NWR ITS Current Practices Supplement

Version: 21 Apr 2014

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

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1.0 General Requirements

1.1 Existing ITS Devices

1.1.1 All existing ITS devices shall be kept operational during the project unless the device has already been replaced and inspected by WSDOT.

1.1.2 Once a new device has replaced an existing ITS device, the new device shall be kept operational.

1.1.3 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.

1.2 Conduit

1.2.1 General

1.2.1.1 Conduits between cabinets on a shared foundation shall not go through any junction boxes.

1.2.2 Size

1.2.2.1 Minimum size conduit for ITS shall be 2” (exception: smaller conduit may be used at type 1 pole foundations and loop lead-in conduit).

1.2.3 Spare Conduits

1.2.3.1 A minimum of one spare 2” is required at each roadway crossing.

1.2.3.2 A minimum of one spare 2” is required through VMS structure foundations.

1.2.3.3 A minimum of one spare 2” is required between each transformer cabinet and its nearest junction box.

1.2.3.4 A minimum of one spare 2” is required between each device cabinet and its nearest junction box with the following additional requirements:

- ES cabinets require two-2” or one-3” spare conduit(s).
- 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.

1.3 Junction Boxes

1.3.1 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).

1.3.2 All existing junction boxes that are in, or are within 3 feet of, the existing or proposed travelled way shall be relocated.

1.4 Vaults

1.4.1 A cable vault shall be located adjacent to all device cabinet foundations.

1.4.2 All existing cable vaults and pull boxes that are in, or are within 3 feet of, the existing or proposed travelled way shall be relocated.

1.5 Cabling

1.5.1 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.

1.5.2 Any cables in ITS conduits that are not part of the permanent ITS network when the project is complete shall be removed.

1.5.3 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.

1.6 Cabinets

1.6.1 Location

1.6.1.1 Cabinets shall be located where they are accessible from WSDOT right of way.

1.6.1.2 Cabinets shall be no closer than 8 feet from the face of nearby guardrail, and 5 feet from the face of non-fixed barrier.

1.6.1.3 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.

1.6.1.4 Cabinets shall not be located behind any structural or noise/sound walls.

1.6.1.5 ITS devices shall not share the same cabinet with any other systems including but not limited to signals, illumination, irrigation, etc.

1.6.1.6 ITS cabinets shall utilize a shared foundation where all other design criteria can be met.

1.6.1.7 Cabinets located on slopes shall utilize special foundations.

1.6.1.7.1 For all slopes uphill from roadway the foundation shall be cut into the hillside according to the ITS detail for sloped foundations.

1.6.1.7.2 For slopes downhill from the roadway the following requirements apply:

1.6.1.7.2.1 For slopes equal to or flatter than 4:1 the foundation shall be cut into the hillside according to the ITS detail for sloped foundations.

1.6.1.7.2.2 For slopes steeper than 4:1 the following features are required:

- 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.
- A fence shall be provided around the perimeter of the raised platform according to Standard Plan L-20.10-00.
- The distance between the fence and the sides of the cabinet shall be no less than 3 feet.

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

1.6.2 Existing Cabinets

1.6.2.1 Existing cabinets within the project limits shall be replaced if any of the following conditions are met:

- Identified for replacement in the contract documents.
- The cabinet is more than 10 years old.
- The cabinet does not meet current NWR ITS specifications.
- The cabinet is damaged

1.6.2.2 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.

1.7 Maintenance Pullouts

1.7.1 Type 1 (Maintenance pickup access)

1.7.1.1 Locations

1.7.1.1.1 Type 1 maintenance pullouts are required next to all cabinet and hub locations.

1.7.1.2 Characteristics

1.7.1.2.1 Type 1 maintenance pullouts shall have these minimum characteristics:

- 8-foot wide paved shoulder
- 80 feet long
- 5:1 entrance taper
- 30:1 exit taper

1.7.2 Type 2 (Maintenance bucket truck access)

1.7.2.1 Locations

1.7.2.1.1 Type 2 maintenance pullouts shall be provided next to all camera poles.

1.7.2.1.2 Type 2 maintenance pullouts shall be provided next to all structures with a walk-in VMS

1.7.2.2 Characteristics

1.7.2.2.1 For pullouts next to camera poles, the pole shall be within 5 feet of the longitudinal center of the pullout.

1.7.2.2.2 For pullouts next to structures with a VMS, a minimum of 35 feet of the pullout shall be upstream of the structure.

1.7.2.2.3 Type 2 maintenance pullouts shall have these minimum characteristics:

- 14-foot wide paved shoulder
- 50 feet long
- 35:1 entrance taper
- 70:1 exit taper

1.8 Maintenance Access Road

1.8.1 Locations

1.8.1.1 Maintenance access roads are required at the following locations:

- Communication hubs.
- HAR Transmitters.
- Camera locations that are not adjacent to the roadway (see camera pole location requirements).

1.8.2 Characteristics

1.8.2.1 Maintenance access roads shall have these minimum characteristics:

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

2.0 Communication system

2.1 Conduit

2.1.1 Location

2.1.1.1 Mainline conduits shall stay on the same longitudinal alignment as long as possible (1 mile minimum).

2.1.1.2 Mainline conduits shall be located on the freeway side of any noise walls or right-of-way fences.

2.1.1.3 Mainline conduits shall be located to minimize impact of future widening.

2.1.1.4 All raceways in the mainline conduits shall be continuous from HUB to HUB (or end to end).

2.1.1.5 Conduits containing fiber optic cables shall be buried unless absolutely necessary.

2.1.1.5.1 Where conduits containing fiber optic cables are attached to a bridge, these conduits shall be installed at a higher elevation than the top of the pull boxes or cable vaults at both ends of the crossing.

2.1.1.5.2 Where conduits containing fiber optic cables are attached to a bridge, the pull boxes or cable vaults at both ends of the crossing shall have drains installed.

2.1.1.6 Any exposed conduits containing fiber optic cables shall be designed with these minimum characteristics:

- A pull box or cable vault shall be located within 50 feet of both ends of the exposed conduit.

- The exposed conduit shall be at a higher elevation than the top of the pull box or cable vault at either end.
- The pull box or cable vault at both ends of the exposed conduit shall include a 2-inch screened drain.

