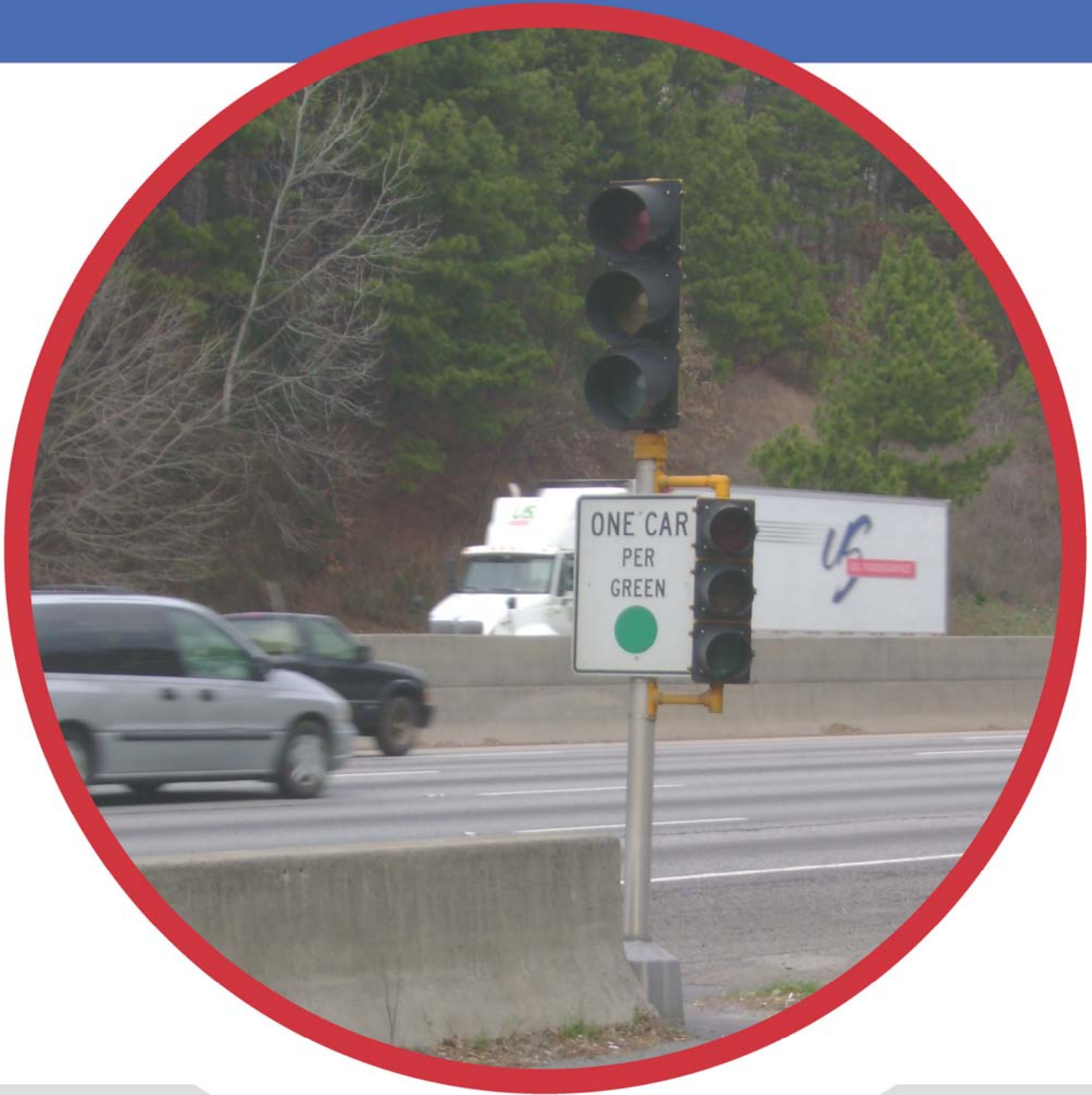


# Typical Cost Estimates



*M-0468 Ramp Metering Feasibility Study for  
Cabarrus, Gaston, Iredell and Mecklenburg  
Counties*

# Notice

This document and its contents have been prepared and are intended solely for the North Carolina Department of Transportation’s (NCDOT) information and use in relation to Ramp Metering Feasibility Study for Cabarrus, Gaston, Iredell and Mecklenburg Counties.

Atkins assumes no responsibility to any other party in respect of, or arising out of, or in connection with this document and/or its contents.

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# Introduction

This report presents typical ramp metering cost estimates for various alternative and optional features. The document describes the assumptions and unit costs used to develop the typical site costs.

For each typical ramp meter configuration, this report includes the site-specific capital costs associated with the following:

- Geometric construction
- Signal displays and supports
- Detection
- Controllers
- Signing
- Pavement markings

Separately, the report includes program costs—procurement and integration of the control software and the controller firmware, which are prorated per site. Training costs are included in the software costs as described in this report. Operations and maintenance costs have been estimated using information from other states.

These planning-level estimates will be used in the development of the Implementation Plan. The cost for a specific location will be developed from the typical cost estimate and customized for any site-specific conditions present at the location. Please note that these are general costs derived for the purpose of this study. Actual costs will vary based on the actual design and implementation of a ramp meter.

The Appendix contains the typical drawings from the Task 7 Typical Design Criteria Report, as well as additional detail of each cost category for each typical layout.

# 1. Typical Cost Methodology

Capital cost estimates are included for six basic ramp meter configurations. The costs of the following alternatives are presented in this report:

- Single-Lane Ramp Meter
- Two-Lane Ramp Meter
- Three-Lane Ramp Meter
- Single-Lane Ramp Meter with Transit Bypass Lane
- Single-Lane Freeway-to-Freeway Ramp Meter
- Two-Lane Freeway-to-Freeway Ramp Meter

In addition, a separate capital cost estimate for optional enforcement features is included in this report. Each of the two optional features presented can be applied individually or together to any of the six basic ramp meter configurations. The optional enforcement features are:

- Paved enforcement area
- Enforcement light

For each alternative, quantity estimates were made for each item of work. For each of these items of work, a planning level unit cost was applied, using NCDOT historical unit costs as a basis. In some cases, vendor quotes and data from other state DOTs were used. For each alternative, costs were applied for engineering design, traffic control, construction inspection, administration, and contingencies.

## 1.1. General Assumptions

For each estimate, certain basic assumptions must be made to produce a “typical” or generic cost estimate. When site-specific costs are developed, these assumptions will be refined on a site-by-site basis. Assumed quantities are shown in the tables documenting each alternative’s costs.

For each alternative the following basic design assumptions were made:

- Ramp meter controllers will be protected by guardrail by placing the controller behind either existing or new guardrail. Each site’s needs will be evaluated in the implementation plan.
- Where trunk fiber-optic communications to the Metrolina Traffic Operations Center is assumed to exist along the corridor, drop cables are included in the costs from the trunk cable to the ramp meter site.
- Ramp detection, which uses inductive loops on the ramp, is shown in Figure C-1 and C-2. For two-lane ramp meters, the same detection layout is used in each lane.
- Mainline detection on the ramp is shown in Figure C-3. The upstream freeway detection site is assumed to be inductive loops detection connected directly to the ramp meter controller cabinet.
- A CCTV camera with communications will be included for those ramps where there is no current camera coverage of the ramp

- Non-freeway-to-freeway signing and pavement markings are shown in Figures D-1 and D-2.
- Freeway-to-freeway signing and pavement markings are shown in Figure D-3.
- Non-freeway-to-freeway ramps are assumed to have a 40-mph design speed. For loop ramps, a design speed of 30 mph is assumed. Based upon AASHTO standards, the formula for calculating taper length is:

$$L = WS^2/60$$

where L = taper length in feet,  
W is the transition width in feet,  
S is the speed in mph.

- Freeway-to-freeway ramps are assumed to have a 50-mph design speed. Based upon AASHTO standards, the formula for calculating taper length is:

$$L = WS$$

where L = taper length in feet,  
W is the transition width in feet,  
S is the speed in mph.



