

A traffic simulation-based approach to model mass evacuation of Auckland City under an imminent threat of volcanic eruption

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Supervisors:

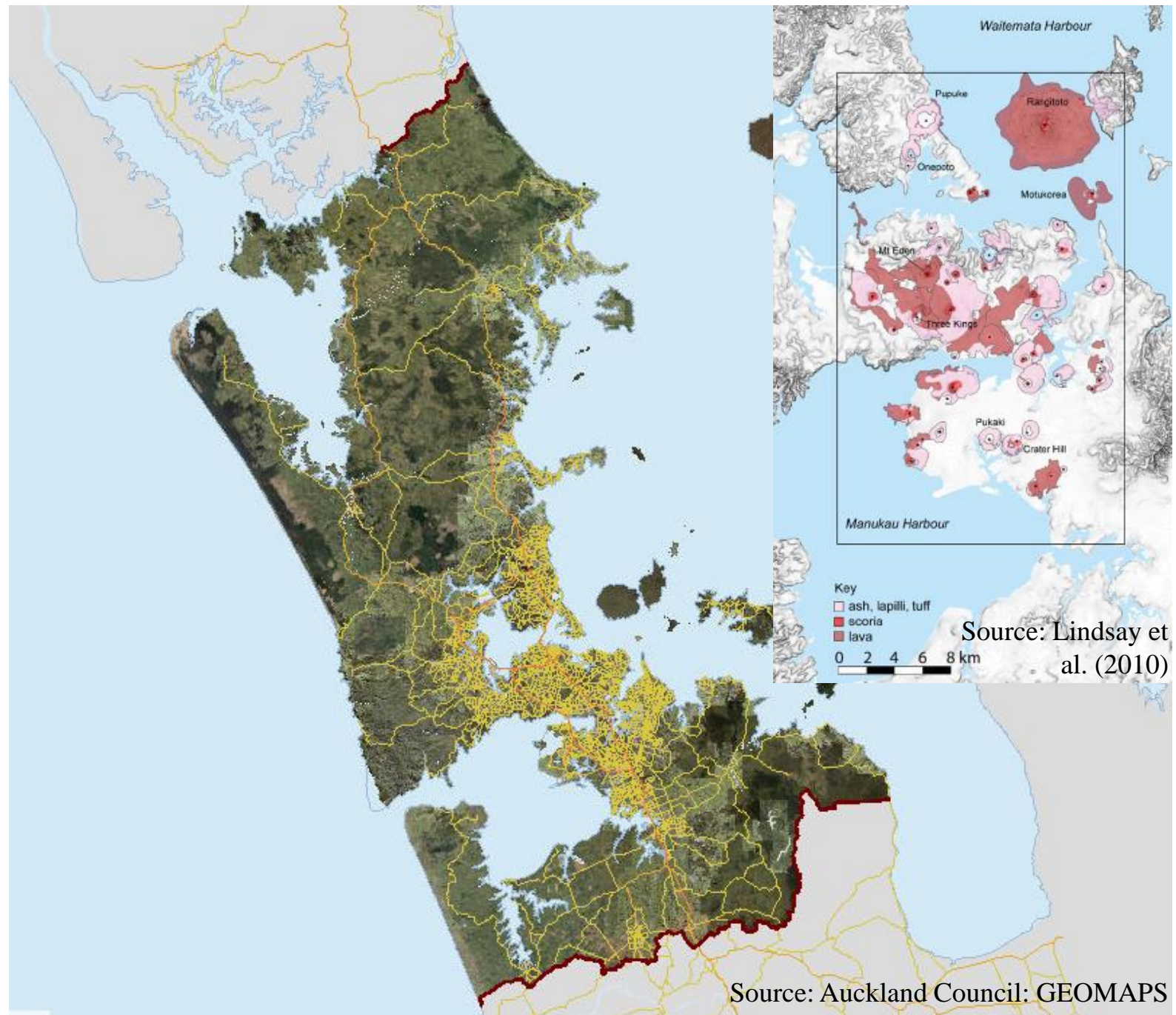
Dr. Prakash Ranjitkar & Assoc. Prof. Seosamh Costello

Background

The main aim of this research is to evaluate mass evacuation of Auckland under impending natural hazard (volcanic eruption) using traffic simulation.

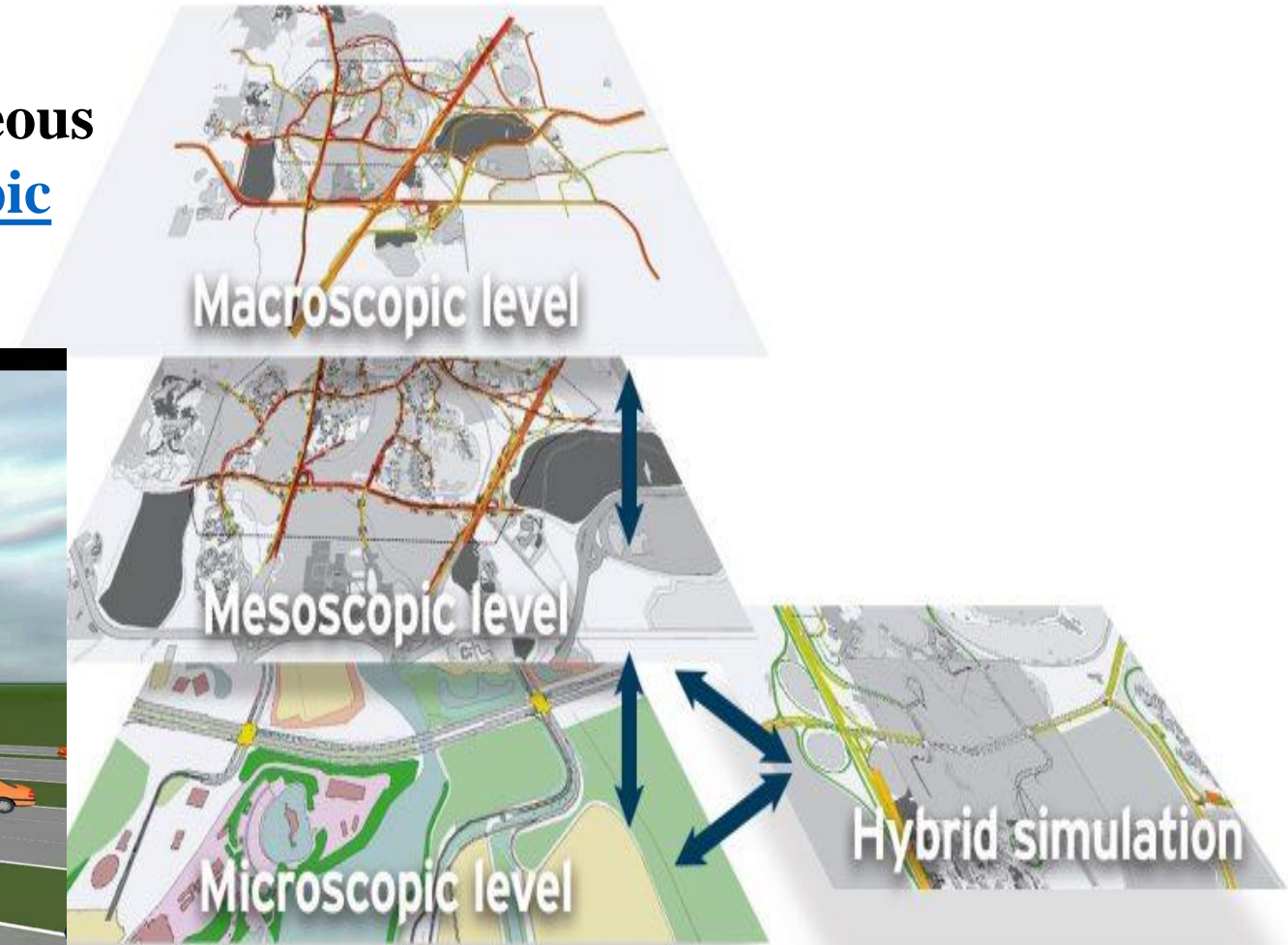
Auckland Characteristics:

