1. Purpose of Document

The purpose of this document is to layout the verification plan of the adaptive signal control technology (ASCT) that will be implemented at the City of Puyallup. This document is part of the System Engineering documents that have been developed to select and deploy an ASCT system for the City. This document describes the scope of the project; the referenced documents that are used to prepare the verification plan; details on the actual conduct of verification; and provides a list of the verification cases and corresponding system requirements to be tested.

The intended audience of this document includes the existing stakeholders of City of Puyallup signal system:

- City of Puyallup
- WSDOT
- FHWA
- Network Users
- City of Puyallup IT Department

2. Scope of Project

The scope of the project includes the implementation of adaptive signal control technology at 17 intersections along the Meridian corridor and the bypass corridor in the City of Puyallup. The adaptive signal control technology will improve the traffic operation and reduce or eliminate the limitations of the existing signal control system.

Each of the system requirements of the selected adaptive signal control technology will be tested according to this verification plan. The results of the verification tests will be documented by the verification conductor. If any test fails to provide satisfactory result, the reason of the failure and the resolution of the corresponding issue shall be documented by the verification conductor.

3. Referenced Documents

The following documents supported the preparation of the verification plan:

- FHWA-HOP-11-027: “Model Systems Engineering Documents for Adaptive Signal Control Technology (ASCT) Systems”, August 2012
- City of Puyallup Adaptive Signal Control Technology – System Requirements, March 2014
- City of Puyallup Adaptive Signal Control Technology – Concept of Operations, March 2014

4. Conducting Verification

The verification will be conducted by the system vendor in presence of the City of Puyallup system operator. The vendor shall conduct the verification tests in two steps. In the first step, the vendor shall bench test the system requirements for each signal at the City signal shop. In the second step, the vendor shall conduct the verification tests in the field. The verification table below indicates where the

test should be conducted. The vendor shall coordinate with the system operator to schedule the testing time periods.

The verification conductor will fill out the verification identification document to include the test results. Any failure or lack of performance to meet the stated system requirements shall be immediately recorded and the vendor shall prepare a report stating why system requirement was not met. The report shall include a proposed solution to resolve the deficiency and shall be submitted to the City within seven days of the failure if discovered. If the vendor is not able to meet a system requirement that was included in the vendor contract, the vendor shall prepare a report and develop a plan to provide similar performance operation. The City does not anticipate any software revision would be required to satisfy the mandatory requirements. Upon completion of all required verification testing, the vendor shall prepare a final Verification Report which will contain all critical information regarding testing conducted including both failures and successes. Resolution of the cause of failures should also be detailed. A list of all hardware, software and special equipment utilized in the testing shall be provided.

5. Verification Identification

The following verification cases shall be tested and documented by the verification conductor. Each verification case consists of the group of system requirements that satisfies an operational need of the system operator. The needs of the system operator are described in the Concept of Operations documents. The verification plan does not include the verification procedure. As a result, the verification tests are not grouped by action procedures. The verification conductor is allowed to rearrange the verification tests by the action procedures. The verification conductor shall provide the action procedures for the tests and logical grouping of the tests (if re-arranged) to the City for review and approval before conducting the verification.

Verification Case Number (Con Ops Reference Number)	Verification Case (Concept of Operations Sample Statements)	City of Puyallup Adaptive Signal Control Technology (ASCT) System Requirements	Test Location	Pass/Fail	Briefly discuss the reasons if the verification test fails an how the issue will be resolved
4	**4 Operational Needs**				
4.1	4.1 Adaptive Strategies				
4.1.0-1.0-1	Maximize the throughput on coordinated routes	2.2.0-4 The ASCT shall calculate offsets to suit the current coordination strategy for the user-specified reference point for each signal controller along a coordinated route within a group. 2.1.1.0-7.0-1 When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers, maximizing the throughput of the coordinated route. 2.1.1.0-7 The ASCT shall alter the adaptive operation to achieve required objectives in user-specified conditions. (The required objectives are specified in Needs Statement 4.1.0-1. Responding to this requirement demonstrates how the proposed system allows the user to define the conditions at which the objectives shift and their associated requirements are fulfilled.) (The alteration may be made by adjusting parameters or by directly controlling the state of signal controllers.) 2.2.0-5.0-2 The ASCT shall limit cycle lengths to a user-specified range. 2.2.0-5.0-4 The ASCT shall limit changes in cycle length to not exceed a user-specified value.	Field Field Bench & Field Bench Bench & Field		
4.1.0-1.0-2	Provide smooth flow along coordinated routes	2.1.1.0-7.0-4 When current measured traffic conditions meet user-defined criteria, the ASCT shall alter the state of signal controllers providing two-way progression on a coordinated route.	Field		
4.1.0-1.0-3	Distribute phase times in an equitable fashion	2.1.1.0-7.0-3	Bench & Field		