2.1.2 Size

2.1.2.1 Along freeways the mainline conduit system shall consist of two 4-inch conduits. Each 4-inch conduit shall contain 4 innerducts.

2.1.2.2 Along non-freeway roadways, the mainline conduit system shall consist of two 2-inch conduits, or larger.

2.1.3 Contents

2.1.3.1 Conduits with innerduct shall only contain mainline and distribution communication cables.

2.1.3.2 Systems with more than one mainline conduit shall have the Mainline fiber and the Distribution fiber located in separate conduits (outerduct).

2.1.4 Existing Infrastructure

2.1.4.1 When impacting or modifying existing mainline conduit, any conduit not meeting current NWR ITS standards (material, size, innerduct quantity, etc.) shall be replaced with new conduit between pull boxes/cable vaults. Conduit repair kits of any kind are not allowed.

2.1.4.2 If modifications to the existing roadway result in existing conduit being located under a travel lane, the existing conduit shall be replaced (from existing vault to existing vault) in a location outside of the paved area (or under the new shoulder if no other location is feasible).

2.1.5 Crossings

2.1.5.1 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.

2.2 Vaults

2.2.1 General

2.2.1.1 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.

2.2.1.2 New and existing cable vaults and pull boxes are not allowed in a traveled lane under any circumstances.

2.2.1.3 Unless approved by WSDOT, new and existing cable vaults and pull boxes shall be located outside of the pavement. If approved for use in the paved shoulder, the following requirements shall be met:

- Shall be equipped with heavy-duty (H-35) lid if located in the shoulder.

- The nearest edge shall be no less than 3 feet from the edge stripe.

2.2.1.4 Except where directly connected to ITS device cabinets, cable vaults and pull boxes that are part of the mainline conduit system shall only contain the mainline and distribution communication cables.

2.2.2 Cable Vaults

2.2.2.1 Required at any underground fiber optic splice location, including known future splice locations.

2.2.2.2 Required at all new and existing communication hubs.

2.2.2.3 Required at all new and existing ITS, tolling, and signal cabinet locations.

2.2.2.4 Required every mile along mainline conduit run.

2.2.2.5 A screened, 2-inch drain pipe shall be provided between all cable vaults and any drainage ditch, swale or pond within 100 feet.

2.2.3 Pull Boxes

2.2.3.1 Located along fiber optic conduit runs with no more than 1000 foot spacing.

2.2.3.2 Located at both ends of crossings, borings, and bridges.

2.2.3.3 Pull boxes are the smallest allowed junction box in any conduit run containing fiber optic cable.

2.2.3.4 A screened, 2-inch drain pipe shall be provided between all pull boxes and any drainage ditch, swale or pond within 100 feet.

2.3 Cabling

2.3.1 Mainline

2.3.1.1 Defined as longitudinal fiber optic cable running along the corridor between communication hubs in the mainline communication conduit system.

2.3.1.2 Splices are allowed every 13,000 – 18,000 feet in locations determined by the NWR ITS engineer.

2.3.1.3 If impacting existing mainline cable, the cable shall be replaced between existing splices (no new splices added).

2.3.1.4 Typically a 48-96 count singlemode cable. Cable strand count shall be determined by the NWR ITS Engineer.

2.3.1.5 Cable Termination

2.3.1.5.1 Preterminated (preterm) patch panels meeting the current WSDOT specifications shall be installed in all locations that the mainline cable is interfaced.

2.3.1.5.2 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.

2.3.1.5.3 There shall be one preterminated patch panel for each optical cable installed in a hub or FTC.

2.3.1.5.4 The mainline and the distribution cables shall be spliced to separate preterminated patch panels where both are terminated in a single cabinet.

2.3.1.5.5 There shall be one fiber optic closure per fiber optic stub cable.

2.3.1.5.6 If the mainline cable ends somewhere other than at a hub, the cable shall be spliced to a preterminated patch panel installed in the ITS cabinet (not ES cabinet) nearest the physical end of the project.

2.3.2 Distribution (AKA "Mainline Distribution")

2.3.2.1 General

2.3.2.1.1 Defined as the fiber optic cable running between roadside ITS and tolling cabinets.

2.3.2.1.2 Uses mainline communication conduit system for all longitudinal runs along the corridor.

2.3.2.1.3 If impacting the distribution cable, the cable shall be replaced between devices currently served by the cable.

2.3.2.1.4 Typically a 36-48 count singlemode cable. Cable strand count shall be determined by the NWR ITS Engineer.

2.3.2.2 Strand Useage

2.3.2.2.1 First 12 strands in both directions are terminated at all ITS cabinets served by cable.

2.3.2.2.2 Unique strands in both directions terminated at each tolling cabinet.

2.3.2.2.3 Additional strands in both directions terminated for agency interface (to be determined by the NWR ITS Engineer).

2.3.2.3 Route Architecture

2.3.2.3.1 The distribution cable shall connect to all ITS cabinets and intersection signal cabinets.

2.3.2.3.2 The distribution cable shall be routed to cabinets in order of milepost.

2.3.2.3.3 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:

1. FTC Cabinet
2. ATM Cabinet
3. CCTV Cabinet
4. HARS Cabinet
5. VMS Cabinet
6. Other ITS Cabinet
7. ES Cabinet
8. UPS Cabinet (334-style)
9. Intersection Signal Cabinet

2.3.2.3.4 The distribution cable shall connect independently to tolling cabinets.

2.3.2.3.5 Cabinets that are on a shared foundation and do not contain a patch panel shall each have an OSP CAT 6 cable routed through the conduits in the foundation to the cabinet containing the patch panel. In this case the Ethernet switch(es) shall be installed in the cabinet with the patch panel.

2.3.2.4 Cable Termination

2.3.2.4.1 Preterminated (preterm) patch panels meeting the current WSDOT specifications shall be installed in all locations that the distribution cable is interfaced.

2.3.2.4.2 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.

2.3.2.4.3 There shall be one preterminated patch panel for each optical cable installed in a hub or FTC. One exception is that distribution cables may be combined into one panel when both cables are on the same roadway (i.e. the I-5 north and south distribution cables may be spliced to the same panel).

2.3.2.4.4 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.

2.3.2.4.5 There shall be one fiber optic closure per preterminated stub cable except where the preterminated patch panels for a tolling cabinet and an ITS cabinet are spliced in the same cable vault. In this case, there shall be no more than two preterminated stub cables connected to one fiber optic closure; one for ITS and one for tolling.

