

CE474: Traffic Systems Design-Fall 2004

Class 14 – System Coordination Concepts –Introduction to Synchrho
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System Coordination

- ◆ The main purpose of signal coordination is to discharge the maximum amount of main street traffic without enforced halts while allowing adequate capacity for cross-street traffic.

System Coordination

- ◆ Two traffic signal system coordination schemes are available:
 - bandwidth system which permits continuous movement in a progression bandwidth
 - disutility system which is aimed at minimizing travel cost (delays, stops, fuel emissions, etc.) along an arterial or through an area.

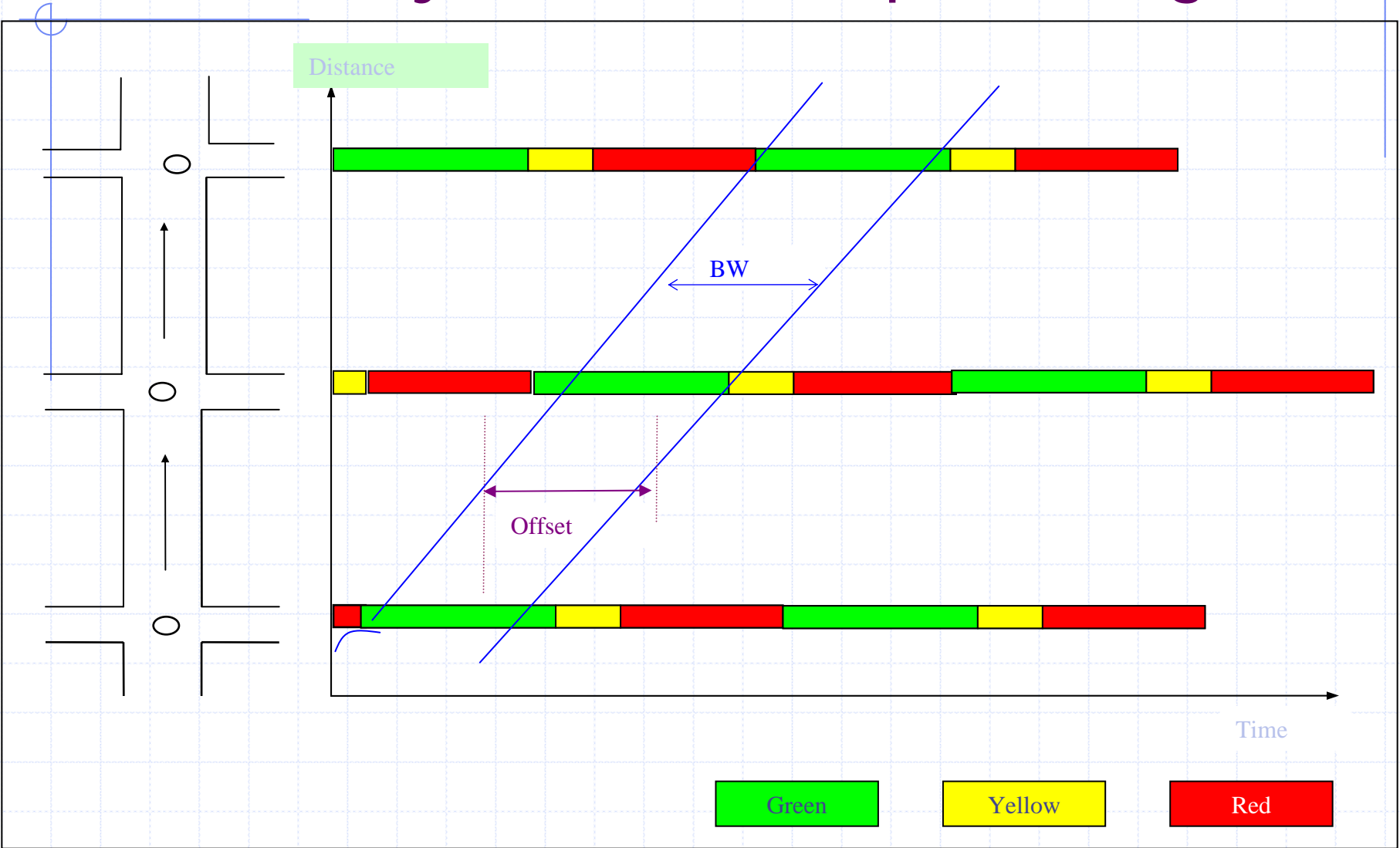
