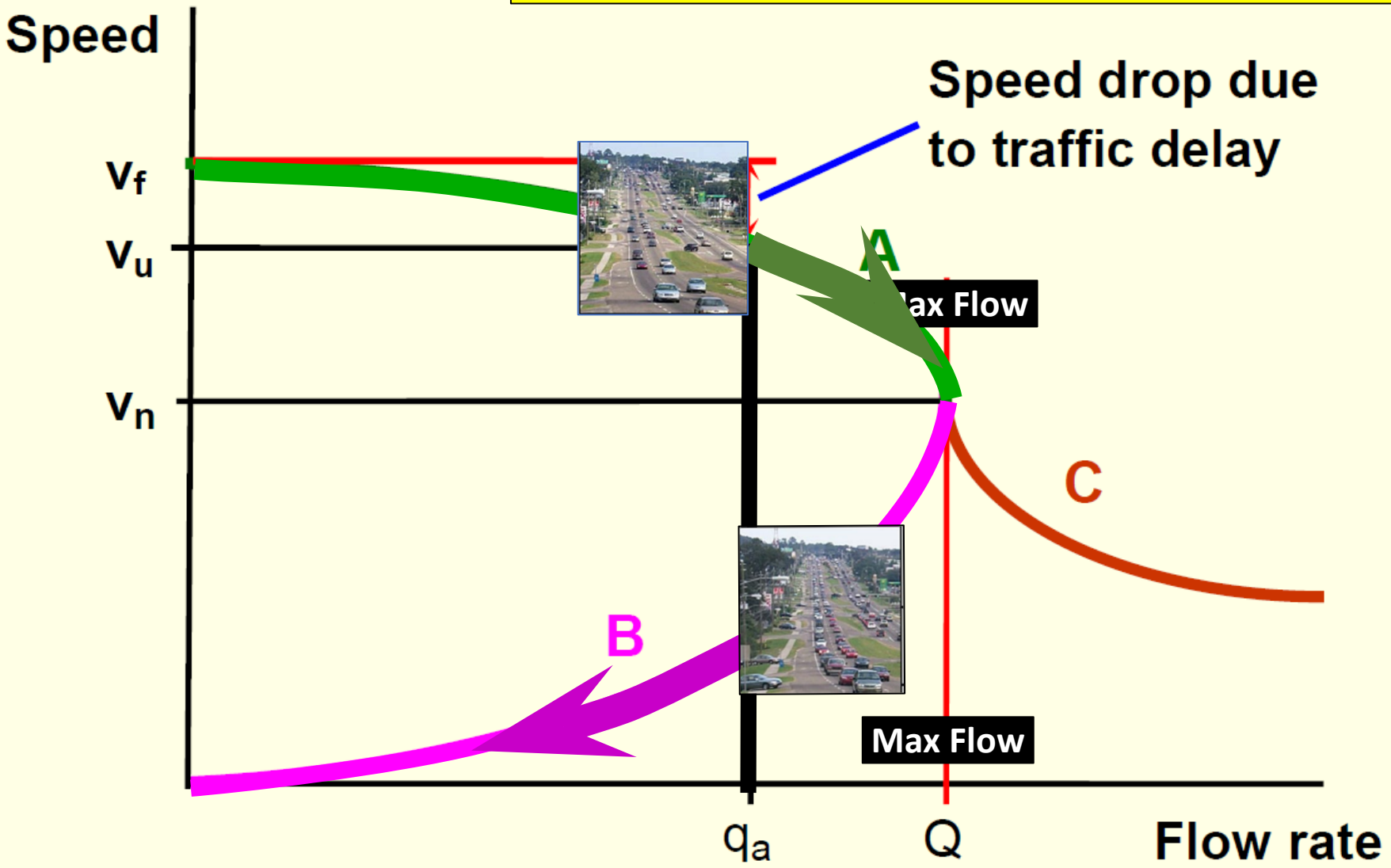
Modelling High Capacity Flows in Emme, SIDRA and Dynameq

Paul van den Bos

Speed-flow curves in transport modelling – from SIDRA Manual

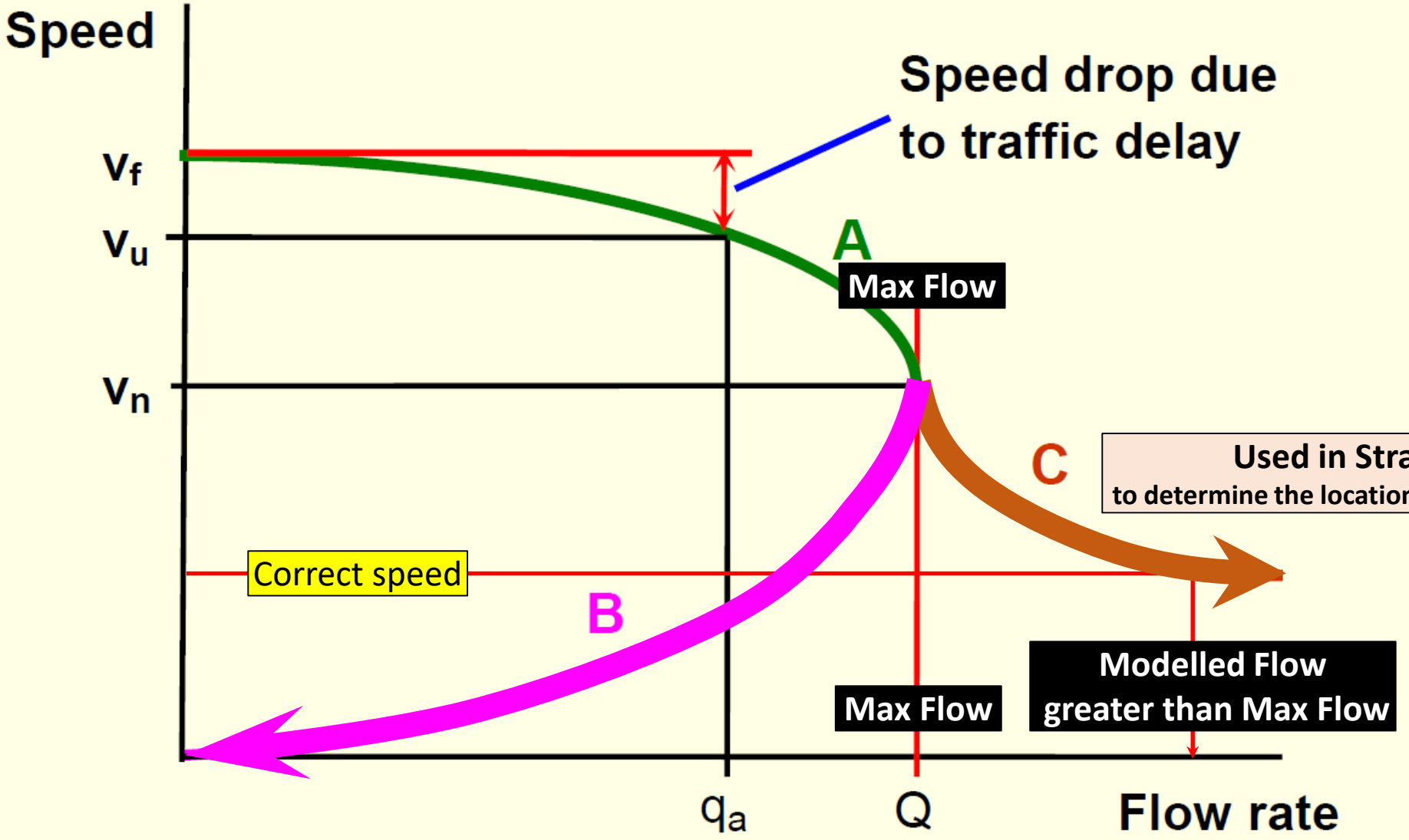


Region A:
Unsaturated
($q_a \leq Q$)

Region B:
Forced flow
(saturated)

Region C:
Oversaturated
($q_a > Q$)

Speed-flow curves in transport modelling – from SIDRA Manual

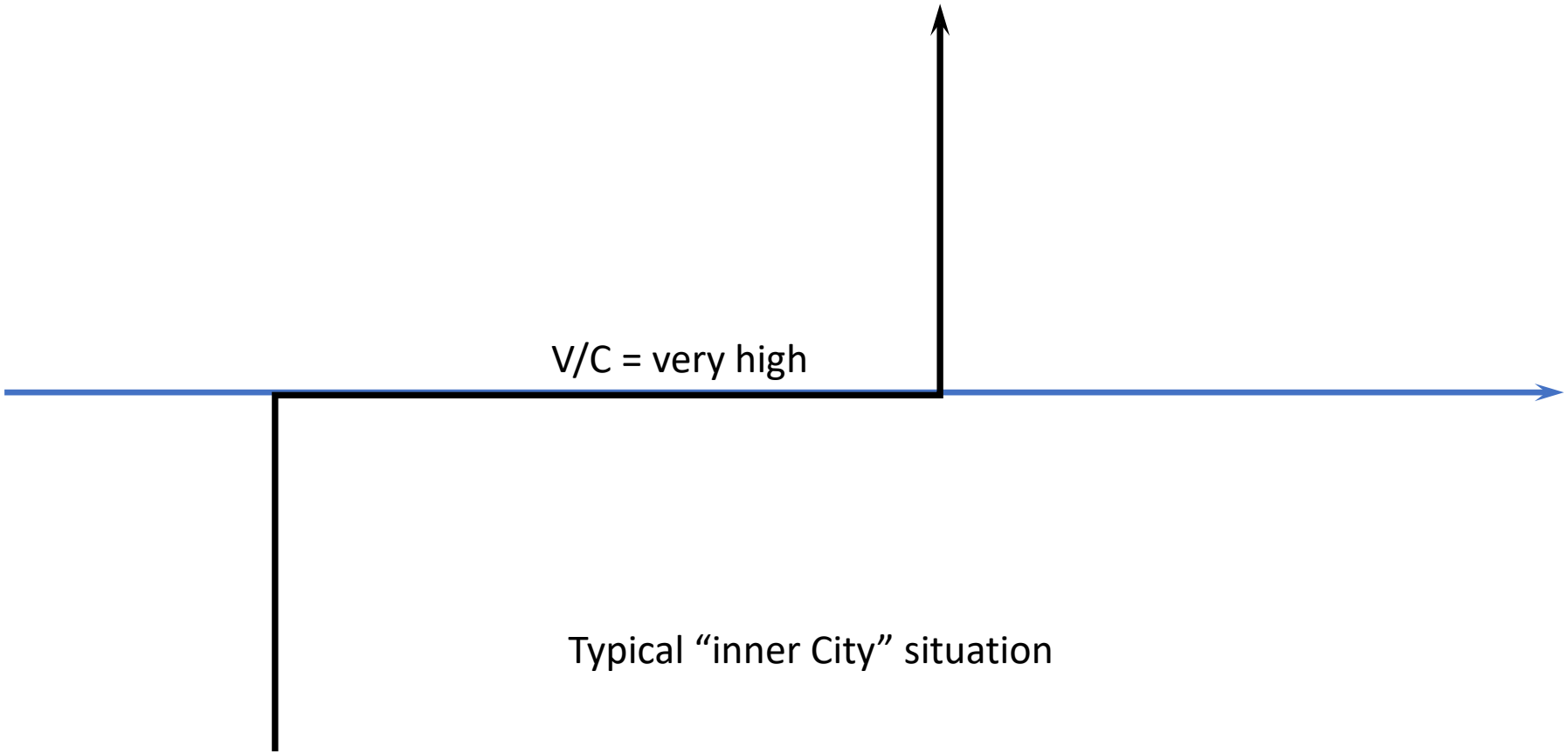


Region A:
Unsaturated
($q_a \leq Q$)

