Automobile Event Data Recorders – What Prosecutors Need to Know

Presented by Richard R. Ruth, P.E.
Police Reconstruction w/EDR Trainer

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What's an Event Data Recorder?

- An EDR is something that records a TIME SERIES of data when a crash occurs
- Not a separate part like an airplane black box – usually built in to the airbag control module, but it could be in any of several electronic modules
- Originally installed by manufacturers to know if their airbag and engine systems worked right
- Upgraded SUBTANTIALLY by federal regulation 49CFR part 563 effective Sept 2012 (2013 MY). Purpose officially changed to supporting EFFECTIVE CRASH RECONSTRUCTION.

EDR's – why do we need them?

- Newer EDR's give speed for 5 seconds before impact – often proving speeding as an additional charge to alcohol or drug impairment prosecutions
- Older methods of getting speed from momentum analysis and tire braking marks are hindered by modern ABS brakes leaving faint to nonexistent tire marks.
- EDR's directly measure speed – jurors don't have to follow complicated police calculations or take police word for it – they can see the numbers for themselves

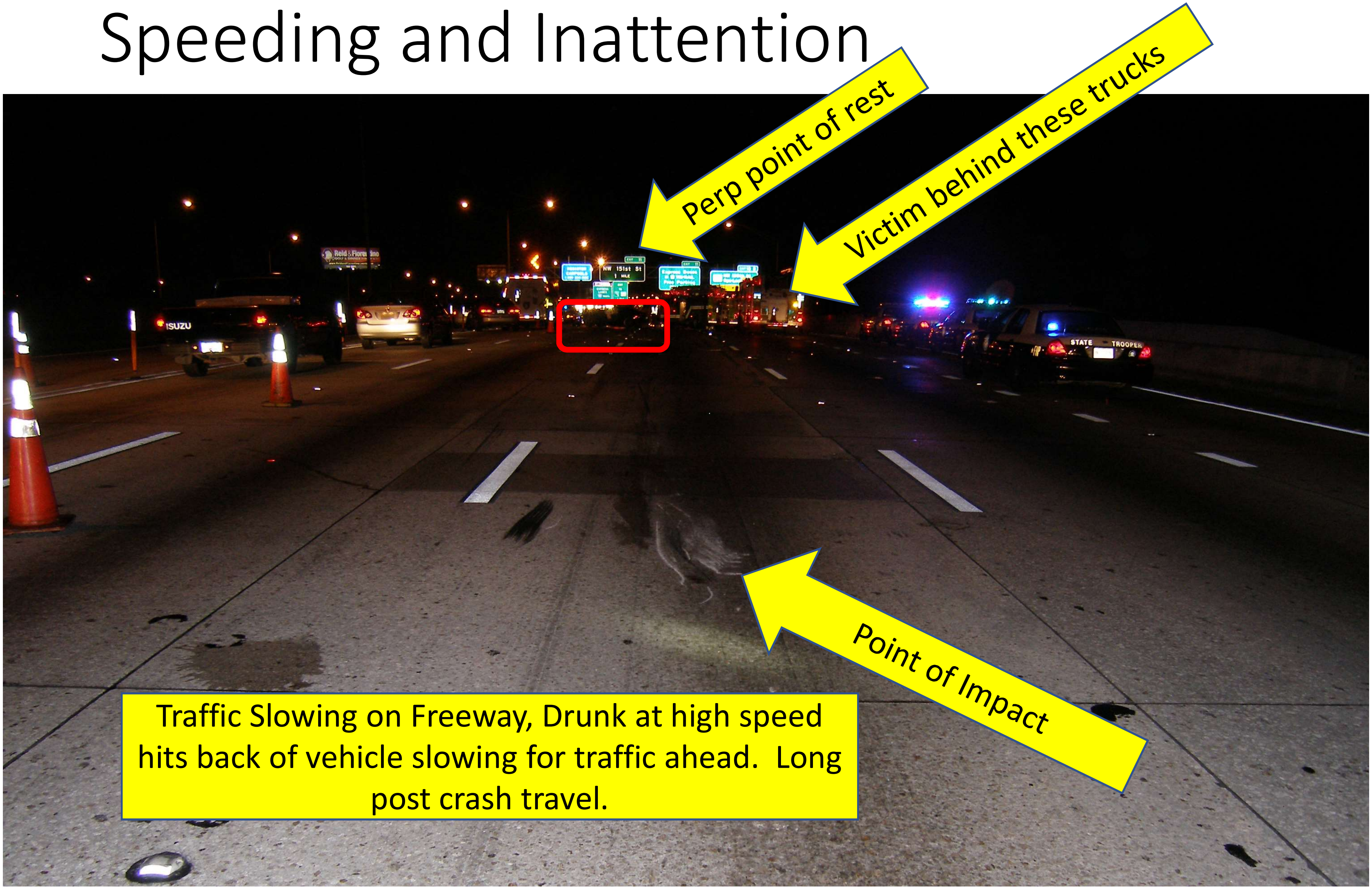
But it's not JUST about speed

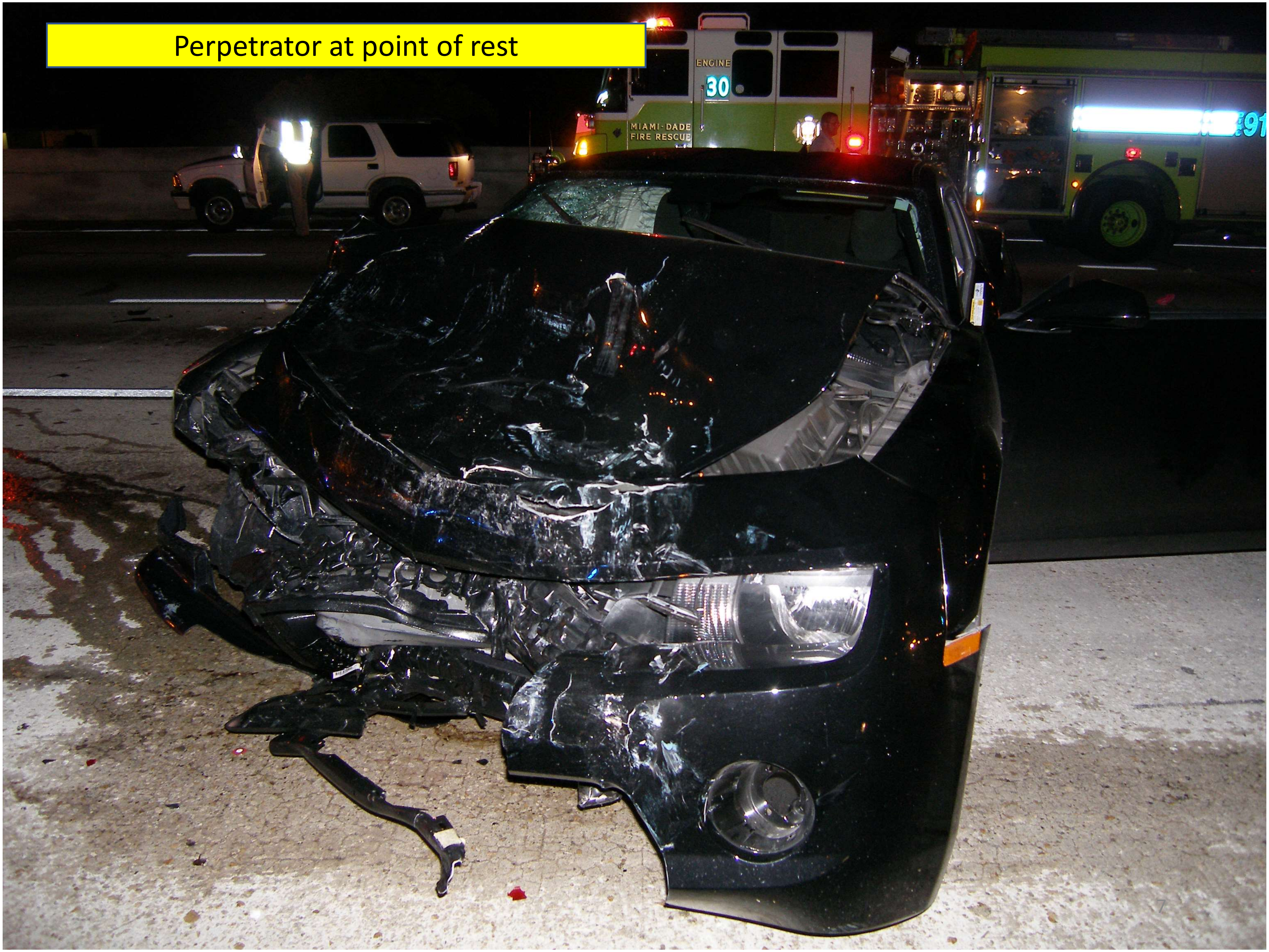
- EDR's show gas and brake pedal status – with some human factors analysis, they sometimes show wanton disregard for the safety of others.
- Time-distance calculations let you show when AND WHERE inputs were made.
- May show late or no reaction to developing crash situation, consistent with impairment.
- May show accelerating to get thru a yellow-becomes-red light quicker instead of braking.
- Some EDR's have steering input and yaw rate or stability control lateral acceleration allowing lateral movement calculations. Helps document drifting over centerline or off road, or intentional passing maneuvers, or sudden swerves.

Human Factors: Guilty v Victim

- Intersection crash: What color was the stoplight?
  - Redlight runners push harder on the accelerator to get thru intersection faster
  - Victim starts when light turns green, accelerates normally, often never sees redlight runner coming
- Cross centerline case
  - Culprit drifts left gradually indicating inattention
  - Alternative Culprit makes sharper input left to pass then straightens out to right
  - Bad guy typically reacts late or never
  - Victim sees situation developing, begins slowing much sooner and fades to right to avoid bad guy

Example DUI Manslaughter Case Speeding and Inattention





Perpetrator at point of rest


Victim at Point of rest
NW 151st St
1 MILE
EXIT 11
EXIT 11
ST. JAMES

Victim Vehicle side view

Victim Vehicle

Perpetrator Vehicle
2012 Camaro

Traditional Reconstruction

- Would have started with a scene diagram measuring distances to point of rest, and estimating a "drag factor" (how quickly it slowed down in G's) from impact to rest.
- Traditional methods need both vehicles to slide to an uncontrolled rest after impact, and for the officer to know the approach and departure angles and vehicle weights. Alas, the victim struck the side wall, and so did not slide to a stop.
- Traditional analysis would have to use rough estimates of rate the Camaro slowed by post impact, resulting in a *large uncertainty* in speed. Defense could potentially claim their guy was going the speed limit and victim was stopped in the road, and "crash was victim's fault".

Event Data Recorder information: Speed is directly measured

Pre-Crash Data -2.5 to -.5 sec (Event Record 1)

Times (sec)	Accelerator Pedal Position (percent)	Brake Switch Circuit State	Engine Speed	Throttle Position (%)	Vehicle Speed (MPH [km/h])
-2.5	53	Off	3584	100	107 [172]
-2.0	45	Off	3584	96	107 [173]
-1.5	20	Off	3456	30	107 [173]
-1.0	0	On	2944	23	106 [171]
-0.5	0	On	2688		105 [169]

Applied brake but didn't slow much – no emergency reaction

Perp slows 37mph during crash

Longitudinal SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	-37 [-59]
Lateral SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	-5 [-8]
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met	-

And with a little training and math…….

- The speed at -2.5 was 107 +/-4% (range **103** to 111)
- A jury will see the last data point recorded is 105 mph. That's not exactly at impact, the car could have slowed down and likely think that is the speed at impact. The vehicle could actually have braked after the last data point was recorded. Speed at impact was 93 to 109 mph (middle of range 91).
- During impact, the EDR measured how much the perpetrator slowed down by (37 mph). Allowing for +/-10% accuracy, the perp was going 91-37= 64 mph after impact.
- Use weight ratio to determine how much victim was sped up
- Add changes in speed from both vehicles to get closing speed, subtract from perp speed to get victim speed 27 mph at impact (slowing for traffic).
- Trained analysts know how much range to put on each number

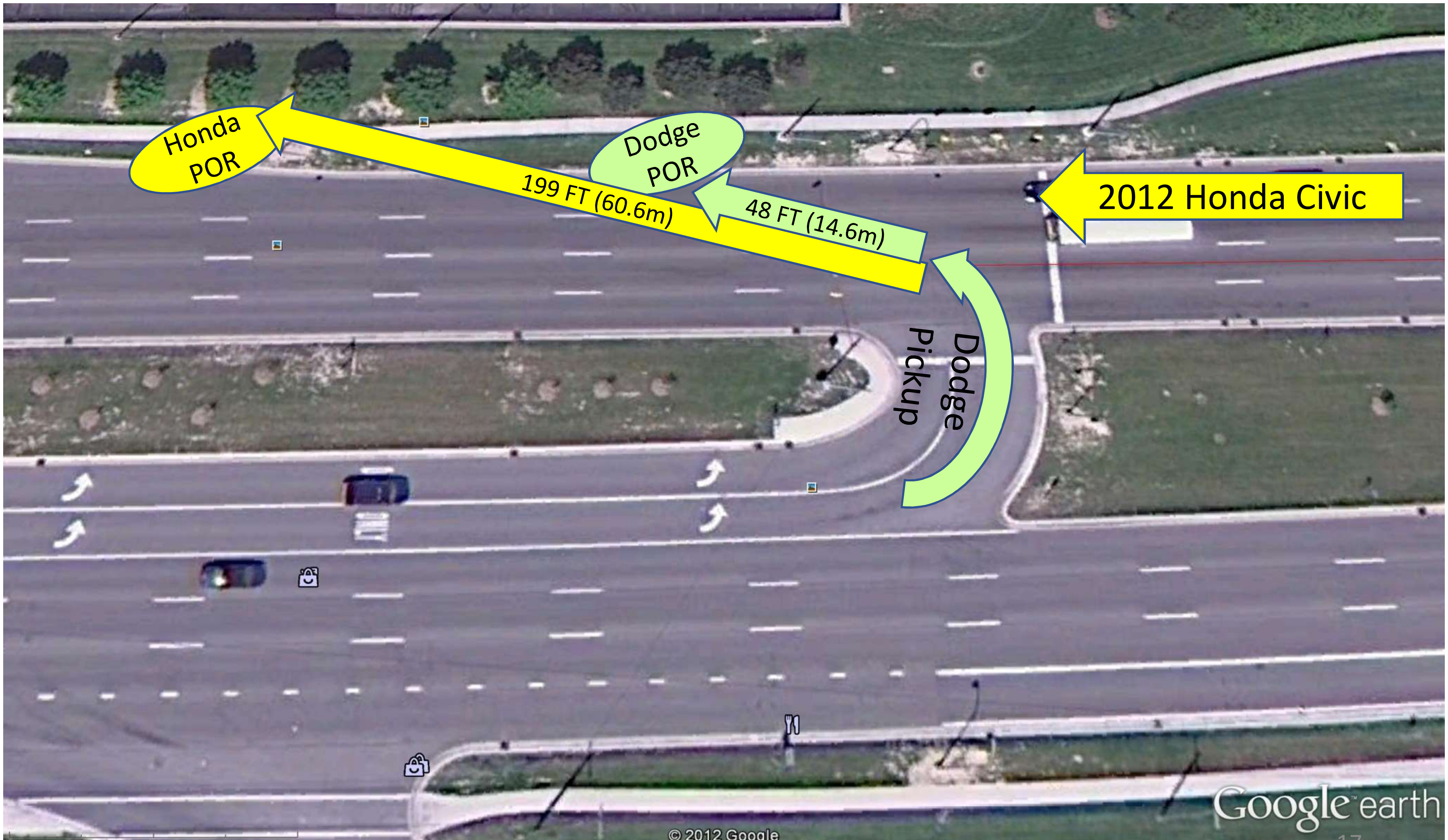
Main Messages

1. EDR's improve recon **accuracy** & get to **causation** – use with **all other** available scene evidence –but EDR can be PRIMARY EVIDENCE.
2. EDR strength is speed **PRIOR** TO *BRAKING* OR *LOSS OF CONTROL, &* DRIVER BEHAVIOR on gas and brake pedal. Modern ABS brakes TOOK AWAY your tire marks, only EDR can "give you back" speed prior to braking. Newer data elements give us EVEN MORE INSIGHT into precrash behavior.
3. Event Data Recording capability and data accessibility ***varies widely*** by **manufacturer, model *and* model year. JUST GET ALL THAT YOU CAN GET from EVERY VEHICLE** involved. NHTSA Part 563 EDR rule Sept 2012 was a game changer – required **Minimum** Data in vehicles equipped with EDR

