

Final Report  
Federal Earmark ITS-9851(003)

Virginia Department of Transportation  
Northern Virginia Smart Traffic Center Video Quality Improvement Program

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## Table of Contents

|      |  |    |
|------|--|----|
| I.   | Background.....                              | 3  |
| II.  | Assessment of CCTV Subsystem .....           | 4  |
|      | Baseline CCTV Field Device Inventory .....   | 4  |
|      | Matrix Switch Assessment.....                | 9  |
|      | Telecommunications Equipment Assessment..... | 11 |
| III. | CCTV Field Device Improvement.....           | 13 |
|      | Post-Installation Quality Assessment .....   | 14 |
|      | Final Quality Assessment .....               | 17 |
| IV.  | System Maintenance Issues .....              | 19 |
| V.   | Summary .....                                | 20 |

## I. Background

The Virginia Department of Transportation (VDOT) operates several traffic management centers, including one in the Northern Virginia District. The Northern Virginia District of VDOT encompasses the counties of Arlington, Fairfax, Prince William and Loudoun.

The VDOT Northern Virginia Smart Traffic Center (NOVA STC) provides a number of operational services in the region including:

- System management
- Incident management
- HOV reversible lane management
- Safety service patrols
- Computerized signal system management
- Traveler information

The NOVA STC has a wealth of ITS field devices including changeable message signs, highway advisory radio, truck rollover warning, HOV lane gate control, imbedded loop sensors, 511 and CCTV cameras. The CCTV subsystem is comprised of over 125 cameras located along I-95, I-395, I-495, I-66 and the Dulles Toll Road.

Like many freeway traffic management systems around the country, the NOVA STC system was implemented in phases over a period of years. As a result, some field components had reached their maximum life cycle, including a portion of the CCTV subsystem.

VDOT retained the services of a team of private sector experts (TrafficLand and Digital Traffic Systems) to review CCTV imagery quality and determine the issues affecting system performance and solutions to improve the quality of the video imagery. This report details the results of that effort.

## **II. Assessment of CCTV Subsystem**

The goal of the Project was to develop and implement a CCTV Quality Improvement Program for the Northern Virginia Smart Traffic Center. The objective was to assess the quality of all CCTV field devices and to identify a subset of field devices experiencing diminishing image quality and recurring operational problems. Once the analysis was conducted, VDOT and the Project Team would work together to identify options for improving the quality of the worst performing field devices. The result of the work will be an improvement in performance for this critical ITS subsystem.

### ***Baseline CCTV Field Device Inventory***

VDOT provided the Project Team with information on the CCTV field devices from the Northern Virginia ITS Asset Inventory (Table 1).

In July 2004, the Project Team performed an evaluation of CCTV imagery coming into the VDOT Northern Virginia Smart Traffic Center. This evaluation identified a number of issues impacting the CCTV subsystem. These problems included:

- Poor image quality
- Lack of pan, tilt, zoom (PTZ) control
- Improper PTZ control functions
- Lack of video signal from field devices
- Improper lense function
- Video interference during PTZ control functions

Table 2 illustrates the quality issues discovered during the baseline CCTV evaluation.