System Coordination: Advantages

- higher speed of progression and fewer stops which alleviate spill-over queues.
- smooth traffic operation which increases capacity, decreases energy consumption and reduces air pollution.
- signal coordination entices drivers to maintain a uniform speed to avoid stopping at red lights within the system, as a result overall speed variations is reduced.

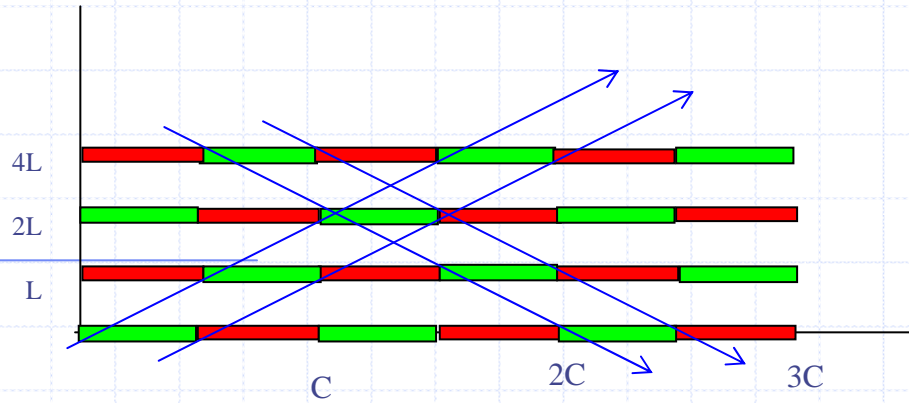
System Coordination: Advantages

- main traffic will tend to remain on the arterial street system instead of using parallel minor streets.
- coordination is meant to prevent the queue of vehicles at one intersection from extending back and interfering with upstream traffic.