## 1.2. Single-Lane Ramp Meter

The geometric layout of the single-lane ramp meter alternative is shown in Figure A-1. This alternative assumes there is no pavement widening, that the typical 16-foot-wide ramp lane is narrowed to 12 feet, and that 12 foot width is maintained for 100 feet upstream of the ramp meter. The transition tapers are 110 feet long for a 40-mph design speed.

Signal heads are pedestal-mounted with breakaway pedestals. Guardrail with approach end treatment on one side of the ramp is included to protect the ramp meter cabinet and pedestal pole.

For the single-lane ramp meter typical layout, costs are estimated as shown in Table 1.

**Table 1. Typical Single-Lane Ramp Meter Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$6,281.28
Guardrail	\$13,450.00
Drainage	\$0.00
Signalization	\$63,603.43
Communications	\$14,955.00
Pavement Marking	\$1,252.12
Signing	\$3,795.00
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$103,336.83</b>
Traffic Control	\$15,500.52
Contingencies	\$10,333.68
<b>TOTAL CONSTRUCTION</b>	<b>\$129,171.03</b>
Design	\$10,333.68
Construction Administration	\$12,917.10
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$152,421.82</b>



### 1.3. Two-Lane Ramp Meter

The geometric layout of this alternative is shown in Figure A-2. It is assumed the existing ramp has a 16-foot lane, so widening would be necessary (although it is a site-specific issue). For this report, it is assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes with 4-foot paved shoulders. The total pavement width will be 32 feet, which results in a net of 8 feet of total widening, or 4 feet on each side of the existing ramp. The transition tapers are 110 feet long for symmetrical widening and a 40-mph design speed.

The ramp detection layout will use the same configuration in each lane as a single-lane ramp. Signal heads are pedestal-mounted with breakaway pedestals. Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet and both pedestal poles.

For the two-lane ramp typical meter layout, the costs are estimated as shown in Table 2.

**Table 2. Typical Two-Lane Ramp Meter Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$3,484.80
Guardrail	\$13,450.00
Paving	\$253,287.50
Drainage	\$3,000.00
Signalization	\$68,353.80
Communications	\$14,955.00
Pavement Marking	\$1,419.45
Signing	\$4,542.50
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$362,493.05</b>
Traffic Control	\$54,373.96
Contingencies	\$36,249.30
<b>TOTAL CONSTRUCTION</b>	<b>\$453,116.31</b>
Design	\$36,249.30
Construction Administration	\$45,311.63
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$534,677.24</b>

## 1.4. Three-Lane Ramp Meter

The geometric layout of this alternative is shown in Figure A-3. It is assumed the existing ramp has a 16-foot lane, so widening would be necessary (although it is a site-specific issue). For this report, it is assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to three 12-foot lanes with 4-foot paved shoulders. The total pavement width will be 44 feet, which results in a net of 20 feet of total widening. The transition tapers are 110 feet long for symmetrical widening and a 40-mph design speed.

Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet, mast arm pole, and advance VMS sign truss structures.

For the three-lane loop/ramp typical meter layout, the costs are estimated as shown in Table 3.

**Table 3. Typical Three-Lane Ramp Meter Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$3,473.28
Guardrail	\$13,450.00
Paving	\$301,280.00
Drainage	\$3,000.00
Signalization	\$86,162.68
Communications	\$14,955.00
Pavement Marking	\$2,073.22
Signing	\$5,290.00
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$429,684.18</b>
Traffic Control	\$64,452.63
Contingencies	\$42,968.42
<b>TOTAL CONSTRUCTION</b>	<b>\$537,105.22</b>
Design	\$42,968.42
Construction Administration	\$53,710.52
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$633,784.16</b>

## 1.5. Single-Lane Ramp Meter with Transit Bypass Lane

The geometric layout of this alternative is shown in Figure A-4. To ensure drivers stay in their respective lanes, a 4-foot traffic separator between the lanes is required.

It is assumed the existing ramp has a 16-foot lane, so widening would likely be necessary (although it is a site-specific issue). It is further assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes, 4-foot paved shoulders, and 4-foot traffic separator. There will be 1 foot between the traffic separator and each driving lane. The total pavement width is 38 feet, which results in a net of 14 feet of total widening, or 7 feet on each side of the existing ramp. The transition tapers are 190 feet long for symmetrical widening and a 40-mph design speed.

This alternative also differs from a single-lane ramp meter by having a different detection scheme in the second, or bypass, lane as shown in Figure C-2.

Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet and both pedestal poles. Additional signing for the bypass lane and some changes in the pavement markings will be necessary.

For the single-lane ramp meter with transit bypass typical layout, the costs are estimated as shown in Table 4.

**Table 4. Typical Single-Lane Ramp Meter with Transit Bypass Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$9,826.56
Guardrail	\$13,450.00
Paving	\$267,022.50
Drainage	\$3,000.00
Signalization	\$56,237.10
Communications	\$14,955.00
Pavement Marking	\$25,976.61
Signing	\$5,175.00
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$395,642.77</b>
Traffic Control	\$59,346.42
Contingencies	\$39,564.28
<b>TOTAL CONSTRUCTION</b>	<b>\$494,553.47</b>
Design	\$39,564.28
Construction Administration	\$49,455.35
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$583,573.09</b>

## 1.6. Single-Lane Freeway-to-Freeway Ramp Meter

The geometric layout of this alternative is shown in Figure A-5. The basic layout assumes no widening is required. It is assumed the typical 16-foot-wide ramp lane is narrowed to 12 feet and that width is maintained for 100 feet. The transition tapers are 200 feet long for a 50-mph design speed.

Signal heads are mast-arm mounted and located outside the clear zone. Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet, mast-arm pole, and two advance variable message sign (VMS) truss structures.

For the single-lane freeway-to-freeway ramp meter typical layout, the costs are estimated as shown in Table 5.

**Table 5. Typical Single-Lane Freeway-to-Freeway Ramp Meter Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$2,249.28
Guardrail	\$13,450.00
Drainage	\$0.00
Signalization	\$83,121.43
Communications	\$14,955.00
Pavement Marking	\$1,902.10
Signing	\$130,295.00
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$245,972.81</b>
Traffic Control	\$36,895.92
Contingencies	\$24,597.28
<b>TOTAL CONSTRUCTION</b>	<b>\$307,466.01</b>
Design	\$24,597.28
Construction Administration	\$30,746.60
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$362,809.89</b>

## 1.7. Two-Lane Freeway-to-Freeway Ramp Meter

The geometric layout of this alternative is shown in Figure A-6. It is assumed the existing ramp has a 16-foot lane so widening would be necessary though it will be a site-specific issue. For this report, it is assumed an existing 16-foot ramp with 4-foot paved shoulders will be widened to two 12-foot lanes with 4-foot paved shoulders. The total pavement width will be 32 feet, which results in a net of 8 feet of total widening, or 4 feet on each side of the existing ramp. The transition tapers are 200 feet long for symmetrical widening and a 50-mph design speed.

Guardrail with approach end treatment on both sides of the ramp is included to protect the ramp meter cabinet, mast arm pole, and two advance VMS sign truss structures.

For the two-lane freeway-to-freeway ramp meter typical layout, the costs are estimated as shown in Table 6.

**Table 6. Typical Two-Lane Freeway-to-Freeway Ramp Meter Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$3,493.44
Guardrail	\$13,450.00
Paving	\$321,100.00
Drainage	\$0.00
Signalization	\$84,473.63
Communications	\$27,205.00
Pavement Marking	\$1,574.93
Signing	\$131,790.00
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$583,086.99</b>
Traffic Control	\$87,463.05
Contingencies	\$58,308.70
<b>TOTAL CONSTRUCTION</b>	<b>\$728,858.74</b>
Design	\$58,308.70
Construction Administration	\$72,885.87
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$860,053.31</b>

## 1.8. Optional Enforcement Features

Optional enforcement features consist of a paved enforcement area and a downstream-facing enforcement light. These features may be included together or individually.

The geometric design of a paved enforcement area located downstream of the ramp meter is shown in Figure E-1. The paved enforcement parking area is 12 feet wide x 75 feet long, plus transition tapers on each end. The paved surface is approximately 188 square yards. A sign has been included to identify the area.

The enforcement light, also shown in Figure E-1, is an additional 12-inch red signal face facing downstream of the ramp meter, wired to be on at the same time the red indication is on for vehicles, so that a law enforcement officer can monitor when the ramp meter is red. No appreciable additional wiring is needed.