**Table 1: Baseline CCTV Asset Inventory Information**

| ID       | MILEPOST | CABINET ID   | CCTV | ADDR | CAB ID            | PROTCL | ROUTE | RT DIR | CLST RT | CLST INT            | NXT RT                | NXT INT               | CONDITN | CONNECT          | STATUS                         |
|----------|----------|--------------|------|------|-------------------|--------|-------|--------|---------|---------------------|-----------------------|-----------------------|---------|------------------|--------------------------------|
| CCTV40   | 50.1     | C424W        | 4    | 81   | C424W             | Vicon  | I-66  | EB     | RT 29   | Lee Hwy             | Compton Rd            | Lee Hwy               | New     | Fiber            | Existing                       |
| CCTV190  | 62.6     | C533E        | 19   | 56   | C533E             | Vicon  | I-66  | EB     | RT 243  | Nutley St           | RT 243                | Nutley St             | New     | Fiber            | Existing                       |
| CCTV220  | 64.2     | C622E        | 22   | 53   | C622E             | Vicon  | I-66  | EB     | I-495   | Capital Beltway     | Gallows Rd            | Capital Beltway       | New     | Fiber            | Existing                       |
| CCTV230  | 64.8     | C13          | 23   | 27   | C13               | Vicon  | I-66  | EB     | I-495   | Capital Beltway     | I-495                 | Capital Beltway       | Old     | Fiber            | Existing                       |
| CCTV250  | 0.0      | C82          | 25   | 39   | C82               | Vicon  | I-66  | EB     | NA      | Arlington Blvd      | T R Bridge            | Arlington Blvd        | Old     | Fiber            | Existing                       |
| CCTV260  | 74.7     | C76          | 26   | 38   | C76               | Vicon  | I-66  | WB     | RT 29   | Lee Hwy             | Lynn St               | Lee Hwy/Rte 29        | Old     | Fiber            | Existing                       |
| CCTV270  | 0.0      | C79          | 27   | 37   | C79               | Vicon  | I-66  | WB     | RT 29   | Lee Hwy             | Westbound             | Rosslynn Tunnel       | Old     | Fiber            | Existing                       |
| CCTV280  | 0.0      | C74          | 28   | 36   | C74               | Vicon  | I-66  | WB     | RT 29   | Lee Hwy             | Eastbound             | Rosslynn Tunnel       | Old     | Fiber            | Existing                       |
| CCTV430  | 0.0      | C588W        | 44   | 76   | C588W             | Vicon  | I-66  | West   | RT 28   | Sully Rd            | RT 28                 | Sully Rd              | New     | T-1              | Existing                       |
| CCTV460  | 151.1    | B169         | 47   | 111  | B169              | Vicon  | I-95  | NB     | RT 619  | Fuller Rd           | RT 234                | Dumfries Rd           | New     | Fiber            | Existing                       |
| CCTV470  | 0.0      | B115         | 48   | 102  | B115              | Vicon  | I-95  | NB     | RT 3000 | Prince William Pkwy | RT 123                | Gordon Blvd           | New     | Fiber            | Existing                       |
| CCTV530  | 0.0      | C186         | 54   | 2    | C186              | Vicon  | I-395 | NB     | RT 644  | Franconia Rd        | RT 644                | Franconia Rd          | New     | Fiber            | Existing                       |
| CCTV535  | 0.0      |              | 55   | 86   | -1                | Vicon  | I-95  | NB     | 644     | Hilton Building     | I-495                 | Capital Beltway       | New     | Fiber            | Existing; Replace old CCTV-770 |
| CCTV540* | 0.0      | B210         | 56   | 90   | Old B210 B011     | Vicon  | I-95  | NB     | RT 644  | Old Keene Mill Rd.  | RT 644                | Old Keene Mill Rd.    | New     | Fiber            | Existing                       |
| CCTV550* | 0.0      | C176 or B217 | 57   | 4    | C176 -STC or B217 | Vicon  | I-395 | NB     | I-495   | Capital Beltway     | I-495                 | Capital Beltway       | Old     | Fiber            | Existing                       |
| CCTV560  | 0.0      | C174         | 58   | 5    | C174              | Vicon  | I-395 | NB     | I-495   | Capital Beltway     | I-495                 | Capital Beltway       | Old     | Fiber            | Existing                       |
| CCTV570  | 0.0      | C172         | 59   | 6    | C172              | Vicon  | I-395 | NB     | I-495   | Capital Beltway     | I-495                 | Capital Beltway       | Old     | Fiber            | Existing                       |
| CCTV640  | 0.0      | C145         | 66   | 13   | C145              | Vicon  | I-395 | NB     | RT 420  | Seminary Rd         | RT 420                | Seminary Rd           | Old     | Fiber            | Existing                       |
| CCTV650  | 0.0      | C139         | 67   | 14   | C139              | Vicon  | I-395 | NB     | RT 420  | Seminary Rd         | RT 420                | Seminary Rd           | Old     | Fiber            | Existing                       |
| CCTV660  | 0.0      | C137         | 68   | 15   | C137              | Vicon  | I-395 | NB     | RT 7    | Leesburg Pike       | RT 420                | Seminary Rd           | Old     | Fiber            | Existing                       |
| CCTV670  | 5.5      | C132         | 69   | 16   | C132              | Vicon  | I-395 | NB     | RT 7    | Leesburg Pike       | RT 7                  | Leesburg Pike         | Old     | Fiber            | Existing                       |
| CCTV680  | 0.0      | C128         | 70   | 17   | C128              | Vicon  | I-395 | NB     | NA      | Quaker Lane         | NA                    | Quaker Lane           | Old     | Fiber            | Existing                       |
| CCTV740  | 0.0      | C94          | 76   | 22   | C94               | Vicon  | I-395 | SB     | RT 27   | Washington Blvd     | RT 27                 | Washington Blvd       | Old     | Fiber            | Existing                       |
| CCTV765* | 0.0      |              | 79   | 88   | -1                | Vicon  | I-95  | SB     | RT 644  | Old Keene Mill Rd.  | RT 644                | Old Keene Mill Rd.    | New     | Fiber            | Existing                       |
| CCTV766* | 0.0      | B210         | 80   | 89   | -1                | Vicon  | I-95  | SB     | RT 644  | Old Keene Mill Rd.  | RT 644                | Old Keene Mill Rd.    | New     | Fiber            | Existing                       |
| CCTV800  | 163.1    | B078         | 83   | 96   | B078              | Vicon  | I-95  | SB     | RT 1    | Richmond Hwy        | RT 1                  | Richmond Hwy          | New     | Fiber            | Existing                       |
| CCTV830  | 160.7    | B092         | 86   | 100  | B092              | Vicon  | I-95  | SB     | RT 123  | Gordon Blvd         | RT 123                | Gordon Blvd           | New     | Fiber            | Existing                       |
| CCTV840  | 159.7    | B104         | 87   | 101  | B104              | Vicon  | I-95  | SB     | RT 123  | Gordon Blvd         | RT 3000               | Prince William Pkwy   | New     | Fiber            | Existing                       |
| CCTV870  | 156.3    | B130         | 90   | 105  | B130              | Vicon  | I-95  | SB     | RT 784  | Dale Blvd           | RT 234                | Dumfries Rd           | New     | Fiber            | Existing                       |
| CCTV890  | 154.5    | B150         | 92   | 107  | B150              | Vicon  | I-95  | SB     | RT 234  | Dumfries Rd         | RT 234                | Dumfries Rd           | New     | Fiber            | Existing                       |
| CCTV930  | 0.0      | C90          | 96   | 23   | C90               | Vicon  | RT 27 | SB     | I-395   | NA                  | I-395                 | NA                    | Old     | Fiber            | Existing                       |
| CCTV950  | 0.0      | NA           | 99   | 45   | NA                | Vicon  | I-95  | NB     | I-295   | Anacostia Freeway   | I-295                 | Wilson Bridge/Md Side | Old     | Twisted Pair/Fib | Existing                       |
| CCTV960  | 0.0      | NA           | 100  | 47   | NA                | Vicon  | I-95  | NB     | RT 210  | Indian Head Hwy     | RT 210                | Indian Head Hwy       | Old     | Twisted Pair/Fib | Existing                       |
| CCTV970  | 4.0      | 249          | 101  | 48   | NA                | Vicon  | I-95  | SB     | RT 210  | Indian Head Hwy     | RT 414                | Saint Barnabas Rd     | Old     | Twisted Pair/Fib | Existing                       |
| CCTV980  | 0.0      | 239          | 102  | 46   | NA                | Vicon  | I-295 | SB     | I-495   | Capital Beltway     | I-295                 | Anacostia Freeway     | Old     | Twisted Pair/Fib | Existing                       |
| CCTV50   | 50.8     | C461W        | 5    | 80   | C461W             | Vicon  | I-66  | EB     | RT 29   | Lee Hwy             | Compton Rd            | Lee Hwy               | New     | Fiber            | Existing                       |
| CCTV360  | 0.0      | C521E        | 36   | 57   | C521E             | Vicon  | I-66  | WB     | RT 243  | Nutley St           | Vienna Metro          | Chain Bridge Rd       | New     | Fiber            | Existing                       |
| CCTV500  | 0.0      | B053         | 51   | 92   | B053              | Vicon  | I-95  | NB     | RT 617  | Fairfax Co. Pkwy    | RT 617                | Fairfax Co. Pkwy      | New     | Fiber            | Existing                       |
| CCTV510  | 0.0      | B047         | 52   | 91   | B047              | Vicon  | I-95  | NB     | RT 617  | Backlick Rd         | RT 617                | Backlick Rd           | New     | Fiber            | Existing                       |
| CCTV520  | 0.0      | C190         | 53   | 1    | C190              | Vicon  | I-395 | NB     | RT 644  | Franconia Rd        | RT 644                | Franconia Rd          | New     | Fiber            | Existing                       |
| CCTV620  | 0.0      | C150         | 64   | 11   | C150              | Vicon  | I-395 | NB     | RT 236  | Duke St             | RT 236                | Duke St               | Old     | Fiber            | Existing                       |
| CCTV630  | 0.0      | C147         | 65   | 12   | C147              | Vicon  | I-395 | NB     | RT 236  | Duke St             | RT 236                | Duke St               | Old     | Fiber            | Existing                       |
| CCTV700  | 0.0      | C117         | 72   | 19   | C117              | Vicon  | I-395 | NB     | RT 27   | Washington Blvd     | RT 27                 | Washington Blvd       | Old     | Fiber            | Existing                       |
| CCTV760  | 0.0      | C115         | 78   | 20   | C115              | Vicon  | I-395 | SB     | RT 27   | Washington Blvd     | RT 27                 | Washington Blvd       | Old     | Fiber            | Existing                       |
| CCTV850  | 0.0      | B120         | 88   | 103  | B120              | Vicon  | I-95  | SB     | RT 3000 | Prince William Pkwy | RT 784                | Dale Blvd             | New     | Fiber            | Existing                       |
| CCTV10   | 46.9     | C254W        | 1    | 85   | C254W             | Vicon  | I-66  | EB     | RT 234  | Sudley Rd           | RT 234                | Sudley Rd             | New     | Fiber            | Existing                       |
| CCTV20   | 48.0     | C307W        | 2    | 83   | C307W             | Vicon  | I-66  | EB     | RT 234  | Sudley Rd           | West Bull Run         | Lee Hwy               | New     | Fiber            | Existing                       |
| CCTV30   | 48.8     | C352W        | 3    | 82   | C352W             | Vicon  | I-66  | EB     | RT 234  | Sudley Rd           | Rest Area             | Lee Hwy               | New     | Fiber            | Existing                       |
| CCTV60   | 52.3     | C525W        | 6    | 78   | C525W             | Vicon  | I-66  | EB     | RT 29   | Lee Hwy             | RT 29                 | Lee Hwy               | New     | Fiber            | Existing                       |
| CCTV70   | 0.0      | C574W        | 7    | 77   | C574W             | Vicon  | I-66  | EB     | RT 28   | Sully Rd            | RT 28                 | Sully Rd              | New     | Fiber            | Existing                       |
| CCTV80   | 0.0      | C589W        | 8    | 75   | C589W             | Vicon  | I-66  | EB     | RT 28   | Sully Rd            | RT 28                 | Sully Rd              | New     | Fiber            | Existing                       |
| CCTV90   | 0.0      | C133E        | 9    | 70   | C133E             | Vicon  | I-66  | EB     | RT 7100 | Fairfax Co. Pkwy    | N Stringfellow Rd     | NA                    | New     | Fiber            | Existing                       |
| CCTV100  | 55.5     | C176E        | 10   | 69   | C176E             | Vicon  | I-66  | EB     | RT 7100 | Fairfax Co. Pkwy    | RT 7100               | Ffx Co Pkwy West      | New     | Fiber            | Existing                       |
| CCTV110  | 55.8     | C187E        | 11   | 68   | C187E             | Vicon  | I-66  | EB     | RT 7100 | Fairfax Co. Pkwy    | FFX Co Pkwy East Side | Rte 50                | New     | Fiber            | Existing                       |