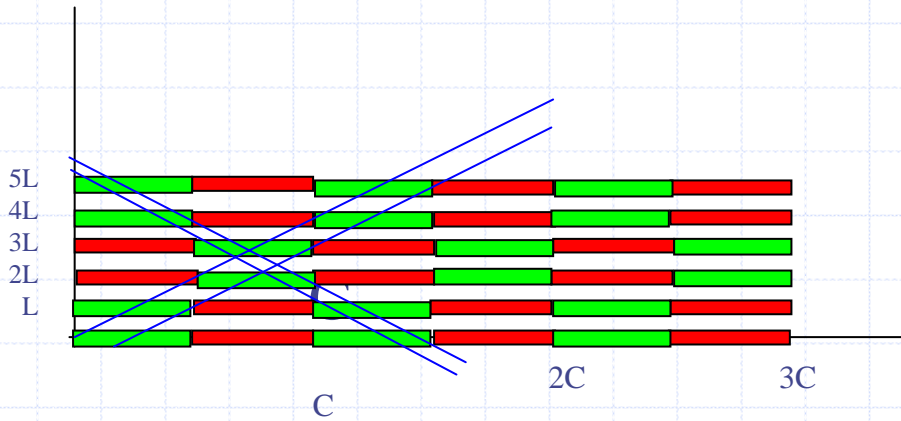
Bandwidth System: Time Space Diagram



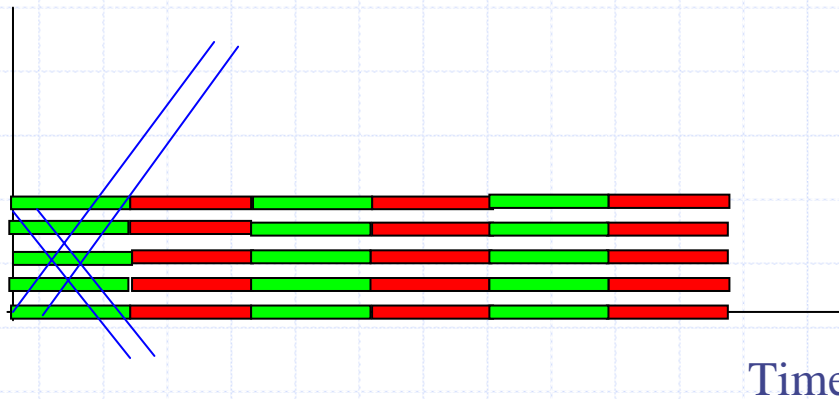
D
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Alternate System



Double Alternate System



Simultaneous System

Bandwidth System

◆ Offset

- The sum of offsets in two directions must be equal to an integer number of cycles.

$$\text{Off}_{ij} + \text{Off}_{ji} = n C$$

◆ Ideal Offset

- $\text{Off}(\text{ideal}) = L / v - (Q * h + \text{Loss}_1)$

Bandwidth System

◆ Efficiency

- is a measure of how much of the cycle length has been used by the bandwidth
- $\text{Efficiency} = (\text{Bandwidth} / \text{Cycle Length}) 100\%$

◆ Attainability

- is a measure of the progression's ability to utilize the available greens of the intersections within the artery
- $\text{Attainability} = (\text{Bandwidth} / \text{Min. Artery Through Green}) 100\%$

Disutility System

- ◆ Disutility is a measure of effectiveness which can be expressed by delays, stops, and other terms, e.g. fuel consumption, queue length, cost
- ◆ $\text{Disutility} = A (\text{Total Delay}) + B (\text{Total Stops}) + C (\text{other terms})$

