
 Ø5	 Ø6 (R)			
12 s	31 s			

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Background Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	152	115	158	136	188	38	312	731	89	55	335	578
Future Volume (vph)	152	115	158	136	188	38	312	731	89	55	335	578
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300	630		630
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			172			158			206			628
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1080			1125			794			427	
Travel Time (s)		21.0			21.9			12.0			6.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	125	172	148	204	41	339	795	97	60	364	628
Shared Lane Traffic (%)												
Lane Group Flow (vph)	165	125	172	148	204	41	339	795	97	60	364	628
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	6	20
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Background Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	3	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	8.0	8.0	4.0	8.0	8.0	4.0	15.0		4.0	15.0	
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	19.0		8.0	19.0	
Total Split (s)	15.0	22.0	22.0	16.0	23.0	23.0	24.0	42.0		10.0	28.0	
Total Split (%)	16.7%	24.4%	24.4%	17.8%	25.6%	25.6%	26.7%	46.7%		11.1%	31.1%	
Maximum Green (s)	11.0	18.0	18.0	12.0	19.0	19.0	20.0	38.0		6.0	24.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	9.4	10.7	10.7	9.2	10.6	10.6	14.1	50.1	90.0	5.9	39.9	90.0
Actuated g/C Ratio	0.10	0.12	0.12	0.10	0.12	0.12	0.16	0.56	1.00	0.07	0.44	1.00
v/c Ratio	0.46	0.30	0.51	0.42	0.49	0.13	0.63	0.40	0.06	0.27	0.23	0.40
Control Delay	42.0	37.5	11.5	41.2	40.9	0.8	40.6	13.4	0.1	41.8	19.0	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.0	37.5	11.5	41.2	40.9	0.8	40.6	13.4	0.1	41.8	19.0	3.6
LOS	D	D	B	D	D	A	D	B	A	D	B	A
Approach Delay		29.4			36.8			19.8			11.1	
Approach LOS		C			D			B			B	
Queue Length 50th (ft)	46	34	0	41	57	0	94	135	0	19	34	48
Queue Length 95th (ft)	76	60	56	69	90	0	131	200	0	m39	133	426
Internal Link Dist (ft)		1000			1045			714			347	
Turn Bay Length (ft)	200			350		250			300	630		630
Base Capacity (vph)	419	707	454	457	747	458	762	1968	1583	228	1570	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.18	0.38	0.32	0.27	0.09	0.44	0.40	0.06	0.26	0.23	0.40

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 50

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 20.5

Intersection LOS: C

Intersection Capacity Utilization 47.9%

ICU Level of Service A

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

 Ø1	 Ø2 (R)	 Ø3	 Ø4
10 s	42 s	15 s	22 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
24 s	28 s	15 s	23 s

Exhibit 16
Traffic Operations Analysis Worksheets
Background 2020 Weekday PM Peak Hour

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	81	427	102	89	158	531	1057	88	150	1123	59
Future Volume (vph)	124	81	427	102	89	158	531	1057	88	150	1123	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.988			0.993	
Flt Protected		0.971		0.950			0.950			0.950		
Satd. Flow (prot)	0	3437	1583	1770	1863	1583	3433	3497	0	1770	3514	0
Flt Permitted		0.971		0.950			0.950			0.950		
Satd. Flow (perm)	0	3437	1583	1770	1863	1583	3433	3497	0	1770	3514	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			464			172		8			5	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	135	88	464	111	97	172	577	1149	96	163	1221	64
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	223	464	111	97	172	577	1245	0	163	1285	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	custom	NA	custom	custom	NA	custom	Prot	NA		Prot	NA	
Protected Phases	8	8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8	8	4	4	4		2			6	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday PM Peak (11.19 update)
12/26/2019

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	19.0	19.0	19.0	16.0	16.0	16.0	20.0	46.0		16.0	42.0	
Total Split (%)	15.8%	15.8%	15.8%	13.3%	13.3%	13.3%	16.7%	38.3%		13.3%	35.0%	
Maximum Green (s)	15.0	15.0	15.0	12.0	12.0	12.0	16.0	42.0		12.0	38.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		13.2	13.2	11.0	11.0	11.0	16.0	63.2		12.0	59.2	
Actuated g/C Ratio		0.11	0.11	0.09	0.09	0.09	0.13	0.53		0.10	0.49	
v/c Ratio		0.59	0.79	0.69	0.57	0.57	1.26	0.67		0.92	0.74	
Control Delay		57.2	15.2	74.1	65.4	15.4	164.4	31.7		103.6	29.3	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		57.2	15.2	74.1	65.4	15.4	164.4	31.7		103.6	29.3	
LOS		E	B	E	E	B	F	C		F	C	
Approach Delay		28.9			45.3			73.7			37.6	
Approach LOS		C			D			E			D	
Queue Length 50th (ft)		87	0	84	73	0	~296	357		127	383	
Queue Length 95th (ft)		128	110	#156	130	67	#416	#658		#260	#757	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		429	603	177	186	313	457	1846		177	1736	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.52	0.77	0.63	0.52	0.55	1.26	0.67		0.92	0.74	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 30 (25%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 120

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.26

Intersection Signal Delay: 52.1

Intersection LOS: D

Intersection Capacity Utilization 76.0%

ICU Level of Service D

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	19%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	13.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Friday PM Peak (11.19 update)
 12/26/2019

Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes

 Ø1 16 s	 Ø2 (R) 46 s	 Ø3 23 s	 Ø4 16 s	 Ø8 19 s
 Ø5 20 s	 Ø6 (R) 42 s			

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Background Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	301	357	376	200	539	214	740	1161	419	296	722	634
Future Volume (vph)	301	357	376	200	539	214	740	1161	419	296	722	634
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300	630		630
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			383			225			267			584
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1080			1125			794			427	
Travel Time (s)		21.0			21.9			12.0			6.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	327	388	409	217	586	233	804	1262	455	322	785	689
Shared Lane Traffic (%)												
Lane Group Flow (vph)	327	388	409	217	586	233	804	1262	455	322	785	689
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	6	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Background Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	3	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	8.0	8.0	4.0	8.0	8.0	4.0	15.0		4.0	15.0	
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	19.0		8.0	19.0	
Total Split (s)	21.0	30.0	30.0	16.0	25.0	25.0	32.0	56.0		18.0	42.0	
Total Split (%)	17.5%	25.0%	25.0%	13.3%	20.8%	20.8%	26.7%	46.7%		15.0%	35.0%	
Maximum Green (s)	17.0	26.0	26.0	12.0	21.0	21.0	28.0	52.0		14.0	38.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	15.5	25.2	25.2	11.3	21.0	21.0	28.0	53.7	120.0	13.7	39.5	120.0
Actuated g/C Ratio	0.13	0.21	0.21	0.09	0.18	0.18	0.23	0.45	1.00	0.11	0.33	1.00
v/c Ratio	0.74	0.52	0.64	0.67	0.95	0.50	1.00	0.80	0.29	0.82	0.67	0.44
Control Delay	60.6	44.8	10.6	63.1	74.4	10.5	78.8	33.5	0.5	77.8	27.4	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	44.8	10.6	63.1	74.4	10.5	78.8	33.5	0.5	77.8	27.4	1.6
LOS	E	D	B	E	E	B	E	C	A	E	C	A
Approach Delay		37.0			57.7			42.0			26.5	
Approach LOS		D			E			D			C	
Queue Length 50th (ft)	125	141	16	84	238	5	~324	441	0	135	236	0
Queue Length 95th (ft)	175	191	113	126	#351	77	#459	540	0	m#194	213	100
Internal Link Dist (ft)		1000			1045			714			347	
Turn Bay Length (ft)	200			350		250			300	630		630
Base Capacity (vph)	486	766	643	343	619	462	801	1584	1583	400	1163	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.51	0.64	0.63	0.95	0.50	1.00	0.80	0.29	0.81	0.67	0.44