Region B:
Forced flow
(Unstable)

Region C:
Oversaturated
($q_a > Q$)

Figure 7-9: Road network volume/capacity ratios in 2031 - AM maximum peak hour

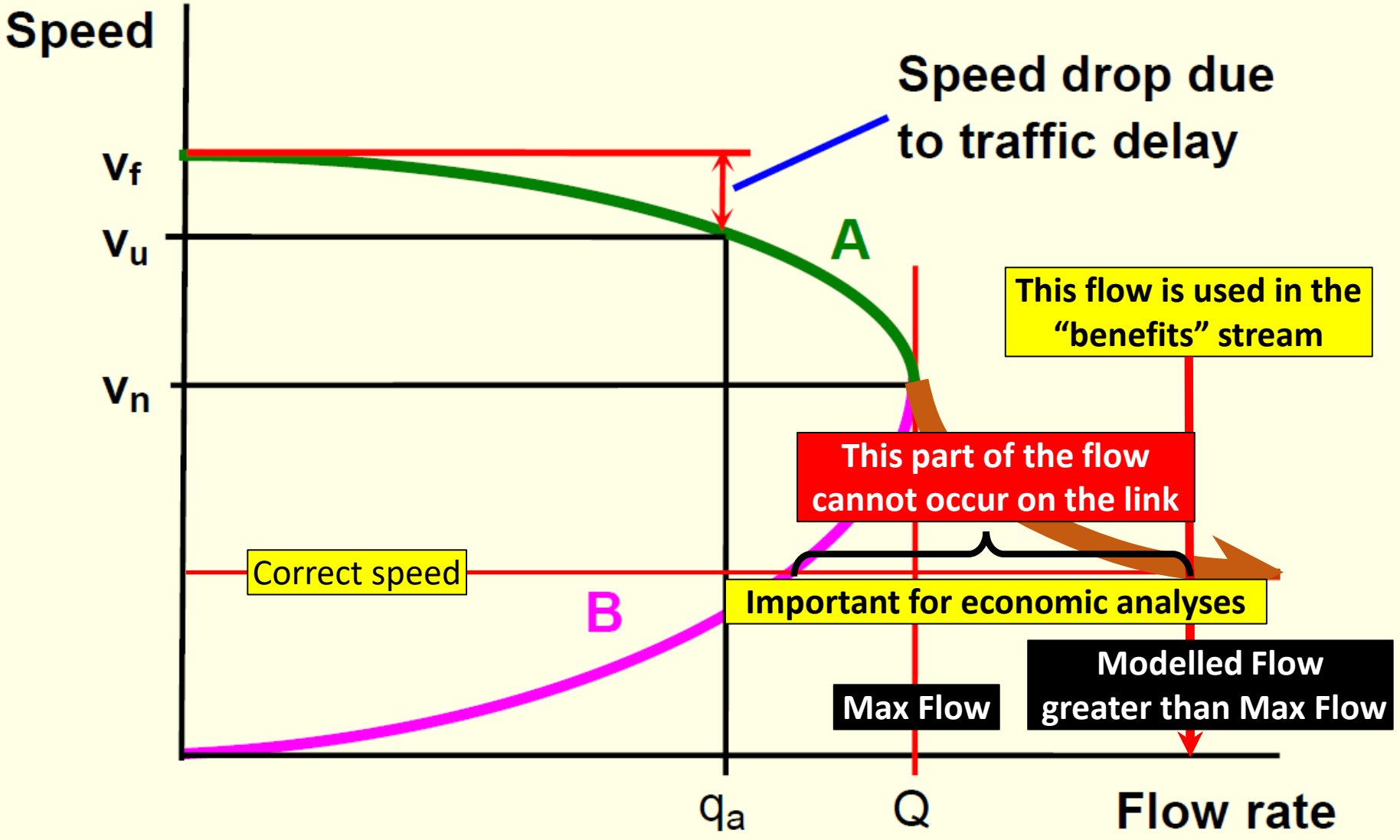


Typical “inner City” situation

Modelled traffic flow numbers are used to

- evaluate priority of network improvements
- in modelling

Speed-flow curves in transport modelling – from SIDRA Manual

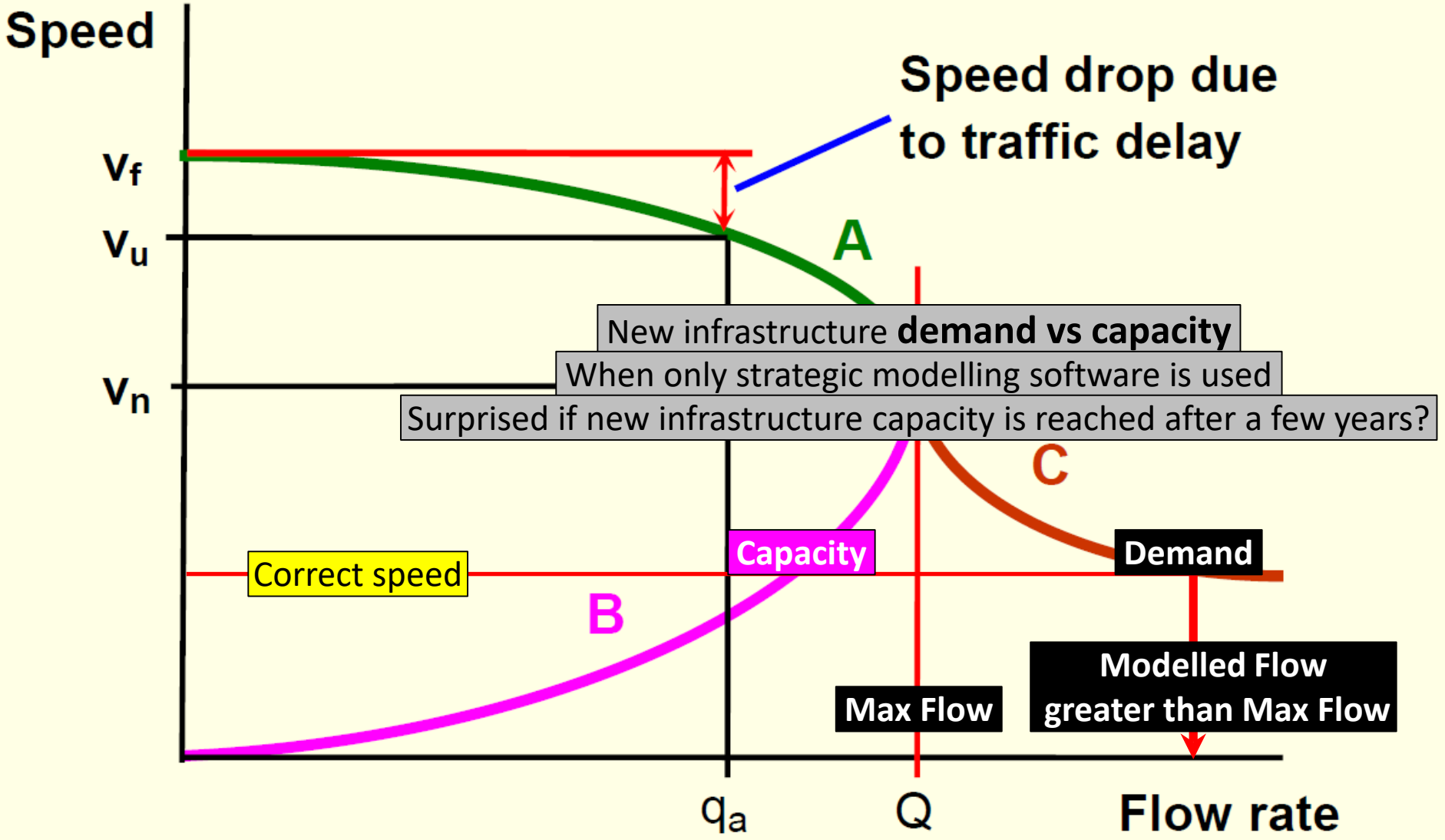


Region A: Unsaturated ($q_a \leq Q$)

Region B: Forced flow (saturated)

Region C: Oversaturated ($q_a > Q$)

Speed-flow curves in transport modelling – from SIDRA Manual



Region A: Unsaturated ($q_a \leq Q$)

Region B: Forced flow (saturated)

Region C: Oversaturated ($q_a > Q$)

How are the high numbers used in SIDRA (and other packages)?