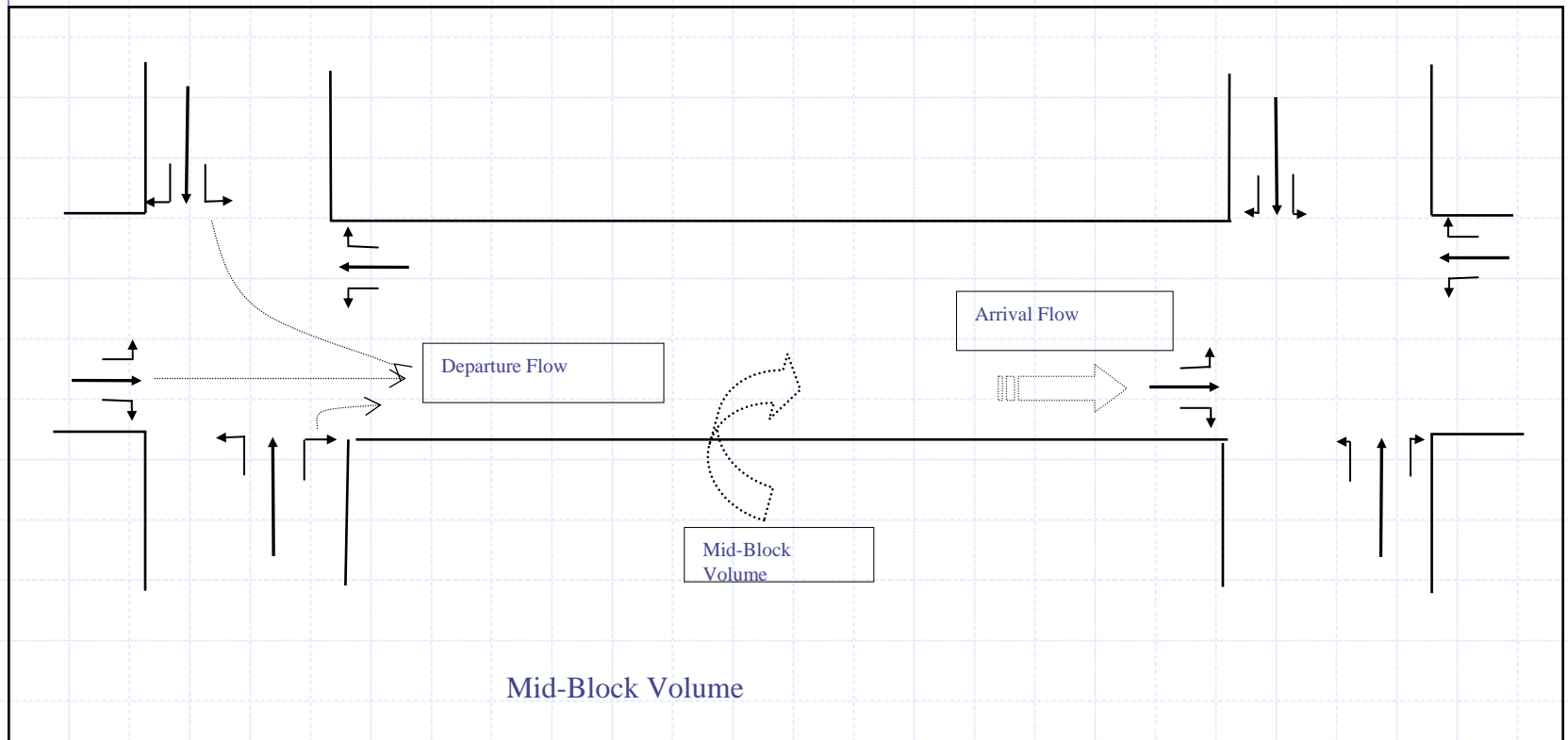
Computer Programs

- ◆ PASSER-II [MAXBAND] – Mathematical bases optimization
- ◆ TRANSYT-7F [Hill-climb – Genetic Algorithm]
- ◆ SYNCHRO [?]

Signal Timing Elements & Contributing Factors

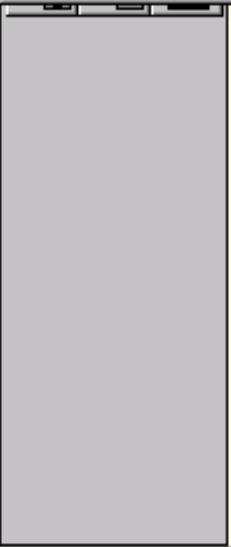
- ◆ Cycle Length
- ◆ Splits
- ◆ Number of Phases
- ◆ Sequence of Phases
 - Lead vs. Lag
- ◆ Offsets
- ◆ Secondary Flows
- ◆ Left Turn Treatment
 - Protected
 - Permitted
 - Combination of Prot/Perm
- ◆ Queue Clearance Time

Secondary Flow



- New Ctrl+N
- Open... Ctrl+O
- Save Ctrl+S
- Save As...
- Save Part...
- Merge...
- DXF ▶
- Print Window Ctrl+P
- Create Report...
- Printer Setup...
- 1 D:\SYNCHRO2\Trafficware\Oregon.sy5
- 2 D:\SYNCHRO2\Trafficware\Palmdale.sy5
- 3 D:\SYNCHRO2\Trafficware\High Point 311 Bypass.sy5
- Exit

Open File





Synchro 3.2 Professional

File Transfer Options Optimize Help

New Ctrl+N

Open... Ctrl+O

Save Ctrl+S

Save As...

Save Part...

Merge...

New File

DXF ▶

Print Window Ctrl+P

Create Report...