No guardrail costs are included for the paved enforcement area.

Costs for the typical layout that includes both optional enforcement features are estimated in Table 7. The cost of an optional paved enforcement area only (without the enforcement light) would not include the Signalization category. The cost of an optional enforcement light without a paved enforcement area would be the Signalization category only.

**Table 7. Optional Enforcement Features Construction Costs**

<b>Categories</b>	<b>Total Cost</b>
Earthwork and Structure	\$0.00
Guardrail	\$0.00
Earthwork and Structures	\$1,138.50
Paving	\$6,918.40
Signalization	\$1,017.75
Pavement Marking	\$360.53
Signing	\$747.50
<b>SUBTOTAL CONSTRUCTION</b>	<b>\$10,182.68</b>
Traffic Control	\$1,527.40
Contingencies	\$1,018.27
<b>TOTAL CONSTRUCTION</b>	<b>\$12,728.34</b>
Design	\$1,018.27
Construction Administration	\$1,272.83
<b>TOTAL DESIGN AND CONSTRUCTION</b>	<b>\$15,019.45</b>

## 2. Program Costs

Program costs include the central software, servers, central communications hardware, integration, training, and firmware costs including installation and calibration.

### 2.1. Central Program Costs

Central program costs consist of the central software, servers, communications hardware, integration, and training. FDOT, Kansas DOT, GDOT, and a ramp metering vendor provided costs of their ramp metering software. Costs include the queue management algorithms to minimize the potential for ramp queues to back up on the cross streets. Cost estimates are as follows:

**Table 8. Program Costs**

Description	Cost
Central Software	
Software and Installation	\$185,000
Driver and Installation	\$130,000
Integration	\$150,000
Training	\$25,000
Servers (2)	\$35,000
Misc. Central Communications Hardware	\$25,000
Cellular Costs	\$43,200
Hosting Costs	\$18,000
<b>Total</b>	<b>\$611,200</b>

### 2.2. Firmware Costs

A vendor quote estimated the firmware the total cost for the controllers at \$131,000 for all 50 sites. Firmware installation and setup is estimated to take 1 day, and calibration is estimated to require 2 days per site.

**Table 9. Firmware Costs per Site**

Description	Cost	Assumptions
Firmware	\$2,273	
Installation	\$1,000	
Calibration	\$2,016	2 days per site
<b>Total</b>	<b>\$5,300</b>	



### **2.3. Maintenance**

Poles, cabinets, and other equipment for ramp meters have essentially the same maintenance cost as is found in a typical traffic signal. Kansas DOT and GDOT provided an estimate of their annual maintenance costs. Data available through project reports and evaluation studies provided additional data points, although many of those costs are unusually low and not well defined concerning what is or is not included, even after adjusting to present-day costs. Based on an average of Kansas and GDOT's costs, the estimated cost of annual scheduled (preventative) maintenance and unscheduled repairs is \$7,500 per site. This cost includes labor, equipment, and parts.

In addition, \$28,000 per year has been included for software support on the advice of FDOT, Kansas DOT, and a ramp metering vendor.

### **2.4. Operations**

Operations costs consist of the cost to monitor the ramp meters from the Metrolina Regional Transportation Management Center (MRTMC), respond to timing issues, and perform periodic adjustments in the operational parameters and management time. Based on information from Kansas DOT and GDOT, approximately 24 hours per site per year are spent monitoring and responding to timing type issues, which equates to:

$$2 \text{ engineers} \times 60,000/\text{each}/167 = \$720 \text{ per site per year.}$$

# Appendices

## Appendix A – Typical Ramp Meter Layouts



Figure A-2: Two Lane Ramp Meter Overview

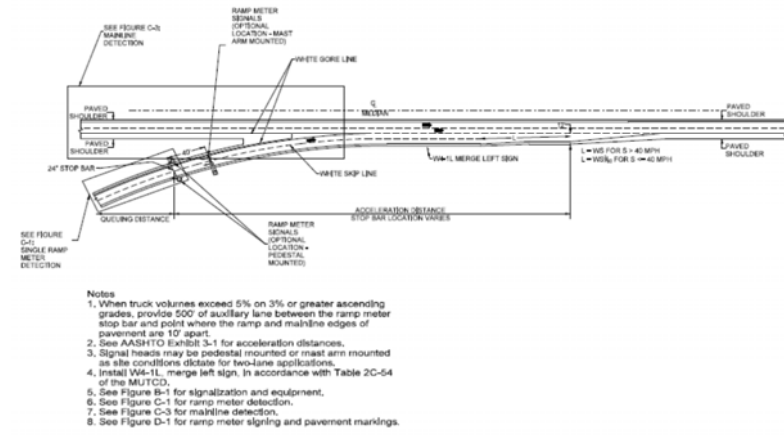
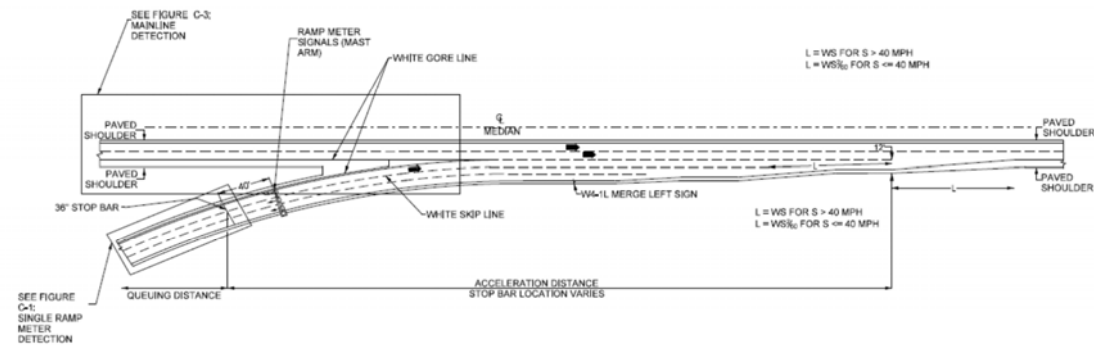


Figure A-3: Three Lane Ramp Meter Overview



**Notes**

1. When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
2. See AASHTO Exhibit 3-1 for acceleration distances.
3. Signal heads shall be mast arm mounted as site conditions dictate for three or more lanes.
4. Install W4-L, merge left sign, in accordance with Table 2C-54 of the MUTCD.
5. See Figure B-3 for signalization and equipment.
6. See Figure C-1 for ramp meter detection.
7. See Figure C-3 for mainline detection.
8. See Figure D-1 and D-3 for ramp meter signing and pavement markings.

Figure A-4: Single Lane Ramp Meter with Transit Bypass Overview

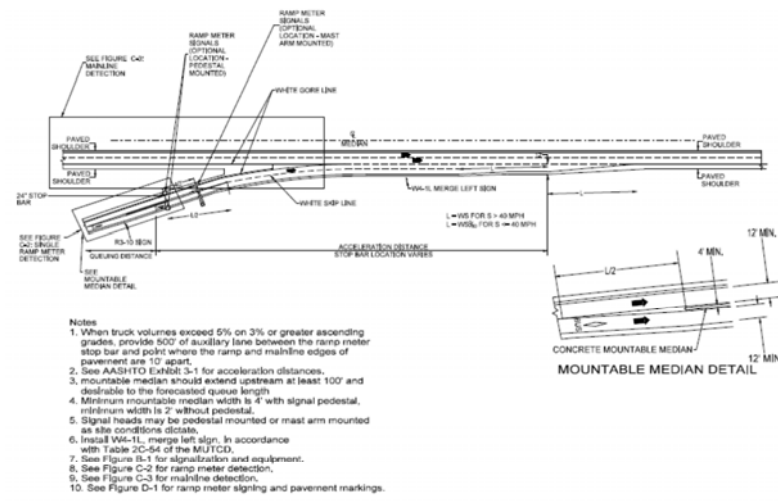
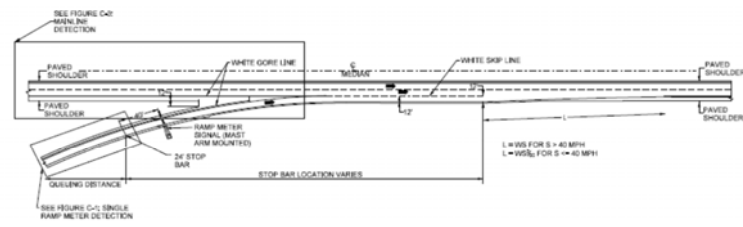


