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Name is Dan I will be your conference operator today. I would like to welcome everyone to the integrating technology applications Massachusetts DOT. After the speaker's remarks, it will be a question-and-answer session. If you would like to ask a question, press*in the number one on your telephone keypad. Thank you. You may begin your conference.

Good afternoon, welcome to the 12th webinar of the Smarter Work Zones Webinar Series, Integrating technology applications MassDOT. My name is Nicole and I will moderate today's webinar. You need to mute your computer speakers. Today we have two presenters Todd Peterson of the Federal Highway Administration Office of Operations, and Neil Boudreau, of the Massachusetts Department of transportation. [Indiscernible - low volume]. For SH -- promote -- [Indiscernible - low volume] to better coordinate highway construction. Todd is a licensed PE and a certified PTOE and received his master's degree in civil engineering. Neil Boudreau of the MassDOT serves as the director of traffic and safety. He has been with MassDOT since 1995 surf in many -- servicing in many roles. He is currently a member of the FHWA everyday counts work zone implementation team. He received his Master's degree in civil engineering. Today's seminar allows 90 minutes, and 30 minutes for audience questions. If you think of a question, you can indicate which presenter your question is for. Presenters will be unable to answer your questions during the presentation. We will answer questions at the end of the presentation. In addition if time allows we will open up the phone lines for questions and comments. The PowerPoint presentation used during the webinar is available for download from the file download box at the lower right-hand corner of your screen. A transcript and recording of the webinar will be available online within the next few weeks. We will notify all attendees when these materials are posted online. Everyday counts Smarter Work Zones Webinar program does not offer PDH. To confirm your participation in the webinar, please submit an individual participation confirmation request to kleinr@battelle.org. You will received the participation email within 5 to 7 days. The response email may be sent to your licensing agency for PDH consideration. The determination of smarter work zones webinar PDH eligibility is the province of the licensing agency, not the smarter webinar series program. I will turn it over to Todd to get us -- Todd to get us started.

Think you -- thank you Nicole. This is the 12th series of our monthly webinar series. We are making our way through a lot of topics. Previous topics have included a lot of the tools that are covered under the smarter work zone initiative as ideas were promoted through the webinars and peer exchanges with the states and other activities associated with the work zone initiatives. If you are interested in any of these prior topics, the link at the bottom is for the work zone safety information and clear house -- where maintaining archive of the recordings of the actual live webinars. It is a good resource to catch up if you have not been able to attend some of the prior -- webinars. Our next webinar after this one we will be covering Step 4 of the Work Zone ITS Implementation Guide which focuses on procurement. That is coming on May 11. If you have not seen a registration notice about that, you should be expected it soon.

For today's webinar we are also going to be focusing on the technology application side of smarter work zones and we would talk a little bit more about what that means. We would talk about MassDOT's implementation of technology applications. Modeling their efforts that they undertook at the state based on the federal Work Zone ITS implementation Guide which is a resource we published in 2014. MassDOT has been on the leading edge of implementing work zone ITS following the examples and structure laid out in the ITS implementation guide. I will give a brief review of what smarter work zones is all about Scott what the technology is all about, and I will handed over to Neil and he can tell us about what Massachusetts is doing in their world.

Can we pause one second? The audio is choppy. We will attempt to restart the audio. Everyone hold on for one second. I will be sending the audio line again. Please go ahead put the line back through.

I believe we are connected.

This is Todd, can you hear me.

Go ahead and start.

A brief summary of what smarter work zones is all about. It encompasses a lot of activities. Could be state policy, business processes. Engineering tools, actual hardware used in traffic management, a lot of techniques and implementation practices to optimize work zone safety and mobility. This can cover a lot of ground in terms of institutionalized policies or business processes at the agency level or specific hardware, or tools used by -- in the design or implementation for work zone construction site. They could apply to activities in the planning phase -- phase for a project to look reduce the collective work so congested on safety and mobility.

The way we broke those down is into two specific initiatives. Project coordination and technology application. Project coordination is more of the upfront planning oriented approach to impacting work zone safety and mobility by looking at the collective impact work zones that will be occurring in the future and planning them got scaling -- scheduling them to reduce the work zone safety and mobility. The technology application side is more focused on the implementation and deployment of intelligent transportation systems for data-driven management of work zone traffic impacts.