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 38 (32%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 75

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.00

Intersection Signal Delay: 39.3

Intersection LOS: D

Intersection Capacity Utilization 77.9%

ICU Level of Service D

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

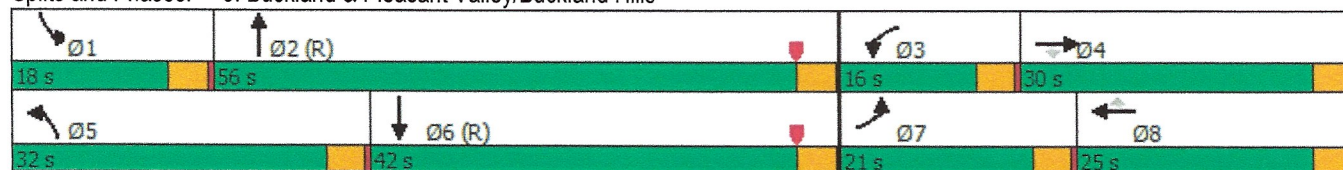


Exhibit 17
Traffic Operations Analysis Worksheets
Background 2020 Saturday Mid-Day Peak Hour

Lanes, Volumes, Timings

Background Saturday Midday Peak (11.19 update)

3: Buckland /Buckland & Tamarack/Lowes

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕	↗	↖	↕	↗	↖↖	↕↕		↖	↕↕	
Traffic Volume (vph)	121	91	524	181	102	193	640	1011	143	201	1211	76
Future Volume (vph)	121	91	524	181	102	193	640	1011	143	201	1211	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.981			0.991	
Flt Protected		0.972		0.950			0.950			0.950		
Satd. Flow (prot)	0	3440	1583	1770	1863	1583	3433	3472	0	1770	3507	0
Flt Permitted		0.972		0.950			0.950			0.950		
Satd. Flow (perm)	0	3440	1583	1770	1863	1583	3433	3472	0	1770	3507	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			449			210		15			6	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	99	570	197	111	210	696	1099	155	218	1316	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	231	570	197	111	210	696	1254	0	218	1399	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	custom	NA	custom	custom	NA	custom	Prot	NA		Prot	NA	
Protected Phases	8	8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8	8	4	4	4		2			6	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Saturday Midday Peak (11.19 update)
12/26/2019

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Background Saturday Midday Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	14.0	14.0	14.0	15.0	15.0	15.0	23.0	49.0		19.0	45.0	
Total Split (%)	11.7%	11.7%	11.7%	12.5%	12.5%	12.5%	19.2%	40.8%		15.8%	37.5%	
Maximum Green (s)	10.0	10.0	10.0	11.0	11.0	11.0	19.0	45.0		15.0	41.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		10.0	10.0	11.0	11.0	11.0	19.0	63.4		15.0	59.4	
Actuated g/C Ratio		0.08	0.08	0.09	0.09	0.09	0.16	0.53		0.12	0.50	
v/c Ratio		0.90dl	1.05	1.22	0.65	0.63	1.28	0.68		0.99	0.80	
Control Delay		75.6	64.8	186.2	71.2	15.8	168.5	29.9		110.0	30.9	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		75.6	64.8	186.2	71.2	15.8	168.5	29.9		110.0	30.9	
LOS		E	E	F	E	B	F	C		F	C	
Approach Delay		67.9			92.5			79.3			41.6	
Approach LOS		E			F			E			D	
Queue Length 50th (ft)		94	~138	~187	84	0	~346	510		171	423	
Queue Length 95th (ft)		#158	#363	#338	#161	75	m#402	m#611		#331	#818	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		286	543	162	170	335	543	1841		221	1739	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.81	1.05	1.22	0.65	0.63	1.28	0.68		0.99	0.80	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 150

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.28

Intersection Signal Delay: 66.4

Intersection LOS: E

Intersection Capacity Utilization 88.4%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	19%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	13.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes

 Ø1	 Ø2 (R)	 Ø3	 Ø4	 Ø8
19 s	49 s	23 s	15 s	14 s
 Ø5	 Ø6 (R)			
23 s	45 s			

Lanes, Volumes, Timings

Background Saturday Midday Peak (11.19 update)

9: Buckland & Pleasant Valley/Buckland Hills

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	328	429	389	308	724	322	752	1144	455	368	860	688
Future Volume (vph)	328	429	389	308	724	322	752	1144	455	368	860	688
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300	630		630
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			422			270			295			497
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1080			1125			794			427	
Travel Time (s)		21.0			21.9			12.0			6.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	357	466	423	335	787	350	817	1243	495	400	935	748
Shared Lane Traffic (%)												
Lane Group Flow (vph)	357	466	423	335	787	350	817	1243	495	400	935	748
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	6	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Background Saturday Midday Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	3	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	8.0	8.0	4.0	8.0	8.0	4.0	15.0		4.0	15.0	
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	19.0		8.0	19.0	
Total Split (s)	16.0	31.0	31.0	18.0	33.0	33.0	35.0	50.0		21.0	36.0	
Total Split (%)	13.3%	25.8%	25.8%	15.0%	27.5%	27.5%	29.2%	41.7%		17.5%	30.0%	
Maximum Green (s)	12.0	27.0	27.0	14.0	29.0	29.0	31.0	46.0		17.0	32.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	12.0	27.0	27.0	13.8	28.9	28.9	30.5	46.6	120.0	16.6	32.7	120.0
Actuated g/C Ratio	0.10	0.22	0.22	0.12	0.24	0.24	0.25	0.39	1.00	0.14	0.27	1.00
v/c Ratio	1.04	0.58	0.62	0.85	0.92	0.60	0.94	0.91	0.31	0.85	0.97	0.47
Control Delay	111.8	44.9	8.1	72.1	62.1	14.6	62.8	45.3	0.5	57.1	49.7	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	111.8	44.9	8.1	72.1	62.1	14.6	62.8	45.3	0.5	57.1	49.7	1.3
LOS	F	D	A	E	E	B	E	D	A	E	D	A
Approach Delay		51.6			53.1			42.3			33.7	
Approach LOS		D			D			D			C	
Queue Length 50th (ft)	~154	170	1	132	314	50	318	476	0	142	377	0
Queue Length 95th (ft)	#251	226	89	#207	#431	149	#436	#616	0	m168	m#466	m9
Internal Link Dist (ft)		1000			1045			714			347	
Turn Bay Length (ft)	200			350		250			300	630		630
Base Capacity (vph)	343	797	683	400	855	587	886	1373	1583	486	963	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.58	0.62	0.84	0.92	0.60	0.92	0.91	0.31	0.82	0.97	0.47