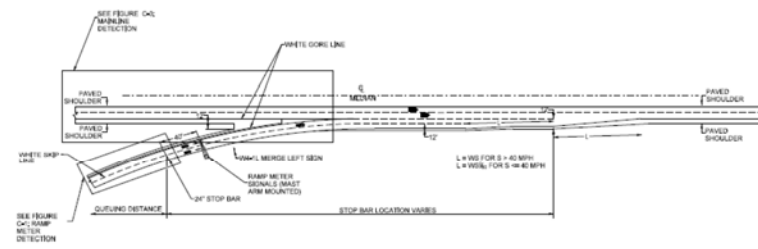


Figure A-5: Single Lane Freeway to Freeway Ramp Meter Overview



- Notes**
1. When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
  2. See AASHTO Exhibit 3-1 for acceleration distances.
  3. Signal heads shall be mast arm mounted as site conditions dictate.
  4. See Figure B-1 for signalization and equipment.
  5. See Figure C-1 for ramp meter detection.
  6. See Figure C-3 for mainline detection.
  7. See Figures D-1 and D-3 for ramp meter signing and pavement markings.

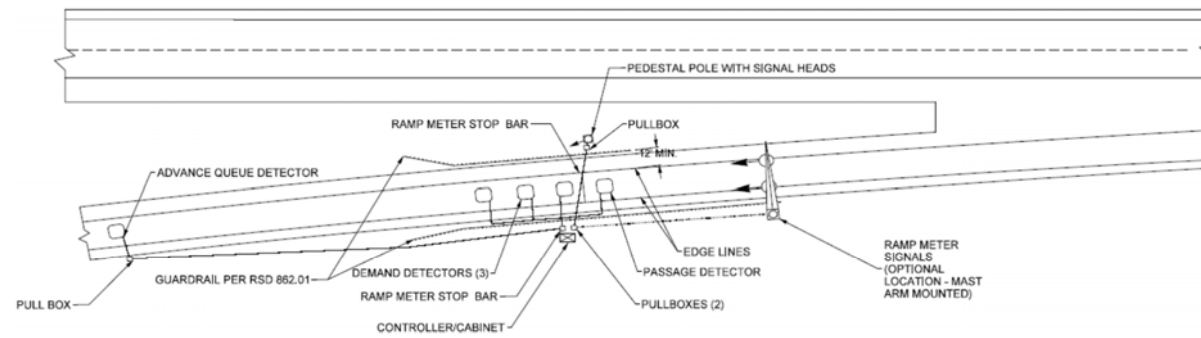
Figure A-6: Two Lane Freeway to Freeway Ramp Meter Overview



- Notes**
1. When truck volumes exceed 5% on 3% or greater ascending grades, provide 500' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 10' apart.
  2. See AASHTO Exhibit S-1 for acceleration distances.
  3. Signal heads shall be mast arm mounted as the conditions dictate.
  4. Install W4-1L merge left sign in accordance with Table 2C-24 of the MUTCD.
  5. See Figure B-3 for signalization and equipment.
  6. See Figure C-1 for ramp meter detection.
  7. See Figure C-3 for mainline detection.
  8. See Figures D-1 and D-3 for ramp meter signing and pavement markings.

## **Appendix B: Signal Head and Equipment Layouts**

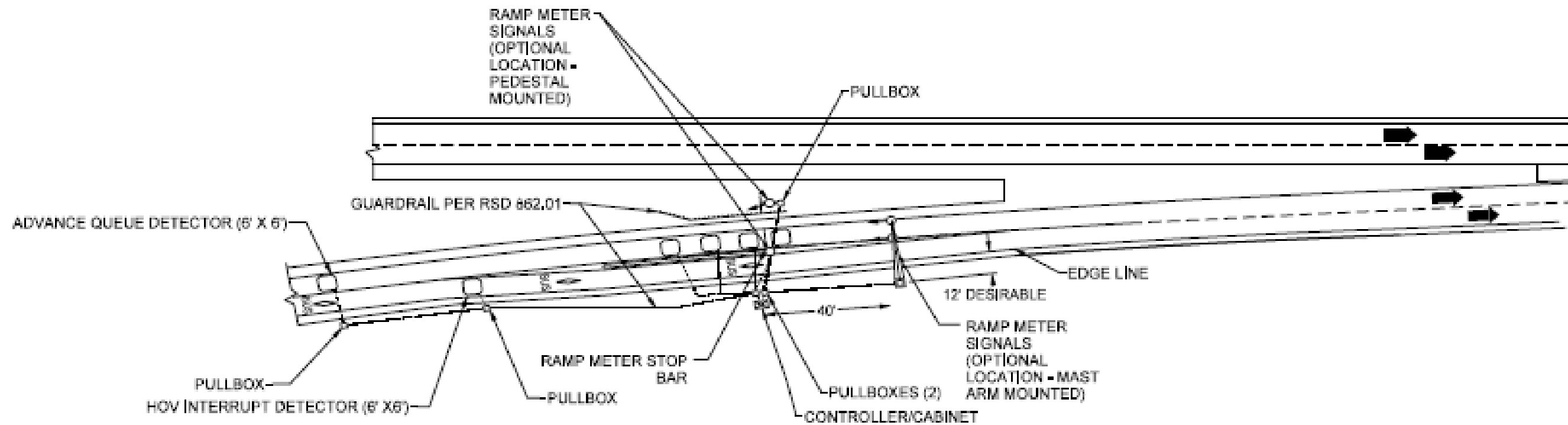
Figure B-1: Single Lane Ramp Meter Signalization and Equipment Layout



Notes

1. Use pedestal mounted signals only for single lane non-freeway to freeway ramp locations. Locate pedestal mounted signals to the left of the ramp and pointed towards the stop bar to minimize view from the mainline.
2. Use mast arm mounted signals only for freeway to freeway ramp locations.
3. Mast arm supports and controller cabinet may be on either side of ramp as site conditions dictate.
4. Use breakaway pedestal poles when guardrail is not existing or otherwise installed.
5. Protect signal cabinet and mast arm supports with guardrail or setback distance in accordance with clear zone standards.

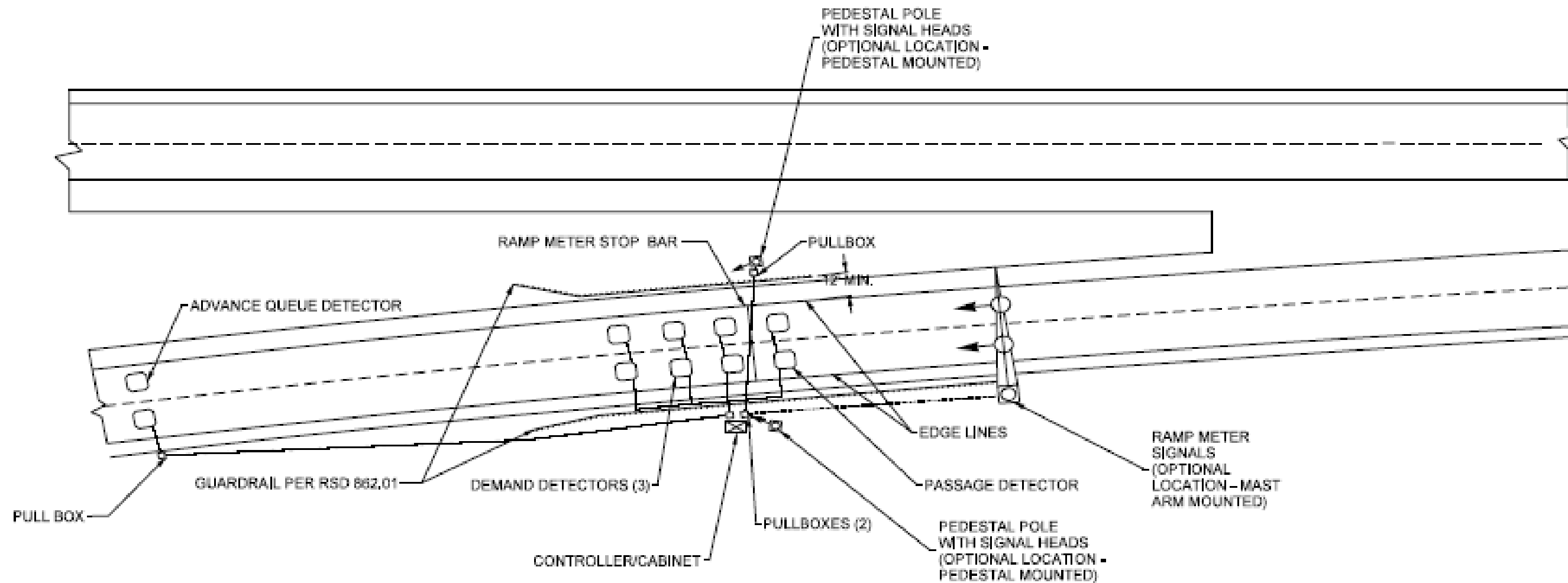
Figure B-2: Single Lane Ramp Meter with Transit Bypass Signalization and Equipment Layout