2.3.3 Lateral

2.3.3.1 General

2.3.3.1.1 Defined as a spur fiber optic cable between one ITS cabinet served by the distribution cable and one non-ITS cabinet or signal cabinet.

2.3.3.1.2 May be used to connect non-ITS devices located within 750 feet of an ITS cabinet served by the distribution cable when approved by the NWR ITS Engineer.

2.3.3.1.3 Any device cabinet served by the distribution cable can utilize no more than 1 lateral cable.

2.3.3.1.4 Any non-ITS cabinet or signal cabinet can utilize no more than 2 lateral cables.

2.3.3.1.5 Typically a 12 count singlemode cable.

2.3.3.2 Cable Termination

2.3.3.2.1 Preterminated (preterm) patch panels meeting the current WSDOT specifications shall be installed in all locations that a lateral cable is interfaced.

2.3.3.2.2 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.

2.3.3.2.3 Lateral fiber cables shall be spliced to 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.

2.3.3.2.4 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.

2.3.3.2.5 There shall be one fiber optic closure per preterminated stub cable.

2.3.4 Interconnect

2.3.4.1 General

2.3.4.1.1 Interconnect cable is defined as a distribution style fiber optic cable connecting signal cabinets and other ITS devices along an arterial state highway.

2.3.4.1.2 Interconnect cable shall meet the same design requirements as fiber optic distribution cable.

2.3.4.2 Cable Termination

2.3.4.2.1 Preterminated (preterm) patch panels meeting the current WSDOT specifications shall be installed in all locations that the interconnect cable is interfaced.

2.3.4.2.2 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.

2.3.4.2.3 Interconnect fiber cables shall be spliced to 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.

2.3.4.2.4 The preterm stub shall be spliced to the interconnect 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.

2.3.4.2.5 There shall be one fiber optic closure per preterminated stub cable.

2.3.5 Fiber Optic Patch Cords

2.3.5.1 Patch cords contained within a patch panel shall not be more than 1 foot longer than required to make the connection.

2.3.5.2 Patch cords between two patch panels shall not be more than 1 foot longer than required to make the connection.

2.3.5.3 Patch cords between a patch panel and a device shall not be more than 2 feet longer than required to make the connection.

2.3.5.4 Patch cords between a patch panel and a device shall be contained inside of 1/2" - 5/8" yellow split loom.

2.3.5.5 Boots shall be glued to the patch cord jacket to prevent spinning.

2.3.6 Other

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

2.3.6.2 A single splice closure shall contain no more than one preterminated stub.

2.3.6.3 Mainline cable splices and distribution cable splices shall not occur in the same splice closure.

2.3.6.4 Only 48-port and larger preterminated panels shall be installed in any hub.

2.3.6.5 Preterminated patch panels shall be used for all fiber optic terminations in all locations. Distribution panels and directly connectorized fibers are not allowed.

2.4 Communication Equipment

2.4.1 Roadside Cabinets

2.4.1.1 Types and Quantities

At a minimum, the listed communication equipment and accessories (including all mounting hardware and cabling, to provide a fully functional system) shall be installed in each of the following types of cabinets (both new and existing):

2.4.1.1.1 ITS Network:

2.4.1.1.1.1 At each ES cabinet (ramp meter, data station):

- One RuggedCom RMC30 terminal server,
- One RuggedCom RS900 switch located in cabinet with preterm panel,
- Where the cabinet is standalone, a RuggedCom RS910 may be used in place of both the RS900 and RMC30.

2.4.1.1.1.2 At each HARS cabinet:

- One RuggedCom RMC30 terminal server,
- One RuggedCom RS900 switch located in cabinet with preterm panel,
- Where the cabinet is standalone, a RuggedCom RS910 may be used in place of both the RS900 and RMC30.

2.4.1.1.1.3 At each ATM cabinet:

- Two RuggedCom RS900 switches,
- One additional RuggedCom RS900 switch for each VMS.

2.4.1.1.1.4 At each PTR cabinet:

- One RuggedCom RS900 switch,
- One Moxa 5210T Terminal Server

2.4.1.1.1.5 At each VMS cabinet:

- One RuggedCom RS900 switch.

2.4.1.1.1.6 At each traffic signal cabinet:

- One RuggedCom RS900 switch (note: if the signal cabinet is utilizing a lateral cable, the RS900 in the ITS cabinet nearest the signal cabinet shall contain 3 optical ports).

2.4.1.1.1.7 At each HAR transmitter cabinet:

- One RuggedCom RS900 switch,
- One Quintum 2-channel FXS VoIP device.

2.4.1.1.1.8 At each RWIS (Weather Station) cabinet:

- One RuggedCom RS900 switch.

2.4.1.1.2 Camera Network:

2.4.1.1.2.1 At each CCTV cabinet, or any cabinet with a camera connected to it:

- One RuggedCom RS900G switch.

2.4.2 Communication Hubs

2.4.2.1 Types and Quantities

At a minimum, each Hub (both new and existing) shall receive the following communication equipment and accessories (including all mounting hardware and cabling, to provide a fully functional system):

2.4.2.1.1 Data System

- One 19-inch wide Ethernet switch mounting bracket for every 5 switches, or part thereof.
- One RuggedCom RS900 switch for each network (ITS, Tolling, etc.) in each direction of State Highway served by the Hub.
- One RuggedCom RS900G switch for the camera network in each direction of State Highway served by the Hub.

2.4.3 Traffic Management Center (TMC)

2.4.3.1 Types and Quantities

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:

2.4.3.1.1 Data System

- Ethernet switches for ITS and camera networks.

3.0 Devices

3.1 CCTV (Closed Circuit Television Cameras)

3.1.1 General

3.1.1.1 Existing cameras and control cables within the project limits shall be replaced if any of the following conditions are met:

- Required by the contract documents,
- The camera is more than 10 years old,
- The camera model is not current according to NWR ITS specifications.

3.1.2 View Requirements

3.1.2.1 Camera shall provide 100% coverage of all freeway lanes and ramps

3.1.2.1.1 Consider signs, luminaires, bridges, trees and roadway alignment (horizontal and vertical curves) when determining coverage.