**Table 1: Baseline CCTV Asset Inventory Information (continued)**

| ID       | MILEPOST | CABINET ID | CCTV | ADDR          | CAB ID | PROTCL  | ROUTE  | RT DIR      | CLST RT                  | CLST INT              | NXT RT                   | NXT INT | CONDITN          | CONNECT  | STATUS |
|----------|----------|------------|------|---------------|--------|---------|--------|-------------|--------------------------|-----------------------|--------------------------|---------|------------------|----------|--------|
| CCTV120  | 56.9     | C244E      | 12   | 66 C244E      | Vicon  | I-66    | EB     | RT 50       | Lee Jackson Mem Hwy      | West Ox Rd            | Rte 50                   | New     | Fiber            | Existing |        |
| CCTV130  | 0.0      | C276E      | 13   | 65 C276E      | Vicon  | I-66    | EB     | RT 50       | Lee Jackson Mem Hwy      | Monument Dr           | Rte 50                   | New     | Fiber            | Existing |        |
| CCTV140  | 0.0      | C299E      | 14   | 63 C299E      | Vicon  | I-66    | EB     | RT 50       | Lee Jackson Mem Hwy      | On WB Rte 50          | I-66                     | New     | Fiber            | Existing |        |
| CCTV150  | 0.0      | C386E      | 15   | 61 C386E      | Vicon  | I-66    | EB     | RT 123      | Chain Bridge Rd          | Jermantown Rd         | Chain Bridge Rd          | New     | Fiber            | Existing |        |
| CCTV160  | 0.0      | C397E      | 16   | 60 C397E      | Vicon  | I-66    | EB     | RT 123      | Chain Bridge Rd          | RT 123                | Chain Bridge Rd          | New     | Fiber            | Existing |        |
| CCTV170  | 0.0      | C450E      | 17   | 59 C450E      | Vicon  | I-66    | EB     | RT 123      | Chain Bridge Rd          | RT 123 East of        | Chain Bridge Rd          | New     | Fiber            | Existing |        |
| CCTV180  | 0.0      | C488E      | 18   | 58 C488E      | Vicon  | I-66    | EB     | RT 123      | Chain Bridge Rd          | Blake Lane            | Chain Bridge Rd          | New     | Fiber            | Existing |        |
| CCTV200  | 0.0      | C556E      | 20   | 55 C556E      | Vicon  | I-66    | EB     | RT 243      | Nutley St                | East of Nutley        | Capital Beltway          | New     | Fiber            | Existing |        |
| CCTV210  | 63.6     | C593E      | 21   | 54 C593E      | Vicon  | I-66    | EB     | RT 243      | Nutley St                | Cedar Lane            | Nutley St                | New     | Fiber            | Existing |        |
| CCTV240  | 0.0      | C51        | 24   | 31 C51        | Vicon  | I-66    | EB     | NA          | George Mason Dr.         | NA                    | George Mason Dr.         | Old     | Coax             | Existing |        |
| CCTV290  | 0.0      | C69        | 29   | 34 C69        | Vicon  | I-66    | WB     | RT 29       | Lee Hwy                  | Lee Hwy               | NA                       | Old     | Fiber            | Existing |        |
| CCTV300  | 0.0      | C67A       | 30   | 35 C67A       | Vicon  | I-66    | WB     | RT 29       | Lee Hwy                  | Scott Street          | NA                       | Old     | Fiber            | Existing |        |
| CCTV310  | 0.0      | C65A       | 31   | 33 C65A       | Vicon  | I-66    | WB     | RT 29       | Lee Hwy                  | Spout Run             | NA                       | Old     | Fiber            | Existing |        |
| CCTV320  | 0.0      | C59        | 32   | 32 C59        | Vicon  | I-66    | WB     | RT 120      | Glebe Rd                 | RT 120                | Glebe Rd                 | Old     | Fiber            | Existing |        |
| CCTV330  | 0.0      | C45A       | 33   | 30 C45A       | Vicon  | I-66    | WB     | RT 237      | Washington Blvd          | Sycamore              | NA                       | Old     | Fiber            | Existing |        |
| CCTV340  | 0.0      | C35        | 34   | 29 C35        | Vicon  | I-66    | WB     | RT 693      | WBmoreland St            | RT 693                | Westmoreland /Wash Blvd  | Old     | Fiber            | Existing |        |
| CCTV350  | 0.0      | C20        | 35   | 28 C20        | Vicon  | I-66    | WB     | RT 7        | Leesburg Pike            | RT 7                  | Leesburg Pike            | Old     | Fiber            | Existing |        |
| CCTV370  | 0.0      | C331E      | 37   | 62 C331E      | Vicon  | I-66    | WB     | RT 50       | Lee Jackson Mem Hwy      | Waples Mill Rd        | Rte 50                   | New     | Fiber            | Existing |        |
| CCTV380  | 0.0      | C298E      | 38   | 64 C298E      | Vicon  | I-66    | WB     | RT 50       | Lee Jackson Mem Hwy      | RT 50                 | Lee Jackson Mem Hwy      | New     | Fiber            | Existing |        |
| CCTV390  | 0.0      | C220E      | 39   | 67 C220E      | Vicon  | I-66    | WB     | RT 7100     | Fairfax Co. Pkwy         | West Ox Rd            | Fairfax Co. Pkwy         | New     | Fiber            | Existing |        |
| CCTV400  | 0.0      | C132E      | 40   | 71 C132E      | Vicon  | I-66    | WB     | RT 7100     | Fairfax Co. Pkwy         | South Stringfellow Rd | Sully Rd                 | New     | Fiber            | Existing |        |
| CCTV410  | 54.9     | C134E      | 41   | 72 C134E      | Vicon  | I-66    | WB     | RT 7100     | Fairfax Co. Pkwy         | East of RT 28         | Sully Rd                 | New     | Fiber            | Existing |        |
| CCTV420  | 0.0      | C84E       | 43   | 74 C84E       | Vicon  | I-66    | WB     | RT 28       | Sully Rd                 | RT 28                 | Sully Rd                 | New     | Fiber            | Existing |        |
| CCTV440  | 0.0      | C531W      | 45   | 79 C531W      | Vicon  | I-66    | WB     | RT 29       | Lee Hwy                  | RT 29                 | Lee Hwy                  | New     | Fiber            | Existing |        |
| CCTV450  | 0.0      | C280W      | 46   | 84 C280W      | Vicon  | I-66    | WB     | RT 234      | Sudley Rd                | RT 234                | Sudley Rd                | New     | Fiber            | Existing |        |
| CCTV480  | 0.0      | B091       | 49   | 98 B091       | Vicon  | I-95    | NB     | RT 1        | Richmond Hwy             | RT 1                  | Richmond Hwy             | New     | Fiber            | Existing |        |
| CCTV490  | 0.0      | B065       | 50   | 93 B065       | Vicon  | I-95    | NB     | RT 617      | Fairfax Co. Pkwy         | RT 617                | Fairfax Co. Pkwy         | New     | Fiber            | Existing |        |
| CCTV580  | 0.0      | C168       | 60   | 7 C168        | Vicon  | I-395   | NB     | I-495       | Capital Beltway          | RT 648                | Edsall Rd                | Old     | Fiber            | Existing |        |
| CCTV590  | 0.0      | C164       | 61   | 8 C164        | Vicon  | I-395   | NB     | RT 648      | Edsall Rd                | RT 648                | Edsall Rd                | Old     | Fiber            | Existing |        |
| CCTV600  | 2.0      | C160       | 62   | 9 C160        | Vicon  | I-395   | NB     | RT 648      | Edsall Rd                | RT 236                | Duke St                  | Old     | Fiber            | Existing |        |