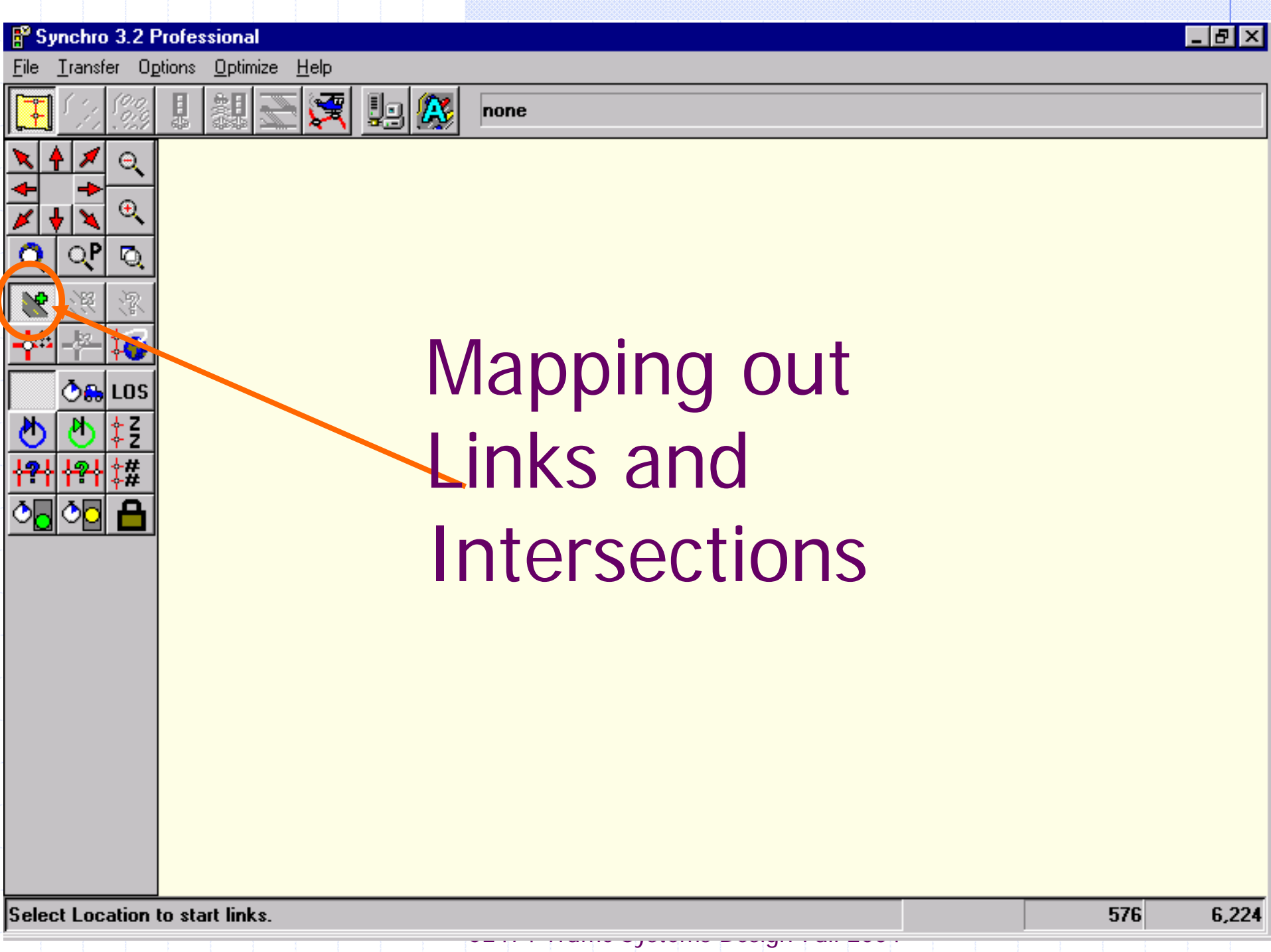
Printer Setup...

