NCHRP 3-65: Applying Roundabouts in the United States

Operations

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Presentation Outline

- **Analytical Computation**
- **Driver Behavior and Geometry**
- **Model Comparison/Calibration**
- **Model Selection**

Capacity Models Tested

Empirical Models

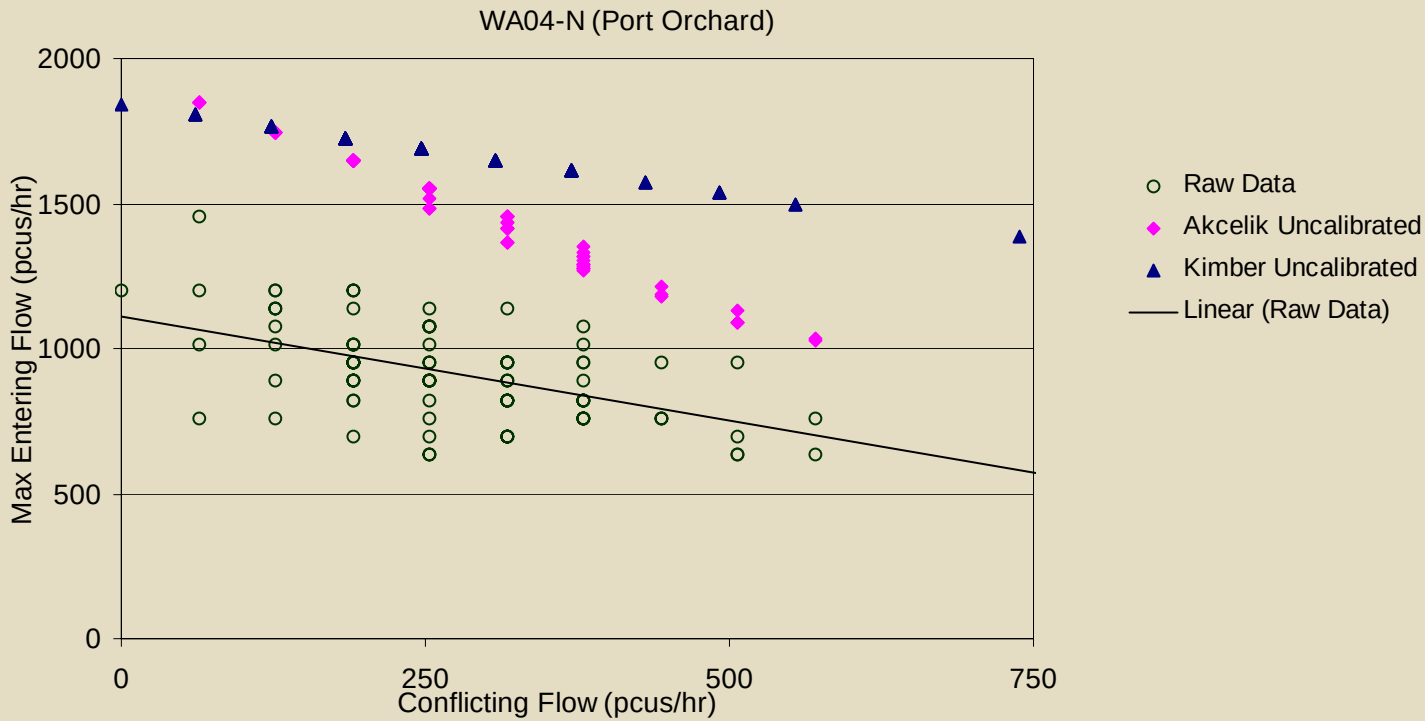
COUNTRY	NAME	TYPE	VARIABLES
British	RODEL/Kimber	Linear	geometry
French	GIRABASE/Louah	Exponential	geometry + tf/tc
Swiss	Lausanne	Linear	geometry
Israel	Polus	Exponential	speed
FHWA	Simplified British	Linear	NA

Analytical Models

German	Wu	tf/tc	
Australian	SIRDA/Troutbeck	tf/tc	limited geometry
HCM		tf/tc	

Analysis of Exiting Models

- **All international models (including SIDRA and RODEL) predict capacities higher than observed**



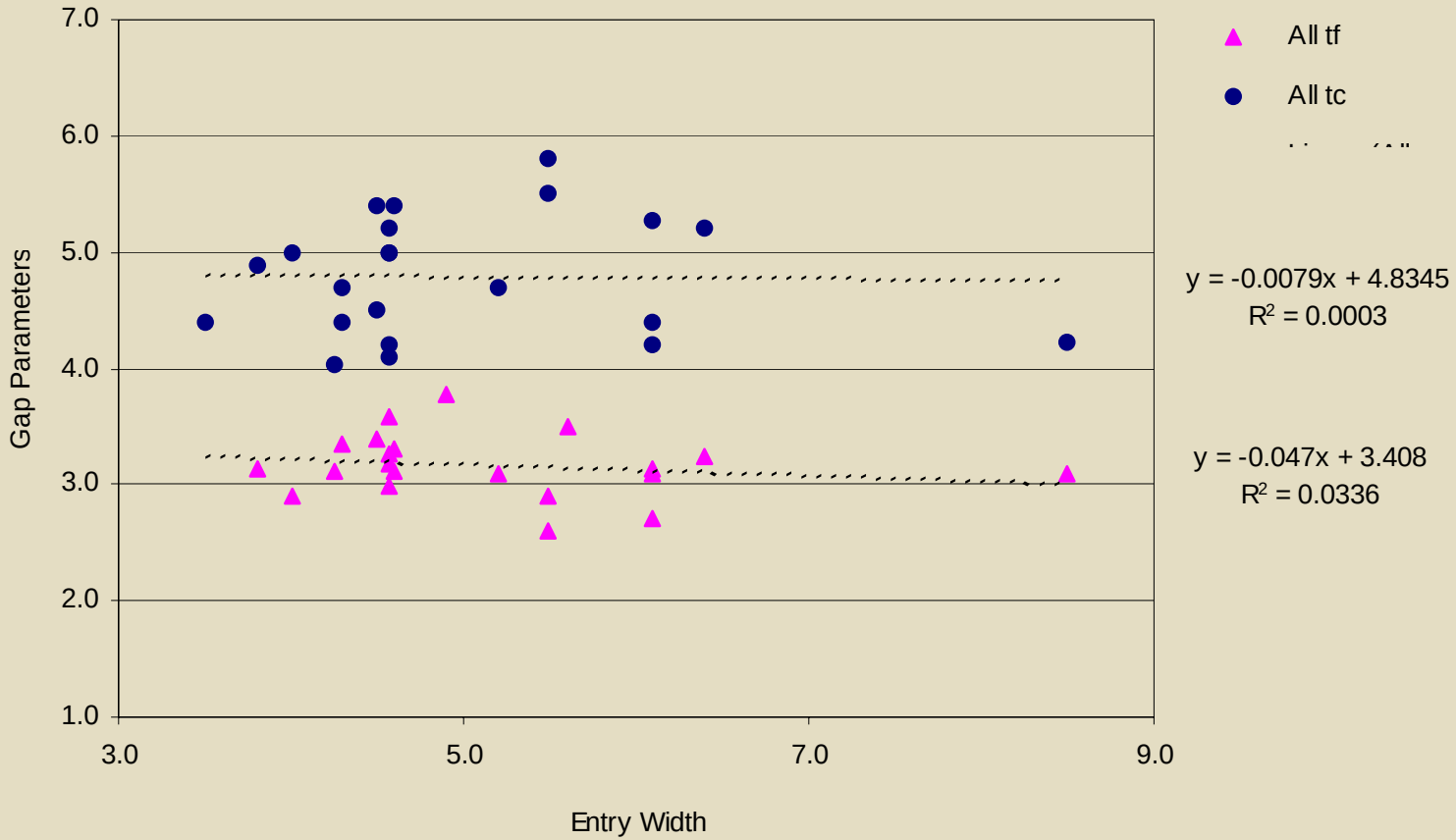
Field Measured Gap Acceptance Parameters

‘Average’ approach critical gap and follow-up times

Model	1 Lane		2 Lane	
	tf	tc	tf	tc
Field Right lane	**2.6-4.3**	**4.2-5.9**	**2.7-4.7**	**3.5-4.9**
Left lane			**2.8-4.4**	**4.2-5.5**
HCM	3.1	4.6	NA	NA
German	3.2	4.4	3.2	4.4
French	2.1	NA	2.1	NA
Akçelik Dominant	1.8-2.7	1.4-4.9	1.8-2.8	1.6-4.1
SubDom			2.2-4.0	