| CCTV610  | 0.0      | C157       | 63   | 10 C157       | Vicon  | I-395   | NB     | RT 236      | Duke St                  | RT 236                | Duke St                  | Old     | Fiber            | Existing |        |
| CCTV690  | 0.0      | C122       | 71   | 18 C122       | Vicon  | I-395   | NB     | RT 120      | SB Glebe Rd              | RT 120                | SB Glebe Rd              | Old     | Fiber            | Existing |        |
| CCTV710  | 0.0      | C107       | 73   | 24 C107       | Vicon  | I-395   | NB     | NA          | Army Navy Dr             | RT 27                 | Washington Blvd          | Old     | Fiber            | Existing |        |
| CCTV720  | 0.0      | C96A       | 74   | 26 C96A       | Vicon  | I-395   | NB     | NA          | Boundary Dr              | NA                    | Boundary Dr              | Old     | Fiber            | Existing |        |
| CCTV730  | 0.0      | C99        | 75   | 25 C99        | Vicon  | I-395   | SB     | NA          | Boundary Dr              | NA                    | Army Navy Dr             | Old     | Fiber            | Existing |        |
| CCTV750  | 0.0      | C113       | 77   | 21 C113       | Vicon  | I-395   | SB     | RT 27       | Washington Blvd          | RT 27                 | Washington Blvd          | Old     | Fiber            | Existing |        |
| CCTV780  | 0.0      | B070       | 81   | 94 B070       | Vicon  | I-95    | SB     | RT 642      | Lorton Rd                | RT 642                | Lorton Rd                | New     | Fiber            | Existing |        |
| CCTV790  | 0.0      | B072       | 82   | 95 B072       | Vicon  | I-95    | SB     | RT 642      | Lorton Rd                | RT 642                | Lorton Rd                | New     | Fiber            | Existing |        |
| CCTV810  | 0.0      | B082       | 84   | 97 B082       | Vicon  | I-95    | SB     | RT 1        | Richmond Hwy             | RT 1                  | Richmond Hwy             | New     | Fiber            | Existing |        |
| CCTV820  | 0.0      | B090       | 85   | 99 B090       | Vicon  | I-95    | SB     | RT 1        | Richmond Hwy             | RT 1                  | Furnace Rd               | New     | Fiber            | Existing |        |
| CCTV860  | 0.0      | B122       | 89   | 104 B122      | Vicon  | I-95    | SB     | RT 784      | Dale Blvd                | RT 784                | Dale Blvd                | New     | Fiber            | Existing |        |
| CCTV880  | 0.0      | B136       | 91   | 106 B136      | Vicon  | I-95    | SB     | RT 784      | Dale Blvd                | RT 234                | Dumfries Rd              | New     | Fiber            | Existing |        |
| CCTV900  | 0.0      | B156       | 93   | 108 B156      | Vicon  | I-95    | SB     | RT 234      | Dumfries Rd              | RT 234                | Dumfries Rd              | New     | Fiber            | Existing |        |
| CCTV910  | 0.0      | B164       | 94   | 109 B164      | Vicon  | I-95    | SB     | RT 234      | Dumfries Rd              | RT 619                | Fuller Rd                | New     | Fiber            | Existing |        |
| CCTV920  | 0.0      | B166       | 95   | 110 B166      | Vicon  | I-95    | SB     | RT 234      | Dumfries Rd              | RT 619                | Fuller Rd                | New     | Fiber            | Existing |        |
| CCTV940  | 0.0      | NA         | 97   | 40 NA         | Vicon  | I-95    | NB     | RT 613      | VAN DORN ST              | i-395/495/95          | INTERCHANGE              | Old     | Twisted Pair/Fib | Existing |        |
| CCTV990  | 0.0      | NA         | 103  | 44 NA         | Vicon  | I-95    | SB     | RT 1        | Richmond Hwy             | RT 1                  | Richmond Hwy             | Old     | Twisted Pair/Fib | Existing |        |
| CCTV1000 | 0.0      | NA         | 104  | 43 NA         | Vicon  | I-95    | SB     | RT 611      | Telegraph Rd             | RT 611                | Telegraph Road           | Old     | Twisted Pair/Fib | Existing |        |
| CCTV1010 | 174.0    | NA         | 105  | 42 NA         | Vicon  | I-95    | SB     | RT 611      | Eisenhower Avenue        | 613                   | Eisenhower Avenue        | Old     | Twisted Pair/Fib | Existing |        |
| CCTV1020 | 0.0      | NA         | 106  | 41 NA         | Vicon  | I-95    | NB     | RT 613      | VAN DORN ST              | RT 613                | Van Dorn Street          | Old     | Twisted Pair/Fib | Existing |        |
| CCTV1040 | 0.0      |            | 108  | 117 -1        | Vicon  | I-495   | SB     | Gallows     | Gallows Rd               | RT 50                 | Arlington Blvd           | New     | T-1              | Existing |        |
| CCTV1050 | 44.3     |            | 110  | 119 -1        | Vicon  | I-495   | SB     | RT 738      | Old Dominion             | 738                   | Old Dominion             | New     | T-1              | Existing |        |
| CCTV1030 | 0.0      |            | 107  | 116 -1        | Vicon  | I-495   | SB     | I-95        | Springfield              | Braddock Rd           | Braddock Rd              | New     | T-1              | Existing |        |
| CCTV1060 | 43.5     | None       | 112  | 121 -1        | Vicon  | I-495   | SB     | RT 193      | Georgetown Pike          | River Oaks            | GW Parkway               | New     | T-1              | Existing |        |
| CCTV1055 | 0.0      |            | 111  | 120 -1        | Vicon  | I-495   | NB     | GW Parkway  | GW Parkway               | -1                    | RTE 193, GeorgeTown Pike | New     | T-1              | Existing |        |
| CCTV1070 | 0.0      |            | 113  | 122 -1        | Vicon  | I-495   | NB     | GW Parkway  | GW Parkway               | -1                    | American Legion Bridge   | New     | T-1              | Existing |        |
| CCTV1080 | 7.0      |            | 114  | 123 -1        | Vicon  | DTR     | EB     | RT 645      | Hunter Mill              | -1                    | Wiehle Ave               | New     | T-1              | Existing |        |
| CCTV1090 | 0.0      |            | 115  | 124 -1        | Vicon  | DTR     | WB     | RT 28       | SULLY RD                 | RT 28                 | RT 28                    | New     | T-1              | Existing |        |
| CCTV1045 | 0.0      |            | 109  | 118 -1        | Vicon  | I-495   | SB     | Lewinsville | Lewinsville Rd           | DTR                   | Dulles Toll Road         | New     | T-1              | Existing |        |
| CCTV945  | 0.0      |            | 98   | 115 -1        | Vicon  | I-495   | SB     | Rte 613     | Van Dorn                 | Rte 613               | Van Dorn St              | Old     | T-1              | Existing |        |
| CCTV415  | 0.0      |            | 42   | 73 Cell Tower | Vicon  | I-66    | EB     | RT 28       | Rt. 28                   | West of 7100          | Ffx Co Pkwy              | New     | T-1              | Existing |        |
|          | 0.0      |            | 116  | TBD           | Vicon  | Rt. 236 | Ramp F | I-495       | Ramp F                   | I-495                 | Capital Beltway          | New     | T1 Modem         | Existing |        |
|          | 0.0      |            | 117  | 0 TBD         | Vicon  | Rt. 236 | Medium | I-495       | Little River Turnpike Me | I-495                 | Capital Beltway          | New     | T1 Modem         | Existing |        |