3.1.2.1.2 If existing cameras do not see 100% of all freeway lanes and ramps, relocate and/or add additional cameras to provide 100% coverage.

3.1.2.2 Camera shall provide view of face of VMS, TRS, SMS & LCS.

3.1.2.2.1 Consider LED cone of vision.

3.1.2.2.2 Camera shall be no more than 2000 feet from VMS, TRS, SMS & LCS.

3.1.2.3 At freeway interchanges, cameras shall be located to provide a full view of ramps and signalized intersections.

3.1.2.4 For arterial location, need to see queuing at intersection signals.

3.1.2.5 Shall provide front view of ramp meter signals.

3.1.2.6 Shall provide front view of HAR sign beacons.

3.1.2.7 The maximum longitudinal distance between consecutive cameras on a corridor is 4500 feet.

3.1.3 Camera Pole

3.1.3.1 General

3.1.3.1.1 For freeway applications, a camera shall not be mounted on anything other than a camera pole.

3.1.3.1.2 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.

3.1.3.2 Pole Height

3.1.3.2.1 Pole height shall be 50 feet unless approved by NWR ITS Engineer.

3.1.3.3 Location Requirements

3.1.3.3.1 The camera pole should not be located more than 10 feet from the edge of the pavement (maintenance pullout). Poles located further than 10 feet from the edge of pavement require a maintenance access road.

3.1.3.3.2 For bridges that cross over the highway, the pole shall be mounted on the bridge or 10-15 feet away from the bridge.

3.1.4 Camera Cabinet

3.1.4.1 Location Requirements

3.1.4.1.1 Cabinet shall be located on the outside shoulder.

3.1.4.1.2 Camera shall be visible from the cabinet location.

3.1.4.1.3 Cabinet shall be located adjacent to the camera pole whenever possible.

3.1.4.1.4 Cabinet shall be located such that the camera control cable does not exceed 300 feet.

3.1.5 Camera

3.1.5.1 All existing cameras within project limits that are not the current model as identified in the NWR ITS specifications shall be replaced with the current model as identified in the NWR ITS specifications.

3.1.5.2 Must also replace camera control cable when existing cameras are replaced.

3.2 ES (Ramp Meter/Data Stations)

3.2.1 General

3.2.1.1 Data stations shall have two-loop speed traps installed on all mainline lanes and specialty use lanes and shoulders within the project limits.

3.2.1.2 Data stations shall have single loops installed on all on ramps, off ramps and specialty use ramps within the project limits.

3.2.1.3 Ramp meters shall have all of the loops required for data stations as well as all of the loops required for a ramp meter.

3.2.2 Cabinets

3.2.2.1 Data stations and ramp meters shall use the same type of cabinet with the same contents.

3.2.2.2 A ramp meter cabinet shall be provided for each metered ramp.

3.2.2.3 Ramp meter cabinets shall be in a location accessible from the ramp being metered.

3.2.2.4 Ramp meter cabinets shall be located where the faces of the signal heads are visible from the cabinet.

3.2.2.5 Data station cabinets shall be located within 100 feet of the mainline loops, along station.

3.2.3 Loop Requirements

3.2.3.1 Install speed loops in all lanes at all mainline locations.

3.2.3.2 Loops shall be centered in the lanes (+/- 1 foot).

3.2.3.3 Mainline loops shall be installed in all lanes, in both directions.

3.2.3.4 Mainline loops shall not be located in the following areas:

- In locations where the roadway is flaring out to add a lane;
- In locations where a lane is being merged or tapered into the remaining lanes;
- In areas with a lot of weaving and lane changes;
- In areas with a lot of merging.

3.2.3.5 Mainline loops shall be located within 100 feet of the end of the dirt gore or physical separation of all on-ramps and off-ramps.

3.2.3.6 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.

3.2.3.7 Between interchange mainline loops, additional mainline loops shall be equally spaced every ½ mile (2600 feet). If there are conflicts or other criteria that needs to be satisfied that prevents this requirement from being met, the spacing for a single set of loops may be adjusted by up to 300 feet in either direction.

3.2.3.8 In cement concrete pavement, locate loops no less than 3 feet from transverse panel joint.

3.2.3.9 In multilane configurations, mainline loop tails shall be installed such that half (+/- 1 lane) are routed to junction boxes on opposite shoulders.

3.2.3.10 Sawcuts for mainline loop tails shall not be cut across ramp lanes.

3.2.3.11 Mainline loops shall be aligned so they are directly adjacent to each other.

3.2.3.12 Loops shall be installed in all on and off ramp lanes.

- 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).
- Loops installed on non-metered on-ramps shall be upstream of, and within 150 feet of, the physical separation of the roadway from the ramp (dirt gore point).
- Loops shall be installed at the beginning and at the end of any ramp that connects one freeway to another freeway.
- Loops in all on and off ramps shall be Type WR loops.

3.2.3.13 Wide loops (Type WR) shall be installed in all lanes wider than 12 feet.

3.2.3.14 The following loops are required on all metered ramps:

3.2.3.14.1 Demand loop – located as shown on the ITS details

3.2.3.14.2 Passage loop – located as shown on the ITS details

3.2.3.14.3 Queue loop - For ramps 1000 feet in length or shorter, located midway between the stop bar and the advance queue loop (minimum 300 feet from the stop bar)

3.2.3.14.4 Intermediate queue loop – include this loop on ramps longer than 1000 feet. Loop to be located midway between queue loop and advance queue loop.

3.2.3.14.5 Advance queue loop – located approximately 100 feet downstream from the entrance of the ramp.

3.2.3.14.6 Merge loop – located 200 feet upstream from the painted gore point.

3.2.3.14.7 HOV passage loop – located adjacent to the passage loop(s).

3.2.3.14.8 HOV demand loop – located in the HOV bypass lane approximately 300 feet upstream of the stop bar.

3.2.3.14.9 HOV demand speed loop – located 17 feet (center-to-center) downstream from the HOV demand loop.

3.2.3.15 Loops more than 400 feet away from the cabinet shall have more than 4 turns (refer to loop detail).

3.2.3.16 At a ramp meter, the maximum detector lead-in length for mainline loops and stop bar loops (demand & passage) is 500 feet, and the maximum detector lead-in length for all other loops is 800 feet.