First, Traffic modelling 101

Queueing theory

Arrivals – random or constant
Service – random or constant
Four possible cases

Random arrival rate

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Random service rate

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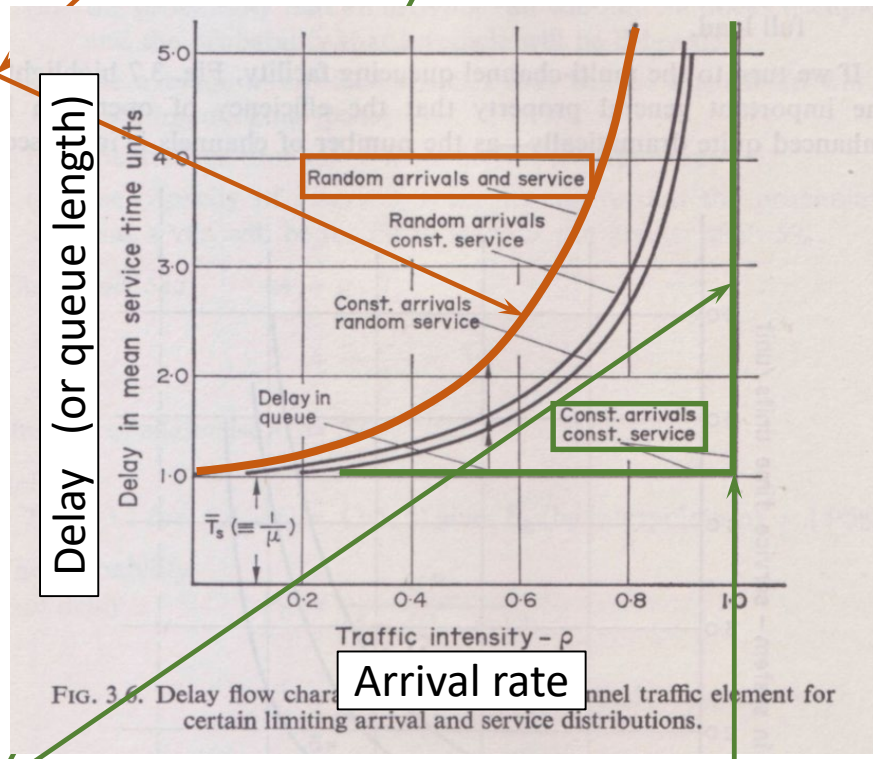
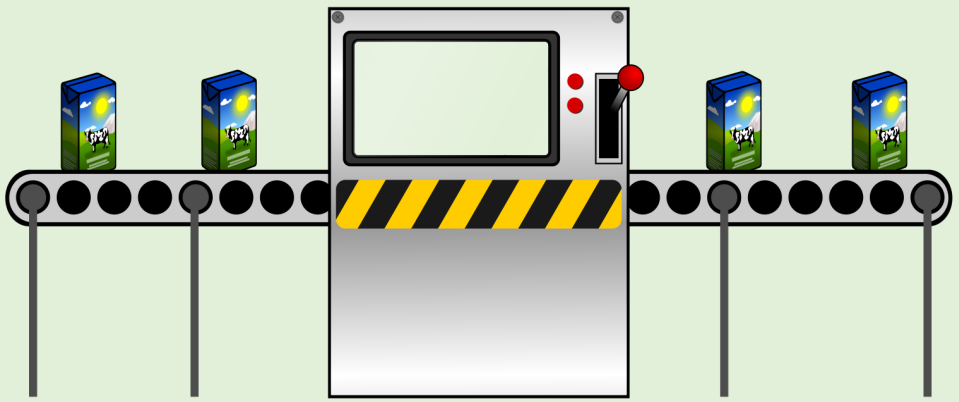


FIG. 3.6. Delay flow chara nnel traffic element for certain limiting arrival and service distributions.

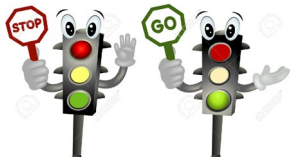
Constant arrival rate



Constant service rate

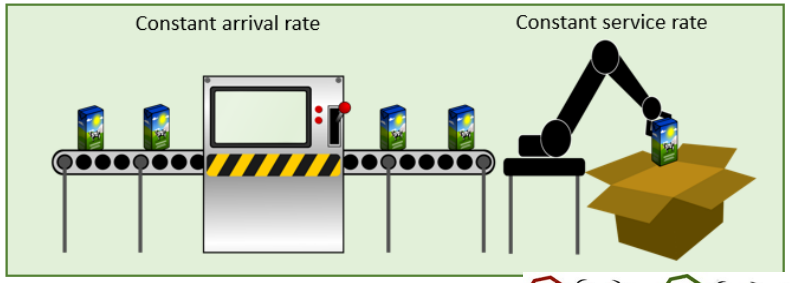
"Brick wall" curve – no warning before capacity is reached
If capacity = 100 and if inflow = 98, 99, 100 => OK
Disaster if inflow = 101, 102 etc. -- no warning

