

NWR ITS Current Practices Supplement

Version: 21-Jun-11

The requirements below that are in conflict with the ITS Current Practices manual supersede those in the ITS Current Practices manual.

Design Elements

1. General Requirements

- a. Existing ITS devices
 - i. All existing ITS devices shall be kept operational during the project unless the device has already been replaced and inspected by WSDOT. Once a new device has replaced an existing ITS device, the new device shall be kept operational. Devices that are damaged by construction activities that are not specifically called out to be replaced or removed in the plans or the RFP shall be restored to new condition or replaced by the Contractor according to WSDOT standards.
- b. Conduit
 - i. Minimum size conduit for ITS shall be 2" (exception: smaller conduit may be used at type 1 pole foundations and loop lead-in conduit).
 - ii. Minimum spare conduit(s) required are:
 1. One 2" at each roadway crossing.
 2. One 2" through VMS structure foundations.
 3. One 2" between each transformer cabinet and its nearest junction box.
 4. One 2" between each device cabinet and its nearest junction box with the following additional requirements:
 - a. ES cabinets require two-2" or one-3" spare conduit(s).
 - b. Foundations installed for future cabinets require three 2" conduits or two 3" conduits plus one 2" conduit to the adjacent ITS cabinet and one 1.5" to the transformer.
 - iii. Conduits between cabinets on shared foundations shall not go through any junction boxes.
- c. Junction Boxes
 - i. Any existing type 3 junction box shall be replaced with a type 8 junction box (exception: if in shoulder shall be heavy duty type 6 or pull box with heavy duty lid).
- d. Vaults
 - i. A cable vault shall be located adjacent to all device cabinet foundations.
- e. Cabling

- i. ITS cabling (not including power to cabinets) shall utilize separate conduit and junction boxes from all other systems, including but not limited to signals, illumination, irrigation, etc.
 - ii. Any cables in ITS conduits that are not part of the permanent ITS network when the project is complete shall be removed.
 - iii. Cabling shall not use cabinets as a raceway or junction box. If a cable is not intended for use in a cabinet it shall not be installed into or through that cabinet.
- f. Cabinets
- i. Location
 1. Cabinets shall be located where they are accessible from WSDOT right of way.
 2. Cabinets shall be no closer than 8 feet from the face of nearby guardrail.
 3. The elevation of the top of a cabinet foundation shall not be lower than the top of any adjacent junction box connected to the foundation with conduit.
 4. Cabinets shall not be located behind any structural or noise/sound walls.
 5. ITS devices shall not share the same cabinet with any other systems including but not limited to signals, illumination, irrigation, etc.
 6. Cabinets located on slopes shall utilize special foundations.
 - a. Uphill from roadway
 - i. For all slopes the foundation shall be cut into hillside according to ITS detail for sloped foundations.
 - b. Downhill from roadway
 - i. For slopes flatter than 4:1
 1. Foundation shall be cut into hillside according to ITS detail for sloped foundations.
 - ii. For slopes steeper than 4:1
 1. A retaining wall shall be built and a platform constructed between the roadway and the retaining wall to support the ITS cabinet foundation. The foundation shall be at the same elevation as the roadway.
 2. A fence shall be provided around the perimeter of the raised platform according to Standard Plan L-20.10-00.
 3. The distance between the fence and the sides of the cabinet shall be no less than 3 feet.

4. The distance between the fence and either door of the cabinet shall be no less than 5 feet.

ii. Existing Cabinets

1. Existing cabinets within the project limits shall be replaced if called out by the contract documents or:
 - a. The cabinet is more than 10 years old
 - b. The cabinet does not meet current NWR ITS specifications.
 - c. If the cabinet is damaged
2. Existing cabinet foundations within the project limits shall be replaced if a new cabinet is being installed and the existing foundation does not meet all design requirements for a new foundation including conduit requirements.

g. Maintenance Pullouts

i. Type 1 (Maintenance pickup access)

