US 36 MANAGED LANE PROJECT – SEGMENTS 1 AND 2
August 2011
CDOT, HPTE, and RTD

INTERGOVERNMENTAL AGREEMENT

THIS INTERGOVERNMENTAL AGREEMENT made this 30th day of August 20__, by and between the State of Colorado for the use and benefit of the Colorado High Performance Transportation Enterprise (HPTE), a division of the Colorado Department of Transportation (CDOT), CDOT, an executive agency of the State of Colorado, and the Regional Transportation District (RTD) a political subdivision of the State of Colorado, 1600 Blake Street, Denver, CO 80202, FEIN: 840597392, and hereinafter collectively referred to as the "Parties."

RECITALS

1. RTD's FasTracks Plan (FasTracks), approved by voters in 2004, includes funding for a Bus Rapid Transit (BRT) along US 36 connecting the existing I-25 HOV lane with managed lanes for buses and autos to Table Mesa in Boulder, Colorado (US 36 Project).

2. RTD and CDOT jointly prepared an Environmental Impact Statement (EIS) under the direction of the Federal Highway and Federal Transit Administrations (FHWA and FTA) for the US 36 Project. A Record of Decision (ROD) was signed by FHWA on December 22, 2009 and FTA on December 22, 2009.

3. RTD, CDOT and HPTE previously entered into an Intergovernmental Agreement dated May 31, 2006 and amended on June 1, 2011 (the I-25 HOV Agreement) for the use of revenues from the managed lane facility on I-25 and, with the authorization of FHWA and FTA, wish to provide for the integration and long term funding and operation of managed lane facilities on US 36 and I-25 and to address the dedication of certain revenues for that purpose.

4. The ROD provides for phased implementation of managed lanes on US 36. RTD, CDOT and HPTE desire to provide for the design, construction, funding and operation of the US 36 Managed Lane Project – Segments 1 and 2 ("Project"), which is a subset of Phase 1 of the ROD, pursuant to the terms and conditions set forth below.

CONDITIONS

A. STATUS OF THE PARTIES

1. The recitals set forth above are incorporated herein by reference.

2. HPTE has applied for a loan from the United Stated Department of Transportation pursuant to the Transportation Infrastructure Financing and Innovation Act (TIFIA) that if awarded will provide sufficient available funds to construct the Project. The Project will

extend from the terminus of the existing managed lanes on US 36 at approximately Pecos Boulevard to Interlocken Boulevard in Broomfield, or further if funds allow, as depicted on **Exhibit A** attached.

3. HPTE was created and authorized pursuant 43-4-806 C.R.S. as amended, in order to finance managed lanes such as those planned for the Project. HPTE will enter into a Master Trust Indenture, dated as of September 1, 2011 ("MTI"), and a TIFIA Loan Agreement, dated as of September 1, 2011 ("Loan Agreement"), relating to the financing of the Project.

4. Pursuant to 43-4-806(i(c)(iii)) C.R.S. as amended, HPTE may contract with other governmental agencies to support HPTE functions.

5. RTD is responsible for developing, maintaining and operating a mass transportation system within the District, pursuant to Sections 32-9-106 and 32-9-107, et seq., C.R.S. as amended.

6. CDOT is a state agency authorized pursuant to 43-1-105 C.R.S. as amended, to plan, develop, construct, coordinate, and promote an integrated transportation system in cooperation with federal, regional, local and other state agencies.

B. ORDER OF PRECEDENCE

In the event of conflicts or inconsistencies between this Intergovernmental Agreement (IGA) and its exhibits, such conflicts or inconsistencies shall be resolved by reference to the documents in the following order of priority:

1. This IGA
2. Exhibit A – US 36 Project Map
3 The I-25 IGA
4. Exhibit B – RTD BRT Project Elements
5. Exhibit C - Concept of Operations for the US 36 Managed Lane
6. Exhibit D - Tolling and Use Policy
7. Exhibit E - Emergency Operations Procedures Manual
8. Exhibit F - RTD Staffing Plan
9. Exhibit G - ITS/Communications Systems Responsibility Requirements
10. Exhibit H – Performance Measures

C. CONSTRUCTION OF THE PHASE I PROJECT

I. CDOT RESPONSIBILITIES

1. CDOT will contract for the design and construction of the Project as generally described in the EIS and approved in the ROD. CDOT will ensure that the BRT elements

including Communications infrastructure and Queue Jumps described in **Exhibit B** attached and required by RTD for operation of the BRT system are included in the Scope of Work for the Project.

2. CDOT will coordinate the procurement process for the design and construction of the Project including preparation of RFP), evaluation criteria, scopes of work, reference documents, and review of all proposer submittals with HPTE and RTD. RTD and HPTE will have the opportunity to review all submittals in coordination with CDOT within the time allowed by the procurement schedule. The parties will agree on the prioritization of Additional Requested Project Elements in the RFP and in the evaluation of proposals. All Parties must approve the RFP prior to publication.

3. CDOT will award a contract for the design and construction of civil and Intelligent Transportation System ("ITS") elements of the Project in forms agreed upon by the Parties. Any contracts for the Project will name RTD and HPTE as third party beneficiaries of the Project. All contracts will require that RTD and HPTE be indemnified and insured to the same extent and in the same amounts as CDOT for all work performed on the Project. CDOT will include the RTD Communications Improvements and Queue Jump Elements specified on **Exhibit B** in contracts awarded for the Project. HPTE has entered into a separate agreement with E-470 Public Highway Authority to manage and maintain tolling customer accounts and perform toll violations processing once the Project is completed.

4. CDOT will provide the Parties with all documents, specifications, and requirements for any equipment required for installation of the elements included in **Exhibit B** to ensure compatibility with all BRT Communications Equipment.

5. CDOT will ensure that TIFIA loan requirements, as they relate to terms and conditions to be included in contracts for the design and construction of the Project, are met.

6. CDOT will be responsible for acquiring all rights of way necessary for the US 36 Project and for compliance with the Uniform Federal Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C.4601, et seq.) requirements.

7. CDOT will be responsible for ensuring compliance with Federal Disadvantaged Business Enterprise requirements in contracts for the Phase I Project. RTD's Workforce Initiative Now (WIN) program as it has been described in the Federal Transit Administration's Innovative Workforce Development Grant Program, and as approved by FHWA, will be included in any contracts awarded for the Phase I Project.

8. CDOT with RTD will provide design and construction management for the Project, and will ensure that all Parties have equal opportunity to participate in construction meetings, and safety meetings and to receive all contractor submittals, test reports, inspection reports, approvals, rejections and other contract and performance documents. CDOT will pay the Contractor(s) for approved work only after written concurrence from the RTD Project Manager.

9. CDOT will maintain all Project documents and make them available for inspection and review by RTD, HPTE and all federal agencies with an interest in the Project for a period of not less than 3 years from completion of the Project.

10. CDOT will ensure that any changes including but not limited to change orders, amendments, schedule adjustments, approved equals, to any contracts awarded for the Project are approved by RTD Project Manager before signing.

11. CDOT will issue final acceptance of work performed under contracts issued for the Project only after it has obtained approvals from RTD.

12. CDOT will require that as built drawings are delivered to RTD in accordance with the US 36 Phase I contract documents.

13. CDOT will designate a Project Director who will serve as liaison to RTD and HPTE who will have primary responsibility for all functions required of CDOT under this agreement except payment of financial obligations and receipt of notices.

II. RTD RESPONSIBILITIES

1. RTD will provide specific design requirements to CDOT for the Communications and Infrastructure and Queue Jumps to be included in the Project 30 days prior to the release of the Project Request for Proposal or as agreed to by both CDOT and RTD.

2. RTD will timely review all plans specifications and other documents submitted to it by CDOT or HPTE for the design and construction of the Project and provide written comments within Project schedule time frames.

3. RTD will designate a Project Manager who will serve as liaison to CDOT and HPTE who will have primary responsibility for all functions required of RTD under this agreement except payment of financial obligations and receipt of notices.

RTD will also designate additional staff as shown in **Exhibit F**. The fully burdened salary rate for the RTD staff assigned to the project are included as part of the original financial commitment from RTD to HPTE and CDOT for the Phase I project. The RTD staff and support costs for this first phase of the US 36 Project are a maximum of $2.3 million which will be reimbursed as Project costs in the amounts shown in **Exhibit F** on an annual basis on presentation of an invoice from RTD to CDOT.

RTD will assign the Deputy Assistant General Manager of Capital Programs as the RTD representative on the Executive Oversight Committee ("EOC"), with full participation in all EOC decision-making aspects of the Project.

4. RTD will inspect all RTD required improvements including those identified in **Exhibit B** to ensure compliance with plans and specifications.

5. RTD will endeavor to support CDOT and HPTE as necessary to obtain a TIFIA loan for the Project, to comply with federal requirements related to any aspect of the Project including EIS and ROD compliance, grant requirements if any are used, TIFIA loan requirements, and any other federal or state requirements necessary for implementation of the Project as a part of the US 36 Project as it was defined in the ROD.

6. RTD will support CDOT and HPTE in integration of the existing North I-25 HOV lane with the US 36 Project, however CDOT and HPTE must ensure the Project does not cause a violation of the level of service requirements of the existing North I-25 HOV lane and the policies and requirements outlined in the Tolling Exhibit, attached as **Exhibit D**.

7. RTD will pay $30 million per year, on or before December 31, 2011, 2012, 2013 and 2014 for a total amount of not more than $120 million for the Project. Payment by RTD shall be subject to annual appropriation by the RTD Board of Directors, and such payments will be included in the annual budget presented by RTD staff to the Board for adoption in November effective January 1 of the following calendar year. Payments will be made for design and construction of the US 36 Project. Contractor default, delay or suspension of the Project or non-payment of the Contractor for any reason in any calendar year will result in a proportional reduction in payments made for construction in that year based on the approved Project schedule and milestones, unless modified by change orders approved by RTD as required by Section I.8. above. CDOT or HPTE shall invoice RTD no later than November 1 of each of those calendar years and shall provide a progress report showing percentage of completed work for the year compared to percentage completion of all work required under contract documents, along with all contractor invoices for the year as back-up. Any delay of invoicing shall result in an equal delay of payment. If payments are delayed, CDOT or HPTE may invoice RTD in 2015 for remaining amounts owed.

RTD will also pay a total of $1.85 million in 2012 for the inclusion of the construction of civil improvements at interchange ramps at Church Ranch and Interlocken as depicted in **Exhibit B**.

8. RTD will be responsible for the operation of all BRT elements on the corridor including elements described in **Exhibit B**. CDOT shall transfer to RTD on final acceptance of the US 36 Project ownership of the fiber optic conduits, cabling, control cabinets and Programmable Information Display System elements specified in **Exhibit B** and assign all warranties associated with such elements to RTD.

9. RTD will provide use (including training and technical support) of Aconex and the RTD Quality Management Oversight (QMO) and RTD Quality Records Database (QRD) programs to CDOT and the Contractor for the duration of the Project. Upon completion of the Project, RTD will provide all quality records from the QMO and QRD to CDOT in a format agreed to by both Parties.

III. HPTE RESPONSIBILITIES

1. HPTE has prepared and submitted a budget and financial plan for the Project for the TIFIA loan agreement and project financing.

HPTE will be responsible for the administration of the TIFIA loan including all accounting, reporting, preparation of draws and other required submittals, document retention, and any and all reporting required thereunder. HPTE will make available to other parties at no cost copies of all TIFIA loan documentation including reports and draw requests.

2. HPTE will be responsible for the contracting for, supervision of and enforcement of all tolling requirements in the managed lanes of the Project.

IV. ADJUSTMENTS TO PROJECT SCOPE AND BUDGET

1. Positive or negative adjustments to the Project may be required due to change in loan amounts, timing of loans, interest rates, bids above or below estimate, or unanticipated events or conditions. Any material adjustments change in the Project budget will be noticed to the Parties through the (monthly) reporting. The Parties' Project Managers shall meet as needed to address changes to the budget that involve changes to the **Exhibit B** work or that require additional funding. Any material adjustments to Project scope or adjustments to budget requiring additional funds for the Parties that the Project Managers recommend will not be adopted unless the governing bodies of the Parties or there designated executives approve such changes and authorize funding.

D. OPERATION OF THE PROJECT

All Parties shall comply with the terms and procedures described in the Emergency Operations Procedures Manual appended hereto as Exhibit E.

I. HPTE RESPONSIBILITIES

1. HPTE shall be responsible for the operation of all tolling equipments and implementation of all tolling requirements on the Project. HPTE shall be responsible for continuing to develop with concurrence of the Parties and monitoring the Concept of Operations Plan appended hereto as **Exhibit C**.

2. HPTE shall be responsible for ensuring that tolling requirements for the Project coordinate with tolling requirements for the existing North I-25 Project and are more fully described in **Exhibit D**. The toll rates for a through trip between US 36/Flatirons and Denver shall not be less than RTD Regional fares during the Peak Period.

3. HPTE shall be responsible for use of and accounting for all revenues for the Project as required by its Master Trust Indenture (MTI) and not withstanding any amendment to the MTI will provide for the following:

- Toll collection cost provided costs are reasonable for the work and meet requirements of the MTI.
- Fees to toll enforcement contractor providing administrative and other services to facility.
- Loan repayment to USDOT (TIFIA), subject to the priorities of the MTI.

- Payment to CDOT Region 6 for services provided for maintenance of the Project consistent with the MTI.
- Creation of a Project Renewal and Replacement Account outlined in terms of the MTI.
- Creation of a System Surplus Fund out of US 36 Project Revenues only and not I-25 Project Revenues for use to complete Phase II of the US 36 Managed Lanes and then for use as described herein.

Any Existing I-25 Express Lanes Excess Revenues (as defined in the MTI dated September 1, 2011) in the I-25 Express Lanes Surplus Account (as defined in the MTI) shall be used as required by the I-25 HOV Agreement. Any Pledged Revenues (as defined in the MTI) in the System Surplus Account (as defined in the MTI) shall be used as required by the MTI; provided that no permitted use under State law then in effect, including for transit purposes in the US 36 corridor, may be made without the consent of RTD.

The TIFIA Loan Agreement dated September 1, 2011 between HPTE and the United States Department of Transportation and the MTI provide that certain revenues from the US 36 Managed Lanes Project, Phase I may be used to complete Phase II of the Project. The Parties agree that all construction of and use of the Phase II Project shall be subject to terms of Exhibits C, D and E and shall include additional compatible BRT elements designed to create a seamless BRT system for both phases. Award of any contract for the Phase II shall require an amendment to this IGA and approval of the Phase II contract by the Parties.

After completion of Phase II of the Project RTD consents to use of surplus revenues for prepayment of the TIFIA loan as provided in the MTI. Any surplus revenues after the TIFIA loan is prepaid will be used based on agreement of the Parties.

4. HPTE shall obtain audits of financial statements as performed by the State Auditor or an independent accounting firm selected and overseen by the State Auditor as required by the MTI. If requested HPTE shall allow any of the Parties, the Federal Transit Administration, the General Accounting Office or any entity under contract to any of them or any other agency of the federal government with oversight over the Managed Lanes to audit the Managed Lanes Facility finances and/or performance with cooperation of HPTE staff at no expense on not more than an annual basis.

5. HPTE shall collect performance data and shall make data available to the Parties monthly. HPTE shall report to RTD quarterly on bus travel times for the measurement area, revenues; vehicle usage by time; accidents; and HOV versus HOT Lane use.

6. HPTE will be responsible for the maintenance of the Managed Lanes portion of the Project except for the RTD Communications Infrastructure and associated station improvements as described in **Exhibit B** and the ITS/Tolling Infrastructure as outlined in **Exhibit G**. HPTE will present an annual proposed budget to RTD for review and comment at least 60 days prior to the start of each HPTE budget year

a. HPTE maintenance responsibilities shall include routine maintenance including but not limited to pavement patching, guard rail repair, barrier separation repair, sweeping, lighting and all other necessary maintenance for operation of the Express Lanes Facility. Snow removal shall be implemented according to the same standards as on all interstate highways maintained by CDOT. RTD and HPTE shall designate emergency maintenance contact personnel on an annual basis. Contact will be made during those events when maintenance performed on the Managed Lanes is not performed as required to maintain safe operations. If HPTE is unable to respond RTD may assume maintenance responsibility for that event. Additional emergency contacts for incident management shall also be designated on an annual basis. All designations shall be by notice pursuant to Notice provisions below.

b. Planned major maintenance which will be agreed upon by the parties as part of annual budget and 6 year capital program presented by HPTE to RTD.

Maintenance funds shall be set aside in a reserve fund maintained by HPTE as described in the original MTI. HPTE will not modify Operation and Maintenance Fund requirements of the MTI without agreement from the Parties.

II. CDOT RESPONSIBILITIES

CDOT will be responsible for the maintenance of the buffer, general purpose lanes and outside shoulder as shown in **Exhibit A.**

III. RTD RESPONSIBILITIES

1. RTD shall be responsible for implementation of the BRT elements shown in **Exhibit B**. RTD may, within its sole discretion, oversee the implementation of additional BRT elements through savings or in coordination with other services provided to service US 36 transit riders.

2. RTD will responsible for maintenance of its Communications Infrastructure and associated station improvements as described in **Exhibits B, and G, and I**.