Notes

1. Use pedestal mounted signals only for single lane non-freeway to freeway ramp locations.
2. Locate pedestal mounted signals to the left of the ramp and pointed towards the stop bar to minimize view from the mainline.
3. Protect signal pedestal and cabinet with guardrail or setback distance in accordance with clear zone standards.
4. Use breakaway pedestal poles when guardrail is not existing or otherwise installed.
5. Protect signal cabinet and mast arm supports with guardrail or setback distance in accordance with clear zone standards.

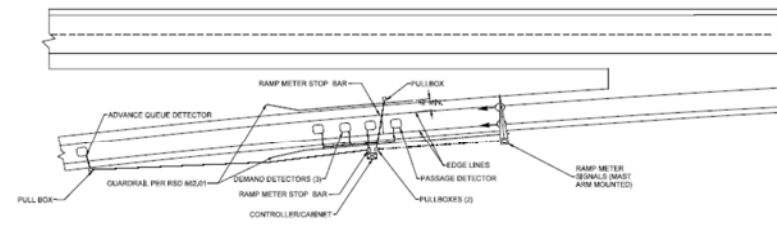
Figure B-3: Two Lane Ramp Meter Signalization and Equipment Layout



**Notes**

1. Use pedestal mounted signals for single and two lane non-freeway to freeway ramp locations. Locate pedestal mounted signals to the left of the ramp and pointed towards the stop bar to minimize view from the mainline.
2. Use mast arm mounted signals only for two lane or freeway to freeway ramp locations.
3. Mast arm supports and controller cabinet may be on either side of ramp as site conditions dictate.
4. Use breakaway pedestal poles when guardrail is not existing or otherwise installed.
5. Protect signal cabinet and mast arm supports with guardrail or setback distance in accordance with clear zone standards.

Figure B-4: Freeway-to-Freeway Ramp Meter Signalization and Equipment Layout

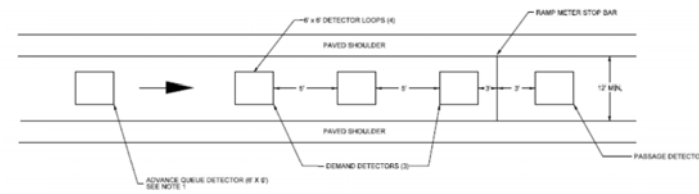


- Notes
1. Use mast arm mounted signals only for freeway to freeway ramp locations.
  2. Mast arm supports and controller cabinet may be on either side of ramp as site conditions dictate.
  3. Use breakaway pedestal poles when guardrail is not existing or otherwise installed.
  4. Protect signal cabinet and mast arm supports with guardrail or setback distance in accordance with clear zone standards.



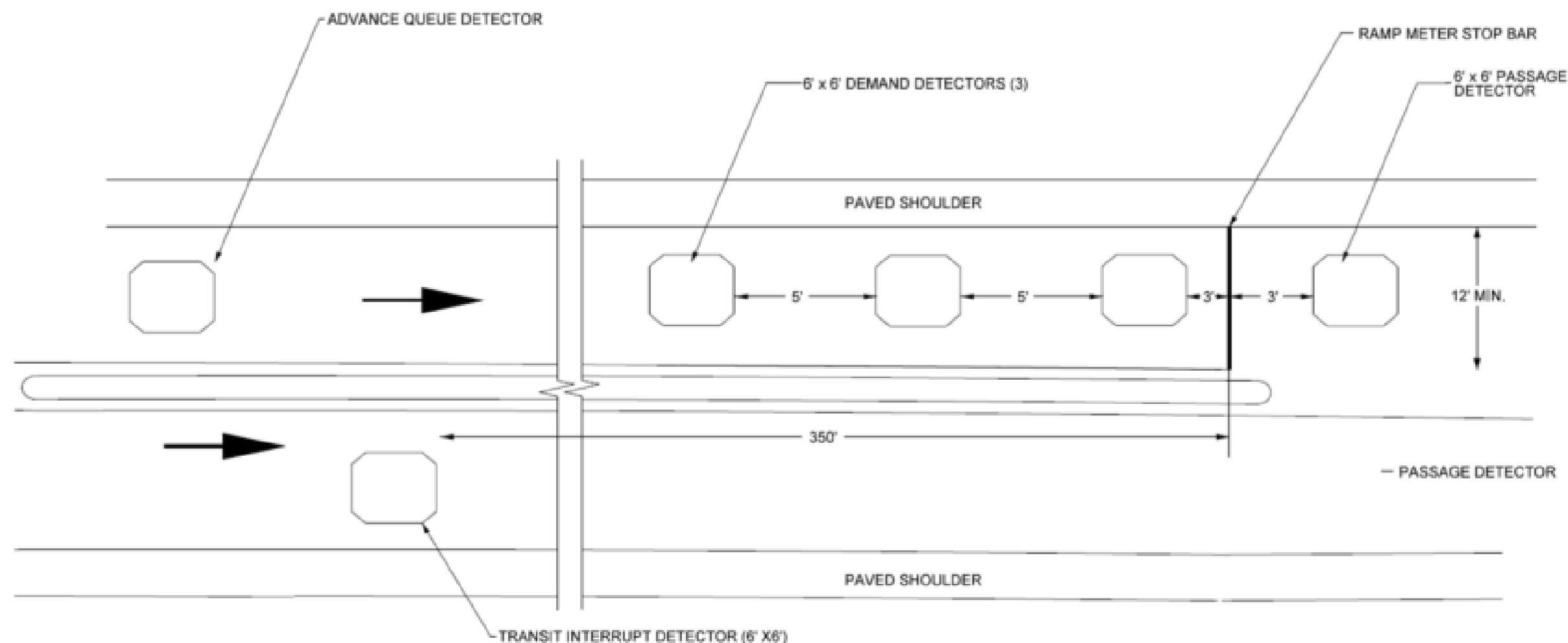
## **Appendix C: Ramp and Mainline Detection Layouts**

Figure C-1: Single Lane Ramp Meter Detection



- Notes
1. Place advance queue detector upstream of predicted queue per Table 4 but no more than 300 feet from the surface street intersection.
  2. For dual lane ramp meter place detectors in second lane at same longitudinal spacing.
  3. See Figure C-3 for multi-lane detection.

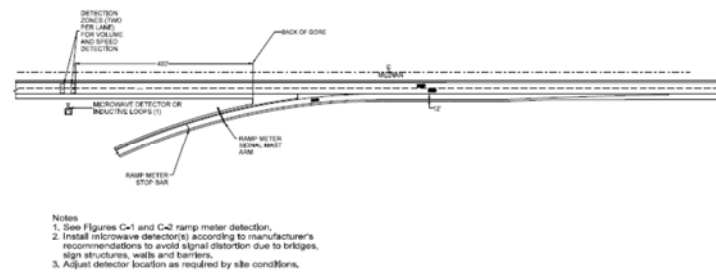
Figure C-2: Single Lane Ramp Meter with Transit Bypass Detection



**Notes**

1. Place advance queue detector upstream of predicted queue per Table 4 but no more than 300 feet from the surface street intersection.
2. For dual lane ramp meter place detectors in second lane at same longitudinal spacing.
3. See Figure C-3 for mainline detection.