1. Required next to all cabinet and hub locations.
2. Pullout has these minimum characteristics:
 - a. 8-foot wide paved shoulder
 - b. 80 feet long
 - c. 5:1 entrance taper
 - d. 30:1 exit taper

ii. Type 2 (Maintenance bucket truck access)

1. Required at the following locations:
 - a. Camera poles
 - b. Structures with a walk-in VMS
2. Pullout has these minimum characteristics:
 - a. 14-foot wide paved shoulder
 - b. 50 feet long
 - c. 35:1 entrance taper
 - d. 70:1 exit taper

h. Maintenance Access Road

i. Required at the following locations:

1. Communication hubs.
2. HAR Transmitters.
3. Camera locations that are not adjacent to the roadway.

ii. The access road has these minimum characteristics:

1. The access road shall be provided to the nearest WSDOT roadway shoulder.
2. The road shall be a minimum of 14 feet wide
3. Constructed according to the attached detail "Maintenance Access Road".
4. A 10' x 15' generator parking pad shall be provided adjacent to the hub transfer switch and connected to the access road.

2. Communication system

a. Conduit

i. Location

1. Mainline conduits shall stay on the same longitudinal alignment as long as possible (1 mile minimum).
2. Mainline conduits shall be located to minimize impact of future widening.
3. All raceways in the mainline conduits shall be continuous from HUB to HUB (or end to end).
4. Conduits containing fiber optic cables shall be buried unless absolutely necessary.
5. Any exposed conduits containing fiber optic cables shall be designed with these minimum characteristics:
 - a. A pull box or cable vault shall be located within 50 feet of both ends of the exposed conduit.
 - b. The exposed conduit shall be at a higher elevation than the top of the pull box or cable vault at either end.
 - c. The pull box or cable vault at both ends of the exposed conduit shall include a 2-inch screened drain.

ii. Size

1. On freeways the mainline conduit system consists of two 4-inch conduits with 4 innerducts each. On other roadways, the mainline conduits system consists of two 2-inch conduit, or larger.

iii. Contents

1. Conduits with innerduct shall only carry mainline and distribution communication cables.
2. Systems with more than one mainline conduit shall have the Mainline fiber and the Distribution fiber located in separate conduits (outerduct).

iv. Existing infrastructure

1. When impacting or modifying existing mainline conduit, any conduit not meeting current NWR ITS standards shall be replaced with new conduit between pull boxes/cable vaults. Conduit repair kits of any kind are not allowed.

v. Crossings

1. Any conduit crossing used to carry the distribution cable between the mainline conduit system and an ITS cabinet shall be no more than 500 feet from that ITS cabinet.

b. Vaults

i. General

1. The top of all cable vaults and pull boxes connected directly to a cabinet foundation shall have the same elevation or a lower elevation as the cabinet foundation.
 2. Not allowed in traveled lane under any circumstances.
 3. Unless approved by WSDOT, shall be located outside of paved shoulder.
 - a. Shall be equipped with heavy-duty (H-35) lid if located in shoulder.
 - b. Nearest edge shall be no less than 3 feet from the fog line.
- ii. Cable vaults
1. Required at any underground fiber optic splice location.
 2. Required at all new and existing ITS and signal cabinet locations.
 3. Required every mile along mainline conduit run.
 4. Screened, 2-inch drain pipes shall be provided between cable vaults and any drainage ditch, swale or pond within 100 feet.
- iii. Pull boxes
1. Located along fiber optic conduit runs with no more than 1000 foot spacing.
 2. Located at both ends of crossings, borings, and bridges.
 3. Pull boxes are the smallest allowed junction box in any conduit run containing fiber optic cable.
 4. Screened, 2-inch drain pipes shall be provided between pull boxes and any drainage ditch, swale or pond within 100 feet
- c. Cabling
- i. Mainline
1. Defined as longitudinal fiber optic cable running along the corridor between communication hubs in the mainline communication conduit system.
 2. Splices allowed every 13,000 – 18,000 feet in locations determined by the ITS engineer.
 3. If impacting existing cable, must replace between existing splices (no new splices added).
 4. Typically a 48-96 count singlemode cable. Cable size shall be determined by the NWR ITS Engineer.
 5. Cable Termination
 - a. Preterminated (preterm) patch panels shall be installed in all locations that the mainline cable is interfaced.
 - b. The preterm cable shall be spliced to the mainline cable in a cable vault or optical cable entrance facility (OCEF) located no more than 100 feet from the cabinet or hub containing the preterm panel.