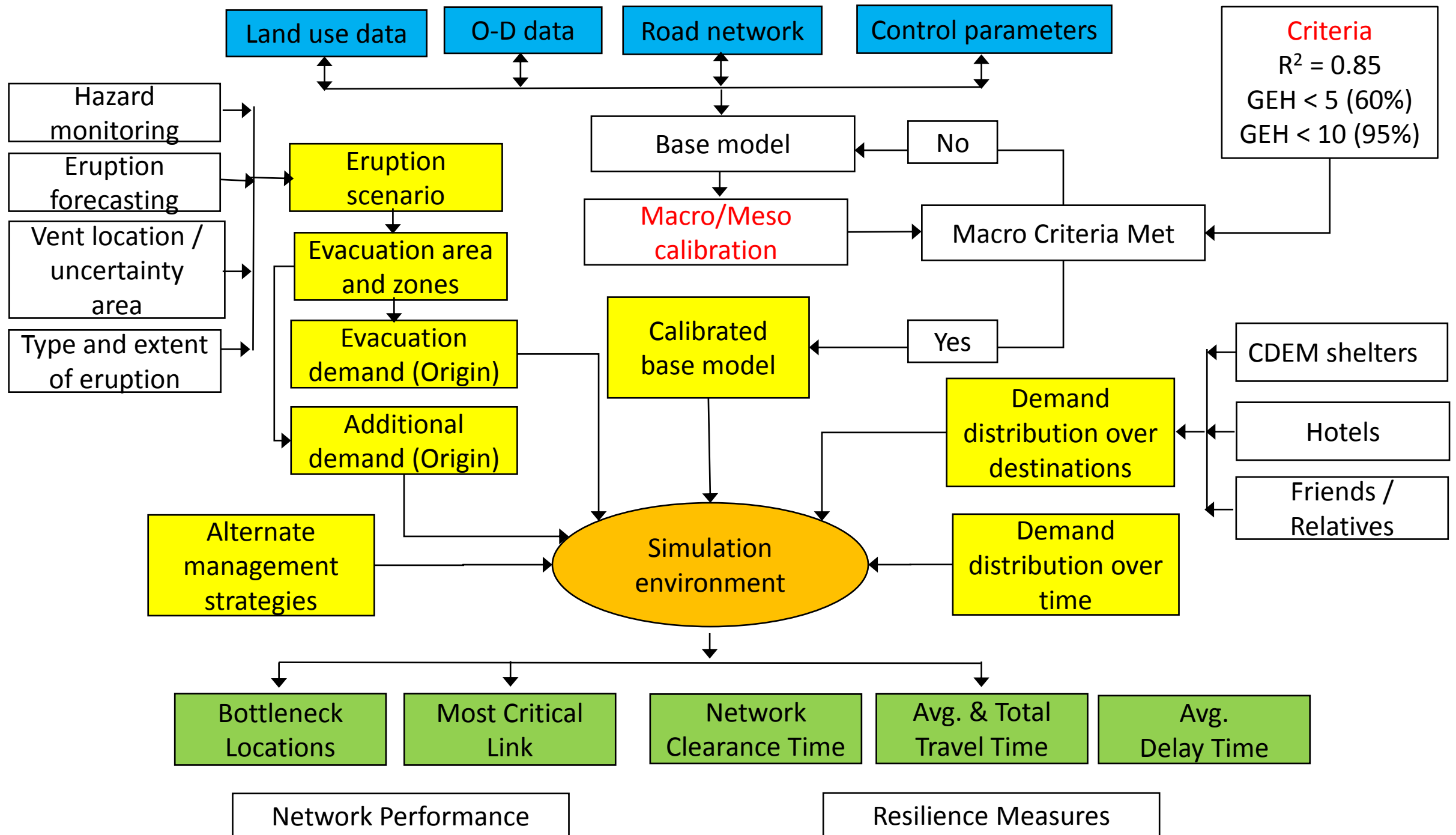
- ❑ Isthmus
- ❑ 4,894 Km² land area
- ❑ 411 unit areas
- ❑ 6,531 km sealed roads as of July, 2016



AIMSUN Traffic Simulation Model

The AIMSUN simulator gives simultaneous macroscopic, mesoscopic and microscopic (2D, 3D) simulation