Random arrival rate



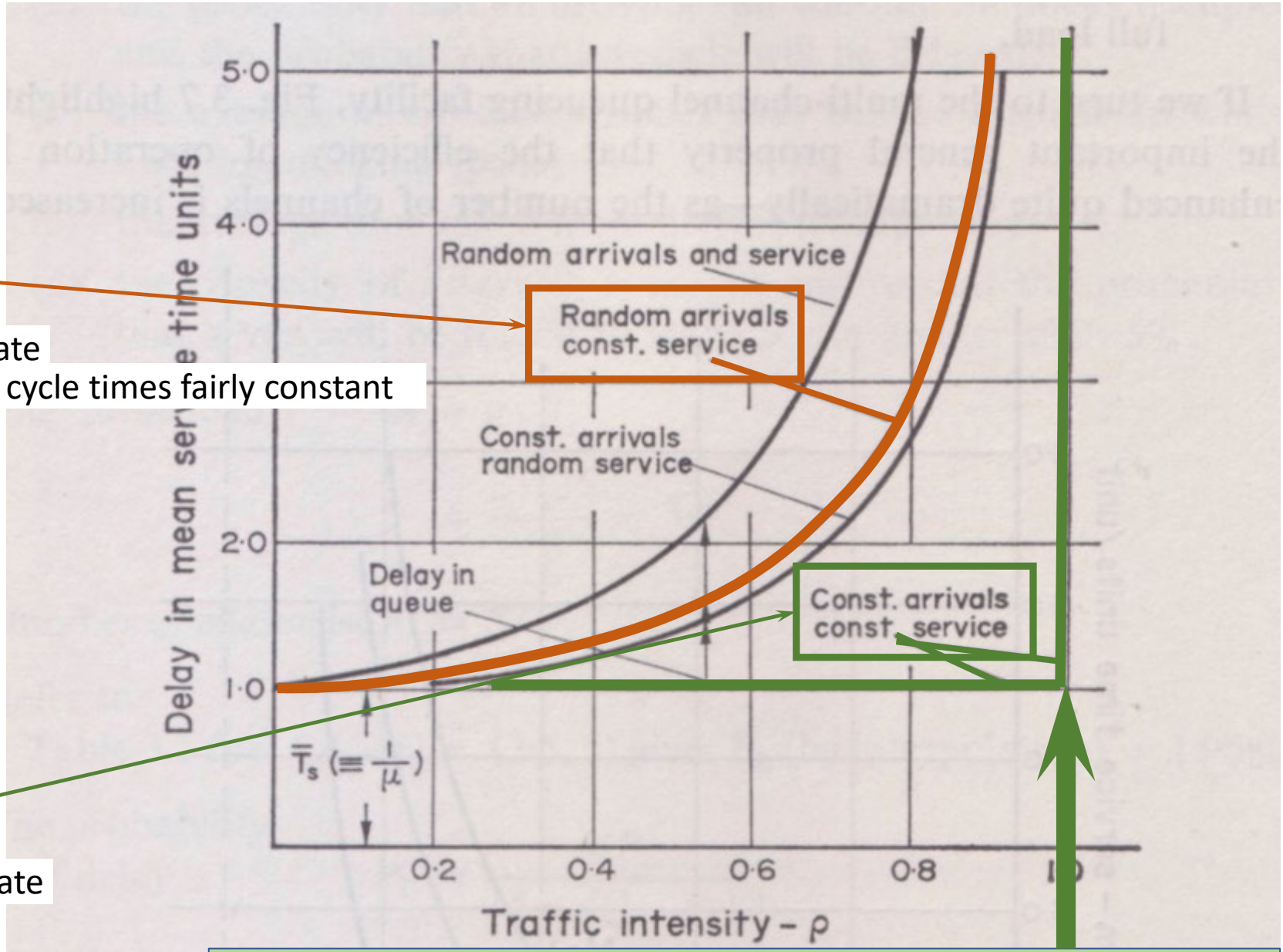
Constant service rate

Green-Yellow-Red cycle times fairly constant



Constant arrival rate

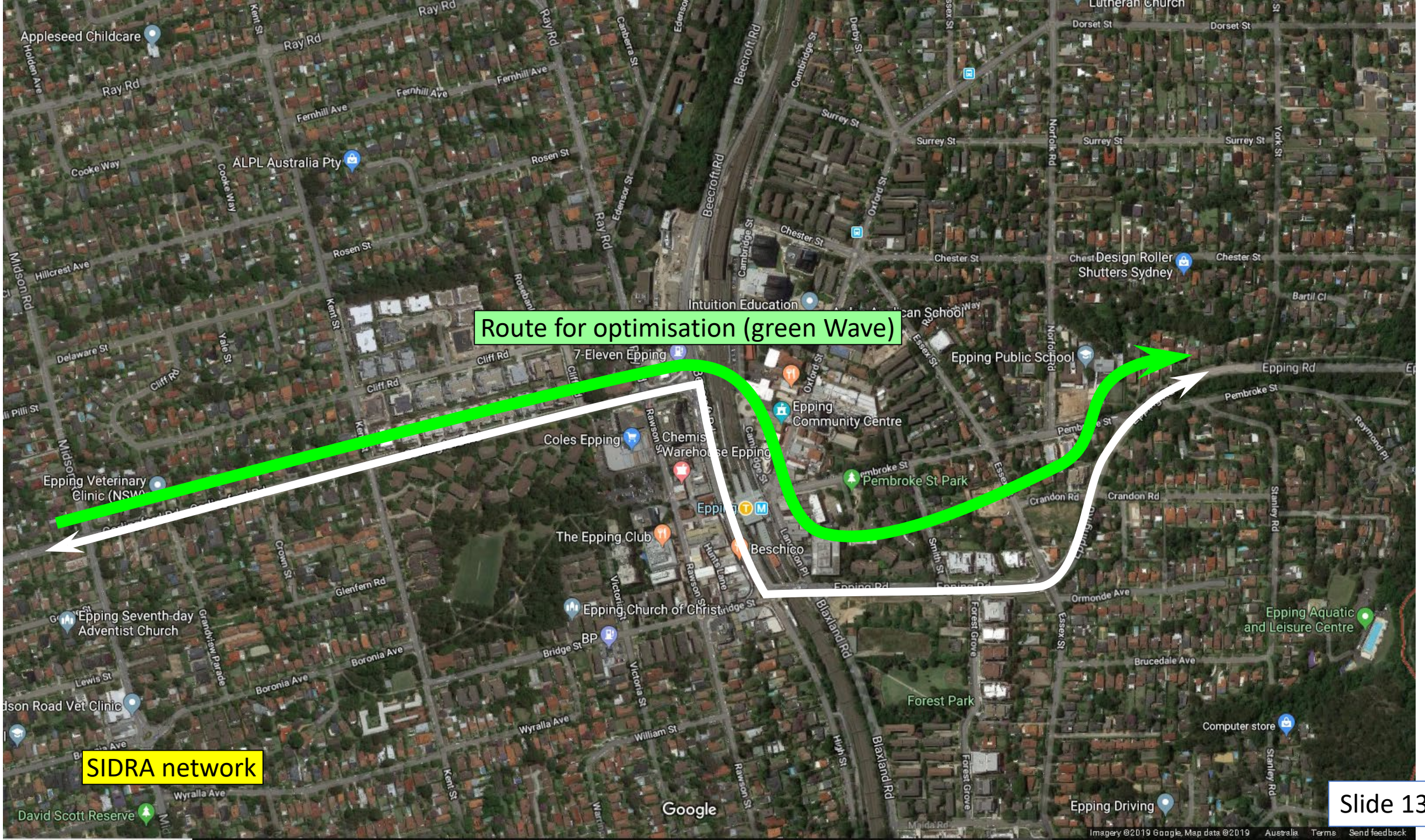
Constant service rate

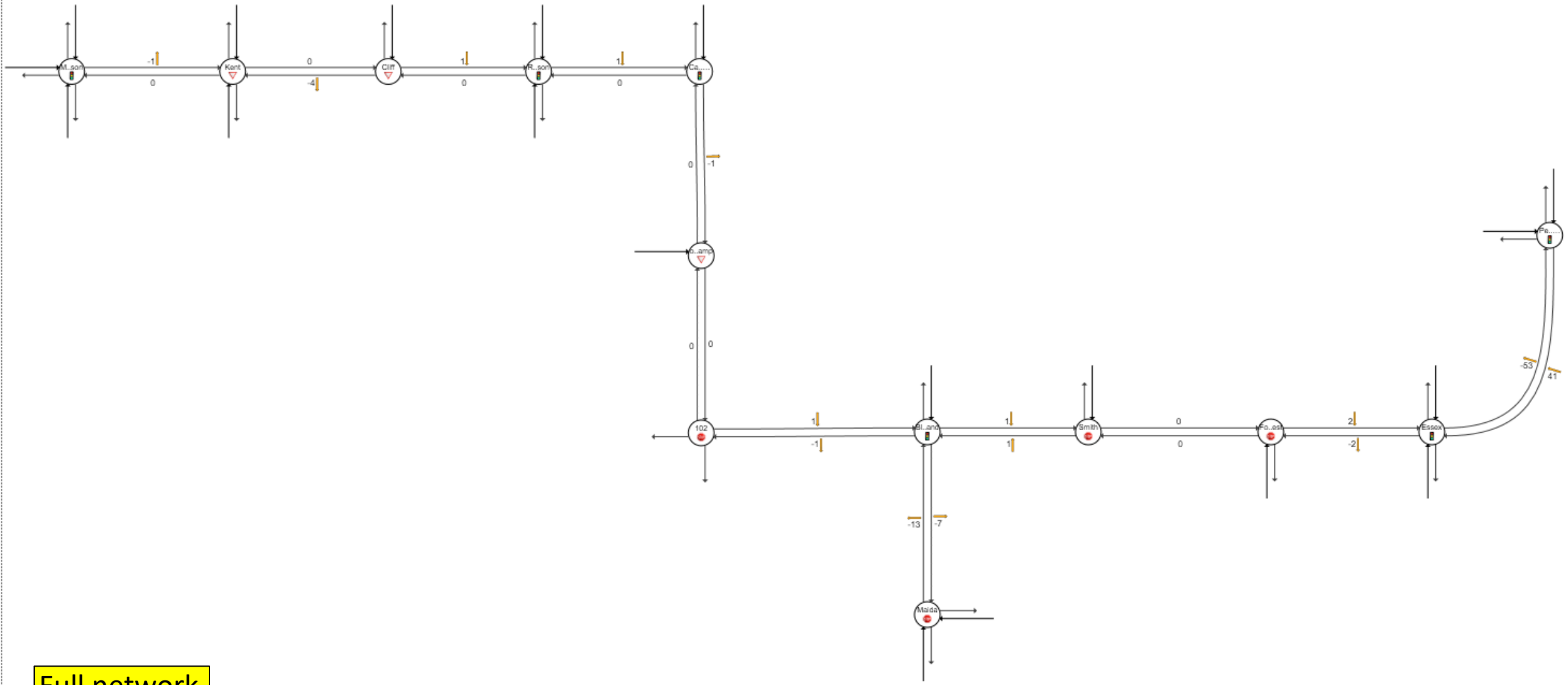


"Brick wall" curve – no warning before **network** capacity is reached

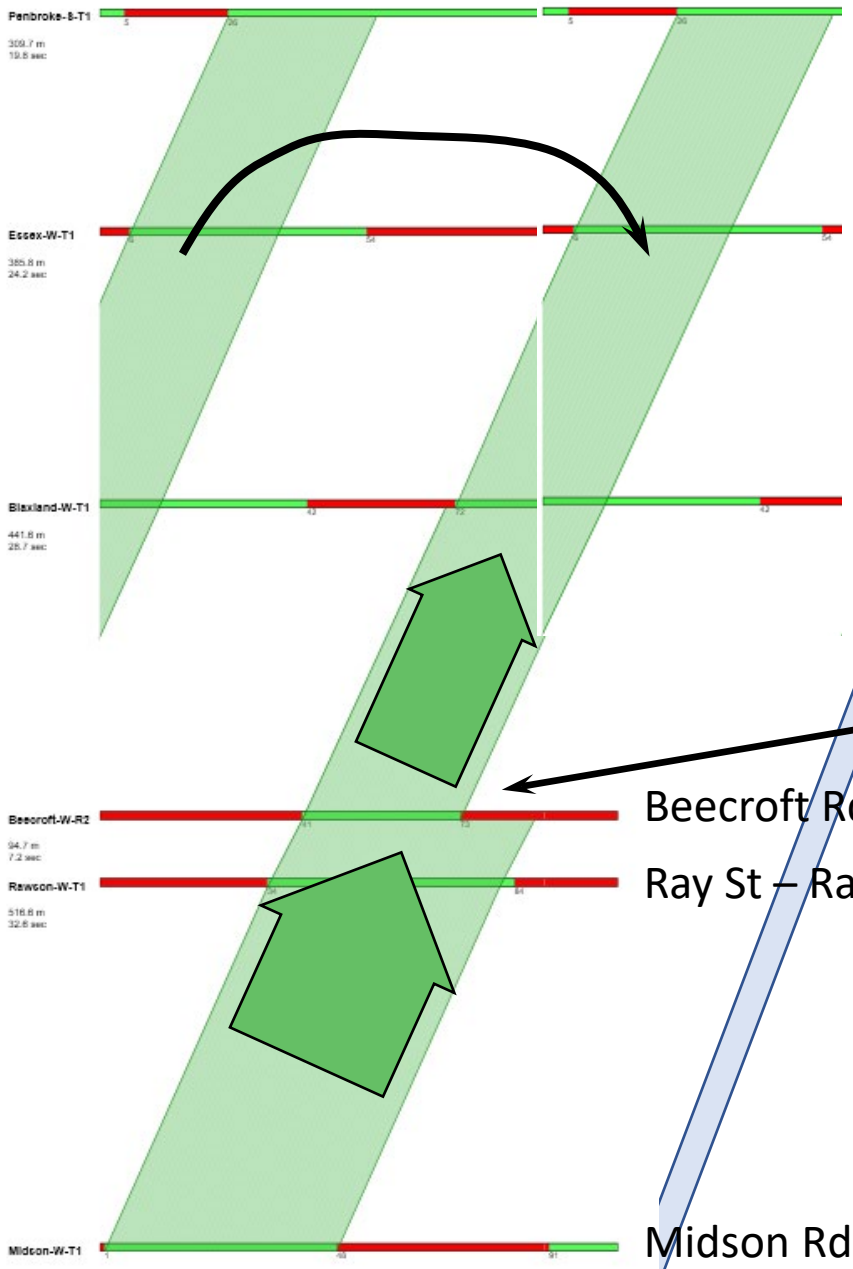
FIG. 3.6. Delay flow characteristics of single-channel traffic element for certain limiting arrival and service distributions.

SIDRA modelling – with high volumes


Route for optimisation (green Wave)
SIDRA network
Appleseed Childcare
ALPL Australia Pty
Intuition Education
Design Roller Shutters Sydney
7-Eleven Epping
Epping Public School
Epping Community Centre
Coles Epping
Pembroke St Park
Epping Veterinary Clinic (NSW)
The Epping Club
Beschico
Epping Church of Christ
Epping Seventh-day Adventist Church
BP
Epping Aquatic and Leisure Centre
Forest Park
Computer store
Epping Driving
David Scott Reserve
Google
Slide 13



Full network



Pembroke St

Essex St

Epping Rd – Blaxland Rd

Beecroft Rd – Carlingford Rd

Ray St – Rawson St

Midson Rd

AM Green wave optimisation

Optimise “routes” through the network

This is for the West – to East – can have others

Pinch Point

MOVEMENT SUMMARY

Site: ID + Description of intersection

Network: Description

Details of signalised intersection

Intersection details

Capacity

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:														
1	L2	211	0.0	211	0.0	1.354	391.4	LOS F	98.3	688.2	1.00	2.01	2.75	6.5
2	T1	416	0.0	416	0.0	1.354	385.9	LOS F	98.3	688.2	1.00	1.95	2.76	6.5
3	R2	399	0.0	399	0.0	1.354	391.6	LOS F	96.6	676.0	1.00	1.78	2.76	2.7
Approach		1025	0.0	1025	0.0	1.354	389.3	LOS F	98.3	688.2	1.00	1.90	2.76	5.1
East:														
4	L2	33	0.0	16	0.0	1.326	368.2	LOS F	91.8	642.9	1.00	2.10	2.67	6.4
5	T1	1974	0.0	947	0.0	1.326	363.0	LOS F	91.8	642.9	1.00	2.08	2.68	7.9
6	R2	179	0.0	86	0.0					37.2	0.89	0.77	0.89	28.8
Approach		2185	0.0	1048 N1	0.0					642.9	0.99	1.97	2.53	8.4
North:														
7	L2	121	0.0	121	0.0					179.6	1.00	1.27	1.73	10.7
8	T1	262	0.0	262	0.0					180.6	1.00	1.27	1.73	15.3
9	R2	93	0.0	93	0.0					180.6	1.00	1.27	1.73	17.9
Approach			0.0		0.0					180.6	1.00	1.27	1.73	14.8
West:														
10	L2		0.0		0.0					1139.8	1.00	2.20	2.70	8.1
11	T1										1.00	2.23	2.71	4.4
12	R2										0.85	0.81	0.85	29.7
Approach											0.98	2.01	2.42	5.7
All Vehicles		5505	0.0	4368 N1										