3. RTD will report to the Parties information on bus travel times obtained from RTD's Automatic Vehicle Locator system provided CDOT and or HPTE informs RTD of the data points, days and times of days for which it wants RTD to collect information. RTD will also provide the information designated as their responsibility under **Exhibit H**. For other data points and times not ordinarily collected by RTD in the normal course of business the Parties shall confer on reasonable periods and frequencies for data collection.

E. USE OF THE MANAGED LANES

All vehicles may use the Managed Lanes under the following conditions:

1. Single occupancy vehicles will be allowed in the Managed Lanes at the toll rates established by HPTE to manage congestion and comply with the requirements of the MTI and this IGA.

2. Vehicles with two or more occupants will be allowed free of charge on the Managed Lanes HOV subject to the provisions of the MTI. Contracts will be entered into and funds provided in the operating budget to properly enforce the occupancy requirements.

3. RTD Buses, RTD ADA vehicles, and RTD contractor operated buses and ADA vehicles ("RTD Buses") will be allowed to use the Managed Lanes without any charge. All designated RTD Buses will be equipped by HPTE, at HPTE's cost, with transponders. Other RTD vehicles may use the Managed Lanes as described in **Exhibit D**.

4. If Managed Lane use exceeds projections and creates congestion on I-25 HOV lane in the such that travel times for RTD Buses fall below target travel times specified in the existing North I-25 HOV IGA Parties will meet and confer on the existing North I-25 Toll Rates and if necessary the US 36 lanes per Section (D)(I)(2) above.

5. CDOT, RTD and HPTE agree that RTD's funding is reasonably related to the overall cost of providing BRT infrastructure on the Project specified in Exhibit B and RTD's right to use the Managed Lanes in perpetuity as provided above. Although ownership of the Managed Lanes will not reside with RTD, RTD's financial contribution to the Project shall not be deemed a local grant to HPTE nor a part of the State's fiscal year spending limitation as described in Article X Section 20 of the Colorado Constitution. Rather, RTD's funds represent payment for BRT infrastructure and its perpetual interest in and right to on-going preferential use of the Managed Lanes for BRT service. Notwithstanding the foregoing, the Parties recognize and acknowledge that RTD's funds are eligible as local matching funds with respect to federal funds used for the Project.

Notwithstanding any other provisions of this IGA, neither payment of funds for construction or maintenance shall be deemed a grant by any of the parties to one another.

F. TERM

This IGA shall be effective on the date shown above. The term of this contract shall continue in perpetuity until amended in writing by the Parties.

G. TERMINATION PROVISIONS

This IGA may be terminated as follows:

Termination for Cause. If, through any cause, one of the Parties should fail to fulfill, in a timely and proper manner, its material obligations under this IGA, the non-violating Parties shall thereupon have the right to terminate this contract for cause by giving written notice to the defaulting party of its intent to terminate and at least thirty (30) days opportunity to cure the default or show cause why termination is otherwise not appropriate. In the event of termination, all finished or unfinished documents, data, studies, surveys, drawings, maps,

models, reports or other material prepared by the defaulting party under this IGA or required under the audit provisions shall be exchanged as required to complete audit and closeout. CDOT acknowledges that once RTD has paid all funds due under this IGA for construction of the managed lanes RTD will have fulfilled its material obligations and this agreement may not be terminated as to RTD's right's hereunder. CDOT and HPTE shall be limited to damages and or injunctive relief against RTD to require fulfillment of remaining obligations.

If after such termination it is determined, for any reason, that the defaulting party was not in default or that the defaulting party's action/inaction was excusable, such termination shall be treated as a termination for convenience, and the rights and obligations of the Parties shall be the same as if the contract had been terminated for convenience, as described herein.

H. LEGAL AUTHORITY

RTD, CDOT and HPTE warrant that they possess the legal authority to enter into this IGA and that they have taken all actions required by their procedures, by-laws, and/or applicable law to exercise that authority, and to lawfully authorize their undersigned signatory to execute this IGA and to bind each party to its terms. The person(s) executing this contract on behalf of each party warrants that such person(s) has full authorization to execute this IGA.

I. REPRESENTATIVES AND NOTICE

All communications relating to the day-to-day activities for the work shall be exchanged between the Project Managers designated by CDOT, HPTE and RTD. All communication, notices, and correspondence shall be addressed to the individuals identified below. Either party may from time to time designate in writing new or substitute representatives.

If to CDOT:

John Schwab
US 36 Project Director
200 S. Holly Street
Denver CO 80222

If to RTD:

Rick Clarke
Assistant General Manager for Capital Programs
RTD-FasTracks
1560 Broadway, Suite 700
Denver CO 80202

If to HPTE:

Michael Cheroutes
Director, HPTE
Colorado Department of Transportation
4201 E. Arkansas Ave.
Denver, CO 80222

J. SUCCESSORS

Except as herein otherwise provided, this contract shall inure to the benefit of and be binding upon the Parties hereto and their respective successor's government entities. No Party may assign its rights to any other person or entity without written authorization of the Parties. Any contractors for the design construction operation or maintenance of the Project shall be managed by the Party responsible for that aspect of performance designated above.

K. THIRD PARTY BENEFICIARIES

It is expressly understood and agreed that the enforcement of the terms and conditions of this IGA and all rights of action relating to such enforcement, shall be strictly reserved to CDOT, HPTE, and RTD. Nothing contained in this contract shall give or allow any claim or right of action whatsoever by any other third person. It is the express intention of the Parties that any such person or entity, other than CDOT, HPTE, and RTD receiving services or benefits under this contract shall be deemed an incidental beneficiary only.

L. GOVERNMENTAL IMMUNITY

Notwithstanding any other provision of this IGA to the contrary, no term or condition of this IGA shall be construed or interpreted as a waiver, express or implied, of any of the immunities, rights, benefits, protection, or other provisions of the Colorado Governmental Immunity Act, § 24-10-101, et seq., C.R.S., as now or hereafter amended. The Parties understand and agree that liability for claims for injuries to persons or property arising out of negligence of HPTE of Colorado, RTD or any of their departments, institutions, agencies, boards, officials and employees is controlled and limited by the provisions of § 24-10-101, et seq., C.R.S., as now or hereafter amended as to CDOT/HPTE and the risk management statutes, §§ 24-30-1501, et seq., C.R.S., as now or hereafter amended.

M. SEVERABILITY

To the extent that this IGA may be executed and performance of the obligations of the Parties may be accomplished within the intent of the contract, the terms of this IGA are severable, and should any term or provision hereof be declared invalid or become inoperative for any reason, such invalidity or failure shall not affect the validity of any other term or provision hereof.

N. WAIVER

The waiver of any breach of a term, provision, or requirement of this IGA shall not be construed or deemed as a waiver of any subsequent breach of such term, provision, or requirement, or of any other term, provision or requirement.

O. ENTIRE UNDERSTANDING

This IGA is intended as the complete integration of all understandings between the Parties. No prior or contemporaneous addition, deletion, or other amendment hereto shall have any

force or affect whatsoever, unless embodied herein by writing. No subsequent novation, renewal, addition, deletion, or other amendment hereto shall have any force or effect unless embodied in a writing executed and approved by the Parties.

P. SURVIVAL OF CONTRACT TERMS

Notwithstanding anything herein to the contrary, the Parties understand and agree that all terms and conditions of this IGA and the exhibits and attachments hereto which may require continued performance, compliance or effect beyond the termination date of the IGA shall survive such termination date and shall be enforceable by the parties as provided herein in the event of such failure to perform or comply by HPTE, CDOT, or RTD.

Q. MODIFICATION AND AMENDMENT

This IGA is subject to such modifications as may be required by changes in federal or State law, or their implementing regulations. Any such required modification shall automatically be incorporated into and be part of this IGA on the effective date of such change as if fully set forth herein.

The Parties may expand, revise or adjust the exhibits attached hereto by the initialing of substitute exhibits by all Parties without other action to effect such amendments to exhibits. On substitution, they shall be incorporated herein with the same effect as previous forms of exhibits.

Except as provided above, no modification of this contract shall be effective unless agreed to in writing by the Parties in an amendment to this IGA that is properly executed and approved in accordance with applicable law.

R. DISPUTES

Any provision of this agreement requiring concurrence, approval, agreement, or authorization (agreement) by any or all of the Parties, and for which agreement is not given within the time specified shall be resolved pursuant to this section. The Parties shall resolve disputes regarding all items in this IGA at the lowest staff level possible. The escalation process shall be:

- Project Director for CDOT and Project Manager for RTD
- CDOT Executive Director, RTD General Manager and HPTE Director
- RTD Board of Directors, CDOT Transportation Commission and HPTE Board of Directors

Resolution of any dispute that may result in loss of federal funds that may be used for the Project or request for return of funds by any federal agency including Federal Transit Administration or Federal Highway Administration shall require concurrence by the

appropriate federal agency(ies) in addition to RTD and CDOT and shall not be binding until concurrence is obtained.

THE PARTIES HERETO HAVE EXECUTED THIS CONTRACT

REGIONAL TRANSPORTATION DISTRICT

By: _____
Phillip A. Washington
General Manager

Approved as to legal form for RTD:

By: _____

HIGH PERFORMANCE TRANSPORTATION ENTERPRISE:

By: _____
Michael Cheroutes
Director

COLORADO DEPARTMENT OF TRANSPORTATION

By: _____
Donald Hunt
Executive Director

EXHIBIT A

US 36 Project Map(s) – Project and future Corridor Projects

EXHIBIT B

RTD BRT PROJECT ELEMENTS

The following BRT elements will be included in the Request for Proposals (RFP) scope of work:

1. **Communications infrastructure**
    a. **Fiber Optic**
        i. Provide 2 backbone conduits (1–7 tube micro-duct, 1-3" HDPE) along US36 extending from CDOT Node # 1 (West 38th Avenue and Fox Street in Denver)to the Table Mesa Park-n-Ride in Boulder and the associated fiber optic cabling. Provide interface manholes at regular intervals in accordance with the project and RTD specifications. Provide separate secure CDOT and RTD pull boxes at each hand hole location.
        ii. Provide additional interface manholes along the trunk line at all the transit stations with 2-2" lateral conduits and associated 24-strand fiber optic cabling to the bus loading platforms on each side of the highway. These transit stations include Westminster Center (Sheridan Blvd & US36), Church Ranch (104th Avenue & US36), Broomfield (116th Avenue & US36), Flatiron (Interlocken & US36), McCaslin (McCaslin Blvd & US36), and Table Mesa (Table Mesa Drive & US36). Lateral conduits shall extend under the US36 on/off ramps to the outside of the platform with interface manholes at the platforms located in coordination with RTD.
        iii. Provide RTD ITS equipment at each transit station as specified in Appendix A – RTD US36 BRT Network Equipment List to this section. ITS equipment shall be located such that is out of the roadway clear zone and accessible for maintenance. Communications cabinets shall be located within 300 feet of the station platform.
        iv. Specific Pull Locations;
            1. **Westminster Station**: Lateral fiber line to be installed into the Westbound (WB) station security room located on the first floor of the parking garage. Additional lateral Line needs to be installed from the security room to the new Eastbound (EB) station control cabinet.
            2. **Church Ranch Station**: Lateral fiber line to be installed into the Westbound (WB) station control cabinet. Additional lateral Line needs to be installed from the WB station control cabinet to the new Eastbound (EB) station control cabinet.
            3. **Broomfield Station**: Lateral fiber line to be installed into the EB station security room located at the Pedestrian Bridge. Additional lateral line to be installed from EB station security room to the WB security room located at the pedestrian bridge.
            4. **Flatirons Station**: Install lateral fiber line to new control cabinet at WB Station. Existing communication room to be demolished by others.

Provide additional lateral line from WB control cabinet to new EB control cabinet.

5. **McCaslin Station**: Lateral fiber line to be installed into the WB station security room located at the Pedestrian Bridge. Additional lateral line to be installed from WB security room to the new EB control cabinet.
6. **Table Mesa Station**: Construct new node facility in existing Table Mesa parking garage adjacent to existing security room (located in basement level). Lateral fiber line and conduit to be installed to base of PIDS at WB and EB stations.

b. Programmable Information Display System (PIDS) Signage

i. Provide and install 2 PIDS signs at each transit station (1 per bus loading platform in each direction for a total of 12 for the project) and the associated support infrastructure including cabling, power, and mounting equipment. Locations shall be approved by RTD.

ii. PIDS support equipment (including mounting hardware) shall be compatible with existing RTD equipment and approved by RTD. Provide a lump sum PIDS spare parts allowance in the amount of $25,000 to be determined by RTD prior to project completion.

iii. All PIDS to be enclosed in a protective and temperature controlled case. Cases shall be compatible with existing RTD equipment.

iv. Lateral fiber line and conduit to terminate at PIDS mounting station. All PIDS shall be connected to lateral fiber line via Ethernet connection.

v. Provide a canopy above PIDS of adequate size to protect against adverse weather conditions and direct sunlight. Canopy design to match materials and architectural style of existing RTD standards and shall be submitted to RTD for approval. PIDS may be attached to canopy pole. All PIDS to be installed facing to the North, if possible, and away from oncoming highway traffic. The PIDS sign locations at each transit station shall be coordinated with RTD.

vi. Remove existing VMS signage located in applicable bus shelters along each transit station. Return all equipment to RTD upon removal.

vii. PIDS shall be 55” diagonal screen size and mounted 12 feet above finished grade at a 27.5 degree angle.

2. Signage

a. Provide and install MUTCD compliant Bus Rapid Transit (BRT) way-finding signage along US36 and the associated interchanges. Signage placement to provide direction to the respective RTD BRT transit stations. Way-finding signage plans and locations shall be approved by RTD.

b. Provide and install signage along the US36 managed lanes indicating the lane is for BRT/HOV/Toll use. BRT signage shall be approved by RTD.

3. Queue Jumps

a. US36 Eastbound and Westbound on-ramps at the 104th Avenue/Church Ranch Exit

i. Design and Construct RTD BRT queue jumps infrastructure consisting of widening the existing ramp to the outside to accommodate the queue jump and BRT/HOV Bypass lane with any associated modifications to the existing ramp metering to accommodate the ramp metering by-pass lanes.
ii. Minimize impacts to adjacent ROW and wetlands.
iii. Minimize reconstruction at all stations.

b. US36 Westbound on-ramp at the Interlocken Exit
    i. Design and Construct BRT/HOV lane consisting of adding an additional lane for exclusive BRT/HOV use to by-pass the ramp metering and any associated modifications to the existing ramp metering to accommodate the ramp metering by-pass lane.

c. Minimize impacts to adjacent ROW and wetlands.If any RTD BRT stations are impacted by the roadway improvements, construct the relocated station elements in accordance with the RTD Bus Transit Facility Design Guidelines and Criteria. Reuse of existing fixtures will be acceptable provided the fixtures are in a like-new condition and meet the current criteria required in the RTD Bus Transit Facility Design Guidelines.

DRAFT

CONCEPT OF OPERATIONS FOR THE US 36 MANAGED LANE

Prepared for:

The Colorado Department of Transportation (CDOT)

Prepared by:

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Version 1.2

August 4, 2011

DOCUMENT VERSION CONTROL

Document Name	Submittal Date	Version No.
Concept of Operations – First Draft	June 2, 2011	1.0
Concept of Operations – Second Draft	July 5, 2011	1.1
Concept of Operations – Third Draft	**August 4, 2011**	**1.2**

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1 PURPOSE OF DOCUMENT

The planned reconstruction of US 36 will extend the existing High-Occupancy Vehicle (HOV) lane west of Federal Boulevard and convert it into two single Managed Lanes. Single-Occupancy Vehicle (SOV) users may utilize the managed lane if they pay a toll while HOV users will be able to utilize the lane for free.

The purpose of this Concept of Operations is to describe the characteristics of the managed lane system from the perspective of the operator, the Colorado Department of Transportation and High Performance Transportation Enterprise (HPTE), and the user. It will serve as a high-level conceptual guide for the design, implementation, and operation of the US 36 managed lane system. This plan identifies the design and operations alternatives, and evaluates them against the project goals to identify a preferred alternative. Guidance on key elements, such as ingress and egress design, electronic toll collection system requirements, ITS equipment requirements, traffic data collection, and enforcement options are included. Information provided in the Concept of Operations will be used in the preliminary design and will aid in preparing procurement documents for the design/build project.

The Concept of Operations document will not provide guidance on pricing strategies, policies, signing and striping beyond basic concepts, implementation and maintenance, and incident management. These elements are being completed outside of this document effort.

2 SCOPE OF PROJECT

The US 36 Managed Lanes/Bus Rapid Transit (BRT) Project (Project) involves the creation of managed lanes along US 36 from I-25 to potentially as far west as the City of Boulder. The exact extents of this project will depend on the amount of infrastructure the selected design/build team can construct with the available funding. The Concept of Operations document will encompass the entire corridor covered by the Environmental Impact Statement (shown in Figure 1) which extends from I-25 to Foothills Parkway in the City of Boulder. The Colorado Department of Transportation (CDOT) will be responsible for the design and construction of the new facility as well as maintenance of the facility and ITS infrastructure. The High Performance Transportation Enterprise (HPTE) will provide a portion of the funding for the project and be responsible for the management and operation of the managed lanes including the tolling system. It is planned that the E-470 Public Highway Authority will provide back office support to process and issue tolls, as well as collect payment.