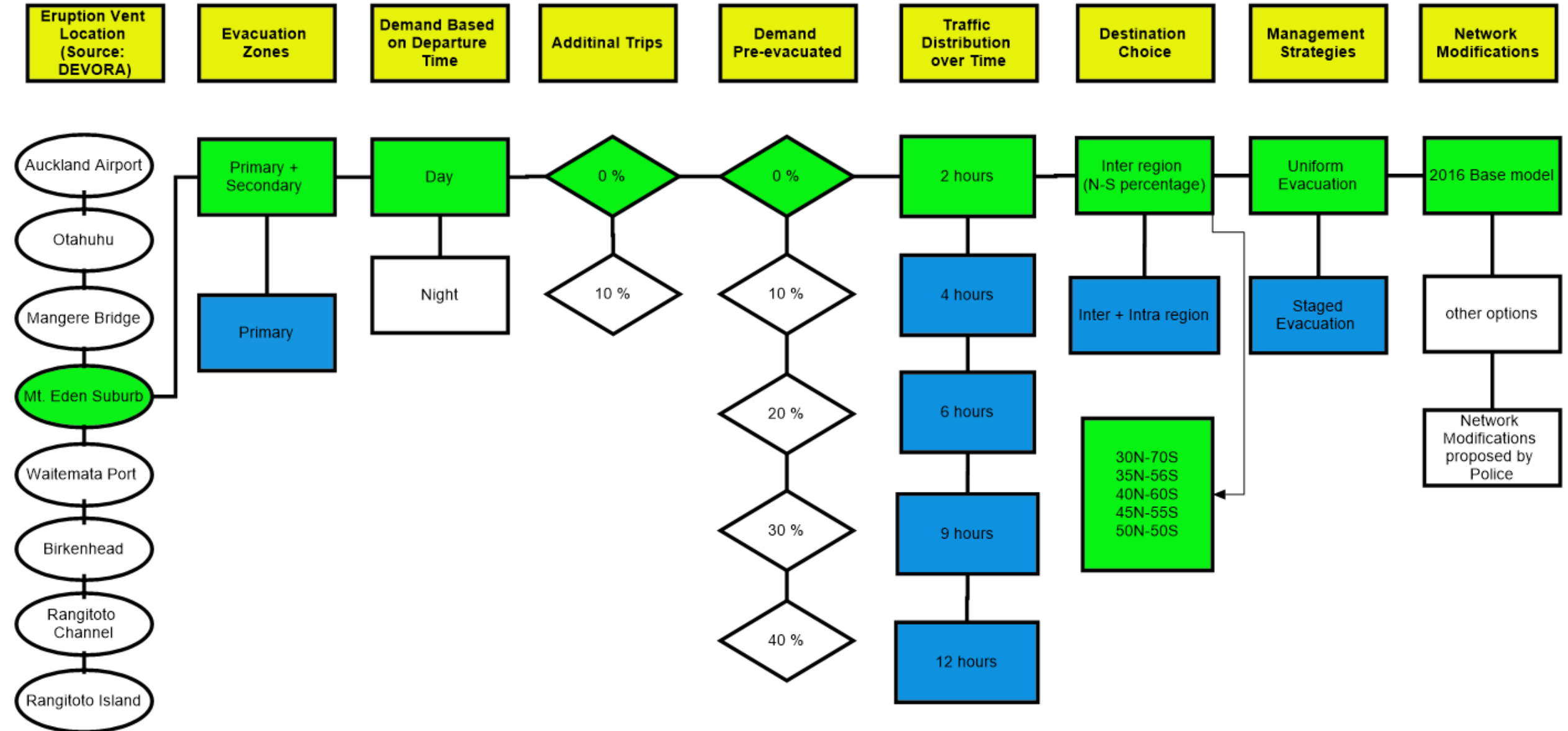


Base model calibration results

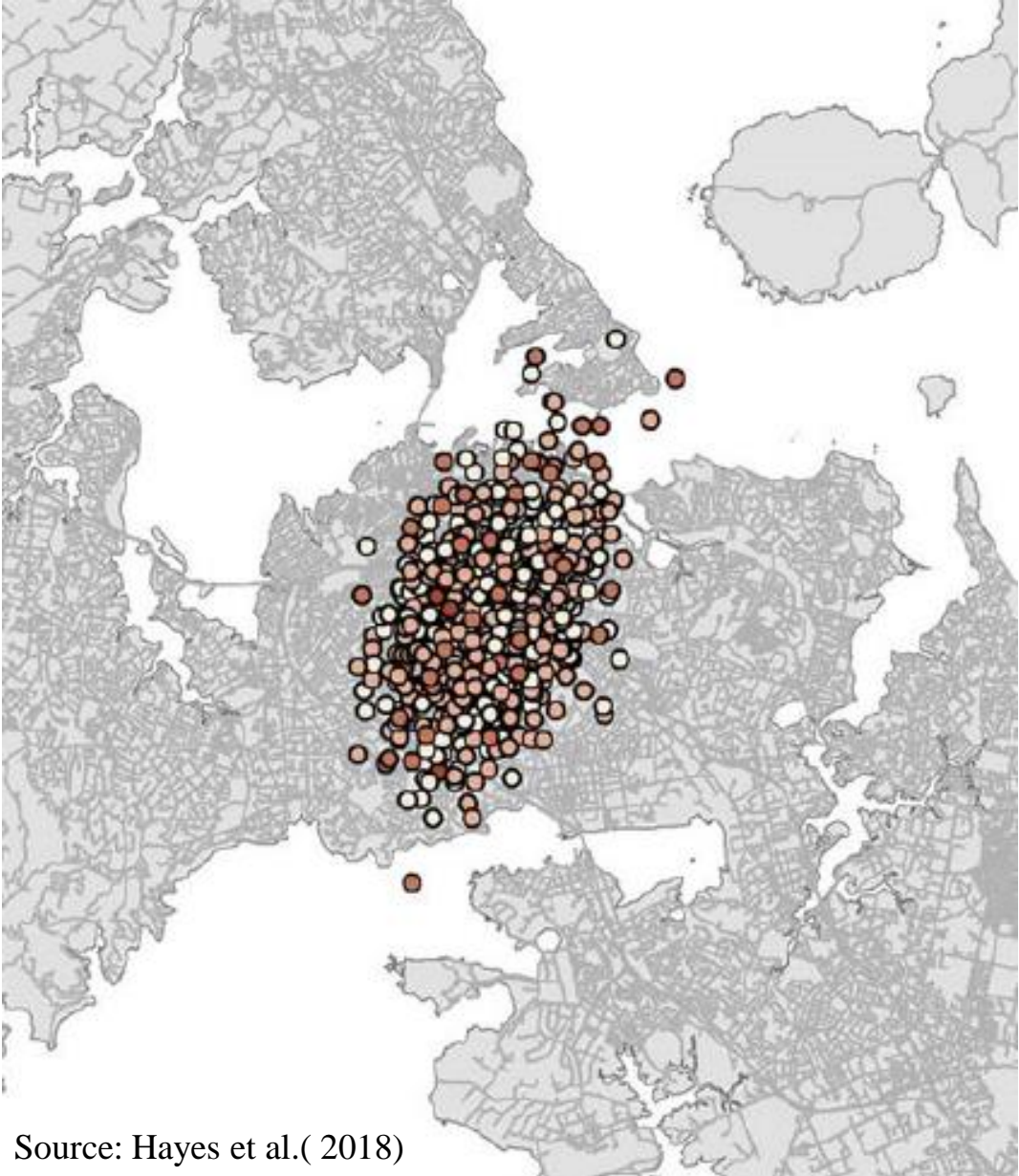
Road Types	Criteria for Regional Network		Simulation Results (Mesoscopic)	Criteria Satisfied
Major Link (Volume<15,000 veh/day)	Count	<±20%	<±20%	Satisfied
Major Links (Volume>15,000 veh/day)	Count	<±20%	<±20%	Satisfied
Motorways	R ² Value	>0.85	0.988	Satisfied
	GEH<5	>65%	80.65%	Satisfied
	GEH<10	>85%	100%	Satisfied
	GEH <12	100%	100%	Satisfied
Complete Network	R ² Value	>0.85	0.949	Satisfied
	GEH<5	>65%	65.37	Satisfied
	GEH<10	>85%	88.52	Satisfied
	GEH <12	100%	100%	Satisfied

(Criteria: NZTA, 2014)