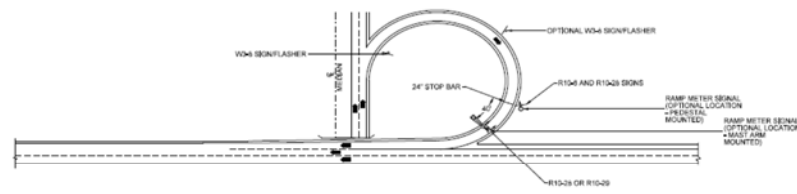
Figure C-3: Mainline Detection



## **Appendix D: Typical Ramp Meter Signing Layouts**



Figure D-2: Single Lane Loop Ramp Meter Signing and Pavement Markings

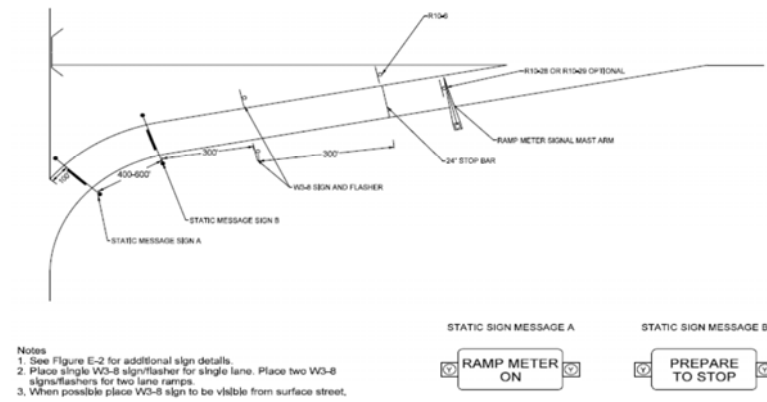


- Notes
1. When truck volumes exceed 5% on 3% or greater ascending grades, provide 100' of auxiliary lane between the ramp meter stop bar and point where the ramp and mainline edges of pavement are 12' apart.
  2. Install additional W5-8 sign and flasher as necessary for locations where sight distance is limited.



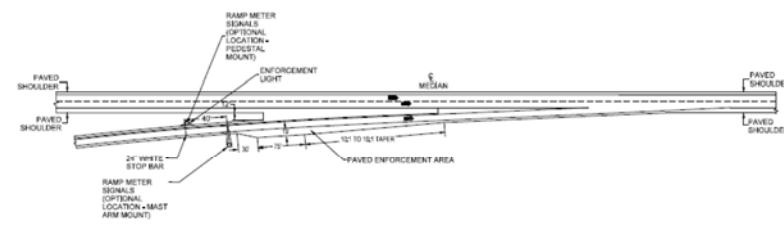


Figure D-3: Freeway to Freeway Ramp Meter Signing and Pavement Markings



## **Appendix E: Optional Enforcement Features**

Figure E-1: Optional Enforcement Features



- Notes
1. Begin taper to enforcement area 0-75' downstream of stop bar.
  2. Dimensions may be adjusted to fit site conditions.
  3. Enforcement areas are suitable locations having two metered lanes or one lane metered and one transit bypass lane.

## **Appendix F: Detailed Typical Cost Estimates**

**Table 10. Typical Design and Construction Costs - Single Lane Ramp Meter**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	2181	\$2.88	\$6,281.28
<b>SUBTOTAL</b>				<b>\$6,281.28</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Drainage</b>				
- Pipe	LF	0	\$60.00	\$0.00
<b>SUBTOTAL</b>				<b>\$0.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	6	\$453.68	\$2,722.05
- 6x6' loops - Ramp	EA	5	\$453.68	\$2,268.38
- Detector Lead-in Cable	EA	850	\$1.73	\$1,466.25
- Pullbox (Std.)	EA	12	\$345.00	\$4,140.00
- Conduit (Trenched)	LF	1725	\$6.90	\$11,902.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	1000	\$5.75	\$5,750.00
- Ground Rods	EA	5	\$82.00	\$410.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	0	\$17,250.00	\$0.00
- Pedestal Pole (Type III with Foundation)	EA	1	\$1,400.00	\$1,400.00
- Two Section Signal Head	EA	2	\$500.00	\$1,000.00
- One Section Signal Head	EA	2	\$575.00	\$1,150.00
- Signal Cable	LF	540	\$3.16	\$1,707.75
<b>SUBTOTAL</b>				<b>\$63,603.43</b>
<b>Communications</b>				

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Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
- Splice Enclosure	EA	0	\$1,150.00	\$0.00
- Pullbox (Special Size)	EA	0	\$2,012.50	\$0.00
- Interconnect Center	EA	0	\$1,725.00	\$0.00
- Fiber-optic Drop Cable (six strands)	LF	0	\$1.73	\$0.00
- Tracer Wire	LF	0	\$14.00	\$0.00
- Broadband Internet Service	LS	1	\$500.00	\$500.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$14,955.00</b>
<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	640	\$0.71	\$456.32
- Raised Pavement Markers	EA	0	\$5.18	\$0.00
- White Edge Line	LF	320	\$1.09	\$349.60
- Yellow Edge Line	LF	320	\$1.09	\$349.60
- 24" Stop Bar	LF	12	\$8.05	\$96.60
<b>SUBTOTAL</b>				<b>\$1,252.12</b>
<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R10-6R and R10-6L, Stop Here on Red	EA	2	\$201.25	\$402.50
- R10-28, One Vehicle Per Green	EA	2	\$201.25	\$402.50
<b>SUBTOTAL</b>				<b>\$3,795.00</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$103,336.83</b>
Traffic Control			15%	\$15,500.52
Contingencies			10%	\$10,333.68
<b>TOTAL CONSTRUCTION</b>				<b>\$129,171.03</b>
Design			8%	\$10,333.68
Construction Administration			10%	\$12,917.10
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$152,421.82</b>

**Table 11. Typical Design and Construction Costs - Two Lane Ramp Meter**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	1210	\$2.88	\$3,484.80
<b>SUBTOTAL</b>				<b>\$3,484.80</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Paving</b>				
- Ramp Widening	SY	<b>3140</b>	\$62.50	\$196,250.00
- Pavement Resurfacing	SY	4225	\$13.50	\$57,037.50
<b>SUBTOTAL</b>				<b>\$253,287.50</b>
<b>Drainage</b>				
- Pipe	LF	50	\$60.00	\$3,000.00
<b>SUBTOTAL</b>				<b>\$3,000.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	6	\$453.68	\$2,722.05
- 6x6' loops - Ramp	EA	10	\$453.68	\$4,536.75
- Detector Lead-in Cable	EA	850	\$1.73	\$1,466.25
- Pullbox (Std.)	EA	12	\$345.00	\$4,140.00
- Conduit (Trenched)	LF	1725	\$6.90	\$11,902.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	1000	\$5.75	\$5,750.00
- Ground Rods	EA	6	\$82.00	\$492.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	0	\$17,250.00	\$0.00

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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- Pedestal Pole (Type III with Foundation)	EA	2	\$1,400.00	\$2,800.00
- Two Section Signal Head	EA	4	\$500.00	\$2,000.00
- One Section Signal Head	EA	2	\$575.00	\$1,150.00
- Signal Cable	LF	540	\$3.16	\$1,707.75
<b>SUBTOTAL</b>				<b>\$68,353.80</b>
<b>Communications</b>				
- Splice Enclosure	EA	0	\$1,150.00	\$0.00
- Pullbox (Special Size)	EA	0	\$2,012.50	\$0.00
- Interconnect Center	EA	0	\$1,725.00	\$0.00
- Fiber-optic Drop Cable (six strands)	LF	0	\$1.73	\$0.00
- Tracer Wire	LF	0	\$14.00	\$0.00
- Broadband Internet Service	LS	1	\$500.00	\$500.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$14,955.00</b>
<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	640	\$0.71	\$456.32
- Raised Pavement Markers	EA	3	\$5.18	\$15.53
- White Edge Line	LF	320	\$1.09	\$349.60
- Yellow Edge Line	LF	320	\$1.09	\$349.60
- White Skip Line	LF	200	\$0.28	\$55.20
- 24" Stop Bar	LF	24	\$8.05	\$193.20
<b>SUBTOTAL</b>				<b>\$1,419.45</b>
<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R10-6R and R10-6L, Stop Here on Red	EA	2	\$201.25	\$402.50
- R10-28, One Vehicle Per Green	EA	2	\$201.25	\$402.50
- W4-1L, Merge Left	EA	1	\$747.50	\$747.50
<b>SUBTOTAL</b>				<b>\$4,542.50</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$362,493.05</b>



