

SOUTHWEST RESEARCH INSTITUTE®

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INTELLIGENT SYSTEMS DIVISION

November 3, 2020

Mr. Charles Blackman
New Hampshire Department of Transportation
PO Box 483
110 Smokey Bear Blvd.
Concord, NH 03302-0483

Subject: New Hampshire High Level Bridge. Southwest Research Institute® Budgetary Estimate No.: B10/2020/0217.

Dear Mr. Blackman:

Southwest Research Institute (SwRI®) is pleased to submit this budgetary estimate to the New Hampshire Department of Transportation (NHDOT), Maine Department of Transportation (MaineDOT), and Maine Turnpike Authority (MTA). A period of performance from April 1, 2021 through June 1, 2024, is assumed for this fixed price (FP) effort.

Scope of Work

SwRI will perform the following tasks:

- Software Development
 - SwRI will make modifications to the New England Compass system to address the requirements requested in the RFP from NHDOT. These modifications include:
 - Integrate the Managed Lanes Subsystem (MLS), the Lane Control Subsystem (LCS), and the General-Purpose Input/output Subsystem (GPIO) into New England Compass as requested by NHDOT, MaineDOT, and MTA to allow:
 - Plan configuration and execution
 - Assignment of plan permissions
 - Device polling of LCS, Beacons, and Gates
 - Automation of the Hard Shoulder Running System via configurable step-by-step checklists.
 - Transitioning LCS, MLS, and GPIO Thick Client windows to Thin Client pages.
 - Add LCS support into the MLS to control devices when executing plans.
- Design
 - User Interface design for MLS interactions.
- Testing
 - SwRI will also develop an Acceptance Test Plan (ATP) for the additional software features.
 - SwRI will perform testing remotely. This will include executing the Acceptance Test with NHDOT.



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- Training
 - SwRI will train via recording for one 4-hour session on how to use the new features which were implemented.
- Installation and System Integration
 - SwRI will remotely install the updated New England Compass Software into the remote hosting facility for NHDOT and MaineDOT.
- Documentation
 - SwRI will modify the New England Compass documents which are delivered when new features are added to the system.
 - These modifications include:
 - Acceptance Test Plan (ATP)
 - Software User Manual (SUM)
- Warranty
 - SwRI warrants that it will perform the services under this project with the degree of high professional skill and sound practices and judgment which is normally exercised by recognized professional firms with respect to services of a similar nature. SwRI shall provide a 12-month warranty on the software enhancements made to the New England Compass software (NEC). SwRI shall correct deficiencies (bug fixes) as a result of modifications made to the MLS, GPIO, LCS modules along with their respective Thin-Client modifications for this project pertaining to mutually agreed upon and accepted requirements. EXCEPT FOR THE SOFTWARE DEFICIENCIES PROVIDED ABOVE, NO WARRANTIES OR GUARANTEES OF ANY NATURE (INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) EXPRESSED OR IMPLIED, IN FACT OR IN LAW, ARE GIVEN FOR THE SERVICES GIVEN OR THE SOFTWARE DEVELOPED UNDER THIS PROJECT.
- 30-Day Burn-In Period
 - SwRI warrants that it will perform the services under this project with the degree of high professional skill and sound practices and judgment which is normally exercised by recognized professional firms with respect to services of a similar nature. SwRI shall provide a 30-day burn-in period on the software enhancements made to the New England Compass software (NEC). SwRI shall correct deficiencies (bug fixes) as a result of modifications made to the MLS, GPIO, LCS modules along with their respective Thin-Client modifications for this project pertaining to mutually agreed upon and accepted requirements. During this 30-day period, no modifications to the software or the environment in which it is running will be made. Should any issues with the software related to the enhancements be detected, SwRI will address the issue. After the issue has been resolved, the 30-day period will restart. EXCEPT FOR THE SOFTWARE DEFICIENCIES PROVIDED ABOVE, NO WARRANTIES OR GUARANTEES OF ANY NATURE (INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) EXPRESSED OR IMPLIED, IN FACT OR IN LAW, ARE GIVEN FOR THE SERVICES GIVEN OR THE SOFTWARE DEVELOPED UNDER THIS PROJECT.