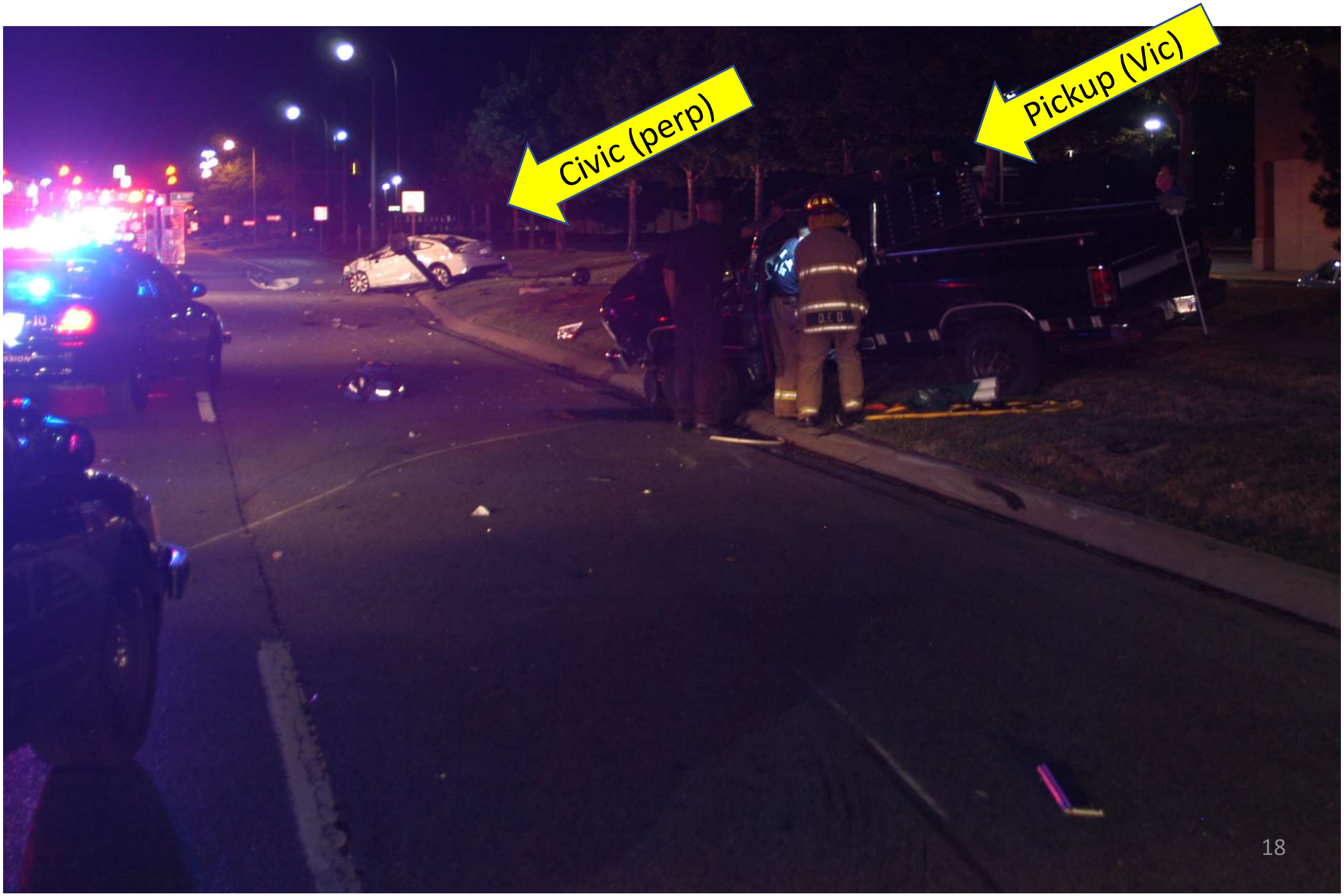
Main Messages

4. Most data is accessed using the Bosch Crash Data Retrieval (CDR) system. Make sure a critical mass of officers have the necessary training and equipment to access EDR's.
5. Follow proper procedure – have officer write a GOOD affidavit for search warrant (details coming). New US law Dec 2015 requires written owner permission or a warrant to access data.
6. Have data analyzed by an officer with proper training. Make sure recording is from your crash. Use multiple methods available from EDR to check speed.
7. If defense challenges admissibility, have Daubert hearing, give judge sufficient supporting docs to get data accepted by trial court AND survive appeal
8. Have police do time/distance work, Prepare visual aids for jury to understand what the EDR data means

Light for Honda turns red, Honda thinks he can get by U-turning traffic before it arrives, hits Dodge Pickup as it starts from green light in Passenger Side from Behind



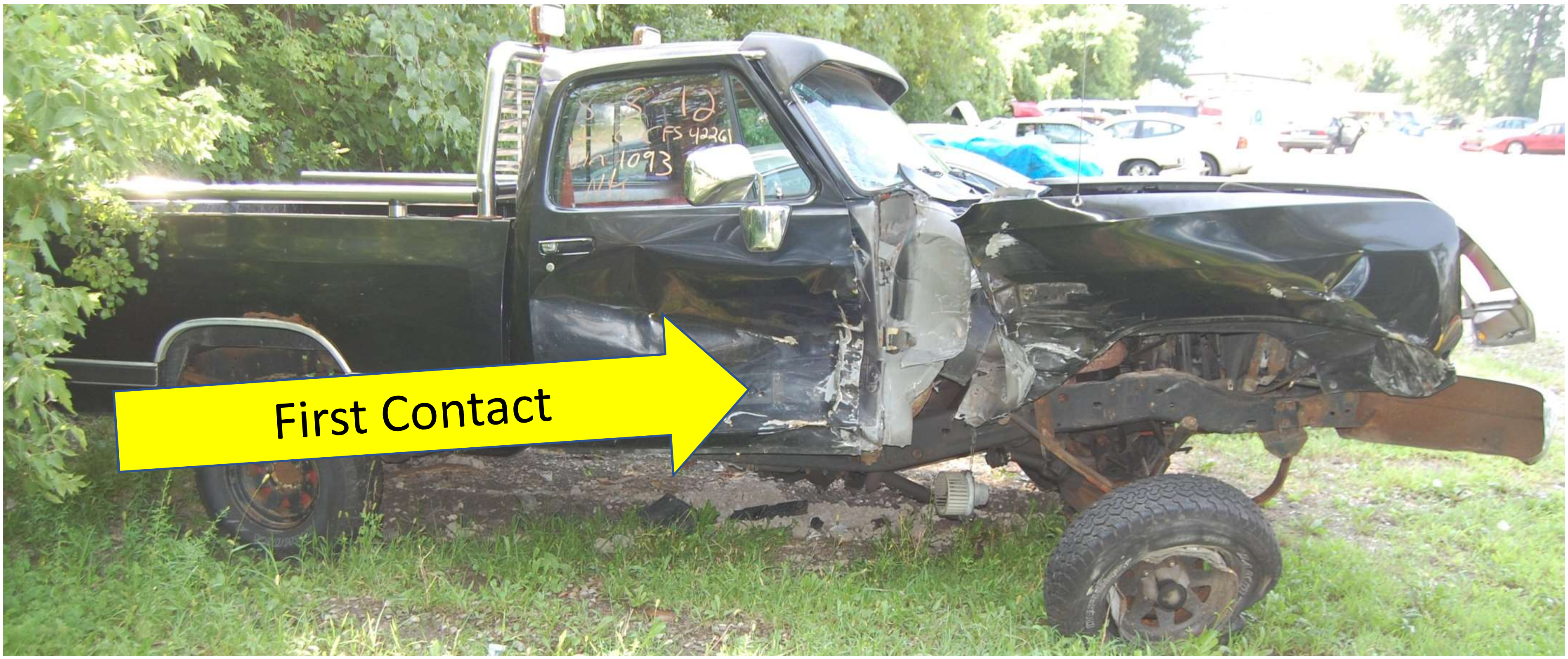
Points of Rest. Honda hits light pole and knocks it over then rolls out.



2012 Honda Civic Damage

First Contact to Driver Front Corner,
then 2 to 3 rolls based on different scratch directions on roof

Older Dodge Pickup Damage



Traditional Scene Evidence Workup (must calculate departure speeds)

<u>Honda Departure Speed</u>

$S=\sqrt{30Df}= \sqrt{30*199*0.6}$ = 59.8 mph

(ignores hitting light pole)

<u>Dodge Departure Speed</u>

$S= \sqrt{30Df}= \sqrt{30*48*0.7*70\%}$ = 26.5 mph

<u>Dodge Approach Speed</u> 10 mph @ 30^o to Honda

Honda Civic Curb Wt 2672 + 300 = 2972 lb

Dodge Weight = 4896 curb + 530 = 5426 lb

Roadway Drag Factor = 0.7G

Traditional Conservation of Momentum <u>Honda original direction of travel only</u>

- M1V1 + M2V2=M1V3 + M2V4
- V1 = [(M1V3)+(M2V4)-(M2V2)]/M1
- V1 = [(2972*59.8)+(5426*26.5)-(5426*10)]/2972
- V1 = **<u>90.1 mph</u>** in 50 mph Speed Limit Zone
- If drag factors are ranged +/-.05, **<u>85.1</u>** to 95.0
- **No Visible Skid Marks on Roadway** – witnesses imply swerve before impact, exact approach angles not known, exact departure angles not known. Could he have been going even faster???

BOSCH

Crash Data Retrieval Report p. 1

CDR CRASH DATA RETRIEVAL

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	2HGFG4A59CH******
User	
Case Number	
EDR Data Imaging Date	08/16/2012
Crash Date	
Filename	2012 HONDA CIVIC ROLL OVER.CDRX
Saved on	Thursday, August 16 2012 at 10:24:35
Collected with CDR version	Crash Data Retrieval Tool 6.0
Reported with CDR version	Crash Data Retrieval Tool 6.0
EDR Device Type	Airbag Control Module
Event(s) recovered	2

TWO events in memory
1. Impact into Pickup Truck
2. Side impact as it rolled over
2nd event "collateral damage", not needed for analysis

Comments

No comments entered.

Page 5 Section 1 – matches event

System Status at Event (Event Record 1)

Safety Belt Status, Driver	Unbuckled
Safety Belt Status, Right Front Passenger	Unbuckled
Seat Track Position Switch, Foremost, Status, Driver	No
Occupant Size Classification, Right Front Passenger Airbag Suppressed (Yes/No)	No
Frontal Air Bag Warning Lamp (On, Off)	Off
Ignition Cycle, Crash	1094
Multi-Event, Number of Events (1, 2)	1
Complete File Recorded (Yes/No)	Yes
Ignition Cycle, Download	1095
Maximum Delta-V, Longitudinal (MPH [km/h])	-22 [-35]
Time, Maximum Delta-V, Longitudinal (msec)	192.5
Maximum Delta-V, Lateral (MPH [km/h])	6 [9]
Time, Maximum Delta-V, Lateral (msec)	52.5
Time, Maximum Delta-V, Resultant (msec)	192.5

BIG and matches crush damage

Driver side consistent w/crash

Page 5 Section 3

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)

(the most recent sampled values are recorded prior to the event)

Same unless brake or stability control override

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	PCM Derived Accelerator Pedal Position, % full	Service Brake (On, Off)	ABS Activity (On, Off)	Stability Control (On, Off, Engaged)	Steering Input (deg)	Engine RPM	Accelerator Pedal Position, % full
-5.0	105 [169]	93	Off	Off	On Non-Engaged	RTFDL Pos=Left	5,800	93
-4.5	106 [170]	93	Off	Off	On Non-Engaged		5,800	93
-4.0	106 [170]	93	Off	Off	On Non-Engaged		5,900	93
-3.5	107 [172]	93	Off	Off	On Non-Engaged	0	5,900	93
-3.0	108 [174]	26	Off	Off	On Non-Engaged	0	5,300	26
-2.5	108 [174]	85	Off	Off	On Non-Engaged	0	4,600	85
-2.0	108 [174]	0	On	Off	On Non-Engaged	-20	4,600	0
-1.5	108 [174]	0	On	Off	On Non-Engaged	-5	4,400	0
-1.0	103 [166]	0	On	On	On Non-Engaged	-20	3,900	0
-0.5	103 [166]	0	On	On	On Non-Engaged	0	3,100	0
0.0	90 [145]	0	On	On	On Non-Engaged	10 ?	2,400	0

Using the Data – Peak Speed
108 +/-4% = 104 to 112 mph

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)