- c. There shall be one preterminated patch panel for each optical cable installed in a hub or FTC.
 - d. There shall be one fiber optic closure per fiber optic stub cable.
 - ii. Distribution (also called “Mainline Distribution”)
 - 1. General
 - a. Defined as fiber optic cable running between roadside ITS devices.
 - b. Uses mainline communication conduit system for all longitudinal runs along the corridor.
 - c. If impacting cable, shall replace between devices currently served by the cable.
 - d. Typically a 36-48 count singlemode cable. Cable size shall be determined by the NWR ITS Engineer.
 - 2. Strand Usage
 - a. First 12 strands terminated at all cabinets served by cable.
 - b. Unique strand terminated at each camera.
 - c. Additional strands terminated for agency interface (to be determined by the NWR ITS Engineer).
 - 3. Route Architecture
 - a. The distribution cable shall connect to all ITS cabinets and intersection signal cabinets.
 - b. The distribution cable shall be routed to cabinets in order of milepost.
 - c. When ITS cabinets are grouped on a shared foundation, the distribution cable shall connect to only one of the cabinets in the following order of importance:
 - i. FTC cabinet
 - ii. ATM cabinet
 - iii. CCTV cabinet
 - iv. HARS cabinet
 - v. VMS cabinet
 - vi. Other ITS cabinet
 - vii. ES cabinet
 - viii. Intersection signal cabinet
 - d. Cabinets that are on a shared foundation and do not contain a patch panel shall have two duplex patch cords routed through the conduits in the foundation to the cabinet with the patch panel. Patch cords shall be indoor/outdoor Optical Fiber Non-conductive Riser (OFNR) rated, or indoor patch cords contained in 3/8” to 1/2” loom. Patch cords shall not be routed through junction boxes. OSP CAT6 shall be installed in lieu of patch cords when

the cabinet is communicating via Ethernet. In that case the Ethernet switch shall be installed into the cabinet with the patch panel.

4. Cable Termination

- a. Preterminated (preterm) patch panels shall be installed in all locations that the distribution cable is interfaced.
- b. There shall be a maximum of one preterminated patch panel in each cabinet except where an outside agency's fiber is terminated in a WSDOT cabinet. In that case there shall be two preterminated panels.
- c. There shall be one preterminated patch panel for each optical cable installed in a hub or FTC. One exception is that distribution cables shall be combined into one panel when both cables are on the same roadway (i.e. the I-5 north and south distribution cables shall be in the same panel).
- d. The preterm cable shall be spliced to the distribution cables in a cable vault or optical cable entrance facility (OCEF) located no more than 100 feet from the cabinet or hub containing the preterm panel.
- e. There shall be one fiber optic closure per fiber optic stub cable.

iii. Lateral

1. Defined as a spur fiber optic cable between one ITS cabinet served by the distribution cable and one non-ITS cabinet.
2. May be used to connect non-ITS devices located within 750 feet of an ITS cabinet served by distribution cable when approved by the ITS Engineer.
3. Any device cabinet can utilize no more than 1 lateral cable.
4. Typically a 12 count singlemode cable.
5. Cable Termination
 - a. Preterminated (preterm) patch panels shall be installed in all locations that a lateral cable is interfaced.
 - b. There shall be a maximum of one preterminated patch panel in each cabinet except where an outside agency's fiber is terminated in a WSDOT cabinet. In that case there shall be two preterminated panels.
 - c. Lateral fiber cables shall be installed into a preterminated patch panel. The preterminated patch panel shall be combined with all other lateral fibers and interconnect fibers going to that location and with a distribution cable if room allows.