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 38 (32%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.04

Intersection Signal Delay: 43.6

Intersection LOS: D

Intersection Capacity Utilization 87.9%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

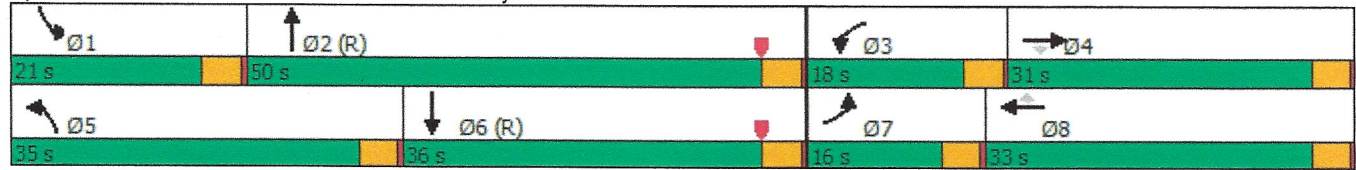


Exhibit 18
Traffic Operations Analysis Worksheets
Combined 2020 Weekday AM Peak Hour

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	15	92	20	32	41	194	670	52	69	863	26
Future Volume (vph)	22	15	92	20	32	41	194	670	52	69	863	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.989			0.996	
Flt Protected		0.971		0.950			0.950			0.950		
Satd. Flow (prot)	0	3437	1583	1770	1863	1583	3433	3500	0	1770	3525	0
Flt Permitted		0.971		0.950			0.950			0.950		
Satd. Flow (perm)	0	3437	1583	1770	1863	1583	3433	3500	0	1770	3525	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			145			145		9			3	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	16	100	22	35	45	211	728	57	75	938	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	40	100	22	35	45	211	785	0	75	966	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	custom	NA	Prot	custom	NA	Prot	Prot	NA		Prot	NA	
Protected Phases	8	8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8		4	4			2			6	

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	31.0		12.0	31.0	
Total Split (%)	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%	34.4%		13.3%	34.4%	
Maximum Green (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	27.0		8.0	27.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		8.0	8.0	8.0	8.0	8.0	8.0	53.4		8.0	50.2	
Actuated g/C Ratio		0.09	0.09	0.09	0.09	0.09	0.09	0.59		0.09	0.56	
v/c Ratio		0.13	0.37	0.14	0.21	0.17	0.69	0.38		0.48	0.49	
Control Delay		39.0	6.6	40.1	41.5	1.3	56.1	8.5		49.8	17.3	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		39.0	6.6	40.1	41.5	1.3	56.1	8.5		49.8	17.3	
LOS		D	A	D	D	A	E	A		D	B	
Approach Delay		15.8			23.5			18.5			19.7	
Approach LOS		B			C			B			B	
Queue Length 50th (ft)		11	0	12	19	0	54	130		41	164	
Queue Length 95th (ft)		27	21	35	48	0	#108	259		86	#397	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		305	272	157	165	272	305	2080		157	1967	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.13	0.37	0.14	0.21	0.17	0.69	0.38		0.48	0.49	

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 36 (40%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 19.1

Intersection LOS: B

Intersection Capacity Utilization 49.2%

ICU Level of Service A

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Friday AM Peak (11.19 update)
12/26/2019

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	26%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	13.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
 3: Buckland /Buckland & Tamarack/Lowes

Combined Friday AM Peak (11.19 update)
 12/26/2019

Queue shown is maximum after two cycles.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes

 Ø1	 Ø2 (R)	 Ø3	 Ø4	 Ø8
12 s	31 s	23 s	12 s	12 s
 Ø5	 Ø6 (R)			
12 s	31 s			

Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Friday AM Peak (11.19 update)

12/26/2019

							
Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	0	3	25	18	916	968	7
Future Volume (vph)	0	3	25	18	916	968	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		200			200
Storage Lanes	0	1		1			1
Taper Length (ft)	25			25			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Frt		0.865					0.850
Fit Protected				0.950			
Satd. Flow (prot)	0	1611	0	1770	3539	3539	1583
Fit Permitted				0.950			
Satd. Flow (perm)	0	1611	0	1770	3539	3539	1583
Right Turn on Red		Yes					Yes
Satd. Flow (RTOR)		212					8
Link Speed (mph)	30				45	45	
Link Distance (ft)	981				163	840	
Travel Time (s)	22.3				2.5	12.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	3	27	20	996	1052	8
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	3	0	47	996	1052	8
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	Left	Right	R NA	Left	Left	Left	Right
Median Width(ft)	0				24	24	
Link Offset(ft)	0				0	0	
Crosswalk Width(ft)	16				16	16	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9	15			9
Number of Detectors		1	1	1	2	2	1
Detector Template		Right	Left	Left	Thru	Thru	Right
Leading Detector (ft)		20	20	20	100	100	20
Trailing Detector (ft)		0	0	0	0	0	0
Detector 1 Position(ft)		0	0	0	0	0	0
Detector 1 Size(ft)		20	20	20	6	6	20
Detector 1 Type		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel							
Detector 1 Extend (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)					94	94	
Detector 2 Size(ft)					6	6	
Detector 2 Type					CI+Ex	CI+Ex	
Detector 2 Channel							
Detector 2 Extend (s)					0.0	0.0	
Turn Type		Prot	custom	custom	NA	NA	custom
Protected Phases		3	1	1	1 2 3	2	2
Permitted Phases		3	1	1	1 2 3	2	2

Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Friday AM Peak (11.19 update)