(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	PCM Derived Accelerator Pedal Position, % full	Service Brake (On, Off)	ABS Activity (On, Off)	Stability Control (On, Off, Engaged)	Steering Input (deg)	Engine RPM	Accelerator Pedal Position, % full
-5.0	105 [169]	93	Off	Off	On Non-Engaged	-5	5,800	93
-4.5	106 [170]	93	Off	Off	On Non-Engaged	-5	5,800	93
-4.0	106 [170]	93	Off	Off	On Non-Engaged	0	5,900	93
-3.5	107 [172]	93	Off	Off	On Non-Engaged	0	5,900	93
-3.0	108 [174]	26	Off	Off	On Non-Engaged	0	5,300	26
-2.5	108 [174]	85	Off	Off	On Non-Engaged	0	4,600	85
-2.0	108 [174]	0	On	Off	On Non-Engaged	-20	4,600	0
-1.5	108 [174]	0	On	Off	On Non-Engaged	-5	4,400	0
-1.0	103 [166]	0	On	On	On Non-Engaged	-20	3,900	0
-0.5	103 [166]	0	On	On	On Non-Engaged	0	3,100	0
0.0	90 [145]	0	On	On	On Non-Engaged	10	2,400	0

Using the Data – Speed at Impact from Speed Data

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)

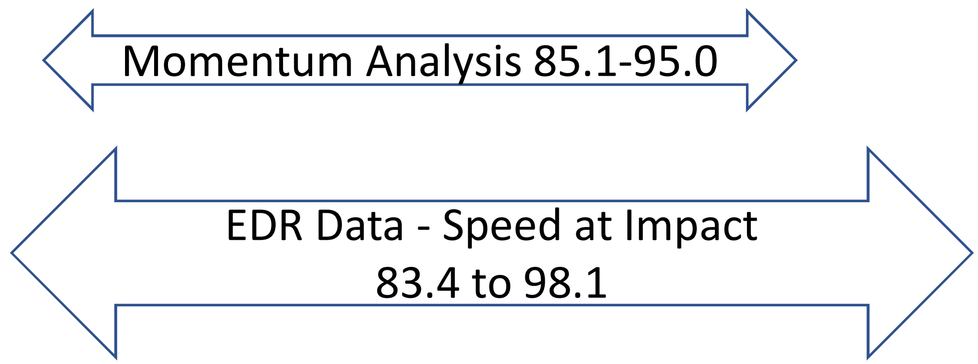
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	PCM Derived Accelerator Pedal Position, % full	Service Brake (On, Off)					Accelerator Pedal Position, % full
-5.0	105 [169]	93	Off					93
-4.5	106 [170]	93	Off					93
-4.0	106 [170]	93	Off					93
-3.5	107 [172]	93	Off					93
-3.0	108 [174]	26	Off					26
-2.5	108 [174]	85	Off	Off	On Non-Engaged	0	4,600	85
-2.0	108 [174]	0	On	Off	On Non-Engaged	-20	4,600	0
-1.5	108 [174]	0	On	Off	On Non-Engaged	-5	4,400	0
-1.0	103 [166]	0	On	On	On Non-Engaged	-20	3,900	0
-0.5	103 [166]	0	On	On	On Non-Engaged	0	3,100	0
0.0	90 [145]	0	On	On	On Non-Engaged	10	2,400	0

Speed at Impact Worksheet

	MIN	MAX
LAST	**90**	**90**
BRAKE	**-7.5**	**0**
ABS SLIP	**+4.5**	**+4.5**
SPEEDO	**-3.6**	**+3.6**
SPEED AT IMPACT	**83.4**	**98.1**

Reconcile EDR and Scene Evidence

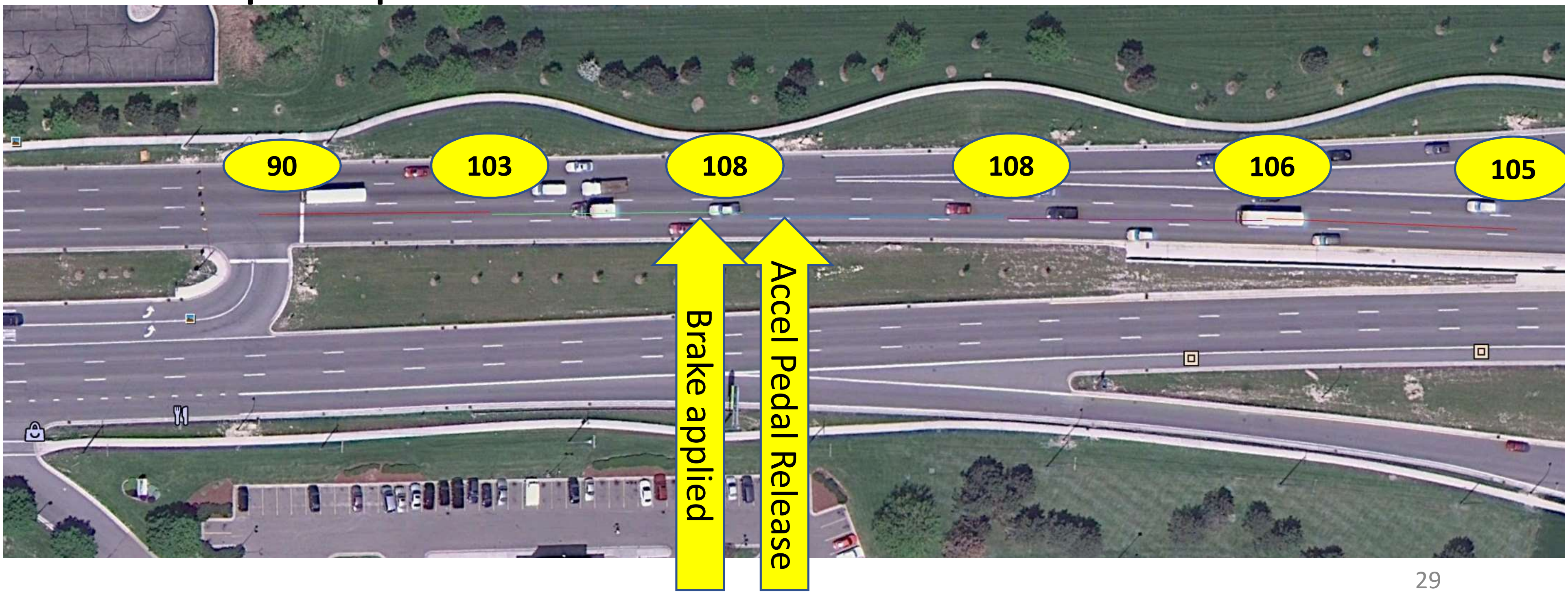


|------------|------------|------------|------------|---------

75 80 85 90 95

Do time distance analysis, place EDR data points on Google Earth photo

- Doing 105 mph at 844 feet to impact – how far back did DRIVER have to start speeding for the vehicle to get up to this speed? Do time distance on pickup truck too.

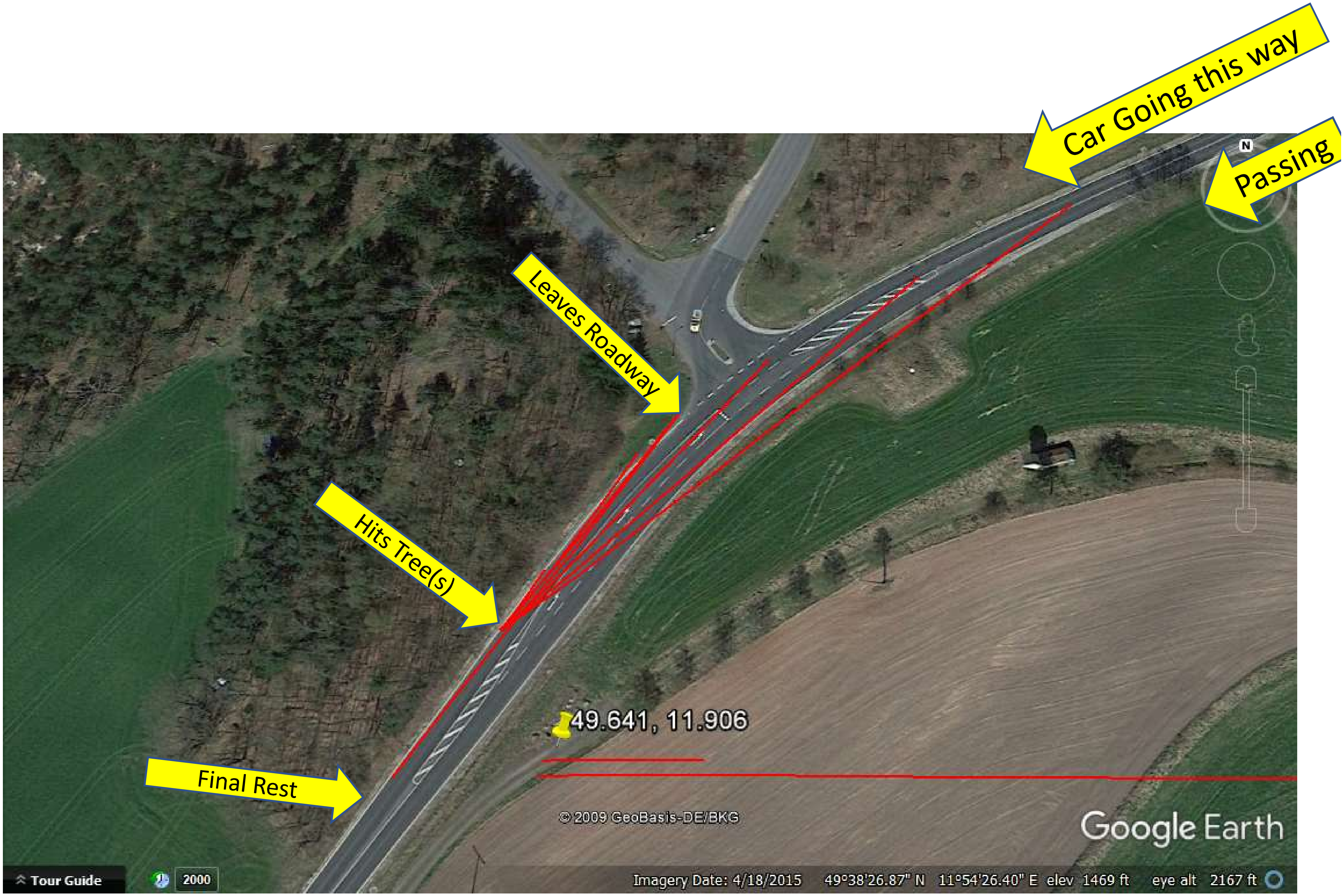


Conclusions

- Honda was racing @ speeds up to 104-112mph
- Speed at Impact was at least 85 mph
- Without EDR there would be no way to know anything other than speed at impact of 85
- EDR combined with time distance on truck shows Honda ACCELERATING, AFTER the light turned red.
- First emergency reaction was accel pedal release @ -2.0, between 296 and 375 feet to impact
- Stopping from 50 mph speed limit takes 119 ft, could have stopped in time if going speed limit.
- Honda swerved right prior to impact to avoid pickup, then left, trying to avoid curb.

Case Study 2
Designated Driver Gone Wrong

- Four US servicemen went out for a night on the town. The 2015 Subaru WRX owner gave the keys to the designated driver. Unfortunately, the designated driver drank too.
- Unrelated, An MP got a call to break up a bar fight among US servicemen at a different location.
- The Subaru was on its way home to its base when they came to the MP running lights but not sirens on its way to its callout.
- The Subaru passed ("overtook") the MP, went into a sweeping left curve, left the roadway to the right, hit the tree line, and a rear seat passenger was killed.
- It is a single vehicle crash with multiple tree contacts



Car Going this way
Passing
Leaves Roadway
Hits Tree(s)
Final Rest
49.641, 11.906
© 2009 GeoBasis-DE/BKG
Google Earth
Tour Guide
2000
Imagery Date: 4/18/2015 49°38'26.87" N 11°54'26.40" E elev 1469 ft eye alt 2167 ft

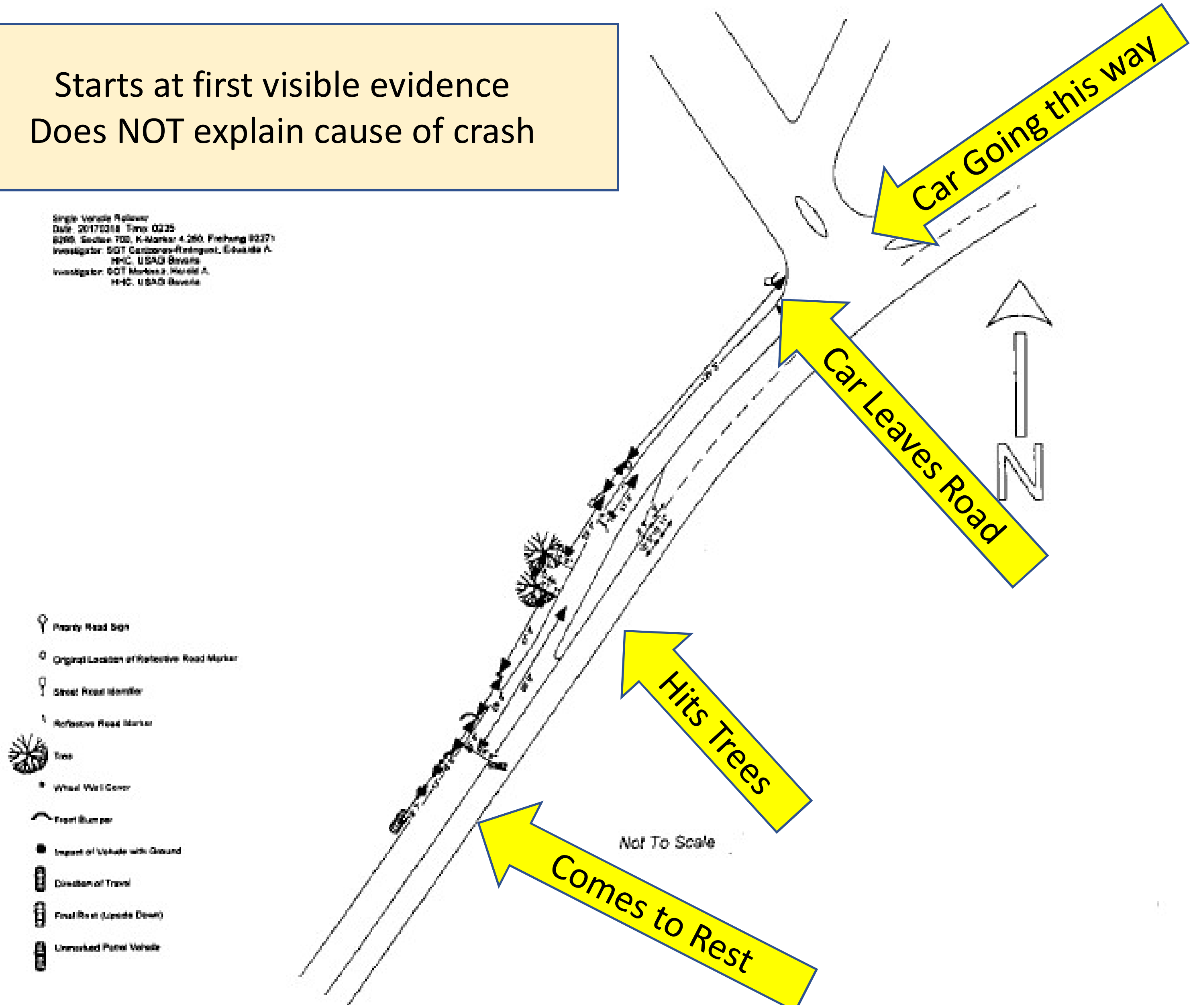
Windshield view approaching crash

Tire prints leaving road


WRX

Traditional Scene Diagram

Starts at first visible evidence
Does NOT explain cause of crash



Any EDR Data in 2015 Subaru WRX?