		When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers providing equitable distribution of green times. 2.2.0-3 The ASCT shall calculate phase lengths for all phases at each signal controller to suit the current coordination strategy. 2.4.0-3 The ASCT shall calculate optimum phase lengths, based on current measured traffic conditions. (The calculation is based on the optimization objectives.) 2.1.1.0-8.0-1 The ASCT shall provide a user-specified maximum value for each phase at each signal controller. 2.1.1.0-8.0-2 The ASCT shall provide a user-specified minimum value for each phase at each signal controller. 2.1.1.0-8.0-2.0-1 The ASCT shall not provide a phase length shorter than the minimum value.	Bench & Field Bench & Field Bench Bench Bench		
4.1.0-1.0-4	Manage the length of queues	2.1.3.0-2 When queues are detected at user-specified locations, the ASCT shall execute user-specified timing plan/operational mode. 2.1.1.0-7.0-2 When current measured traffic conditions meet user-specified criteria, the ASCT shall alter the state of signal controllers, preventing queues from exceeding the storage capacity at user-specified locations. 2.1.3.0-1 The ASCT shall detect the presence of queues at pre-configured locations. 2.1.3.0-3 When queues are detected at user-specified locations, the ASCT shall execute user-specified adaptive operation strategy.	Bench & Field Field Field Bench & Field		
4.1.0-1.0-6	At an isolated intersection, optimize operation with a minimum of phase failures (based on the optimization objectives)	2.4.0-2 The ASCT shall calculate a cycle length of a single intersection, based on current measured traffic conditions. (The calculation is based on the optimization objectives.)	Bench & Field		
4.1.0-2	The system operator needs to manage the coordination in small groups of signals to link phase service at some intersections with phase service at adjacent intersections	2.5.0-3 The ASCT shall calculate the time at which a user-specified phase shall be green at an intersection.	Bench & Field		

4.1.0-4	The system operator needs to detect repeated phase failures and control signal timing to prevent phase failures building up queues. The operator in this case is trying to prevent a routine queue from forming where it will block another movement in the cycle unnecessarily. For example, the operator may need to prevent a queue resulting from the trailing end of the through green from blocking the storage needed by an entering side-street left turn in the subsequent phase. An overall queue management strategy, particularly when congestion is present, is covered under 4.1.0-1.0-5	2.1.1.0-9.0-1 The ASCT shall alter operations, to minimize repeated phase failures.	Bench & Field		
4.1.0-5	The system operator needs to minimize the chance that a queue forms at a specified location	2.2.0-5.0-5 The ASCT shall adjust offsets to minimize the chance of stopping vehicles approaching a signal that have been served by a user-specified phase at an upstream signal.	Field		
4.1.0-6	The system operator needs to modify the sequence of phases to support the various operational strategies	7.0-6 The ASCT shall provide a minimum of two different user-defined phase sequences for each signal.	Bench		
4.1.0-7	The system operator needs to fix the sequence of phases at any specified location. For example, the operator may need to fix the phase order at a diamond interchange	2.1.2.0-12 The ASCT shall not alter the order of phases at a user-specified intersection.	Bench & Field		
4.1.0-8	The system operator needs to designate the coordinated route based on traffic conditions and the selected operational strategy	2.1.1.0-11 The ASCT shall provide coordination along a route. 2.1.1.0-11.0-1 The ASCT shall coordinate along a user-defined route. 2.1.1.0-11.0-4.0-1 The ASCT shall implement a stored coordinated route by operator command.	Field Bench & Field Bench & Field		
4.1.0-9	The system operator needs to set signal timing parameters (such as minimum green, maximum green and extension time) to comply with agency policies	2.1.1.0-12 The ASCT shall not prevent the use of phase timings in the local controller set by agency policy.	Bench		
4.1.0-10	The system operator needs to set special event traffic flush out plans	2.1.1.0-13.0-1 The ASCT shall allow user to set specific timing plan in operation 2.1.1.0-13.0-2 The ASCT shall detect the sudden large shift in traffic and change operation as soon as system detects the change is traffic	Bench Field		
4.2	4.2 Network characteristics				
4.2.0-1	The system operator needs to eventually adaptively control up to 33 signals, up to 2.5 miles from the TMC (or specified location).	1.0-1 The ASCT shall control a minimum of 17 signals concurrently	Field		