12/26/2019



Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Detector Phase		3	1	1	1 2 3	2	2
Switch Phase							
Minimum Initial (s)		5.0	5.0	5.0		5.0	5.0
Minimum Split (s)		9.5	9.5	9.5		22.5	22.5
Total Split (s)		12.0	12.0	12.0		66.0	66.0
Total Split (%)		13.3%	13.3%	13.3%		73.3%	73.3%
Maximum Green (s)		7.5	8.0	8.0		61.5	61.5
Yellow Time (s)		3.5	3.5	3.5		3.5	3.5
All-Red Time (s)		1.0	0.5	0.5		1.0	1.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0
Total Lost Time (s)		4.5		4.0		4.5	4.5
Lead/Lag			Lead	Lead		Lag	Lag
Lead-Lag Optimize?							
Vehicle Extension (s)		3.0	3.0	3.0		3.0	3.0
Recall Mode		None	None	None		C-Min	C-Min
Act Effct Green (s)		7.5		7.9	90.0	61.6	61.6
Actuated g/C Ratio		0.08		0.09	1.00	0.68	0.68
v/c Ratio		0.01		0.30	0.28	0.43	0.01
Control Delay		0.0		37.9	0.2	2.7	0.1
Queue Delay		0.0		0.0	0.0	0.0	0.0
Total Delay		0.0		37.9	0.2	2.7	0.1
LOS		A		D	A	A	A
Approach Delay					1.9	2.7	
Approach LOS					A	A	
Queue Length 50th (ft)		0		26	0	8	0
Queue Length 95th (ft)		0		62	0	19	m0
Internal Link Dist (ft)	901				83	760	
Turn Bay Length (ft)				200			200
Base Capacity (vph)		328		157	3511	2422	1086
Starvation Cap Reductn		0		0	0	0	0
Spillback Cap Reductn		0		0	0	0	0
Storage Cap Reductn		0		0	0	0	0
Reduced v/c Ratio		0.01		0.30	0.28	0.43	0.01

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 81 (90%), Referenced to phase 2:NBSB, Start of Yellow

Natural Cycle: 45

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.43

Intersection Signal Delay: 2.3

Intersection LOS: A

Intersection Capacity Utilization 45.9%

ICU Level of Service A

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: One Buckland Center & Buckland



One Buckland Center, South Windsor 11/26/2019 Combined Friday AM Peak (11.19 update)

Synchro 9 Light Report

Bubaris Traffic Associates

Page 7

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	158	115	158	136	178	54	298	746	89	1	56	336
Future Volume (vph)	158	115	158	136	178	54	298	746	89	1	56	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300		500	
Storage Lanes	2		1	2		1	2		1		2	
Taper Length (ft)	25			25			25				25	
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.95	0.97	0.95
Frt			0.850			0.850			0.850			
Flt Protected	0.950			0.950			0.950				0.950	
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	0	3433	3539
Flt Permitted	0.950			0.950			0.950				0.950	
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	0	3433	3539
Right Turn on Red			Yes			Yes			Yes			
Satd. Flow (RTOR)			172			158			206			
Link Speed (mph)		35			35			45				45
Link Distance (ft)		1080			1125			794				427
Travel Time (s)		21.0			21.9			12.0				6.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	172	125	172	148	193	59	324	811	97	1	61	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	172	125	172	148	193	59	324	811	97	0	62	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Left
Median Width(ft)		24			24			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	9	15	
Number of Detectors	1	2	1	1	2	1	1	2	1	1	1	2
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Left	Thru
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	20	100
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	20	6
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex				CI+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	custom	Prot	NA
Protected Phases	7	4		3	8		5	2		1	1	6
Permitted Phases			4			8			Free	1		

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday AM Peak (11.19 update)
12/26/2019

Lane Group	SBR
Lane Configurations	F
Traffic Volume (vph)	579
Future Volume (vph)	579
Ideal Flow (vphpl)	1900
Storage Length (ft)	500
Storage Lanes	1
Taper Length (ft)	
Lane Util. Factor	1.00
Frt	0.850
Flt Protected	
Satd. Flow (prot)	1583
Flt Permitted	
Satd. Flow (perm)	1583
Right Turn on Red	Yes
Satd. Flow (RTOR)	629
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	0.92
Adj. Flow (vph)	629
Shared Lane Traffic (%)	
Lane Group Flow (vph)	629
Enter Blocked Intersection	No
Lane Alignment	Right
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	1.00
Turning Speed (mph)	9
Number of Detectors	1
Detector Template	Right
Leading Detector (ft)	20
Trailing Detector (ft)	0
Detector 1 Position(ft)	0
Detector 1 Size(ft)	20
Detector 1 Type	CI+Ex
Detector 1 Channel	
Detector 1 Extend (s)	0.0
Detector 1 Queue (s)	0.0
Detector 1 Delay (s)	0.0
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	Free
Protected Phases	
Permitted Phases	Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday AM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Detector Phase	7	4	4	3	8	8	5	2		1	1	6
Switch Phase												
Minimum Initial (s)	4.0	8.0	8.0	4.0	8.0	8.0	4.0	15.0		4.0	4.0	15.0
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	19.0		8.0	8.0	19.0
Total Split (s)	15.0	22.0	22.0	16.0	23.0	23.0	24.0	42.0		10.0	10.0	28.0
Total Split (%)	16.7%	24.4%	24.4%	17.8%	25.6%	25.6%	26.7%	46.7%		11.1%	11.1%	31.1%
Maximum Green (s)	11.0	18.0	18.0	12.0	19.0	19.0	20.0	38.0		6.0	6.0	24.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lead	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None	None	None	C-Max		None	None	C-Max
Act Effct Green (s)	9.5	10.6	10.6	9.2	10.3	10.3	13.7	50.2	90.0		5.9	40.4
Actuated g/C Ratio	0.11	0.12	0.12	0.10	0.11	0.11	0.15	0.56	1.00		0.07	0.45
v/c Ratio	0.48	0.30	0.51	0.42	0.48	0.18	0.62	0.41	0.06		0.28	0.23
Control Delay	42.1	37.7	11.6	41.2	40.9	1.3	40.7	13.4	0.1		38.3	23.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	42.1	37.7	11.6	41.2	40.9	1.3	40.7	13.4	0.1		38.3	23.1
LOS	D	D	B	D	D	A	D	B	A		D	C
Approach Delay		29.8			35.2			19.5				12.1
Approach LOS		C			D			B				B
Queue Length 50th (ft)	47	34	0	41	55	0	90	138	0		17	106
Queue Length 95th (ft)	78	60	56	69	86	0	126	203	0		29	160
Internal Link Dist (ft)		1000			1045			714				347
Turn Bay Length (ft)	200			350		250			300		500	
Base Capacity (vph)	419	707	454	457	747	458	762	1972	1583		228	1590
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.41	0.18	0.38	0.32	0.26	0.13	0.43	0.41	0.06		0.27	0.23

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 50

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.62

Intersection Signal Delay: 20.5

Intersection LOS: C

Intersection Capacity Utilization 48.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

 Ø1	 Ø2 (R)	 Ø3	 Ø4
10 s	42 s	16 s	22 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
24 s	28 s	15 s	23 s

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday AM Peak (11.19 update)
12/26/2019