- Police were at first stymied by vehicle being a Subaru, which cannot be read with the normal Bosch Crash Data Retrieval System.
- Prosecutors contacted a Subaru specialty equipment owner to read the data for them.

Comparison of Timing of 4 Events based on speed data

Time to side bag deploy	Front New	Front Old	Side New	Side Old	Speed mph
	--------------------Speed in KPH-------------				
-4.7			**159**	**159**	99
-4.2			155	155	96
-3.7			151	151	94
-3.2		144	144	144	89
-2.7	135	135	135	135	84
-2.2	123	123	123	123	76
-1.7	127	127	127	127	79
-1.2	109	109	109	109	68
-0.7	*82*	*82*	*82*	*82*	51
-0.2	88	88	88	88	55
-0.1	(by analyst	judgement)		**87**	54
0	(by analyst	judgement	**84**		52
0.3	77	77			48
0.8	50	50			31
1.3	28	28			17
1.8	29	**29**			18
1.9-2.1	**29**				18

in <

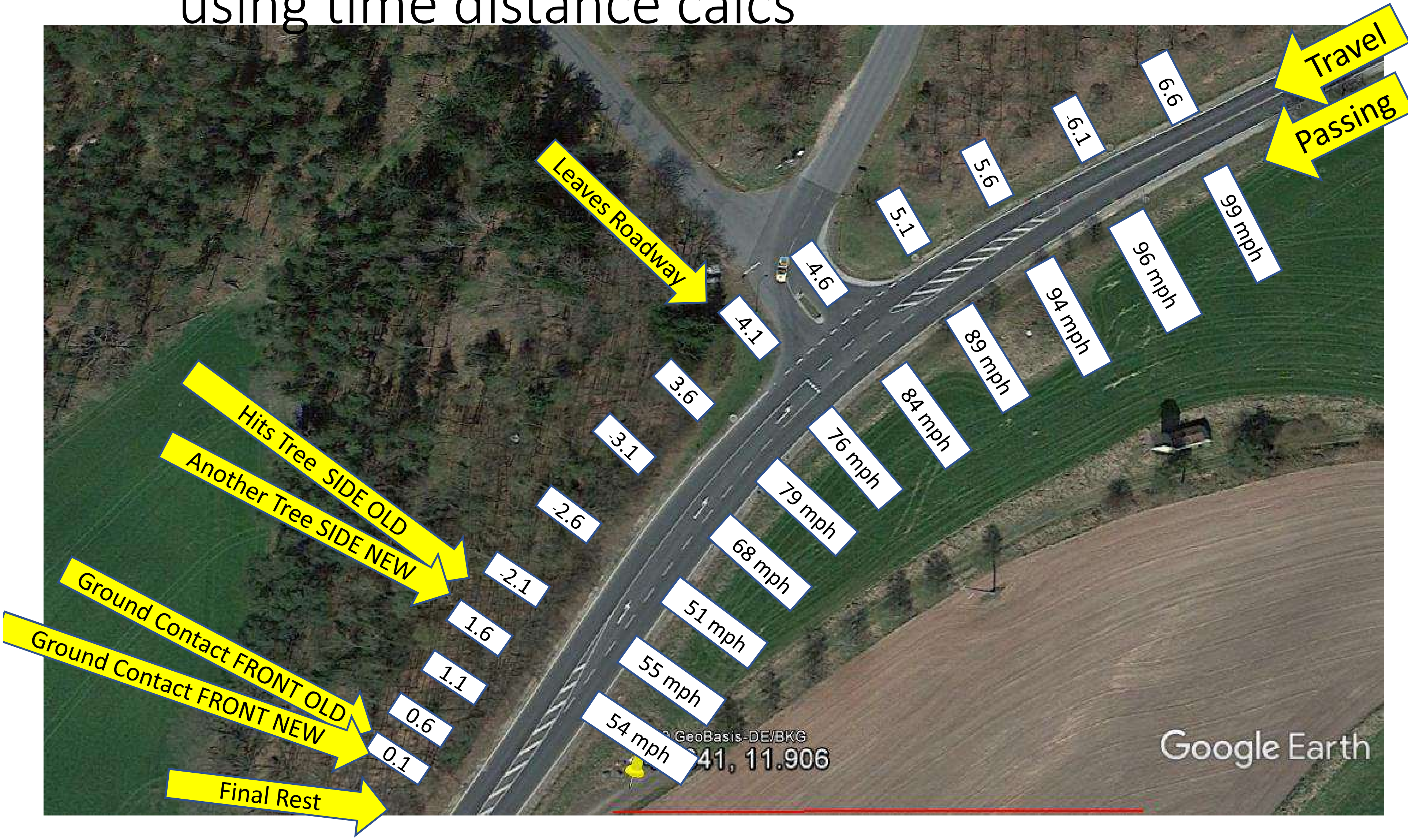
All 4 precrash files put together to see big picture

Consolidated EDR Data

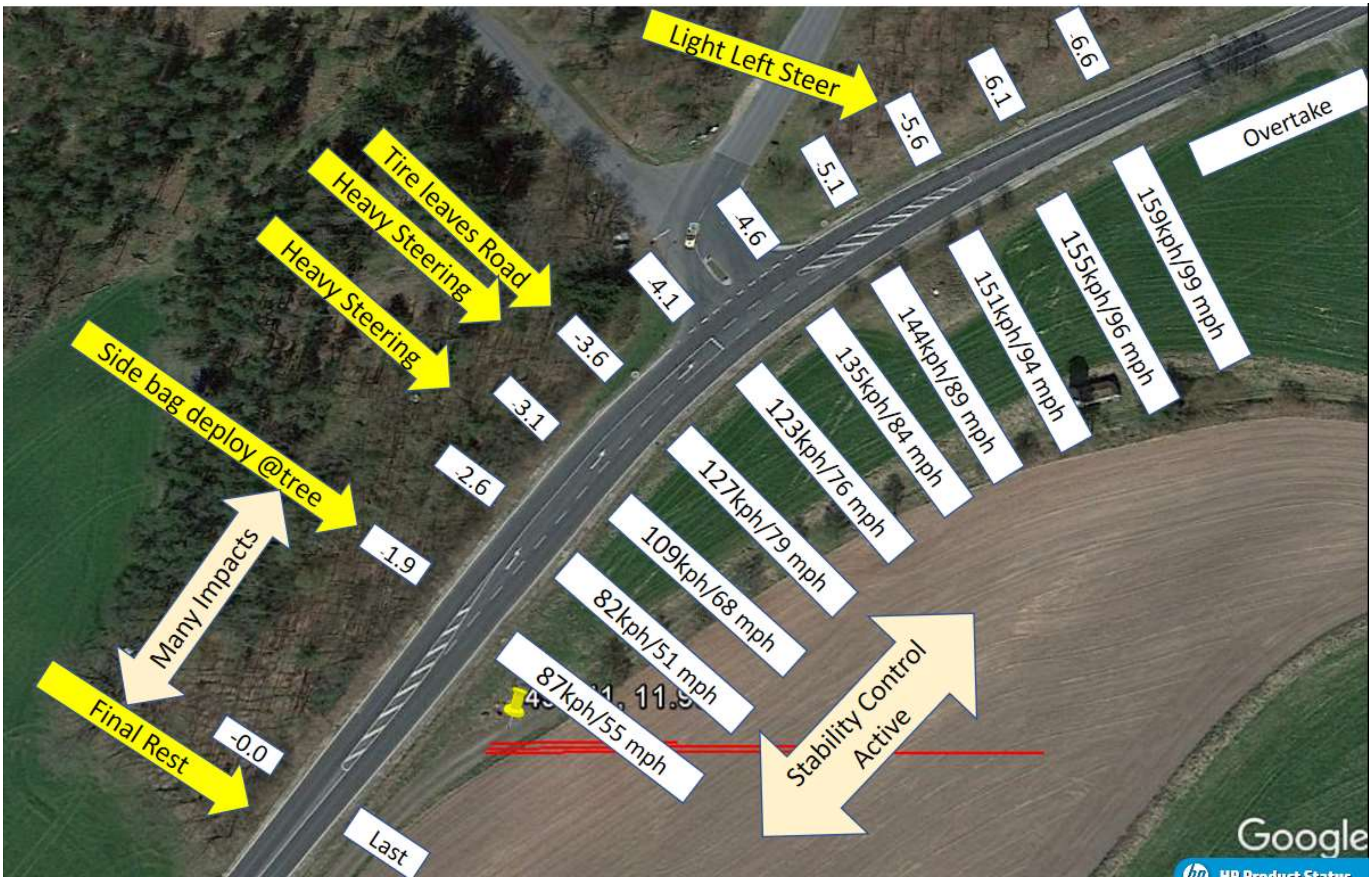
Time to tree deploy	Speed KPH	Speed MPH	Feet to tree deploy	Accel Pedal %	Brake	Engine RPM	ABS activity	Stabilty Control	Steering Angle	Comments, Scene Location
-4.7	159	99	-555.9	0	ON	3600	OFF	ON	0.0	Finished Overtake
-4.2	155	96	-483.5	0	ON	3500	OFF	ON	5.0	Before intersection
-3.7	151	94	-412.8	0	ON	3400	OFF	ON	17.5	
-3.2	144	89	-344.0	0	ON	3300	OFF	ON	17.5	
-2.7	135	84	-278.4	0	ON	3000	OFF	ON	12.5	enterng intersection
-2.2	***123***	76	-216.9	0	ON	3000	ON	Engaged	37.5	Almost where RF tire leaves road
-1.7	127	79	-160.9	0	ON	3000	ON	Engaged	92.5	R front tire off road
-1.2	109	68	-103.0	0	ON	2400	ON	Engaged	117.5	Emergency Reaction
-0.7	***82***	51	-53.3	0	ON	1900	ON	Engaged	90.0	
-0.2	88	55	-16.0	65	ON	1900	ON	Engaged	35.0	
-0.1	87	54	-7.9	65	ON	1900	ON	Engaged	32.5	Strikes first tree -4X, -12Y
0	84	52	0.0	0	OFF	2400	ON	ON	-57.5	Strikes second tree -3X, -6Y
0.3	77	48	24.1	0	OFF	1900	ON	ON	0.0	After initial impact
0.8	50	31	45.2	0	OFF	1000	ON	ON	155.0	Vehicle is no longer under
1.3	28	17	68.0	0	OFF	800	ON	ON	180.0	driver control (greyed out)
1.8	29	18	80.7	0	OFF	800	ON	ON	165.0	Ground Contact -21X, +13Y
1.9-2.1	29	18	94.0	0	OFF	800	ON	ON	165.0	Ground Contact -23X, +11Y

Bold italicized values are understated due to wheel slip during hard ABS braking

Place EDR data on scene photo using time distance calcs



Add steering info



Conclusions

- EDR data from event
- Speed 99mph in a 37 zone before leaving road
- Overlay multiple events to see back farther in time
- Driver off gas at -6.6, no braking until leaving road
- Driver does not follow left turn in road (<u>impaired</u>)
- Driver inputs heavy left steering too late, after off road
- Multiple tree contacts & rollover make traditional recon difficult

This concludes the case study

Getting the EDR Data (general)

- Need proper authority – Driver Privacy Act of 2015 requires warrant, or written consent, or electronic or <u>recorded</u> audio consent to access EDR.
- Affidavit of Probable cause is stronger if it contains detail based of officers' training and experience
  - I see large crush damage therefore I think high speed
  - I see large postcrash travel therefore I think high speed
  - I see dead people therefore I think high speed.
  - A policy of reading EDR's under specific circumstances may help
  - I see two cars hit each other so at least one of the two drivers may have been inattentive – EDR will show gas/brake pedal application -
- Get BOTH perpetrator and victim EDR's if they have them – victim's family will typically give consent.

Getting the EDR Data

- Get a list of WHICH AGENCIES have Bosch CDR systems and whether they are DLC only systems or also have the direct to module cable set (costs much more). Support larger agencies getting and maintaining their CDR system.
- **Iowa State Patrol** (5 Bosch CDR kits, one for each of 4 regions)

  (1 Kia & 1 Hyundai kit also) ***(3 trained analysts)***

  Chris Starrett
  Matt Schwenn
  Lynn Olson
- Counties – 5 of 99
  - Cass
  - *Fayette*
  - Linn
  - Polk
  - Pottawattamie
- Cities
  - Des Moines
  - Cedar Rapids
  - Council Bluffs
  - Dubuque
  - Waterloo

EDR in vehicles in your crash?

- Your *cops* that have Bosch CDR systems *should tell you*
- The current list of CDR-supported vehicles is on the web
- https://www.boschdiagnostics.com/cdr/sites/cdr/files/CDR_v17.8_Vehicle_Coverage_List_R1_0_1.pdf
- That file is in the reference materials on conf website
- Also on your conf website is my presentation "US EDR Status" with colored charts by make/model year/model, one page per manufacturer
- My presentation has brands not covered by CDR
- GM's started having speed data in 1999 and all GM had speed data by 2002.

Vehicles with data easily available (71 pgs)

https://www.boschdiagnostics.com/cdr/sites/cdr/files/CDR_v17.8_Vehicle_Coverage_List_R1_0_1.pdf

CDR® Vehicle List

CDR Software 17.8

Important Information about Vehicle Coverage

BOSCH
Invented for life

The Bosch Crash Data Retrieval Software and Hardware products support the retrieval of crash data from vehicles listed below.

Many vehicles listed in this document include coverage notes which may indicate limitations in CDR product coverage. Make sure that you read the coverage notes included below. For more detailed coverage information and/or limitations, refer to the

Bosch takes all reasonable actions to ensure the CDR product supports all vehicles in the markets specified in this and other CDR product documentation. However, there may be some vehicles listed that the CDR system is unable to retrieve EDR data from. This may be caused by (but not limited to) information that was not available to Bosch at the time the product was developed or, EDR retrieval may be available only on vehicles with particular options.