4.2.0-2	The system operator needs to be able to adaptively control up to 10 independent groups of signals	1.0-2 The ASCT shall support groups of signals. 1.0-2.0-2 The ASCT shall control a minimum of 10 groups of signals. 1.0-2.0-4 Each group shall operate independently 1.0-2.0-1 The boundaries surrounding signal controllers that operate in a coordinated fashion shall be defined by the user.	Bench & Field Field Field Bench & Field		
4.2.0-3	The system operator needs to vary the number of signals in an adaptively controlled group to accommodate the prevailing traffic conditions.	1.0-2.0-3 The size of a group shall range from 1 to 20 signals. 1.0-2.0-5.0-2 The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system according to traffic conditions. (For example: this may be achieved by assigning signals to different groups or by combining groups.) 1.0-2.0-5 The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the ASCT system according to configured parameters. 1.0-2.0-5.0-3 The boundaries surrounding signal controllers that operate in a coordinated fashion shall be altered by the system when commanded by the user.	Bench Field Field Field		
4.3	4.3 Coordination across boundaries				
4.3.0-3	The system operator needs to adaptively coordinate signals on two crossing routes simultaneously.	4.0-1.0-4 The ASCT shall support adaptive coordination on crossing routes.	Field		
4.3.0-5	The system operator needs to constrain the adaptive system to operate a cycle length compatible with the crossing arterial.	4.0-1.0-2 The ASCT shall operate a fixed cycle length to match the cycle length of an adjacent system.	Bench & Field		
4.4	4.4 Security				
4.4.0-1	The system operator needs to have a security management and administrative system that allows access and operational privileges to be assigned, monitored and controlled by an administrator, and conform to the agency's access and network infrastructure security policies.	5.0-1 The ASCT shall be implemented with a security policy that addresses the following selected elements: 5.0-1.0-1 Local access to the ASCT 5.0-1.0-2 Remote access to the ASCT	Bench Bench		

		5.0-1.0-3 System monitoring 5.0-1.0-4 System manual override 5.0-1.0-7 User login 5.0-1.0-8 User password 5.0-1.0-9 Administration of the system 5.0-1.0-16 Configuration	Bench Bench Bench Bench Bench Bench		
4.6	4.6 Pedestrians				
4.6.0-2	The system operator needs to accommodate infrequent pedestrian operation while maintaining adaptive operation. (This is appropriate for pedestrian calls that are common but not frequent that they drive the operational needs.)	8.0-2 When a pedestrian phase is called, the ASCT shall accommodate pedestrian crossing times during adaptive operations.	Bench & Field		
4.6.0-3	The system operator needs to incorporate frequent pedestrian operation into routine adaptive operation. (This is appropriate when pedestrians are frequent enough that they must be assumed to be present every cycle or nearly every cycle.)	8.0-5 The ASCT shall execute pedestrian recall on user-defined phases in accordance with a time of day schedule. 8.0-7 When specified by the user, the ASCT shall execute pedestrian recall on pedestrian phase adjacent to coordinated phases. 8.0-8 When the pedestrian phases are on recall, the ASCT shall accommodate pedestrian timing during adaptive operation.	Bench Bench Bench & Field		
4.6.0-4	The system operator needs to accommodate the following custom pedestrian features.	8.0-9 During preemption system shall not truncate don't walk, but can truncate the walk time 8.0-10 Capability to extend the walk time based on pedestrian volume and actuations	Bench Bench		
4.6.0-5	The system operator needs to accommodate early start of walk and exclusive pedestrian phases.	8.0-1 When a pedestrian phase is called, the ASCT shall execute pedestrian phases up to 9 seconds before the vehicle green of the related vehicles phase.	Bench		

