### Impacts Assessment to Prepare for Future Transportation System

**Impact Area: Work Zones**

| Descriptions | Work zones present some of the most challenging environments for automated vehicles due to highly variable conditions and the need to sometimes navigate outside the normal road marking and travel lanes. The presence of construction vehicles in addition to regular traffic adds to this complexity.  

To safely respond to work zones, automated vehicles must safely navigate roads that require the vehicle to stop, change direction or disregard the standard rules of the road. Work zones often require vehicles to respond to flaggers or other devices and be directed around the work zone while ignoring the existing striping. Many work zones on high speed facilities uses channelization devices to move vehicles to open lanes while also ignoring the existing striping. Automated vehicles will need to react to this variation of travel outside of the usual protocol of following road striping. Also, in many work zones, construction vehicles are present in addition to conventional traffic flows.  

Connected vehicle technology could alleviate this problem by helping automated vehicles identify or avoid work zones. For example, connected vehicle technology could allow for real-time data about work zones to be transmitted to approaching vehicles. These alerts would include information about lane closures, speed limits, and the parameters of the work zone. This would be a completely new data source that is not currently being transmitted. |
The safety of people in work zones is paramount, and allowing technology to communicate to automated vehicles directly about their exact location has the potential to save lives. Virginia Tech is evaluating wearable connected technology installed in road crew member’s high visibility vests to address this issue.¹

Infrastructure owner/operators can also provide data regarding work zones directly to AV manufacturers/AVs. U.S. DOT has developed a work zone data standard to allow infrastructure owners and operators to standardize and share work zone data with manufacturers specifically to aid in navigating work zones. ODOT currently gathers information about construction and shares that data through an open data portal. ODOT also provides a web based tool allowing local agencies to share information about construction and other road incidents through that same data portal.

Another potential solution for gathering work zone data includes using intelligent traffic control equipment, such as upgraded arrow boards or smart cones, that can automatically share data about lane closures based on their activation and use. This data could allow a transportation agency to receive and share more accurate, real-time data about work zone operations on their roads.

Another potential solution for AVs to safety navigate through work zones is by having AV manufacturers utilizing remote operators who can pilot AVs when they encounter work zones or other difficult circumstances. While this may work for the occasional vehicle, using

this technology with a large number of vehicles is prohibitive.

Automated vehicles will also have to interact with flaggers and other road crew members in work zones. Safety in these environments might be improved if automated vehicles have some method to communicate their intentions and reassure pedestrians and road construction workers. For example, Jaguar Land Rover has tested an automated vehicle equipped with electronic eyes that look at pedestrians to demonstrate the vehicle has noticed them.\(^2\)

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<th>Certainty/potential time horizon</th>
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<td>Automated vehicles will need to be able to safely navigate work zones. It is uncertain whether automated vehicle manufacturers will design AVs capable of safely navigating work zones without outside input, or whether connected vehicle or other technology will be needed to addresses these situations.</td>
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<th>Co-benefits/advancing established goals</th>
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<td>Connected vehicle roadside equipment for work zones could improve safety for both motorists and work crews. The improvements in safety will be greater with a larger saturation of connected vehicles. It could provide safety benefits for conventional vehicles as well. Data sharing between infrastructure owners and operators and automated vehicle manufactures could provide benefits beyond the safe operation of AVs. Transportation agencies could receive data that would allow them to better manage and design their transportation systems.</td>
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| **Barriers** | Construction zones may be too unpredictable for automated vehicles to assess. Automated vehicles are not currently capable of responding to hand signals from construction crews and the array of cones, construction vehicles and crews on the road. Since construction sites change constantly, it will be difficult for automated vehicle technology to “learn” to read the area.

Current work zone reporting processes don’t gather data at the specificity required for automated vehicles. Also current process don’t include data gathering for utility work or other permitted construction work that occurs on the road system. Gathering more accurate, real time work zone status information would require implementing new more uniform and disciplined reporting procedures.

Implementing smart work zone traffic control technology would require agencies and contractors to upgrade equipment and would require investment in systems for storing, analyzing and communicating the additional data. |
| **Impact to infrastructure owner/operator** | Costs would include installation of connected vehicle infrastructure, as well as building the organizational capacity needed to establish, manage, and maintain the system on an ongoing basis. There would also be additional costs for acquiring, storing and analyzing new data from work zones.

Keeping detailed and up-to-date work zone data would require owner/operators to change some of their

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reporting practices. It would also cost time and resources to train staff and contractors, particularly if new technology is utilized.

### Relevant national guidance/key decision makers

The federal government has maintained a technology agnostic stance regarding DSRC and 5G, although the FCC has reserved some of the 5.9 GHz band for DSRC vehicle safety applications.

U.S. DOT has launched a policy initiative called Data for Automated Vehicle Integration (DAVI). The goal of DAVI is to identify and address data sharing needs for AVs to be integrated safely in the transportation system. One component of DAVI is the Work Zone Data Exchange (WZDx) Specification. This is an effort to standardize work zone data so that it can be shared among data owners and automated vehicles to improve safety.

### Next steps

Pilot or invest in roadside communication devices in work zones or connected vehicle systems in work vehicles. Engage in dialogue with AV manufacturers about data needs for V2I and V2V.