- d. The preterm stub shall be spliced to the lateral cables in a cable vault or optical cable entrance facility (OCEF) located no more than 100 feet from the cabinet or hub containing the preterm panel.
- e. There shall be one fiber optic closure per fiber optic stub cable.

iv. Interconnect

- 1. Interconnect cable is defined as a distribution style fiber optic cable connecting signal cabinets and other ITS devices along an arterial state highway.
- 2. Interconnect cable shall meet the same design requirements as fiber optic distribution cable.
- 3. Cable Termination
 - a. Preterminated (preterm) patch panels shall be installed in all locations that interconnect cable is interfaced.
 - b. There shall be a maximum of one preterminated patch panel in each cabinet except where an outside agency's fiber is terminated in a WSDOT cabinet. In that case there shall be two preterminated panels.
 - c. Interconnect fiber cables shall be installed into a preterminated patch panel. The preterminated patch panel shall be combined with all other interconnect fibers and lateral fibers going to that location and with a distribution cable if room allows.
 - d. The preterm stub shall be spliced to the distribution cables in a cable vault or optical cable entrance facility (OCEF) located no more than 100 feet from the cabinet or hub containing the preterm panel.
 - e. There shall be one fiber optic closure per fiber optic stub cable.

v. Fiber optic patch cords

- 1. Patch cords contained within a patch panel shall not be more than 1 foot longer than required to make the connection.
- 2. Patch cords between two patch panels shall not be more than 1 foot longer than required to make the connection.
- 3. Patch cords between a patch panel and a device shall not be more than 2 feet longer than required to make the connection.
- 4. Patch cords between a patch panel and a device shall be contained inside of 1/2" - 5/8" yellow split loom.
- 5. Boots shall be glued to prevent spinning

vi. Other

- 1. Communication cables shall not occupy the same conduits or junction boxes as power conductors.

2. A single splice closure shall contain no more than one preterminated stub.
 3. Mainline cable splices and distribution cable splices shall not occur in the same splice closure.
 4. Only 48-port and larger preterminated panels shall be installed in any hub.
 5. Preterminated patch panels shall be used for all fiber optic terminations in all locations. Distribution panels are not allowed.
- d. Communication Equipment
- i. At a minimum, each of the following types of cabinets (new and existing) shall receive the following communication equipment and accessories (including all mounting hardware and cabling, to provide a fully functional system):
 1. Each ramp meter, data station and HAR sign cabinet:
 - a. One RuggedCom RMC30 terminal server and one RuggedCom RS900 switch.
 - b. Where the cabinet is standalone, a RuggedCom RS910 may be used in place of both the RS900 and RMC30.
 2. Each CCTV cabinet:
 - a. One Optelecom video/data transmitter for a single camera and one two-channel Optelecom video/data transmitter with RS-422 data for up to two cameras;
 - b. One RuggedCom RS900 switch.
 3. Each ATM control cabinet:
 - a. Two RuggedCom RS900 switches;
 - b. One additional RuggedCom RS900 switch for each VMS.
 4. Each PTR cabinet:
 - a. One RuggedCom RS900 switch;
 - b. One Digi TS 1 H Terminal Server.
 5. Each VMS cabinet:
 - a. One RuggedCom RS900 switch.
 6. Each traffic signal cabinet:
 - a. One RuggedCom RS900 switch (note: the RS900 nearest the signal cabinet shall contain 3 optical ports)
 7. Each HAR transmitter cabinet:
 - a. One RuggedCom RS900 switch;
 - b. One Quintum 2-channel FXS VoIP device.
 - ii. At a minimum, each HUB (new and existing) shall receive the following communication equipment and accessories (including all mounting hardware and cabling, to provide a fully functional system):