Cost

This budgetary estimate is being proposed on a fixed-price basis. The rates used assume a period of performance from April 1, 2021 through June 1, 2024. All work performed will be subject to the availability of the budget. An additional budget may be needed for those tasks that need to be performed beyond the budget authorized.

The cost of this project is broken down as follows:

EFFORT	PHASE	COST
Lonestar Integration	Base	\$10,608
LCS Integration	Base	\$94,057
MLS Integration	Base	\$215,008
GPIO Integration	Base	\$73,771
MLS Modifications (LCS Support)	Base	\$54,747
Training	Base	\$4,699
ATP	Base	\$12,856
Warranty (1 year)	Base	\$13,260
30-Day Burn-In (2 Deployments)	Base	\$13,260
PTSU Chronology Report	Optional	\$11,400
PTSU Vehicle Density Report	Optional	\$7,091
PTSU Travel Time Report	Optional	\$7,091
PTSU Crash Rate Report	Optional	\$7,091
PTSU Crash Severity Report	Optional	\$7,091
Total Delay Report	Optional	\$7,091
Delay Cost Report	Optional	\$8,417
Travel Time Reliability Report	Optional	\$7,091
System Modification (Archive LCS Data)	Base	\$23,003
System Modification (TSS Groups)	Optional	\$21,677
Bi-Directional Activation	Base	\$4,670
MLS Modifications (GPIO Support)	Base	\$47,929
MLS Modifications (CNA Support)	Base	\$47,929
TOTAL		\$699,837.00

Assumptions

SwRI made various assumptions to produce the cost estimates listed above. The assumptions can be found in ATTACHMENT I of this document.

Project Oversight

SwRI will monitor and control cost, schedule, and quality as part of its standard project management process. SwRI will provide status reports and an invoice for each four-week accounting period when work has been performed. The status report will include a list of project tasks accomplished in the period, project activities planned, cost and schedule status, open risk and action item status, and other critical project status information. SwRI will also assign a project manager that will be the main point of contact for NHDOT.

Summary

Please note that this pre-proposal estimate is submitted as a guide and merely represents our estimate time and/or price to perform services based upon our general understanding of the program and your needs at this time. The estimated time and price as set forth herein are subject to change. This pre-proposal estimate shall not constitute an offer for services and is intended for discussion purposes only. Should you decide to have SwRI conduct this program, SwRI will prepare a formal proposal that will include a statement of work and contract for services.

If you have any questions or comments, please call me at (210) 522-2534 or via email at jperez@swri.org.

Sincerely,



Jose Luis Perez
Lead Computer Scientist
Intelligent Transportation Systems

Approved by:



Amit Misra
Assistant Director – R&D
Intelligent Transportation Systems

JLP/dd

Attachment

ATTACHMENT I
HLB Compass Requirement

HLB Compass Requirements

Lane Control Subsystem Interface Requirements	SwRI Assumptions
<p>The PTSU system shall allow an authorized administrative user to define all devices within a PTSU activation plan, including but not limited to NB, SB, or partial activations. The PTSU Managed Activation Plans shall be able to be saved and reused the same as Managed Response Plans. PTSU shall provide an Extensible Markup Language (XML) interface consistent with the SDI Program ITS Software Architecture.</p>	
<p>Control Protocol Requirements</p>	
<p>PTSU shall support communication with devices using the National Transportation Communications for ITS Protocol (NTCIP) 1203 Version 02.35</p>	
<p>Lane Control Command Requirements</p>	
<p>PTSU shall allow the each LCS controller to be queried for current status.</p>	
<p>PTSU status polls shall include an overall pixel or lamp status value, OK or Error.</p>	<p>It was determined that the lamp status value was not going to be provided due to a conflict with New England Compass removing the ability to retrieve the lamp status.</p>
<p>PTSU status polls shall include the current display of each LCS head.</p>	
<p>PTSU status polls shall include the current brightness mode: Automatic or Manual.</p>	
<p>PTSU status polls shall include the current brightness level: Day or Night.</p>	
<p>PTSU shall allow the brightness level to be set for each LCS head to Auto, Day or Night.</p>	
<p>PTSU shall allow the display of LCS heads to be set</p>	
<p>PTSU shall allow display of an LCS head to be set to one of the following values (if display type is supported):</p>	
<ul style="list-style-type: none"> • Blank • Steady Red X • Steady Down Green Arrow • Steady Yellow X • Steady Down Yellow Arrow • Steady Down Yellow Arrow Slanted 45 degrees right • Steady Down Yellow Arrow Slanted 45 degrees left. 	
<p>PTSU shall process the display setting of an LCS set as an atomic transaction.</p>	
<p>If one or more LCS heads in a set fails to display the requested signal, an error will be returned with the failed LCS heads specified.</p>	
<p>PTSU shall allow the request for displaying signals for a set of LCS heads to override single head errors.</p>	
<p>When overriding single LCS head errors, LCS shall return a successful response if at least one LCS head reports successful display of the requested signal.</p>	<p>It was determined that this requirement was to be removed as it contradicts item 18.</p>
<p>PTSU shall log individual LCS head failures when processing a display request.</p>	
<p>The PTSU User Interface shall visually display the status of all devices within the shoulder use area.</p>	
<p>PTSU shall allow beacons to be queried for lamp status.</p>	
<p>PTSU shall allow LCS sets to be queried for LED pixel status.</p>	
<p>PTSU shall allow individual heads of a set of LCS heads to be specified when querying for pixel status.</p>	<p>It was determined that this requirement was to allow for the querying of an individual LCS head.</p>
<p>PTSU shall allow a set of LCS heads to be queried for LED pixel status.</p>	
<p>PTSU shall allow an LCS set to be queried for the current display.</p>	
<p>PTSU shall allow the operational status of a set of LCS heads to be set to either Active or Out of Service.</p>	
<p>PTSU shall allow display order to be set for devices.</p>	
<p>PTSU shall allow users to add, delete and modify LCS groups.</p>	
<p>PTSU shall allow group display order for each LCS in a group.</p>	
<p>PTSU shall allow individual display order for LCS devices in each group.</p>	
<p>PTSU shall allow users to get and set statuses for all LCS devices in a group.</p>	
<p>PTSU shall allow users to control head statuses for all LCS devices in a group.</p>	