**Table 2: Initial Video Quality Assessment  
(as of July 21/22, 2005)**

| Matrix In/VDOT List | Camera Num | Description from VDOT LIST                   | Server Num/Inpout | VDS System | Dist Amplipout | Camera Housing |              |          | Equipment Make & Model Numbers |                |                |                      | Lens Iris Wiring |        |      | Discrepancies from 7/21 & 7/22 2004   |
|---------------------|------------|--|-------------------|------------|----------------|----------------|--------------|----------|--------------------------------|----------------|----------------|----------------------|------------------|--------|------|---|
|                     |            |  |                   |            |                | Done           | Presaturated | Standard | Camera                         | Lens           | PTZ Unit       | Receiver Driver Unit | Auto             | Manual | Both |   |
| 85                  | 10         | ROUTE 234, SUDLEY RD                         | 01/1              |            | 1/01           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  |        | X    | Lines running through video while panning and tilting   |
| 83                  | 20         | WEST BULL RUN, LEE HWY                       | 20/2              | yes        | 5/02           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 82                  | 30         | REST AREA, LEE HWY                           |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 81                  | 40         | COMPTON RD, LEE HWY                          | 20/3              | yes        | 5/03           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 80                  | 50         | COMPTON RD, LEE HWY                          | 01/2              |            | 1/02           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      |   |
| 78                  | 60         | ROUTE 29, LEE HWY                            | 01/3              | yes        | 1/03           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Lines running through video while panning and tilting. Focus Button also controls Iris - Near will close Iris & Far will open Iris                |
| 77                  | 70         | ROUTE 28, SULLY RD                           | 01/4              |            | 1/04           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 75                  | 80         | ROUTE 28, SULLY RD                           | 11/2              | yes        | 3/10           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      |   |
| 70                  | 90         | N. STRINGFELLOW ROAD                         | 02/1              |            | 1/05           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      |   |
| 89                  | 100        | RT 7100 FFX CO. PKWY WEST                    | 19/1              | yes        | 5/05           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Lines running through video while panning and tilting   |
| 68                  | 110        | FFX CO. PKWY EAST SIDE, RTE 50               |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 66                  | 120        | WEST OX RD, RTE 50                           | 02/2              | yes        | 1/06           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris, Video coloring distorted Green Tint                                  |
| 65                  | 130        | MONUMENT DR, RTE 50                          | 11/3              |            | 3/11           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 63                  | 140        | ON DVW RTE 50, L66                           | 02/3              | yes        | 1/07           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      |   |
| 61                  | 150        | JERMANTOWN RD, CHAIN BRIDGE RD               | 02/4              |            | 1/08           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      |   |
| 60                  | 160        | RT 123, CHAIN BRIDGE RD                      | 11/4              | yes        | 3/12           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 59                  | 170        | RT 123 EAST OF CHAIN BRIDGE RD               | 03/1              |            | 1/09           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 58                  | 180        | BLAKE LANE, CHAIN BRIDGE RD                  | 03/2              | yes        | 1/10           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 56                  | 190        | RT 243, NUTLEY ST                            | 12/1              |            | 3/13           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Controls   |
| 55                  | 200        | EAST OF NUTLEY, L495                         | 12/2              | yes        | 3/14           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 54                  | 210        | L66 CEDAR LANE, NUTLEY ST                    |                   | yes        |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 53                  | 220        | GALLOWAY ROAD, CAPITAL BELTWAY               |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Lines running through video while panning and tilting (Very bad), Auto Iris won't allow lens to open picture dark                                 |
| 27                  | 230        | L495, CAPITAL BELTWAY                        | 03/3              |            | 1/11           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Interference in video faint scrolling lines, no controls  |
| 31                  | 240        | GEORGE MASON DR, T.R. BRIDGE, ARLINGTON BLVD | 19/2              |            | 5/06           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control  |
| 39                  | 250        | LYNN ST, LEE HWY/RTE 29                      | 03/4              | yes        | 1/12           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 38                  | 260        | WESTBOUND, ROSSLYN TUNNEL                    | 12/3              | yes        | 3/15           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 37                  | 270        | EASTBOUND, ROSSLYN TUNNEL                    | 04/1              |            | 1/13           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Video  |
| 36                  | 280        | LEE HIGHWAY                                  | 12/4              | yes        | 3/16           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Doesn't tilt down & No Iris or Zoom Controls  |
| 34                  | 290        | SCOTT STREET                                 | 14/3              | yes        | 4/07           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control  |
| 35                  | 300        | SPOUT RUN                                    | 04/2              | yes        | 1/14           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 33                  | 310        | RT 120, GLEBE ROAD                           | 14/4              | yes        | 4/08           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 32                  | 320        | SYCAMORE                                     | 04/3              | yes        | 1/15           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 30                  | 330        | WESTMORELAND / WASH BLVD                     |                   |            |                |                | X            |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 29                  | 340        | RT 7, LEESBURG PKE                           | 15/1              | yes        | 4/09           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control  |
| 28                  | 350        | VENNA METRO, CHAIN BRIDGE RD                 | 04/4              | yes        | 1/16           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 57                  | 360        | WAPLES MILL RD, RTE 50                       | 15/2              | yes        | 4/10           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Video  |
| 62                  | 370        | RT 50, LEE JACKSON MEM HWY                   | 05/1              | yes        | 2/01           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris, Video coloring distorted Green Tint                   |
| 64                  | 380        | WEST OX RD, FARFAX CO. PKWY                  | 15/3              | yes        | 4/11           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | EXCELLENT CONTROL   |
| 67                  | 390        | SOUTH STRANGFELLOW RD, SULLY RD              | 05/2              |            | 2/02           | X              |              |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris   |
| 71                  | 400        | EAST OF RT 28, SULLY RD                      | 21/4              | yes        | 6/16           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 72                  | 410        | WEST OF 7100, FFX CO. PKWY                   | 15/4              | yes        | 4/12           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris, Out of Focus (Back Focus)  |
| 73                  | 415        | RT 28, SULLY RD                              | 16/3              | yes        | 4/15           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris, Lines running through video while panning and tilting |
| 74                  | 420        | RT 28, SULLY RD                              |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Control Response issues - Starts and doesn't stop   |
| 76                  | 430        | RT 29, LEE HWY                               | 16/2              |            | 4/14           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open Iris, Out of Focus (Back Focus)  |
| 79                  | 440        | RT 234, SUDLEY RD                            | 16/3              | yes        | 5/11           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Video  |
| 84                  | 450        | RT 619, FULLER RD                            | 24/4              | yes        | 6/04           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris, dirty lens cover                                      |
| 111                 | 460        | PR WM PKWY                                   | 24/3              | yes        | 6/03           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 98                  | 480        | RT 1, RICHMOND HWY                           | 24/2              | yes        | 6/02           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 93                  | 490        | RT 617, FARFAX CO. PKWY                      | 18/2              |            | 5/10           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 92                  | 500        | RT 617, FARFAX CO. PKWY                      | 18/1              |            | 5/09           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 91                  | 510        | RT 617, BACKLICK RD                          | 24/1              | yes        | 6/01           |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 1                   | 520        | RT 644, FRANCONIA RD                         |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Lens Functions wrong - Iris and Zoom controls switched  |
| 2                   | 530        | FSP, SOUTH TERMINAL                          |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 86                  | 535        | HOV, ROUTE 644                               |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | EXCELLENT CONTROL   |
| 90                  | 540        | RT 644, OLD KEENE MILL RD                    |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris  |
| 4                   | 550        | COMMERCE ST, L495                            |                   |            |                |                | X            |          | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Control  |
|                     | 562        |  |                   |            |                |                | X            |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control  |
|                     | 564        |  |                   |            |                |                | X            |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control  |
| 5                   | 560        | L495, CAPITAL BELTWAY                        | 14/2              | yes        | 4/06           | X              |              |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      |   |
| 6                   | 570        | L495, CAPITAL BELTWAY                        | 05/3              |            | 2/03           |                | X            |          | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      |   |
| 7                   | 580        | RT 648, EDGALL RD                            | 05/4              | yes        | 2/04           |                | X            |          | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      |   |
| 8                   | 590        | RT 648, EDGALL RD                            | 06/1              | yes        | 2/05           |                | X            |          | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      |   |
| 9                   | 600        | RT 236, DUKE ST                              | 14/1              | yes        | 4/05           |                | X            |          | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Video coloring distorted Blue Tint, wiper in the screen, and no iris controls   |