This portion of US 36 was selected for managed lane implementation because it currently experiences significant traffic congestion, especially during morning and evening peak periods. The facility provides direct access to the City of Boulder, downtown Denver, and other high employment areas in between. Implementation of the managed lanes will result in a more efficient use of available roadway capacity to improve traffic flow and reduce travel times in the corridor. In addition, the managed lane will support Bus Rapid Transit (BRT) along the corridor and provide more consistent transit travel times for the many express transit routes that currently serve the corridor.

Currently, the existing HOV lanes provide access to/from the reversible managed lane that connects US 36 with the I-25 Express Lanes. Under the new managed lane configuration all eligible users (HOVs, registered hybrid vehicles, motorcycles, buses and toll-paying SOVs) will be able to access the managed lane at designated ingress/egress points.

The following basic assumptions will be utilized in developing the Concept of Operations document:

- The managed lane is designed to operate 24 hours a day, seven days a week.
- Access points to and from the managed lane will be limited to designated locations.
- Assessed toll will initially be variable based on time-of-day to ensure that the managed lane traffic flow will be maintained at an appropriate level of service. Intelligent Transportation System (ITS) infrastructure, however, will be put in place to support a migration to a dynamic pricing model.

- Tolling rates will be posted on highly visible Variable Toll Message Signs (VTMS) which will be located upstream from the ingress/egress points to the managed lane allowing SOV motorists to choose whether or not to use the excess capacity in the lane for the posted toll rate.
- Additional static signs will clearly identify the ingress and egress points of the managed lane.
- The tolling operation will be fully electronic with no means for cash payments in the lanes.
- The implementation will support and be consistent with the recommendations of the *US 36 Environmental Impact Statement* (EIS).

Figure 1 Project Limits

3 PROJECT GOALS AND OBJECTIVES

The proposed US 36 managed lane system will offer more choices to commuters and make the best use of available freeway capacity. The project has several key goals which include:

- Utilize managed lanes to improve flow in the general purpose lanes and thereby improve travel along the corridor for all roadway users;
- Provide a means for public transit to achieve better on-time performance by removing them from the congestion in the general purpose lanes; and,
- Encourage alternate modes by free use of the managed lane for public transit and HOV users;
- Encourage the further economic growth in the corridor by providing a more efficient transportation system.

4 REFERENCE DOCUMENTS

The following are reference documents upon which this document is based:

- *US 36 Final Environmental Impact Statement (FEIS)*, US Department of Transportation, October 2009.
- *US 36 Record of Decision,* December 2009.
- *US 36 EIS: ITS and Engineering Elements – Implementation Plan for Managed Lanes*, Apex Design PC, December 2008.
- *US 36 Tolling & Revenue Study*, Wilbur Smith Associates
- *US 36 Ramp Metering Feasibility Study*, Apex Design PC, 2005.
- *Manual on Uniform Traffic Control Devices (MUTCD),* Federal Highway Administration, 2009.
- *A Policy on Geometric Design of Highways and Streets*, 5th Edition, American Association of State Highway and Transportation Officials, 2004.
- *Highway Capacity Manual*, Transportation Research Board, 2000.

5 EXISTING CONDITIONS

US 36 is a key transportation facility in the Denver Metro Area connecting downtown Denver with the City of Boulder and many of the northwest suburbs. There are significant employment centers along this facility which draw residents from all over the Denver Metro Area. This results in high peak-hour demand that has slowly increased the amount of congestion along the facility. Projections of the future peak-hour highway conditions show increased congestion in the corridor. The traffic analysis in the *US 36 FEIS* indicates that without improvements, traffic along several sections of US 36 in 2035 would be worse than CDOT's LOS D goal for urban area highways. Traffic on US 36 would exceed what the system can accommodate, resulting in traffic backups onto local streets. The following sections describe in more detail the current conditions along US 36 related to ITS and tolling.

5.1 EXISTING MANAGED LANES

There is one existing buffer/barrier-separated HOV lane in each direction along US 36 from I-25 to Pecos Street that provides access to the I-25 Express Lanes via a reversible lane. The I-25 Express Lanes begin at US 36 and extend south for approximately four miles to downtown Denver. Figure 2 shows the extent of the I-25 Express Lanes. Two lanes are provided in the Express Lanes, one for HOV vehicles and one for SOV vehicles that are assessed a toll. The lanes are separated from the general purpose lanes with a concrete barrier. HPTE operates the lanes which are open from 5 a.m. to 10 a.m. in the southbound direction and from 12 p.m. to 3 a.m. in the northbound direction.

5.2 ENFORCEMENT

Enforcement along US 36 is currently carried out by the local agencies. Although the Colorado State Patrol (CSP) has jurisdiction to patrol US 36, their current patrol boundary ends at Pecos Street. There are no dedicated enforcement areas along the facility. Law enforcement stops are currently done on the paved right-hand shoulder.

The I-25 Express Lanes currently enforce HOV occupancy via the CSP under a 5-year contract with HPTE that is renewed each year. Officers enforce the facility daily for at least 50 percent of the morning and evening peak hours (6:00 a.m. to 10:00 a.m. and 2:00 p.m. to 6:00 p.m.). These shifts are in addition to the regular patrols, and are therefore considered overtime. Personnel are switched every four weeks to minimize driver expectancy. Officers patrolling the Express Lanes do not generally respond to other calls, but if they do, their time is not charged to CDOT.

5.3 TOLLING INFRASTRUCTURE

Along with the I-25 Express Lanes, there are two other toll facilities in the Denver Metro Area. These are the Northwest Parkway north of US 36 and E-470 in the eastern portion of the Metro Area. All of the facilities are interoperable with the automatic

vehicle identification being branded as ExpressToll. The E-470 Public Highway Authority issues the transponders and manages all of the customer accounts for all toll facilities. The following describes the electronic toll collection technologies and policies that are currently in place for each facility:

- **I-25 Express Lanes:** The I-25 Express Lanes is a two-lane reversible facility that segregates vehicles into one lane for HOV vehicles and one lane for SOV vehicles at the tolling point. There is one gantry along the seven mile segment where vehicle transponders are read and SOVs are assessed a toll. All vehicles in the HOV lane with transponders are read but are not assessed a toll, while all vehicles in the SOV lane are read and tolled. When E-470 converted their system to all-electronic, the option for license-plate tolling (LPT) was added for SOVs. Currently the base toll rates for both transponders and LPT are the same but it is expected that action will be taken in the near future to match of the E-470 approach of a higher toll rate for LPT. Access to the Express Lanes is controlled by automatic gates located along I-25 in the northbound direction and along US 36 at Pecos Street in the southbound direction. Three Variable Message Signs (VMS) are located along US 36 to provide eastbound drivers along US 36 with information regarding the I-25 Express Lanes (such as open/closed status and toll rate).

- **Northwest Parkway:** Northwest Parkway is a four-lane freeway toll facility that provides access from US 36 to I-25. All vehicles using the facility are assessed a toll, regardless of whether they are SOV or HOV. Northwest Parkway is a 100 percent electronic facility. At the mainline, the same fee is charged for both transponders and LPT. A 10 percent discount is offered at the ramps for customers with transponders and for LPT customers who have an automatic billing account. .

- **E-470:** E-470 is a four-lane freeway toll facility that serves as a regional connector in the eastern portion of the Denver Metro Area. The facility provides direct access to I-25, I-70, C-470, and Pena Boulevard and connects with the Northwest Parkway. As with Northwest Parkway, all vehicles using the facility are assessed a toll, regardless of whether they are SOV or HOV. Transponders are encouraged and read by electronic tolling equipment. For users without transponders, video license-plate tolling is used and the toll rate has a premium of approximately 25 percent over the transponder rate.

Figure 2 I-25 Express Lanes

I-25 HOV/Tolled Express Lane
Corridor Map

5.4 MAINTENANCE

Maintenance of the roadway and ITS facilities along US 36 is currently performed by CDOT Regions 4 and 6 and CDOT ITS. Maintenance of the I-25 Express Lanes is currently performed by a combination of CDOT Region 6, a private maintenance company, and CDOT ITS with the tolling equipment maintained by HPTE through an agreement with E-470.

5.5 INTELLIGENT TRANSPORTATION SYSTEM (ITS) INFRASTRUCTURE

There are various ITS components currently utilized along the US 36 corridor. These include:

- **Closed Circuit Television (CCTV) Cameras:** The corridor has a total of 15 existing CCTV cameras. The cameras are used for monitoring travel conditions in the corridor, such as weather conditions, accidents, traffic congestion, and other events (reversible gate closure/opening). The video images are also shared with the public via the internet (www.CoTrip.org) and television news agencies.

- **Variable Message Signs (VMS):** There are a total of seven existing VMS in the US 36 corridor used by CDOT. Three are in the westbound direction and are primarily located in the western portion of the corridor. The remaining four are in the eastbound direction with three of them clustered in the eastern portion of the corridor. The three easternmost VMS are exclusively used to provide information to eastbound drivers regarding whether or not the reversible I-25 Express Lanes are open. All VMS are also used for a wide range of other purposes, including providing driver information regarding weather advisories, amber alerts, and construction and incident notifications.

- **Microwave Vehicle Radar Detectors (MVRD):** MVRD, also referred to as side-fire radar, are used to measure volume, occupancy, speed, and classification in each lane of travel. There are five MVRD units along the corridor. A single unit can generally measure all lanes of travel in both directions, unless there is significant grade separation or obstructions. The data is used primarily for measuring and analysis of traffic conditions, both in real-time and for studies. The data can be connected to other devices or alarms to trigger an action when volumes, occupancy, or speed extend beyond a predefined threshold.

- **Travel Time Indicators (TTI):** TTI sites are comprised of 900MHz antennas and readers that detect Title 21 toll tag transponders in vehicles, as used on the E-470, Northwest Parkway, and the I-25 Express Lanes toll facilities. While MVRD units give volume, occupancy, and speed data at a given point, the TTI are used to track vehicle travel times across segments spanning from one TTI location to the next. There are 10 TTI segments within the corridor (Pecos Street, Sheridan Boulevard, Wadsworth Boulevard, McCaslin Boulevard, and Foothills Parkway). The data is used in a custom algorithm CDOT developed to estimate travel time in each segment. Travel times for different segments are posted online at www.CoTrip.org.

- **Automatic Traffic Recorder (ATR):** There are two existing CDOT Region 6 ATR stations along US 36, both in the westbound direction. ATR stations are permanent counting stations that continuously collect vehicle volume and functional classification data. Data collection is performed by piezoelectric loops and is transmitted back to CDOT Region 6 for processing and analysis.

- **Permanent Traffic Counting Stations:** There are two existing permanent traffic counting stations along US 36, one in each direction, that collect traffic count data collected by CDOT's Division of Transportation Development (DTD). The counting stations continuously collect vehicle volume and functional classification data using in-pavement loops. The data is downloaded manually by DTD staff.

- **Doppler:** There are currently 14 Doppler units operating within the US 36 corridor. These are self-contained, solar-powered units that collect point travel data and transit it wirelessly to their manufacturer SpeedInfo. The data is then sold to CDOT, broadcast media, online services, and other entities.

- **Wireless:** The existing communication network along the US 36 corridor consists of both a wireless backbone that extends the full extent of the corridor and wireless laterals that are used to connect the various ITS devices to the wireless backbone. It is expected that the project will extend fiber that will connect to Node 2 and the Colorado Transportation Management Center (CTMC). The wireless backbone will be replaced.

- **Ramp Meter Stations (RMS):** There are currently 10 RMS operating within the US 36 corridor:

    - Eastbound on-ramp at the Pecos Street interchange (Region 6)
    - Eastbound on-ramp at the Federal Boulevard interchange (Region 6)
    - Eastbound on-ramp at the Sheridan Boulevard interchange (Region 6)

- Eastbound on-ramp at the 104th Avenue interchange (Region 6)
- Eastbound on-ramp at the Wadsworth Boulevard interchange (Region 6)
- Eastbound on-ramp at the Foothills Parkway interchange (Region 4)
- Westbound on-ramp at the Sheridan Boulevard interchange (Region 6)
- Westbound on-ramp at the 104th Avenue interchange (Region 6)
- Westbound on-ramp at the Interlocken interchange (Region 4)
- Westbound on-ramp at the McCaslin Boulevard interchange (Region 4)

The RMS help control the number of vehicles entering US 36 when the highway experiences congestion.

The table below provides a brief summary of the existing ITS components currently utilized along the US 36 corridor:

ITS Device	Westbound	Eastbound	Total
Closed Circuit Television (CCTV) Camera	6	9	15
Variable Message Sign (VMS)	3	4	7
Microwave Vehicle Radar Detector (MVRD)	2	3	5
Travel Time Indicator (TTI)	5	5	10
Ramp Meter Station (RMS)	4	6	10
Automatic Traffic Recorder (ATR)	2		2
Permanent Traffic Counting Stations			2
Doppler			14
Wireless			6
Total ITS Devices			**71**

- **Other Communications Infrastructure:** All ITS devices in the corridor are connected via a mix of wireline and wireless backbone along US 36. Data is sent to and from field devices to the Node 2 regeneration building, the CTMC, and CDOT Region 6. There is existing fiber in a 3-conduit duct bank extending from Node 2 west to Sheridan Boulevard. However, since the Project will begin at Federal Boulevard, it is expected that all fiber west of Federal Boulevard will be

replaced. In addition, there is empty conduit located along the north side of US 36 between Wadsworth Boulevard and 88th Street. It was installed by CDOT in partnership with the Boulder Valley School District and may be available.

- **ITS Software:** There are several existing software programs used to assist with ITS infrastructure maintenance and operations.
  - **Colorado Transportation Management Software (CTMS**): CTMS is a customized software application that integrates various ITS devices into a single program. The software resides at the CTMC and is used to post messages to the various VMS. The program is also used to collect and assemble the TTI, MVRD, and RMS data, and then disseminate this information to the traveling public.
  - **Camera Cameleon ITS Client:** The Camera Cameleon ITS client is a software program used to view and control CCTV surveillance cameras. There are client versions of the software at CTMC, CDOT Region 6, and other agencies.
  - **Camera Cameleon ITS Client (HOV software):** Camera Cameleon ITS Client (HOV software) is a version of Camera Cameleon customized for the I-25 Express Lanes. This software resides at CDOT Region 6, and Nodes 1 and 2 regeneration buildings. The software controls the HOV VMS and automatic gates.

5.6 ROLES AND RESPONSIBILITIES

There are many stakeholder groups that will have a role in the design, construction, maintenance, financing, and operation of the proposed managed lane facility. These groups, along with their responsibilities relating to ITS and tolling, are discussed below:

- **HPTE:** HPTE has the responsibility for managing and operating the I-25 and future US 36 toll facilities. They will provide a critical portion of the funding for the managed lane project through a Transportation Finance and Innovation Act (TIFIA) loan from the United States Department of Transportation(USDOT) backed by US 36 toll revenues. Once the loan is approved and financing for the project is secured, HPTE will partner with CDOT engineering and construction staff to execute the project.

- **CDOT ITS:** The CDOT ITS branch will operate and maintain the existing and proposed ITS infrastructure along US 36. This includes many of the ITS elements discussed in Section 5.5 but will not include the tolling equipment.

- **CDOT Headquarters:** The Division of Transportation Development (DTD) and CDOT Staff Traffic and Safety are located at CDOT Headquarters. The DTD will maintain the existing permanent traffic counters. CDOT Staff Traffic and Safety, who oversees all safety programs throughout the State, will evaluate safety performance in the corridor.

- **CDOT Region 4:** CDOT Region 4 will operate and perform general maintenance of the US 36 facility west of Wadsworth Boulevard. Region 4 will also be involved in the design and construction of the Project.

- **CDOT Region 6:** CDOT Region 6 will operate and perform general maintenance of the US 36 managed lane facility. They will continue to be responsible for opening and closing the I-25 Express Lanes (under an agreement with HPTE), and ensure that the existing and new VTMS are operational. Region 6 will also oversee the design and construction of the Project.

- **Regional Transportation District (RTD):** RTD is providing funding for the Project and will have specific requirements related to the use of the facility by public transit vehicles. In addition, coordination with RTD will be necessary to ensure that the proposed Project is consistent with the queue by-pass project that will be completed by RTD prior to the completion of the Project.

- **E-470:** Through an agreement with HPTE, the E-470 Public Highway Authority currently provides back-office support for HPTE for the I-25 Express Lanes. It is expected that they will have a similar role for the managed lane along US 36. In addition, they will provide and install the toll collection equipment for the managed lanes.

- **Northwest Parkway:** No direct connection between the US 36 managed lane and Northwest Parkway is proposed. As a result, the role of the Northwest Parkway will be limited.

- **Denver Regional Council of Governments (DRCOG):** DRCOG is providing a portion of the funding for the project and will be involved as the Metropolitan Planning Organization (MPO) for the project.

- **Mayors and Commissioners Coalition:** The Mayors and Commissioners Coalition includes representatives from the Cities of Westminster, Broomfield, Louisville and Boulder along with the Town of Superior and Boulder County. These communities will be directly impacted by the managed lane and their feedback and concerns will be incorporated into the concept of operations, design, and final construction.

- **36 Commuting Solutions:** This non-profit public/private partnership organization has a goal to enhance mobility along the US 36 corridor for today and the future. As a result, their input will be considered related to the concept of operations.

- **Federal Highway Administration (FHWA):** Since US 36 is part of the United States Highway System, FHWA will have input into the final design of the facility. In addition, FHWA through the TIFIA Joint Program Office is administering The Transportation Infrastructure Finance and Innovation Act (TIFIA) loan that is providing a significant portion of the funding for the Project.

