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Memorandum

To:	Jay Falstad, QACA
From:	Fred Jacobs and Matthew T. Carmody, P.E., RSP1
Date:	November 15, 2022
Re:	Maryland Transportation Authority (MDTA) Bay Crossing Study – Tier 2 EIS Scope
cc:	Jim Campbell, QACA

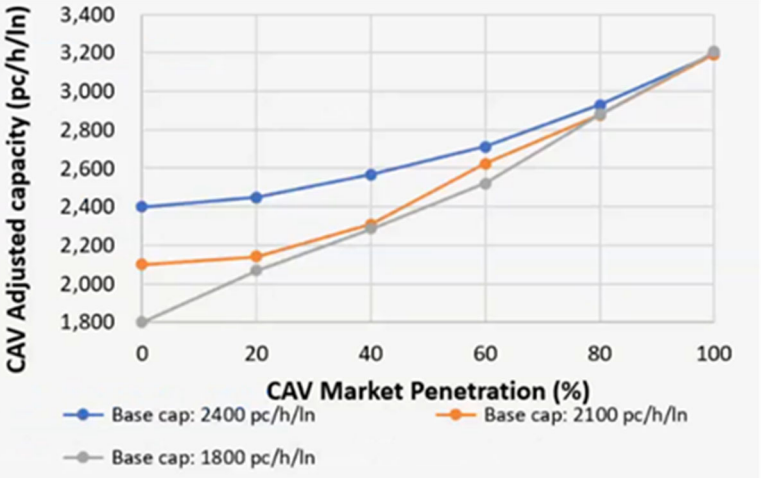
In a meeting on September 21, 2022 with the Queen Anne's Conservation Association ("QACA") and AKRF, Inc. ("AKRF"), QACA requested that AKRF identify emergent transportation technologies that should be considered in the Tier 2 Environmental Impact Statement (EIS) for the MDTA Bay Crossing Study (BCS). AKRF has conducted research into Connected and Automated Vehicle (CAV) technology, which will be operational by the BCS EIS traffic analysis year of 2040 at substantial enough levels of adoption to effect improvements in highway traffic capacity. Based on research summarized in the attachment, AKRF asserts that the Tier 2 EIS consider the effects of CAV on traffic capacity, using technical guidance per the latest edition of the Highway Capacity Manual (HCM). The HCM is reference guide published by the Transportation Research Board, recommended by the Federal Highway Administration as "one of the most widely-used transportation documents for evaluating the performance of transportation facilities," and is used by MDTA, the Maryland Department of Transportation, and other state transportation agencies and authorities as the fundamental planning and engineering document for traffic analysis.

Introduction: Connected and Automated Vehicles

Connected and Automated Vehicles (CAV) rely on sensors, communications, and other technology to allow vehicles to "talk" to other vehicles and roadside infrastructure, and more efficiently and safely self-drive as compared to a human driver. On-board GPS systems direct the vehicle to the destination, while various sensors on the vehicle detect other vehicles, road signs, travel lanes, and obstacles such as debris or pedestrians. Communication systems connect CAV with traffic control devices and other connected vehicles to optimize vehicle travel. As of 2022, this technology is in use at a limited capacity. Most new vehicles are currently equipped with advanced driver assistance features as an early form of full vehicle autonomy, such as forward collision warning, automatic emergency braking and brake assist, lane-keeping assistance, blind spot detection, and self-parking. As these technologies advance and market penetration increases, CAV will lead to measurable improvements in traffic operating conditions and vehicle crash safety. It is projected that fully autonomous CAV will be available by the late 2020s, with half of new vehicle sales being CAV by 2045 according to the Victoria Transport Policy Institute. Market penetration rates will have increasingly positive effects on traffic capacity and safety, as discussed below.