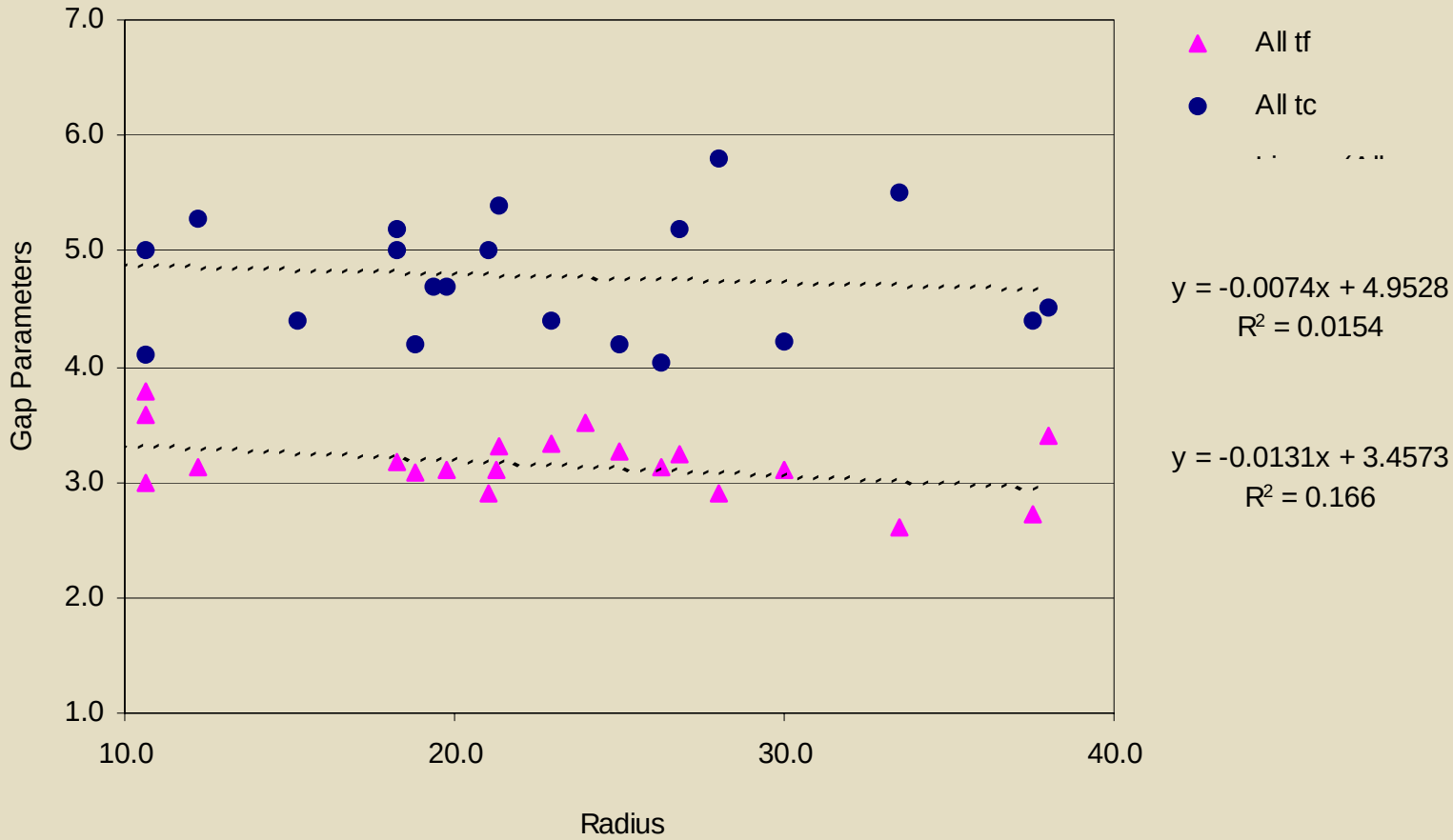
Influence of Flow & Geometry on Driver Behavior

- **Entry lane width = entry width / #lanes**



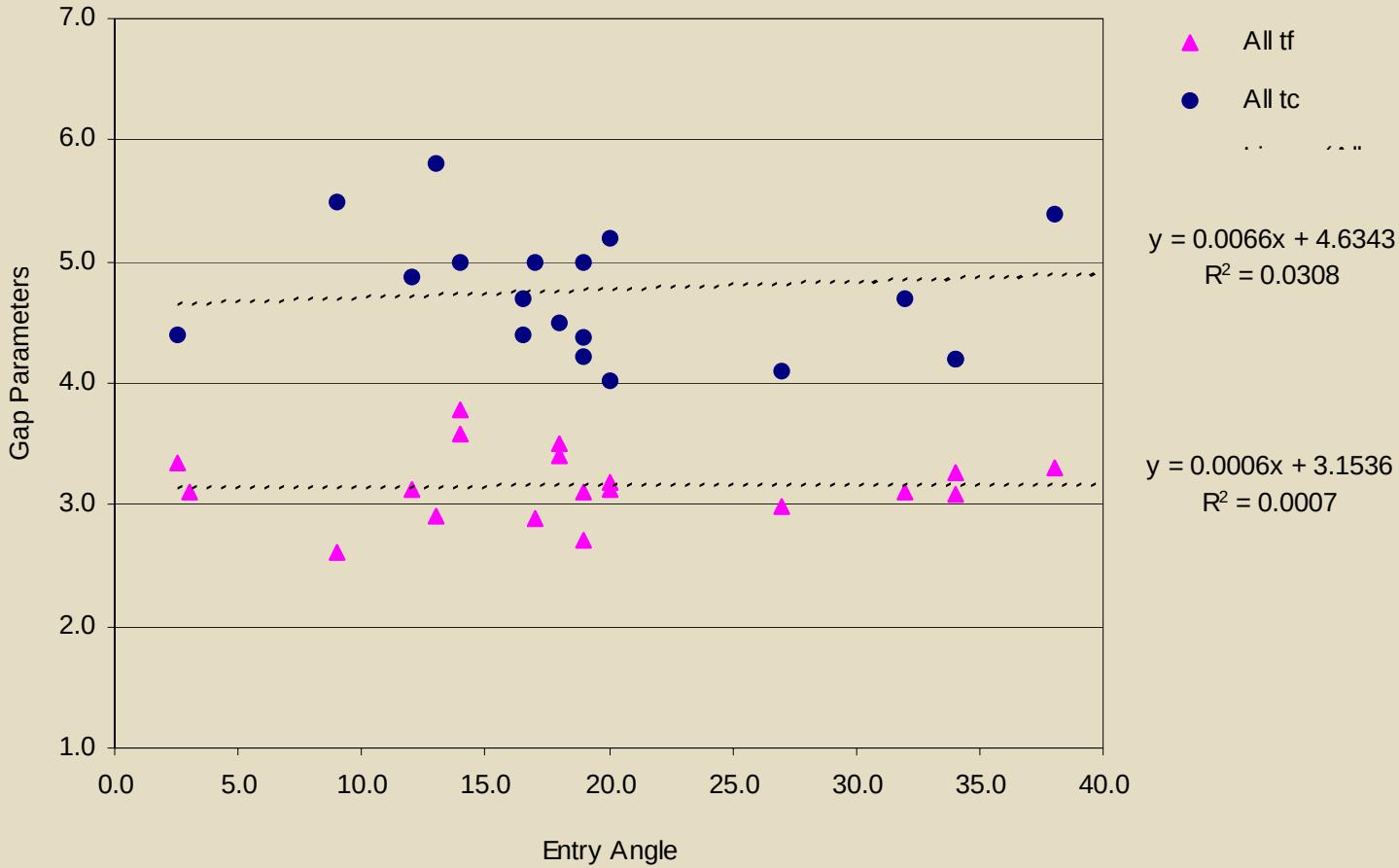
Influence of Flow & Geometry on Driver Behavior