Lane Group	SBR
Detector Phase	
Switch Phase	
Minimum Initial (s)	
Minimum Split (s)	
Total Split (s)	
Total Split (%)	
Maximum Green (s)	
Yellow Time (s)	
All-Red Time (s)	
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	
Recall Mode	
Act Effct Green (s)	90.0
Actuated g/C Ratio	1.00
v/c Ratio	0.40
Control Delay	3.1
Queue Delay	0.0
Total Delay	3.1
LOS	A
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	41
Queue Length 95th (ft)	111
Internal Link Dist (ft)	
Turn Bay Length (ft)	500
Base Capacity (vph)	1583
Starvation Cap Reductn	0
Spillback Cap Reductn	0
Storage Cap Reductn	0
Reduced v/c Ratio	0.40
Intersection Summary	

Exhibit 19
Traffic Operations Analysis Worksheets
Combined 2020 Weekday PM Peak Hour

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	81	427	102	89	158	531	1065	88	150	1131	59
Future Volume (vph)	124	81	427	102	89	158	531	1065	88	150	1131	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.989			0.993	
Flt Protected		0.971		0.950			0.950			0.950		
Satd. Flow (prot)	0	3437	1583	1770	1863	1583	3433	3500	0	1770	3514	0
Flt Permitted		0.971		0.950			0.950			0.950		
Satd. Flow (perm)	0	3437	1583	1770	1863	1583	3433	3500	0	1770	3514	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			464			172		8			5	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	135	88	464	111	97	172	577	1158	96	163	1229	64
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	223	464	111	97	172	577	1254	0	163	1293	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	custom	NA	custom	custom	NA	custom	Prot	NA		Prot	NA	
Protected Phases	8	8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8	8	4	4	4		2			6	

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	19.0	19.0	19.0	16.0	16.0	16.0	20.0	46.0		16.0	42.0	
Total Split (%)	15.8%	15.8%	15.8%	13.3%	13.3%	13.3%	16.7%	38.3%		13.3%	35.0%	
Maximum Green (s)	15.0	15.0	15.0	12.0	12.0	12.0	16.0	42.0		12.0	38.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		13.2	13.2	11.0	11.0	11.0	16.0	63.2		12.0	59.2	
Actuated g/C Ratio		0.11	0.11	0.09	0.09	0.09	0.13	0.53		0.10	0.49	
v/c Ratio		0.59	0.79	0.69	0.57	0.57	1.26	0.68		0.92	0.74	
Control Delay		57.2	15.2	74.1	65.4	15.4	176.6	19.7		103.6	29.4	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		57.2	15.2	74.1	65.4	15.4	176.6	19.7		103.6	29.4	
LOS		E	B	E	E	B	F	B		F	C	
Approach Delay		28.9			45.3			69.1			37.7	
Approach LOS		C			D			E			D	
Queue Length 50th (ft)		87	0	84	73	0	~282	415		127	387	
Queue Length 95th (ft)		128	110	#156	130	67	#400	#698		#260	#764	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		429	603	177	186	313	457	1847		177	1736	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.52	0.77	0.63	0.52	0.55	1.26	0.68		0.92	0.74	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 94 (78%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 120

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.26

Intersection Signal Delay: 50.2

Intersection LOS: D

Intersection Capacity Utilization 76.2%

ICU Level of Service D

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	7.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	19%
Maximum Green (s)	20.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	13.0
Pedestrian Calls (#/hr)	5
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
 3: Buckland /Buckland & Tamarack/Lowes

Combined Friday PM Peak (11.19 update)
 12/26/2019

Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes

 Ø1 16 s	 Ø2 (R) 46 s	 Ø3 23 s	 Ø4 16 s	 Ø8 19 s
 Ø5 20 s	 Ø6 (R) 42 s			

Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Friday PM Peak (11.19 update)

12/26/2019

							
Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	0	34	64	24	1684	1652	8
Future Volume (vph)	0	34	64	24	1684	1652	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		200			200
Storage Lanes	0	1		1			1
Taper Length (ft)	25			25			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Frt		0.865					0.850
Flt Protected				0.950			
Satd. Flow (prot)	0	1611	0	1770	3539	3539	1583
Flt Permitted				0.950			
Satd. Flow (perm)	0	1611	0	1770	3539	3539	1583
Right Turn on Red		Yes					Yes
Satd. Flow (RTOR)		118					9
Link Speed (mph)	30				30	45	
Link Distance (ft)	981				163	840	
Travel Time (s)	22.3				3.7	12.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	37	70	26	1830	1796	9
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	37	0	96	1830	1796	9
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	Left	Right	R NA	Left	Left	Left	Right
Median Width(ft)	0				24	24	
Link Offset(ft)	0				0	0	
Crosswalk Width(ft)	16				16	16	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9	15			9
Number of Detectors		1	1	1	2	2	1
Detector Template		Right	Left	Left	Thru	Thru	Right
Leading Detector (ft)		20	20	20	100	100	20
Trailing Detector (ft)		0	0	0	0	0	0
Detector 1 Position(ft)		0	0	0	0	0	0
Detector 1 Size(ft)		20	20	20	6	6	20
Detector 1 Type		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel							
Detector 1 Extend (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)					94	94	
Detector 2 Size(ft)					6	6	
Detector 2 Type					CI+Ex	CI+Ex	
Detector 2 Channel							
Detector 2 Extend (s)					0.0	0.0	
Turn Type		Prot	custom	custom	NA	NA	custom
Protected Phases		3	1	1	1 2 3	2	2
Permitted Phases		3	1	1	1 2 3	2	2

Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Friday PM Peak (11.19 update)

12/26/2019



Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Detector Phase		3	1	1	1 2 3	2	2
Switch Phase							
Minimum Initial (s)		5.0	5.0	5.0		5.0	5.0
Minimum Split (s)		9.5	9.5	9.5		22.5	22.5
Total Split (s)		10.0	20.0	20.0		90.0	90.0
Total Split (%)		8.3%	16.7%	16.7%		75.0%	75.0%
Maximum Green (s)		5.5	16.0	16.0		85.5	85.5
Yellow Time (s)		3.5	3.5	3.5		3.5	3.5
All-Red Time (s)		1.0	0.5	0.5		1.0	1.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0
Total Lost Time (s)		4.5		4.0		4.5	4.5
Lead/Lag			Lead	Lead		Lag	Lag
Lead-Lag Optimize?							
Vehicle Extension (s)		3.0	3.0	3.0		3.0	3.0
Recall Mode		None	None	None		C-Min	C-Min
Act Effct Green (s)		5.5		16.0	120.0	85.5	85.5
Actuated g/C Ratio		0.05		0.13	1.00	0.71	0.71
v/c Ratio		0.20		0.41	0.52	0.71	0.01
Control Delay		2.4		42.7	1.0	5.7	0.6
Queue Delay		0.0		0.0	0.0	0.6	0.0
Total Delay		2.4		42.7	1.0	6.2	0.6
LOS		A		D	A	A	A
Approach Delay	2.4				3.1	6.2	
Approach LOS	A				A	A	
Queue Length 50th (ft)		0		56	5	56	0
Queue Length 95th (ft)		0		m81	0	163	m0
Internal Link Dist (ft)	901				83	760	
Turn Bay Length (ft)				200			200
Base Capacity (vph)		186		236	3539	2521	1130
Starvation Cap Reductn		0		0	0	328	0
Spillback Cap Reductn		0		0	0	0	0
Storage Cap Reductn		0		0	0	0	0
Reduced v/c Ratio		0.20		0.41	0.52	0.82	0.01