Market	Year	Make	Model	Important Coverage Notes
US, Canada	2019	Acura	MDX	
US, Canada	2019	Acura	RDX	
US, Canada	2019	Acura	RLX	
US, Canada	2019	Acura	TLX	
US, Canada	2018	Acura	ILX	
US, Canada	2018	Acura	MDX	
US, Canada	2018	Acura	NSX	
US, Canada	2018	Acura	RDX	
US, Canada	2018	Acura	RLX	
US, Canada	2018	Acura	TLX	

Ruth chart for Nissan – 2013+ CDR and 2006-2012 non-CDR with data

563 -38%

Yellow area not covered by CDR

Model	Location													
Last 3 digits of Bosch CDR cable number		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
INFINITI														
G CONVERTIBLE	TUNNEL BETWEEN SEATS				*		Jul-12		780					
G COUPE	TUNNEL BETWEEN SEATS		*	Yellow = Proprietary Consult Tool Only					780					
G SEDAN	TUNNEL BETWEEN SEATS						Jul-12		780					
M	TUNNEL BETWEEN SEATS								780					
Q40	TUNNEL BETWEEN SEATS										780			
Q50	TUNNEL BETWEEN SEATS								780	780	780	780	780	780
Q60	TUNNEL BETWEEN SEATS								780	780	780		780	780
Q70	TUNNEL BETWEEN SEATS								780	780	780	780	780	780
EX	TUNNEL BETWEEN SEATS			Dealers do NOT have special software					780					
FX	TUNNEL BETWEEN SEATS			required to read EDR					780					
JX35	TUNNEL BETWEEN SEATS								780					
QX50-80	TUNNEL BETWEEN SEATS								780	780	780	780	780	QX60 so fa
QX30	TUNNEL BETWEEN SEATS												780	780
NISSAN		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
370Z	TUNNEL BETWEEN SEATS		*				Aug-12		780	780	780	780	780	780
ALTIMA COUPE	TUNNEL BETWEEN SEATS			*					780					
ALTIMA SEDAN	TUNNEL BETWEEN SEATS		*	Yellow = Proprietary Consult Tool Only					780	780	780	780	780	780
ARMADA	TUNNEL BETWEEN SEATS	*		No direct to module cables					780	780	780	?	780	780
CUBE	TUNNEL BETWEEN SEATS				*				780	780				
FRONTIER	TUNNEL BETWEEN SEATS	*					Oct-12		780	780	780	780	780	780
GT-R	TUNNEL BETWEEN SEATS				*					780	780	780	780	780
JUKE	TUNNEL BETWEEN SEATS								780	780	780	780	780	
LEAF	TUNNEL BETWEEN SEATS								780	780	780	780	780	
MAXIMA SEDAN	TUNNEL BETWEEN SEATS		*						780	780	780	780	780	780
MICRA	Check Manual										780	780	780	780
MURANO	TUNNEL BETWEEN SEATS		*		*				780	780	780	780	780	
MURANO CROSS C	TUNNEL BETWEEN SEATS								included in above					
NV200	TUNNEL BETWEEN SEATS								780	780	780	780	780	780
PATHFINDER	TUNNEL BETWEEN SEATS	*							780	780	780	780	780	780
QUEST	CTR CONSOLE NEAR FRONT		*						780	780	780	780	780	
ROGUE	Check Manual			*					780	780	780	780	780	780
SENTRA	TUNNEL BETWEEN SEATS		*						780	780	780	780	780	780
TITAN	TUNNEL BETWEEN SEATS	*							780	780	780	780	780	780
VERSA SEDAN	TUNNEL BETWEEN SEATS		*						780	780	780	780		780
VERSA NOTE HB	TUNNEL BETWEEN SEATS						Sep-12		780	780	780	780	780	780
XTERRA	TUNNEL BETWEEN SEATS	*					Oct-12		780	780	780			

Getting the EDR Data

- System users should be trained. There is **not** a formal certification, just training completion certificates. Support a critical mass of officers getting this training.
- Many agencies will CDR kits will assist other agencies without them in reading crashed vehicle EDR's.
- **56%** of cars & light trucks on the road have an EDR with data accessible by the Bosch CDR system. 87+% of new autos are supported by Bosch CDR.
- Another 12% have EDR accessible by other tools. (Hyundai, Kia, Subaru, Mitsubishi). ISP has Kia/Hyundai. Most cops won't have the specialty tools but can rent them. **99%** have EDR.
- If not supported by CDR, police may be able to get manufacturer or supplier to read data in older modules (2006-2012 Nissan, mid to late 2000's Fords, etc).

Don’t forget the non-EDR data

- Common mistake is police may not have resources to map scene and do a reconstruction, or they don’t think reconstruction is needed because they think alcohol alone will get a conviction.
- Alcohol admissibility is often challenged, sometimes the alcohol doesn’t “get in”.
- Defense can challenge EDR data, claim it is new and unreliable. The best comeback is to show the EDR agrees with all the other available scene evidence.
- You can figure out 80% of what happened with EDR, 80% from scene evidence – to know 100%, you MUST PUT EDR & SCENE EVIDENCE TOGETHER

Have trained Analyst Review Data

- The analyst must first confirm the recording has captured the event under investigation
- Under some circumstances old events have filled up the memory, or new events do not get recorded due to power loss at impact, or events AFTER the initial crash have overwritten the event of the crash you are interested in.
- Must check that change in velocity magnitude AND DIRECTION match physical evidence of crash

Example of *not* verifying recording is from event of interest

- Car on secondary road comes to highway, car has stop sign.
- Car pulls out in front of motorcycle group, two cyclists T-bone car
- Police read module. It contains a side deployment with no speed data and a frontal event that says the car was going a steady 45 mph. Cop concludes car blew through stop sign. Prosecutor charges car driver with wonton negligence.
- Car driver claims to have stopped at stop sign before pulling out.
- Frontal event was an ***old*** event left in the memory.
- If the car had been going 45, the car's momentum would carry it forward a long way and take the bikes with it
- The car an bikes were found far left of the car's original path of travel, indicating the MC's had much more momentum that the car. *A good analyst would notice the momentum was not agreeing with the EDR.*

Develop two or more state EDR “experts” & use them

- It is common for police with EDR equipment to read EDR files for local agencies, but most tell the locals they are “on their own” to interpret it.
- Smaller local agencies ***don’t*** have trained analysts
- Need to “change the system” from local agencies with jurisdiction to have the trained analysts assist those agencies with untrained analysts. Need a “super expert” to get involved in the really tough cases.
- Need a “peer review” process to make sure the first analyst caught everything. Some EDR files are easy to interpret, some are much harder. Some new EDR’s have 75+ page reports – creating “information overload”. It takes experience and skill to quickly “sort the wheat from chaff”.

What should the analyst do?

- Determine recording is from crash of interest
- Determine if fastest speed in the recording is speeding and by how much. Determine if speed is critical to the case or not.
- Do very basic human factors check to determine if driver reaction was appropriate for the situation. Do time distance calculations and locate each EDR data point on a google earth photo/map. Lay in accelerator pedal release and brake application (and steering if available), if any, and whether they were appropriate.
- Note EDR data goes back much farther in time and distance than the police scene diagram. Police Scene diagram starts at first piece of visible evidence, EDR goes back to -5 seconds. You can see the driver behavior over a much longer period of time.

What should the analyst do?

- The EDR is not just ONE tool, it is several tools in one.
- If speed is critical, Calculate speeds using SEVERAL different methods.
  - Speed from speed data at -5 vs speed from engine RPM
  - Speed at impact from last data point
  - Speed at impact from Delta V and slide to stop
  - Speed at impact from closing speed (use Delta V and relative weights, adjust for offset and ground forces if necessary)
- See where all the methods overlap. That is where the truth lies.

Getting the EDR data in

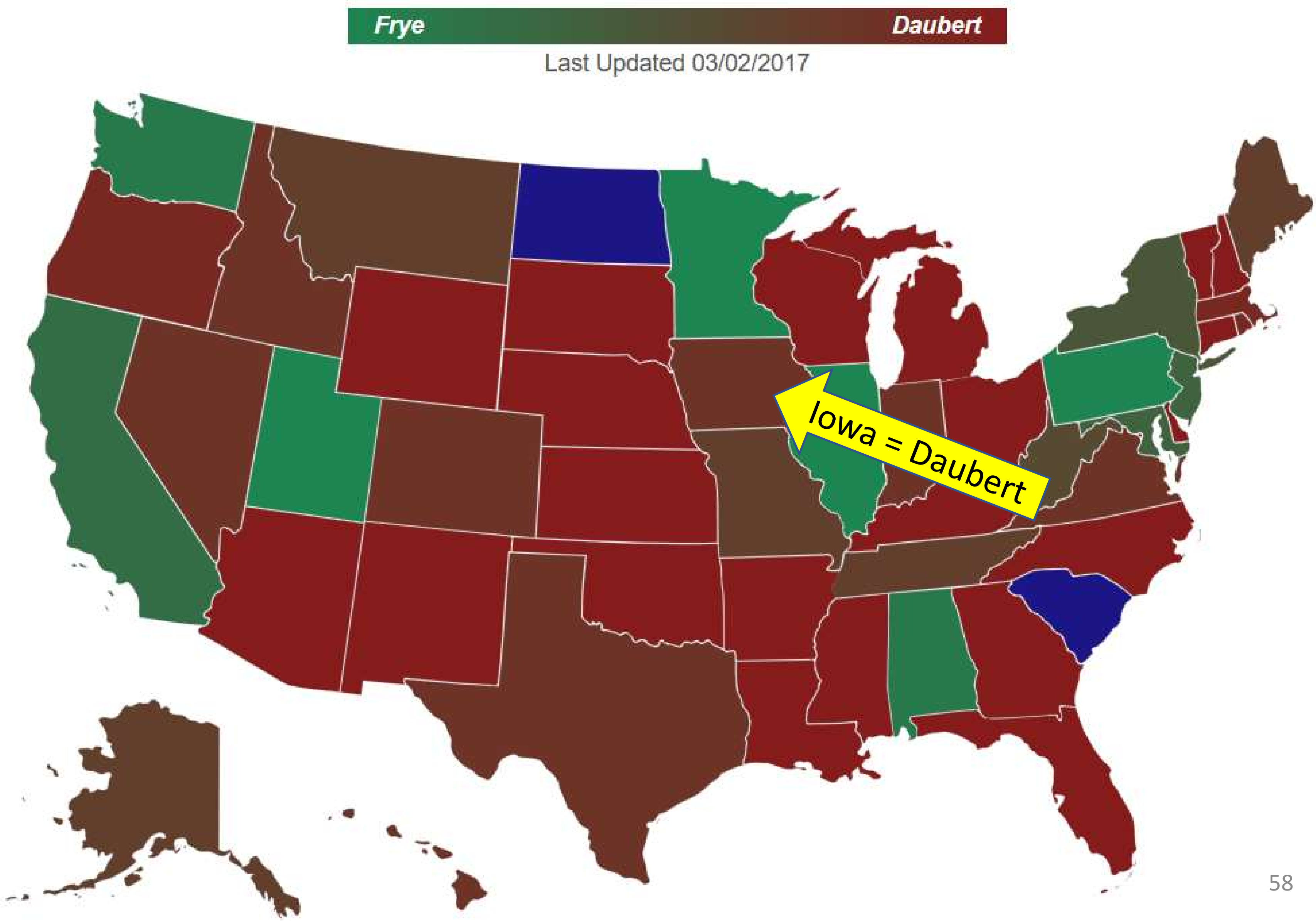
- Lay foundation for EDR admissibility. Consider having the state expert author a report long before trial so defense has plenty of time to either hire their own expert or object, so you can address any specific objection before trial.
- Use example reports from cases provided.

  Byard – Delaware

  Germany Subaru

  New Jersey

The Latest State Case Law for Expert Evidence



"Frye" Standard predates Daubert still used in ¼ of states

- Frye only applies if the judge decides the EDR is "**new or novel**" scientific evidence.
- If new, is it "sufficiently established to have gained ***general acceptance*** in the particular field in which it belongs"
- The first EDR case to address this was **Bachman** v General Motors, *776 N.E.2d 262,* 281 (Ill. App. Ct. 2002).
- We should NEVER lose a Frye hearing

Bachman v. Gen. Motors, 776 N.E.2d 262,
281 (Ill. App. Ct. 2002).

"We agree with the trial court that the process of recording and downloading SDM data does **not** appear to constitute a **novel** technique or method. . . . Crash sensors such as the SDM have been in production in automobiles for **over a decade**, and the microprocessors that run them and record their data also run everyday appliances, such as computers and televisions."

Bachman v. Gen. Motors, 776 N.E.2d 262,
281 (Ill. App. Ct. 2002).

The Bachman court went on to find *in the alternative* that the SDM data **satisfied the *Frye* test** for admissibility. *Id. at 282-83.*

Note the Bachman SDM was limited to longitudinal Delta V data

Florida v. Matos (Appeal)

CASE NO. 4D03-2043 – Opinion 3/30/2005

The court cited BACHMAN, and ruled:

"We agree on both points. The process of recording and downloading SDM data is **not a novel technique** or method. In any event, the state demonstrated that when used as a tool of automotive accident reconstruction, the **SDM data is generally accepted** in the relevant scientific field, warranting its introduction."

Note Matos SDM included precrash speed data

Daubert v. Merrell Dow Pharmaceuticals (92-102), 509 U.S. 579 (1993).

- Based on the Federal Rules of Evidence
- Determined “General Acceptance” could exclude new but reliable scientific information
- Created additional guidance for judges on how to determine if new scientific evidence is reliable.

Link to decision:
http://supct.law.cornell.edu/supct/html/92-102.ZO.html

U.S. "Daubert" criteria for evaluating the admissibility of expert testimony:

1. Whether the methods upon which the testimony is based are centered upon a **testable** hypothesis;
2. Whether the method has been subject to **peer review & publication**
3. The known or potential **rate of error** associated with the method;

4\. The existence of **Standards** controlling the technique's operation

5\. Whether the method is **generally accepted in the relevant scientific community** ***(same as Frye)***

Source: decision records

1. Tested or Testable Hypothesis

- Manufacturers test during product development crash tests
- NHTSA conducts crash tests regularly and now collects the EDR data and periodically compares it to reference instrumentation .
- Independent Researchers have artificially created crash signals to get EDR recordings and tested data versus reference instrumentation.
- For Ford PCM EDR, you can drive down the road at 60 mph, time yourself between 2 mile markers at 60 seconds, then pull over and shut the key off. Read the PCM and confirm to yourself the vehicle was reported as traveling 60 mph with accelerator pedal at cruise and that you then hit the brake.