- **Law Enforcement Agencies:** The local law enforcement agencies and/or the Colorado State Patrol (CSP) will have a critical role of providing enforcement along the facility to ensure safe operations and compliance with HOV occupancy requirements. HPTE will enter into appropriate agreements to provide HOV enforcement for the managed lanes.

6 CURRENT STATE OF THE INDUSTRY – TECHNOLOGY

Currently, there are two primary means of electronically assessing tolls on roadway users - video license plate recognition and with electronic toll tag readers. Tolling facilities can utilize these technologies separately or in combination in order to collect tolls along the facility. Both technologies are discussed below in further detail.

6.1 LICENSE PLATE TOLLING

License plate tolling (also referred to as video tolling) utilizes Automatic License Plate Recognition (ALPR) cameras and Optical Character Recognition (OCR) technology to identify a vehicle's license plate number. This technology is currently being used on all three existing toll facilities in the Denver Metro Area. The license plate numbers are collected and the name and addresses of the registered users are requested from the State Department of Motor Vehicles. Once address data has been obtained, bills for all the tolls incurred during a specific period are aggregated and sent out to collect payment.

6.2 TRANSPONDERS

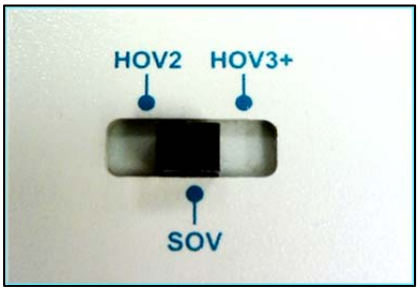
The primary means of electronic tolling involves the use of electronic toll tag readers that read data from transponders mounted on vehicles. There are two main types of toll tag transponders in the industry today - a hard plastic form factor transponder and a sticker transponder, both of which are typically installed on the vehicle windshield. Both types of transponders are used by agencies throughout the United States and internationally. A more detailed description of both types of transponders is provided below.

6.2.1 HARD CASE TRANSPONDER

Hard case transponders are the more prevalent type of transponder, given that they have been in circulation longer and because some of the new tolling schemes being implemented necessitate their use. These transponders are small hard plastic cases that typically attach to the inside of the windshield via Velcro and contain the necessary electronic components to be read by a wayside (i.e., roadside) toll tag reader to identify the user and record the transaction. Each transponder is set with a unique independent electronic signature that is linked to a specific user account. The transponders currently used for all of the toll facilities in Colorado are plastic cases approximately 3 x 3.5 inches with batteries.

Some hard case transponders have the ability to be disabled (i.e., turned on or off) or switched into a different mode (i.e., allow users to declare their status as SOV or HOV while still transmitting a signal to the reader,). For example, the Express Pass used along I-15 in Salt Lake City, Utah has the ability to be turned on and off depending upon vehicle occupancy. The Utah Express Lanes are free if two or more people are in the vehicle, but a toll is assessed for SOV users. With the tab pulled down on the

transponder, the tag is disabled and cannot be detected by the wayside toll tag reader. In an attempt to make enforcement easier, when the pull tab is in the off position, the opposite side of the transponder is red. This allows the enforcement personnel to visually confirm the transponder position and then visually confirm that the vehicle occupancy matches the transponder setting. It should be noted that video tolling cannot be used with this type of transponder since the wayside reader does not detect a disabled transponder and it simply appears as if no transponder is present.



The FasTrak multi-mode hard case transponder is anticipated to be deployed in California's Bay Area for managed lanes on I-580 and I-680. Similar to the I-15 Express Pass, the FasTrak transponder allows users to perform self-declaration. However, the difference is that this particular transponder has a switch that changes the declared occupancy in the vehicle from SOV to HOV2 and HOV3+. For all three modes, the tag is still read by the wayside reader and the occupancy of the vehicle is registered by the system. Since the tolling system registers the occupancy of each vehicle, video license plate tolling can be used for all users that do not have a transponder.

6.2.2 STICKER TRANSPONDER

The type of transponder that is rapidly gaining in popularity is a sticker-type transponder. As the name implies, this type of transponder is not manufactured with a large hard case form factor, but instead is a sticker or thin plastic strip containing the electronic toll tag. These sticker-type transponders have certain advantages over hard case transponders. They are smaller, less expensive (generally cost only a couple of dollars as compared to 20 dollars per unit for the hard case transponders), and are passive tags that do not require a battery. Also, they are not prone to the adhesion problems which hard case transponders experience as the Velcro (which attaches the hard case to the windshield) wears out over time. Generally, sticker-type transponders are placed on a vehicle's windshield; however, there are variations that can be mounted outside on the vehicle's bumper or headlamp. Heavy vehicles generally use external sticker tags on their license plates due to the elevated location of their windshields. E-470 is currently in the process of switching the standard transponders for Colorado to a sticker transponder using an open protocol tag known as 6C. They expect to start issuing them late summer of 2011.

The major difference between the sticker-type transponders and the hard case transponders is that sticker-type transponders currently cannot be physically switched to allow roadway users to perform self-declaration. Shields are used in some locations to block the tag from being read by the wayside reader.

Although the majority of sticker-type transponders are in fact stickers that must be permanently adhered to the vehicle, there are slight variations in the form. For example,

the Washington State Department of Transportation Good to Go! program uses several forms of a sticker-type transponders.

- **Sticker Pass** – Simple sticker with a toll tag embedded into the sticker. The device is approximately the size of a Band-Aid and would typically be adhered to the windshield somewhere close to the rearview mirror. It is considered a permanent device in that it cannot be moved between vehicles. This transponder is the type that E-470 will primarily use when they switch to a sticker tag.

- **Moveable Pass** – This is essentially a simple sticker that is adhered to a long thin piece of plastic. The moveable pass has Velcro pieces that allow it to be adhered to the windshield when in use, but also allows it to be moved and placed in a different vehicle. The device is sometimes referred to as a "Popsicle Stick" transponder.

- **Motorcycle Pass** – This type of transponder is a variation of the sticker tag made for external use on a motorcycle. The device is approximately the size of two Band-Aids and would typically be adhered to the front headlight with a clear sticker so as to not obstruct the headlight. It is considered a permanent device in that it cannot be moved between motorcycles and is constructed such that if removed the device becomes inoperable.

6.3 COMMUNICATION PROTOCOLS

This section focuses on two communications protocols: Title 21 and ISO 18000-6C. Title 21 is currently in use at all of the tolling facilities in the Denver Metro Area. However, E-470 is in the process of procuring 18000-6C tags and tag readers. The Colorado Legislature requires interoperability between tolling facilities within the State. As a result, multi-protocol Radio Frequency Identification (RFID) tag readers will need to be used to allow for the deployment of different communications protocols within RFID tags while still keeping interoperability intact between facilities. Both these types of RFID tags operate in the 860 MHz to 960 MHz Industrial, Scientific, and Medical band.

- **Title 21 Protocol** - The Title 21 protocol was developed by Caltrans in the early 1990's. Caltrans identified a frequency band that would be utilized strictly for electronic toll transponders and readers. Title 21 refers to the related section of the California Code of Regulations which describes compatibility requirements and data format for Automatic Vehicle Identification (AVI) equipment between vehicle-mounted tags and fixed-position roadside readers. Caltrans continues to use the Title 21 frequencies for electronic toll collection. Colorado followed suit and all toll facilities within the State currently operate under the Title 21 protocol. This is changing though, as discussed in the following section.

- **ISO 18000-6C** – Similar to the Title 21 protocol, this International Standards Organization (ISO) protocol defines the air interface between the readers and the tags. E-470 is procuring ISO 18000-6C sticker-type tags to replace the existing hard case Title 21 transponders. 6C is an open standard; however some manufacturers have developed modified versions that are proprietary. 6C-type tags can be manufactured as both sticker tags and hard case tags, and both are passive and do not require batteries. As mentioned previously, there are not currently any switchable 6C sticker tags currently in use in the industry.

7 CURRENT STATE OF THE INDUSTRY – TOLLING FACILITIES

7.1 COLORADO

As previously stated, there are three separate tolled facilities that are currently in operation in the Denver Metro Area. These toll facilities include the I-25 Express Lanes (HOT), E-470 (Managed Lanes) and the Northwest Parkway (Managed Lanes.) A brief description of each toll facility and their overall tolling operations is provided below.

7.1.1 I-25 EXPRESS LANES

The I-25 Express Lanes operate for seven miles from approximately 20th Avenue on the southern terminus to 70th Avenue on the northern end, with a separate, direct connection US 36. The facility contains two lanes and operates as a reversible facility (southbound in the morning and northbound in the evening). The lanes are in the center median area of I-25 and are separated from the general purpose lanes by a concrete median barrier on both sides. The lanes operate for the majority of the day except between 10 a.m. to 12 p.m. and 3 a.m. to 5 a.m. for maintenance and to transition between the two directions. Drivers using the toll facility are required to utilize one of the two Express Lanes depending on their vehicle occupancy. A single gantry is located within the facility which straddles an exclusive HOV lane and an exclusive SOV lane in the toll zone. If there are two or more people in a vehicle, they must use the HOV2+ lane to avoid a toll. Conversely, SOV users must use the SOV lane so that they are assessed a toll by the tolling system. Tolls are collected one of two ways - transponders and license plate tolling. Vehicles in the SOV lane with a transponder are recorded and billed to their existing registered account. Vehicles in the SOV lane without a transponder have their front and rear license plates photographed and the registered owner will receive a bill for all tolls incurred during a specific period. Payment must be received by the date specified on the bill or the transactions listed on the statement will be subject to additional fees, collection action and ultimately become toll violations.

7.1.2 E-470

E-470 is a toll highway that runs along the eastern perimeter of the Denver Metro Area. The 47-mile highway extends from State Highway C-470 at I-25 in Douglas County south of Denver, runs east and then north through Aurora, passes along the western edge of the Denver International Airport, and turns back towards the west, terminating at I-25 on the north end of the Denver Metro Area just south of 160th Avenue. There is no differentiation between HOV and SOV vehicles along E-470; all users are assessed a toll. However, the tolling operations are similar to the I-25 Express Lanes in that all tolls are collected electronically through the use of transponders and license plate tolling. Transponders are recorded by the wayside toll tag readers and a toll is billed to the registered account. Vehicles without a transponder have their front and rear license photographed and the registered owner will receive a bill for all tolls incurred during a

specific period. Payment must be received by the date specified on the bill or the transactions listed on the statement will be subject to additional fees, collection action and ultimately become toll violations.

7.1.3 NORTHWEST PARKWAY

The Northwest Parkway is a toll road that connects E-470 in the east, at north I-25, with US 36 and State Highway 128 in Broomfield. Similar to E-470, there is no differentiation between HOV and SOV vehicles along E-470 since all roadway users are assessed a toll. Northwest Parkway has separately branded their license plate tolling process as GO-PASS and reduces the cost of advertised tolls by 10 percent at the ramps if users sign up for the Auto-Bill service. Users drive through designated GO-PASS lanes and their license plate is photographed and a bill is sent to the registered owner of the vehicle for all the tolls incurred during a specific period. Currently a small processing fee is charged per bill for GO-PASS for Auto-Bill. If not set-up for Auto-Bill, GO-PASS tolls also pay a per transaction fee. Payment must be received by the date specified on the bill or the transactions listed on the statement will late fees will be assessed and will ultimately become toll violations. Those individuals that also have an E-470 Express Toll transponder can utilize their existing transponder for tolling along Northwest Parkway in addition to the GO-PASS system.

7.2 OTHER MANAGED LANE FACILITIES IN THE UNITED STATES

The following section summarizes the key components of other Managed and High-Occupancy Toll (HOT) lane facilities in the United States. Specifically, the type of barrier, High Occupancy Vehicle (HOV) and toll policies, the use of transponders, enforcement and the use of license plate tolling are summarized. The following Managed/ HOT lane (ML/HOT) facilities are currently operating in other parts of the US:

- I-15 in San Diego, CA
- SR-91 in Los Angeles, CA
- I-580 (eastbound only) in Alameda County, CA
- I-680 (southbound only) in Alameda County, CA
- I-95 in Miami, FL
- I-394 in Minneapolis, MN
- I-35W in Minneapolis, MN
- I-10 in Harris County, TX
- I-15 in Salt Lake City, UT
- SR 167 in Renton, WA

The following summarizes the schemes that have been implemented for the existing HOT lane facilities:

7.2.1 TYPE OF BARRIER

Of the locations listed above, a majority utilize a painted double white line to separate general purpose lanes from the managed lane. A couple of facilities use a concrete barrier with limited ingress and egress locations. In addition, the I-95 utilizes breakaway plastic poles in the painted buffer to further separate traffic and SR 91 uses delineators.

7.2.2 HOV POLICY

Most of the operational facilities have established a HOV2+ policy for non-tolled usage of the facility. Exceptions are SR-91 and I-95 which have a HOV3+ policy for non-tolled passage. I-95 was one of the Urban Partnership Program projects and only allows that benefit to registered (employer-based) carpools. All of the operational facilities exclude motorcycles and transit vehicles from paying tolls and most facilities also exclude hybrid or registered “clean” vehicles from paying tolls.

7.2.3 TOLL POLICY

ML/HOT facilities use variable toll pricing schemes that are either based on set time of day/week rates (such as I-25 Express Lanes currently employ) or dynamic pricing that updates rates based on the actual congestion in the lanes. Both are variable rate toll policies that adjust rates to maintain free flow travel during peak periods.

7.2.4 USE OF TRANSPONDERS

Transponders, also referred to as “tags”, are small devices which are typically attached to the windshield of the vehicle in order to electronically identify the user and charge the appropriate toll. All ML/HOT lane facilities require transponders for SOV users unless license plate tolling is permitted. HOV users with transponders must either shield the transponder, pre-register, or utilize a dedicated lane if available. With the increasing popularity of HOT lanes there is a more widespread consideration of aiding the enforcement process by using transponders to identify HOV users. This is rapidly evolving as new HOT lanes come on line, particularly because there is rarely available space for dedicated declaration lanes such as those found on I-25 in Denver. Many projects to date have been implemented as HOV to HOT conversions with limited capital investment. As new projects are developed that have a financing component they must establish demonstrated effective enforcement strategies which typically require options such as dedicated HOV declaration lanes, HOV transponders or HOV pre-registration. For instance, Georgia is developing an HOV to HOT conversion project on I-85 as well as a new Northwest Corridor ML project as a Public Private Partnership (PPP). In both cases transponders will be required for HOV users.

7.2.5 TYPE OF TRANSPONDERS

There are a wide range of suppliers, technologies, and protocols for the transponders used. Some agencies use more than one transponder type. The technology protocol is typically set based on interoperability standards of a particular geographic area. As

discussed above, Colorado currently uses Title 21 compliant transponders but E-470 will be transitioning to a new protocol known as “6C” that will allow the use of more inexpensive transponders including “sticker tags.” A particular type of transponder is usually available with various “form factors” based on customer requirements. Typically there will be accommodations for interoperability either because the transponders have the same internal “chip” regardless of their external shell, or the reader allows for multiple protocols. For example, readers have been installed in Colorado that will be able to seamlessly read both the current Title 21 transponders and the new 6C variety. Most facilities currently utilize a single mode form-factor transponder. Due to demand from agencies implementing HOT lanes, most manufacturers are moving towards providing “switchable” transponders that can switch between SOV and HOV status to allow designation of vehicle occupancy via the transponder.

Current Agencies: The I-15 HOT lanes in Salt Lake City use a switchable transponder form factor which allows HOV users to disable the transponder. WSDOT currently uses a windshield sticker transponder that must be shielded for HOV users to avoid a toll for its SR167 HOT lane. WSDOT has also decided to switch protocols and have just started selling a 6C switchable transponder which will also be used on their new 520 toll lanes. In California a large number of agencies are implementing or planning for new HOT lanes. Although it will require a change in the current California state-wide interoperability standard (Title 21), these transportation agencies are supporting a change to a multiple protocol switchable transponder that can support multiple occupancy modes as a necessary component to implement their desired managed lane policies.

7.2.6 USE OF VIDEO, PHOTO, OR LICENSE PLATE TOLLING

Using an image of a license plate to bill toll transactions is interchangeably known as Video, Photo or License Plate tolling. E-470 uses the term License Plate Tolling (LPT). In a HOT lane environment, use of LPT is limited to those locations where dedicated lanes for HOV users are available (I-25 Express Lanes in Denver and I-10 in Houston, TX) or where HOV registration or transponders are required. LPT is used along I-95 in Miami where HOV and SOV vehicles share a single managed lane. To avoid receiving a toll via the LPT, HOV users must pre-register their vehicles.

7.2.7 TRAFFIC MANAGEMENT

Most of the facilities try to maintain average traffic speeds of approximately 45 to 55 mph and/or operations of Level of Service C or better in the managed lane.

7.2.8 ENFORCEMENT

Visual inspection by law enforcement personnel is used at all the existing MLHOT lane facilities to enforce occupancy limits. SR-91 and I-95 have violation enforcement cameras along the lanes or at the gantries, respectively. I-15 in San Diego and SR-167 in Renton also have beacons at the toll zones to alert law enforcement personnel of

vehicle status. On the I-394 and I-35W in Minnesota, police use mobile enforcement units and handheld readers. The specific enforcement strategy is closely tied to whether individual lanes are available to separate HOV from SOV vehicles. Single lane systems have the greatest enforcement challenges. Most HOT lanes do not have debt outstanding that is directly tied to repayment by toll revenues. When rating agencies and investors are involved such as on the Capital Beltway project in Virginia, it is critical that sufficient enforcement strategies are in place to assess tolls for SOVs. Currently no automated system is available to detect vehicle occupancy.