1 D:\SYNCHRO2\Trafficware\Oregon.sy5

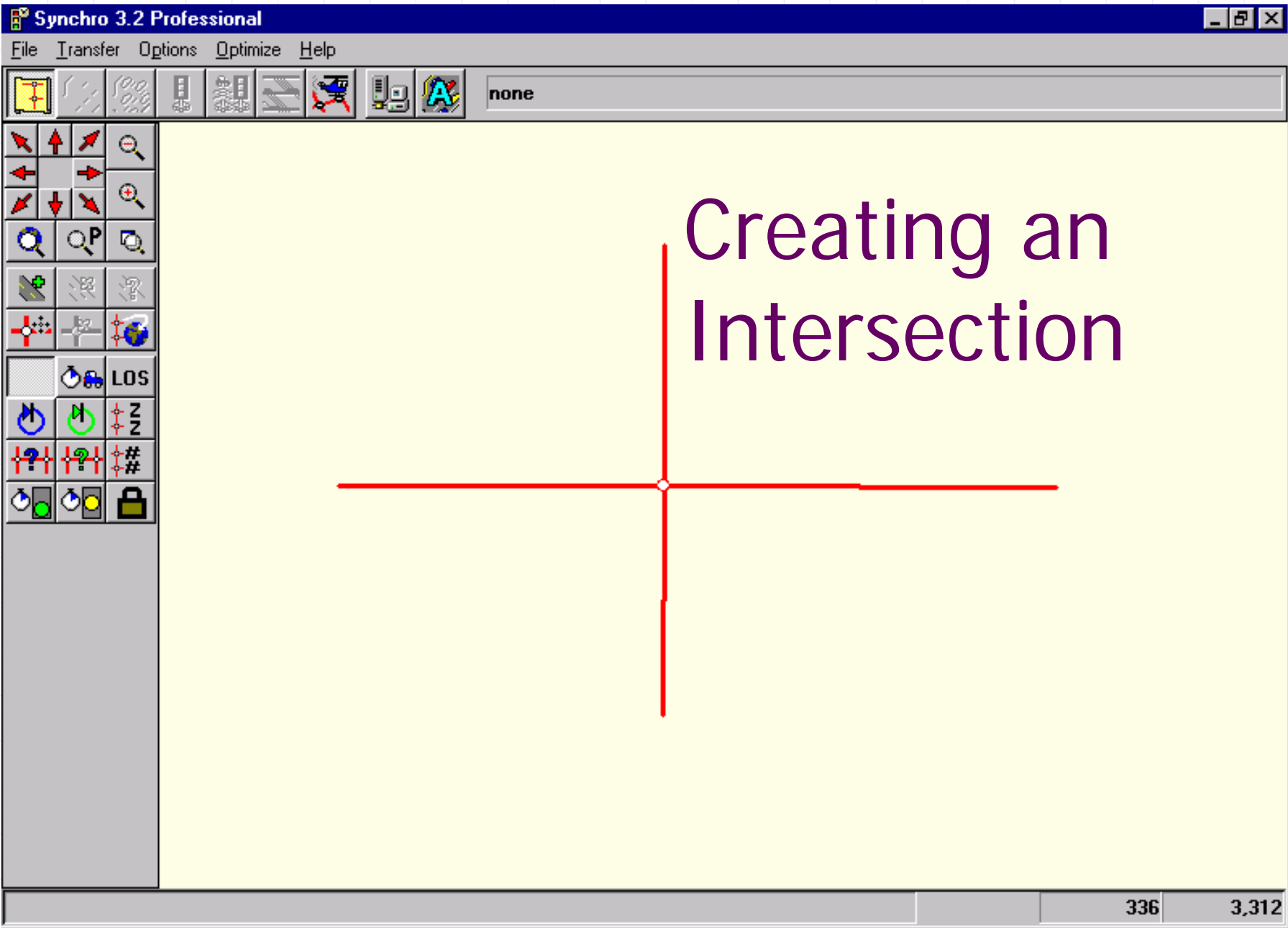
2 D:\SYNCHRO2\Trafficware\Palmdale.sy5

3 D:\SYNCHRO2\Trafficware\High Point 311 Bypass.sy5

Exit

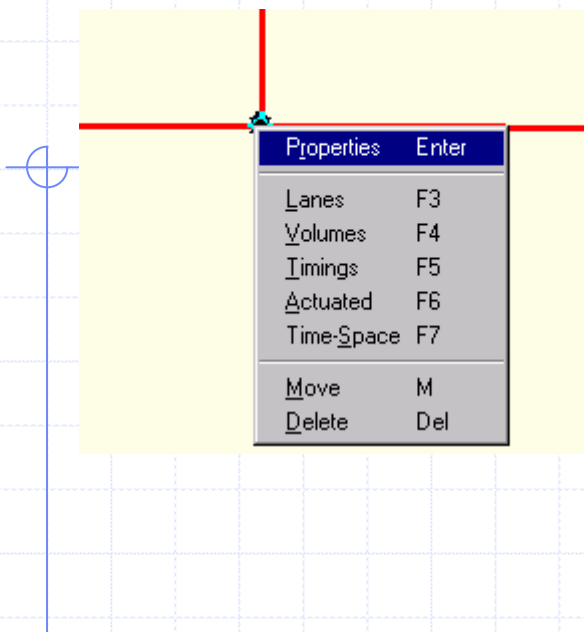


Mapping out
Links and
Intersections



Intersection properties

<u>P</u> roperties	Enter
<u>L</u> anes	F3
<u>V</u> olumes	F4
<u>T</u> imings	F5
<u>A</u> ctuated	F6
Time- <u>S</u> pace	F7
<u>M</u> ove	M
<u>D</u> elete	Del



Intersection Properties

Intersection ID #

Zone:

Cycle Length:

Controller Type:

Lock Timings

Cycle Lengths

Splits

X East (ft):

Y North (ft):

Intersection Geometric

Synchro 3.2 Professional

File Transfer Options Optimize Help

LANES												
EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lanes and Sharing (#RL)	↗	↗↘		↗	↗↘		↗	↗↘		↗	↗↘	↗
Ideal Satd. Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	12	11	11	12	11	11	12	11	11	12	11
Grade (%)		0			0			0			0	
Area Type		Other		Other			Other			Other		
Storage Length (ft)	100		0	100		0	100		0	100		120
First Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Last Ext. Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Right Turn on Red			Yes			Yes			Yes			Yes
Right Turn Factor (prot)	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	No
Left Turn Factor (prot)	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	Yes
Saturated Flow Rate (prot)	1711	3725		1711	3725		1711	3725		1711	3725	1531