- **Radius**



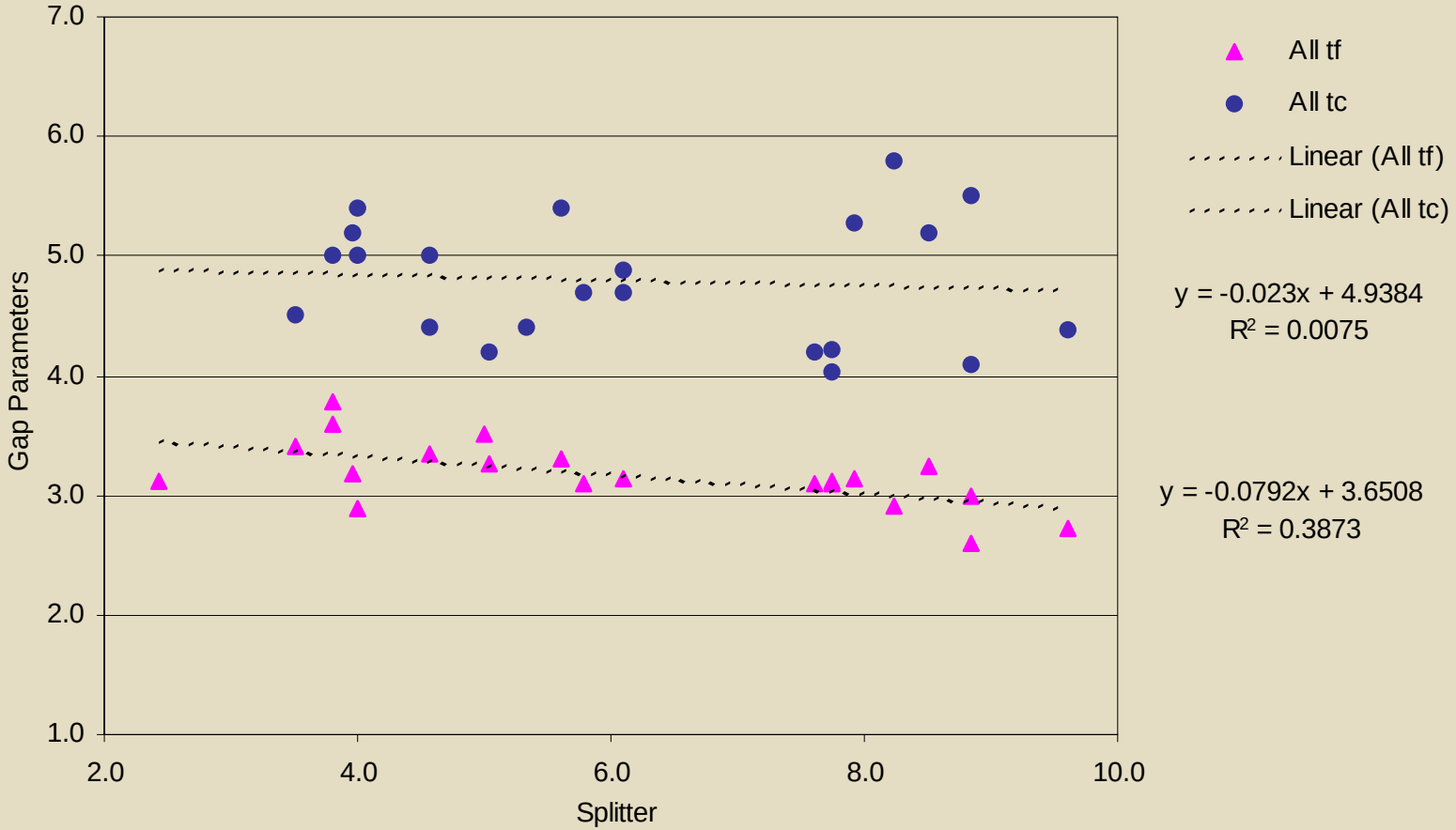
Influence of Flow & Geometry on Driver Behavior

- **Entry Angle**



Influence of Flow & Geometry on Driver Behavior

- **Splitter Width**

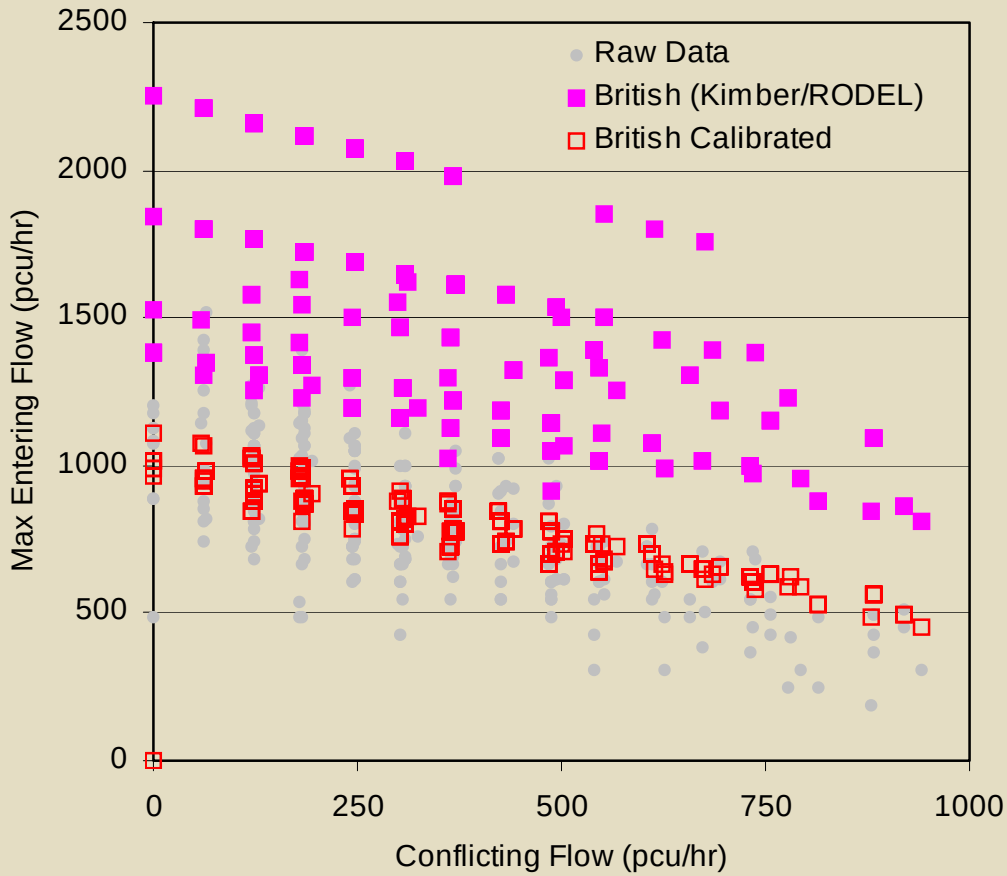


One Lane Calibration

MODEL	None (All veh/hr)	*pcus*	*geometry*	*geometry &F (1L sites only)*	*geometry & F (All sites)*	*geometry tf; tc mup<6*	*Include exit + 100% conflicting mup<6*
Kimber	795	773	421	167	169	-	228
Akcelik	593	545	-		-	160	440
Kreisel	**294**	**215**	-	-	-	**143**	396
French	1191	1234	-	-	-	258	-
Swiss	376	343	-	-	-	323	-
HCM Upper	326	322	-	-	-	**145**	342
HCM Lower	**180**	**176**	-	-	-	-	-
FHWA	240	224	-	-	-	-	270