Technology application is again primarily it's a fancy word for work zone ITS. We're looking to utilize the technology that is available through the ITS systems to collect information about what's happening on the road cut get information on traffic speeds volumes. We process that information either on-site or TMC or something like that and use adjective -- use that to convey information back to drivers to help them react to what is happening in a work so. The sign that is presented in the picture says 40 minutes to end of work zone. The ideas to use this not just generalized information, but actionable information. If we could tell drivers what they can expect in terms of delay, a reduction of speeds, or the need to take a detour, or alternate travel times

using different routes, if we could convey that information to drivers earlier they can make better advised decisions. It could resumes reduce congestion to the work zone. They're not coming on the back of a stopped queue. That is the idea.

We about a year and a half through the smarter work zone initiatives. One goal to help states implement business processes for work zone ITS technologies as identified in the guide. As could be policies, or incorporating deployment, Kermit Reckitt -- mechanisms, for project delivery. The next goal is alternatively for states to employ ITS for implementation on site. If we wanted to get 35 states doing one of the other that we are on track with that goal. If you are associated with the state that's working toward one of those goals, I appreciate your continued efforts on that. We are here to help you along the way. Again, the technology applications implementation in the smarter work zones initiative is to -- this is the publication we put out in 2014. It lays out a six step engineering type approach to work zone ITS implementation. The steps, as Neil will state that Massachusetts has adapted the steps for their state process. Is a good example of how the state has utilize this guide is a foundation for their own institutionalization of the work zone ITS implementation. I will handed over to kneel we drove -- Neil Boudreau.

Thank you Todd and good afternoon. Today I will give an overview of how we are implementing smarter work zone technology here in Massachusetts. I would like to give you a quick overview of the presentation. We will highlight what we are doing now in Massachusetts, how we define our goals, and how we developed our implementation plan. I want to introduce some of our specific workflow processes that covers smart zone standards and walk you through the operating procedures and contractors who will be doing the work for us. Finally, I will wrap things up with lessons learned with the technology applications.

To set the table of where we are Massachusetts, we have used smart work zone technology in over 12 applications on projects to date. Our experience has shown that providing real-time traffic feedback help lessen driver frustration of the delays experienced on the roadways. The specification that we use continues to evolve for each and every project as we learn more about best practices. Finally, sharing access to the system in real-time data with our partner agencies helps to build overall credibility and also gives credence to the management of the system.

When we signed on to support smart work zone initiatives we had the first document where we thought will be able to start. Because we have done these projects are ready, we considered ourselves to be in what's called the demonstration phase. What we were lacking was formal documentation on how we determine when to use work zone ITS and how to do it. At the end of the two-year effort we want to institutionalize the practice here in Massachusetts. We developed our goal for standard operating procedures for planning, designing, and construction. How do we plan achieve these goals. We need to smart work zone design standards to help our consultants better evaluate the need to develop the concept of operations for using these portable devices. We also want to update our smart work zone specification better defined what is needed for each application we employ. We want to develop standard operating procedures for contractors to understand what is expected of them to use this technology. Finally, we want to process real-time data to evaluate effectiveness of the systems and generate work zone capacity values that we could use for future efforts.

This set the stage for our initial focus on our implementation plan. The roadmap to success for small -- smart work zones in Massachusetts. We want to build upon our experience and use the work zone implementation guide, we wanted to take that and drafted and publish our own design standards for the consultants to use. We also wanted to take the samples of work -- smart work zone applications major and configure them to reflect Massachusetts experience. We wanted to use our existing specification in the work zone ITS implementation for contractors to follow when they bid on our smart work zone systems. Finally to provide a training workshop to document how to use these for documents I mention so others will understand how to do business.

Our long-range goals were bit more far-reaching. We want to develop a standalone concept of operations to help designers to better understand the situation they are facing on a particular construction project and look for the use of work zone ITS for mitigation. Currently on behalf of our consultants by giving them information they need to help them develop or project. We want our contracts and consultants to be able to do this. We want to review our existing specification and configure them in what's called the plug-and-play format to assist designers on the best selection of applications needed to mitigate the project needs. We want to start for the data warehouse to capture the real-time data so we can evaluate the data, learn about our capacity in the safety implementation and if it's of using our smart work zone system all with the goal of meeting the safety goal. In the completion of the data warehouse initiate a project to develop a public facing dashboard to evaluate performance evaluations and our customers now we are doing.