3.2.3.17 Loop splices shall not be contained in a pull box or cable vault.

3.2.4 Ramp Meter Signal Pole

3.2.4.1 Type 1 Signal Pole

3.2.4.1.1 May only be used for single lane ramp meters.

3.2.4.1.2 Shall include signing in accordance with the Standard Plans and attached detail “Ramp with Type 1 Meter Pole”.

3.2.4.2 Type 2 Signal Pole

3.2.4.2.1 May be used for single or double lane ramp meters.

3.2.4.2.2 Mast arm shall not span the HOV bypass lane.

3.2.4.2.3 Shall have signing according to the attached detail “Ramp with Type 2 Meter Pole”.

3.2.5 Metered Ramp Lanes

3.2.5.1 Minimum of one metered lane when the peak hour volume is below 600 vehicles per hour.

3.2.5.2 Minimum of two metered lanes when the peak hour volume is between 600 and 1,200 vehicles per hour.

3.2.5.3 Three metered lanes when the peak hour volume is over 1,200 vehicles per hour.

3.2.5.4 An HOV bypass lane shall be provided whenever possible.

3.2.5.4.1 Ramps without existing HOV facilities: The HOV bypass lane shall be located on the left side of the metered lane(s) whenever possible.

3.2.5.4.2 Ramps with existing HOV facilities (bus stop, arterial HOV lane, etc.): The HOV bypass lane shall be located on the same side of the ramp as the HOV facility.

3.2.6 Ramp Meter Storage

3.2.6.1 Minimum storage for a ramp meter shall be equal to the peak hour volume multiplied by 1.2, where the resulting number is the storage length in feet.

3.2.6.1.1 Ramp meters shall have an absolute minimum storage length of 350 feet.

3.2.7 Advance Warning Sign and Beacon (AWS)

3.2.7.1 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.

3.2.7.2 A mid-ramp AWS shall be provided on ramps longer than 1500 feet.

3.2.7.3 Sign Details

3.2.7.3.1 All AWS signs shall have black text on a yellow background.

3.2.7.3.2 A 3' x 3' sign shall be used for ramps with a signed approach speed less than or equal to 35 mph.

3.2.7.3.3 A 4' x 4' sign shall be used for ramps with a signed approach speed greater than 35 mph.

3.3 VMS (Variable Message Signs)

3.3.1 Location

3.3.1.1 In advance of major decision point (freeway-to-freeway interchanges, access to alternate routes, etc.).

3.3.1.2 Every 3-4 miles along the corridor.

3.3.1.3 Minimum 800 feet of tangent sight distance required.

3.3.2 Size

3.3.2.1 Use 18" character height for freeway applications.

3.3.2.2 Use 12" character height for arterial and ramp applications.

3.3.2.3 3 lines, 18 characters per line.

3.3.3 Cabinet

3.3.3.1 General

3.3.3.1.1 The VMS shall utilize a ground-mounted, 334-style cabinet.

3.3.3.1.2 Sign controller shall be located in the ground-mounted cabinet.

3.3.3.2 Location

3.3.3.2.1 Shall be located on same side of road as maintenance pullout.

3.3.3.2.2 Shall be located adjacent to the VMS structure or within 150 feet upstream of the structure.

3.3.4 Mounting

3.3.4.1 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).

3.3.4.2 The bottom of the VMS housing shall be a minimum of 20 feet above the roadway. If the VMS is mounted over the shoulder, it shall be a

minimum of 20 feet above a line projected from the road surface, and a minimum of 10 feet above the highest immediate ground surface.

3.3.4.3 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.

3.4 HAR Signs

3.4.1 General

3.4.1.1 The radio frequency on the HAR sign shall match the broadcast frequency of the associated HAR transmitter.

3.4.2 Sign Location

3.4.2.1 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).

3.4.2.2 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.

3.4.3 Cabinet

3.4.3.1 General

3.4.3.1.1 HAR signs utilize a ground-mounted, 334-style cabinet.

3.4.3.2 Location

3.4.3.2.1 Shall be able to see the face of the HAR sign and beacons from the cabinet location.

3.5 RWIS (Weather Stations)

3.5.1 Location

3.5.1.1 The location of the RWIS shall be determined by the NWR Area Maintenance Supervisor.

3.5.2 Cabinet

3.5.2.1 The RWIS shall utilize a ground-mounted, 334-style cabinet.

3.6 Communication Hub

3.6.1 Location

3.6.1.1 The location of the Hub shall be determined by the NWR ITS Engineer.

3.6.2 Existing Communication Hubs

3.6.2.1 Existing Communications Hubs within the project limits shall be replaced if any of the following conditions are met:

- Identified for replacement in the contract documents.
- The communications hub is more than 20 years old.

3.6.3 Exterior Treatment

3.6.3.1 The area around the Hub shall be prepared and fenced in accordance with the NWR ITS details.

3.7 ATM (Active Traffic Management)

3.7.1 Location

3.7.1.1 ATM installation shall have ½ mile nominal spacing.

3.7.1.2 ATM installations shall not be located anywhere within a curve; they require a minimum of 500 feet tangent sight distance.

3.7.1.3 ATM installations shall be located away from on-ramps, off-ramps, and merge areas.

3.7.1.3.1 Installations shall be a minimum of 800 feet upstream of an exit ramp.

3.7.1.3.2 Installations are allowed downstream of an exit ramp as long as other restrictions are met.

3.7.1.3.3 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).

3.7.2 Cabinet

3.7.2.1 Each ATM installation shall utilize a ground-mounted, double-wide 334D cabinet.

3.7.2.2 Each direction of travel requires one cabinet at each ATM installation.

3.7.3 ATM Signs

3.7.3.1 LCS (Lane Control Signs)

3.7.3.1.1 One LCS shall be centered over each lane.

3.7.3.2 SMS (Side-mount Signs)

3.7.3.2.1 Shall be on every other ATM installation (alternate with VMS).

3.7.3.2.2 Shall be installed in the median and outside shoulder.

3.7.3.2.3 Shall be no more than 20 feet from the mainline edge stripe.

3.7.3.2.4 The top of each SMS should be mounted at the same elevation as the bottom of the LCS at the same location.

3.7.3.3 VMS (Variable Message Sign)

3.7.3.3.1 Shall be on the first ATM installation of a corridor.

3.7.3.3.2 Shall be on any ATM installation more than 2 miles from the nearest upstream ATM installation.

3.7.3.3.3 Shall be on every other ATM installation (alternate with SMS)

3.7.3.3.4 The VMS shall be on the same structure as the LCS.

3.7.3.3.5 The VMS shall be no more than 5 feet from the nearest LCS.

3.7.3.3.6 The VMS may be located above the LCS.

3.7.4 ATM Vehicle Speed Detection

3.7.4.1 Loop-based speed detection is required between all ATM installations.

3.7.4.1.1 Option 1: A single location of speed loop-based detection centered between two ATM installations (greater than 1000 feet from any ATM installation).