In addition to the existing ML/HOT lane facilities listed above, there are several other projects throughout the county that are either currently being constructed or are in the planning process. Of those, two projects are far enough along that reliable data could be collected.

- **I-495 (Capital Beltway) in Washington, DC** – VDOT is currently under a public-private partnership agreement to construct approximately 14 miles of HOT lanes along I-495 in the Washington, DC area. SOV and HOV 2 users will be required to pay a toll while HOV3+ users can use the facility for free. The managed lane will be separated from general purpose traffic via a painted buffer. Transponders will be required for all users and will allow HOV 2 and HOV 3+ to declare occupancy status via a switch. Video tolling will be used for all users without transponders.
- **I-85 in Atlanta, GA** – The Georgia Department of Transportation (GDOT) is currently constructing approximately 15 miles of HOT lanes along I-85 in the Atlanta area. SOV and HOV2 users will be required to pay a toll while HOV 3+ users will use the facility for free. The managed lane will be separated from general purpose traffic via a painted buffer. Sticker transponders will be required for all users; however, it is not clear how the occupancy status of each vehicle will be determined. Video tolling will be used for all users without transponders.

Additional express/HOT lane facilities that are in development or under construction include I-45 US-59 and US 290 in Houston, Texas; I-635 (LBJ) in Dallas, Texas; North Tarrant Expressway in Tarrant County Texas; and the Northwest Corridor in Georgia.

In summary, the majority of existing managed lane and high-occupancy toll facilities utilize the following operational schemes:

- **Type of Barrier**: Painted
- **HOV Policy**: HOV2+, motorcycles and transit vehicles excluded from tolls
- **Toll Policy**: Variable pricing
- **Use of Transponders**: Transponder required for SOV users, with some variations based on policy and emerging issues related to financing

- **Type of Transponder**: Non-switchable transponder with emerging movement towards switchable
- **Use of video, photo, or license plate tolling**: Emerging emphasis in concert with implementation of switchable transponders
- **Traffic Management**: Traffic management goal of 45-55 mph or LOS C
- **Enforcement**: Visual enforcement with camera or beacons

8 PROJECT NEEDS

This section describes the objectives and needs that drive the requirements for the system.

8.1 GENERAL CONSIDERATIONS

In order to achieve the goals discussed in Section 3 of this report, the primary needs of the managed lane system are as follows:

- Maximize use of available capacity;
- Minimize burden on users;
- Minimize revenue loss;
- Match driver expectancy;
- Maintain consistency with existing toll facilities; and,
- Maximize enforcement efficiency.

In addition, although the current managed lane project may not extend the full length of the corridor, the operational plan and design of the ITS and tolling elements need to account for the future extension of the managed lane to Foothills Parkway. Finally, although not a requirement of the initial phase, the system is being designed to provide the ability to be expanded in the future to incorporate dynamic pricing.

The project also needs to support some additional goals defined in the *US 36 FEIS* Combined Alternative Package (Preferred Alternative) and *Record of Decision* (ROD), as summarized below:

- Add one painted, 4-foot, buffer separated managed lane in each direction and provide a connection to the existing I-25 Express Lanes
- Keep managed lane traffic flow at 45 mph or faster and ensure reliability of toll lanes
- Install the necessary ITS components to effectively operate the Tolling System
- Minimize throw away and temporary items
- Address the maintenance needs of the facility
- Provide effective ingress and egress points located between each interchange
- Implement Travel Demand Management (TDM) elements during construction and provide TDM improvements throughout the corridor
- Implement ITS technology to alert drivers of roadway conditions and utilize an Incident Management Plan and Courtesy Patrol to minimize congestion

- Incorporate planned Bus Rapid Transit (BRT) improvements, such as variable message signing, fare boxes, ticket vending stations, smart cards, CCTV, emergency telephones, and transit signal priority

8.2 OPERATIONAL NEEDS

Efficient operation of the system is critical in order to achieve one of the primary goals of the project, to improve the efficiency of the corridor as a whole and improve travel times for all users. As a result, the system will need to incorporate the following operational needs:

- Provide service 24 hours a day and 7 days a week, with periodic closures to perform maintenance
- Provide access to transit vehicles, HOV users, and SOV users that pay a toll
- Provide effective ingress and egress points located between each interchange with no additional auxiliary lanes
- Provide a means to effectively accommodate the following operational elements:
    - Transit vehicles
    - HOV users
    - SOV users
    - Motorcycle, and registered hybrid vehicles
    - Heavy vehicles
    - Emergency response vehicles
    - Courtesy Patrol
    - Allow for efficient equipment maintenance
    - Allow for efficient snow removal
    - Effectively manage incidents in the general purpose lanes
    - Effectively manage incidents in the managed lane
    - Perform effective managed lane violation enforcement

8.3 ENFORCEMENT NEEDS

Effective enforcement will be a critical component of the managed lane system. Law enforcement personnel will need to have the ability to properly enforce the facility by having safe, effective locations to identify violators and issue citations. Potential enforcement strategies and technologies that demonstrate this will need to be provided.

8.4 TECHNOLOGICAL NEEDS

The proposed system must also satisfy several technological needs. These include:

- Tolled users must be identified by the system in order to assess tolls, either through a transponder or license plate tolling

- Toll tag readers must be multi-protocol and read both the Title 21 and ISO 18000-6C protocols
- The technology needs to account for both HOV and toll-paying SOV in a single, shared lane
- The system will needs to integrate with the existing, barrier separated reversible I-25 Express Lanes at Pecos Street
- The system will need effective ITS subsystems to support tolling operations

9 TOLLING ALTERNATIVES ANALYSIS

Four tolling scheme alternatives were identified for the proposed US 36 managed lane. Of the four, a preferred alternative was chosen. The first three were differentiated based on the type of users that would be required, or encouraged, to have a transponder. The fourth alternative is differentiated by the fact that HOV users will be able to perform self-declaration at various entry points to the managed lane section of US 36. More specifically, the four alternatives are defined as:

1. **All Users**: all users utilize transponders, with license plate tolling used for SOV users as a secondary measure;
2. **SOV Only**: only SOV users would be required to have transponders;
3. **License-Plate Tolling:** no users would be required to have a transponder and all tolling would be done via license plate tolling; or,
4. **HOV Declaration Lanes:** HOV users would be able to perform self-declaration at dedicated locations as they enter the managed lane segment.

In order to clearly differentiate the four alternatives, each alternative will be discussed in detail with respect to these five differentiating factors:

1. **Transponder Use**: the requirement of specific users to have transponders in order to use the facility;
2. **Consistency with I-25 Express Lanes:** the extent to which each alternative is consistent with the existing policy along the I-25 Express Lanes;
3. **Occupancy Declaration:** the method with which users will perform occupancy declaration, which may include the use a switchable transponder or pre-registration of transponders/license plates using a web-based service, phone, or mail;
4. **Automated License Plate Tolling Use:** the ability, or inability, to perform automated tolling via license plate video tolling as a means of collecting tolls; and
5. **Enforcement:** the likely enforcement scheme.

Of the four alternatives, the first alternative has been identified as the preferred alternative and is discussed first. The subsequent sections discuss the other three alternatives and provide reasoning for why each alternative was eliminated.

9.1 SELECTED ALTERNATIVE – ALL USERS

The first alternative was identified as the Selected Alternative for the US 36 managed lane project by the various technical groups and stakeholders. It would encourage all users of the facility to have a transponder. For those users without a transponder, video

license plate tolling would be used as a secondary means of tolling. The specific details for the Selected Alternative relating to the five differentiating factors are listed below:

- **Transponder Use:** The Selected Alternative will strongly encourage all users of the facility to have a transponder that will allow the system to know the occupancy status of each vehicle that is read. Casual use of the facility by SOV users without transponders can be accommodated since video license-plate tolling is possible as a secondary means of tolling. However, free travel for casual HOV use will likely only be possible if casual HOV users have a switchable transponder or pre-register their transponder.
- **Consistency with I-25 Express Lanes:** The Selected Alternative is not completely consistent with the I-25 Express Lanes in that HOV users are not currently required to have a transponder to use the Express Lanes. The following details the user experience for SOV and HOV users traveling in each direction between the I-25 Express Lanes and the US 36 managed lane:
    - Eastbound SOV user: Since a transponder (or license plate tolling) will be encouraged on US 36 and will be able to be read at the I-25 Express Lanes, a SOV user heading eastbound will not experience an inconsistency between the two facilities.
    - Eastbound HOV user: A transponder will be required for HOV users on US 36. HOV users along the I-25 Express Lanes do not have such a requirement. As a result, an HOV user heading eastbound will not experience an inconsistency between the two facilities because they can utilize the I-25 Express Lanes after being on US 36.
    - Westbound SOV user: Currently, SOV users are not required to have a transponder to utilize the I-25 Express Lanes. Since license plate tolling can be used for SOV vehicles along the US 36 managed lane in this alternative, a SOV user heading westbound will not experience an inconsistency between the two facilities.
    - Westbound HOV user: Currently, HOV users are not required to have a transponder to utilize the I-25 Express Lanes. Since a transponder will be required for HOV users (or some form of pre-registration of license plate in order to avoid video license plate tolling), an HOV user heading westbound will experience an inconsistency between the two facilities.
- **Occupancy Declaration:** Occupancy declaration for this alternative will be performed either via a switchable transponder that is provided for HOV users, and/or pre-registration of their transponders that are not switchable.
- **Automated License Plate Tolling Use:** Due to the fact that transponders will be required for all HOV users and encouraged for SOV users, video license plate tolling will be utilized as a secondary means of tolling for those SOV users

without transponders. This will be especially effective for casual, spur-of-the-moment SOV users that wish to use the managed lane during times of congestion. It is anticipated that license plate tolling users will have a higher toll rate or surcharge.

- **Enforcement:** The potential occupancy enforcement options for the Preferred Alternative primarily include manual enforcement at the tolling points. Specifically, since HOV users will be required to have a transponder and will be known to the system (either by switching their switchable transponder or pre-registering) a transaction status beacon can be used to signal to law enforcement if they are a declared HOV user. The officer would then need to visually confirm the occupancy of vehicles to ensure that they are in fact HOV users. The other enforcement benefit is that any users without a transponder can automatically receive a license plate tolling bill, substantially increasing enforcement effectiveness.

The Selected Alternative was selected because of its ability to accommodate a large percentage of the anticipated users, with the only exception being free travel for casual HOV users that do not have a switchable transponder or did not pre-register themselves as an HOV. However, since this is primarily a commuter facility and HOV use is typically more premeditated than "spur-of-the-moment" SOV use of the managed lane, it is not expected that casual HOV use of the managed lane will be significant. The primary focus is on assuring transit priority and promoting "deliberate" carpooling. Therefore, the Selected Alternative is expected to achieve the primary goal of increasing the capacity of the corridor. CDOT and HPTE will address the policy inconsistency between the US 36 managed lane and the I-25 Express Lanes. For example, the policy along the I-25 Express Lanes could be changed so that all HOV users are strongly encouraged to have a transponder. This would make the policies along the I-25 Express Lanes and the US 36 managed lane consistent and reduce driver confusion.

9.2 ALTERNATIVE 2 – SOV ONLY

The second alternative would require only SOV users to have a transponder and tolls would only be assessed to users with transponders. The specific details for the second alternative relating to the five differentiating factors are listed below:

- **Transponder Use**: Alternative 2 will require that only SOV users have a transponder while all HOV users can have free use the facility without the need for any transponders or pre-registration. One exception is HOV users with existing non-switchable form-factor transponders used by E-470. Assuming that by the time of opening all transponders have been replaced by the new sticker tags, these users will need to shield it or pre-register their transponder as an HOV for purposes of using the US 36 lanes. Since the tolling system will not be able to determine the occupancy status of vehicles without transponders, video

license-plate tolling will not be possible as a secondary means of tolling. As a result, use of the managed lane by SOV users who do not have transponders will not be possible.

- **Consistency with I-25 Express Lanes:** Alternative 2 is not consistent with the I-25 Express Lanes in that SOV users that do not have a transponder are able to use the Express Lanes but will not be able to use the US 36 managed lane. The following details the user experience for SOV and HOV users traveling in each direction between the I-25 Express Lanes to the US 36 managed lane:
    - Eastbound SOV user: Since a transponder will be required on US 36 and is optional along the I-25 Express Lanes, a SOV user heading eastbound will not experience an inconsistency between the two facilities.
    - Eastbound HOV user: Since a transponder will not be required on US 36 and is not currently required on the I-25 Express Lanes, an HOV user heading eastbound will not experience an inconsistency between the two facilities.
    - Westbound SOV user: Currently, SOV users are not required to have a transponder to utilize the I-25 Express Lanes. Since transponders will be required on the US 36 managed lane and video license plate tolling will not be possible, a SOV user heading westbound will experience an inconsistency between the two facilities and may not be able to use the US 36 managed lane.
    - Westbound HOV user: Since a transponder will not be required on US 36 and is not currently required on the I-25 Express Lanes, an HOV user heading westbound will not experience an inconsistency between the two facilities.
- **Occupancy Declaration:** Occupancy declaration for Alternative 2 will be performed primarily by whether or not a user has a transponder. If a transponder is detected, the vehicle will be assumed to be a SOV and will be assessed a toll unless it is matched to a list of pre-registered HOV users. If a transponder is not detected, either because one is not present or it is shielded, the vehicle will be assumed to be an HOV and will not be assessed a toll.
- **Automated License Plate Tolling Use:** Since transponders will not be required for HOV users, video license plate tolling may not be utilized as a secondary means of tolling. This is due to the fact that the system will not be able to determine the occupancy status of vehicles without transponders.
- **Enforcement:** The potential enforcement options for Alternative 2 primarily include manual enforcement at the tolling points. Specifically, since HOV users will not be read by the system, a transaction status beacon can be used to signal to law enforcement that a particular vehicle was assessed a toll. The officer

would then need to confirm that vehicles that are not assessed a toll contain the correct number of occupants. Automated enforcement could not be used since no reliable technology exists to discern occupancy within a vehicle. This significantly increases the violation potential on the lanes.

Unlike the Preferred Alternative, casual HOV can be accommodated in Alternative 2. However, SOV users without transponders cannot be accommodated. Since this prevents spur-of-the-moment use by SOV during times of congestion, which is expected to be higher than casual HOV use, it is likely that less potential users will be able to utilize the managed lane when compared to the Preferred Alternative. Most importantly, video license plate tolling may not be used under this alternative, which will limit enforcement to manual enforcement only and will result in higher violation rates. The uncertainty as to the impact on collection of toll revenues due to this higher violation rate would present a significant challenge to the financial viability of the facility.

9.3 ALTERNATIVE 3 – LICENSE-PLATE TOLLING

The third alternative would not require transponders for any users and will rely completely on video license plate tolling. HOV users would need to pre-register their license plate so as not to be assessed a toll.

The specific details relating to the five differentiating factors are listed below:

- **Transponder Use:** Alternative 3 would not utilize transponders. Existing transponders could be present in vehicles but would not be read.
- **Consistency with I-25 Express Lanes:** Alternative 3 is not consistent with the I-25 Express Lanes in that HOV users would be required to pre-register their license plates to utilize the US 36 managed lane, which is not currently required at the I-25 Express Lanes. The following details the user experience for SOV and HOV users traveling in each direction between the I-25 Express Lanes to the US 36 managed lane:
    - Eastbound SOV user: Since US 36 will utilize video license plate tolling and the I-25 Express Lanes also utilize video tolling as a secondary means of tolling, a SOV user heading eastbound will not experience an inconsistency between the two facilities.
    - Eastbound HOV user: Since transponders will not be utilized along the US 36 managed lanes and they are not currently required for HOV users along the I-25 Express Lanes, an HOV user heading eastbound will not experience an inconsistency between the two facilities.
    - Westbound SOV user: Currently, SOV users are not required to have a transponder to utilize the I-25 Express Lanes and video license plate tolling is used as a secondary means of tolling. As a result, a SOV user

heading westbound will not experience an inconsistency between the two facilities and video tolling will be used to assess tolls on both facilities.

  - Westbound HOV user: In order to utilize the US 36 managed lane, an HOV user must pre-register their license plate. Such a requirement is not currently in place along the I-25 Express Lanes. As a result, an HOV user heading westbound will experience an inconsistency between the two facilities since they may not be able to use the US 36 managed lane if they are not pre-registered as an HOV in the tolling system.

- **Occupancy Declaration:** Occupancy declaration for Alternative 3 would be performed by HOV users who would need to pre-register (via the phone, internet, or participating retailers). The tolling system would read each vehicle's license plate, compare against a list of pre-registered HOV users, and if no match is made, a toll will be assessed to the user. However, this would occur in the "back office" since it would not be possible in "real-time".
- **Automated License Plate Tolling Use:** Alternative 3 would utilize video license plate tolling as the primary means of tolling. HOV users would need to pre-register their license plate and all other users would be assumed to be an SOV and assessed a toll.
- **Enforcement:** Enforcement at tolling points would not be possible for Alternative 3 since the automatic license plate recognition system is unable to perform optical character recognition of license plates quickly enough to make a transaction status beacon usable. As a result, violators (SOV users that falsely pre-register as an HOV) will not be able to be enforced. Although Alternative 3 provides the benefit that no transponders and associated equipment are necessary, the downsides when compared to the Preferred Alternative are that it will be unable to accommodate casual HOV use and enforcement at the tolling points will not be possible. Also, there is a higher processing cost for collecting tolls via license plate tolling and the net revenues would be lower than the transponder scenarios. The lower net revenue, lack of enforcement and potential for willful violation presents a significant challenge to the financial viability of the facility.