How are we doing things right now? December 2015 we completed the smart work zone design standards and the SOP. We realize we made a couple of adjustments and updated them in February of this year. We've also completed the message shows -- Massachusetts -- we released - - we made note that we are continuing to evaluate this assessment. What we released to our consultants today, may not be the best and we are willing to adapt as we go along. Finally got we are underway with the development.

I want to show you how we put this all together into a workflow process. Shows the Federal Highway six step implementation process. Step 1, assessment of needs, step 2 concept development and feasibility, step 3 detailed system planning and design, step 4 procurement, step five system deployment, step 6 system operation, maintenance, and evaluation.

Following the guidance MassDOT decided to develop a seven step to better help our consultants and contractors. We separate the last step into two part. Operating maintain the smart work zone system and evaluate the smart work zone system. This is because our goal is to pull all the information into a data warehouse that will allow us -- to evaluate the effectiveness of our system. This will ensure our customers the benefits.

We will take a look closely of what the individual steps we put together and define how Massachusetts has configured things. We need to ask the following questions when we are assessing the need for smart work zones. Where we try to help out with use of the ITS in the work zone. How do we assess those expected impacts and use that to determine our needs? We need to define the goals of the project and how we can leverage smart work zone applications to

support them? Who are stakeholders and how do we engage them in the use of smart work zone systems to support the TMP?

This chart lists some of the smart work zone applications. We broke it down into three categories, mobility applications, safety applications, and planning and monitoring applications. Mobility applications include monitoring traffic flow and using the message boards to guide motorists to make informed decisions and diverting traffic as necessary. For safety want the ability to quickly detect incidents, provide warning, monitor the entries and exits of work zones, we use video surveillance of the works on two collect smart work zone data so we can evaluate performance. We also use the data, through data driven enforcement to accelerate construction.

If we want to look at a specific project, they have developed a series of for categories to meet the work zone safety rule. The lowest impact is level 1 and level 4 would be the higher impact. In this case we have dictated that level 3 and 4 shall include all monitoring program. We can start looking into our smarter work zone design guide. This show how applications can be used to benefit the project in various impact levels. In level 4 insignificant project -- impact level 3 are highly suggested but not necessarily always required. It shows some basic options for consultants to look at in these categories.

On step 2 we focus on planning smart work zone applications. We must first determine what the ITS concepts of operations are. We ask the following questions, we want to find the expected system operation, we wanted to five that dataflow between the system components will beat cop and we wanted to find how the system will be managed. These are essential as we are starting to develop the framework for smart work zone systems. The following diagram provides a flowchart of how it works. In the field you might use a number of detection devices or sensors and cameras depending on the size of the project and the impacts. The data is captured from these detections and sent via the ancillary system or the modem to the central processing system where the travel times or delay times are computed. The results are sent back to the portable signboards to disseminate them. Images are sent to the system website and external 511 site or the highways operation system. DOT will have full access of monitoring and control the information. We can view or download traffic operation data as we support our mission.

As part of step 2 we established the two-page project scoring criteria. The intent for the site -- criteria, providing an approach for ITS project. There's been a lot of time discussing and making modifications, trying to reflect conditions in our state. Let's take a closer look at the scoring board. The view here covers three of the information that was on the previous slide. The first one is we wanted to establish a base criteria about the existing condition of the project. This is not using the actual scoring cut just to get an understanding of what we dealing with. This deals with the roadway geometry. Are we losing the shoulder? Are we narrowing the lanes? That is three points. Are we taking a lane or multiple lanes, one lane is six points, multiple lanes is 10 points. Step two covers the duration of the work. Whether it is less than six months, one point, 6 to 12 months, for points, one year, six points. Is summarized into the form.

Factor 3. We are looking at the availability of alternate routes for detours or diversion of traffic. We have several alternate routes available with spare capacity, zero points. If we have no viable alternates routes, 4 points. Factor 4 -- anticipated duration of work zone queueing above

reoccurring peak our conditions. Want to differentiate recurring with project related queueing. We let -- add less than hour per day, is three points. 1 to 2 hours is five points, Two to four hours per day is seven points. Four hours per day is 10 points. Factor 5 looks at the delay time -- average delay of vehicles above and beyond existing conditions. We wanted to keep queueing and delay in our score form. -- In our cueing -- queue for -- form. Our form is being evaluated to see if it is effective as we move forward.