Demand

through

80% can ge ion

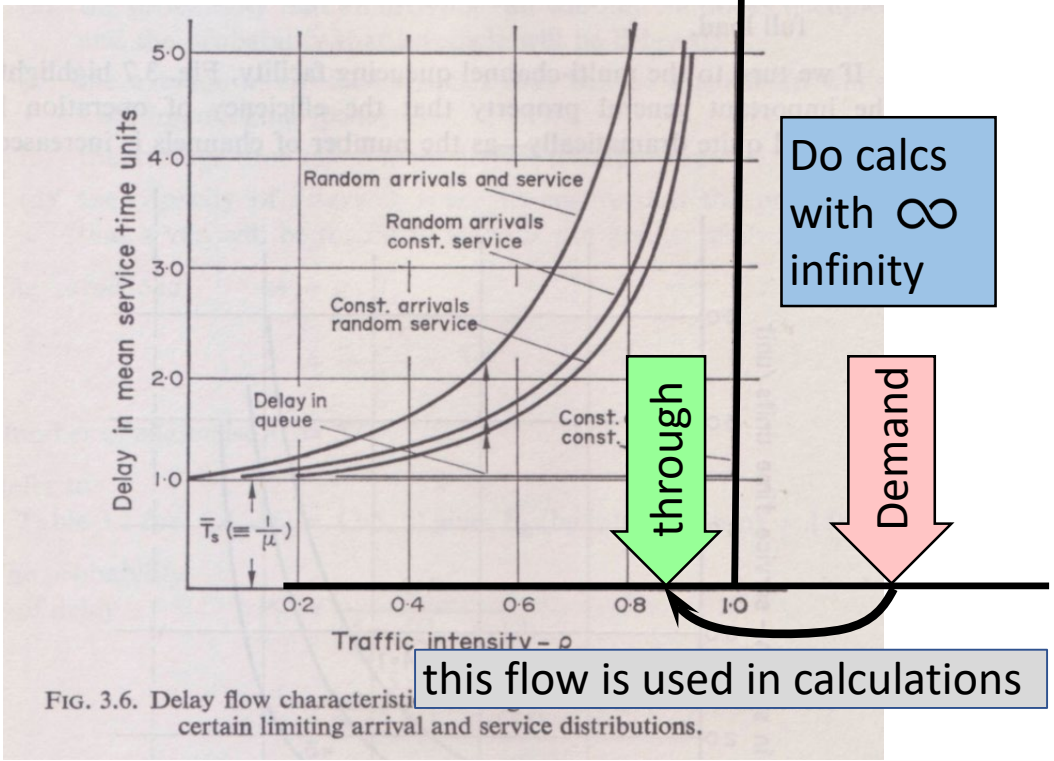


FIG. 3.6. Delay flow characteristi
certain limiting arrival and service distributions.

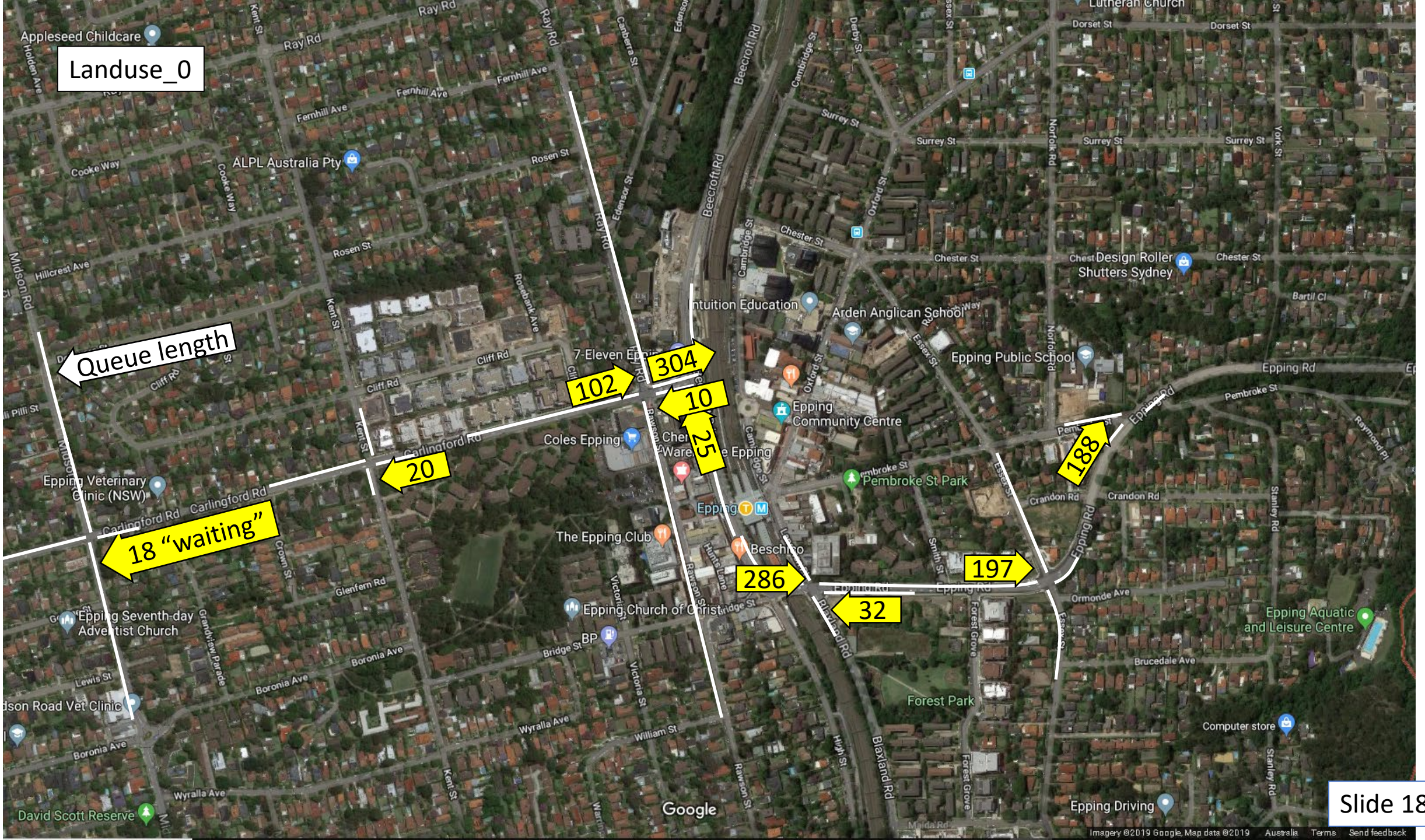
Do calcs with ∞ infinity

this flow is used in calculations

Highlighted in Yellow – warning – NOT ALL vehicles travel through intersection

Look at those “yellow” numbers

Calc the difference = vehicles “waiting”


Landuse_0
Queue length
304
102
10
25
20
18 "waiting"
286
197
32
188
Appleseed Childcare
ALPL Australia Pty
Coles Epping
Epping Veterinary Clinic (NSW)
Epping Community Centre
Pembroke St Park
Epping Public School
Arden Anglican School
Intuition Education
Design Roller Shutters Sydney
The Epping Club
Epping Church of Christ
Epping Seventh-day Adventist Church
Epping Aquatic and Leisure Centre
Forest Park
Computer store
Epping Driving
David Scott Reserve
Google
Slide 18

	A	B	C	D	E	F	G	H	I
1				AM				PM	
2			Landuse_0	Landuse_1	Landuse_2		Landuse_0	Landuse_1	Landuse_2
3		Av car length							
4									
5	Demand flows (Total for all Sites		24,770	25,497	25,677		21,321	22,036	22,135
6	Arrival Flows (Total for all Sites		23,471	23,856	23,939		21,077	21,659	21,753
7	Waiting		1,299	1,641	1,738		244	377	382
8	Equiv queue length km	6.75	8.8	11.1	11.7		1.6	2.5	2.6
9									
10									
11	Demand Flows (Entry Total)		7,864	8,206	8,273		6,960	7,282	7,332
12									
13	sec		38,772	5,266	5,746		529	1,172	1,187
14	Max wait time								
15	sec		12	46	46		49	32	47
16	min		46	27	35		8	19	19
17	hours		10	1	1		0	0	0
18									
19	Check		38,772	5,266	5,746		529	1,172	1,187
20									
21									
22	Degree of saturation		5.277	6.821	7.354		1	2.21	2.280
23									
24	Travel Speed (Average)		16.7	11.5	12.3		28.3	24.2	23.7
25	Effective Stop rate		0.73	0.85	0.78		0.66	0.68	0.68