**Table 2: Initial Video Quality Assessment (continued)  
(as of July 21/22, 2005)**

| Matrix In/VDOT List | Camera Num | Description from VDOT LIST     | Server Num/In/put | VDS System | Dist Amp/In/put    | Camera Housing |          |          | Equipment Make & Model Numbers |                |                |                      | Lens Iris Wiring |        |      | Discrepancies from 7/21 8/22 2004   |
|---------------------|------------|--------------------------------|-------------------|------------|--------------------|----------------|----------|----------|--------------------------------|----------------|----------------|----------------------|------------------|--------|------|---|
|                     |            |                                |                   |            |                    | Done           | Presumpt | Standard | Camera                         | Lens           | PTZ Unit       | Receiver Driver Unit | Auto             | Manual | Both |   |
| 10                  | 610        | RT 236, DUKE ST                | 06/2              |            | 2/06               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls   |
| 11                  | 620        | RT 236, DUKE ST                | 06/3              | yes        | 2/07               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Lens Functions, PTZ Control is very touchy and Very Poor Video   |
| 12                  | 630        | RT 236, DUKE ST                | 13/4              |            | 4/04               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Lines running through video while panning and tilting, no focus or iris control                                 |
| 13                  | 640        | RT 420, SEMINARY RD            |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls   |
| 14                  | 650        | RT 420, SEMINARY RD            | 13/3              | yes        | 4/03               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Lens Functions - Out of Focus (Back Focus)   |
| 15                  | 660        | SEMINARY RD, KING ST           | 06/4              | yes        | 2/08               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls   |
| 16                  | 670        | RT 7, KING STREET              |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 17                  | 680        | SHIRLINGTON                    | 07/11             |            | 2/09               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls, Video coloring distorted Blue Tint   |
| 18                  | 690        | RT 120, SB GLEBE RD            | 21/2              | yes        | 6/14               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Iris Controls  |
| 19                  | 700        | RT 27, WASHINGTON BLVD         |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls, Video coloring distorted Blue Tint, Dirty Lens                                       |
| 24                  | 710        | RT 27, WASHINGTON BLVD         | 21/3              | yes        | 6/15               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Video Interference while using focus buttons, no iris controls  |
| 26                  | 720        | BOUNDRY DR                     | 13/2              | yes        | 4/02               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls, Zoom in/out buttons overreacted  |
| 25                  | 730        | ARMY NAVY DR                   | 07/2              | yes        | 2/10               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 22                  | 740        | RT 27, WASHINGTON BLVD         | 07/3              |            | 2/11               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Focus or Iris Controls   |
| 21                  | 750        | RT 27, WASHINGTON BLVD         |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Auto Iris, nor Iris control  |
| 20                  | 760        | RT 27, WASHINGTON BLVD         |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Iris Controls  |
| 88                  | 765        | RTE 644, OLD KEENE MILL RD     | 07/4              | yes        | 2/12               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 89                  | 766        | RTE 644, OLD KEENE MILL RD     |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 94                  | 780        | RT 642, LORTON RD              | 13/1              | yes        | 4/01               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 95                  | 790        | RT 642, LORTON RD              | 08/1              |            | 2/13               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Pan tilt Control   |
| 96                  | 800        | RT 1, RICHMOND HWY             | 21/1              | yes        | 6/13               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 97                  | 810        | RT 1, RICHMOND HWY             | 08/2              |            | 2/14               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 99                  | 820        | RT 1, FURNACE RD               | 08/3              | yes        | 2/15               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus button will slowly move zoom  |
| 100                 | 830        | RT 123, GORSON BLVD            |                   | yes        |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 101                 | 840        | RT 3000, PRINCE WILLIAM PKWY   |                   | yes        |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Focus or Iris Controls   |
| 103                 | 850        | RT 784 DALE BLVD               |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 104                 | 860        | RT 784 DALE BLVD               | 08/4              |            | 2/16               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | While panning left or down camera moves left & Down simultaneously  |
| 105                 | 870        | RT 234, DUMFRIES RD            |                   | yes        |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Control  |
| 106                 | 880        | RT 234, DUMFRIES RD            | 09/1              |            | 3/01               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open iris, Video coloring distorted Blue Tint |
| 107                 | 890        | WEIGH STATION                  | 09/2              |            | 3/02               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus & Zoom Buttons also controls Iris - Near/In will close Iris & Far/Out will open Iris                      |
| 108                 | 900        | RT 234, DUMFRIES RD            |                   | yes        |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | Focus Button also controls Iris - Near will close Iris & Far will open iris                                     |
| 109                 | 910        | RT 234                         | 20/1              | yes        | 5/01               |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Control  |
| 110                 | 920        | MINE RD                        |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Vicon V390-APT | V1311R               |                  | X      |      | No Iris Controls  |
| 23                  | 930        | I-395                          | 11/1              | yes        | 3/09               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                |                  | X      |      | No Focus or Iris Controls, Video Interference   |
| 40                  | 940        | I-395/495/95, INTERCHANGE      | 22/4              | yes        | 6/12               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Video  |
| 115                 | 945        | RT 613, VAN DORN ST            | 09/3              |            | 3/03               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Video  |
| 45                  | 950        | I-395, WILSON BRIDGE / MD SIDE |                   |            |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 47                  | 960        | RT 210, INDIAN HEAD HWY        | 09/4              | yes        | 3/04               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 48                  | 970        | RT 414, SAINT BARNABUS RD      | 22/3              | yes        | 6/11               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 46                  | 980        | I-295, ANACOSTIA FREEWAY       | 18/4              | yes        | 5/12               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 44                  | 990        | RT 1, RICHMOND HWY             | 10/1              |            | 3/05               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 140                 | 993        | RTE 241, TELEGRAPH RD          | 22/2              | yes        | 6/10               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Video  |
| 141                 | 995        | RTE 1, RICHMOND HWY            | 25/4              | yes        | 7/16 Not installed |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | New Dome with bad video   |
| 142                 | 997        | I-95 WILSON BRIDGE/VIA SIDE    | 10/2              |            | 3/06               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Very dirty bubble   |
| 43                  | 1000       | RT 613, TELEGRAPH ROAD         |                   | yes        |                    |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Iris Controls, Out of Focus (Back Focus)   |
| 42                  | 1010       | RT 613, EISENHOWER AVE         | 22/1              | yes        | 6/09               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | Interference in video rolling white lines, No Focus or Iris Controls  |
| 41                  | 1020       | RT 613, VAN DORN STREET        | 19/3              | yes        | 5/07               |                |          | X        | VC2820                         | Fujinon C10x16 | Pleco Housing  | V1200                | X                |        |      | No Iris Controls, Lost video while panning & very dirty bubble  |
| 116                 | 1030       | RTE 620, BRADDOCK RD           |                   |            |                    | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 112                 | 1035       | RT 236, LITTLE RIVER TURNPIKE  | 10/3              |            | 3/07               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 113                 | 1037       | RT 236, LITTLE RIVER TURNPIKE  | 23/4              |            | 6/08               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Scratched Dirty Bubble  |
| 117                 | 1040       | RT 50, ARLINGTON BLVD          | 25/3              | yes        | 6/07               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 118                 | 1045       | RTE 267, DULLES TOLL RD        | 23/3              | yes        | 6/07               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Scratched Dirty Bubble  |
| 119                 | 1050       | RTE 738, OLD DOMINION          | 25/2              | yes        | 7/14 Not installed | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 120                 | 1055       | RT 180, GEORGETOWN PKE         | 25/1              | yes        | 7/13 Not installed | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 121                 | 1060       | RIVER OAKS, GW PARKWAY         | 23/2              | yes        | 6/06               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Digital Signal (T-1 ?) quality "fair"   |
| 122                 | 1070       | AMERICAN LEGION BRIDGE         | 10/4              | yes        | 3/08               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | Digital Signal (T-1 ?) quality "fair"   |
| 123                 | 1080       | WIEHLE AVE, HUNTER MILL        | 19/4              | yes        | 5/08               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Control, Digital Signal (T-1 ?) quality "fair"   |
| 124                 | 1090       | RTE 28, SULLY RD               | 23/1              |            | 6/05               | X              |          |          | S2-RW23                        | N/A            | Dome S2-PR     | V1311R               |                  | X      |      | No Video  |

In addition, TrafficLand staff performed an evaluation of the CCTV control equipment located inside the Northern Virginia Smart Traffic Center. This included an evaluation of the VICON Matrix Switch and the video handling and communications hardware in the center.

### ***Matrix Switch Assessment***

The Vicon Matrix Switch located at the NOVA STC is currently configured for a maximum of 160 “Camera” Inputs by a maximum of 128 Selectable “Monitor” Outputs (160 X 128). This means that any of the 160 cameras can be displayed on any of the 128 Monitor Outputs.

The system consists of multiple Vicon Matrix 66 Card Cages, each card cage contains up to 8 video switcher cards that accept 32 camera inputs each, for a total capacity of 256 camera inputs and 16 monitor outputs. In the NOVA STC system, 8 card cages are stacked to support 128 monitor outputs and the 160 camera inputs are looped through each of the bays and terminated at the last.

The current Vicon Central Processor Unit (CPU) was modified previously to accommodate for all the pan tilt zoom cameras “PTZ” that were transmitting over the 600 baud coaxial cable. Recently the coaxial cable system was upgraded to a fiber optic network. This fiber optic network should allow the PTZ cameras to operate at a much higher baud rate and alleviate any need to modify a new CPU.

Due to the advanced age of the current VICON matrix, the lack of manufacturer support, and the difficulty in finding spares for the unit, VDOT asked the Project Team to evaluate several options for addressing the Matrix Switch portion of the CCTV subsystem.

***Option #1*** - Purchase (1) additional Vicon V1300 CPU as backup.

***Option #2*** - Purchase a new Vicon V1500 CPU w/Automatic built in Redundancy.

***Option #3*** - Upgrade Matrix from 160 camera inputs to 256 camera inputs.

***Option #4*** – Remove and replace the Vicon Matrix with a new Matrix.

The purpose of the four options is to help the NOVA STC understand the current and future costs associated with expanding the Vicon Matrix, versus replacing the matrix with a newer fully supportable system. The electronics industry is always a changing environment and in many cases older equipment is declared obsolete with no regard for supportability or for compatibility issues.

**Option #1** Purchase (1) additional Vicon V1300 CPU as backup.

The V1300 CPU has been discontinued by Vicon but Trafficland, at the request of the NOVA STC, was able to locate a used unit. The used V1300 needs to be sent to a factory authorized service center for reconditioning and or repairs. This unit should then replace the current operating unit which will be sent back for reconditioning.

In order for either unit to work properly after reconditioning, all of the PTZs and/or receivers/drivers currently running on a 600 baud rate will need to be modified to 4800 prior to installation of the CPU.

In addition, there will be no automated hot swapping of the V1300 CPUs and a technician will be required to manually remove, replace and update the programming should a CPU fail.

This approach is just a temporary fix and does not address the discontinued CPU issue and supportability of this mission-critical equipment. There are also no guarantees that an off the shelf CPU will work properly with the current Lockheed Martin Control Room Software or for how long. Generally used/reconditioned equipment is sold as is or with a minimal warranty period. In this case, ninety (90) days is the expected warranty period.

The cost associated with this option is approximately \$1,000 - \$2,000.

**Option #2** Purchase a new Vicon V1500 CPU w/Automatic built in Redundancy.

This option removes and replaces the old Vicon V1300 CPU with a redundant “Factory New” Vicon V1500 CPU. The V1500 is a two-piece system consisting of a CPU which stores all system configuration information and CDU “Communication Distribution Unit” that communicates to all of the non-network products such as matrix card cages, keyboards and cameras.

The system will consist of two V1500 CPU’s attached to a network hub operating simultaneously and one CDU cage configured with a redundant network card, power supply, serial card, and video card. The CDU will also contain one non-redundant time date title card.

This option addresses the discontinued CPU issue, but there still maybe some issues with an off the shelf product working properly with the current Lockheed Martin Control Room Software.

The cost associated with this option is approximately \$25,000 - \$30,000.

**Option #3** Upgrade Matrix from 160 camera inputs to 256 camera inputs

This option shows the costs associated with expanding the current matrix card cages from 160 camera inputs to 256 camera inputs. Under this option, VDOT would need to be very certain up front that their camera input needs would not exceed 256. In that event, the 257<sup>th</sup> camera added to the system will require a doubling of the current number of matrix card cages. This will also require the addition of more racks, resulting in significant increased costs.

The cost associated with this option is approximately \$35,000 - \$40,000.

**Option #4** Purchase and Install New Matrix Switch

This Option is offered as a value-added alternative to the previous Options. Based upon the comparative cost to expand the existing matrix (Options 2 or 3 above), as well as lack of supportability of the older system versus a new two (2) year factory warranty, we have conducted an assessment of the market and would recommend the removal and replacement of the Vicon Matrix with a new Matrix Switch.