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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Traffic Control			15%	\$54,373.96
Contingencies	\$0.10			\$36,249.30
<b>TOTAL CONSTRUCTION</b>				<b>\$453,116.31</b>
Design	\$0.08			\$36,249.30
Construction Administration	\$0.10			\$45,311.63
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$534,677.24</b>

**Table 12. Typical Design and Construction Costs - Three Lane Ramp Meter**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	1206	\$2.88	\$3,473.28
<b>SUBTOTAL</b>				<b>\$3,473.28</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Paving</b>				
- Ramp Widening	SY	<b>3140</b>	\$62.50	\$196,250.00
- Pavement Resurfacing	SY	<b>7780</b>	\$13.50	\$105,030.00
<b>SUBTOTAL</b>				<b>\$301,280.00</b>
<b>Drainage</b>				
- Pipe	LF	50	\$60.00	\$3,000.00
<b>SUBTOTAL</b>				<b>\$3,000.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	6	\$453.68	\$2,722.05
- 6x6' loops - Ramp	EA	15	\$453.68	\$6,805.13
- Detector Lead-in Cable	EA	950	\$1.73	\$1,638.75
- Pullbox (Std.)	EA	12	\$345.00	\$4,140.00
- Conduit (Trenched)	LF	1725	\$6.90	\$11,902.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	1000	\$5.75	\$5,750.00
- Ground Rods	EA	5	\$82.00	\$410.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	1	\$17,250.00	\$17,250.00

M-0468 Ramp Metering Feasibility Study for Cabarrus, Gaston, Iredell and Mecklenburg Counties  
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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- Pedestal Pole (Type III with Foundation)	EA	0	\$1,400.00	\$0.00
- Two Section Signal Head	EA	6	\$500.00	\$3,000.00
- One Section Signal Head	EA	2	\$575.00	\$1,150.00
- Signal Cable	LF	540	\$3.16	\$1,707.75
<b>SUBTOTAL</b>				<b>\$86,162.68</b>
<b>Communications</b>				
- Splice Enclosure	EA	0	\$1,150.00	\$0.00
- Pullbox (Special Size)	EA	0	\$2,012.50	\$0.00
- Interconnect Center	EA	0	\$1,725.00	\$0.00
- Fiber-optic Drop Cable (six strands)	LF	0	\$1.73	\$0.00
- Tracer Wire	LF	0	\$14.00	\$0.00
- Broadband Internet Service	LS	1	\$500.00	\$500.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$14,955.00</b>
<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	940	\$0.71	\$670.22
- Raised Pavement Markers	EA	6	\$5.18	\$31.05
- White Edge Line	LF	470	\$1.09	\$513.48
- Yellow Edge Line	LF	470	\$1.09	\$513.48
- White Skip Line	LF	200	\$0.28	\$55.20
- 24" Stop Bar	LF	36	\$8.05	\$289.80
<b>SUBTOTAL</b>				<b>\$2,073.22</b>
<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R10-6R and R10-6L, Stop Here on Red	EA	2	\$201.25	\$402.50
- R10-28, One Vehicle Per Green	EA	2	\$201.25	\$402.50
- W4-1L, Merge Left	EA	2	\$747.50	\$1,495.00
<b>SUBTOTAL</b>				<b>\$5,290.00</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$429,684.18</b>

M-0468 Ramp Metering Feasibility Study for Cabarrus, Gaston, Iredell and Mecklenburg Counties  
 Typical Cost Estimates

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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Traffic Control	\$0.15			\$64,452.63
Contingencies	\$0.10			\$42,968.42
<b>TOTAL CONSTRUCTION</b>				<b>\$537,105.22</b>
Design	\$0.08			\$42,968.42
Construction Administration	\$0.10			\$53,710.52
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$633,784.16</b>

**Table 13. Typical Design and Construction Costs – Single Lane Ramp Meter with Transit Bypass**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	3412	\$2.88	\$9,826.56
<b>SUBTOTAL</b>				<b>\$9,826.56</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Paving</b>				
- Traffic Separator, 4' wide	LF	1050	\$62.50	\$65,625.00
- Ramp Widening	SY	3120	\$62.50	\$195,000.00
- Pavement Resurfacing	SY	5335	\$13.50	\$72,022.50
<b>SUBTOTAL</b>				<b>\$267,022.50</b>
<b>Drainage</b>				
- Pipe	LF	50	\$60.00	\$3,000.00
<b>SUBTOTAL</b>				<b>\$3,000.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	6	\$453.68	\$2,722.05
- 6x6' loops - Ramp	EA	6	\$453.68	\$2,722.05
- Detector Lead-in Cable	EA	850	\$1.73	\$1,466.25
- Pullbox (Std.)	EA	6	\$345.00	\$2,070.00
- Conduit (Trenched)	LF	1725	\$6.90	\$11,902.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	0	\$5.75	\$0.00
- Ground Rods	EA	5	\$82.00	\$410.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00

M-0468 Ramp Metering Feasibility Study for Cabarrus, Gaston, Iredell and Mecklenburg Counties  
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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	0	\$17,250.00	\$0.00
- Pedestal Pole (Type III with Foundation)	EA	1	\$1,400.00	\$1,400.00
- Two Section Signal Head	EA	2	\$500.00	\$1,000.00
- One Section Signal Head	EA	2	\$575.00	\$1,150.00
- Signal Cable	LF	540	\$3.16	\$1,707.75
<b>SUBTOTAL</b>				<b>\$56,237.10</b>

<b>Communications</b>				
- Splice Enclosure	EA	0	\$1,150.00	\$0.00
- Pullbox (Special Size)	EA	0	\$2,012.50	\$0.00
- Interconnect Center	EA	0	\$1,725.00	\$0.00
- Fiber-optic Drop Cable (six strands)	LF	0	\$1.73	\$0.00
- Tracer Wire	LF	0	\$14.00	\$0.00
- Broadband Internet Service	LS	1	\$500.00	\$500.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$14,955.00</b>

<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	0	\$0.71	\$19.96
- Raised Pavement Markers	EA	28	\$5.18	\$18,267.75
- White Edge Line	LF	3530	\$1.09	\$3,856.53
- Yellow Edge Line	LF	1430	\$1.09	\$1,562.28
- White Skip Line	LF	0	\$0.28	\$0.00
- 24" Stop Bar	LF	12	\$8.05	\$96.60
- Bus Message	EA	3	\$586.50	\$1,759.50
- Diamond Symbol	EA	3	\$138.00	\$414.00
<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
<b>SUBTOTAL</b>				<b>\$25,976.61</b>

<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R3-11b, Buses Only	EA	3	\$345.00	\$1,035.00

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 Typical Cost Estimates

<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- R10-6R and R10-6L, Stop Here on Red	EA	1	\$201.25	\$201.25
- R10-28, One Vehicle Per Green	EA	1	\$201.25	\$201.25
- W4-1L, Merge Left	EA	1	\$747.50	\$747.50
<b>SUBTOTAL</b>				<b>\$5,175.00</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$395,642.77</b>
Traffic Control			15%	\$59,346.42
Contingencies			10%	\$39,564.28
<b>TOTAL CONSTRUCTION</b>				<b>\$494,553.47</b>
Design			8%	\$39,564.28
Construction Administration			10%	\$49,455.35
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$583,573.09</b>