Traffic Effects

Traffic congestion will be reduced by CAV technology, since it makes existing roadways more efficient without physical changes. The level of improvement is correlated to the percentage of CAV market penetration, which will begin this decade and increase in the 2030s and 2040s. CAV technology can substantially increase roadway capacity, which is the measure of maximum sustainable hourly flow rate of vehicular travel, measured in passenger cars per hour per lane (pc/h/ln). Because CAV can travel with smaller distances between vehicles and improve reaction times of vehicular acceleration and braking during heavy traffic congestion, aka "stop-and-go traffic," the roadway capacity increases with greater CAV saturation. CAVs can also virtually link up to each other if their occupants are going the same direction and drive as a tightly-spaced caravan, called platooning, which can provide even greater benefits to traffic capacity. According to the latest edition of the Highway Capacity Manual **(see figure at left)**, roadway capacity increases with greater market penetration of CAV. Furthermore, as illustrated by the 1,800 pc/h/ln data points in the graph, which are indicative of higher levels of traffic congestion such as those experienced by motorists during the peak summer conditions at the Bay Bridge, the effectiveness of only 20 percent CAV market penetration is even more pronounced.



Proportion of CAVs in Traffic Stream	Adjusted Segment Capacity		
	2,400 pc/h/ln	2,100 pc/h/ln	1,800 pc/h/ln
0	1.00	1.00	1.00
20	1.02	1.02	1.15
40	1.07	1.10	1.27
60	1.13	1.25	1.40
80	1.22	1.37	1.60
100	1.33	1.52	1.78

Capacity adjustments – Basic Segments

According to estimates, the CAV market penetration rate in 2040, the future year of forecasting presented in the MDTA Bay Crossing Study, could reach 20 percent. At that level of market saturation, CAV would increase traffic capacity during Friday evenings in the eastbound direction and Sunday afternoons in the westbound direction by 15 percent. The heavy traffic congestion levels forecasted by the MDTA study in 2040 would be even further extended into the future due to increasing saturation by CAV. This compounding effect would mean that even with the unrealistic overestimates of traffic growth projections used by MDTA to analyze traffic congestion, the increase of CAV on the bridge each year would continually move the threshold for congested traffic conditions forecasted by MDTA farther out into the future.

Safety and Collision Effects

Traffic collision frequency and severity will be reduced by CAV technology, resulting in fewer deaths and serious injuries. Greater market penetration will also lead to improved traffic effects and less need for emergency responses and supplemental traffic lanes such as highway shoulders to manage collisions. According to the Maryland Department of Transportation (MDOT) website, advanced driver assistance technology currently available on new cars has the potential to prevent roughly 40 percent of all crashes if all vehicles were operating with the technology. Features include forward collision warning, automatic emergency braking and brake assist, lane assistance, and blind spot detection, which can reduce rear-end and sideswipe crashes, which are the most common crash types on the Bay Bridge during times of heavy traffic congestion. Nearly two dozen automobile manufacturers have committed to implementing automatic emergency braking features on their vehicles by September 2022, representing 99 percent of new cars and by September 2025 for new trucks weighing less than 10,000 pounds. Research conducted by the Insurance Institute for Highway Safety (IIHS) concluded that if automobile manufacturers meet their commitments, rear-end crashes would be reduced by 40 percent by 2025. Research published in the International Journal of Transportation Science and Technology found that a CAV market penetration rate of 25 percent would reduce crash risk by 33.3 percent, and even a limited market penetration market penetration rate of 5 percent would reduce crash risk by 10 percent.

Conclusion

The inevitable migration to CAV will be transformational for the increased efficiency and safety of the transportation of people and goods. There has been extensive investment, planning, and research on CAV by Federal, State, local, and private organizations, including by MDTA and MDOT. With fully automated CAV technology anticipated to be available this decade, and 10 to 20 percent of vehicles on the road operating with it within the next 20 years, the technology will result in traffic capacity and safety improvements along all roadway facilities. By 2040, a CAV saturation rate of 20 percent on the Bay Bridge could provide 15 percent more traffic capacity to reduce summer weekend congestion, and a 40 percent decrease in the types of collisions experienced during congested traffic conditions. Significant increases in traffic capacity on the Bridge are also expected beyond 20 years with further implementation of CAV, which warrants a hard look by the MDTA of CAV effects in its analysis of the need for a third bridge span in the Tier 2 EIS.