1. One RuggedCom RS900 switch for each direction of communication into or out of the hub for all ITS equipment.
 2. One Ethernet switch mounting bracket.
 3. Optelecom video/data receivers equaling the number of CCTV cabinets with a single camera served by the hub.
 4. Optelecom two-Channel video/data receivers with RS-422 data equaling the number of CCTV cabinets with multiple cameras (up to two) served by the hub.
 5. One Optelecom hub chassis with two chassis power supplies and one NIC card per set of 10 video/data receivers, or part thereof, served by the hub.
 6. One DeciMux transmitter per set of 10 cameras, or part thereof, served by the hub.
 7. One Vicon RS-422 combiner per set of 10 cameras, or part thereof, served by the hub.
- iii. At a minimum, the TMC shall receive all equipment necessary to support the new field equipment, existing equipment that is required to remain, and communication hub equipment (including all mounting hardware and cabling, to provide a fully functional system). This shall include, but not be limited to:
1. Ethernet switches;
 2. Video/data receivers;
 3. Video multiplexors;
 4. Data modems;
 5. One DeciMux receiver for every DeciMux transmitter installed in the Communication Hub.

3. Devices

a. CCTV

i. View requirements

1. Shall provide 100% coverage of all freeway lanes and ramps.
 - a. Consider signs, luminaires, bridges, trees and roadway alignment.
 - b. If existing cameras no longer see 100% - relocate and/or add additional cameras to provide 100% coverage.
2. Shall provide view of face of VMS, SMS & LCS.
 - a. Consider LED cone of vision;
 - b. 2000 feet maximum distance from sign.
3. For arterial location, need to see queuing at intersection signals.
4. Shall provide front view of ramp meter signals.
5. Shall provide front view HAR sign beacons.

ii. Pole

1. Pole height
 - a. Pole height shall be 50 feet unless approved by NWR ITS Engineer.
 2. Location requirements
 - a. When near bridges, pole shall be on the bridge or 10-15 feet away from the bridge.
 3. If the pole is located more than 100 feet from the cabinet a junction box containing the camera control cable shall be located at the base of the camera pole.
- iii. Cabinet
 1. Location
 - a. Shall be located on the outside shoulder.
 - b. Shall be able to see camera from cabinet.
 - c. Located adjacent to the camera pole whenever possible.
 - d. Prefer to locate adjacent to other cabinets.
 - iv. Camera
 1. All existing cameras within project limits shall be replaced with the current model as identified in the NWR ITS specifications.
 2. Must also replace camera control cable when existing cameras are replaced.
- b. Ramp Meter/Data Stations (ES)
 - i. Cabinets
 1. Data stations and ramp meters shall use the same type of cabinet with the same contents.
 2. A ramp meter cabinet shall be provided for each metered ramp.
 3. Ramp meter cabinets shall be located where the faces of the signal heads are visible from the cabinet.
 4. Data station cabinets shall be located within 100 feet of the mainline loops, along station.
 - ii. Loops (type, size, quantity, location)
 1. Install speed loops in all lanes at all mainline locations.
 2. Mainline loops shall be installed in all lanes, in both directions.
 3. Mainline loops shall be located just upstream of the merge point of all on-ramps.
 4. Within interchanges the loops not adjacent to the on-ramp may be omitted where the distance between mainline loops in the same direction will be less than 1000 feet.
 5. Between interchange mainline loops, additional mainline loops shall be equally spaced every ½ mile (+/- 300 feet).
 6. In multilane configurations, mainline loop tails shall be installed such that half (+/- 1 lane) are routed to junction boxes on opposite shoulders.