Looking at the delay, if we have a 12 to 20 minute delay for our is two points, 20 to 30 minute delay for our is five points. Delays over 30 minutes for at least two hours per day, that would be a 10 point score.

We have Factor 6 which looks at the commercial motor vehicle impacts if we have less than 5% heavy vehicles, one point. 5% -- 10% cut three point, 10% cut six-point. Doctor 7 covers a number of specific issues. Given a point if there is the impact, or zero if it's no impact. Existing crash history, traffic speed durability, increase travel time restricted access, unusual or unpredictable -- unpredictable weather patterns. Discovers seven of the 10. Want to add up the accumulative score. Where using a greater than 30 score is likely to provide significant benefits for the project. A score between 10 and 30 points indicates the use of ITS may provide benefits to treat the impacts. Under 10 points, this is a situation that we would not consider work zone ITS to provide enough benefits to justify.

Also on the step 2 we created the implementation guide table 7 page 26 the following matrix which is a listing of working ITS applications for different scenarios, critical project characteristics. The function is to illustrate how some of the applications may be designed to address certain work zone conditions. Similarly, the matrix demonstrate how workable -- work zone conditions -- one or more type applications. Recognizing that the work zone application matrix was difficult to read, I wanted zooming closely so I can cover a few in more detail.

Looking at the critical project characteristics, we see their projects that expect frequent planed lane closures which will create high-speed differentials between queues in high -- that puts us in addition -- situation that suggests real-time information system, or the use of a dynamic lane merge. A project that closes off the use of emergency shoulders. We went -- queue warning system or real-time information. The matrix goes on and provide several different project characteristics to help the consultant review and understand what is -- what the options are in choosing an application.

I like to take a minute to demonstrate scoring criteria -- I-93 Fast 14 project. The existing challenge we have four lanes in each direction, with an ADT of 200,000 vehicles per day. For the weekend, it was approaching 6000 vehicles per hour during the peak hours. For this plan, we wanted to use crossover for traffic management and essentially cut our capacity in a half. Two lanes in each direction from the normal for. We had no viable alternate routes that have capacity in which we could accept that displaced traffic. In addition, the local street network would be bisected and resulted in several detours. It made it very difficult. The plan calls for one complete reach removal and replacement over 55 over 50 5R we get. With all these factors renew or whatever challenge in mitigating the traffic.

We walked through the scoring for this project. While this is a weekend construction there were still some conjunction -- congestion, we knew we would have to address the higher levels of traffic. We scored a 10 point here -- hit. It was scheduled for only weekends in a short span of 10 weekends to do all bridges that we only gave it a point. There were no viable routes, we gave for points for that section. Cutting that capacity and half are both directions. We were looking at a 10 point -- regular basis throughout the weekend. The delay would be 20+ minutes and gave it a score of five points. There was not a big impact for commercial vehicles so we only gave it a score of one point. Factor seven, we figured we would travel in packs seven out of 10 items which is +7. The end result was a score of 38 and indicated that this was a good candidate for smart work zone systems. It was MassDOT's first make a smart zone system and it was very successful in helping the project mitigate the traffic impact.

Now we would jump to the polling question.

And coup, Neil -- thank you, Neil. We will be answering questions. Today we only have one polling question. How does your agency state, county or local evaluate the need for use of work zone ITS application on a project? You may select one of the options. Follow the FHWA simple scoring system quite curia from table 6 of the work zone ITS implementation guide, utilize a customized scoring criteria form, use some other document -- documented process to evaluate need, do not have a formal process in place, no vote. We would like to pause and let people into the questions.

Looks like everyone has answered all the questions. The results are coming in. I will bring back up the presentation. Neil, you can resume.

I would like to make a note, I was the only person that had the customized scoring. Todd I don't know if you took notice, the federal highway sample sheet, I did not score anything.

I did take notice of that.