9.4 ALTERNATIVE 4 – HOV DECLARATION LANES

The fourth and final alternative is constructed to explore a potential solution to the occupancy status limitation of the first three alternatives by creating areas at the entry points, such as on-ramps and mainline approaches to the managed lane corridor, where HOV users could declare their status. This approach was assessed to determine if there was a more convenient system to accommodate all potential users.

The basic concept of the lane declaration alternative is to provide a designated area where HOV users can physically declare themselves and be recorded in the tolling

system. For on-ramp locations, this would require a separate HOV-only lane. For other entry points (US 36 from Boulder, I-25, and I-270), this would require a segment where only HOV users would be allowed to travel. This could take the form of a new HOV-only segment constructed alongside the general purpose lanes or allowing HOV vehicles to enter the managed lane prior to SOV.

The specific details relating to the five differentiating factors are listed below:

- **Transponder Use:** The use of transponders for Alternative 4 would be optional but would be encouraged with a reduced toll rate. Video license plate tolling could be used in lieu of transponders but would not provide any data for enforcement. However, the read accuracy and speed is higher with transponders and therefore it would be beneficial to provide equipment to identify those users that do have a transponder. In addition, back-office processing and collection of tolls would be more efficient if users use transponders.
- **Consistency with I-25 Express Lanes:** Due to the presence of the HOV declaration lane areas, Alternative 4 is the most consistent, in theory, of all the alternatives with the I-25 Express Lanes. As on the I-25 Express Lanes, transponder use would be optional and video license plate tolling could be used to identify vehicles and assess tolls to SOV users. Therefore, both SOV and HOV users would not experience any inconsistencies related to transponders or license plate tolling between the two facilities.
- **Occupancy Declaration:** Occupancy declaration for Alternative 4 would be performed by the users as they enter the facility. As previously mentioned, separate HOV declaration lane areas would be provided to record HOV users in the system. HOV users would need to be directed to these areas and pass through them in order to be read by toll tag or license plate readers and flagged in the system as HOV. They would then be able to travel along the managed lane and not be assessed a toll by the system. The toll adjustment would occur in the back office because it is not possible to process the license plate images in real-time.
- **Automated License Plate Tolling Use:** Due to the fact that transponders would not be required for any users and HOV vehicles would be flagged in the system, video license plate tolling would be required. All vehicles would be recorded and only those that are not flagged in the system as HOV will be assessed a toll. However, because of the additional processing that will be required to identify the registered user of each vehicle based on the license plate information, transponders will still be encouraged.
- **Enforcement:** The potential enforcement options for Alternative 4 primarily include manual enforcement at the declaration areas. Since HOV users are flagged only by use of the declaration lane, the enforcement must be a manual

observation as vehicles enter the declaration lanes. It will not be possible to use the transaction status beacon because the images cannot be processed real-time The officer would then need to confirm the vehicles using the HOV declaration lane contain the correct number of occupants. If not, they would receive a HOV violation (regardless of whether they were going to use the managed lane) and if they chose to use the managed lanes their license plate would be flagged to charge a toll.

The primary challenges with implementing this alternative are the creation of the HOV self-declaration areas and the conformance by the users. The use of the HOV declaration lane does not mean the users will necessarily use the managed lane. They would also serve as "queue jump" for all HOV users. The manual enforcement of HOV occupancy would be extremely difficult at the non-ramp declaration points. Also this approach would require creation of new software to process the HOV images separately from any managed lane images, insert HOV status, compare them to actual transactions in the managed lanes based on time parameters and then change the toll rate to zero. Further there would need to be a process for voiding the HOV designation for any vehicles that were apprehended violating the vehicle occupancy requirements.

As previously mentioned, the mainline entry points at US 36, I-25, and I-270 would need to be modified to create a HOV self-declaration area. It may be difficult and costly to provide these areas. Of greater concern, they would be located outside the current Project boundary. In addition, the following on-ramps would need to be widened to create a separate HOV lane with some being outside the current Project boundary:

Westbound US 36	Eastbound US 36
• Broadway(1) • Pecos Street(1) • Federal Boulevard(1) • Sheridan Boulevard • 104th Avenue(2) • Wadsworth Parkway	• Interlocken Parkway • East Flatiron Circle • Wadsworth Parkway • 104th Avenue(2) • Sheridan Boulevard • Federal Boulevard(1)
(1) Location is outside current project boundary. (2) Ramp is planned to have HOV/bus queue bypass lanes that could be used as HOV self-declaration areas.	

Of the locations shown above, the following table lists the on-ramp locations where ramp meters are currently present.

Westbound US 36		Eastbound US 36	
Location	**On-Ramp Peak-Hour Volume(1)**	**Location**	**On-Ramp Peak-Hour Volume(1)**
• Sheridan Boulevard • 104th Avenue • Interlocken Parkway • McCaslin Boulevard	520 670 720 970	• Foothills Parkway • Wadsworth Parkway • 104th Avenue • Sheridan Boulevard • Federal Boulevard	1,390 980 960 1,360 1,160
(1) Volumes shown are the highest weekday peak-hour volume (either AM or PM peak).			

The locations where ramp metering is currently implemented were determined in the *US 36 Ramp Metering Feasibility Study* (RMFS) that was performed in 2005. The RMFS evaluated the need for ramp metering at all on-ramp locations and made recommendations based upon peak-hour volumes (shown in the previous table), safety, and feasibility. As a result of the RMFS, most of the ramp metering locations (all except Sheridan Boulevard and Interlocken Parkway in the westbound direction) were widened to accommodate two lanes in order to provide additional storage and prevent queues from extending to the arterial street and impacting their operations.

The use of an existing ramp metering lane for exclusive HOV declaration is not feasible because:

- As was evaluated in the RMFS, two lanes were deemed necessary to provide acceptable operations and minimize the potential for queues extending to the arterial street.
- The HOV declaration lanes will only be used by HOV users who intend to use the managed lane. This is expected to be a small percentage of all vehicles utilizing

the on-ramps. As a result, dedicating one of the ramp meter lanes exclusively as a HOV declaration lane would create a significant utilization imbalance between the two lanes. This would have negative impacts to the operations of the ramp meter and would significantly increase the potential for the on-ramp traffic backing up to the arterial street.

- A significant utilization imbalance between the two lanes may encourage violations as SOV users become frustrated with the large queue in the SOV-only lane and decide to use the HOV declaration lane. These users may then decide to utilize the managed lane and would not be assessed a toll by the system since they would be flagged as HOV users in the tolling system.

As a result, an additional lane would need to be constructed at all of the on-ramp locations in order to implement the HOV declaration lane alternative.

Additional challenges with implementing this alternative include:

- Providing clear signage as drivers enter US 36 so that the self-declaration areas are used properly. It may be difficult to clearly direct drivers to the self-declaration areas. If signage is not effective, complaints by HOV users who are assessed a toll can become significant. This may be more of a concern at on-ramps, where right and left-turning vehicles from the arterial street enter the ramp and must quickly identify and maneuver into whichever lane they want to enter, the HOV declaration lane or SOV-only lane. If signage is not clear and users are not given enough time to enter the correct lane, they will not be able to declare themselves. There also may be an issue during periods when the ramp meter is off, or at locations where ramp metering does not exist, because users will take the shortest path to enter the freeway and may miss the declaration areas.
- As previously stated, the technology's ability to match and reconcile the HOV users' toll tag transponders and license plates at the on-ramp with those read along US 36 is a concern. Of even more concern is the speed at which the HOV declaration could be matched with license plates or transponders and transmitted for enforcement purposes.
- As mentioned above, the need for creating custom software to allow this matching process which will require additional development and sophistication of the algorithm. The extent and magnitude of this effort is unknown since this alternative is believed to be the first known scheme of its kind.

A variation of Alternative 4 was also discussed which would not provide separate HOV declaration areas at the entry points into the managed lane but would instead provide separate ingress points for HOV users. Since HOV users would enter the managed lane at different points than the SOV users, they could be flagged by the system as HOV and not assessed a toll at downstream toll collection points. However, the following challenges would be introduced with this variation:

- More electronic tolling read points would be needed; one for each SOV and one for each HOV entry point.
- The more complex matching may induce additional burdens and expenses in toll processing and thus reduce net toll revenues.
- Additional signage would be required in this corridor, which will already be heavily populated with signs. The ability to effectively communicate these requirements to users is highly likely to create significant operational challenges.
- Space is limited between certain interchanges for a 3,000 foot combined HOV-only ingress/all user egress, 1,500 foot buffer, and 1,500 foot SOV-only ingress. There also must be room for weaving to/from ramps to be completed. These additional weave areas may potentially cause more “friction” along the corridor by disrupting the general purpose lanes.
- Having the HOV and SOV ingresses separate would delay the entrance for SOV users, thus reducing the useable segment for paying users by forcing them to delay their entry; which may affect the toll revenue.

Due to the many challenges discussed above, both variations of Alternative 4 were deemed not feasible and therefore were not selected as the Preferred Alternative.

10 ACCESS DESIGN ALTERNATIVES ANALYSIS

In addition to the tolling alternatives analysis, an evaluation of the access alternatives was also performed to identify a preferred design for the ingress/egress points.

The *US-36 EIS: ITS and Engineering Elements – Implementation Plan for Managed Lanes* discussed two design alternatives for the ingress and egress points that would provide access between the managed lane and the general purpose lanes. The first alternative would provide a 1,500 foot buffer opening where ingress and egress movements would be made. The second alternative would also provide a 1,500 foot ingress/egress opening for entering and exiting the managed lane. However, this alternative would provide a second lane between the managed lane and the general purpose lanes that would accommodate the acceleration/deceleration of vehicles entering/exiting the managed lane.

For both alternatives, the *Implementation Plan* assumed that ingress and egress points would be separate. However, due to the limited spacing between interchanges along US 36 (especially in the eastern portion of the corridor) and the large amount of signing that would be required to clearly direct users to the egress and ingress points, a single combined 3,000 foot ingress/egress area was deemed more favorable. Providing such a long area would also minimize the amount of weaving that would occur.

Similar to the alternatives discussed in the *Implementation Plan*, two design options were considered for the combined ingress/egress area. The first alternative would provide a simple 3,000 foot buffer opening where ingress and egress movements would be made. The second alternative would also provide a 3,000 foot ingress/egress opening but would provide an additional lane between the managed lane and the general purpose lanes that would accommodate the acceleration/deceleration of vehicles entering/exiting the managed lane. Each alternative is discussed in more detail below.

10.1 ALTERNATIVE 1 – SIMPLE BUFFER OPENING

Figure 3 graphically displays the ingress/egress configuration for Alternative 1. As previously stated, this alternative has a 3,000 foot buffer opening where the ingress and egress movements can be made. This opening would have a single dotted line as opposed to the typical double white line that will be found along the corridor.

The main benefit to this alternative is that there are no impacts to the shoulder or buffer width, which maintains consistency and provides an area to accommodate accidents, disabled vehicles, maintenance access, and enforcement. However, if there is a high speed differential between the managed lane and the general purpose lanes, there may be safety and operational concerns. In terms of safety, likely crash types will be rear ends and sideswipes. Operationally, the performance of the managed lane may be impacted if vehicles are slowing to merge into the general purpose lanes.

10.2 ALTERNATIVE 2 – BUFFER OPENING WITH ACCELERATION/DECELERATION LANE

Also shown in Figure 3 is the ingress/egress configuration for Alternative 2. This alternative has a proposed lane shift towards the inside shoulder, then a 3,000 foot ingress/egress that will provide an additional acceleration/deceleration lane, and then a lane shift back towards the general purpose lane. This proposed option does not impact the proposed ROW template, but rather reduces the shoulder from 12 feet to 4 feet and maintains the managed lane and acceleration/deceleration lane at 12 feet.

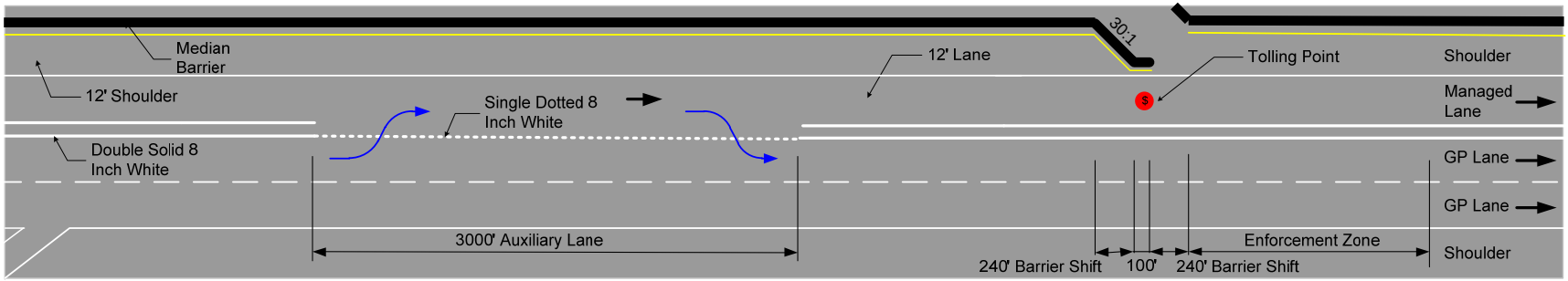
The main benefit of this alternative is that if there is a high speed differential between the managed lane and the general purpose lane, the traffic that will enter or exit the managed lane is separated from that lane and is given an opportunity to accelerate or decelerate in a separate lane.

Due to the need for lane shifts and the separate acceleration/deceleration lane, only a 4 foot shoulder width will be available for use within the transition areas as well as along the actual ingress/egress location. Based on a 65 mph design speed, the total length of the reduced shoulder section would be approximately 5,140 feet. This poses potential safety and operational problems since accidents and disabled vehicles would not be able to utilize the shoulder to move out of the traffic lanes. In addition, the separate acceleration/deceleration lane may experience significant weaving problems since vehicles will be attempting to accelerate and decelerate in the same location.

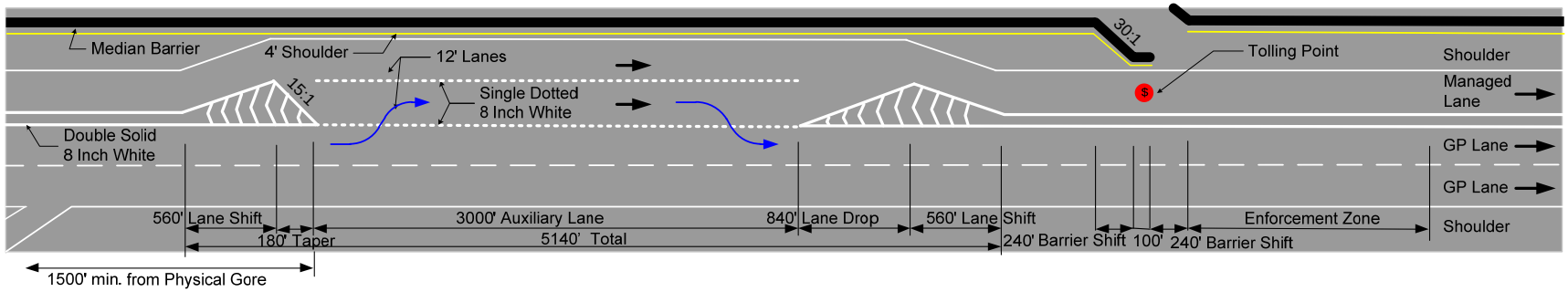
Based upon the challenges associated with Alternative 2, the fact that the design shown in Alternative 1 is currently used at most other managed lane facilities in the United States, and feedback from the various technical groups and stakeholders, Alternative 1 has been identified as the Selected Alternative for the design of the ingress/egress points.

Figure 3 Access Design Alternatives

Alternative 1



Alternative 2



Notes
This drawing is not to scale.
The assumed design speed is 70 mph.
Conceptual only. Not for design or construction.

11 PROPOSED PROCEDURES

This section provides a high-level conceptual description of the proposed ITS and tolling system to be implemented along US 36.

11.1 ITS AND TOLLING INTEGRATION

The ITS components along the corridor will be constructed and installed by the design/build team. This includes the infrastructure, ITS devices, and communications network. CDOT ITS will prepare network and splicing diagrams for the design/build team to utilize in the deployment of the ITS system.

The tolling system will be installed separately under a contract with the tolling integrator. The integrator will procure, install and configure all tolling equipment and integrate the system to the back-office.

11.2 HOURS OF OPERATION

The managed lane will operate 24 hours a day, seven days a week. Though temporary closures will be necessary for maintenance purposes; these would occur outside of the peak traffic periods whenever possible.

11.3 PROTOCOL

The toll tag reader equipment and transponders used for the US 36 managed lane project will utilize the Title 21 and ISO 18000-6C protocol. This will allow consistency between existing transponders, the transponders that will be provided to users of the US 36 facility, and the sticker-type tags to which E-470 is planning to transition to. Therefore, the project will need to install multi-protocol RFID toll tag readers in order to be able to read the mix of transponder protocols.