Calc: Demand - Arrival

Dynameq – mesoscopic modelling software

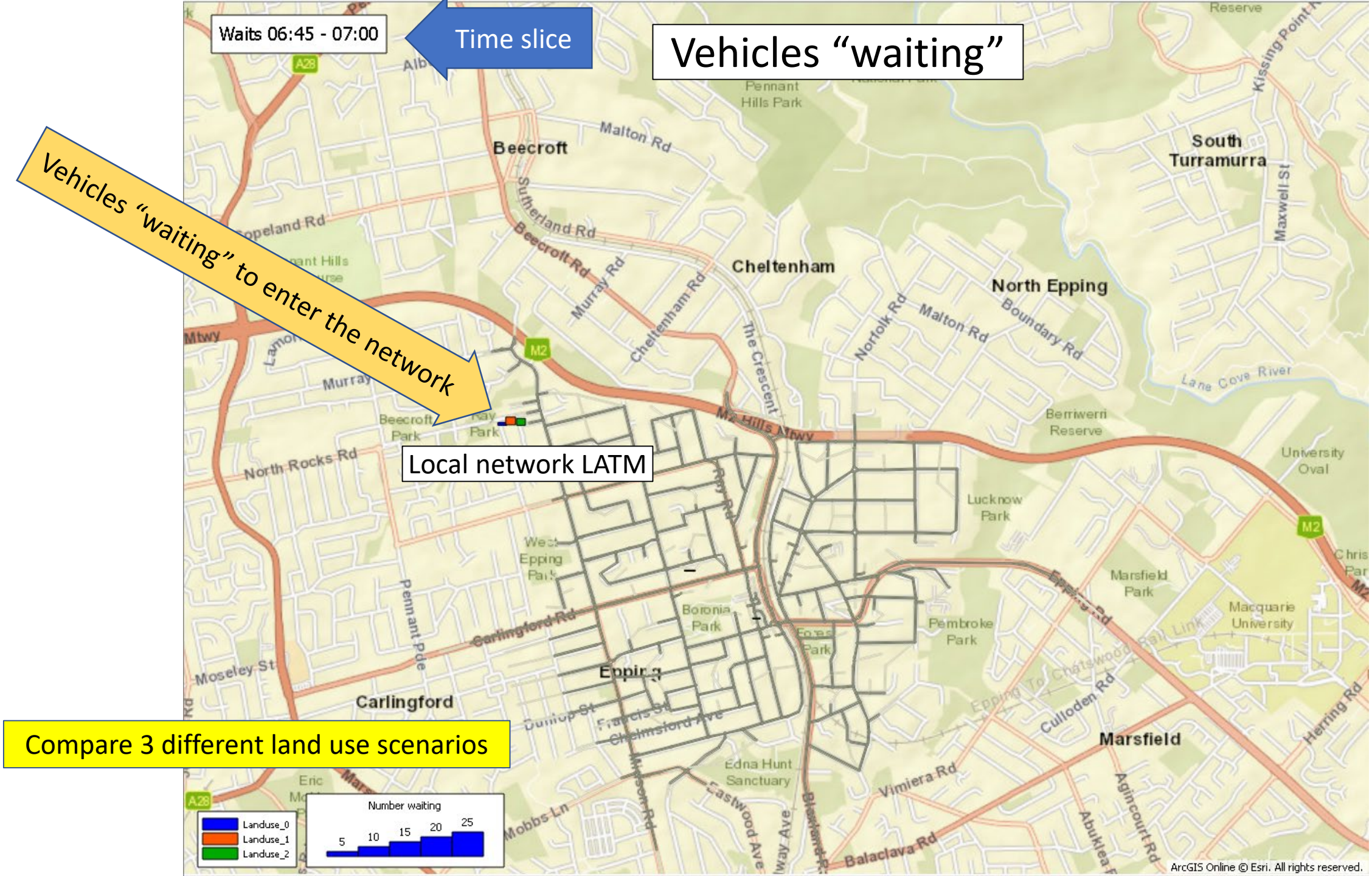
Consider whole network

Time-slice the demand to better reflect reality

- 15-minute slices
- each slice has its unique origin-destination pattern

Time slicing based on land use:

- Blue Collar trips to industrial areas – starts very early 07:00 am
- Schools – typically 15-20 minutes before school start time
- Early workers in retail – general white collar employment
- Through-trippers that arrive “on-time – at another destination” – ½ hour away