3.7.4.1.2 Option 2: Two locations of speed loop-based detection between two ATM installations (both greater than 500 feet from their nearest ATM installation).

3.7.4.1.3 Where neither option 1 nor option 2 are attainable and where all other data station loop spacing requirements are satisfied, install a supplemental Wavetronix speed detector midway between ATM installations (+/- 300 feet).

4.0 Temporary ITS

4.1 General

4.1.1 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.

4.2 Communication System

4.2.1 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.

4.3 CCTV

4.3.1 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.

4.4 Ramp Meters

4.4.1 Ramp meters shall remain operational during construction.

4.4.2 Relocate signal heads and provide temporary detection as needed to accommodate construction phasing.

4.4.3 Advance warning signs shall remain operational.

4.4.4 Signing for ramp meters shall remain visible during construction and meet WSDOT signing standards.

4.5 Temporary Vehicle Detection

4.5.1 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.

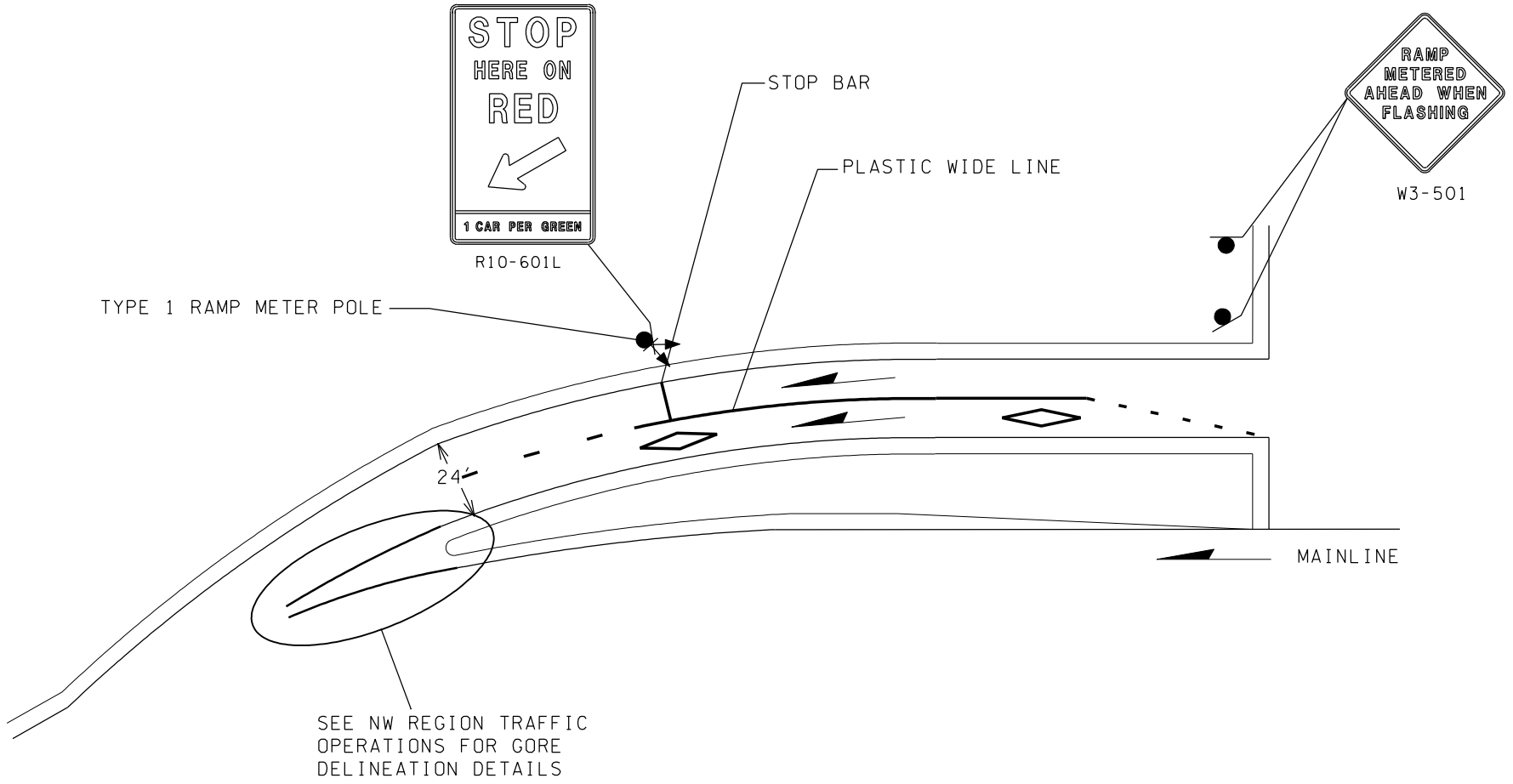
4.5.1.1 Approved methods for vehicle detection on mainline lanes, off-ramps, and non-metered on-ramps are embedded induction loops and Wavetronix detectors.

4.5.1.2 The only approved method for detection on a metered on-ramp is the embedded induction loop.

4.5.1.3 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.