Right Turn Factor (perm)	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	0.85
Left Turn Factor (perm)	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Saturated Flow Rate (perm)	1711	3725		1711	3725		1711	3725		1711	3725	1531
Headway Factor	1.04	1.00	1.04	1.04	1.00	1.04	1.04	1.00	1.04	1.04	1.00	1.04

Network Settings

Lanes | Volumes | Timings | Actuated | Delays

Lane Width (ft):

Flow Rate (vphpl):

Vehicle Length (ft):

First Detector to Stopbar (ft):

Last Extension to Stopbar (ft):

Simulation Left Turn Speed (mph):

Simulation Right Turn Speed (mph):

Allow Right Turns On Red

Set All Scope

Zone

Entire Network

Network Settings

Intersection Volumes

Synchro 3.2 Professional

File Transfer Options Optimize Help

VOLUMES												
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	255	480	110	85	270	300	105	490	80	270	460	215
Conflicting Peds. (#/hr)	0		50	0		50	0		50	0		50
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth 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
Heavy Vehicles (%)		2			2			2			2	
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Adj. Parking Lane?	No	No	No	No	No	No	No	No	No	No	No	No
Parking Maneuvers (#/hr)												
Traffic from mid-block (%)		0			0			0			0	
Adjusted Flow (vph)	283	533	122	94	300	333	117	544	89	300	511	239
Lane Utilization Factor	1.00	1.05	1.05	1.00	1.05	1.05	1.00	1.05	1.05	1.00	1.05	1.00
Lane Group Flow (vph)	283	688	0	94	665	0	117	664	0	300	537	239

