

EVALUATION TOOL KIT FOR AUTOMATED SHUTTLE TRANSIT READINESS OF THE AREA

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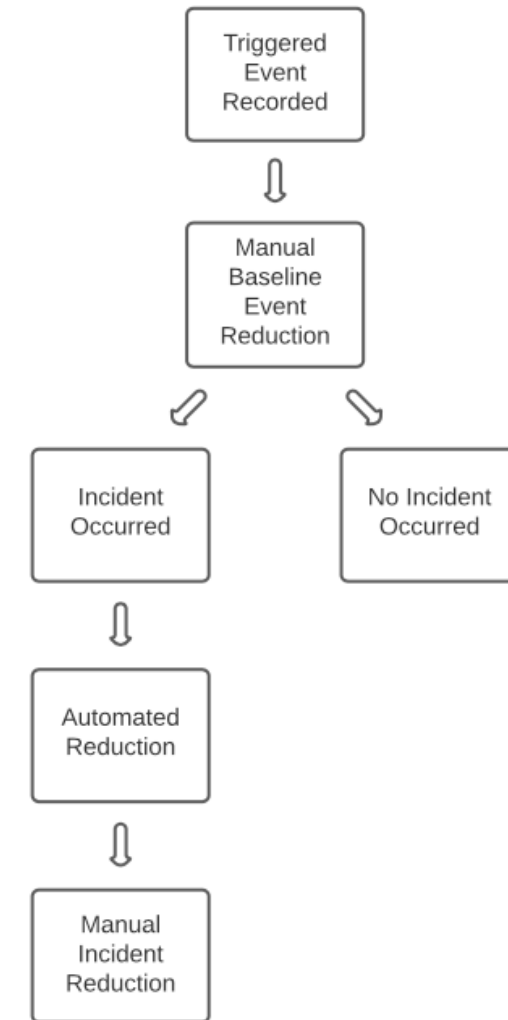
REDUCTION PROCESS AND VOCABULARY

Critical event types

- Crash
- Near-Crash
- Crash-Relevant Conflict
- Non-Conflict

Type of event triggers

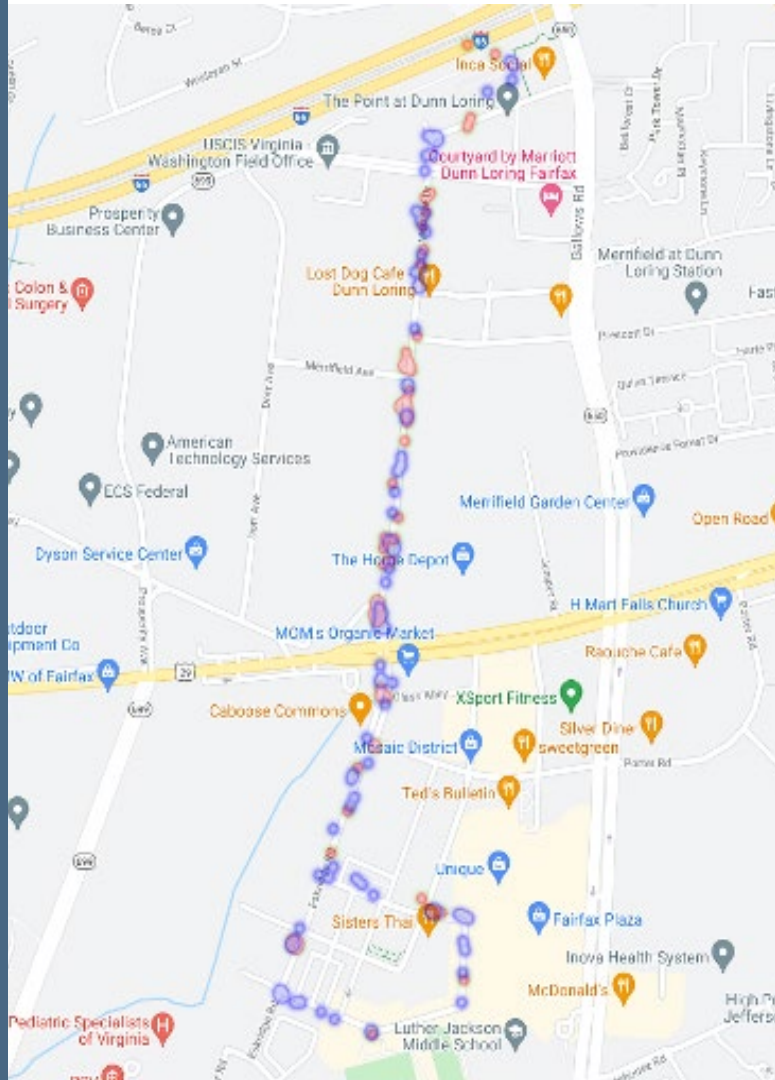
- E-Stop, valid (Vehicle stops itself due to other road user or potential conflict)
- E-Stop, invalid (Vehicle stops itself due to sensor error or potential over-sensitivity, such as blowing leaves or trash, small object in road such as snow chunk, or perhaps unknown reason)
- Soft Stop (operator stops the vehicle manually)
- Circumvention (operator takes steering control)
- Video/SPAT Trigger (in intersection during phase change)
- Baseline (definition to be determined)