Waits 06:45 - 07:00
Time slice
Vehicles “waiting”
Vehicles “waiting” to enter the network
Local network LATM
Compare 3 different land use scenarios
Number waiting
5
10
15
20
25
Landuse_0
Landuse_1
Landuse_2
Beecroft
Cheltenham
North Epping
South Turramurra
Carlingford
Eppin g
Marsfield
Pennant Hills Park
Malton Rd
Beecroft Rd
Sutherland Rd
Murray Rd
Cheltenham Rd
The Crescent
Norfolk Rd
Boundary Rd
Maxwell St
Lane Cove River
Berriwerri Reserve
University Oval
Lucknow Park
Marsfield Park
Macquarie University
Pembroke Park
Boronia Park
West Epping Park
Beecroft Park
North Rocks Rd
Pennant Pde
Carlingford Rd
Moseley St
Dunlop St
Chelmsford Ave
Edna Hunt Sanctuary
Eastwood Ave
Vimiera Rd
Culloden Rd
Balaclava Rd
Herring Rd
Mobbs Ln
M2
M2 Hills Mtwy
Mtwy
A28
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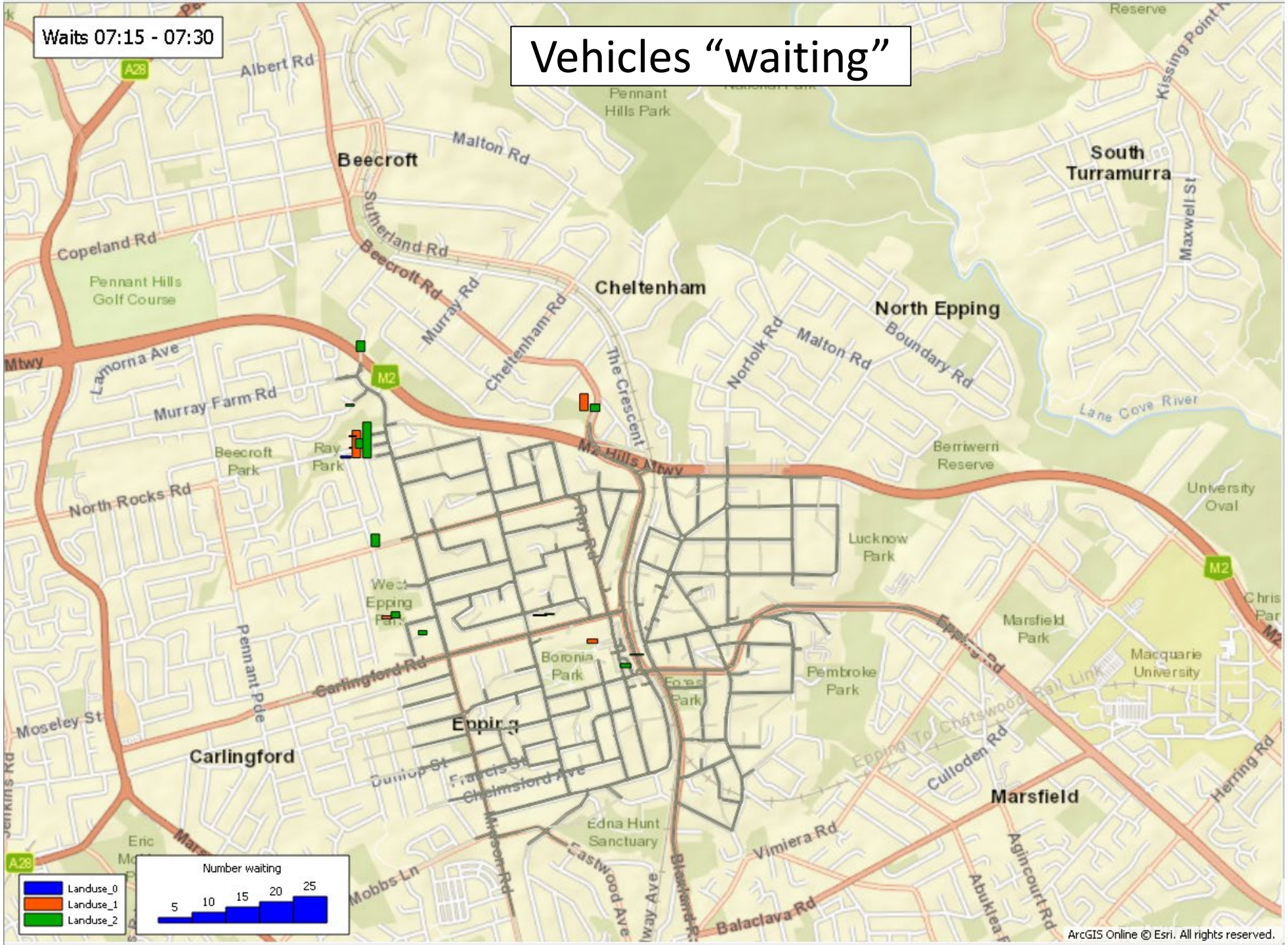
Waits 07:15 - 07:30
Vehicles “waiting”
Beecroft
Cheltenham
North Epping
South Turramurra
Carlingford
Eppin g
Marsfield
Pennant Hills Golf Course
Beecroft Park
Ray Park
West Epping Park
Boronia Park
Forest Park
Pembroke Park
Marsfield Park
Macquarie University
Lucknow Park
Berriwerri Reserve
University Oval
Edna Hunt Sanctuary
Eric
Albert Rd
Malton Rd
Sutherland Rd
Beecroft Rd
Murray Rd
Cheltenham Rd
The Crescent
Norfolk Rd
Boundary Rd
Copeland Rd
Lamorna Ave
Murray Farm Rd
North Rocks Rd
Pennant Pde
Carlingford Rd
Moseley St
Dunlop St
Francis St
Chelmsford Ave
Midson Rd
Eastwood Ave
Blaxland Rd
Mobbs Ln
Vimiera Rd
Culloden Rd
Balaclava Rd
Agincourt Rd
Herring Rd
Maxwell St
Kissing Point
Lane Cove River
Epping To Chatswood Rail Link
Mtwy
M2
M2 Hills Mtwy
A28
Number waiting
5
10
15
20
25
Landuse_0
Landuse_1
Landuse_2
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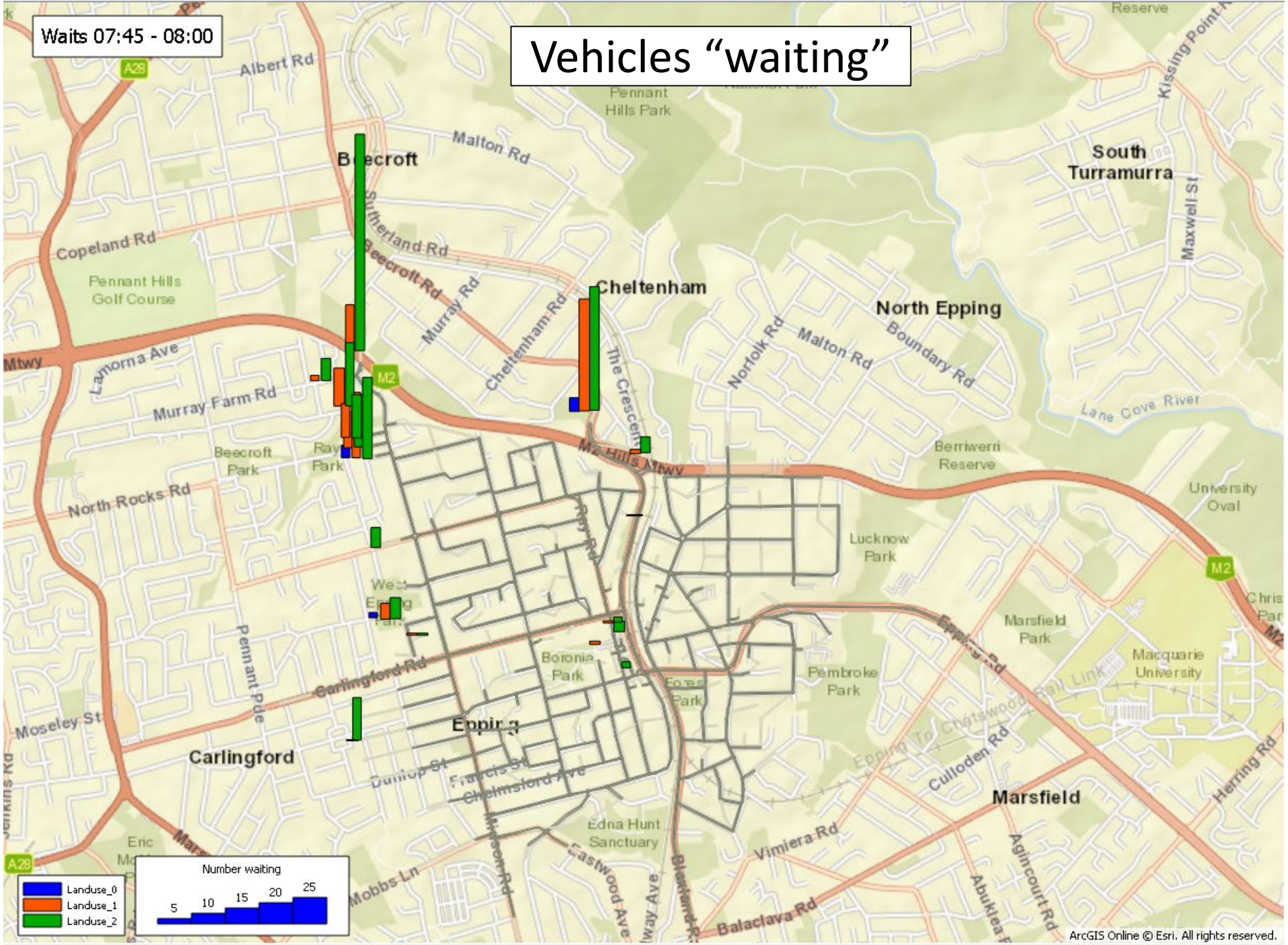
Waits 07:45 - 08:00
Vehicles “waiting”
Beecroft
Cheltenham
North Epping
South Turramurra
Carlingford
Eppin g
Marsfield
Pennant Hills Golf Course
Beecroft Park
Ray Park
West Epping Park
Boronia Park
Forest Park
Pembroke Park
Lucknow Park
Marsfield Park
Berriwerri Reserve
University Oval
Macquarie University
Edna Hunt Sanctuary
Lane Cove River
Albert Rd
Malton Rd
Copeland Rd
Lamorna Ave
Murray Farm Rd
North Rocks Rd
Beecroft Rd
Sutherland Rd
Murray Rd
Cheltenham Rd
The Crescent
Norfolk Rd
Boundary Rd
Maxwell St
Kissing Point Rd
Pennant Hills Park
Mtwy
M2
M2 Hills Mtwy
Carlingford Rd
Pennant Pde
Moseley St
Dunlop St
Francis St
Chelmsford Ave
Midson Rd
Eastwood Ave
Blaxland Rd
Vimiera Rd
Culloden Rd
Agincourt Rd
Herring Rd
Mobbs Ln
Eric
A28
Number waiting
5
10
15
20
25
Landuse_0
Landuse_1
Landuse_2
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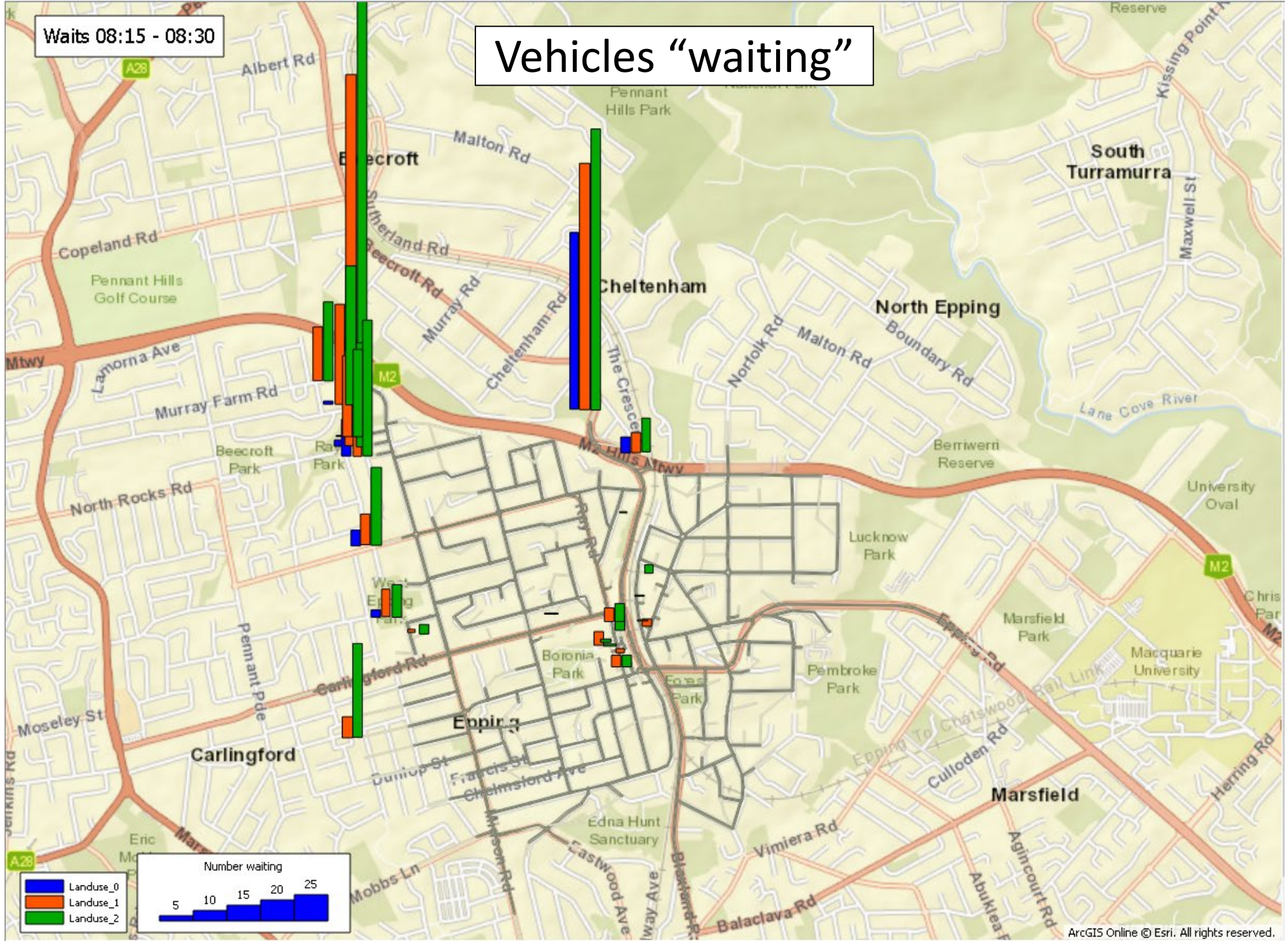
Waits 08:15 - 08:30
Vehicles “waiting”
Albert Rd
Malton Rd
Pennant Hills Park
Beecroft
Copeland Rd
Pennant Hills Golf Course
Sutherland Rd
Beecroft Rd
Murray Rd
Cheltenham Rd
Cheltenham
South Turramurra
Maxwell St
Kissing Point
Reserve
North Epping
Boundary Rd
Norfolk Rd
Malton Rd
Lane Cove River
Mtwy
Lamorna Ave
Murray Farm Rd
M2
M2 Hills Mtwy
Beecroft Park
North Rocks Rd
Berriwerri Reserve
University Oval
Lucknow Park
Marsfield Park
Macquarie University
Pembroke Park
Boronia Park
Pennant Pde
Carlingford Rd
Carlingford
Moseley St
Eppin
Dunlop St
Francis St
Chelmsford Ave
Edna Hunt Sanctuary
Eastwood Ave
Vimiera Rd
Culloden Rd
Marsfield
Herring Rd
Balaclava Rd
Mobbs Ln
Eric
A28
Number waiting
5
10
15
20
25
Landuse_0
Landuse_1
Landuse_2
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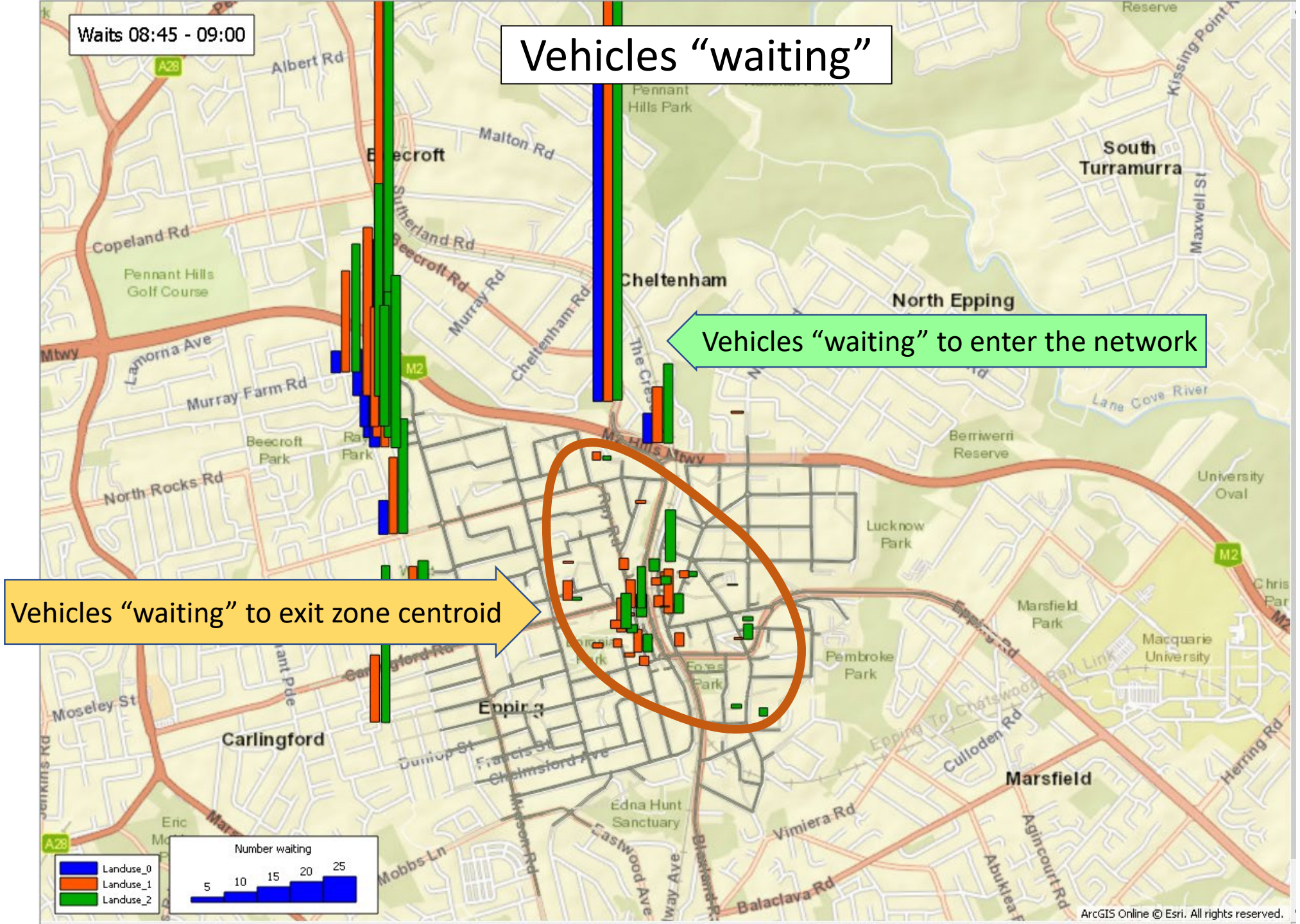
Waits 08:45 - 09:00
Vehicles “waiting”
Vehicles “waiting” to enter the network
Vehicles “waiting” to exit zone centroid
Number waiting
5
10
15
20
25
Landuse_0
Landuse_1
Landuse_2
Albert Rd
Malton Rd
Beecroft
Pennant Hills Park
South Turramurra
Maxwell St
Copeland Rd
Pennant Hills Golf Course
Sutherland Rd
Beecroft Rd
Murray Rd
Cheltenham Rd
Cheltenham
North Epping
Mtwy
Lamorna Ave
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Marsfield Park
Macquarie University
Pembroke Park
Carlingford
Moseley St
Dunlop St
Francis St
Chelmsford Ave
Edna Hunt Sanctuary
Eastwood Ave
Vimiera Rd
Culloden Rd
Marsfield
Herring Rd
Mobbs Ln
Balaclava Rd
Agincourt Rd
A28
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Do a 1-to-1 comparison