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 4 (3%), Referenced to phase 2:NBSB, Start of Yellow
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 4.6
Intersection Capacity Utilization 65.5%
Analysis Period (min) 15
Intersection LOS: A
ICU Level of Service C
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: One Buckland Center & Buckland



Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	309	357	376	200	512	249	703	1206	419	8	312	731
Future Volume (vph)	309	357	376	200	512	249	703	1206	419	8	312	731
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300		600	
Storage Lanes	2		1	2		1	2		1		2	
Taper Length (ft)	25			25			25				25	
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.95	0.97	0.95
Frt			0.850			0.850			0.850			
Flt Protected	0.950			0.950			0.950				0.950	
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	0	3433	3539
Flt Permitted	0.950			0.950			0.950				0.950	
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	0	3433	3539
Right Turn on Red			Yes			Yes			Yes			
Satd. Flow (RTOR)			409			271			257			
Link Speed (mph)		35			35			45				45
Link Distance (ft)		1080			1125			794				427
Travel Time (s)		21.0			21.9			12.0				6.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	336	388	409	217	557	271	764	1311	455	9	339	795
Shared Lane Traffic (%)												
Lane Group Flow (vph)	336	388	409	217	557	271	764	1311	455	0	348	795
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	R NA	Left	Left
Median Width(ft)		24			24			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9		15	
Number of Detectors	1	2	1	1	2	1	1	2	1	1	1	2
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Left	Thru
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	20	100
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	20	6
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94				94
Detector 2 Size(ft)		6			6			6				6
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex				CI+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	custom	NA	Free	custom	NA	Free	custom	NA	Free	custom	custom	NA
Protected Phases	7	4		3	8		5	2		1	1	6
Permitted Phases	7	4	Free	3	8	Free	5	2	Free	1	1	6

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday PM Peak (11.19 update)
12/26/2019

Lane Group	SBR
Lane Configurations	7
Traffic Volume (vph)	643
Future Volume (vph)	643
Ideal Flow (vphpl)	1900
Storage Length (ft)	600
Storage Lanes	1
Taper Length (ft)	
Lane Util. Factor	1.00
Frt	0.850
Flt Protected	
Satd. Flow (prot)	1583
Flt Permitted	
Satd. Flow (perm)	1583
Right Turn on Red	Yes
Satd. Flow (RTOR)	586
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	0.92
Adj. Flow (vph)	699
Shared Lane Traffic (%)	
Lane Group Flow (vph)	699
Enter Blocked Intersection	No
Lane Alignment	Right
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	1.00
Turning Speed (mph)	9
Number of Detectors	1
Detector Template	Right
Leading Detector (ft)	20
Trailing Detector (ft)	0
Detector 1 Position(ft)	0
Detector 1 Size(ft)	20
Detector 1 Type	CI+Ex
Detector 1 Channel	
Detector 1 Extend (s)	0.0
Detector 1 Queue (s)	0.0
Detector 1 Delay (s)	0.0
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	Free
Protected Phases	
Permitted Phases	Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Friday PM Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Detector Phase	7	4		3	8		5	2		1	1	6
Switch Phase												
Minimum Initial (s)	4.0	8.0		4.0	8.0		4.0	15.0		4.0	4.0	15.0
Minimum Split (s)	8.0	12.0		8.0	12.0		8.0	19.0		8.0	8.0	19.0
Total Split (s)	21.0	30.0		16.0	25.0		32.0	54.0		20.0	20.0	42.0
Total Split (%)	17.5%	25.0%		13.3%	20.8%		26.7%	45.0%		16.7%	16.7%	35.0%
Maximum Green (s)	17.0	26.0		12.0	21.0		28.0	50.0		16.0	16.0	38.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0			0.0	0.0
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0			4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lead	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		None	None	C-Max
Act Effct Green (s)	15.7	25.1	120.0	11.3	20.7	120.0	27.9	52.2	120.0		15.4	39.6
Actuated g/C Ratio	0.13	0.21	1.00	0.09	0.17	1.00	0.23	0.44	1.00		0.13	0.33
v/c Ratio	0.75	0.53	0.26	0.67	0.91	0.17	0.96	0.85	0.29		0.79	0.68
Control Delay	61.1	44.9	0.4	63.1	69.2	0.2	68.5	37.6	0.5		51.7	43.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	61.1	44.9	0.4	63.1	69.2	0.2	68.5	37.6	0.5		51.7	43.9
LOS	E	D	A	E	E	A	E	D	A		D	D
Approach Delay		33.6			50.0			40.2				29.0
Approach LOS		C			D			D				C
Queue Length 50th (ft)	129	140	0	84	224	0	302	486	0		130	338
Queue Length 95th (ft)	180	191	0	126	#325	0	#424	591	0		#183	406
Internal Link Dist (ft)		1000			1045			714				347
Turn Bay Length (ft)	200			350		250			300		600	
Base Capacity (vph)	486	766	1583	343	619	1583	801	1540	1583		457	1168
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0		0	0
Reduced v/c Ratio	0.69	0.51	0.26	0.63	0.90	0.17	0.95	0.85	0.29		0.76	0.68

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 32 (27%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 75

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 37.5

Intersection LOS: D

Intersection Capacity Utilization 78.8%

ICU Level of Service D

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.



Lane Group	SBR
Detector Phase	
Switch Phase	
Minimum Initial (s)	
Minimum Split (s)	
Total Split (s)	
Total Split (%)	
Maximum Green (s)	
Yellow Time (s)	
All-Red Time (s)	
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Vehicle Extension (s)	
Recall Mode	
Act Effct Green (s)	120.0
Actuated g/C Ratio	1.00
v/c Ratio	0.44
Control Delay	0.6
Queue Delay	0.0
Total Delay	0.6
LOS	A
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	0
Queue Length 95th (ft)	0
Internal Link Dist (ft)	
Turn Bay Length (ft)	600
Base Capacity (vph)	1583
Starvation Cap Reductn	0
Spillback Cap Reductn	0
Storage Cap Reductn	0
Reduced v/c Ratio	0.44
Intersection Summary	