2. Published and Peer Reviewed

- Chidester “Recording Automotive Crash Event Data” at Intn’l Symposium on Transportation Recorders-1999
- Lawrence “The accuracy of pre-crash speed captured by event data recorders” SAE 2003-01-0889.
- Niehoff “Evaluation of Event Data Recorders in full system crash tests” 19th International Technical Conference on Enhanced Safety of Vehicles (2005).
- **Gabler et al, “Preliminary Evaluation of Advanced Air Bag Field Performance Using Event Data Recorders”** NHTSA 2008 Report DOT HS 811 015
- Tsoi et al, “Validation of Event Data **Rec**orders in High Severity Full-Frontal Crash Tests”, SAE 2013-01-1265
- 49CFR Part 563 published 2006 effective 9/1/2012
- Additional publications listed at end of this section.

3. Known Error Rate – (Speed)

- 1999 Chidester: GM EDR speed data accuracy +/- 4%.
- 2003 Lawrence created artificial crash signals during normal driving and found the GM EDR speed to be under reported by 1.5 kph (about 1 mph) at low speeds and over reported by 3.7 kph (about 2.3 mph) at high speed.
- 2005 Niehoff reported 28 crash tests from 40 to 64 kph and determined the average error rate in GM EDR pre-impact speed was 1.1% with a maximum of 3.7%.
- 2008 Gabler reported 48 crash tests from 25-40 mph and determined pre-crash speed was within 3% except for one test where speed was under-reported by 7mph.
- 2008 Ruth reported 18 test runs each on 3 vehicles with Ford PCM EDR steady state speed data within approximately +/-1% in the 30 to 70 mph range.
- For vehicles produced after 9/1/2012, 49CFR Part 563 requires speed accuracy to be +/- 1 kph.

4. Existence & Maintenance of Standards

- The National Highway Traffic Safety Administration (NHTSA) issued final rule 49CFR Part 563 in 2006 setting minimum content, resolution, and accuracy for EDR data elements, effective 9/1/2012.
- The Society of Automotive Engineers (SAE) published recommended practice J1698 for EDR's in 200X, recently updated.
- The International Standards Organization has has an EDR document.

5. General Acceptance

- Auto manufacturers install EDR's and rely upon the EDR data to investigate field concerns and to give feedback to product development on current product performance to influence future designs.
- In 1997 the National Transportation Safety Board called for EDR's to be installed in all vehicles (REFERENCE "H97-18").
- National Highway Traffic Safety Administration (NHTSA) estimated that 65 to 90 percent of new vehicles already had some type of recording capability in 2004. In 2017, 99% of all new cars and light trucks are equipped with an EDR.
- NHTSA proposed requiring EDR's in all cars by 9/2014 (still pending).

5. General Acceptance cont'd

- Vetronix Corporation (now Bosch), began making a tool to read EDR's in 2000, over 2,000 are in use today.
- For over 13 years there has been an annual Crash Data Retrieval User's "Summit" (conference) with 2018 drawing 298 attendees.
- There is a user group with over 1300 participants on Yahoo known as "CDR Tool" which has been in operation since 2000 and logged over 23,400 message posts.
- Since 2011 Society of Automotive Engineers World Congress had a technical session dedicated exclusively to Event Data Recorders.
- There is an EDR Westlaw Document 17_19_46 briefing attorneys on EDR use in legal matters.

Courtroom Presentation

- Jurors may initially be shocked cars have EDR's, worry if govt is spying on them – warm them up
- Have your expert explain history of EDR and why they are good – they are the only objective witnesses and they speak for the dead victim who can't tell us their story
- Use big, easy to read colorful visual aids with EDR data and EDR data overlaid on google earth photos
- Keep it simple on direct. Jurors can see the speed numbers, they will take them literally as long as they make sense – have cop explain anomalies.
- CSI TV-watchers jurors expect to be dazzled with tech

Other electronic data (NOT EDR) in cars & light trucks - Infotainment

- More for gang & organized crime investigations
- Some newer vehicles have factory GPS systems that store “breadcrumbs” of where they have been and when.
- Automakers do NOT authorize access to this data, for privacy reasons, but a small company of talented hackers, BERLA, sell hardware and training to access some factory EDR data (Ford Sync Gen 2 & 3, and GM ONSTAR)
- This requires access to the hard drive in the infotainment system, and forensic lab type analysis.
- Use only for special cases that justify resources to get it

Iowa Traffic Homicide Case Study

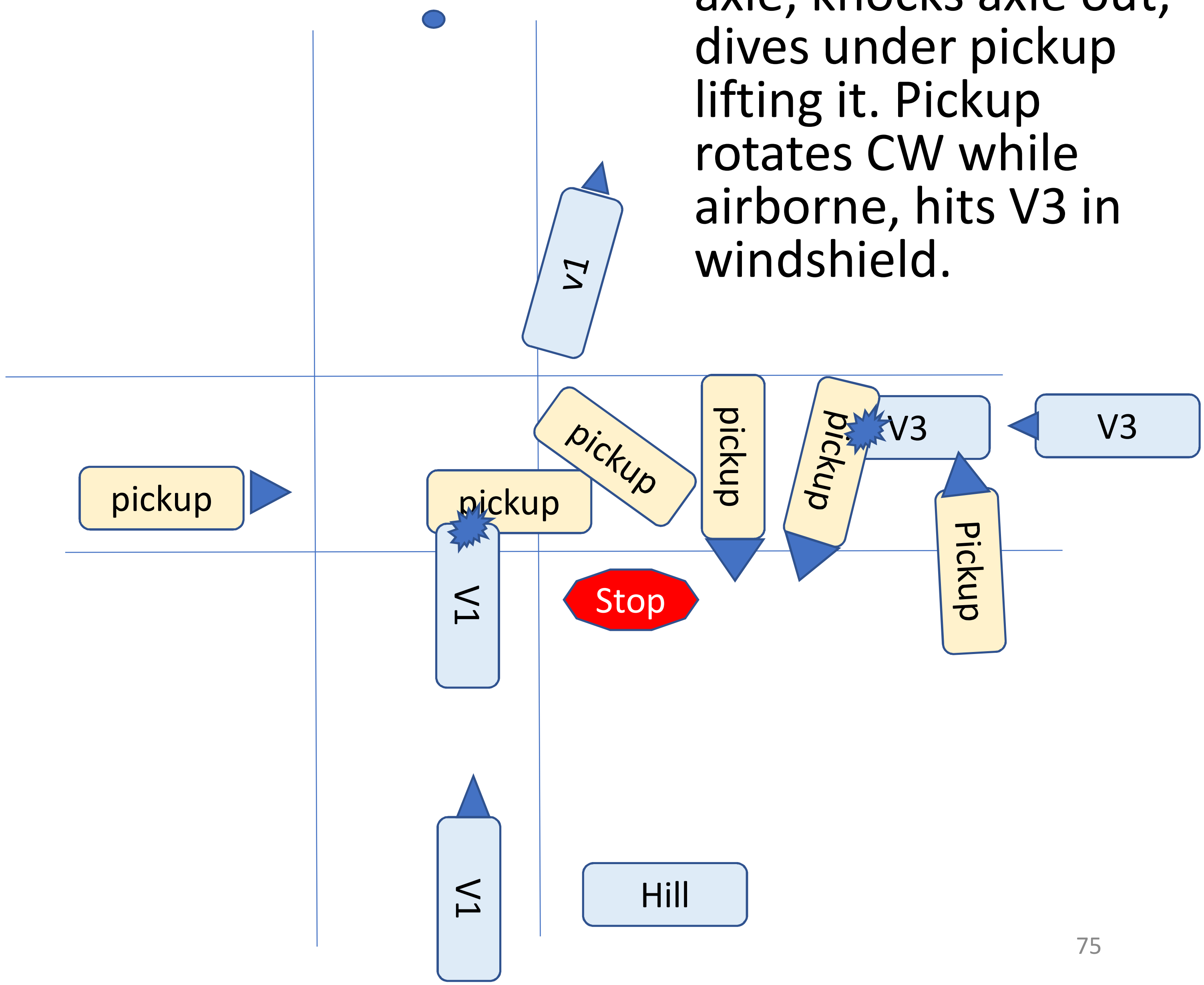
- Criminal Prosecution Case – Reckless Driving resulting in Death (no alcohol involved)
- Charged V1 driver is in 25 mph residential area, comes over top of small hill at 48 mph (per EDR), sees stop sign at intersection at bottom of hill.
- Driver may slow but enters intersection, pickup crossing from right gets hit in rear axle (Pickup had no traffic control device)
- V1 knocks axle out front under V2 pickup, goes under pickup and lifts pickup rear off the ground and rotates it clockwise (pirouetting).

Case Description Cont'd

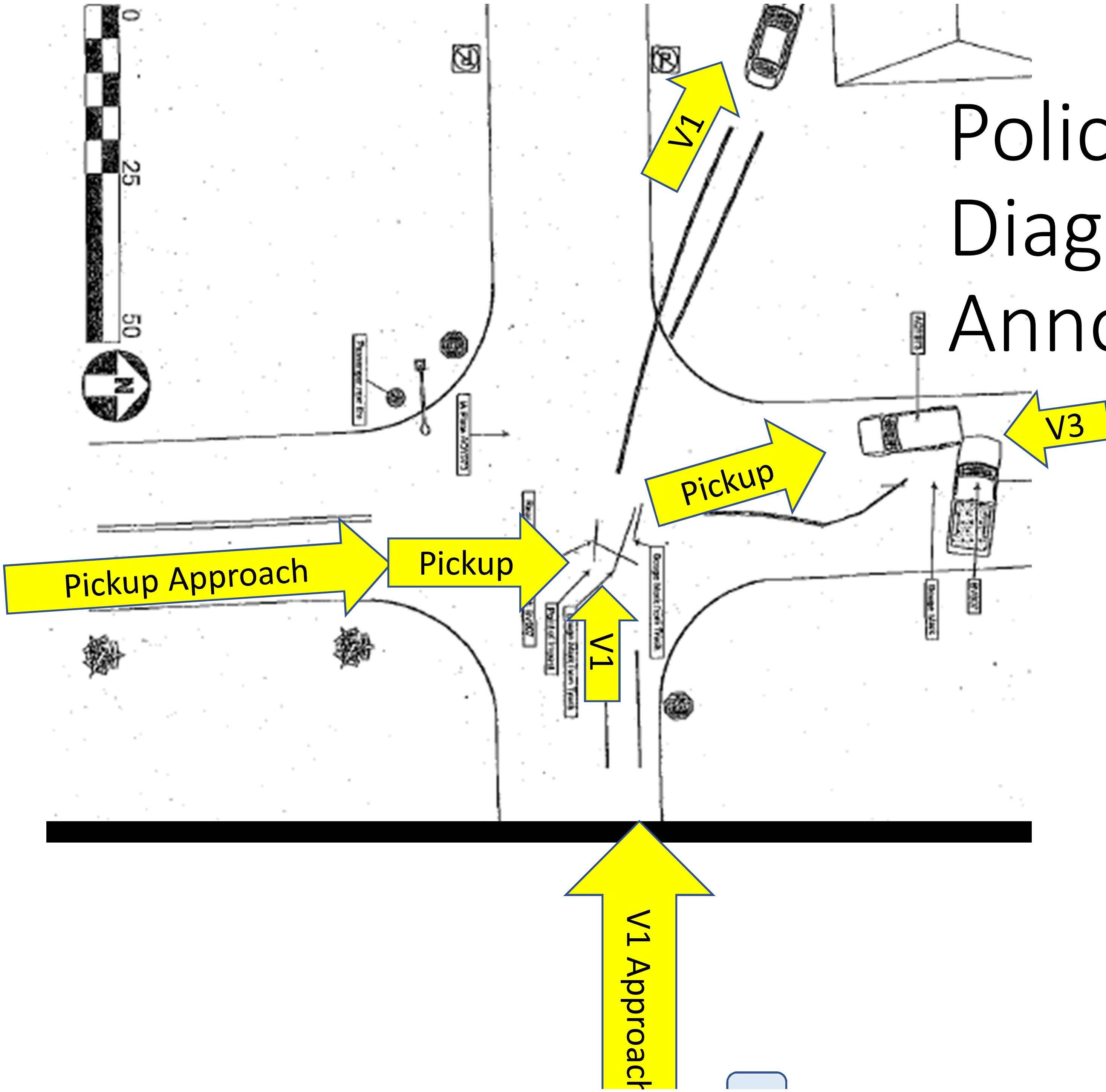
- V3 victim approaches from right
- Airborne pickup V2 rear end crashes through windshield of V3, killing front seat passenger (a child)
- V2 pickup rotates back counterclockwise and comes to rest behind V3
- After V1 goes under pickup it continues forward and right into yard

Crash Scenario

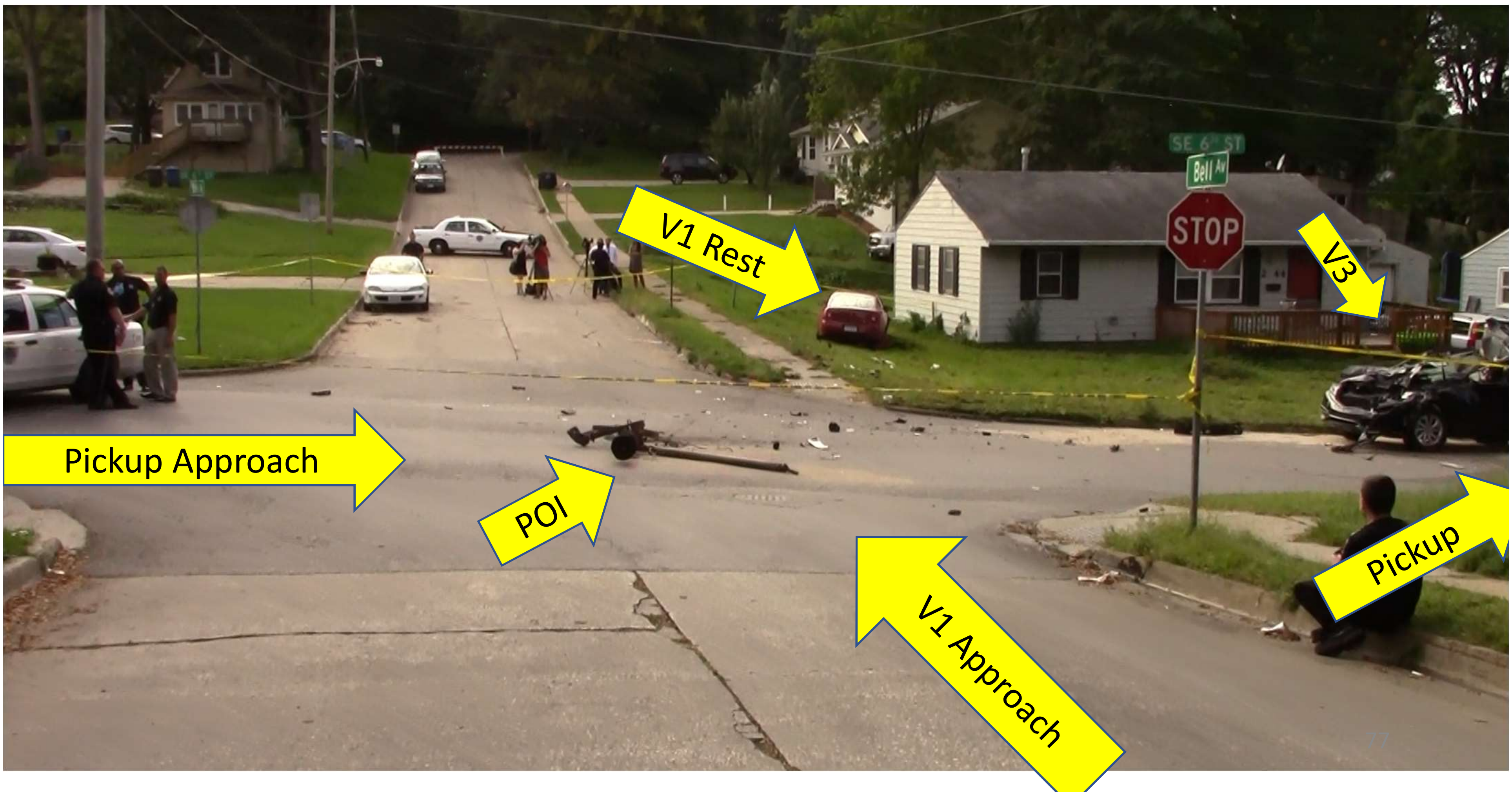
- V1 hits pickup in rear axle, knocks axle out, dives under pickup lifting it. Pickup rotates CW while airborne, hits V3 in windshield.