HLB Compass Requirements

Lane Control Rules Requirements	
PTSU shall verify display requests do not conflict with display rules prior to sending requests to the devices.	Stakeholders will provide display rules during design phase. Current assumption is only Item 43 and 44 are the only rules.
PTSU shall send conflict notification messages when display requests conflict with display rules.	
PTSU shall require conflicts be resolved prior to sending out display requests.	
If a conflict resolution message is not resolved within a configurable timeout, an error response shall be returned to the requesting user.	
PTSU shall allow display requests to override conflict resolution.	
PTSU shall perform conflict resolution for LCS heads within an LCS set.	
PTSU shall register a conflict when a down left or right slanted yellow arrow is placed on an LCS head adjacent to a red X, but with the arrow pointing towards the red X.	
PTSU shall register a conflict when a slanted yellow arrow is placed on an LCS head adjacent to another slanted arrow and the two arrows point towards each other.	
Lane Control Plan Requirements	
PTSU shall allow commands for multiple LCS sets to be sent as a plan.	
PTSU shall implement an LCS plan as an atomic transaction.	
PTSU shall return an error for a plan request if any failures setting LCS sets occur.	
PTSU shall allow an LCS plan to be requested as a non-atomic transaction.	It was determined that this requirement is to be removed as it conflicts with item 48.
When overriding LCS set and head errors, PTSU shall return a successful response if at least one LCS head reports successful display of the requested signal.	It was determined that this requirement is to be removed as it conflicts with item 49.
PTSU shall log individual LCS set and head failures when processing a display request.	
Lane Control Permission Requirements	
PTSU shall verify permission for configuring LCS sets and heads.	
PTSU shall verify permission for sending a display command for an LCS set.	
PTSU shall verify permission for activating an LCS plan.	
PTSU shall verify permission for requesting status of LCS sets.	
PTSU shall verify permission for setting the brightness level of LCS sets.	
PTSU shall verify permission for requesting the lamp or pixel status of LCS sets.	
PTSU shall verify permission for approving or overriding a conflict.	
PTSU shall verify permission for changing the operational status of LCS sets.	
Lane Control Polling Requirements	
PTSU shall poll LCS sets for their status on a configurable frequency.	
PTSU shall report the current status of an LCS set as <i>Active</i> , <i>Error</i> , <i>Failed</i> , or <i>Out of Service</i> .	
PTSU shall report an LCS set as <i>Active</i> if communication to the LCS set is established and any LCS head is online.	
PTSU shall report an LCS set as <i>Error</i> if either communication to the LCS set cannot be established or all LCS heads are offline.	
PTSU shall report an LCS set as <i>Failed</i> if the LCS set has been in <i>Error</i> status for a configurable number of communication attempts.	
PTSU shall report an LCS set as <i>Out of Service</i> if the LCS set has been manually placed in <i>Out of Service</i> status.	
PTSU shall not poll LCS sets which are <i>Out of Service</i> or <i>Failed</i> .	It was determined that the PTSU system shall not poll LCS sets which are Out of Service (which is consistent with New England Compass).
PTSU shall resume polling <i>Failed</i> LCS sets when they are manually placed in <i>Active</i> status.	It was determined that the PTSU system shall resume polling of Out of Service LCS sets when it meets the criteria (replace Failed).

HLB Compass Requirements

Action List Requirements	
The PTSU system shall have a configurable checklist procedure for operations to follow to activate, deactivate, partially activate or deactivate the PTSU system.	
The PTSU system shall support an administrative user defined deactivation procedure for all or partial shoulder use when congestion has been mitigated.	This was determined to be a duplicate of item 75.
The PTSU system shall provide stakeholders with system generated email and or SMS message notifications when the PTSU system is Transitioning, is fully active, partially active and when the PTSU has been deactivated	
The PTSU system shall provide a mechanism to trigger a system generated email and SMS notifications from within the PTSU system UI.	This will be met by using an Action List item to send the notification to a predefined user or by allowing a user to send the notification manually.