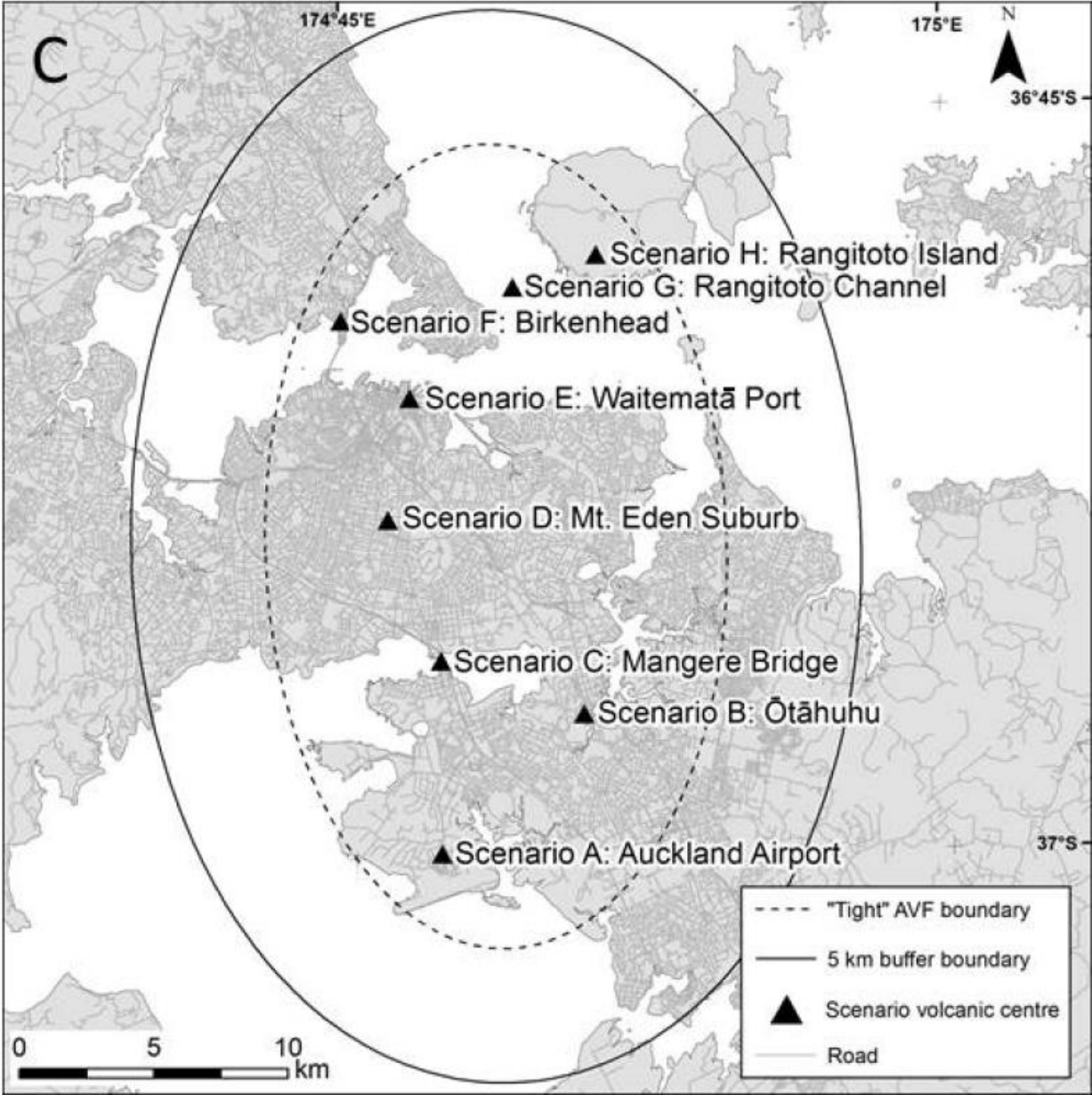
Evacuation Scenario



Mt. EDEN Scenario & Eruption Vent Locations

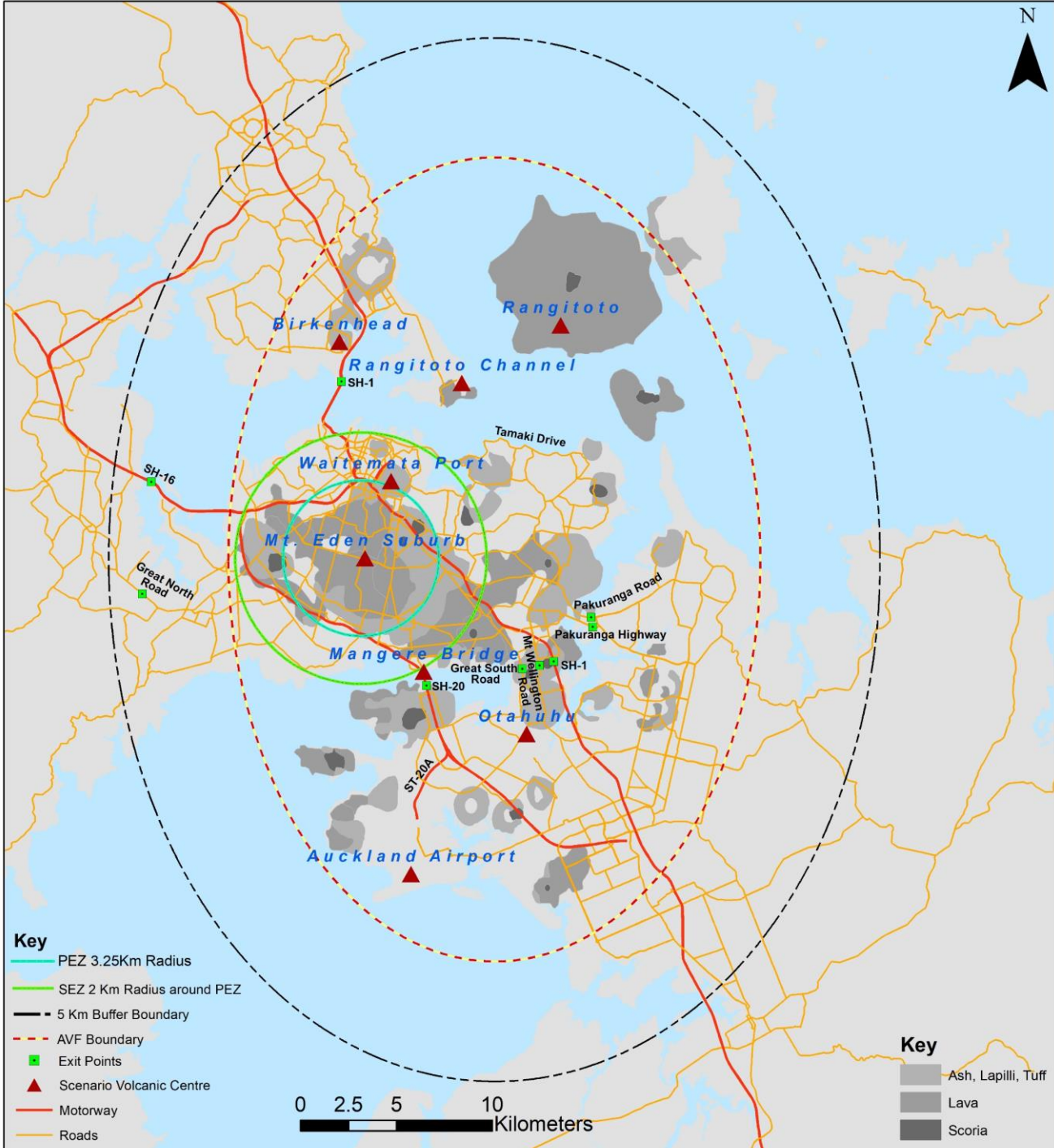


Source: Hayes et al.(2018)