Intersection Signal Timings

Synchro 3.2 Professional

File Transfer Options Optimize Help

Controller Type: **Pretimed**

Current Cycle Length: **120**

Natural C.L.: 80

Int. V/C Ratio: 0.80

Int. Delay: 30

Int. LOS: D

Lock Timings

Offset Settings

Current Offset: **113**

Reference Style: **Begin of Greer**

Reference Phase: **2+6 - SBT+NB**

Master Intersectn.

TIMINGS	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR	PED
Left Turn Type	Prot		Prot		Prot		Prot			
Right Turn Treatment									Pm+Ov	
Phase Number	7	4	3	8	1	6	5	2		0
Phase Lagging?	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag		
Phase can lead or lag?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Maximum Split (s)	31	46	16	31	19	29	29	39		
Minimum Split (s)	8	20	8	20	8	20	8	20		
Yellow + All Red Time (s)	4	4	4	4	4	4	4	4		
Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Green to Cycle Ratio	0.23	0.36	0.11	0.23	0.13	0.22	0.22	0.30	0.53	
Actuated G/C Ratio	0.23	0.36	0.11	0.23	0.13	0.22	0.22	0.30	0.53	
Volume to Capacity Ratio	0.71	0.53	0.51	0.97dr	0.51	0.84	0.81	0.48	0.30	
Actuated V/C Ratio	0.71	0.53	0.51	0.84	0.51	0.84	0.81	0.48	0.30	
Percentile Delay (s)	32.3	23.3	38.4	35.6	36.8	36.5	39.1	26.2	10.7	
Level of Service	D	C	D	D	D	D	D	D	D	B

Minimum Split (min green + yellow, or walk + FDW + yellow) 8 to 50 s

V/C ok Mins ok

Timing Optimization

Synchro 3.2 Professional: D:\SYNCHRO2\Trafficware\Ironwood.sy5

File Transfer Options **Optimize** Help

Controller Type: Pretimed

Current Cycle Length: 80

Natural C.L.: 80

Int. V/C Ratio: 0.85

Int. Delay: 24

Int. LOS: C

Lock Timings

Offset Settings

Current Offset: 0

Reference Style: Begin of Greer

Reference Phase: 2+6 - SBT+NB

Master Intersctn.

TIMINGS	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR	PED
Left Turn Type	Prot		Prot		Prot		Prot			
Right Turn Treatment									Pm+Ov	
Phase Number	7	4	3	8	1	6	5	2		0
Phase Lagging?	Lag	Lag	Lead	Lead	Lead	Lag	Lead	Lag		
Phase can lead or lag?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Maximum Split (s)	18	26	13	21	15	22	19	26		
Minimum Split (s)	8	20	8	20	8	20	8	20		
Yellow + All Red Time (s)	4	4	4	4	4	4	4	4		
Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Green to Cycle Ratio	0.19	0.29	0.13	0.23	0.15	0.24	0.20	0.29	0.48	
Actuated G/C Ratio	0.19	0.29	0.13	0.23	0.15	0.24	0.20	0.29	0.48	
Volume to Capacity Ratio	0.88	0.66	0.44	1.01dr	0.46	0.77	0.88	0.50	0.33	
Actuated V/C Ratio	0.88	0.66	0.44	0.87	0.46	0.77	0.88	0.50	0.33	
Percentile Delay (s)	43.6	19.3	24.7	28.5	23.6	22.9	40.1	18.1	5.1	
Level of Service	E	C	C	D	C	C	E	C	B	

← 1	↓ 2	↙ 3	→ 4
15	26	13	26
19	22	21	18
↘ 5	↑ 6	← 8	↗ 7

Minimum Split (min green + yellow, or walk + FDW + yellow) 8 to 50 s

V/C > 1 Mins ok