The PTSU shall allow an administrative user to establish standard procedures for Operations staff to activate and deactivate PTSU.	
The PTSU system shall not be able to be activated without all steps in the standard procedures to be acknowledged as completed by an authorized user.	The standard procedures are every step within the MLS action list.
The PTSU shall enable an administrative user to define multiple procedures for activation / partial activation / deactivation of the PTSU system.	
The PTSU system shall use the Contact Notification Application contacts to select individual contacts and contact groups to notify when the PTSU system is being activated and deactivated.	
PTSU action list templates shall include action templates and a description	
PTSU action templates shall include a description and an optional camera id and optional preset for verification use	
PTSU action templates shall include the following types of actions: -Prerequisite verification -Manual step and verification -Gate control -DMS control	It was determined that on this project the following will be added to the requirement: -LCS control, -Beacon control, -Notification
A prerequisite template shall allow verification steps prior to initiating an active action list: -Verify DMS messages displayed -Verify status of gates -Verify a manual activity (e.g., sweep of the lanes)	
PTSU shall allow a user to create an active action list from an PTSU template	
An active action list shall have an owner	
Ownership of an active action list shall be transferred by a user reassigning the list	
If a user logs out while the owner of an active list, the list will be reassigned to an available operator as soon as one is available	It was determined that if a user logs out who is the owner of an active list, the list will be able to be manually reassigned to another user.
An active action list shall require the user to proceed through the actions in order	
PTSU shall require a user to either verify or override each action before proceeding to the next action	
If a user verifies an action, PTSU shall require verification text from the user	
If a user overrides an action, PTSU shall require a reason for the override	
When a user executes an action, PTSU shall return the successful response or an error	
PTSU shall provide the history of the execution of the action list during execution	
PTSU shall allow an active action list to be aborted	
PTSU shall require the user to enter a reason for aborting an active action list	
PTSU shall verify a user has permission to create and execute an action list.	
PTSU shall verify a user has permission to modify a controller's status	
PTSU shall verify a user has permission to add, modify, or delete managed lane devices	
PTSU shall log execution steps for active action lists including the user who performed each action	
PTSU shall log verifications for each action including the user who verified the action	
PTSU shall log the reason for any overrides to actions in an active action list including the user who overrode the action	
The PTSU module shall be able to control Beacons that will be mounted on static signs.	
Gate Control Requirements	
A gate controller shall have an operational status	
PTSU shall allow a user to set a gate controller's operational status to Active or Out of Service	
PTSU shall provide updates to the operational status of a controller when device communication errors occur	
PTSU shall poll controllers for gate status	
PTSU shall send updates to users when a gate's state changes	
PTSU gate states shall include: -Closing -Opening -Closed -Opened -Failed -Reset -Unknown	
PTSU shall report an error string if the gate state is failed	
PTSU shall report timestamps for a controller for the last successful poll, the last communication attempt, and the last successful control operation	
PTSU shall report the following controller errors if the device supports: -Communication error -Power error -An attached gate error -Controller configuration error -Controller cabinet door open	
A gate controller shall have one or more gates	
The PTSU system shall activate Beacons to notify the public about the status of the PTSU system.	This was determined to be a duplicate of item 105. Suggest to remove.
MVDS Requirements	
The ATMS shall allow authorized users to add, delete and modify MVDS groups.	
The ATMS shall allow group display order for each MVDS in a group.	
The PTSU system shall generate user configurable MVDS Alarms within the Compass ATMS system via configurable Pop-up messages.	This will be done using DPA.
The ATMS shall allow authorized users to get and set statuses for all MVDS devices in a group.	