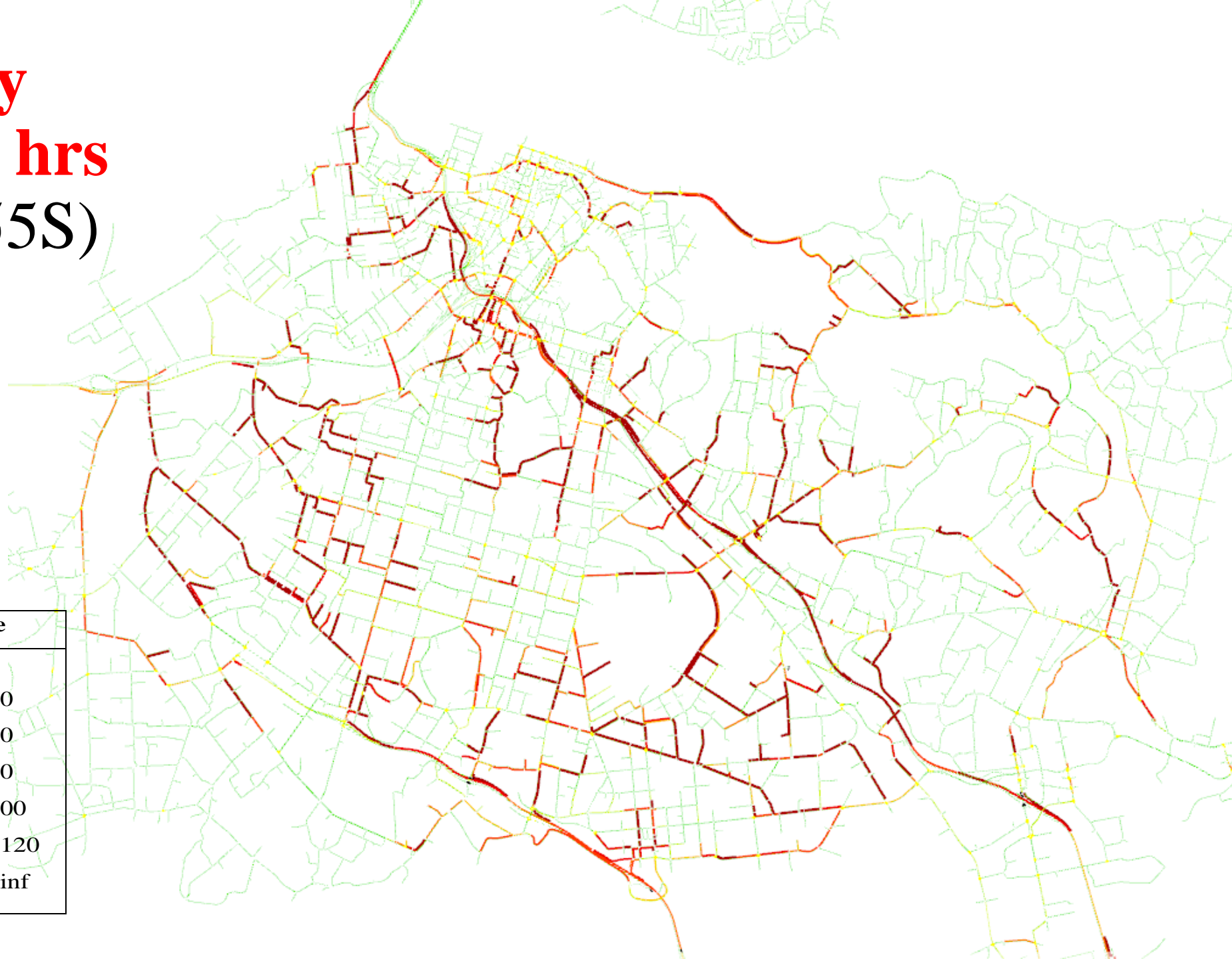


Mt. Eden Scenario Results

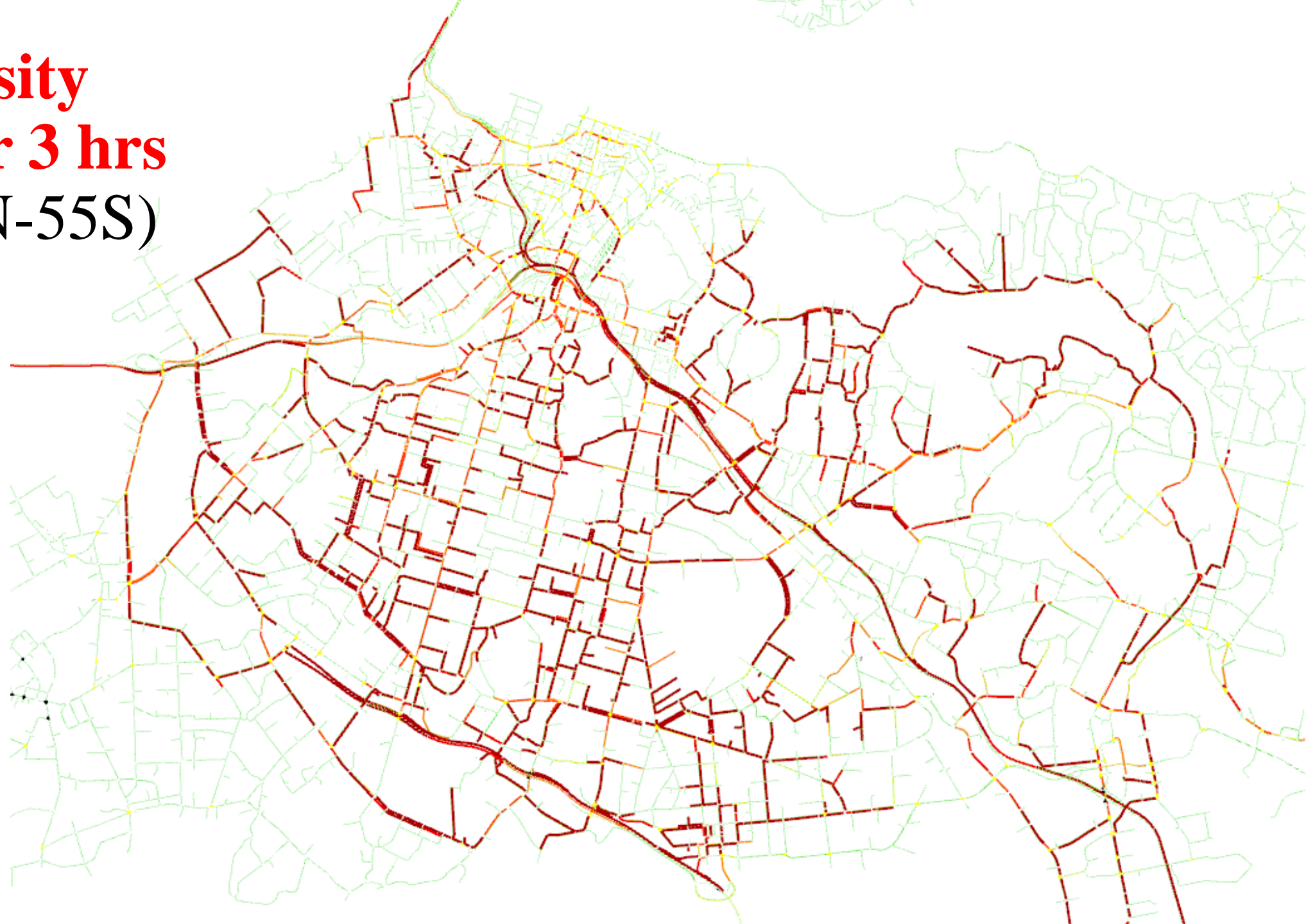
Sr #	Scenarios	Clearance Time (hrs)					Total Travel Time (Million hrs)	Avg. Travel Time (sec/km)	Speed (Km/hr)
		50% Evacuated	75% Evacuated	95% Evacuated	99% Evacuated	100% Evacuated			
1	30N-70S	5.75	11.50	18.50	19.50	20.75	1.51	552	13.34
2	35N-65S	5	10.25	16.25	19	20.25	1.47	510	13.49
3	40N-60S	5	9.75	14.75	17.25	19.25	1.48	489	13.58
4	45N-55S	4	8.50	14	15.25	16.25	1.44	450	14.51
5	50N-50S	5.50	10.50	16.15	20	23	1.65	491	13.58