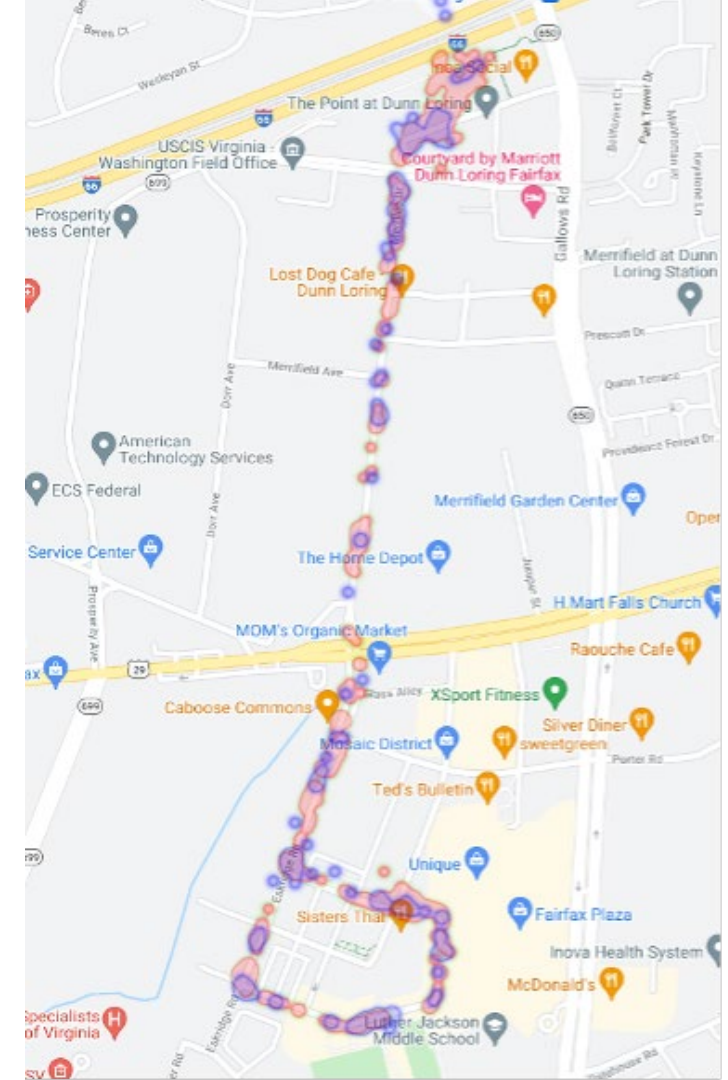
GPS ROUTE MAP AND LSAV



HEAT MAP

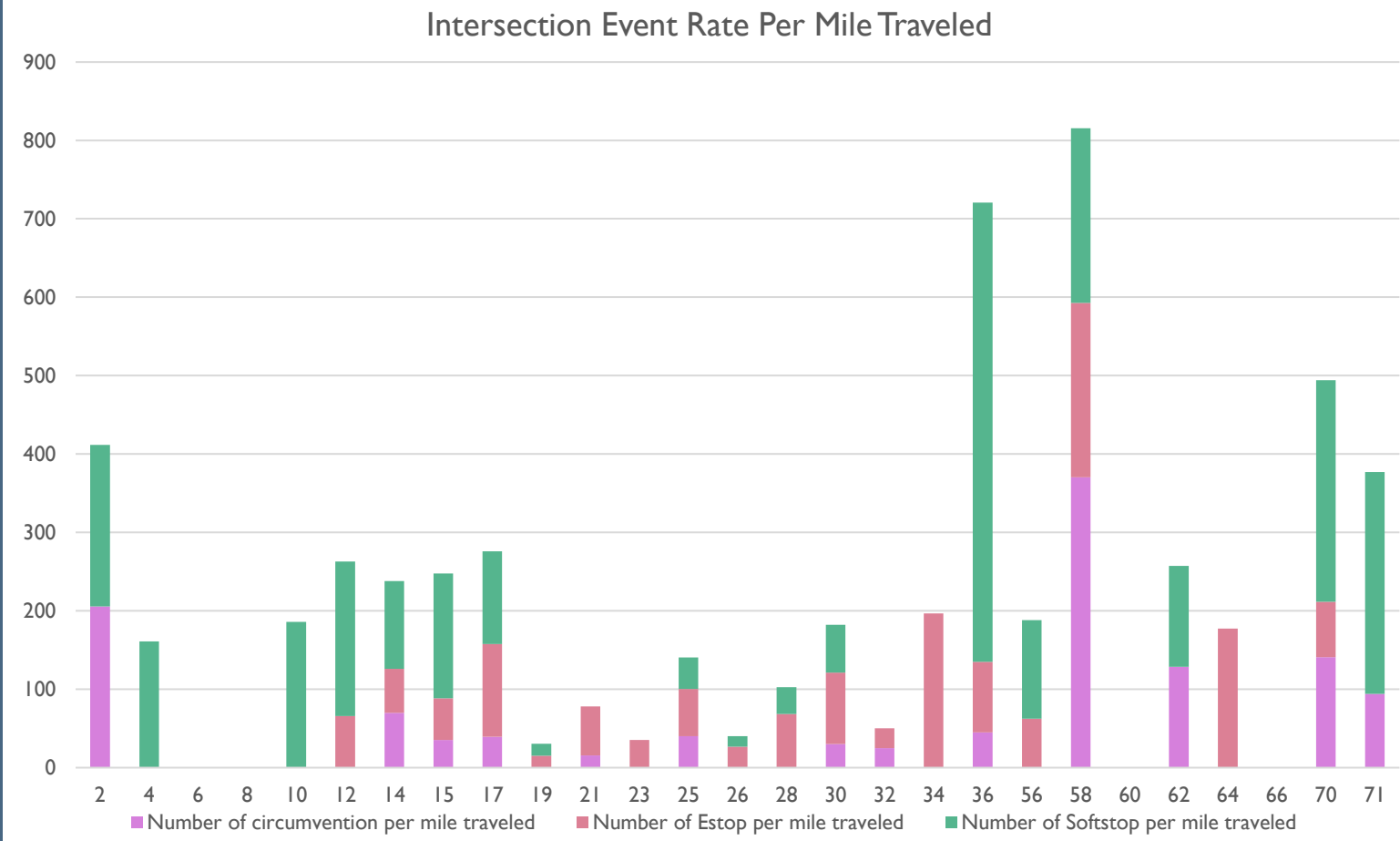


Distribution of E-Stops Along the LSAV route, Red Represents Valid E-stops and Blue Represents Invalid E-stops



Distribution of Soft Stops and Circumventions Along the LSAV route, Red Represents Soft Stops and Blue Represents Circumventions