		8.0-4 The ASCT shall execute user-specified exclusive pedestrian phases during adaptive operation.	Bench & Field		
4.7	4.7 Non-adaptive situations				
4.7.0-1	The system operator needs to detect traffic conditions during which adaptive control is not the preferred operation, and implement some pre-defined operation while that condition is present.	2.1.1.0-1 The ASCT shall operate non-adaptively during the presence of a defined condition.	Bench & Field		
4.7.0-3	The system operator needs to override adaptive operation.	2.1.1.0-3 The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptively controlling a group of signals. 2.1.1.0-4 The ASCT shall operate non-adaptively when a user manually commands the ASCT to cease adaptive operation. 2.1.1.0-13 The ASCT shall allow operator to override one individual intersection to manual operation while keeping others under adaptive operation.	Bench & Field Bench & Field Field		
4.8	4.8 System responsiveness				
4.8.0-1	The system operator needs to modify the ASCT operation to closely follow changes in traffic conditions.	2.6.0-1 The ASCT shall limit the change in consecutive cycle lengths to be less than a user-specified value. 2.6.0-3 The ASCT shall limit the changes in the direction of primary coordination to a user-specified frequency.	Bench & Field Field		
4.8.0-2	The system operator needs to constrain the selection of cycle lengths to those that provide acceptable operations, such as when resonant progression solutions are desired.	2.6.0-4 When a large change in traffic demand is detected, the ASCT shall respond more quickly than normal operation, subject to user-specified limits. The changes in consecutive cycles shall not exceed more than 20 seconds.	Field		
4.9	4.9 Complex coordination and controller features				
4.9.0-1	The system operator needs to implement the following advanced controller features while maintaining adaptive operation:				
4.9.0-1.0-1	Service a phase more than once per cycle	7.0-1 When specified by the user, the ASCT shall serve a vehicle phase more than once for each time the coordinated phase is served.	Bench		
4.9.0-1.0-2	Operate at least two overlap phases	7.0-2 The ASCT shall provide a minimum of two phase overlaps.	Bench		
4.9.0-1.0-3	Operate two rings, 8 vehicle phases, 4 pedestrian phases and up to two phases per ring	7.0-3 The ASCT shall accommodate a minimum of 8 vehicle phases and 4 pedestrian phases at each signal. 7.0-4	Bench Bench		

		The ASCT shall accommodate a minimum of 2 rings at each signal. 7.0-5 The ASCT shall accommodate a minimum of 2 phases per ring.	 Bench		
4.9.0-1.0-4	Permit different phase sequences under different traffic conditions	7.0-6 The ASCT shall provide a minimum of 8 different user defined phase sequences for each signal. 7.0-6.0-1 Each permissible phase sequence shall be user-assignable to any signal timing plan. 7.0-6.0-2 Each permissible phase sequence shall be executable by a time of day schedule. 7.0-6.0-3 Each permissible phase sequence shall be executable based on measured traffic conditions	Bench Bench Bench Field		
4.9.0-1.0-5	Allow one or more phases to be omitted (disabled) under certain traffic conditions or signal states.	2.1.2.0-6 The ASCT shall omit a user-specified phase when the cycle length is below a user-specified value. 2.1.2.0-9 The ASCT shall omit a user-specified phase according to a time of day schedule. 2.1.2.0-7 The ASCT shall omit a user-specified phase based on measured traffic conditions. 2.1.2.0-8 The ASCT shall omit a user-specified phase based on the state of a user-specified external input.	Bench & Field Bench Field Bench		
4.9.0-1.0-6	Prevent one or more phases being skipped under certain traffic conditions or signal states	2.1.2.0-5 The ASCT shall prevent skipping a user-specified phase according to a time of day schedule. 2.1.2.0-3 The ASCT shall prevent skipping a user-specified phase when the user-specified phase sequence is operating.	Bench Field		
4.9.0-1.0-10	Allow the operator to specify which phase receives unused time from a preceding phase	2.1.2.0-10 The ASCT shall assign unused time from a preceding phase that terminates early to a user-specified phase as follows: • Next phase • Next coordinate phase • User-specified phase	Bench		