RAMP WITH TYPE 1 METER POLE

(SIGNS AND SCHEMATIC--NOT TO SCALE)

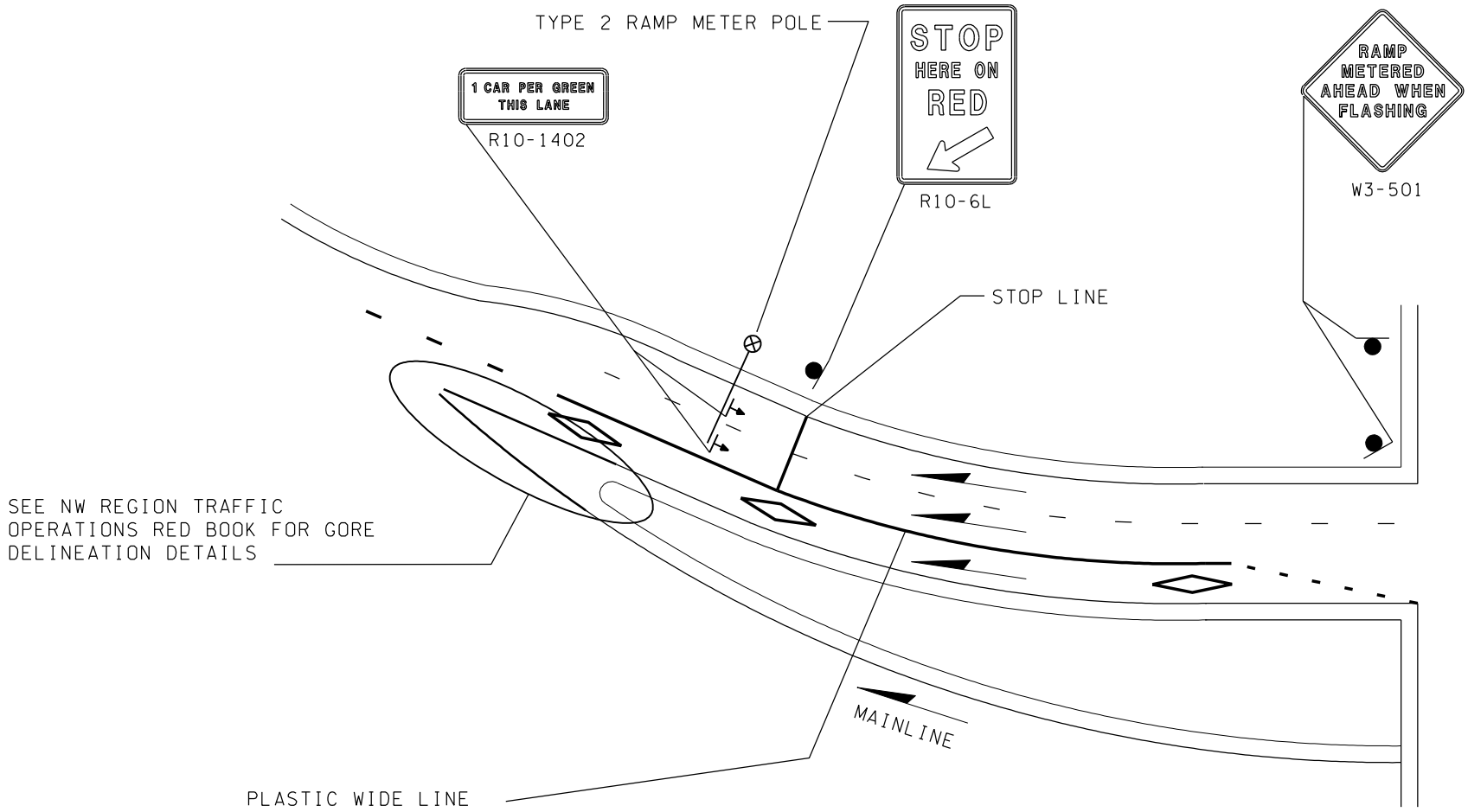


NOTES:

1) DETAIL FOR REQIRED ITS SIGNING ONLY. NOT ALL REQUIRED RAMP SIGNING IS SHOWN.

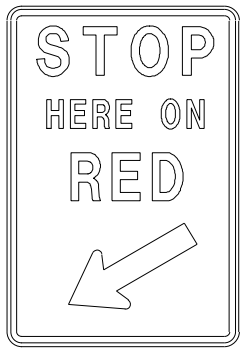
RAMP WITH TYPE 2 METER POLE

(SIGNS AND SCHEMATIC--NOT TO SCALE)

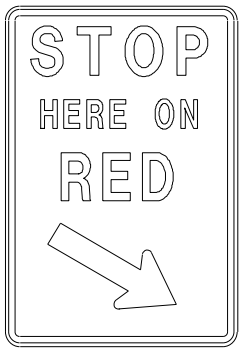


NOTES:

1) DETAIL FOR REQIRED ITS SIGNING ONLY. NOT ALL REQUIRED RAMP SIGNING IS SHOWN.

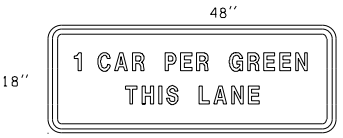


R10-6L
BLACK ON WHITE



R10-6R
BLACK ON WHITE

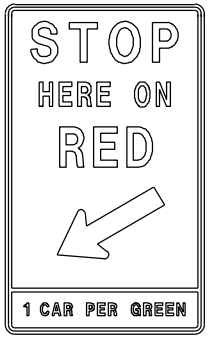
INSTALL NEXT TO THE STOP BAR ON ALL RAMPS WITH A TYPE 2 RAMP METER POLE.



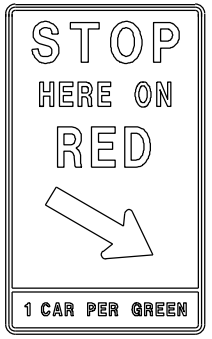
R10-1402
BLACK ON WHITE

USE NEXT TO EACH SIGNAL HEAD ON A TYPE 2 METER POLE.