Police Diagram Annotated

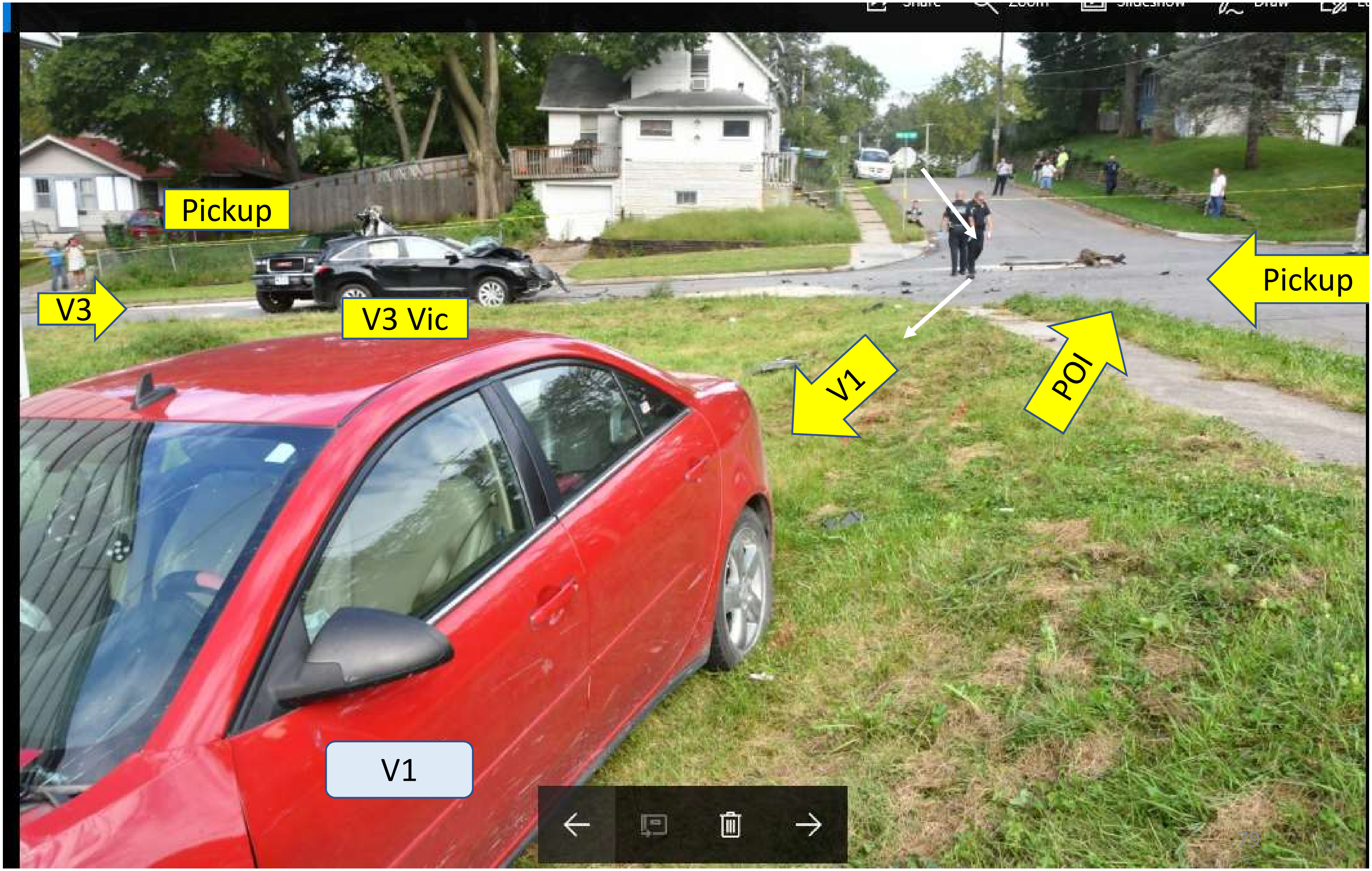


Crash Scene – note tire marks on police diagram are not very visible



Crash Scene aftermath

Crash Scene Aftermath



Defendant's car at rest
Went underneath pickup rear end

Pickup at Rest (V3 to right)
Defendant went under, tore axle

Other Facts of Interest

- 18 year old with no Driver's License
- Buying car from his dad with payments, has been driving 11 months with no license and no driver training
- Girl friend in front pass seat, two kids in the back seat
- Pickup Driver sees V1 is going to blow stop sign, tries to speed up to get through ahead of him
- Victim V3 is just in the wrong place at the wrong time – what are the odds a pickup truck rear end will come airborne thru your windshield on a residential street??????
- No Alcohol involved

BOSCH 16-27805 CDR CRASH DATA RETRIEVAL

EXAMINE CDR REPORT

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	1G2ZH578764183735
User	Hedlund, J. 5070
Case Number	20160027805
EDR Data Imaging Date	09/09/2016
Crash Date	09/08/2016
Filename	16-27805 PONTIAC G6.CDRX
Saved on	Friday, September 9 2016 at 18:36:51
Collected with CDR version	Crash Data Retrieval Tool 16.6
Reported with CDR version	Crash Data Retrieval Tool 16.6
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as Deployment Event #2, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds of a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.

The second type of SDM recorded crash event is the Deployment Event. It also may contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. If a second Deployment Event occurs any time after the Deployment Event, the

Defendant was at 100% throttle climbing blind hill

Pre-Crash Data

Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	47	48	47	46	42
Engine Speed (RPM)	3712	3584	1536	1408	1216
Percent Throttle	100	27	0	0	0
Brake Switch Circuit State	OFF	OFF	OFF	ON	ON
Accelerator Pedal Position (percent)	100	41	0	0	0
Antilock Brake System Active (If Equipped)	No	No	No	No	No
Lateral Acceleration (feet/s²)(If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Yaw Rate (degrees per second) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

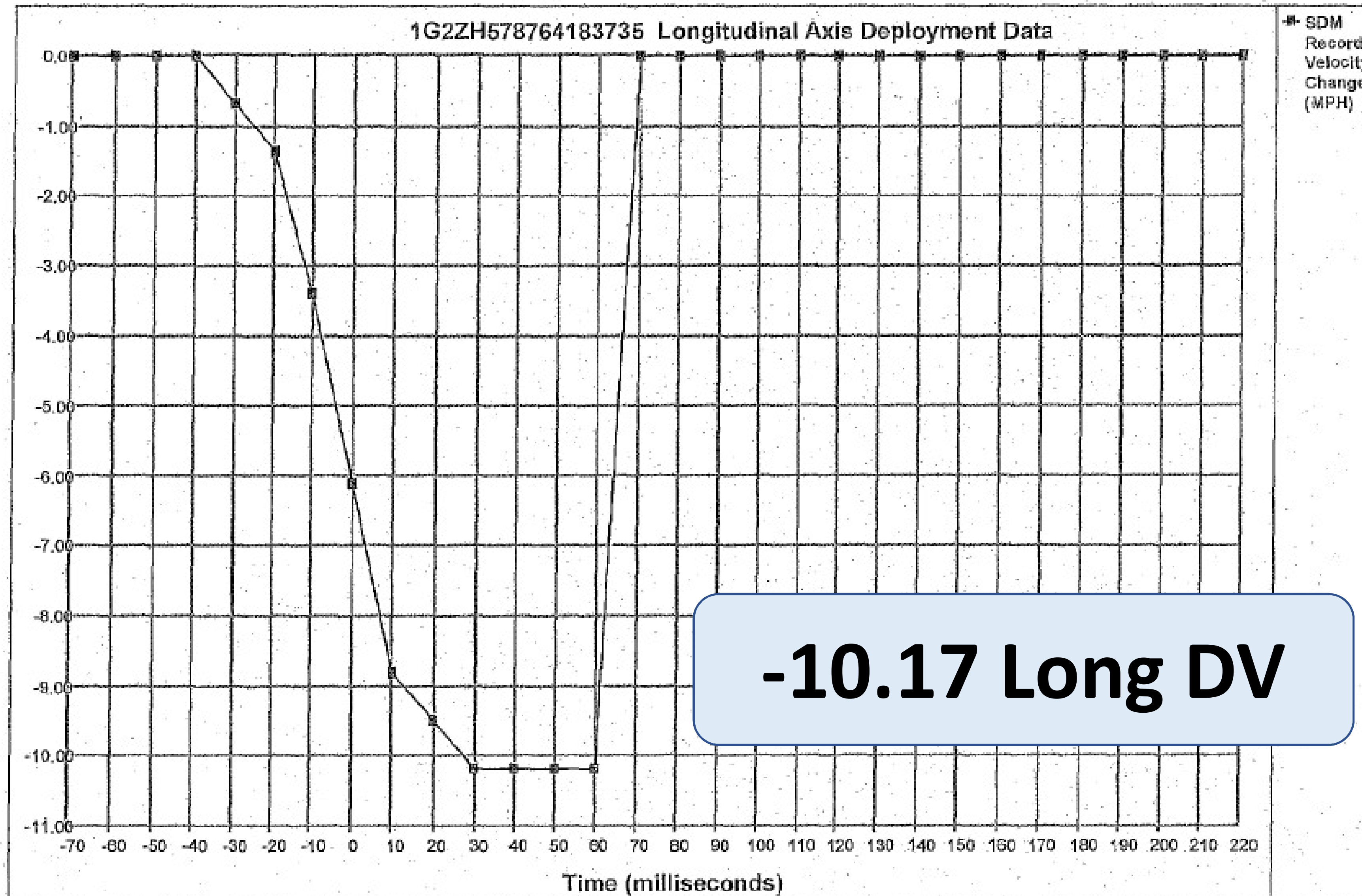
FASTEST 48

LAST REPORTED 42

100

ON

No ABS



-10.17 Long DV

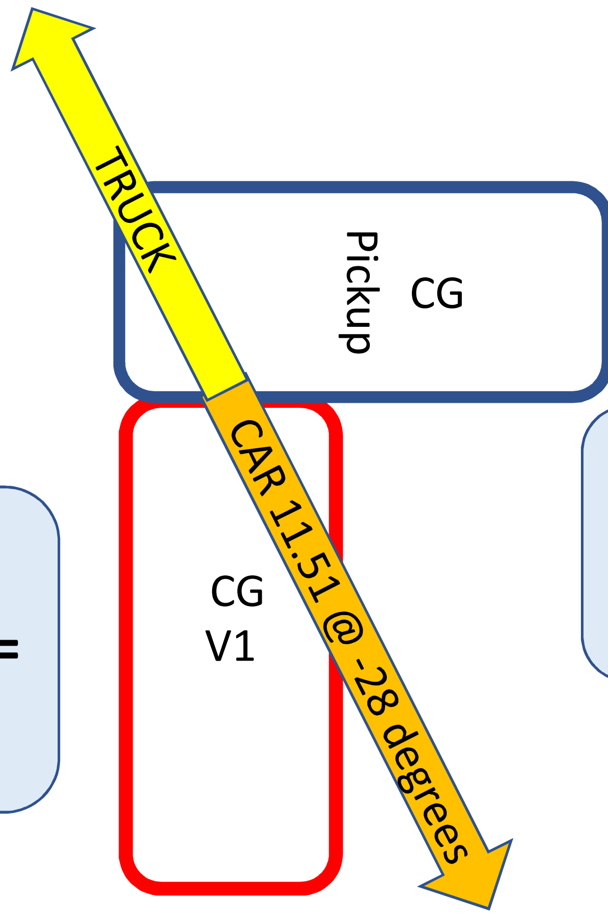
Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	-0.68	-1.36	-3.39	-6.10	-8.81	-9.49	-10.17	-10.17	-10.17

ANALYSIS – IS THIS RECORDING FROM MY CRASH??

- Complete Recording
- Key Cycles Match 20585 vs 20585
- Delta V magnitude 11.51@ 28 degrees fits damage
- Last reported speed of 42 and slowing seems consistent with lifting pickup into air
- It's a deployment, deployments are rare

SKETCH VEHICLES @ MAX ENGAGE

- Draw Vehicles at Max Engagement and Draw PDOF Line



Total DV = Sqrt($10.17^2+5.42^2$)= 11.51

PDOF = ATAN 5.42/10.21 = -28 degrees

Prosecution Dilemma

- In this jurisdiction, you cannot get Reckless Homicide by SPEED Alone
- + Limited sightline due to hill enough???
- Defense is prepared to concede 48 mph EDR speed, but will argue Defendant **reacted appropriately** by braking after seeing stop sign and that prosecution ONLY has speed
- But **did he**????