		2.1.2.0-11 The ASCT shall assign unused time from a preceding phase that is skipped to a user-specified phase as follows: • Previous phase • Next phase • Next coordinated phase • User-specified phase	Bench		
4.9.0-1.0.11	Allow the controller to respond independently to individual lanes of an approach.	7.0-12 The ASCT shall not prevent the local signal controller from performing actuated phase control using user specified extension/ passage timers as assigned to user-specified vehicle detector input channels in the local controller. 9.0-1 The ASCT shall set a specific state for each special function output based on the occupancy on a user-specified detector. 7.0-12.0-1 The ASCT shall operate adaptively using user-specified detector channels.	Bench Bench Bench		
4.9.0-1.0-12	Allow the coordinated phase to terminate early under prescribed traffic conditions.	7.0-10 The ASCT shall have the option for a coordinated phase to be released early based on a user-definable point in the phase or cycle. (User select phase or cycle.)	Bench		
4.9.0-1.0-13	Allow flexible timing of non-coordinate phases (such as late start of a phase) while maintaining coordination.	8.0-6 The ASCT shall begin a non-coordinated phase later than its normal starting point within the cycle when all of the following conditions exist: • The user enables this feature • Sufficient time in the cycle remains to serve the minimum green times for the phase and the subsequent non-coordinated phases before the beginning of the coordinated phase • The phase is called after its normal start time • The associated pedestrian phase is not called	Bench		
4.9.0-1.0-14	Protected/permissive phasing and alternate left turn phase sequences.	2.1.2.0-1 The ASCT shall allow protected/permissive left turn phase operation. 2.1.2.0-2 The ASCT shall allow the protected left turn phase to lead or lag the opposing through phase based upon user-specified conditions.	Bench Bench		
4.9.0-1.0-15	Use flashing yellow arrow to control permissive left turns	7.0-11 The ASCT shall not prevent the controller from displaying flashing yellow arrow left turn or right turn	Bench		
4.9.0-1.0-16	Service side streets and pedestrian phases at minor locations more often than at adjacent signals when this can be done without compromising the quality of the coordination (e.g., double-cycle mid-block pedestrian crossing signals)	7.0-13 The ASCT shall allow half cycle or double cycle operation to provide service to side streets or pedestrian phases more often than adjacent signal	Bench & Field		

4.9.0-1.0-17	Use negative pedestrian phasing to prevent an overlap conflicting with a pedestrian walk/don't walk	8.0-9 The ASCT shall not inhibit negative vehicle and pedestrian phase timing.	Bench		
4.9.0-1.0-18	Allow coordination with double cycle or half cycle to better serve pedestrians	8.0-10 The ASCT shall allow double cycle or half cycle operation of a specific intersection within a signal group.	Field		
4.9.0-1.0-19	Allow pedestrian phase recycle operation	8.0-11 When specified by the user, the ASCT shall serve a pedestrian phase more than once if not rest-in-walk and phase split is long enough serving the clearance time.	Bench		
4.10	4.10 Monitoring and control				
4.10.0-1	The system operator needs to monitor and control all required features of adaptive operation from the following locations:	5.0-2 The ASCT shall provide monitoring and control access at the following locations:			
4.10.0-1.0-1	Agency TMC	5.0-2.0-1 Agency TMC	Bench		
4.10.0-1.0-2	Maintenance facility	5.0-2.0-2 Signal Shop	Bench		
4.10.0-1.0-3	Workstations on agency LAN or WAN located at (specify)	5.0-2.0-3 Agency LAN or WAN	Bench		
4.10.0-1.0-5	Local controller cabinets	5.0-2.0-5 Local controller cabinets	Field		
4.10.0-1.0-7	Field locations	5.0-2.0-7 Field locations via internet	Field		
4.11	4.11 Performance reporting				
4.11.0-2	The system operator needs to store and report data used to calculate signal timing and have the data available for subsequent analysis.	6.0-4 The ASCT shall store results of all signal timing parameter calculations for a minimum of 365 days (desired to have 16 months of data). 6.0-5 The ASCT shall store the following measured data in the form used as input to the adaptive algorithm for a minimum of 365 days: (edit as appropriate) • Volume • Occupancy • Queue length • Phase utilization • Arrivals in green • Green band efficiency 6.0-12 The ASCT shall store the following data in 15 minute increments (desirably cycle by cycle): • Volume • Occupancy • Queue length	Bench Bench Bench		