Use same SIDRA flows

Use ¼ of the demand flow for each 15-minute peak hour slice

	A	B	C	D	E	F
1		6:30:00	6:45:00	7:00:00	7:15:00	7:3
2	In_Count					
3	Epping_am_lu0	2834	2915	2861	2913	
4	Epping_am_lu1	2990	3030	2999	2997	
5	Epping_am_lu2	3016	3052	3010	2913	
6						
7						
8	Out_Count					
9	Epping_am_lu0	2050	2751	2789	2728	
10	Epping_am_lu1	1997	2845	2700	2698	
11	Epping_am_lu2	1966	2644	2605	2551	
12						
13	Waiting					
14	06:30-06:45		83			
15	06:45-07:00			209		
16	07:00-07:15				342	
17	07:15-07:30					622
18	07:30-07:45					787
19	07:45-08:00					
20	08:00-08:15					
21	08:30-08:45					
22	08:45-09:00					
23						

Same calculation as for SIDRA

	A	B	C	D	E	F	G	H	I
1				AM				PM	
2			Landuse_0	Landuse_1	Landuse_2		Landuse_0	Landuse_1	Landuse_2
3		Av car length							
4									
5	Demand flows (Total for all Sites		24,770	25,497	25,677		21,321	22,036	22,135
6	Arrival Flows (Total for all Sites		23,471	23,856	23,939		21,077	21,659	21,753
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8	Equiv queue length km	6.75	8.8	11.1	11.7		1.6	2.5	2.6
9									
10									
11	Demand Flows (Entry Total)		7,864	8,206	8,273		6,960	7,282	7,332
12									
13	sec		38,772	5,266	5,746		529	1,172	1,187
14	Max wait time								
15	sec		12	46	46		49	32	47
16	min		46	27	35		8	19	19
17	hours		10	1	1		0	0	0
18									
19	Check		38,772	5,266	5,746		529	1,172	1,187
20									
21									
22	Degree of saturation		5.277	6.821	7.354		1	2.21	2.280
23									
24	Travel Speed (Average)						.3	24.2	23.7
25	Effective Stop rate						66	0.68	0.68

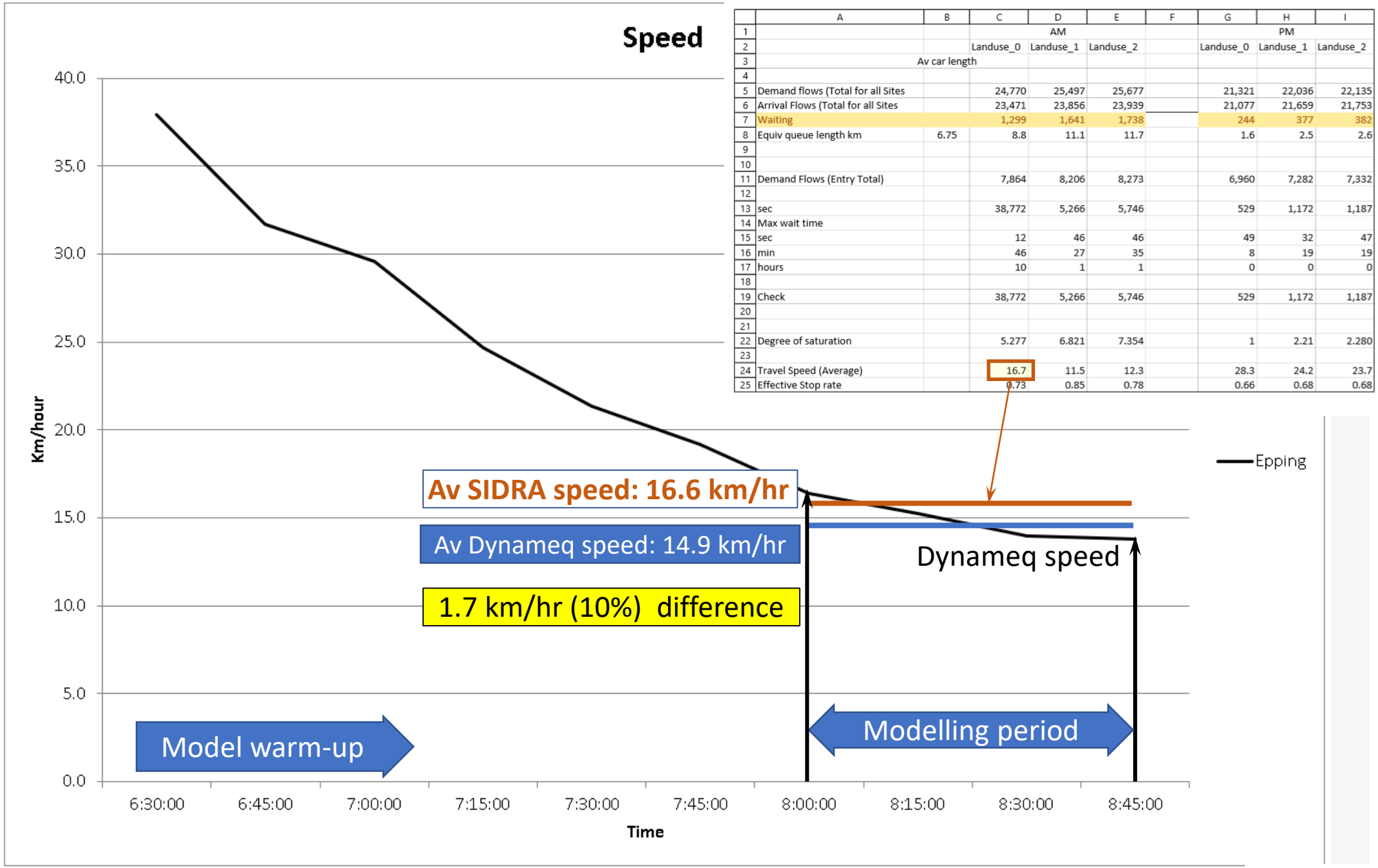
SIDRA - 1 hour average = 1,299

Dynameq - 1 hour average = 1,195

8% difference

1,046			
	1,166		
		1,249	
			1,318

Travel speed



	A	B	C	D	E	F	G	H	I
1				AM				PM	
2			Landuse_0	Landuse_1	Landuse_2		Landuse_0	Landuse_1	Landuse_2
3		Av car length							
4									
5	Demand flows (Total for all Sites		24,770	25,497	25,677		21,321	22,036	22,135
6	Arrival Flows (Total for all Sites		23,471	23,856	23,939		21,077	21,659	21,753
7	Waiting		1,299	1,641	1,738		244	377	382
8	Equiv queue length km	6.75	8.8	11.1	11.7		1.6	2.5	2.6
9									
10									
11	Demand Flows (Entry Total)		7,864	8,206	8,273		6,960	7,282	7,332
12									
13	sec		38,772	5,266	5,746		529	1,172	1,187
14	Max wait time								
15	sec		12	46	46		49	32	47
16	min		46	27	35		8	19	19
17	hours		10	1	1		0	0	0
18									
19	Check		38,772	5,266	5,746		529	1,172	1,187
20									
21									
22	Degree of saturation		5.277	6.821	7.354		1	2.21	2.280
23									
24	Travel Speed (Average)		16.7	11.5	12.3		28.3	24.2	23.7
25	Effective Stop rate		0.73	0.85	0.78		0.66	0.68	0.68

Colours | Documentation | Start Here | Demand | In_Count | Out_Count | Waiting | Travelling | Density | VHT | VHT-Total | VHT-Virtual | VHD | VHD-Total | VKT | Speed | Combined_ | Epping

Under high traffic volumes

Two different software packages

- developed for very different purposes
- yield very similar results for
  - vehicles that cannot enter the network
  - Overall network speed

Questions?