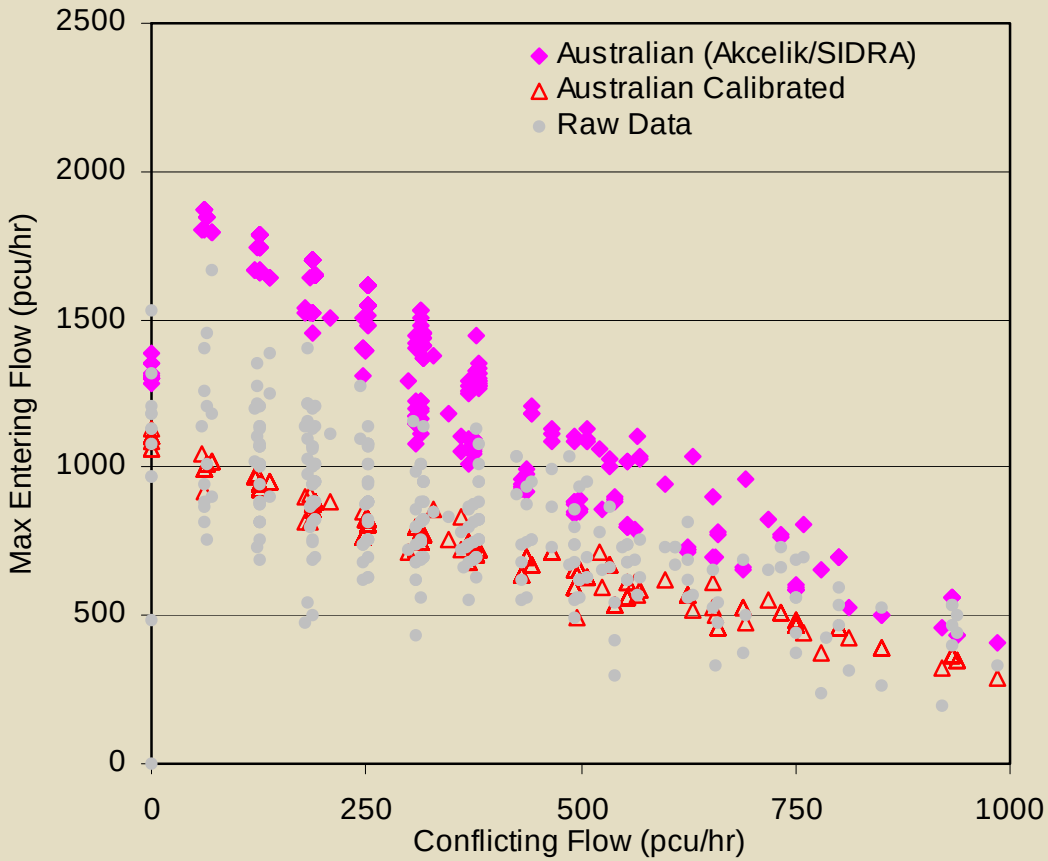
One Lane Calibration

- **British – All single lane approaches**



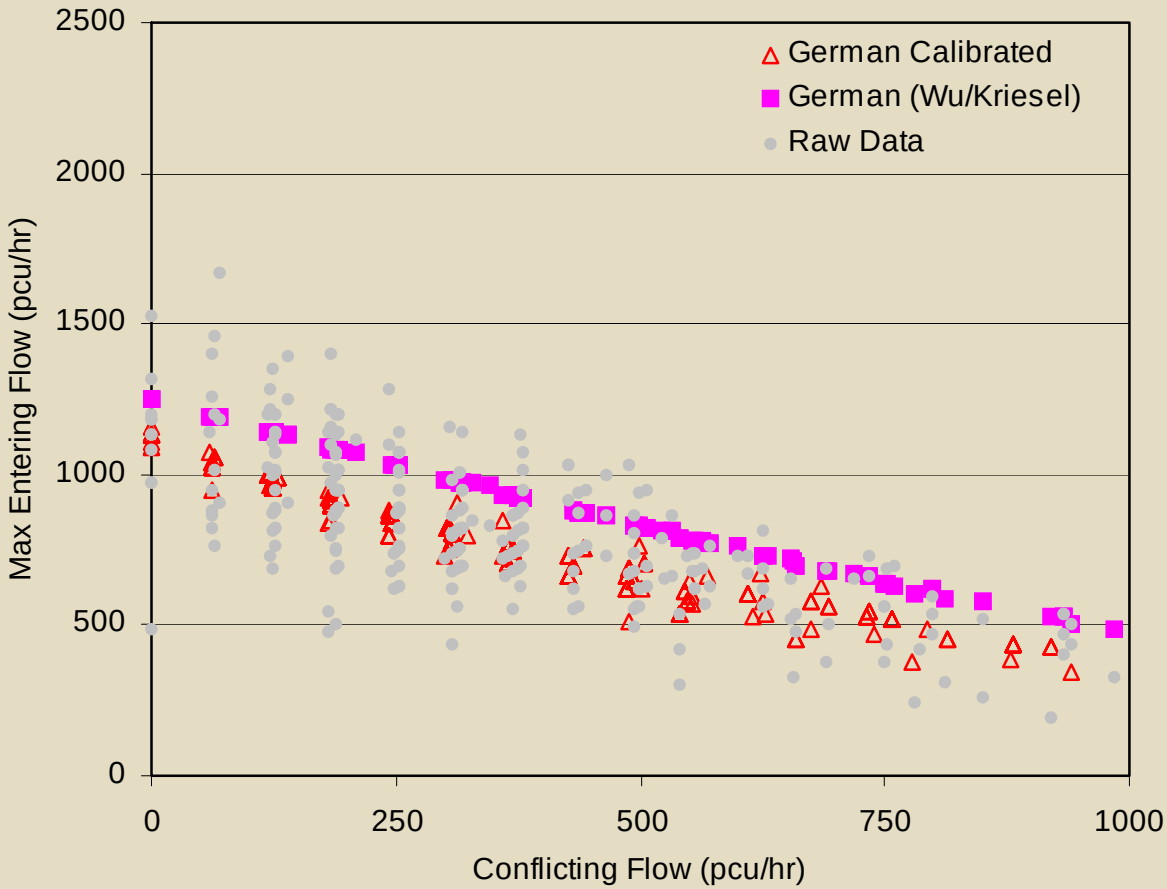
One Lane Calibration

- **Australian – All single lane approaches**



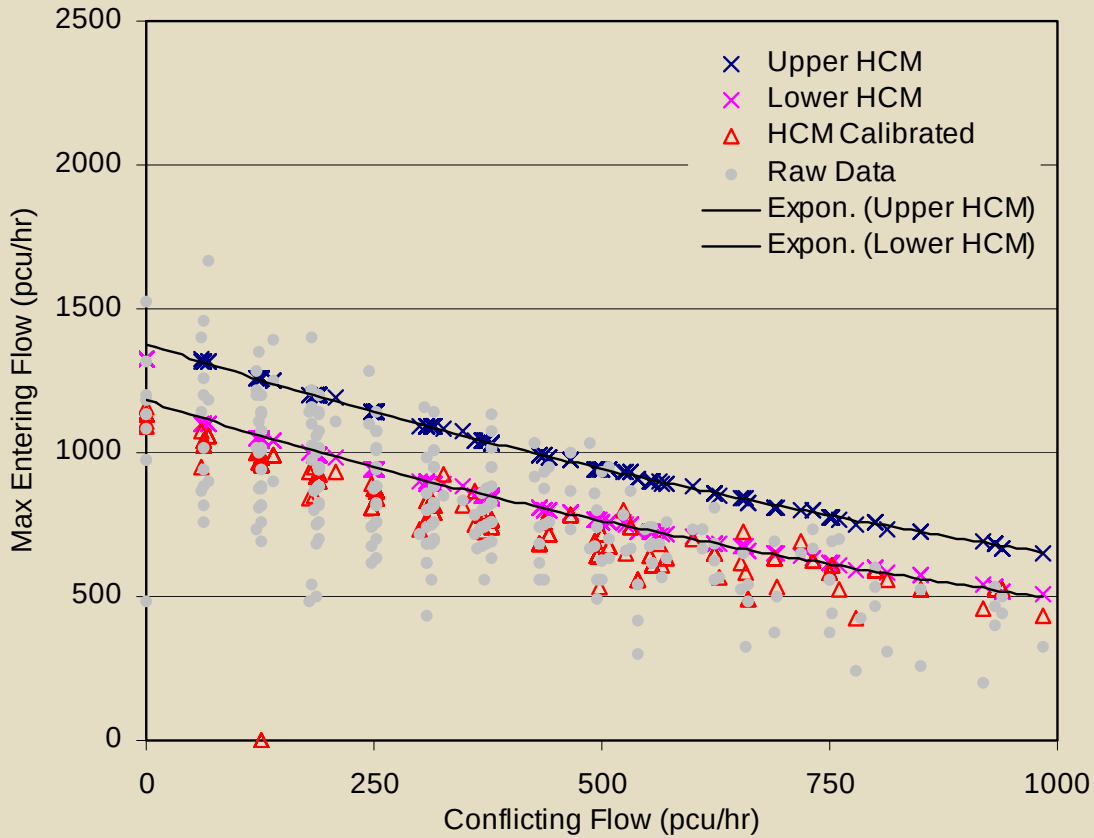
One Lane Calibration

- **German – All single lane approaches**



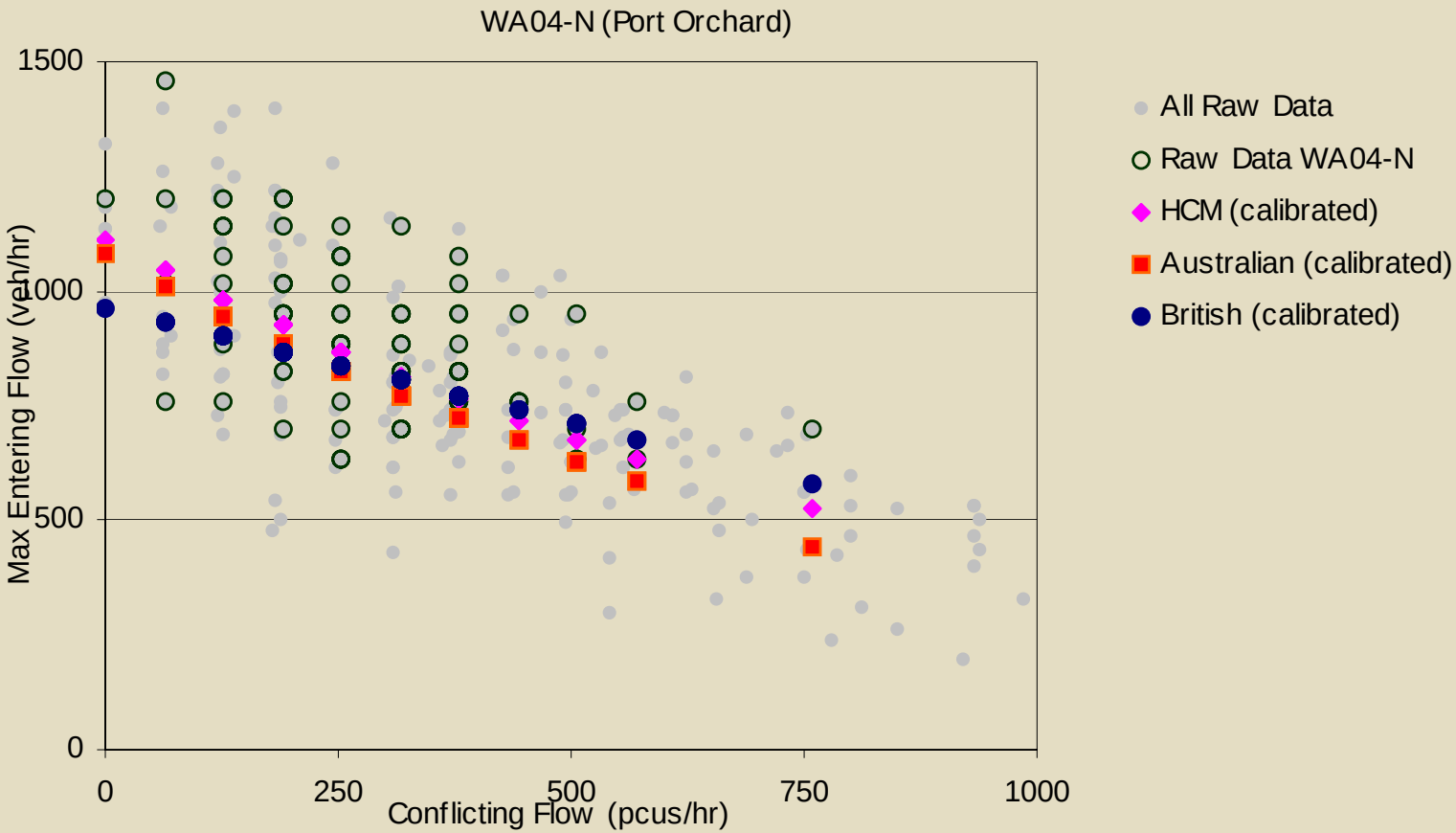
One lane Calibration

- **HCM – All single lane approaches**



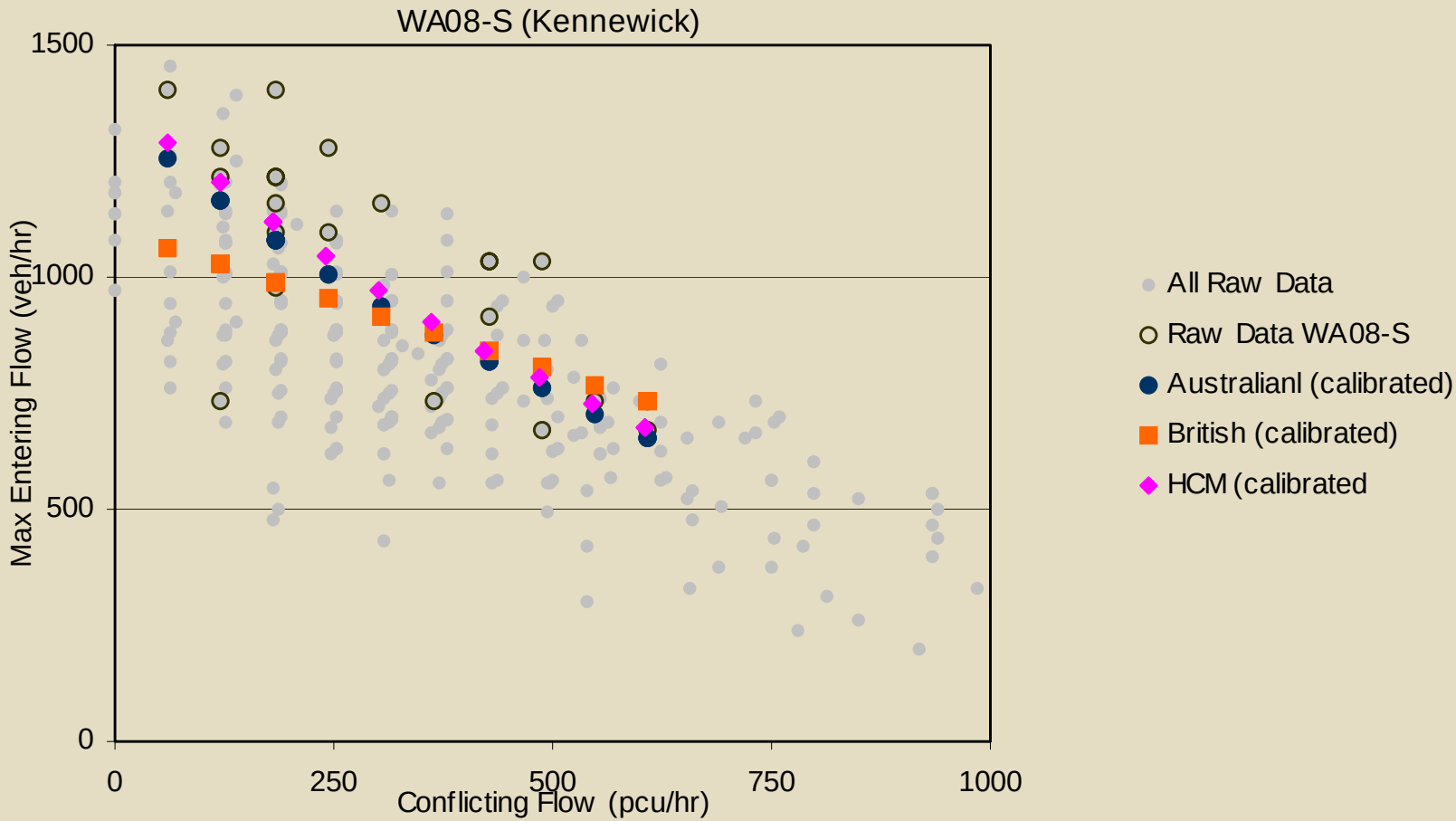
One Lane Calibration

- **Port Orchard north (average entry flow)**



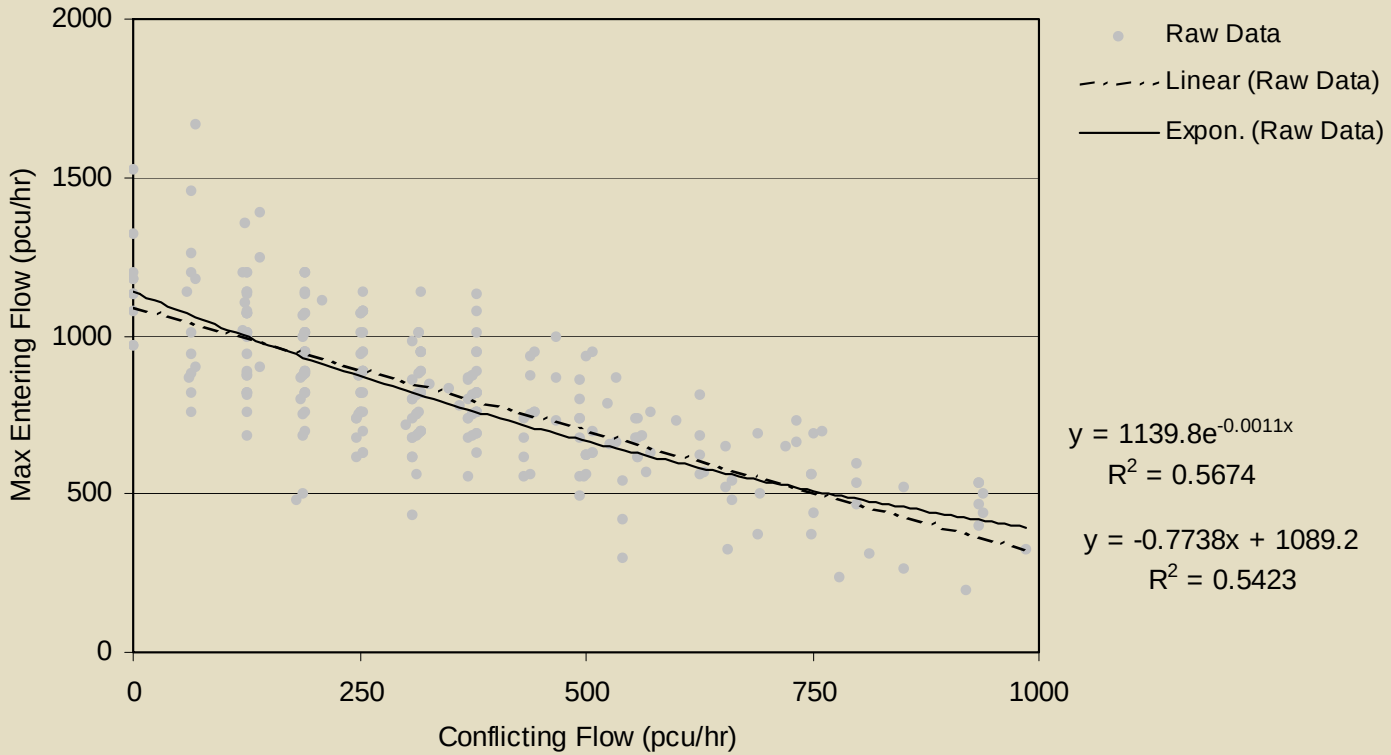
One Lane Calibration

- **Kennewick south (high entry flow)**