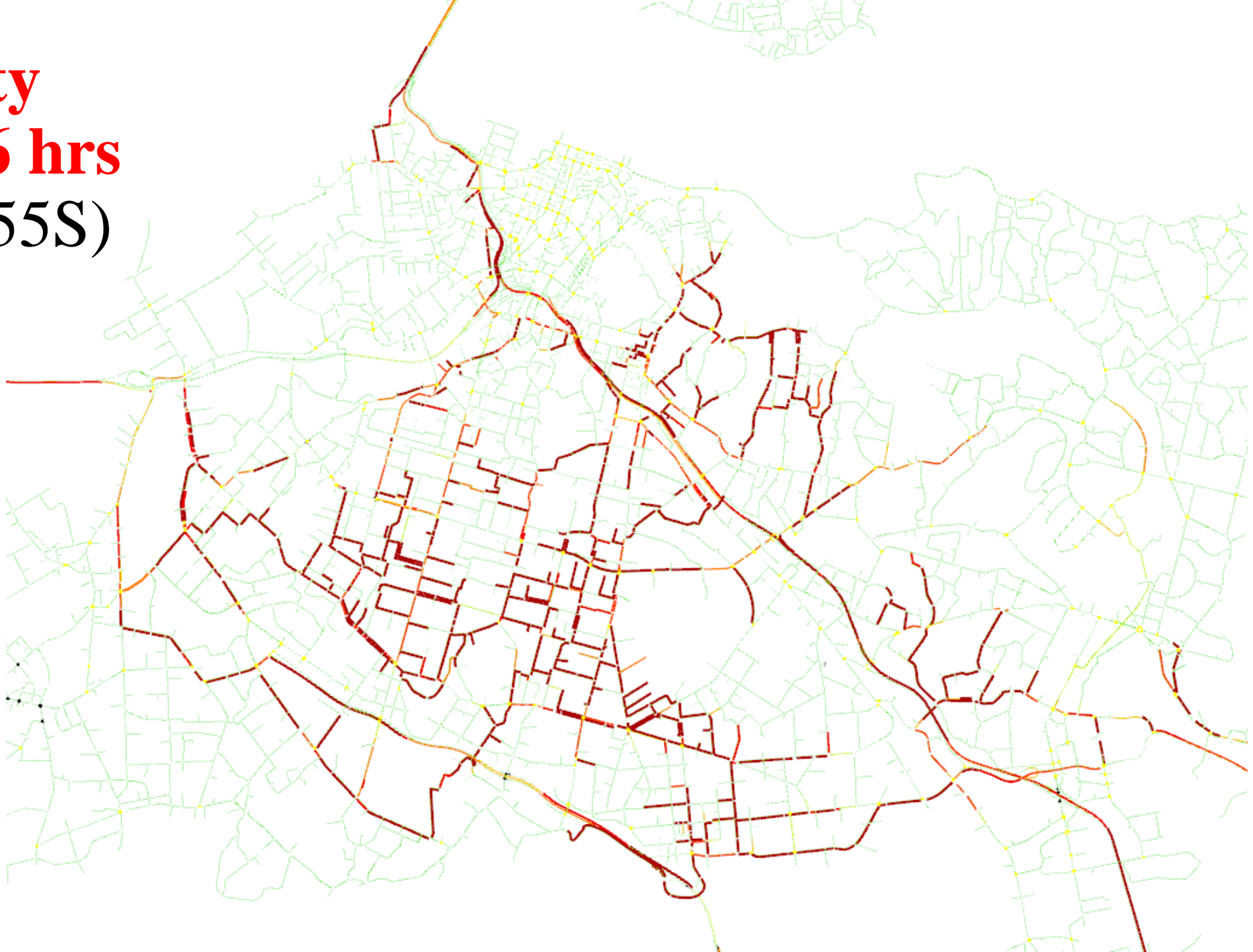
Density after 1 hrs (45N-55S)



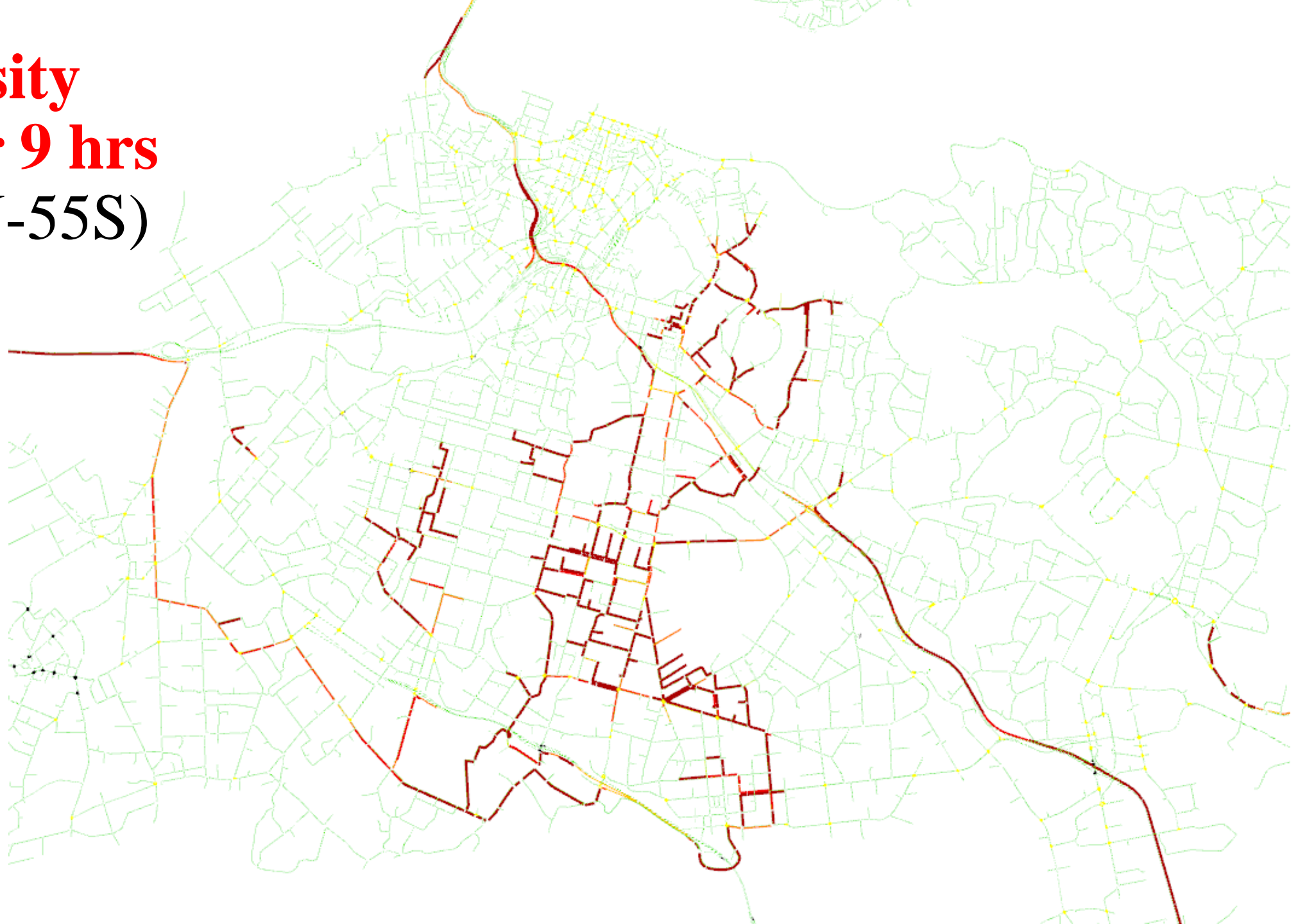
Density
after 3 hrs
(45N-55S)