7. Sawcuts for mainline loop tails shall not be cut across ramp lanes.
8. Mainline loops shall be aligned so they are directly adjacent to each other.
9. Loops shall be installed in all on and off ramp lanes.
10. Loops installed on off-ramps shall be located downstream of, and within 150 feet of, the physical separation of the roadway from the ramp (dirt gore point).
11. Wide loops (Type WR) shall be installed in all lanes wider than 12 feet.
12. Metered ramp loop requirements:
 - a. Demand loop – located as shown on the ITS details
 - b. Passage loop – located as shown on the ITS details
 - c. Queue loop
 - i. For ramps 1000 feet long or shorter, located midway between the stop bar and the advance queue loop (minimum 300 feet from the stop bar).
 - d. Intermediate queue loop – include this loop on ramps longer than 1000 feet.
 - e. Advance queue loop – located approximately 100 feet from the entrance of the ramp.
 - f. Secondary queue loop – located approximately 200 feet upstream from the painted gore point.
 - g. HOV passage loop – located adjacent to the passage loop(s).
 - h. HOV demand loop – located in the HOV bypass lane approximately 300 feet upstream of the stop bar.
 - i. HOV demand speed loop – located 17 feet (center-to-center) downstream from the HOV demand loop.
13. Loops more than 400 feet away from the cabinet shall have more than 4 turns (refer to loop detail).
14. Loop splices shall not be contained in a pull box or cable vault that is part of the communication conduit system.

iii. Signal Pole

1. Type 1 signal pole
 - a. May only be used for single lane ramp meters.
 - b. Shall include signing in accordance with the Standard Plans and attached detail “Ramp with Type 1 Meter Pole”.
2. Type 2 signal pole
 - a. May be used for single or double lane ramp meters.
 - b. Mast arm shall not span the HOV bypass lane.
 - c. Shall have signing according to the attached detail “Ramp with Type 2 Meter Pole”.

- iv. Advance Warning Sign and Beacon (AWS)
 - 1. Enough AWS shall be provided so that all vehicles approaching the ramp entrance have a clear view of a sign and beacon before they commit to entering the ramp.
 - 2. A mid-ramp AWS shall be provided on ramps longer than 1500 feet.
 - 3. AWS sign
 - a. All AWS signs shall have black text on a yellow background.
 - b. A 3' x 3' sign shall be used for ramps with a signed approach speed less than or equal to 35 mph.
 - c. A 4' x 4' sign shall be used for ramps with a signed approach speed greater than 35 mph.

- c. VMS

- i. Location

- 1. In advance of major decision point (freeway-to-freeway interchanges, access to alternate routes, etc.).
 - 2. Every 3-4 miles along corridor.
 - 3. Minimum 800 feet of tangent sight distance.

- ii. Size

- 1. 18" character height for freeway, 12" character height for arterial and ramps.
 - 2. 3 lines, 18 characters per line.

- iii. Cabinet

- 1. General

- a. Ground-mounted, 334-style cabinet.
 - b. Sign controller located in ground-mounted cabinet.

- 2. Location

- a. Shall be located on same side of road as maintenance pullout.
 - b. Should be located adjacent to the VMS structure.

- iv. Mounting

- 1. VMS shall be centered over the freeway lanes (exception: the sign may be shoulder-mounted on a "T" structure for roadways with fewer than 3 lanes in the viewing direction of travel).
 - 2. The bottom of the VMS housing shall be a minimum of 20 feet above the roadway.
 - 3. Maintenance walkway (catwalk) is required in accordance with the standard plans; the five-foot catwalk noted in the standard plans as optional is required for all walk-in VMS installations. The catwalk shall extend to the fog line on the side of road with the maintenance pullout.

- d. HAR

- i. Signs

- 1. Location

- a. HAR signs shall be mounted on a sign structure over the freeway lanes (exception: the sign may be shoulder-mounted next to roadways with fewer than 3 lanes in the direction of travel).
 - b. HAR signs shall be located 1-3 miles in advance of the HAR transmitter. For HAR transmitters located within an interchange, this distance shall be measured from the beginning of the interchange's furthest exit ramp.
 - 2. Cabinet
 - a. General
 - i. HAR signs utilize a ground-mounted, 334-style cabinet.
 - b. Location
 - i. Shall be able to see the face of the HAR sign and beacons from the cabinet location.
- e. RWIS
 - i. Location
 - 1. The location of the RWIS shall be determined by the NWR Area Maintenance Supervisor.
 - ii. Cabinet
 - 1. The RWIS shall utilize a ground-mounted, 334-style cabinet.
- f. Communication Hub
 - i. Location
 - 1. The location of the hub shall be determined by the NWR ITS Engineer.
 - ii. Exterior Treatment
 - 1. The area around the hub shall be prepared and fenced in accordance with the NWR ITS details.
- g. ATM
 - i. Location
 - 1. ATM installation shall have ½ mile nominal spacing.
 - 2. ATM installations shall not be located anywhere within a curve; they require a minimum of 500 feet tangent sight distance
 - 3. ATM installations shall be located away from on-ramps, off-ramps, and merge areas.
 - a. Installations shall be a minimum of 800 feet upstream of an exit ramp.
 - b. Installations are allowed downstream of an exit ramp as long as other restrictions are met.
 - c. Installations shall not be located within 300 feet of an on-ramp merge area (defined as the area between the gore point and the end of the merge taper).
 - ii. Cabinet