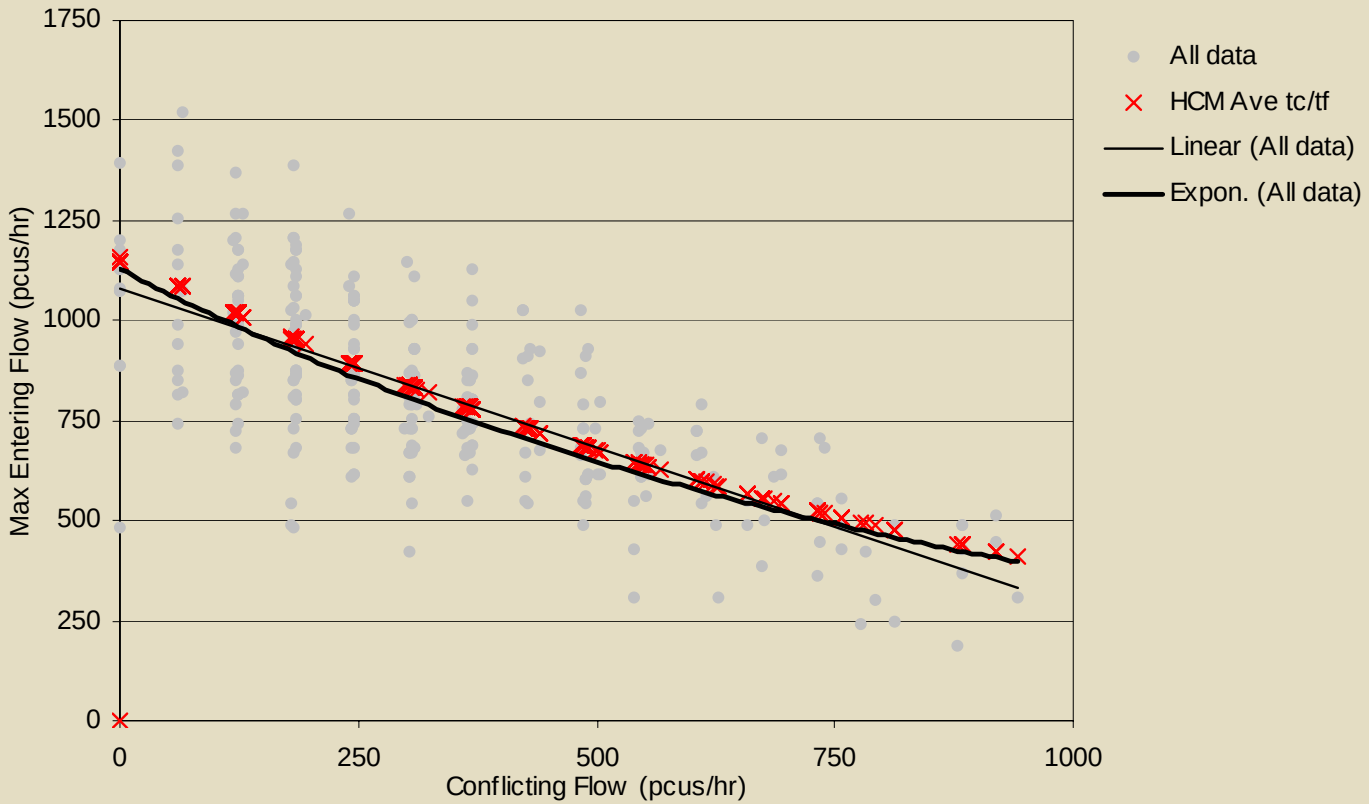
One lane Calibration

- **Linear or exponential regression**
  - *RMSE = 160*



Critical Gap and Follow-up time estimates

- **Average critical gap and follow-up time similar to using regression**



Multi-Lane Calibration

- **Several sites exhibit strong queuing in only one lane**
  - Turning movement effects
  - Other possible constraints (path overlap, etc.)

	LEFT LANE	RIGHT LANE	L	T	R	U	Comment
WA09-e	**18%**	82%	9%	**86%**	5%	1%	10% of Throughs in LL
MD04-E	55%	**45%**	**72%**	28%	1%	0%	20% of Lefts in RL
MD05-SW-NW	0%	100%					
MD05-SW-W	0%	100%					