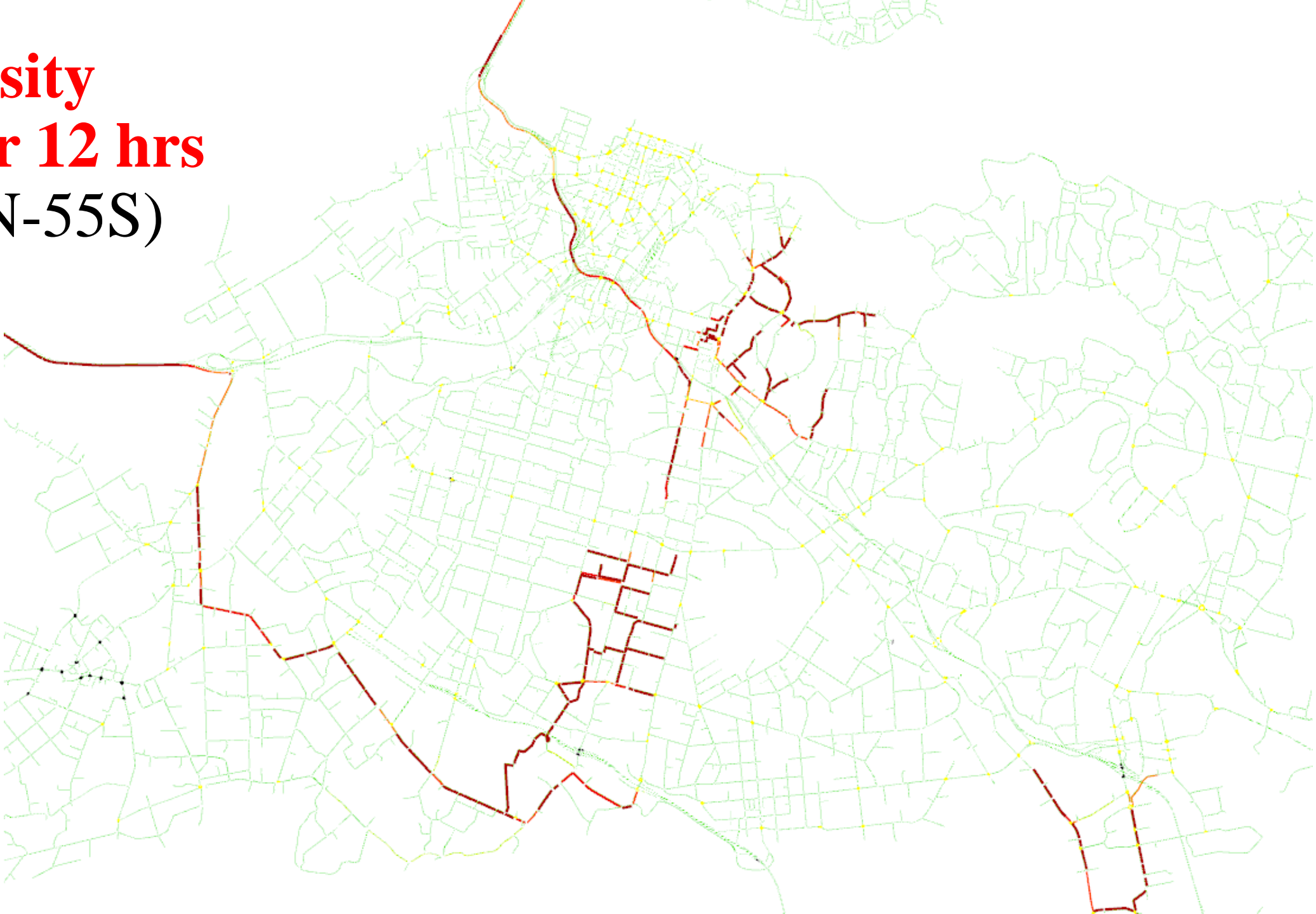
Density
after 6 hrs
(45N-55S)



Density
after 9 hrs
(45N-55S)