11.4 OPERATIONAL SCENARIOS

The following sections illustrate the intended operation of the system from the various users that are expected to utilize the managed lane. This exercise will ensure that all operational scenarios have been considered in defining the proposed procedures for the system.

11.4.1 HOV USER WITH A TRANSPONDER

A HOV user with a switchable transponder wishing to utilize the managed lane along US 36 will need to set their transponder to “HOV”. This will allow the tolling system to identify them as a HOV and not assess a toll. HOV users with other types of transponders (i.e. existing form-factor or sticker-type transponders expected to be utilized by E-470), would need to pre-register their transponder using a web-based or mobile application service, by phone, or by mail.

11.4.2 SOV USER WITH A TRANSPONDER

All SOV users that have a switchable transponder will need to set their transponder to "SOV" to identify themselves as SOV users to the tolling system. Once their transponder is read, they will be assessed a toll. For SOV users with other types of transponders, the system will read those transponders to identify the user and assess a toll.

11.4.3 HOV USER WITHOUT A TRANSPONDER

For all users without a transponder, license plate tolling will be used. Since current technology cannot determine the occupancy status of a vehicle, HOV and SOV users without transponders will be treated the same and will be assessed a toll.

11.4.4 SOV USER WITHOUT A TRANSPONDER

As stated above, all SOV users without a transponder will be tolled via license plate tolling. However, tolls collected via license plate tolling will be higher than those collected via transponders in order to cover the additional back-office processing costs. As a result, SOV users who are assessed tolls via license plate tolling will be encouraged to obtain transponders to save costs for both the user and the back-office.

11.4.5 BUSES, MOTORCYCLES, ELECTRIC AND HYBRID VEHICLES

Transit vehicles and motorcycles will be allowed to utilize the managed lane without paying a toll. They will each have a special transponder that identifies them as transit/motorcycle vehicles to the tolling system.

CDOT currently has a pilot program that allows a limited number of electric and hybrid vehicles with a single occupant to utilize HOV lanes. These users are also able to utilize the I-25 Express Lanes without paying a toll and will be able to utilize the US 36 managed lane in a similar manner. Each user in the program receives a special transponder which will identify them as being exempt from having to pay tolls to use the managed lane. CDOT has established rules that require permits and limits the number of permits to 2,000.

11.4.6 HEAVY VEHICLES

It is expected that heavy vehicles (vehicles with four or more axles) may be allowed to utilize the managed lane in a manner similar to the I-25 Express Lanes policy, which currently allow heavy vehicles to use the facility at a fee of $18 per trip in addition to the regular toll.

11.4.7 EMERGENCY RESPONSE VEHICLES

Emergency response vehicles that are actively responding to an emergency will be exempt from paying tolls to use the managed lane. Similar to transit vehicles, they will be provided transponders and coded in the system to identify them as exempt vehicles.

It will be a violation to use the lanes with such a transponder if they are not responding to an emergency.

11.4.8 COURTESY PATROL AND SNOW PLOWS

Courtesy patrol vehicles and snow plows that have a contract with CDOT will be exempt from paying tolls to use the managed lane. Similar to transit vehicles, they will be provided transponders and coded in the system to identify them as exempt vehicles or be reimbursed for tolls.

11.4.9 EQUIPMENT MAINTENANCE

Maintenance is essential for proper operations of the facility, including the roadway and tolling equipment. Maintenance of the roadway is expected to be performed by CDOT Regions 4 and 6 while CDOT ITS will maintain the ITS equipment.

Considerations for maintenance include:

- **Infrastructure Location:** Equipment should be located where maintenance personnel can safely access it by setting up traffic control for a shoulder closure. The exception is any overhead signs or gantries which are required to be placed directly above travel lane(s). Infrastructure should also be installed at locations that minimize exposure to traffic and the possibility of being struck by an errant vehicle or debris. This includes mounting position on structures, placing equipment out of the traveled way, and installing equipment inside the barrier.
- **Maintenance Planning:** Special consideration will have to be given to the impact of maintenance on the managed lane and coordination will need to take place to schedule activities and any special closures. These efforts should be documented in the form of a “policy” or “operations” manual. This exercise will assure that routine maintenance procedures can be accomplished effectively without impacting managed lane operations. For example, if a closure is needed in the managed lanes, the public needs to be notified and proper traffic control needs to be put in place to prevent drivers from using the managed lanes and being tolled for a portion of the facility that may be closed for repair. Such activities would be planned for non-peak periods.
- **Roadway Maintenance:** Roadway maintenance includes removing debris from the roadway, snow plowing, roadway repair, sign repair, and street sweeping. Within the existing barrier separated managed lanes on the existing I-25 Express Lanes, snow removal, street sweeping, and certain other maintenance activities are contracted out through HPTE. However, since US36 is not barrier separated

it is expected that CDOT Regions 4 and 6 will handle all maintenance duties within the managed lane.

11.4.10 INCIDENT IN GENERAL PURPOSE LANE

Presently, two courtesy vehicles patrol on US 36 between I-25 and 120th Avenue from 6:30 a.m. to 9:00 a.m. and from 3:30 p.m. to 6:30 p.m. on weekdays. Courtesy patrol is dispatched through the CTMC with funding contributions for US 36 through Region 6. It is expected that the courtesy patrol program will be expanded to include the entire US 36 corridor with additional funding from Region 4.

11.4.11 INCIDENT IN MANAGED LANE

Similar to an incident in the general purpose lanes, courtesy patrol vehicles will be available to clear any incidents that occur in the managed lane. It will be important that accidents be moved to the left shoulder as soon as possible in order to maintain good traffic flow along the managed lane. This will reduce congestion and maintain good operations and travel times for managed lane users. Frequent congestion along the managed lane will discourage HOV and SOV use since drivers will not see the value in using the lane. In addition, transit travel times and schedule adherence will be negatively impacted. Courtesy patrols that currently cover the I-25 Express Lanes will be extended to cover the US 36 managed lanes and supplemented as necessary.

11.4.12 MANAGED LANE ENFORCEMENT

Primary tolling enforcement will occur at the tolling points where dedicated enforcement zones will need to be constructed. These enforcement areas will be located in the median, should be bi-directional, and need to accommodate a parked vehicle. They will also need to be close enough to the tolling point so enforcement officers can see the transaction status beacons. If a vehicle with an HOV status is in the lane, the transaction status beacons will provide visual feedback to the officer. The officer will then need to confirm that the subject vehicle has the correct occupancy. If the officer deems the vehicle to be in violation, they will either pursue the violator to issue the citation or radio ahead to other enforcement personnel.

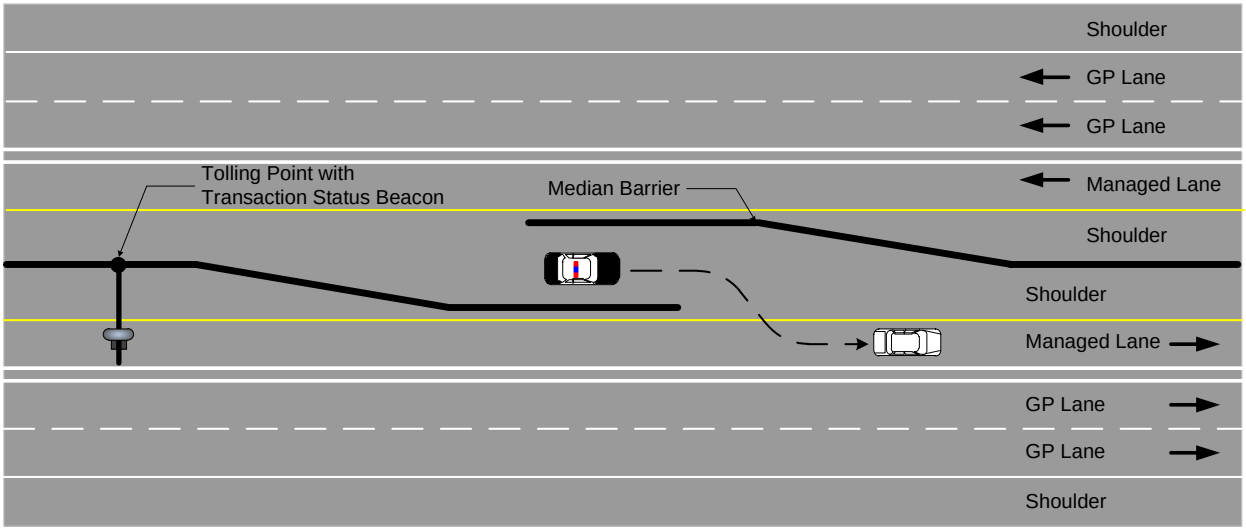
A graphic showing the conceptual layout of the enforcement areas is included in Figure 4. As shown, an enforcement officer can visually inspect vehicle occupancy and the transaction status beacon from a stationary position and can face either direction of travel. Note that this type of area can also be placed at midstream locations to enforce violators who cross the double white lane line. Dimensions for the enforcement area will be finalized pending further discussions with law enforcement personnel to determine the exact geometric configuration needed. This exercise is more appropriate at a design level as opposed to a planning level.

Locations need to exist where potential violators can be safely pulled over. These locations should include full shoulder width areas downstream of tolling locations. It is

important that enforcement stops be accommodated without creating friction and reducing speeds along the managed lane.

In addition to the transaction status beacon, enforcement personnel may also be equipped with handheld readers. These will allow an officer to scan the transponders of passing vehicles and find out when a toll transaction last occurred. If it appears that the user violated a prior tolling point, the enforcement officer may issue a citation.

Figure 4 Enforcement Area



12 SYSTEM OVERVIEW

The following sections provide an overview of the tolling and ITS systems to be developed and describe their purpose, scope, users, interfaces, capabilities, and system architecture.

12.1 TOLLING SYSTEM

This section describes in detail the different elements of the tolling system and how they will function as a system. The primary goal of the tolling system will be to provide clear direction to the roadway users while at the same time performing the necessary task of identifying individual users and assessing tolls.

12.1.1 GENERAL OVERVIEW

The tolling system will need to operate efficiently in order to achieve the primary goal of increasing the capacity of the US 36 corridor and maximizing travel times for all users. Currently, it is planned that the system will operate 24 hours a day with periodic closures during off-peak periods for maintenance purposes. A tolling point will be located between each interchange (as shown in Figure 5) and tolls will be displayed to the roadway users for the next two segments. Between consecutive tolling points, an egress/ingress zone will provide a location for users to enter or exit the managed lane.

12.1.2 ROADWAY USER COMPONENTS

The first task of the tolling system will be to clearly convey tolling information to the roadway users so they are able to make a decision whether or not to utilize the managed lane. Once their decision is made, the signing and striping will need to clearly convey to them the proper location to enter or exit the managed lane. To do this, the following tolling system elements will be utilized:

- **Variable Tolling Message Signs (VTMS):** The VTMS will be a combination of a static sign with an electronic VMS insert that will be utilized to display the specific tolls for each segment of the corridor. These will be positioned overhead between the managed lane and the leftmost general purpose lane to inform both the managed lane users as well as the general purpose users that may wish to enter or exit the managed lane at the next ingress/egress point. Figure 6 shows a conceptual layout of a VTMS sign. As shown, the toll information for the next two toll zones will be displayed. Also shown in Figure 6 are two alternatives that were considered which show a different number of destination points. The stakeholder group decided the concept that shows only the next two toll zones was preferable. The VTMS will be located upstream of the managed lane ingress/egress point in order to allow the roadway users sufficient time to make their decision.

  Initially, the managed lane will be tolled via a variable pricing scheme. Specifically, tolls will vary by time of day as is currently implemented along the I-

25 Express Lanes. If the current system architecture remains in place, then the toll rates will be communicated to the VTMS by the Camera Chameleon ITS Client at Node 2. At each specific time period, the software will relay the correct tolls to each VTMS and the correct display will be confirmed by the software operator. In addition, the correct display regarding the I-25 Express Lanes (closed or open) will need to be shown at those VMS and VTMS where I-25 Express Lane information is provided to inform eastbound drivers as they approach the reversible lane.

It is planned that a future phase will implement dynamic pricing where tolls are adjusted in real-time depending on roadway conditions. Since the VTMS will be directly connected to the proposed fiber backbone and therefore to CDOT Region 6 and the back-office, toll information could be adjusted in real-time by software located at these locations.

- **Signing and Striping:** The signing and striping associated with the tolling operations will be a critical component of the tolling system. Sufficient signage will be necessary in order to provide enough advance warning to drivers of the location of the ingress/egress point so that they are easily able to enter and exit the managed lane. In addition, clear signing and striping will reduce confusion for drivers and minimize lane buffer violations in which drivers enter and exit the managed lane at locations outside of the designated ingress/egress points. Although signing and striping is generally outside of the scope of this document, Figure 7 provides a conceptual layout of what the proposed signing and striping may look like.

  As shown, a buffer zone, identified by two solid white stripes, will divide the managed lane from the general purpose lanes. The width of the buffer will be 4 feet and no physical delineators should be used in the buffer zone.

- **Ingress/Egress Points:** As previously mentioned, a single 3,000 ft ingress/egress point is preferred between each interchange to accommodate the users entering and exiting the managed lane. Once roadway users interpret the toll information shown on the VTMS and make a decision regarding their use of the managed lane, they will have the opportunity to enter or exit the managed lane at the next ingress/egress point.

Figure 5 Electronic Tolling Point Locations

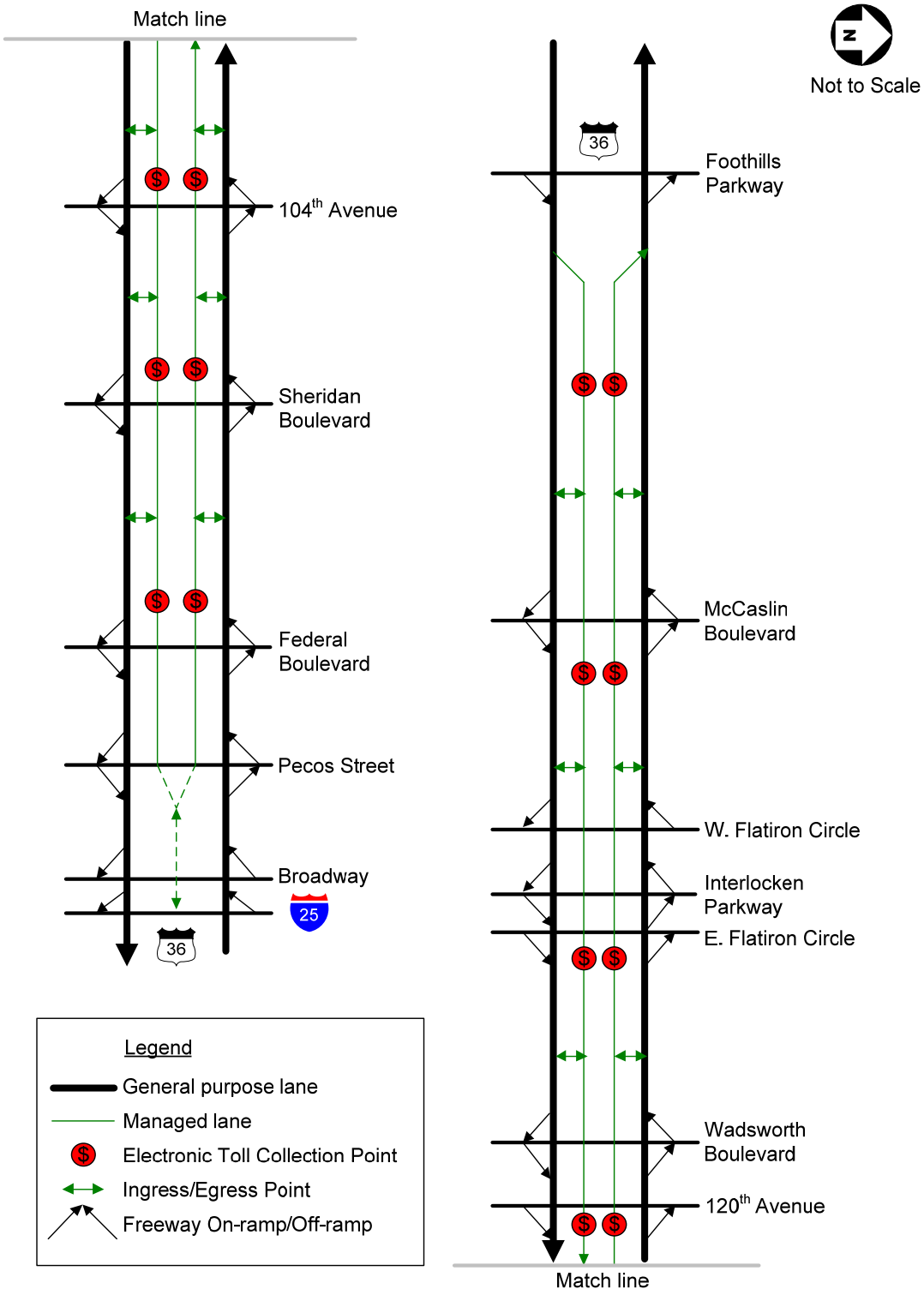
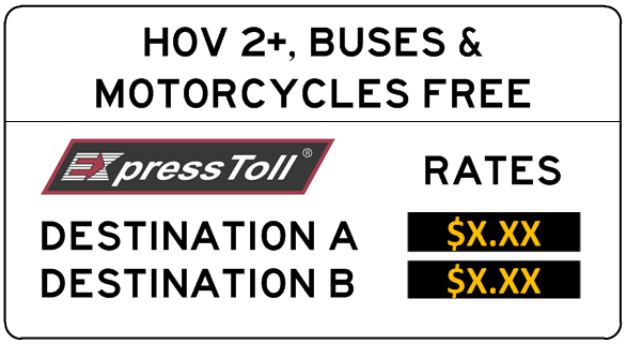