VT03-E	45%	55%	30%	49%	21%	0%	50% of Lefts in RL; 15% of Throughs in LL
VT03-S	33%	67%	28%	39%	31%	3%	
VT03-W	35%	65%	19%	32%	46%	4%	

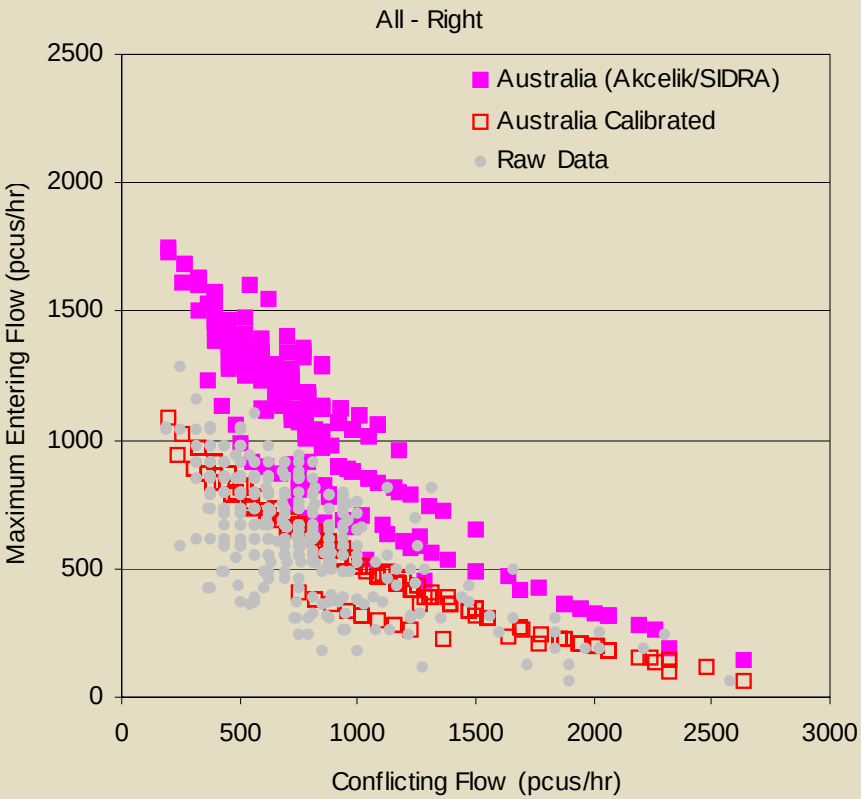
Multi-Lane Calibration

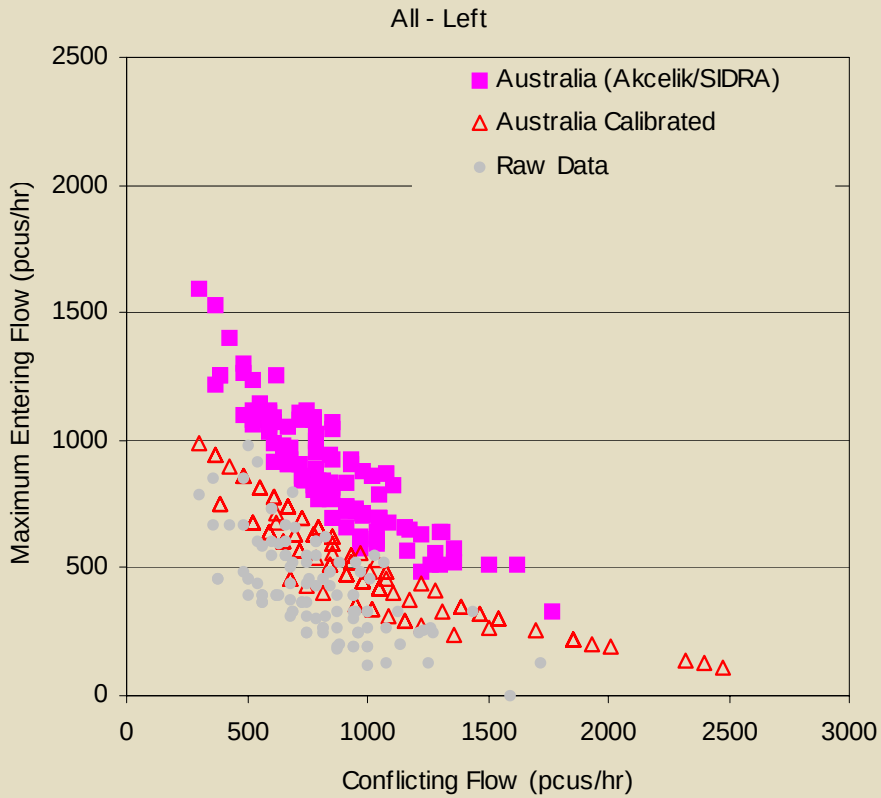
Multi-Lane Summary

MODEL	LANE	# Obs	None (All veh/hr)	*pcus*	*geometry &F*	*geometry &F (All Sites)*	*geometry tf; tc* *mup<6*
British		143	1057	982	270	324	-
Austalian	Right	385	478	480	-	-	163
	Left	120	480	488	-	-	189
German		143	**385**	**323**	**-**	**-**	257
French		128	821	692	-	-	230
Swiss		143	528	444	-	-	-
HCM Lower		143	**272**	**320**	-	-	372
HCM Upper		143	368	426	-	-	
FHWA		71	953	857	-	-	-