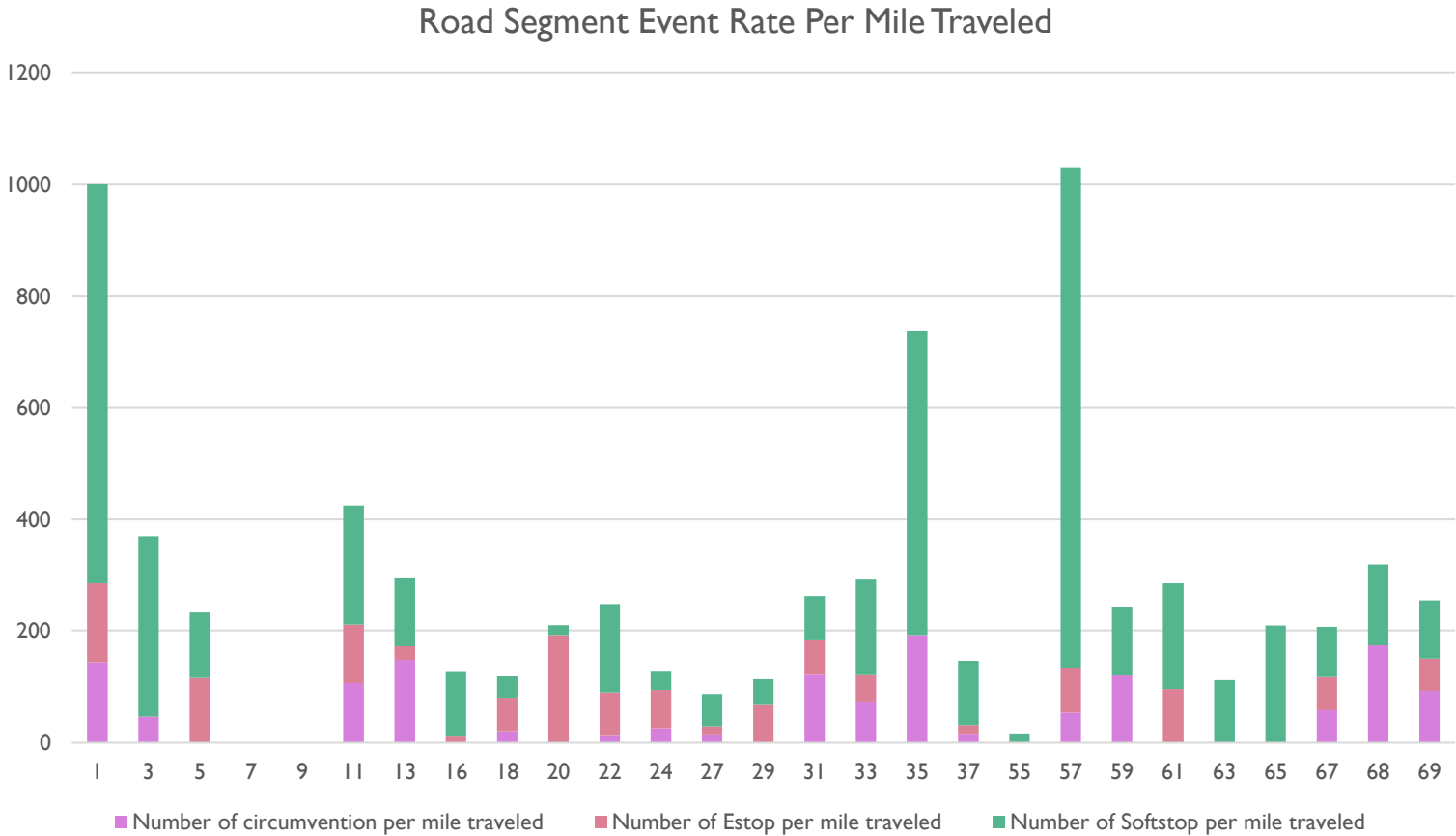
RESULTS:
TRIGGERED EVENT
RATES BY
INTERSECTION
SEGMENTS



Most Problematic Intersection

36	T- intersection with stop sign controlled side street	3 lane road	N/A
58	Stop-sign controlled 4 way intersection	4 lane road	N/A
70	Open area/loading area entrance	no marking	loading area entrance/lots of truck traffic