Defense Expert Calculations

Speed at Impact method 3 = Speed from last Edr reported speed data	MIN	MAX
Last speed reported in EDR	42	42
Change since last reported speed	-18.2	0
Wheel Slip adjustment	0	0
Speedometer Error	-1.68	1.68
Speed at Impact	22.1	43.7 mph

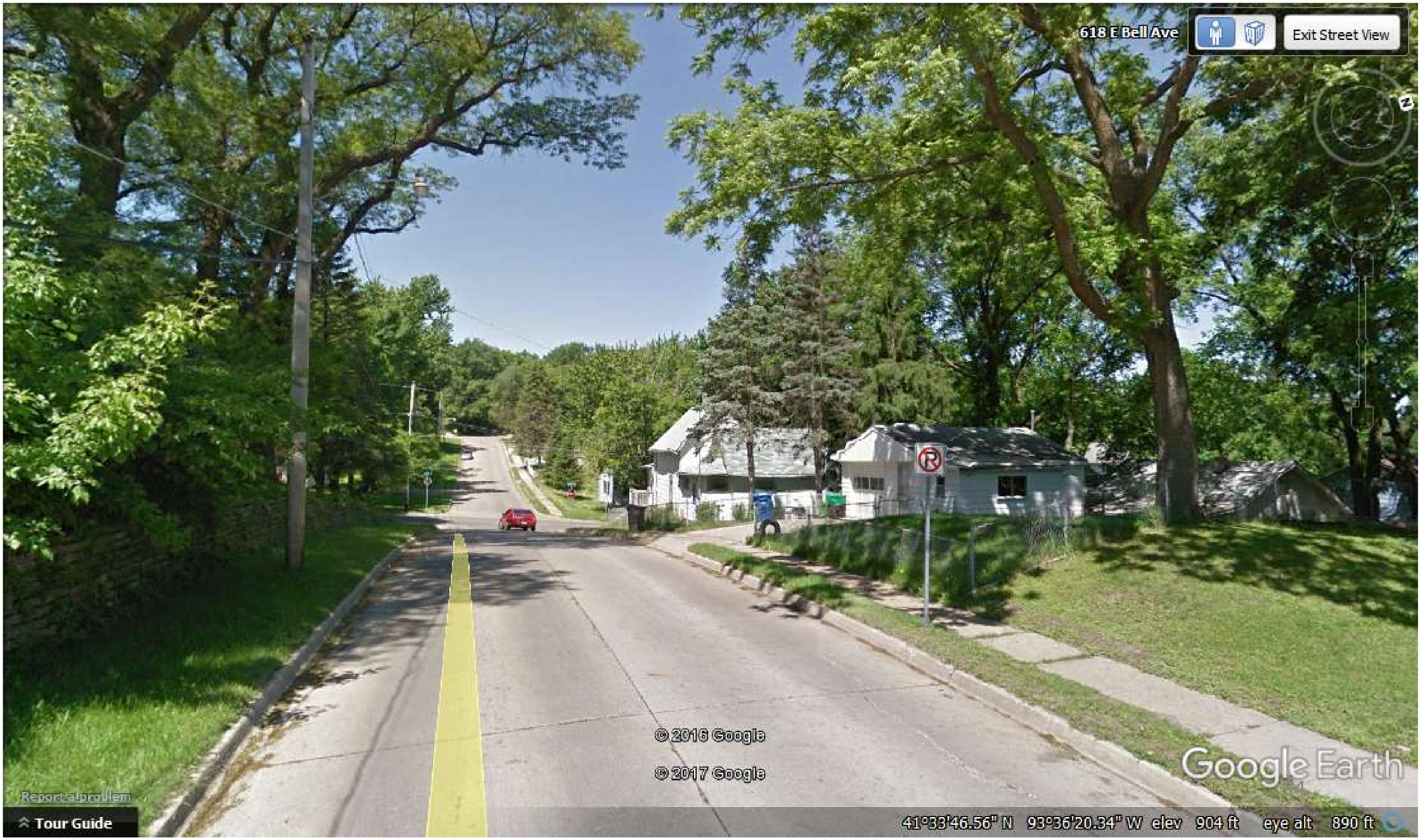
Defense Logic

- 3 seconds from when stop sign was first visible
- 48 mph at first visibility
- Perception Reaction time 1.5 seconds
- Speed loss 1.5 sec * 18 mph/sec = 27 mph
- 48 mph – 27 mph = 21 at impact
- Speed at impact calc from last speed data point of 42 yields 22 mph = Reacted Normally
- Defense further says momentum , while not impossible, would be very difficult due to airborne truck and 3rd vehicle, range on answer would be wide.

Defense Expert Stopped There

Stop sign visible at 200 feet (3 sec)


620 E Bell Ave
Exit Street View
© 2016 Google
© 2017 Google
Google Earth
Report a problem
Tour Guide
Imagery Date: 6/2011 41°33'45.02" N 93°36'19.77" W elev 1008 ft eye alt 886 ft


618 E Bell Ave
Exit Street View
© 2016 Google
© 2017 Google
Google Earth
Report a problem
Tour Guide
41°33'46.56" N 93°36'20.34" W elev 904 ft eye alt 890 ft

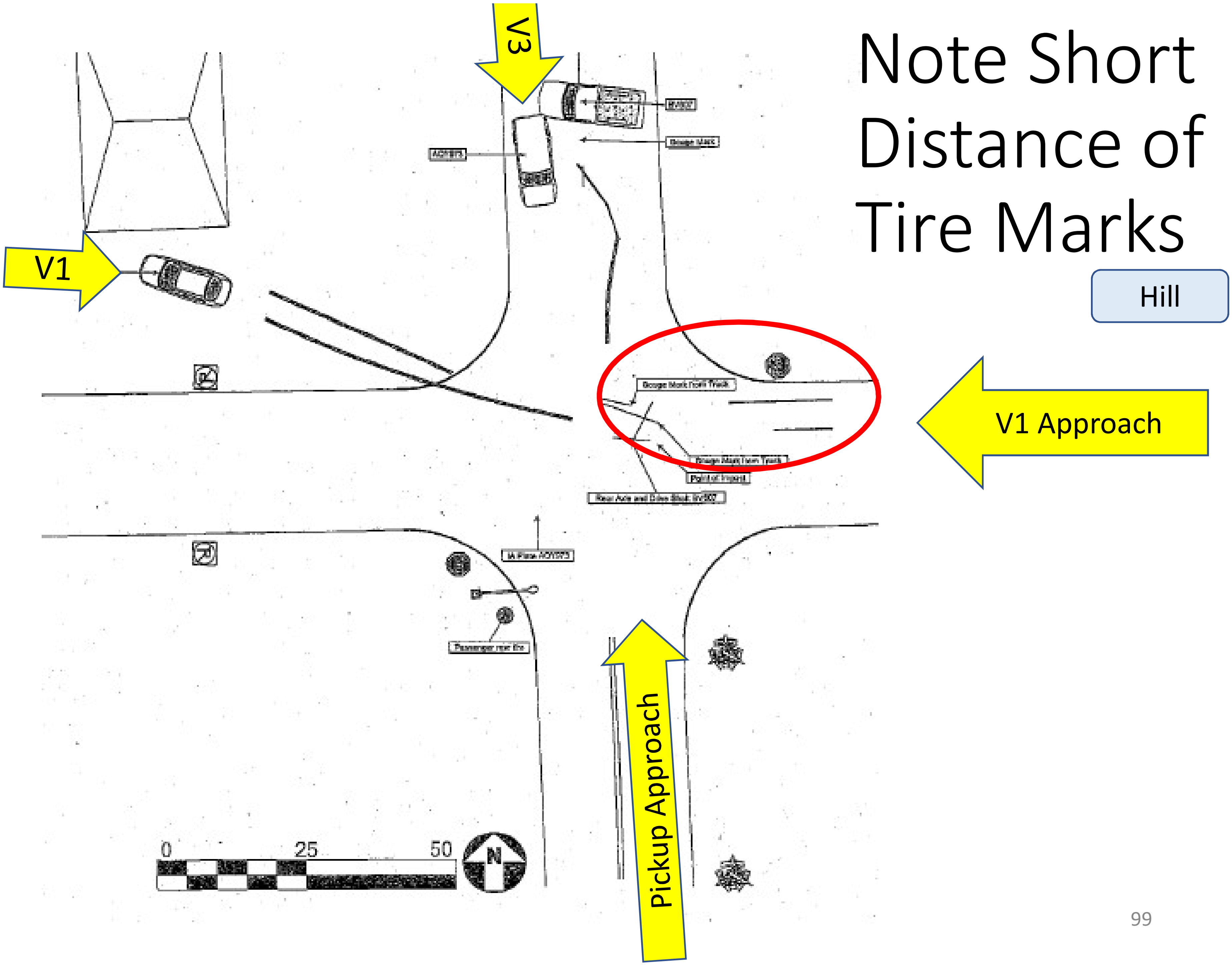
Note Limited Visibility Left due to mound

Note Limited Visibility Left due to mound

Note Limited Visibility Left due to mound

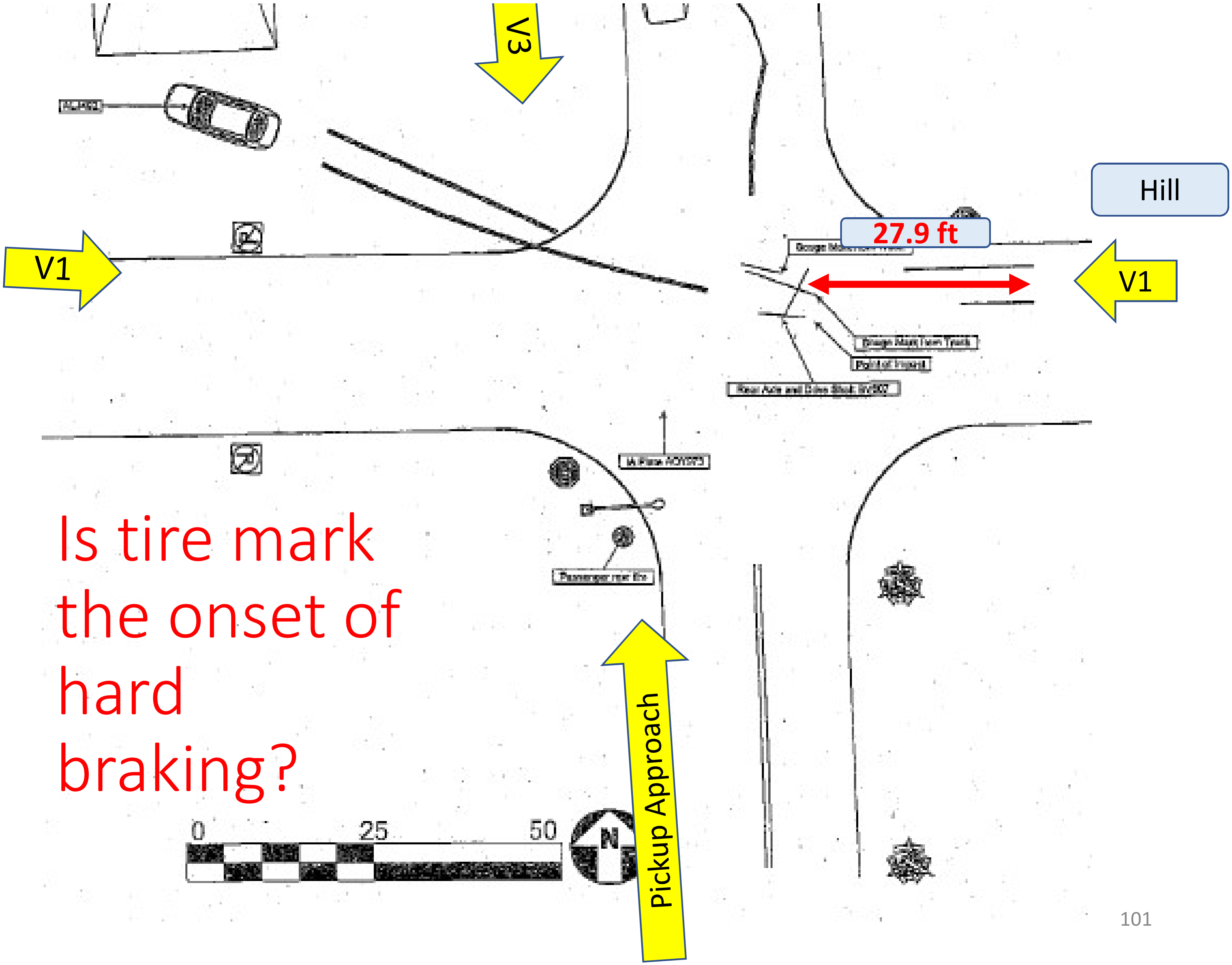
Note Limited Visibility Left due to mound

Note Short Distance of Tire Marks



Prosecution Working Theory

- Defendant did NOT begin braking in response to seeing stop sign- he either PLANNED to blow thru it or didn’t react to the stop sign.
- Police did re-enactments, hit brakes when stop sign was visible, were able to stop long before intersection.
- Defendant braked when he saw the pickup coming from the right side.
- Tire marks indicate onset of braking



Is tire mark the onset of hard braking?

Compare the Different Methods

Defense Position

Pros. Position

|----------Speed from Last EDR speed of 42---------------------|

22 43

Speed from Braking Last EDR speed of 42 |---|

Based on shortness of tire marks 37 38

|----------Delta V and Postcrash---|

31 38

|----------Closing Speed------------|

31 38

CONSENSUS IS SPEED AT IMPACT IS NEAR 37-38

CONCLUSION

- V1 did **NOT** begin to brake in reaction to seeing the stop sign (or reacted very late to it)
- V1 likely **intended to blow the stop sign**
- V1 likely braked in response to the pickup coming from the left
- Whether the braking was late for the stop sign or for the pickup, this adds another degree of Recklessness to V1’s driving in addition to speeding with limited visibility coming over the hill top unable to stop

Stopping Distance at Speed Limit vs 48 mph

- Formula for stop distance is $D=S^2/(30*f)$ where

  D is the distance in feet,

  S is the speed in MPH, and

  f is the drag factor in G's (how fast the car can slow down)

- At 25 mph: $D=\frac{25mph*25mph}{30*0.65g}$ = 32 feet

- At 48 mph, $D=\frac{48mph*48mph}{30*0.65g}$ = 118 feet

- 118/32 = ***3.68 times the stopping distance***

EDR Take Aways

- EDR is a game changer in traffic homicides
- Much better at getting speed before braking than conventional reconstruction – measured directly!
- Alcohol + Speed (when present) = better case
- It’s not just about speed – its about appropriate behavior for situation - check human factors
- Get ALL the Data – Perp EDR, Vic EDR, scene evidence!!
- Get a warrant, with a GOOD affidavit!!!
- Make sure officers get proper training/equipment
- Create “EDR expert” within state police or major cities, make sure they CAN HELP SMALLER AGENCIES.
- Use google earth photos with EDR data overlaid

Ruth Consulting

Contact Information

Richard R. Ruth, P.E.
313 910 5809
ruthconsulting@comcast.net
www.ruthconsulting.com