This option shows the costs associated with replacing the current Vicon Matrix with a new Synectics Matrix. The Matrix will be a one-chassis unit configured for 256 camera inputs by 128 monitor outputs (Looping) and will fit in one equipment rack. The system will control the existing Vicon PTZ cameras (Plus numerous others) and readily integrate with the Lockheed Martin Control Room Software.

The cost associated with this option is approximately \$150,000 - \$200,000.

## ***Telecommunications Equipment Assessment***

Like other subsystems in the NOVA STC architecture, the telecommunications system has evolved over time. The last major overhaul converted the field communications system on I-395 inside the Capital Beltway from coaxial cable to fiber optic cable.

As part of the NOVA STC Video Quality Improvement Program, the Project Team made observations of the telecommunications aspects of the CCTV subsystem. These observations took place over numerous periods during the project and may shed light on some of the continuing CCTV communication and control issues that were observed both prior to and after the replacement of the 25 CCTV field devices.

During the initial video quality assessment (see Table 2), the Project Team identified a variety of camera communication and control problems throughout the entire CCTV subsystem. These issues included:

- No focus control
- No iris control
- No PTZ control
- Focus control also controlling iris function
- Focus and zoom control also controlling iris function
- No video control at all

Since the VQIP project focused on the replacement of 25 cameras that were not sending video imagery back to the NOVA STC, these communication and control problems remain for much of the rest of the CCTV system.

In addition, the Project Team identified a number of potential issues affecting CCTV communication and control. These issues include:

- Multiple RS 422 – RS232 – RS422 conversions of the camera control signal between STC workstations and the field cameras themselves.
- Inconsistent wiring of data cables from Vicon Data Units to RS422 – RS 232 converters.
- Reducing the baud rate in the field from 4800 baud to 600 baud to accommodate daisy chain design of field comm. architecture
- Improperly wired jumper cables in CCTV field cabinets between local control cables and fiber optic patch panel.

At this point it is hard to determine the effect of the issues identified above. VDOT should conduct a thorough analysis of the existing communication equipment and wiring to determine if these issues are contributing to diminished CCTV system performance.

### III. CCTV Field Device Improvement

In Phase II of the Work, TrafficLand worked with VDOT staff to determine the CCTV field devices in greatest need of improvement based on the initial survey results. The cameras that were not sending video back to the Smart Traffic Center were selected as the highest priority. This initial group included 25 CCTV field devices.

Table 3 identifies the cameras selected for remediation under this project.

*Table 3: Cameras Selected for Quality Improvement Program*

| Number | Camera | Name                                    |
|--------|--------|---|
| 1      | 160    | I-66 (E/W)- Chain Bridge Rd.            |
| 2      | 270    | I-66 W- Rosslyn Tunnel W                |
| 3      | 280    | I-66 E- Rosslyn Tunnel E                |
| 4      | 470    | I-95 (N/S)- Pr. William Pky. (N/S)      |
| 5      | 520    | I-95 (N/S)- Franconia Rd.               |
| 6      | 590    | I-395 (N/S)- Edsall Rd.                 |
| 7      | 600    | I-395 (N/S)- Duke St.                   |
| 8      | 610    | I-395 (N/S)- Duke St.                   |
| 9      | 620    | I-395 (N/S)- Duke ST.                   |
| 10     | 630    | I-395 (N/S)- Duke St.                   |
| 11     | 640    | I-395 (N/S)- Seminary Rd. (N/S)         |
| 12     | 650    | I-395 (N/S)- Seminary Rd.               |
| 13     | 660    | I-395 (N/S)- King St.                   |
| 14     | 670    | I-395 (N/S)- King St.                   |
| 15     | 680    | I-395 (N/S)- Shirlington Rd.            |
| 16     | 690    | I-395 (N/S)- Glebe Rd.                  |
| 17     | 700    | I-395 (N/S)- Washington Blvd.           |
| 18     | 710    | I-395 (N/S) Washington Blvd.            |
| 19     | 720    | I-395 (N/S)- Boundry Channel Dr.        |
| 20     | 730    | I-395 (N/S)- Boundry Channel Dr.        |
| 21     | 740    | Washington Blvd. (E/W) -; I395          |
| 22     | 750    | I-395 (N/S)- Boundry Channel Dr.        |
| 23     | 760    | I-395 (N/S)- Boundry Channel Dr.        |
| 24     | 930    | Washington Blvd. (E/W) -; I395          |
| 25     | 1080   | Dulles Toll Rd. (E/W) - Hunter Mill Rd. |

VDOT conducted a thorough analysis of various camera manufacturers and products. VDOT evaluated Pelco, COHU and Vicon cameras. VDOT selected the COHU 3925-3100-PEND dome camera for use in this project.

## ***Post-Installation Quality Assessment***

After all improvements and/or CCTV field device replacements were completed, the Project Team conducted a post installation quality assessment to determine the level of quality improvement on the CCTV subsystem and to develop a benchmark for future maintenance of the system (Figure 4).

The field device remediation phase demonstrated a number of difficulties in working with an aging CCTV system. Some of the issues encountered in the field include:

- Interior of camera poles blocked with debris
- Incompatible bolt patterns between old and new camera mounts
- Difficulty in removing old video cable
- Difficulty in pulling new video cable through CCTV poles

As Table 4 shows, once installation of new cameras was accomplished, a second set of issues arose.

- Cameras that had no video before had no video after installation of new camera
- The need to program cameras to interface with different encoders in the field
- Intermittent video being transmitted from field to operations center
- Difficulty controlling camera speed from operations center

**Table 4: Initial Post-Installation Analysis**

| <b>ID</b> | <b>CABINET ID</b> | <b>CAMERA ADDRESS</b> | <b>RTE</b> | <b>DIR</b> | <b>STATUS</b> | <b>POST INSTALATION ISSUES</b>              | <b>COMPLETION DATE</b> |
|-----------|-------------------|-----------------------|------------|------------|---------------|---|------------------------|
| CCTV1080  | N/A               | 123                   | DTR        | EB         | COMPLETED     | STC HAS VIDEO BUT NO CONTROL; ENCODER ISSUE | 12/15/04               |
| CCTV160   | C397E             | 60                    | I-66       | EB         | COMPLETED     | INTERMITTENT VIDEO                          | 11/02/04               |
| CCTV270   | C79               | 37                    | I-66       | WB         | COMPLETED     | QUALITY GOOD                                | 12/07/04               |
| CCTV280   | C74               | 36                    | I-66       | WB         | COMPLETED     | QUALITY GOOD                                | 12/07/04               |
| CCTV470   | B115              | 102                   | I-95       | NB         | COMPLETED     | QUALITY GOOD                                | 12/07/04               |
| CCTV520   | C190              | 1                     | I-395      | NB         | COMPLETED     | STC HAS VIDEO BUT NO CONTROL                | 12/14/04               |
| CCTV590   | C164              | 8                     | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 12/08/04               |
| CCTV600   | C160              | 9                     | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 11/16/04               |
| CCTV610   | C157              | 10                    | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 12/08/04               |
| CCTV620   | C150              | 11                    | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 11/17/04               |
| CCTV630   | C147              | 12                    | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 12/14/04               |
| CCTV640   | C145              | 13                    | I-395      | NB         | COMPLETED     | QUALITY GOOD                                | 12/09/04               |
| CCTV650   | C139              | 14                    | I-395      | NB         | COMPLETED     | POLE BLOCKED                                | 12/09/04               |

|         |      |    |       |    |           |   |          |
|---------|------|----|-------|----|-----------|---|----------|
| CCTV660 | C137 | 15 | I-395 | NB | COMPLETED | QUALITY GOOD                                      | 12/09/04 |
| CCTV670 | C132 | 16 | I-395 | NB | COMPLETED | QUALITY GOOD                                      | 12/14/04 |
| CCTV680 | C128 | 17 | I-395 | NB | COMPLETED | QUALITY GOOD                                      | 12/14/04 |
| CCTV690 | C122 | 18 | I-395 | NB | COMPLETED | QUALITY GOOD                                      | 11/18/04 |
| CCTV700 | C117 | 19 | I-395 | NB | COMPLETED | ADJUST INSTALLATION<br>ANGLE                      | 12/07/04 |
| CCTV710 | C107 | 24 | I-395 | NB | COMPLETED | CAMERA REPORTS<br>ADJUST BALANCE                  | 12/07/04 |
| CCTV720 | C96A | 26 | I-395 | NB | COMPLETED | QUALITY GOOD                                      | 11/18/04 |
| CCTV730 | C99  | 25 | I-395 | SB | COMPLETED | QUALITY GOOD                                      | 11/16/04 |
| CCTV740 | C94  | 22 | US-27 | SB | COMPLETED | QUALITY GOOD                                      | 11/16/04 |
| CCTV750 | C113 | 21 | I-395 | SB | COMPLETED | CAMERA REPORTS<br>TEMP AND PRESSURE               | 12/17/04 |
| CCTV760 | C115 | 20 | I-395 | SB | COMPLETED | QUALITY GOOD                                      | 12/09/04 |
| CCTV930 | C90  | 23 | I-395 | SB | COMPLETED | STC HAS VIDEO BUT NO<br>CONTROL;<br>ENCODER ISSUE | 12/14/04 |

## ***Final Quality Assessment***

After reviewing the immediate post-installation issues with VDOT staff, the Project Team redeployed into the field to address the remaining quality issues. After this second round of field work, the Project Team conducted a final quality assessment of the cameras included in the Video Quality Improvement Project. The results of that final quality assessment are illustrated in Table 5.