RESULTS:
TRIGGERED EVENT
REDUCTION
RESULTS BY ROAD
SEGMENTS



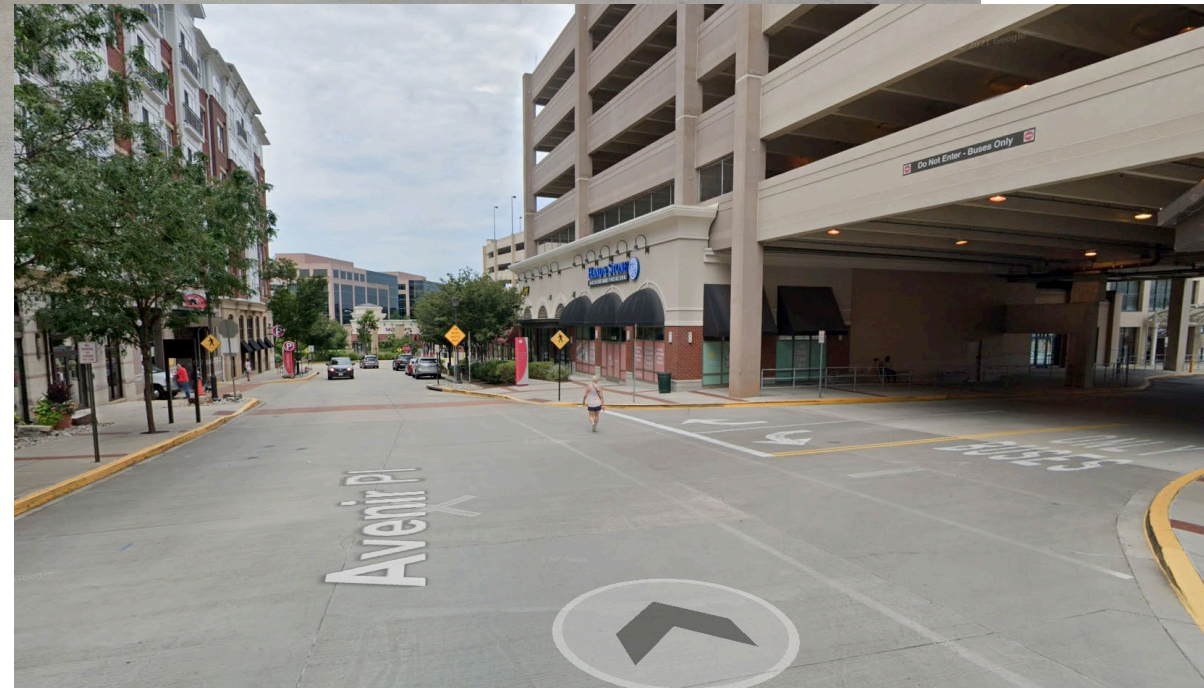
Most Problematic Road Segments

	1 Road Segment	2 lane shared road with no clear marking	N/A
	35 Road Segment	2 lane road with no clear marking	N/A
	57 Road Segment	3 lane road (2 in the direction of travel)	left turn lane

RESULTS: MOST PROBLEMATIC ROAD SEGMENTS



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CONCLUSION

- a) Stop sign controlled 4-way intersection and 3 lane roads have the highest rate of safety critical events when compared to other segment types/lane configurations.
 - a) We thought the multi-lane, signalized intersections would be problematic initially and they were not.
 - b) 3-lane roads had safety concerns due to vehicles passing LSAV, potentially into on coming traffic, and cutting in front of the LSAV causing the e-stops.
 - c) Turning lanes are in general problematic, but right turn lanes sees the highest rates of safety critical events.
- b) For triggered events, stop sign controlled 4-way intersection shows the highest rates of circumvention and soft stops.
 - a) Additionally, the operator is more likely to intervene with the normal operation of LSAVs when there are no clear lane markings
 - b) This is also confirmed by the higher number of valid E-stops when clear markings are present which can be counter intuitive.
- c) Turning lanes can be problematic for the LSAVs as well.
 - a) When left turn lanes, residential area, open area and curvy roads are present, the rates for soft stop is significantly higher.
 - b) For valid E-stops, the rates are higher when right turn lane is present. This could be due to the operator not paying as much attention when the LSAV is turning right, since it is an easier maneuver compared to turning left.

Any Questions or Comments?