1. Each ATM installation shall utilize a ground-mounted, double-wide 334D cabinet;
 2. Each direction of travel requires one cabinet at each ATM installation.
- iii. ATM Signs
1. LCS (Lane Control Signs)
 - a. One LCS shall be centered over each lane.
 2. SMS (Side-mount Signs)
 - a. Shall be on every other ATM installation (alternate with VMS).
 - b. Shall be installed in the median and outside shoulder.
 - c. Shall be no more than 20 feet from the mainline edge stripe.
 3. VMS
 - a. Shall be on the first ATM installation of a corridor.
 - b. Shall be on any ATM installation more than 2 miles from the nearest upstream ATM installation.
 - c. Shall be on every other ATM installation (alternate with SMS).
 - d. The VMS shall be on the same structure as the LCS
 - e. The VMS shall be no more than 5 feet from the nearest LCS.
 - f. The VMS may be located above the LCS.
- iv. ATM Vehicle Speed Detection
1. Loop-based speed detection is required between all ATM installations.
 - a. Option 1: A single loop-based detection location centered between two ATM installations (greater than 1000 feet from any ATM installation).
 - b. Option 2: Two loop-based detection locations between two ATM installations (both greater than 500 feet from their nearest ATM installation)
 2. Supplemental Wavetronix speed detection
 - a. Where neither option 1 nor option 2 are attainable and where all other data station loop spacing requirements are satisfied, install a Wavetronix detector midway between ATM installations (+/- 300 feet).
4. Temporary ITS
- a. General
 - i. Consider aspects of the construction process to ensure ITS devices remain operational at all times; except as allowed by the contract documents. Consider power, communication, and other

conduit/wiring aspects of devices. Be aware of grading, saw cutting & grinding (loops), drainage work, lane shifts, etc.

- b. Communication system
 - i. Temporary lane striping shall not route traffic over existing junction boxes or vaults without approval from a WSDOT structural engineer. Junction boxes and vault lids that are exposed to traffic shall be replaced.
- c. Cameras
 - i. Cameras shall remain operational during construction. Cameras impacted by construction activities shall be replaced by temporary cameras or permanent cameras in new locations. 100 percent freeway coverage shall be maintained throughout the life of the project.
- d. Ramp Meters
 - i. Ramp meters shall remain operational during construction.
 - ii. Relocate signal heads and provide temporary detection as needed to accommodate construction phasing.
 - iii. Advance warning signs shall remain operational.
 - iv. Signing for ramp meters shall remain visible during construction and meet WSDOT signing standards.
- e. Temporary detection
 - i. Temporary detection shall be provided for all mainline lanes and on all ramps during construction. The temporary detection areas on the mainline, off-ramps, and non-metered on-ramps shall be within 200 feet of the existing loops. Metered ramps require the installation of embedded induction loops in accordance with the ITS details.
 - 1. Approved detection methods include embedded induction loops and Wavetronix detectors.
 - 2. Alternate detection methods may be proposed by the contractor. To be approved, the contractor must build a prototype site adjacent to an existing operational ES site and connect it WSDOT's central computer. Two weeks of collected data will be analyzed by WSDOT. Acceptable detection methods shall provide volume and occupancy data within 10% of current loop-based data.