HLB Compass Requirements

Overall PTSU System Requirements	
The PTSU system shall provide 100 % CCTV Monitoring of the shoulder running area	CCTV Monitoring is dependant on coverage of the area.
The system shall support a decision making process for activating the system.	The MLS system shall be used to support a linear decision making process for activating the system.
Field devices shall communicate with the New England Compass ATMS.	
The PTSU system shall be a module within the Tri-State Compass ATMS system.	
The PTSU system shall be accessible and controllable by operators at the NHDOT TMC, MaineDOT TMC, and MTA TMCC.	
All ITS Roadside equipment shall be shared within the NEC system.	It was determined that a new login will be provided so other Stakeholders will be able to log into the other system and activate/deactivate shoulder running. Devices will also be configured in the other Stakeholders' system so that they would be able to control the side they are responsible for.
All shared ITS Roadside equipment shall be accessible to NHDOT, MaineDOT and MTA.	Same assumption as above.
Traffic information shall be shared between NHDOT, MaineDOT, MTA and other authorized users of the ATMS.	
The ATMS Vendor shall provide training for NHDOT TMC, Maine DOT TMC, and MTA TMCC staff.	
The PTSU system training shall include but is not limited to: Manipulation of CCTV cameras, the ability to retrieve, compile and understand traffic data from MVDS and RWIS stations,	
The PTSU training shall include the ability to post and modify messages on Lane Control Signs (LCS).	
The PTSU training shall include how to activate, monitor, and deactivate the PTSU system.	
The system shall include procedures for transitioning from inactive to active PTSU system including notification to stakeholders.	
Travelers shall be notified when the PTSU is: inactive (the shoulder is only open as an emergency breakdown lane), active (the shoulder is open as a general travel lane and is not available for emergency stopping), or is transitioning between the two scenarios.	Notifications will be part of the MLS checklist. It was determined that any additional notifications will be performed by the operations center.
The system shall be largely automated, with a need for information to be messaged to logged in users during critical times or when system operations decisions must be made. Messaging may include notifications and alarms based on pre-determined thresholds or time-of-day triggers.	It was determined that full automation was to be removed. Instead the system will guide users via a checklist to perform the actions. These actions will be done by the system as long as the user steps through them.
The PTSU system shall include notifications and alarms to TMS operators based upon threshold triggers that are configurable by an authorized administrator user.	
The PTSU system shall provide incident information to be shared with first responders for rapid and effective response.	It was determined that the Stakeholders will be providing this information as part of their Standard Operating Procedures. The PTSU system shall not do this and as a result the requirement should be removed.
Local maintainers of the bridge and highways shall be provided information on the status of the PTSU system by the system when the PTSU is activated.	It was determined that the Stakeholders will be providing this information as part of their Standard Operating Procedures. The PTSU system shall not do this and as a result the requirement should be removed.
The PTSU system shall provide incident information to local maintainers of the bridge and highways.	It was determined that the Stakeholders will be providing this information as part of their Standard Operating Procedures. The PTSU system shall not do this and as a result the requirement should be removed.
The reliability of the PTSU system shall shall maintain 99.99% of uptime per year for the contract period.	
The system shall provide the following functions:	
· Pre-activation inspection	
· System activation	
· System operations	
· System deactivation	
· Incident detection and verification	
· System reporting and record keeping	
· System maintenance (preventative and emergency)	
· System enhancement and expansion	
The PTSU system shall be able to be activated, directionally, bi-directionally, or in segments.	Bi-direction activation will be accomplished by activating in sequence.
The system shall provide procedures to alert and notify first responders of incidents within the limits of the PTSU system.	It was determined that the Stakeholders will be providing this information as part of their Standard Operating Procedures. The PTSU system shall not do this and as a result the requirement should be removed.
The system shall provide system status reporting.	
For PTSU Activation the system shall provide a verification checklist.	
The verification checklist shall verify: The shoulder is prepared for travel, Alarms indicate there is freeway congestion, the conditions meet an administrative user configurable thresholds to initiate the PTSU system.	Each of these items will be accomplished using the manual verification step.
The verification checklist shall include: CCTV verification to ensure no vehicles or debris are in shoulder, Traffic volume, speed and weather are verified for proper shoulder use.	Each of these items will be accomplished using the manual verification step.

HLB Compass Requirements

PTSU Active operations	
When the PTSU system is active the ATMS shall visually display that the system is in use.	
The PTSU system shall allow shoulder use activation when traffic volumes and or traffic speed thresholds have been met.	This item will be accomplished using the manual verification step.
The PTSU system shall provide system monitoring using CCTV, RWIS and MVDS data.	
During an incident the PTSU system shall support an administrative user defined emergency deactivation procedure to quickly deactivate all or partial shoulder use.	The action list will still be ran through but all verification and override steps will be skipped.
The PTSU shall have a transitioning status when shoulder running is being activated or deactivated.	
CCTVs shall provide real-time video monitoring of the PTSU system.	Snapshots will be provided as noted in the MLS prototype to allow an operator/user the ability to view a camera.
The ATMS shall display all traveler messaging for PTSU.	
Weather, traffic volume and speed data shall be displayed in real time within the PTSU module in Compass.	
Realtime display of data shall be at a minimum within 30 seconds or less.	
PTSU Deactivation	
The ATMS PTSU module shall notify Operators when traffic volumes have decreased below authorized user configurable traffic volume thresholds.	
The ATMS PTSU module shall notify Operators when inclement Weather is approaching based upon user configurable thresholds.	
When an incident occurs in the PTSU area an alarm shall be generated to the TMC operator when speed and volume conditions reach a user configurable threshold.	
The PTSU Module shall provide the ability to activate shoulder use in one direction, two directions, or partial shoulder use in user configurable areas.	Bi-direction activation will be accomplished by activating in sequence.
The ATMS PTSU system shall provide travelers with real time status of shoulder use lanes using LCS and DMS messages.	
The ATMS shall provide real-time CCTV snapshot images of all cameras within the PTSU area for verification of PTSU activation and deactivation.	It was determined that Video Streams would not be used in the application but Snapshots would suffice.
Performance Measure and Reporting Requirements	
The PTSU shall monitor travel times before, during and after PTSU activation.	
The system shall log the status of the system for record keeping.	
The PTSU system shall log all PTSU activations, full or partial and all deactivations, full or partial.	
The PTSU activation logging shall include, but is not limited to; date / time, the owner's User ID, procedure checklist steps completed, DMS Messages, LCS activated, Traffic Volumes at detectors and all notifications sent.	
The PTSU deactivation logging shall include, but is not limited to; date / time, the owner's User ID, procedure checklist steps completed, DMS Messages, LCS activated, Traffic Volumes at Detectors and all notifications sent.	
The PTSU emergency deactivation logging shall include, but is not limited to; date / time, the owner's User ID, procedure checklist steps completed, DMS Messages, LCS activated, Traffic Volume at detectors and all notifications sent.	
Probe Data Usage	
Maine to purchase TomTom in NH, NH to purchase TT in Maine?	