4.11.0-4	The system operator needs to store all operational data, signal timing parameters, and performance data calculated by the adaptive system in the city's server.	6.0-1 The ASCT shall export its systems log in the following formats: • MS Excel • Text • CSV 6.0-3 The ASCT shall store the event log for a minimum of 365 days (desired to have 16 months of data).	Bench Bench		
4.11.0-6	The system operator needs to be able to report the exact state of signal timing and input data for a specified period, to allow historical analysis of the system operation.	6.0-1 The ASCT shall log the following events: 6.0-1.0-1 Tim-stamped vehicle phase calls 6.0-1.0-2 Tim-stamped pedestrian phase calls 6.0-1.0-3 Time-stamped emergency vehicle preemption calls 6.0-1.0-4 Time-stamped transit priority calls 6.0-1.0-5 Time-stamped railroad preemption calls 6.0-1.0-6 Time-stamped start and end of each phase 6.0-1.0-7 Time-stamped controller interval changes 6.0-1.0-8 Time-stamped start and end of each transition to a new timing plan 6.0-1.0-9 Time-stamped detection actuation per lane	Bench		
4.11.0-7	Have the ability to generate historic and real-time reports that effectively support operation, maintenance and reporting of system performance and traffic conditions.	6.0-8 The ASCT shall calculate and report relative data quality including: • The extent data is affected by detector faults • Other applicable items 6.0-9 The ASCT shall report comparison of logged data when requested by the user: • Day to day	Bench Bench		

		• Hour to hour • Hour of day to hour of day • Hour of week to hour of week • Day of week to day of week • Day of year to day of year			
4.12	4.12 Failure notification				
4.12.0-1	The system operator needs to immediately notify maintenance and operations staff of alarms and alerts.	13.1.0-3 In the event of a detector failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.) 13.2-2 In the event of communications failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.) 13.3-2 In the event of adaptive processor failure, the ASCT shall issue an alarm to user-specified recipients. (This requirement may be fulfilled by sending the alarm to a designated list of recipients by a designated means, or by using an external maintenance management system.)	Bench Bench Bench		
4.12.0-3	The system operator needs to maintain a complete log of alarms and failure events.	13.1.0-4 In the event of a failure, the ASCT shall log details of the failure in a permanent log. 13.1.0-5 The permanent failure log shall be searchable, achievable and exportable.	Bench Bench		
4.13	4.13 Preemption and priority				
4.13.0-1	The system operator needs to accommodate railroad preemption	11.0-1 The ASCT shall maintain adaptive operation at non-preempted intersections during railroad preemption. 11.0-4 The ASCT shall resume adaptive control of signal controllers when preemptions are released. 11.0-5 The ASCT shall execute user-specified actions at preempted signal controllers during preemption. (E.g., inhibit a phase, activate a sign,). 11.0-8 The ASCT shall allow the local signal controller to operate in normally detected limited-service actuated mode during preemption.	Field Bench & Field Bench Bench		