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

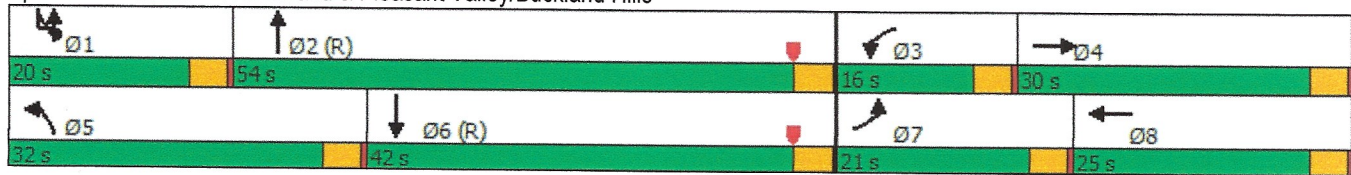


Exhibit 20
Traffic Operations Analysis Worksheets
Combined 2020 Saturday Mid-Day Peak Hour

Lanes, Volumes, Timings
3: Buckland /Buckland & Tamarack/Lowes

Combined Saturday Midday Peak (11.19 update)

12/28/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕	↗	↖	↕	↗	↖↖	↕↕		↖	↕↕	
Traffic Volume (vph)	121	91	524	181	102	193	640	1022	143	201	1223	76
Future Volume (vph)	121	91	524	181	102	193	640	1022	143	201	1223	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		250	250		250	300		0	250		0
Storage Lanes	0		1	1		1	2		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.97	0.95	0.95	1.00	0.95	0.95
Frt			0.850			0.850		0.982			0.991	
Flt Protected		0.972		0.950			0.950			0.950		
Satd. Flow (prot)	0	3440	1583	1770	1863	1583	3433	3476	0	1770	3507	0
Flt Permitted		0.759		0.950			0.950			0.950		
Satd. Flow (perm)	0	2686	1583	1770	1863	1583	3433	3476	0	1770	3507	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			561			210		14			5	
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1049			1178			840			377	
Travel Time (s)		20.4			22.9			12.7			5.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	99	570	197	111	210	696	1111	155	218	1329	83
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	231	570	197	111	210	696	1266	0	218	1412	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	custom	custom	NA	custom	Prot	NA		Prot	NA	
Protected Phases		8	8	4	4	4	5	2		1	6	
Permitted Phases	8	8	8	4	4	4		2			6	

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Number of Detectors	
Detector Template	
Leading Detector (ft)	
Trailing Detector (ft)	
Detector 1 Position(ft)	
Detector 1 Size(ft)	
Detector 1 Type	
Detector 1 Channel	
Detector 1 Extend (s)	
Detector 1 Queue (s)	
Detector 1 Delay (s)	
Detector 2 Position(ft)	
Detector 2 Size(ft)	
Detector 2 Type	
Detector 2 Channel	
Detector 2 Extend (s)	
Turn Type	
Protected Phases	3
Permitted Phases	

Lanes, Volumes, Timings

Combined Saturday Midday Peak (11.19 update)

3: Buckland /Buckland & Tamarack/Lowes

12/28/2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	8	8	8	4	4	4	5	2		1	6	
Switch Phase												
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	15.0		8.0	5.0	
Minimum Split (s)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	19.0		12.0	19.0	
Total Split (s)	19.0	19.0	19.0	16.0	16.0	16.0	30.0	46.0		16.0	32.0	
Total Split (%)	15.8%	15.8%	15.8%	13.3%	13.3%	13.3%	25.0%	38.3%		13.3%	26.7%	
Maximum Green (s)	15.0	15.0	15.0	12.0	12.0	12.0	26.0	42.0		12.0	28.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag				Lag	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)		14.4	14.4	12.0	12.0	12.0	25.8	65.6		12.0	51.8	
Actuated g/C Ratio		0.12	0.12	0.10	0.10	0.10	0.22	0.55		0.10	0.43	
v/c Ratio		0.87dl	0.83	1.11	0.60	0.61	0.94	0.66		1.23	0.93	
Control Delay		64.1	16.4	150.5	65.7	14.7	68.6	21.4		188.4	44.6	
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		64.1	16.4	150.5	65.7	14.7	68.6	21.4		188.4	44.6	
LOS		E	B	F	E	B	E	C		F	D	
Approach Delay		30.2			77.3			38.1			63.8	
Approach LOS		C			E			D			E	
Queue Length 50th (ft)		91	6	~175	84	0	275	352		~209	542	
Queue Length 95th (ft)		136	#176	#326	145	75	#389	429		#367	#703	
Internal Link Dist (ft)		969			1098			760			297	
Turn Bay Length (ft)			250	250		250	300			250		
Base Capacity (vph)		335	688	177	186	347	743	1907		177	1517	
Starvation Cap Reductn		0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio		0.69	0.83	1.11	0.60	0.61	0.94	0.66		1.23	0.93	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 100 (83%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 140

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.23

Intersection Signal Delay: 49.5

Intersection LOS: D

Intersection Capacity Utilization 88.7%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

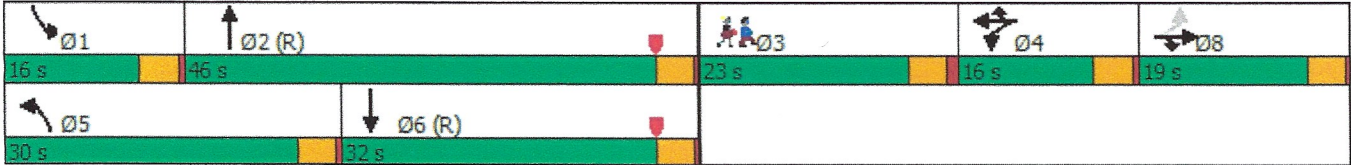
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Lane Group	Ø3
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	9.5
Total Split (s)	23.0
Total Split (%)	19%
Maximum Green (s)	18.5
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 3: Buckland /Buckland & Tamarack/Lowes



Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Saturday Midday Peak (11.19 update)

12/27/2019

							
Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	0	41	74	33	1805	1916	12
Future Volume (vph)	0	41	74	33	1805	1916	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0		200			200
Storage Lanes	0	1		1			1
Taper Length (ft)	25			25			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.95	0.95	1.00
Frt		0.865					0.850
Flt Protected				0.950			
Satd. Flow (prot)	0	1611	0	1770	3539	3539	1583
Flt Permitted				0.950			
Satd. Flow (perm)	0	1611	0	1770	3539	3539	1583
Right Turn on Red		Yes					Yes
Satd. Flow (RTOR)		104					11
Link Speed (mph)	25				45	45	
Link Distance (ft)	981				163	840	
Travel Time (s)	26.8				2.5	12.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	45	80	36	1962	2083	13
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	45	0	116	1962	2083	13
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	Left	Right	R NA	Left	Left	Left	Right
Median Width(ft)	0				24	24	
Link Offset(ft)	0				0	0	
Crosswalk Width(ft)	16				16	16	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	9	15			9
Number of Detectors		1	1	1	2	2	1
Detector Template		Right	Left	Left	Thru	Thru	Right
Leading Detector (ft)		20	20	20	100	100	20
Trailing Detector (ft)		0	0	0	0	0	0
Detector 1 Position(ft)		0	0	0	0	0	0
Detector 1 Size(ft)		20	20	20	6	6	20
Detector 1 Type		CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel							
Detector 1 Extend (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)		0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)					94	94	
Detector 2 Size(ft)					6	6	
Detector 2 Type					CI+Ex	CI+Ex	
Detector 2 Channel							
Detector 2 Extend (s)					0.0	0.0	
Turn Type		Prot	custom	custom	NA	NA	custom
Protected Phases		3	1	1	1 2 3	2	2
Permitted Phases		3	1	1	1 2 3	2	2