I think we will move now into step three this is designing your smart work zone application for your project. This covers the layout and design. There is a lot of information on this slide. Essentially we want to focus on the key locations for your project. That mean your start and in point of your smart work zone system. You want to identify where your merge points for raindrops are. You want to put a sensor or detection device together information. You want to cover your approaches to the project site within a half-mile. We also look to do upstream decision points. We also -- we find this key in our experience is weak like to find points upstream and downstream a bottleneck traffic should be stable. This is beneficial for us to see how we have impacted the traffic as you are entering the works on how the merging operation you always have a little bit of turbulence. As you get settled into the closed lanes, the lanes that are open, and the lanes that are close, we like to capture what is moving through those points. We like to replace detection and surveillance a question -- equipment each of these location. This indicates where we would like to put our portable -- so we can disseminate messages back to the public and navigating through the work zone. Another thing that we are -- we require is to capture the GIS coordinates for each location so we can put it on our map. It helps us better define where our equipment is so we can draw conclusions on doing calculations.

As we talk about all the smart work zone equipment, here's an overview of what we are talking about. We have detection and surveillance equipment. These your portable cameras, your radar Doppler sensors, Bluetooth sensors, some cases probe data. Speed feedback signs, or system website, which is shown on the picture finally the central processing system, which is a smart work zone system operating system provided by the vendor.

I would like to show you how the equipment layout looks that we have up and running on our I-91 in Springfield Massachusetts. It is located in the downtown area of Springfield, on Connecticut River, and on and off ramps. Is a secondary state highway which has helped to provide some capacity to bypass the work so but not enough. For this project as you can see there are a lot of icons on the screen this covers 18 radar systems, 53 probe data sites, 19 portable changing message boards, on cameras, and for first time, we also have six Highway advisory radios. There's a lot of equipment on this project due to the magnitude of the project in the impact on interstate system we felt it necessary. So far it has been helping us manage the full-time loss of a lane and shoulder.

This is a classification of projects based on the work zone impacts. The impact level 3 you can see the difference between level 4 and how they reflect the conflict points based on the number of off ramps. We consider of -- level 3 the typical layout. Under impact level 4 there are far more conflict points introduced in multiple interchanges. This reflects more of an urban application. There are several other drawings here to help guide our consultant forces.

Step 4. We can cover some of the key takeaways and focus on the lessons we have learned. It is essential that your specification include detailed descriptions of the required equipment and what expected functions would be. You have to clearly define your expectations for how you want your system to operate. You need to invest the time to document specifics on the placement of the equipment, how it should be calibrated, with you expect for testing procedures, and how to validate the operations. Finally, you need to define the expected performance of the systems in the deliverables. All of these items are clearly defined in the specifications of a great system.

For MassDOT specification we include the purpose for system management in our specification document. In this case the contract vendor so supply the necessary equipment to monitor traffic, collect data, and provide real-time reporting and remote messaging via the vendor supplied and maintained website. This paragraph sums it up for us in terms of what our expectations are for the system and what we want the contractor to provide. We also make note that require personnel for each project. Project manager who is the overall project lead to manage RTTM. We use this term interchangeably -- interchangeably. We also need a local systems manager. This is the most important to the operation and success of your system. The local systems manager will be experienced in managing the day-to-day operation and maintenance of the SWZ systems and equipment. The local field maintenance/repair technicians, these are the troops their roles are to maintain devices cut adjust the panels, the nuances of dealing with portable trailers and equipment on the roadside. Finally, the software specialist. This person is in charge of configuration of the system logic and calibration of the algorithms to deliver real-time information necessary.

As part of each specification that MassDOT puts out, we require the contractor and vendor to give us names a person now that shows experience in managing a smart work zone system before we expect -- except the qualifications.

Step 5. This take us to the contractor's responsibility. The diagram on the right are there -- is what expected of the vendor. It lists the activities and steps provided as to who is in charge and responsible. The important take away for this activity are we want to ensure the safe deployment of all the equipment, follow the roadside design guide in terms of clear zone, we want to capture the GPS coordinates for the actual equipment locations. We want to make sure it's calibrated to the field conditions and we want to make sure we develop a testing plan that will exercise the equipment and demonstrate proper operation to meet our performance goal.

Step 6 -- deliver on the overall operation and maintenance of the smart work so. This is essential to the project. We need to have a well-organized training session to TEACH are and uses a DOT how to work the system and provide ongoing support as necessary as the project moves along. We want to meet -- be from active -- be proactive disclosure to the stress. We want to anticipate issues with batteries cost solar panels cut aiming camera lenses, and more. If the contractor and vendor work together to anticipate these problems before we have them, it will continue to operate. Finally, it's all about reliable operation. It depends on the two topics in the configuration and calibration of the system to grab the data and deliver timely information back to the public. If you can address all of these three you will have a successful smart work zone implementation.