		11.0-9 The ASCT shall return to a user specified phases for a user specified time.	Bench & Field		
4.13.0-2	The system operator needs to accommodate emergency vehicle preemption	11.0-2 The ASCT shall maintain adaptive operation at non-preempted intersections during emergency vehicle preemption.	Field		
4.14	4.14 Failure and fallback				
4.14.0-1	The system operator needs to fall back to TOD or isolated free operation, as specified by the operator, without causing disruption to traffic flow, in the event of equipment, communications and software failure.	13.1.0-2 The ASCT shall use the following alternate data sources for operations in the absence of the real-time data from a detector: 13.1.0-2.0-3 The ASCT shall switch to the alternate source in real time without operator intervention. 13.1.0-1 The ASCT shall take user-specified action in the absence of valid detector data from one or more vehicle detectors within a group: • Switch to recall • Switch to different max time 13.1.0-1.0-2 The ASCT shall release control to local operations to operate under its own time-of-day schedule. 13.2-1 The ASCT shall execute user-specified actions when communications to one or more signal controllers fails within a group: 13.2-1.0-1 In the event of loss of communication to a user-specified signal controller, the ASCT shall release control of all signal controllers within a user-specified group to local control. 13.2-1.0-2 The ASCT shall switch to the alternate operation in real time without operator intervention. 13.3-1 The ASCT shall execute user-specified actions when adaptive control fails. 13.3-1.0-1 The ASCT shall release control to central system control. 13.3-4 During adaptive processor failure, the ASCT shall provide all local detector inputs to the local controller.	Field Bench & Field Bench Bench & Field Bench & Field Bench & Field Bench & Field Bench & Field Bench		

		2.1.1.0-2 The ASCT shall operate non-adaptively when adaptive control equipment fails.	Bench		
4.15	4.15 Constraints				
4.15.0-1	The system operator is constrained to use the following equipment:				
4.15.0-1.0-1	Controller type (list acceptable equipment)	14.0-3 The ASCT shall fully satisfy all requirements when connected with the controllers of type: • type 170 or 2070	Bench		
4.15.0-2	The system operator needs to use equipment and software acceptable under current agency IT policies and procedures.	14.0-1 The vendor's adaptive software shall be fully operational within the following platform: (edit as appropriate) • Windows-PC	Bench		
4.16	4.16 Training and support				
4.16.0-1	The agency needs all staff involved in operation and maintenance to receive appropriate training.	15.0-1.0-1 The vendor shall provide training on the operations of the adaptive system. 15.0-1.0-9 The vendor shall provide a minimum of one to two days before implementation, one to two days after implementation and one day or two after six months of implementation. 15.0-1 The vendor shall provide the following training. 15.0-1.0-2 The vendor shall provide training on troubleshooting the system. 15.0-1.0-3 The vendor shall provide training on preventive maintenance and repair of equipment. 15.0-1.0-4 The vendor shall provide training on system configuration. 15.0-1.0-5 The vendor shall provide training on administration of the system. 15.0-1.0-6 The vendor shall provide training on system calibration. 15.0-1.0-7			

		The vendor's training delivery shall include: printed course materials and references, electronic copies of presentations and references. 15.0-1.0-8 The vendor's training shall be delivered at TMC			
4.16.0-2	The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to be maintained to repair faults that are not defects in materials and workmanship.	16.0-1 The initial implementation shall include three years of maintenance. The Maintenance Vendor shall provide maintenance according to a separate maintenance contract. That contract should identify repairs necessary to preserve requirements fulfillment, responsiveness in effecting those repairs, and all requirements on the maintenance provider while performing the repairs.			
4.16.0-3	The agency needs the system to fulfill all requirements for the life of the system. The agency therefore needs the system to remain free of defects in materials and workmanship that result in requirements no long being fulfilled.	16.0-3 The initial implementation shall provide one to three years of Warranty. The Vendor shall warrant the system to be free of defects in materials and workmanship. Warranty is defined as correcting defects in materials and workmanship (subject to other language included in the purchase documents). Defect is defined as any circumstance in which the material does not perform according to its specification.			
4.16.0-4	The City will also need support to keep the software and the software environment updated as necessary to prevent requirements no longer being fulfilled.	16.0-2 The Vendor shall provide routine updates to the software and software environment necessary to preserve the fulfillment of requirements for period of three years. Preservation of requirements fulfillment especially includes all IT management requirements a previously identified.			
4.17	4.17 External interfaces				
4.17.0-2	The system operator needs to react to commands issued by Lahar system and manually activate the evacuation timing plan.	9.0-4 User shall be able to manually activate the specific evacuation plan or emergency plan for each group individually. 9.0-5 User shall be able to manually activate the specific evacuation plan or emergency plan for the whole system.	Bench & Field Bench & Field		
4.17.0-3	The system operator needs to react to traffic volume and traffic operation condition change due to fair event.	9.0-6 The ASCT shall add a user specified phase based on a user specified input.	Bench & Field		