Lanes, Volumes, Timings
6: One Buckland Center & Buckland

Combined Saturday Midday Peak (11.19 update)

12/27/2019



Lane Group	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Detector Phase		3	1	1	1 2 3	2	2
Switch Phase							
Minimum Initial (s)		5.0	5.0	5.0		5.0	5.0
Minimum Split (s)		9.5	9.5	9.5		22.5	22.5
Total Split (s)		9.5	21.0	21.0		89.5	89.5
Total Split (%)		7.9%	17.5%	17.5%		74.6%	74.6%
Maximum Green (s)		5.0	17.0	17.0		85.0	85.0
Yellow Time (s)		3.5	3.5	3.5		3.5	3.5
All-Red Time (s)		1.0	0.5	0.5		1.0	1.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0
Total Lost Time (s)		4.5		4.0		4.5	4.5
Lead/Lag			Lead	Lead		Lag	Lag
Lead-Lag Optimize?							
Vehicle Extension (s)		3.0	3.0	3.0		3.0	3.0
Recall Mode		None	None	None		C-Max	C-Max
Walk Time (s)						7.0	7.0
Flash Dont Walk (s)						11.0	11.0
Pedestrian Calls (#/hr)						0	0
Act Effct Green (s)		5.0		17.0	120.0	85.0	85.0
Actuated g/C Ratio		0.04		0.14	1.00	0.71	0.71
v/c Ratio		0.27		0.46	0.55	0.83	0.01
Control Delay		4.0		67.7	1.5	18.3	5.3
Queue Delay		0.0		0.0	0.0	0.0	0.0
Total Delay		4.0		67.7	1.5	18.3	5.3
LOS		A		E	A	B	A
Approach Delay	4.0				5.2	18.2	
Approach LOS	A				A	B	
Queue Length 50th (ft)		0		94	24	531	1
Queue Length 95th (ft)		0		m115	m10	m563	m1
Internal Link Dist (ft)	901				83	760	
Turn Bay Length (ft)				200			200
Base Capacity (vph)		166		250	3539	2506	1124
Starvation Cap Reductn		0		0	0	4	0
Spillback Cap Reductn		0		0	0	0	0
Storage Cap Reductn		0		0	0	0	0
Reduced v/c Ratio		0.27		0.46	0.55	0.83	0.01

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green

Natural Cycle: 75

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 11.6

Intersection LOS: B

Intersection Capacity Utilization 73.9%

ICU Level of Service D

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 6: One Buckland Center & Buckland



Lanes, Volumes, Timings

Combined Saturday Midday Peak (11.19 update)

9: Buckland & Pleasant Valley/Buckland Hills

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	328	429	389	308	724	322	752	1144	455	368	860	688
Future Volume (vph)	328	429	389	308	724	322	752	1144	455	368	860	688
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	350		250	0		300	630		630
Storage Lanes	2		1	2		1	2		1	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frnt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	1583	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			422			270			295			497
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1080			1125			794			427	
Travel Time (s)		21.0			21.9			12.0			6.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	357	466	423	335	787	350	817	1243	495	400	935	748
Shared Lane Traffic (%)												
Lane Group Flow (vph)	357	466	423	335	787	350	817	1243	495	400	935	748
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2	1	1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Leading Detector (ft)	20	100	20	20	100	20	20	100	20	20	100	20
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0	0	0	0	0	0	0
Detector 1 Size(ft)	20	6	20	20	6	20	20	6	20	20	6	20
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex	CI+Ex
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free

Lanes, Volumes, Timings
9: Buckland & Pleasant Valley/Buckland Hills

Combined Saturday Midday Peak (11.19 update)

12/26/2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Detector Phase	7	4	4	3	8	8	5	2		1	6	
Switch Phase												
Minimum Initial (s)	4.0	8.0	8.0	4.0	8.0	8.0	4.0	15.0		4.0	15.0	
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	19.0		8.0	19.0	
Total Split (s)	16.0	31.0	31.0	18.0	33.0	33.0	35.0	50.0		21.0	36.0	
Total Split (%)	13.3%	25.8%	25.8%	15.0%	27.5%	27.5%	29.2%	41.7%		17.5%	30.0%	
Maximum Green (s)	12.0	27.0	27.0	14.0	29.0	29.0	31.0	46.0		17.0	32.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None	None	None	None	None	None	C-Max		None	C-Max	
Act Effct Green (s)	12.0	27.0	27.0	13.8	28.9	28.9	30.5	46.6	120.0	16.6	32.7	120.0
Actuated g/C Ratio	0.10	0.22	0.22	0.12	0.24	0.24	0.25	0.39	1.00	0.14	0.27	1.00
v/c Ratio	1.04	0.58	0.62	0.85	0.92	0.60	0.94	0.91	0.31	0.85	0.97	0.47
Control Delay	111.8	44.9	8.1	72.1	62.1	14.6	62.8	45.3	0.5	47.0	49.8	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	111.8	44.9	8.1	72.1	62.1	14.6	62.8	45.3	0.5	47.0	49.8	0.3
LOS	F	D	A	E	E	B	E	D	A	D	D	A
Approach Delay		51.6			53.1			42.3			31.5	
Approach LOS		D			D			D			C	
Queue Length 50th (ft)	~154	170	1	132	314	50	318	476	0	143	387	0
Queue Length 95th (ft)	#251	226	89	#207	#431	149	#436	#616	0	m154	m#426	m0
Internal Link Dist (ft)		1000			1045			714			347	
Turn Bay Length (ft)	200			350		250			300	630		630
Base Capacity (vph)	343	797	683	400	855	587	886	1373	1583	486	963	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.04	0.58	0.62	0.84	0.92	0.60	0.92	0.91	0.31	0.82	0.97	0.47

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 38 (32%), Referenced to phase 2:NBT and 6:SBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.04

Intersection Signal Delay: 43.0

Intersection LOS: D

Intersection Capacity Utilization 87.9%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Buckland & Pleasant Valley/Buckland Hills

 Ø1 21 s	 Ø2 (R) 50 s	 Ø3 18 s	 Ø4 31 s
 Ø5 35 s	 Ø6 (R) 36 s	 Ø7 16 s	 Ø8 33 s