Upon completion of the final quality assessment, a few nagging issues remained. These primarily focused on camera control speed and the possibility of a defective camera at Camera 1080 on the Dulles Toll Road.

Initially, the new cameras were set at the maximum speed of Level 15. That speed was ultimately lowered to Level 5 through field testing and control from the NOVA STC control room. NOVA STC operators indicated that the control speed for the new cameras was different depending on whether the camera was being controlled from the integration software or directly from the camera system control keyboard. At the time this report was written, the consensus among those involved in the project was that the issue was likely the result of inconsistent communication protocols inherent in the field architecture such as differing communication baud rates and a multitude of control signal switching points.

These issues would best be addressed by a separate work effort focused on the CCTV system hardware in the operations center and the communication architecture between that hardware and the CCTV field devices.

**Table 5: Final Video Quality Assessment**

| Final Review Date | Text Title Set by Ray                   | Text Title per Meeting with Marlowe on 6/1/05 | PAN | TILT | ZOOM | AUTO FOCUS | IRIS | FLIP | Day/ Night | Remaining Issues  | Final Issues   |
|-------------------|---|---|-----|------|------|------------|------|------|------------|---|--|
| 6/1/2005          | 160 I-66 EAST CHAIN BRIDGE R            | I-66 E CHAIN BRIDGE RD                        | OK  | OK   | OK   | OK         | OK   | OK   | *          | No Auto Focus, Dome Dirty   | Dirty dome is outside the scope of task order.   |
| 6/1/2005          | 270 I-66 WEST ROSSLYN TUNNEL            | I-66 W ROSSLYN TUNNEL                         | OK  | OK   | OK   | OK         | OK   | OK   | *          | Dome Dirty  | Dirty dome is outside the scope of task order.   |
| 6/1/2005          | 280 I-66 EAST ROSSLYN TUNNEL            | I-66 E ROSSLYN TUNNEL                         | OK  | OK   | OK   | OK         | OK   | OK   | *          |   |  |
| 6/1/2005          | 470 I-95 NORTH PR. WILLIAM P            | I-95 N. PR. WILLIAM PKY                       | OK  | OK   | OK   | OK         | OK   | OK   | *          | No Auto Focus   |  |
| 6/1/2005          | 520 I-95 NORTH FRANCONIA RD             | I-95 N. FRANCONIA RD                          | OK  | OK   | OK   | OK         | OK   | OK   | *          | Video too bright at STC- works fine at camera site- comm problem? Per Gerry, not a camera problem- have Marlowe check switch input or gain control on fiber converter | Gerry Amato to work with Marlowe on video brightness issue.  |
| 6/1/2005          | 590 I-395 NORTH EDSALL RD               | I-395 N EDSALL RD                             | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 600 I-395 NORTH DUKE ST.                | I-395 N DUKE ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 610 I-395 NORTH DUKE ST.                | I-395 N DUKE ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 620 I-395 NORTH DUKE ST.                | I-395 N DUKE ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 630 I-395 NORTH DUKE ST.                | I-395 N DUKE ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 640 I-395 NORTH SEMINARY RD.            | I-395 N SEMINARY RD                           | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 650 I-395 NORTH SEMINARY RD.            | I-395 N SEMINARY RD                           | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 660 I-395 NORTH KING ST.                | I-395 N KING ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 670 I-395 NORTH KING ST.                | I-395 N KING ST                               | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 680 I-395 NORTH SHIRLINGTON             | I-395 N SHIRLINGTON                           | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 690 I-395 NORTH GLEBE RD.               | I-395 N GLEBE RD                              | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too slow   |  |
| 6/1/2005          | 700 I-395 NORTH WASHINGTON              | I-395 N WASHINGTON BLVD                       | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 710 I-395 NORTH PENTAGON                | I-395 N PENTAGON                              | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast. Adjust C38 to Balance message. Per Gerry, this is an erroneous text title  |  |
| 6/1/2005          | 720 I-395 NORTH 14 ST BRIDGE            | I-395 N 14 ST BRIDGE                          | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 730 I-395 NORTH BOUNDRY CHAN            | I-395 N BOUNDRY CHANNEL                       | OK  | OK   | OK   | OK         | OK   | OK   | *          |   |  |
| 6/1/2005          | 740 I-395 WEST WASHINGTON BL            | WASHINGTON BLVD E-I-395                       | OK  | OK   | OK   | OK         | OK   | OK   | *          |   |  |
| 6/1/2005          | 750 I-395 BOUNDRY CHANNEL DR            | I-395 N WASHINGTON BLVD                       | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast. Pressure & temp on video. Per Gerry, need to turn Maintenance Mode off.  |  |
| 6/1/2005          | 760 I-395 NORTH BOUNDRY CHAN            | I-395 N WASHINGTON BLVD                       | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too fast   |  |
| 6/1/2005          | 930 I-395 EASTWASHINGTON BLV            | WASHINGTON BLVD EAST - I-395                  | OK  | OK   | OK   | OK         | OK   | OK   | *          | Speed- too slow   |  |
| 6/1/2005          | 1080 DULLES TOLL RD. EAST - HUNTER MILL | DULLES TOLL RD. E. - HUNTER MILL              |     |      |      |            |      |      | *          | Inconsistent video- comm problem? Per Gerry, need to replace camera   | Camera tested ok in field- does not appear to be a bad camera. Data communications problem still exists- outside scope of task. Felix said he would change the Core Tec to see if that corrects the problem. |

## **IV. System Maintenance Issues**

As new CCTV field devices are deployed under this program, it is essential to address the issue of system maintenance to ensure proper operation of the new devices.

### ***Equipment Warranty and Warranty Service***

The COHU cameras used in this remediation program are available with either a two (2) or three (3) year factory warranty. VDOT elected to go with the three (3) year warranty.

Warranty service is provided through the COHU regional sales representative, who is responsible for accepting any defective or malfunctioning equipment and relaying that to COHU for repair or replacement.

One excellent strategy is to purchase additional cameras as spares. If a field device experiences problems, that device can be immediately swapped out for one of the spares. This allows the field technician to determine if in fact the camera was the problem, or if the problem was caused by another component of the system. If the camera is found to be the problem, the DOT experiences minimal downtime for that camera location.

The problem camera unit is then sent back to the manufacturer for repair or replacement. By policy, COHU replaces any defective camera unit with a new unit.

### ***Good Maintenance Practices***

The COHU cameras installed under this project are essentially maintenance-free. One good practice, however, is to periodically clean the glass domes and apply an anti-rain product such as Rain-X™. This will keep the rain from accumulating on the dome and improve visibility.

As the COHU cameras require nothing in the way of specialized maintenance, these units can easily be maintained by DOT staff.

## V. Summary

The VDOT Northern Virginia Video Quality Improvement Program was commissioned as an effort to troubleshoot an aging CCTV subsystem and provide lessons-learned to other DOTs on the issues that they might encounter under a similar effort with their systems.

The assessment and remediation program identified a variety of issues – some addressed under this program, some reserved for future VDOT study.

Some of the lessons learned include:

- Clearly define the work scope and areas of responsibility
  - Who is responsible for issues that may arise outside of the defined scope of work, i.e. issues with the field comm. network?
  - What defines the “end” of the remediation activity?
  - How is quality improvement defined or measured?
  - Who does final acceptance testing?
  - Who is responsible for addressing any problems within the equipment warranty period?
- Set-up weekly technical progress meetings to discuss unexpected issues that arise during field work.
  - Regular communication can help avoid misunderstandings regarding expectations.
- Determine how old field devices will be returned to the agency and taken out of inventory.
  - Most DOTs have inventory control systems and the old CCTV field devices need to be catalogued as they come in from the field and taken out of inventory.
  - How and when does this hand-over of equipment happen?
- Identify any special equipment needs, such as a 45’ bucket truck, to reach higher camera installations.
  - During certain periods of the year, larger bucket trucks are harder to lease, for example, after a major hurricane on the eastern seaboard.