**Table 14. Typical Design and Construction Costs – Single Lane Freeway-to-Freeway Ramp Meter**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	781	\$2.88	\$2,249.28
<b>SUBTOTAL</b>				<b>\$2,249.28</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Drainage</b>				
- Pipe	LF	0	\$60.00	\$0.00
<b>SUBTOTAL</b>				<b>\$0.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	6	\$453.68	\$2,722.05
- 6x6' loops - Ramp	EA	10	\$453.68	\$4,536.75
- Detector Lead-in Cable	EA	390	\$1.73	\$672.75
- Pullbox (Std.)	EA	12	\$345.00	\$4,140.00
- Conduit (Trenched)	LF	1725	\$6.90	\$11,902.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	1000	\$5.75	\$5,750.00
- Ground Rods	EA	5	\$82.00	\$410.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	1	\$17,250.00	\$17,250.00
- Pedestal Pole (Type III with Foundation)	EA	0	\$1,400.00	\$0.00
- Two Section Signal Head	EA	4	\$500.00	\$2,000.00
- One Section Signal Head	EA	6	\$575.00	\$3,450.00
- Signal Cable	LF	190	\$3.16	\$600.88



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 Typical Cost Estimates

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>SUBTOTAL</b>				<b>\$83,121.43</b>
<b>Communications</b>				
- Splice Enclosure	EA	0	\$1,150.00	\$0.00
- Pullbox (Special Size)	EA	0	\$2,012.50	\$0.00
- Interconnect Center	EA	0	\$1,725.00	\$0.00
- Fiber-optic Drop Cable (six strands)	LF	0	\$1.73	\$0.00
- Tracer Wire	LF	0	\$14.00	\$0.00
- Broadband Internet Service	LS	1	\$500.00	\$500.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$14,955.00</b>
<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	1000	\$0.71	\$713.00
- Raised Pavement Markers	EA	0	\$5.18	\$0.00
- White Edge Line	LF	500	\$1.09	\$546.25
- Yellow Edge Line	LF	500	\$1.09	\$546.25
- 24" Stop Bar	LF	12	\$8.05	\$96.60
<b>SUBTOTAL</b>				<b>\$1,902.10</b>
<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R10-6R and R10-6L, Stop Here on Red	EA	2	\$201.25	\$402.50
- R10-28, One Vehicle Per Green	EA	2	\$201.25	\$402.50
- Sign Structure (Cantilever)	EA	2	\$57,500.00	\$115,000.00
- Ramp Meter On Sign (Message A)	EA	1	\$5,750.00	\$5,750.00
- Ramp Meter On Sign (Message B)	EA	1	\$5,750.00	\$5,750.00
<b>SUBTOTAL</b>				<b>\$130,295.00</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$245,972.81</b>
Traffic Control			15%	\$36,895.92
Contingencies			10%	\$24,597.28
<b>TOTAL CONSTRUCTION</b>				<b>\$307,466.01</b>

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 Typical Cost Estimates

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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Design			8%	\$24,597.28
Construction Administration			10%	\$30,746.60
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$362,809.89</b>

**Table 15. Typical Design and Construction Costs – Two Lane Freeway-to-Freeway Ramp Meter**

Categories Descriptions	Unit	Quantity	Unit Cost	Total Cost
<b>Earthwork and Structure</b>				
- Retaining Wall	SF	0	\$85.00	\$0.00
- Excavation	CY	0	\$25.00	\$0.00
- Fill	CY	0	\$22.00	\$0.00
- Seeding	SY	1213	\$2.88	\$3,493.44
<b>SUBTOTAL</b>				<b>\$3,493.44</b>
<b>Guardrail</b>				
- Guardrail Rail	LF	500	\$20.00	\$10,000.00
- Guardrail Approach End Treatment	EA	2	\$1,725.00	\$3,450.00
<b>SUBTOTAL</b>				<b>\$13,450.00</b>
<b>Paving</b>				
- Ramp Widening	SY	<b>4225</b>	\$62.50	\$264,062.50
- Pavement Resurfacing	SY	<b>4225</b>	\$13.50	\$57,037.50
<b>SUBTOTAL</b>				<b>\$321,100.00</b>
<b>Drainage</b>				
- Pipe	LF	0	\$60.00	\$0.00
<b>SUBTOTAL</b>				<b>\$0.00</b>
<b>Signalization</b>				
- 6x6' loops - Mainline	EA	10	\$453.68	\$4,536.75
- 6x6' loops - Ramp	EA	10	\$453.68	\$4,536.75
- Detector Lead-in Cable	EA	390	\$1.73	\$672.75
- Pullbox (Std.)	EA	12	\$345.00	\$4,140.00
- Conduit (Trenched)	LF	1735	\$6.90	\$11,971.50
- Conduit (Directional Drilled)	LF	340	\$16.10	\$5,474.00
- Electrical Service	EA	1	\$1,500.00	\$1,500.00
- Electrical Conductors	LF	1000	\$5.75	\$5,750.00
- Ground Rods	EA	3	\$82.00	\$246.00
- ATC/2070E Controller and Cabinet	EA	1	\$16,100.00	\$16,100.00
- Firmware/Calibration	EA	1	\$6,095.00	\$6,095.00
- Cabinet Foundation	EA	1	\$517.50	\$517.50
- 45' Mast Arm Poles and Foundation	EA	1	\$17,250.00	\$17,250.00

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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- Pedestal Pole (Type III with Foundation)	EA	0	\$1,400.00	\$0.00
- Two Section Signal Head	EA	2	\$500.00	\$1,000.00
- One Section Signal Head	EA	6	\$575.00	\$3,450.00
- Signal Cable	LF	390	\$3.16	\$1,233.38
<b>SUBTOTAL</b>				<b>\$84,473.63</b>
<b>Communications</b>				
- Splice Enclosure	EA	1	\$1,150.00	\$1,150.00
- Pullbox (Special Size)	EA	1	\$2,012.50	\$2,012.50
- Interconnect Center	EA	1	\$1,725.00	\$1,725.00
- Fiber-optic Drop Cable (six strands)	LF	500	\$1.73	\$862.50
- Tracer Wire	LF	500	\$14.00	\$7,000.00
- Broadband Internet Service	LS	0	\$500.00	\$0.00
- Ethernet Switch	EA	1	\$1,955.00	\$1,955.00
- CCTV Pole (55' Wood)	EA	1	\$4,600.00	\$4,600.00
- CCTV Cabinet (Pole Mount, Type 336)	EA	1	\$3,300.00	\$3,300.00
- CCTV Assembly	EA	1	\$4,600.00	\$4,600.00
<b>SUBTOTAL</b>				<b>\$27,205.00</b>
<b>Pavement Marking</b>				
- Pavement Marking Removal	LF	0	\$0.71	\$0.00
- Raised Pavement Markers	EA	3	\$5.18	\$15.53
- White Edge Line	LF	600	\$1.09	\$655.50
- Yellow Edge Line	LF	600	\$1.09	\$655.50
- White Skip Line	LF	200	\$0.28	\$55.20
- 24" Stop Bar	LF	24	\$8.05	\$193.20
<b>SUBTOTAL</b>				<b>\$1,574.93</b>
<b>Signing</b>				
- W3-7, Ramp Meter Ahead	EA	2	\$747.50	\$1,495.00
- W3-8, Ramp Metered When Flashing	EA	2	\$747.50	\$1,495.00
- R10-6R and R10-6L, Stop Here on Red	EA	2	\$201.25	\$402.50
- R10-28, One Vehicle Per Green	EA	2	\$201.25	\$402.50
- W4-1L, Merge Left	EA	2	\$747.50	\$1,495.00
- Sign Structure (Cantilever)	EA	2	\$57,500.00	\$115,000.00
- Ramp Meter On Sign (Message A)	EA	1	\$5,750.00	\$5,750.00

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<b>Categories Descriptions</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
- Ramp Meter On Sign (Message B)	EA	1	\$5,750.00	\$5,750.00
<b>SUBTOTAL</b>				<b>\$131,790.00</b>
<b>SUBTOTAL CONSTRUCTION</b>				<b>\$583,086.99</b>
Traffic Control		15%		\$87,463.05
Contingencies		10%		\$58,308.70
<b>TOTAL CONSTRUCTION</b>				<b>\$728,858.74</b>
Design		8%		\$58,308.70
Construction Administration		10%		\$72,885.87
<b>TOTAL DESIGN AND CONSTRUCTION</b>				<b>\$860,053.31</b>

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