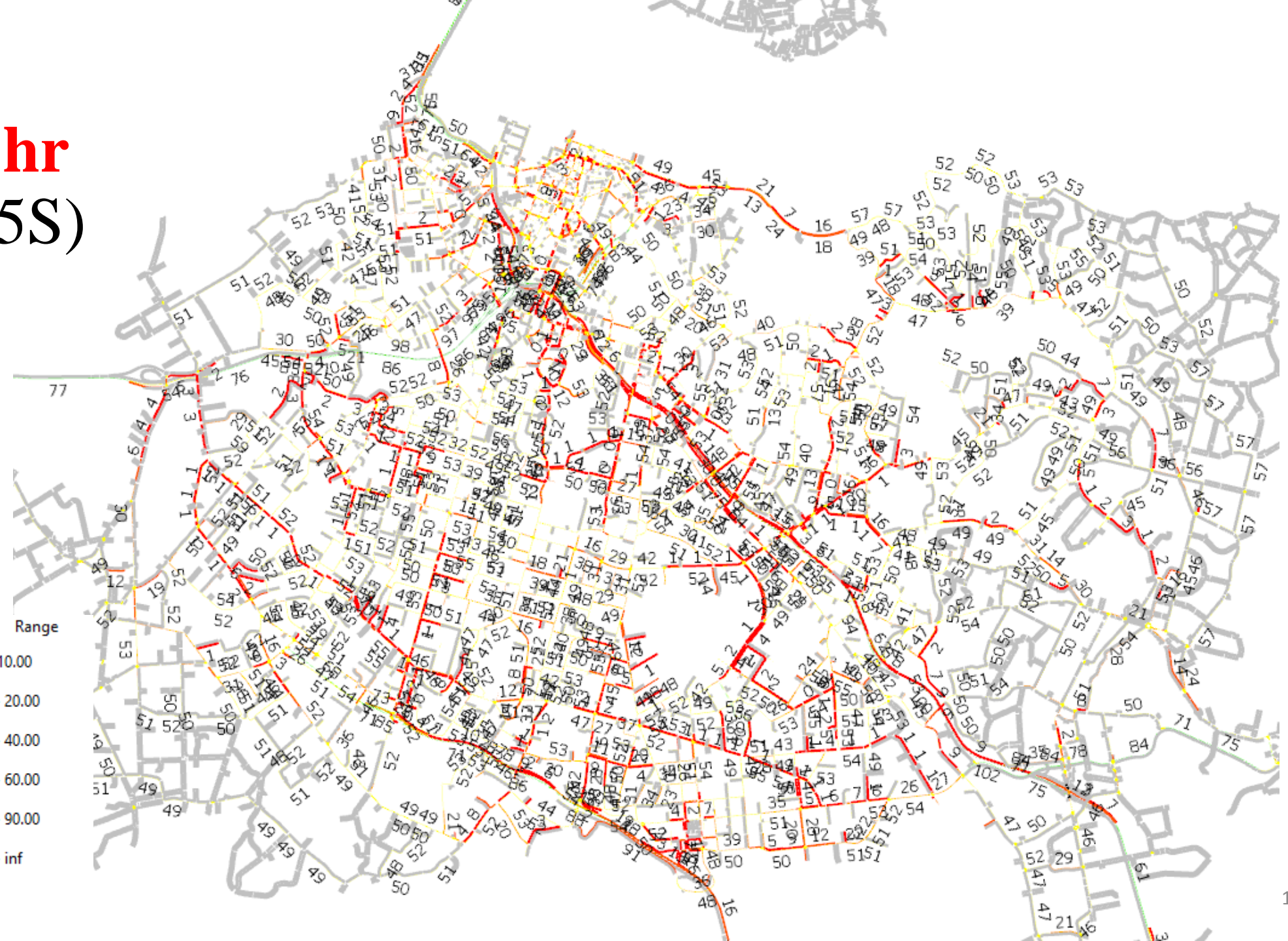
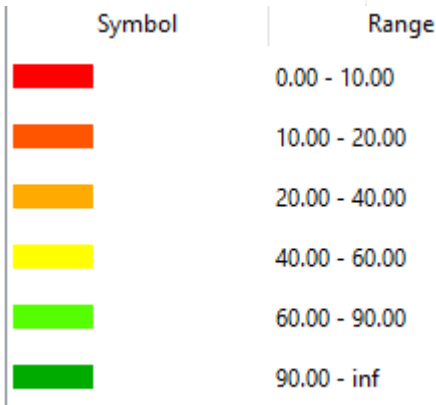
Density
after 12 hrs
(45N-55S)



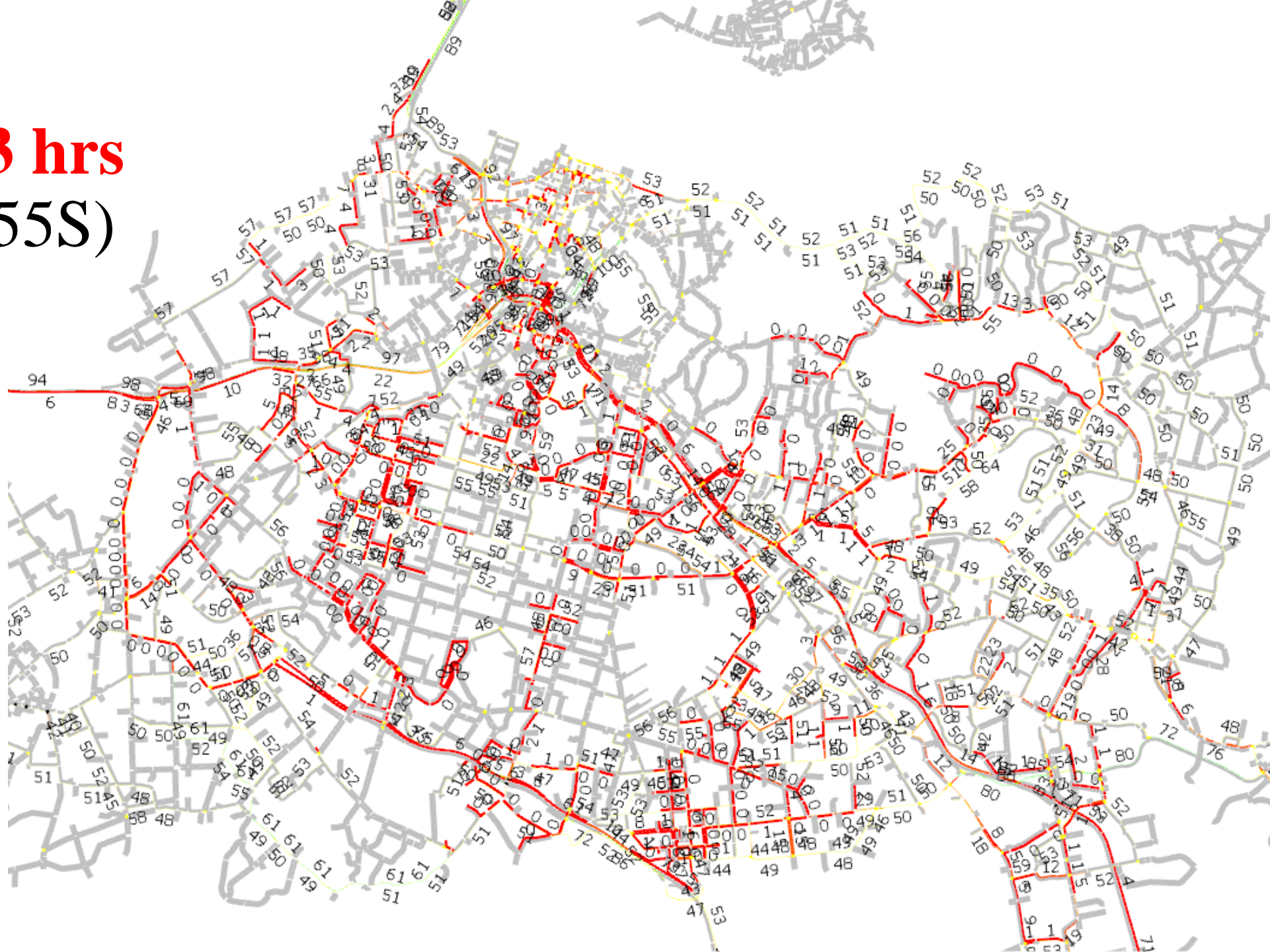
Density
after 15 hrs
(45N-55S)



Speed after 1 hr (45N-55S)



Speed after 3 hrs (45N-55S)



Speed after 6 hrs (45N-55S)



Speed after 9 hrs (45N-55S)



Speed after 12 hrs (45N-55S)



**Speed
after 15 hrs
(45N-55S)**



Bottleneck locations

- Northern SH1 (Johnstones Hill Tunnel)
- Northern SH16 (Whenuapai West roundabout) State Highways
- Southern SH1 and Gt South Road (bridges at Slippery Creek)

Thanks

What I have done & what I am doing

- Uniform evacuation (presented paper 1)
- Improve evacuation time using traffic demand management (writing paper 2)
 - Staged Evacuation
 - Inter-region + intra-region evacuation
- Improve evacuation time by modifying network (paper 3)