Moving into step 7 we want to cover the evaluation of the smart work zone data. We asked the question why are we capturing all the data in one of the benefits? The data allowed us for ongoing evaluation of actual work zone operation support construction work hours. The data gives us the ability to calculate work zone throughout capacity. We can supply work zone safety mobility performance measures, eventually develop public facing works own dashboard to allow our customers to see how we are doing, and also give his opportunity to share the information we are collecting. Ultimately having this data flat out allows us to better plan for future Travis traffic management plans.

Here is an example of the smart work zones benefits of the data we have from MassDOT's I-95 bridge project which is currently under construction. The following chart displays a lane closure chart which is based on time of the year, day of the week, and time of the day. This was revamped from the original contract document work hours based on modification review of the real-time data collected from the smart works own system. In other words, like most state DOT's and others, you put out a contract in work zone hours. Traditionally this is based on historical volume data in based on when his opportunity for us to take a lane out of service and not have an impact a delay to our customer. Having a benefit of real-time data we can use it and work with the data. This project we were able to refine our work hours based on the time of the year this particular roadway is seasonal, interstate that feeds out toward the New Hampshire seacoast as well as points north. It gives the contractor access to the roadway for additional work hours that he was not granted during the contracting process, but also the trade-off knowing that due to the seasonal variations, some days we will have to cut the day short to make sure we don't have backups on the highway.

Another example of the benefits of the smart work zone data, lane by lane speed graph that shows the northbound versus outbound direction. Being able to monitor one sensor or group of sensors allows us to better understand our lane closures and the speeds through them. We can also share this information with state police that we use for dedicated work zones beat enforcement to help them best targeting what times to run their detail operations.

How we doing our implementation plan? Is a mention, we have completed the design standard, we have updated the application metrics and scoring criteria to follow MassDOT's specific procedures. We have developed contractors, we completed one round of training for consultants but we need to do more. We need to set up a dedicated training for our contractors and vendors to better system on bidding on jobs. We have kicked out our concept of operations development and we are working on the plug-and-play specifications. We still have yet to initiate data warehouse modules but we will be doing so soon as we have started the initial discussion. Finally, we would develop a real-time data dashboard that we can share information with our partners.

In wrapping up I'd like to talk about some of the lessons learned. Use of portable ideas in the works own should be tools in the tool zone to mitigate. The key to success is start planning the Con Ops early in the planning process, and get stakeholders involved earlier, get there by into your approach and offer to share data and information with them. Make sure you invest the time and effort to develop detailed project specifications. If you have sensors on the project, make sure you capture data and use it to demonstrate your success. Finally, give your stakeholders access to the system so they can remotely monitor conditions and see firsthand what is going on in the true benefits of having the system.

With that, thank you for the opposite -- opportunity to present today. I hope you can get I hope you got some benefit. My contact information is listed here if you'd like to get more information. Thank you.

Thanks, Neil. We have a question. We want to give Neil a chance to answer that.

He would like to know if you have had any negative feedback on the scoring? Is a burdensome?

Thanks Russ. So far, we haven't seen anything come in on the project. We did the training workshop back in March, and we distribute it the guidance in all the documentation. We have not seen one come in yet. Prior to us releasing that document, we went through and had people individually score projects that we knew were good for small work zones. We did a couple of examples of those that would not be to see if the values would flesh out. We anticipate getting a lot of questions. So far we have not.

Thank you. Which vendor has MassDOT use the most?

I think it is pretty even. Currently, we have Ver-Mac systems. We have done a couple of projects with PDP that have wrapped up. I just took delivery of the data earlier this year. We have a Renaissance, and we have use iCone. In this era of staff reductions how do you find resources to develop detailed specifications?

That is a good question. I have been lucky in my effort and having a consulting -- consultant that has been working with me on work zone ITS and actually develop those developing my implementation plan. I have had the benefit of relying on that consultant support. We have had several meetings, we get together and draft of some stuff and see how it reads. Every project we put out on the roadway, we evaluate how that specification was, how was understood by contractor in vendor, we make adjustments each time so we are very clear on what we are expecting for our needs, but also for the contractors to know what they are bidding on. It is a long process.

How is queueing defined when applying values to the scoring criteria?