Multi Lane Calibration

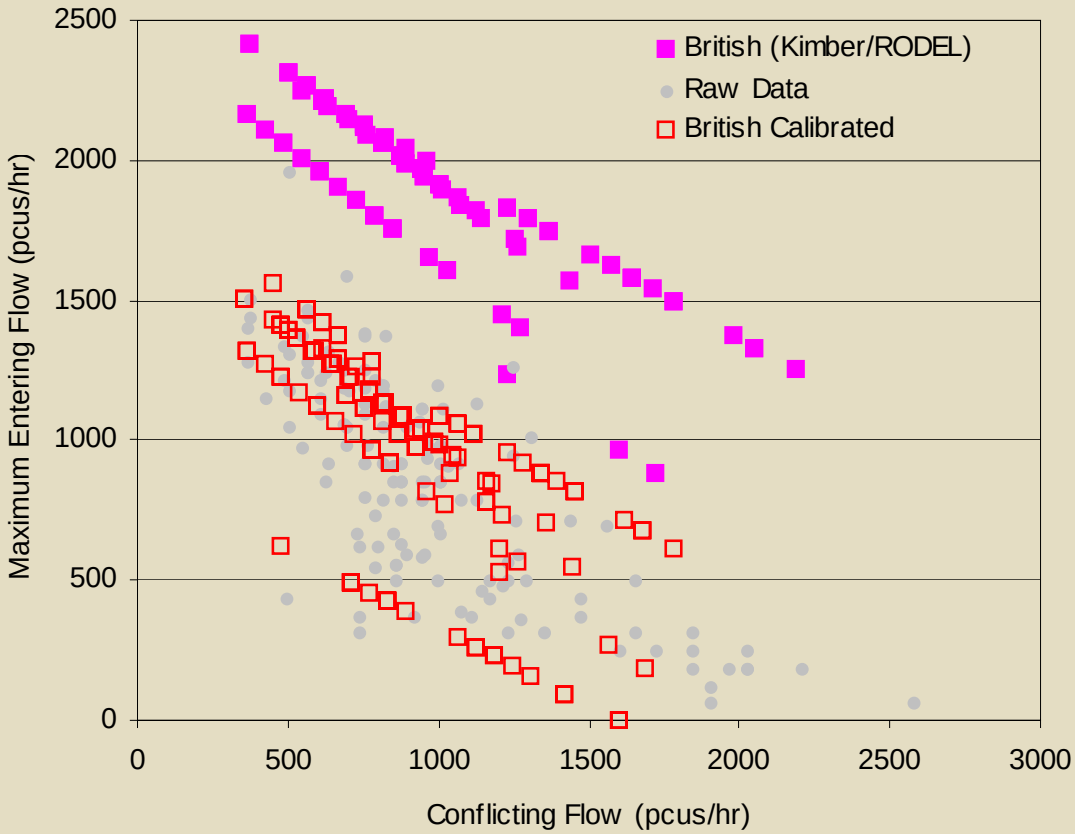
- **Australian - All multilane approaches**
- **Lane based model**





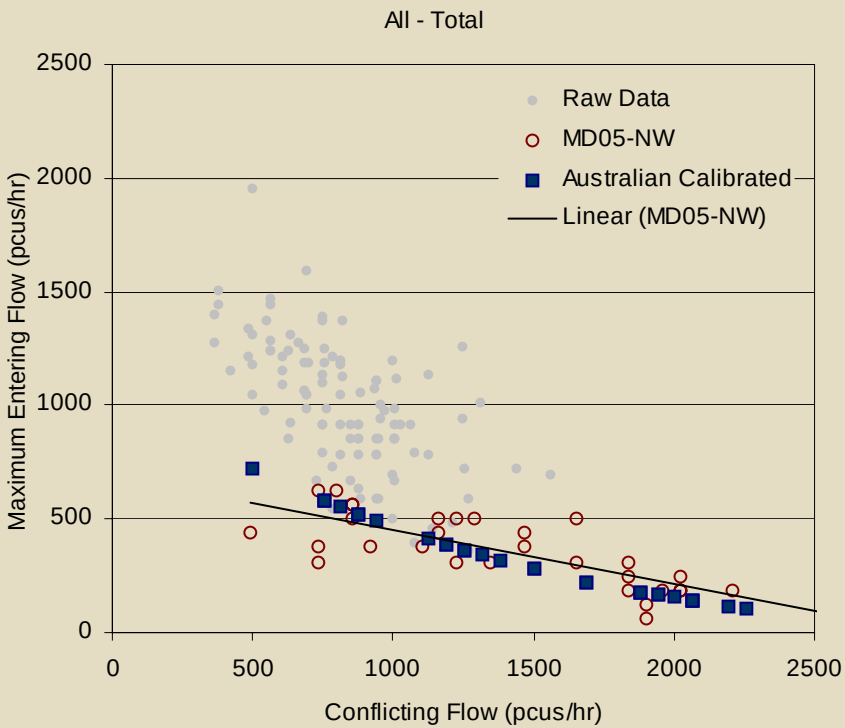
Multilane Calibration

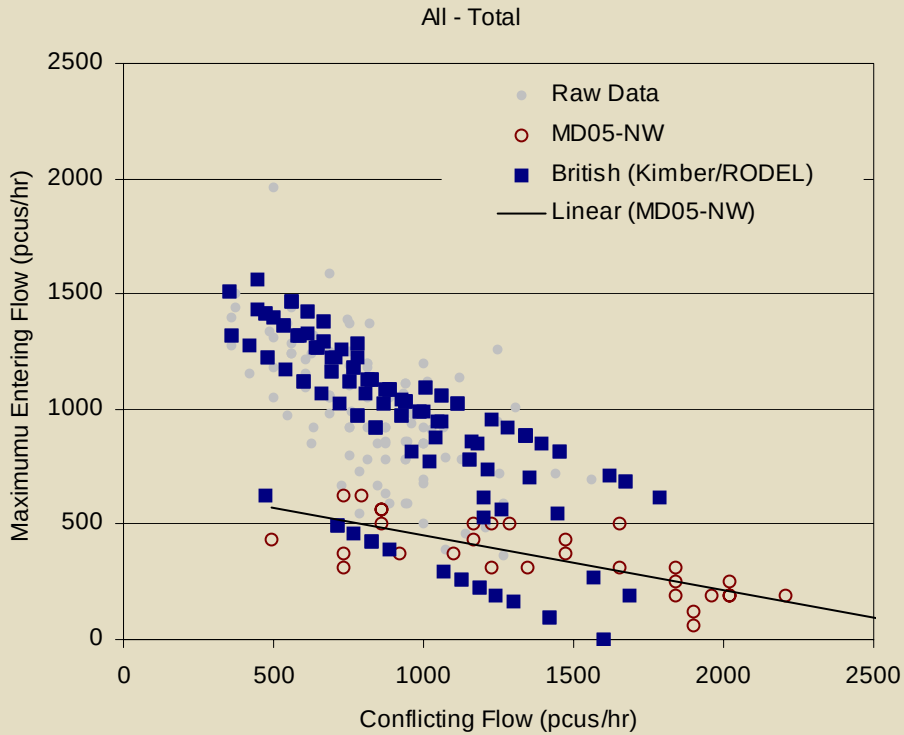
- **British – All multilane approaches**
- **Total approach model**