FOR USE WITH TYPE 2 RAMP METER POLE



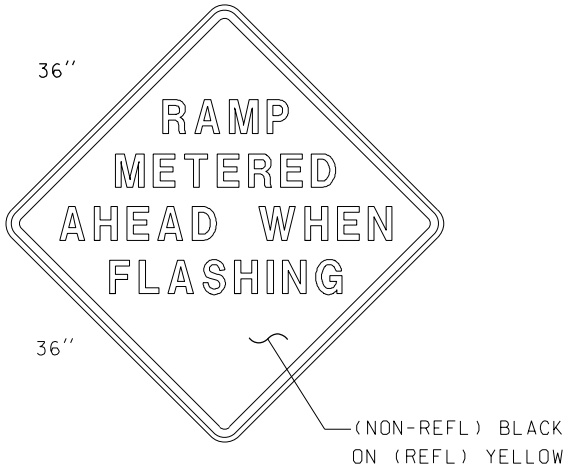
R10-601L
BLACK ON WHITE



R10-601R
BLACK ON WHITE

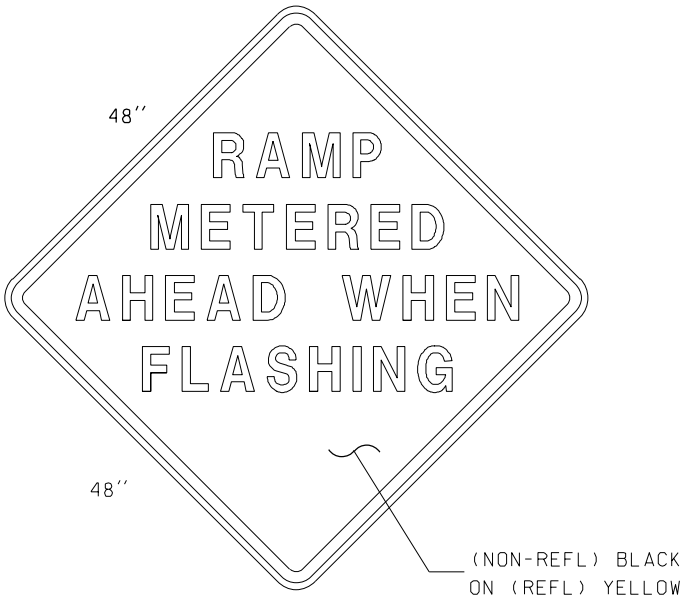
MOUNT ON EACH TYPE 1 RAMP METER POLE ACCORDING TO THE STANDARD PLANS

FOR USE WITH TYPE 1 RAMP METER POLE



W3-501

USE FOR ALL ON-RAMPS WITH AN APPROACH SPEED OF 35 MPH OR LESS.

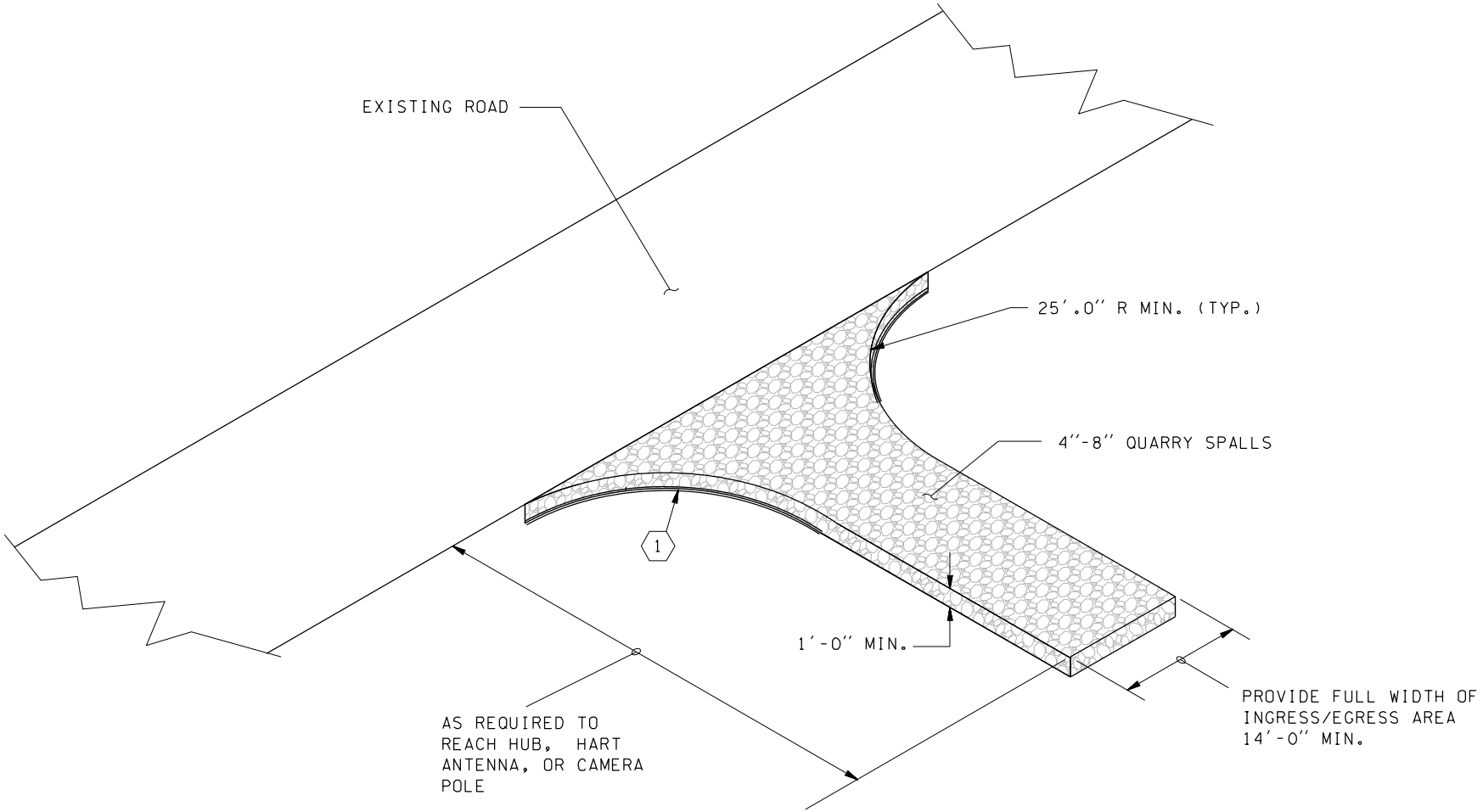


W3-501

USE FOR ALL ON-RAMPS WITH AN APPROACH SPEED OF GREATER THAN 35 MPH.

FOR USE WITH ALL NEW RAMP METERS

(1) PLACE CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION AND A MINIMUM OF 0.15' CRUSHED ROCK UNDER THE SPALLS, FROM THE EDGE OF THE EXISTING ROADWAY TO THE RADIUS RETURNS, OR AS DIRECTED BY THE ENGINEER



ISOMETRIC VIEW
MAINTENANCE ACCESS ROAD