Right now MassDOT has a work zone delay form that has the late in cues -- queue. It was developed in the late 80s. We continually use that to evaluate our projects. We spent a little bit of money back in the early 2000's and had WPI do a soup to nuts review of all the queue methodologies out there from quick so, -- quick zone. It was the easiest thing to use. We continue to use it.

How does the development of the management plan deviate when used on alternate delivery projects (P3, design-build)?

We haven't done any P3's in Massachusetts but we have experience in design build. Generally because a smart work zone system is developed as part of the initial, when we do the base technical concept, the 25% plans, the matter what that means a message end of being, we are already at the point where the project will have a significant impact. We lay out the groundwork for what should be included in the smart works own system in terms of all those approaches, information and capturing sensors, if the contractor chooses to alter, can we work with them to refine the requirement of the smart works own system. So far it has worked okay. We have not have any -- not had any major hiccups.

Please keep the questions coming in chat. Todd will provide us to do some wrap-up slides. If you have a question over the phone, please press*one to be placed in the telephone queue. Todd?

I just want to briefly go over what Federal Highway resources to help states implement smarter work zones. I mention the work zone safety information clearinghouse. This is a resource we have been collecting a lot of information studies, webinars that we have conducted through the smarter or so series, loss of information on the technology application and project ordination elements of smarter work zones. It's a good one-stop shop for all the materials have been developed to date on smarter work zones. If you have any questions, stop in there first and see which you can find, if you cannot find it, feel free to contact one of us on the smarter works own limitation teen -- team. Other resources we have, I mentioned the ITS implementation guide which is the publication number 14008. That is the middle bullet here. I do not expect everybody to write down links. You can get a copy of the presentation if you go to federal highway safety and mobility program homepage, which is the root of most of the URL that are listed here, or if you do a web search for federal highway work zone safety and mobility or smarter work zones, our websites you come up and provide links to all the information. We have a number of

publications both in regards to the implementation guide. We also have a guide that is currently under development and will be completed and published shortly on project coordination. That is something to be looking forward to.

With that, that wraps up the discussion for today. Again, keep an eye out for registration on webinar number 13 is coming on May 11. A link is here on this page for registering if you want to do that. You can continue checking for updates and weight -- links to register on the clearinghouse website. If you have any questions or comments or just want to talk to somebody about how to implement smarter work zones in your state, the point of contact for this is our program management. His email is listed at the bottom of the page. -- Jawad.

As a reminder, if you would like to ask the question, press * one to be placed in queue.

Is queueing defined as traffic traveling below a predetermined speed?

The spreadsheet -- how many lanes you have, your traffic volume history, you indicate what the speed is going to be through the work zones. If it is a 55 mile our zone, it would be 45. You have your volumes, the number of lanes, and then you have that typical free flow speed, and then you take the lane out of the system. If you go from a four-lane to a three lane, that is basically how the system worked -- works. If you are starting your work at 7 PM and you still have higher volumes, you are going to expect some delays in queue, but as the volume dissipates, so will the queue. The queue was start to drop. Is start -- it is based on information from the end user.

How many MassDOT employees versus consultants are currently involved in developing smarter work zones?

I am in the headquarters office and I have three people that I consider my smart work zone team including myself. Each of our districts have a district traffic engineer. If the project is in a district to area, we work very closely with that district traffic office as well as the engineer for that office. The key to the success in developing the plan is to engage her stakeholders. For that project we brought in representation from the city of Springfield, we had other regional planning agency people and other people involved. We are recognizing what the impacts would be, basically they thought of some things that I might not have. It is project specific. Once we get folks trained on putting the systems together, they generally are good to help drive the ship the next time.

At this time we do not have any new questions. I will give everybody to type any questions and or press*one on the telephone I want to point out, the scoring sheets are available in the file share box. I encourage everybody to take a moment to look at the documents available through file share. Will pause for just a moment to see if anyone has any more questions before we wrap up. They don't see any new questions and we do not have anyone in the queue. A recording will be available online 2 to 3 weeks. I was Sonata email for everybody was registered. Will be held on Wednesday on Wednesday, May 11 from one to 2:30 PM Eastern time. Registration is open. The link is available on your screen. If you download the presentation you have the link to see it. I will be sending out an invitation in the next day or two. Thank you for all of our presenters.

This concludes our call, you may now disconnect.

[Event Concluded]