Multilane Calibration

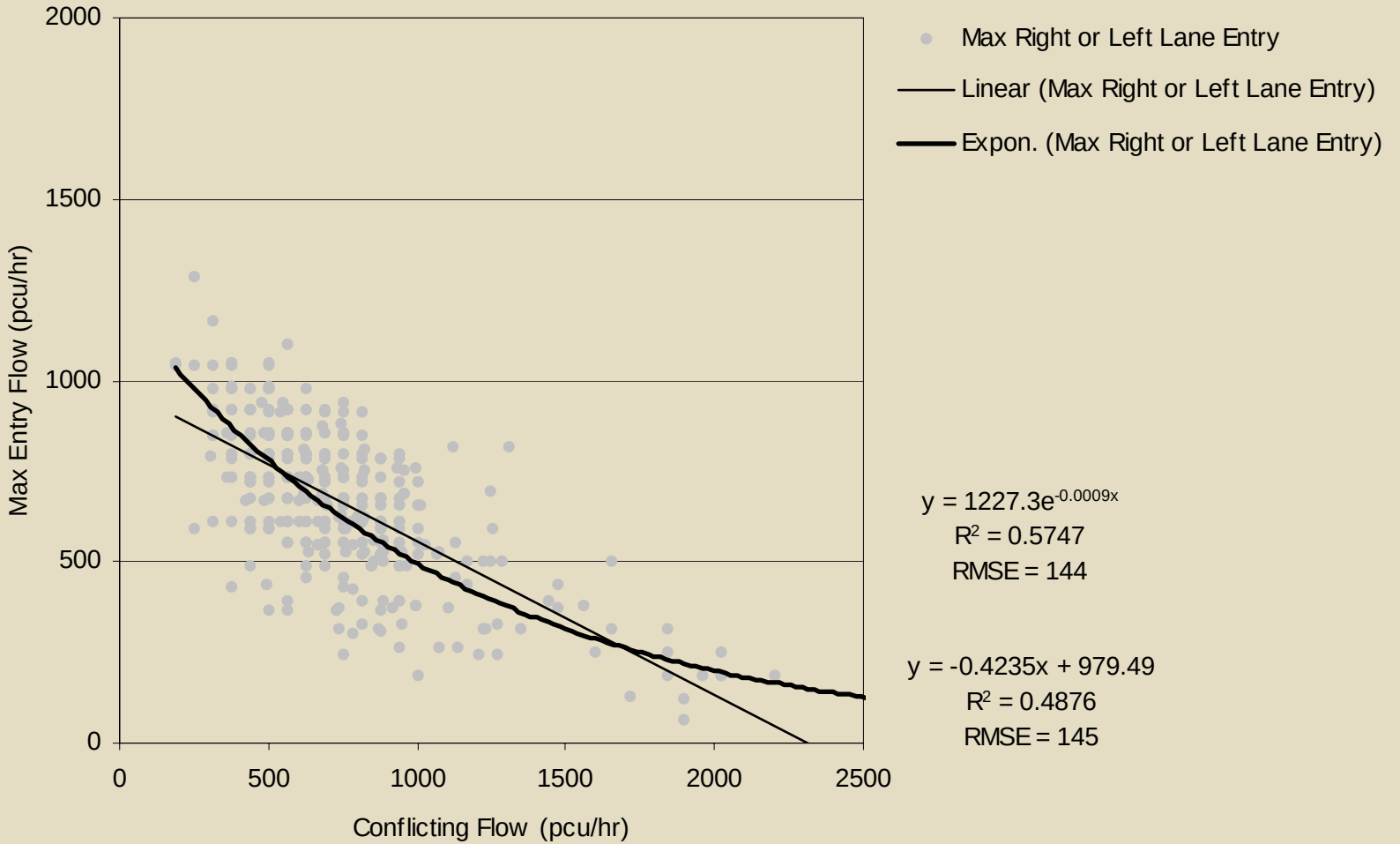
- **Single lane entry – correlation to entry width**





Multilane Calibration

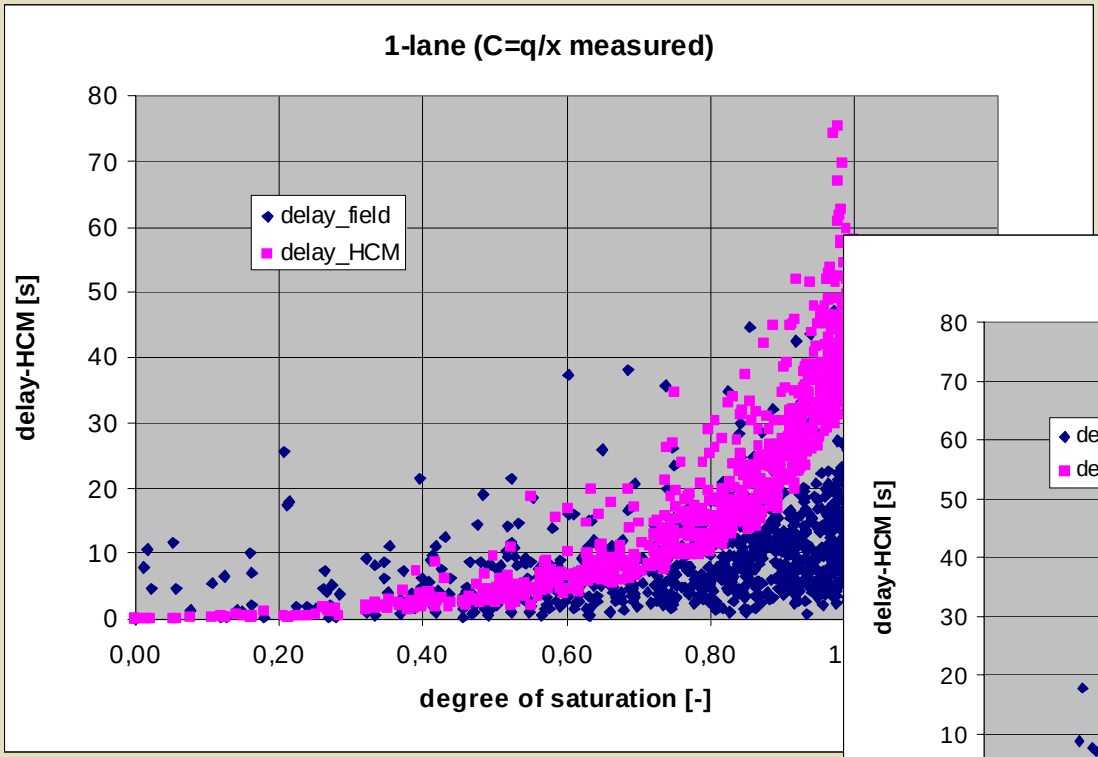
- **Critical lane model - Capacity of critical lane of two-lane approach**

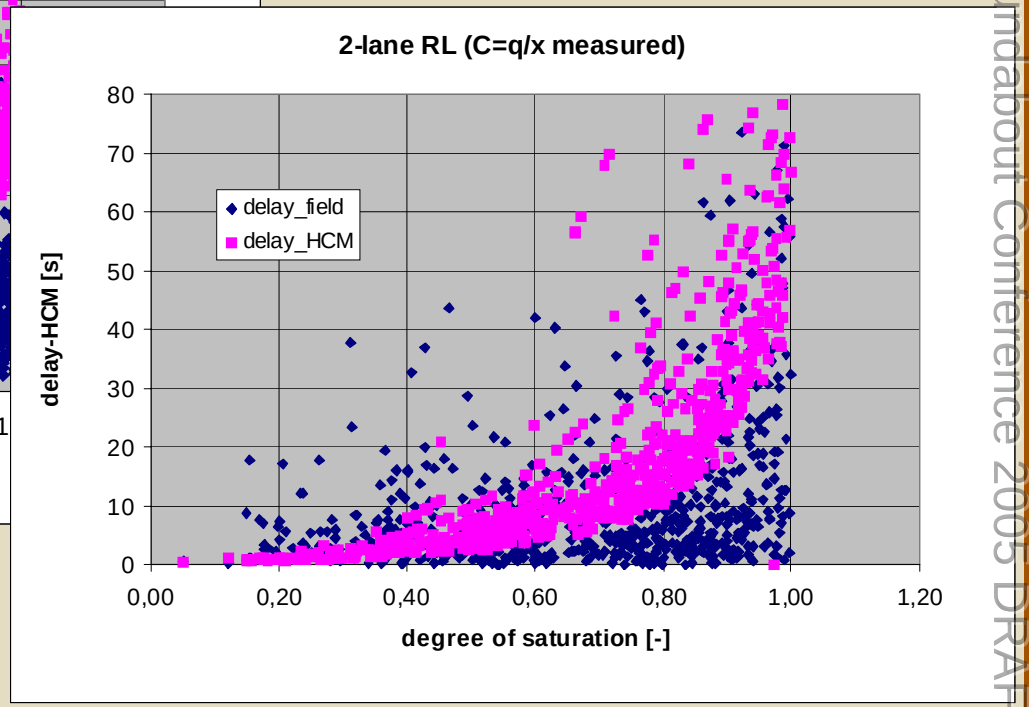


Delay

- HCM delay tested against field data
- Data collection limits true understanding of delay for high v/c;
- For v/c > 0.9; HCM difficult to estimate because initial queue is unknown
- Variation large; correlation factor = 0.44
- Recommendation: HCM delay equation appears to be reasonably valid

Delay





HCM Draft Chapter Recommendations

- **1-Lane : HCM Model (revised parameters)**
- **Multi-Lane : Simple regression model for critical lane**
- **Delay : HCM Formulae**
- **Additional effort to explain findings in the HCM chapter:**
  - *Description of first order parameters*
  - *Description of the lack of correlation to geometry*