HLB Compass Requirements

Custom Reports	
PTSU Chronolgy Report	A custom report shall be created for all the actions taken in a PTSU activation (full, partial and deactivation) similar to the current Event Chronolgy report.
Vehicle density during PTSU activation vs. vehicle density during similar time periods without PTSU	A custom report shall show vehicle density on a group of MVDS or a singular MVDS on multiple user selectable time periods to compare the vehicle density during those time periods. This report data shall be able to be filtered in 15 minutes, hourly, or daily intervals. This report shall be able to be generated in a data table layout and in a line graph format.
Travel time during PTSU activation vs. travel time during similar time periods without PTSU	A custom report shall show travel times on a travel time link on multiple user selectable time periods to compare the travel times during those time periods. This report data shall be able to be filtered in 15 minutes, hourly, or daily intervals. This report shall be able to be shown in a data table layout and also a line graph format.
Total crashes (crash frequency)	A custom report shall be able to show the frequency of incidents using all the parameters in the current Event Chronology report.
Crash rate during PTSU activation vs. crash rate during similar time periods without PTSU	A custom report shall show the crash rate in an area on multiple user selectable time periods to compare the crash rates during those time periods. This report data shall be able to be filtered in hourly, 4 hour, 8 hour, 12 hour, or daily intervals. This report shall be able to be shown in a data table layout and also a bar chart format. This report shall use all the parameters in the current Event Chronology report.
Crash severity during PTSU activation vs. crash severity during similar time periods without PTSU	A custom report shall show the crash severity in an area on multiple user selectable time periods to compare the crash severity during those time periods. This report data shall be able to be filtered in hourly, 4 hour, 8 hour, 12 hour, or daily intervals. This report shall be able to be shown in a data table layout and also a bar chart format. This report shall use all the parameters in the current Event Chronology report.
Traffic volumes diverted onto local roadways	It was determined that this requirement should be removed as no MVDS devices would be on the exit ramps to create this report.
Total delay per vehicle	A custom report shall show total delay per vehicle on a travel time link on a user selectable time period. This report data shall be able to be filtered in 15 minutes, hourly, or daily intervals. This report shall be able to be shown in a data table layout and also a line graph format.
User delay Cost	A custom report shall show user delay cost on a travel time link on a user selectable time period. This report data shall be able to be filtered in 15 minutes, hourly, or daily intervals. The user delay cost shall be a number parameter to enter. The user shall be able to select a mvds or mvds group for the volume data. This report shall be able to be shown in a data table layout and also a line graph format.
Travel time reliability during peak traffic volume periods	A custom report shall show travel time reliability on a travel time link on a user selectable time period. This report data shall be able to be filtered in hourly, 4 hour, 8 hour, 12 hour, or daily, weekly, and monthly intervals. This report shall be able to be shown in a data table layout and also a line graph format.