Figure 6 Variable Toll Message Sign (VTMS)

Selected VTMS Alternative



Additional VTMS Alternatives

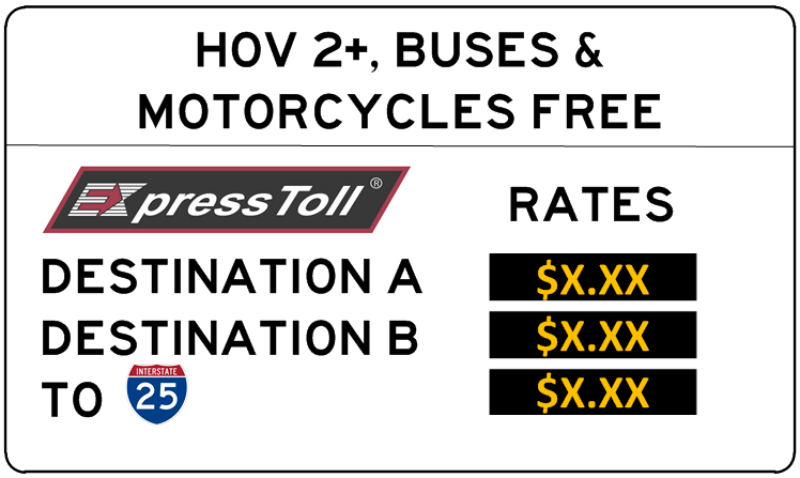
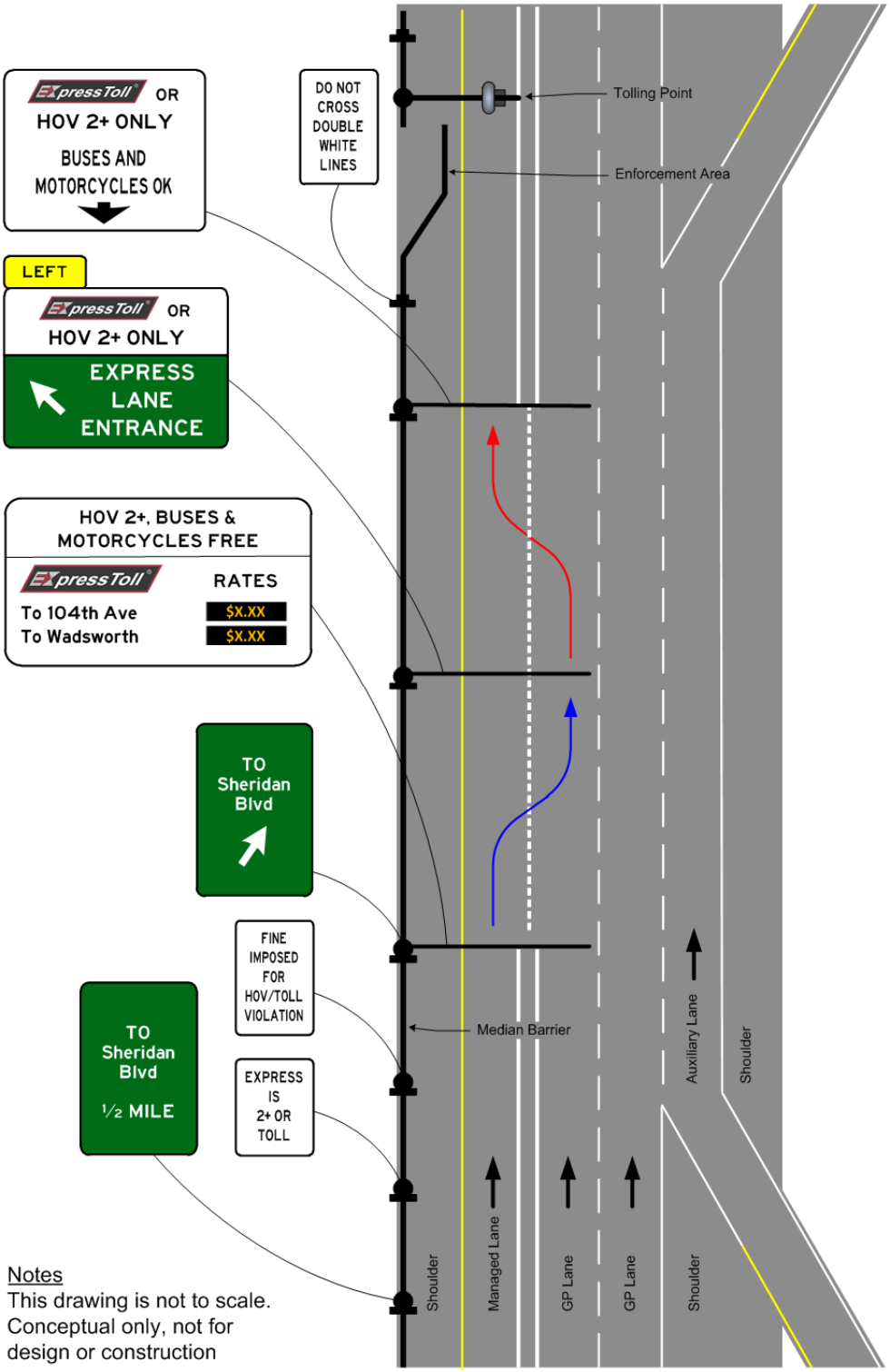


Figure 7 Conceptual Signing and Striping Plan



12.1.3 TOLLING POINT COMPONENTS

Once the users are in the managed lane, the tolling system will need to identify them and assess tolls to non-exempt users. The primary method for toll collection will be via transponders. Each tolling location will contain several components that will be mounted over /beside the managed lane to either read the transponders or utilize license plate cameras to identify users. Figure 8 contains a conceptual schematic of a potential tolling point. Each component in the system is discussed in more detail below:

- **Transponder**: As discussed in Section 9.1, the Preferred Alternative for tolling will encourage all users (both SOV and HOV) to have transponders. In order to differentiate between the two types of users, the transponders will either be switchable (dual-mode SOV/HOV or tri-mode SOV/HOV2+/HOV3+) or the mode will be set via the internet. For the switchable transponders, both modes will need to be active so that either a toll is assessed or HOV status is provided to the enforcement beacons. Disabling of the transponder for HOV users will not be sufficient. The transponders will need to contain ISO 18000-6C tags which is the preferred protocol for the US 36 managed lane.
- **Automatic Vehicle Identification (AVI) Reader**: AVI antennas will be mounted directly above the managed lane and will read the tag information stored inside each transponder. The AVI reader will need to be multi-protocol (Title 21 and ISO 18000-6C) so that it is compatible with US 36 transponders as well as Title 21 transponders currently used on existing facilities. Once a toll tag is read, information will be sent to the lane controller where it will be processed to determine if the user is an SOV or HOV.
- **Automatic License Plate Recognition (ALPR) Camera**: For vehicles where no transponder is present or where the transponder is unable to be read, ALPR cameras will be used to obtain an image of the vehicle's license plate. Once the image is taken, an Optical Character Recognition system will process the image to identify the vehicle's license plate. This information will then be sent to the lane controller.

  In-pavement loops, or a similar detection system, will be used to signal to the ALPR camera that a vehicle is present. Additional loops will be in place to classify heavy vehicles and assess the appropriate toll.
- **Lane Controller:** The lane controller will be located in the flared out enforcement area and will be connected to the equipment mounted over the managed lane using conduit bored under the roadway. It will be responsible for much of the data processing and will transmit the transponder tag and license plate information via the fiber communications network to the back-office for processing.

  The lane controller will need to be designed to provide redundancy in the system. This will ensure that tolling operations will continue even during a failure in the

primary processing unit. In addition, the lane controller will need to accommodate a storage system that will buffer transactions in the event that communications between the lane controller and the back-office are interrupted.

- **Enforcement:** If the lane controller determines that a particular user is an HOV, a signal will be sent back to the tolling point to light up an enforcement beacon. These beacons will need to be visible to officers stationed at the dedicated enforcement locations and will need to activate quickly enough to allow them to associate a beacon with a particular vehicle and then have enough time to confirm the correct occupancy. Since the flashes will be limited to HOV and exempt users (hybrids, motorcycles, etc.), it will reduce the burden on the enforcement personnel and clearly identify the vehicles where an occupancy check will need to be performed. If a user identified as HOV fails an occupancy check and appears to be in violation, the officer will pursue the offender or radio ahead to other enforcement personnel.

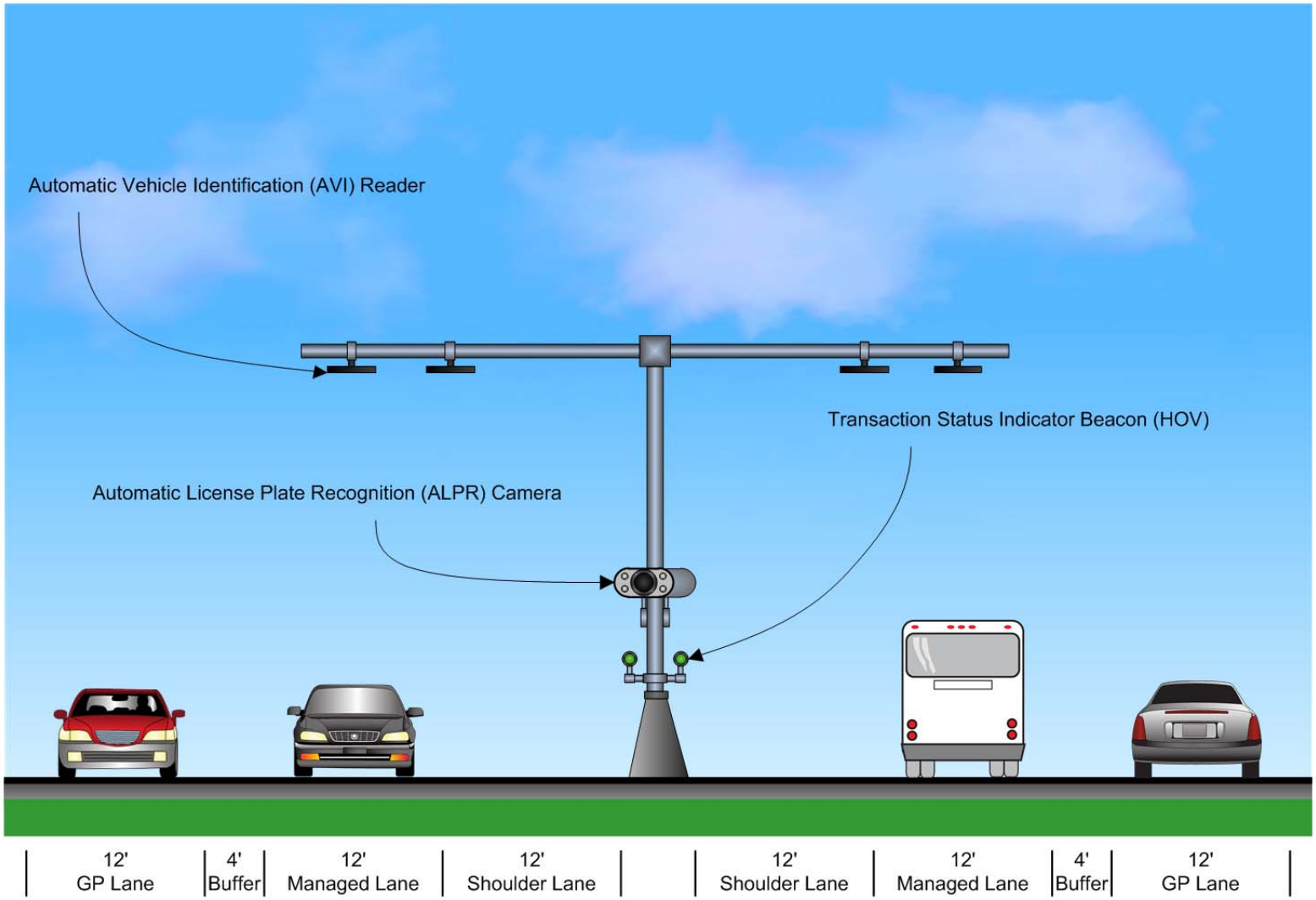
  Enforcement personnel may also be equipped with handheld readers and perform tolling point enforcement at locations other than the dedicated enforcement locations. These units will be located inside enforcement vehicles and allow an officer to scan the transponders of passing vehicles and find out when a toll transaction last occurred. If it appears that the user violated a prior tolling point, the enforcement officer may issue a citation.

  In addition to the tolling point enforcement, buffer violations will also need to be enforced. This will be done manually by officers patrolling the corridor.

- **Customer Service Center (CSC) Back Office:** The E-470 CSC back-office will receive all transponder tag and license plate information from the lane controller and assess tolls on the individual roadway users.

  Additional processing will be required for users tolled via license plate since the names and addresses of the registered users will need to be obtained from the State Department of Motor Vehicles. Once this information has been obtained, all the tolls incurred during a specific period are aggregated and bills will be sent out to collect payment. It is expected that slightly higher tolls will be assessed for these users to cover the costs of the additional processing that will be required and the fact that not all tolls may be recovered using this method. It is likely that this higher rate will also encourage users to obtain a transponder if they plan to utilize the corridor with sufficient frequency.

Figure 8 Conceptual Layout of Tolling Point



12.2 ITS SYSTEM

The Project will expand the ITS system currently present along the corridor. This will include new ITS equipment and a new communications network. New ITS elements and their intended function, the proposed communication network that will be used to transfer the information collected by the overall ITS system, and means by which the data will be disseminated will be discussed in the following sections.

12.2.1 SYSTEM COMPONENTS

The existing ITS components currently present along the corridor were discussed in Section 5.5 of this document. In the proposed project, additional equipment to expand the functionality of the existing system will be installed. Specifically, the following additional components are planned:

- **Closed Circuit Television (CCTV) Cameras:** The corridor currently has a total of 15 existing CCTV cameras. These cameras will be removed and replaced with new Ethernet-based cameras that will be connected to the fiber backbone and information will be relayed back to Node 2, the fiber optic regeneration building, and the CTMC. A sufficient number of new cameras will need to be installed to provide full CCTV coverage within the corridor. These cameras will be used by CDOT for various purposes including monitoring the corridor for weather conditions, accidents, traffic congestion, and other events.

- **Variable Message Signs (VMS):** There are a total of seven existing VMS in the US 36 corridor used by CDOT. Three are in the westbound direction and are primarily located in the western portion of the corridor. These VMS will remain and will continue to serve their existing function. The remaining four are in the eastbound direction with three of them clustered in the eastern portion of the corridor. These VMS are primarily used to provide information to eastbound drivers regarding the availability of the I-25 Express Lanes. It is expected that some of the uses of the existing eastbound VMS will be replaced by the new VTMS. As a result, the VMS currently located at Sheridan Boulevard will be removed from its current location but may be repurposed at a new location.

  New VMS will be installed as part of this project. The exact number and locations of these will be determined by CDOT ITS. These new VMS will not be used for tolling purposes but will be primarily used for other purposes such as providing driver information regarding travel times, weather advisories, and incident notifications.

- **Microwave Vehicle Radar Detectors (MVRD):** MVRD, also referred to as side-fire radar, are used to measure volume, occupancy, speed, and classification in each lane of travel. There are currently five MVRD units along the corridor that will need to remain functional during construction. Ultimately, MVRD units will

need to be provided every half-mile along the full extent of the project and configured to read both the managed lanes and the general purpose lanes. These units will be used to measure volume, speed, and occupancy to assist in calculating travel times along the corridor as well as adjust toll rates once dynamic tolling is implemented.

- **Travel Time Indicators (TTI):** The TTI antennas and readers currently detect Title 21 toll tag transponders in vehicles and use a custom algorithm that CDOT developed to estimate the travel time in each segment. The travel times for different segments are posted on VMS and online at www.CoTrip.org. The existing TTI will need to be upgraded to contain multi-protocol readers that can detect both the Title 21 and the ISO 18000-6C protocols. In addition, the software in the new TTI units may need to be modified to include the custom algorithm that CDOT currently uses in their existing TTI to extract traffic data.

  A sufficient number of new readers will need to be installed to provide enough data to be able to accurately predict travel times in the corridor. Data for the managed lane will need to be separate from data for the general purpose lanes in order to provide travel time for each. CDOT's intent is to post both travel times at www.CoTrip.org.

- **Ramp Meter Stations (RMS):** There are currently 10 RMS operating within the corridor. It is expected that many of these will be impacted by the reconstruction. The existing in-pavement loops along mainline US 36 will be removed and the gore points of many of the ramps will likely be relocated. As a result, those RMS locations that will be impacted will need to be re-designed and use MVRD to measure mainline data instead of in-pavement loops. Wireless pucks will replace the loops on the ramps, if affected.

- **Automatic Traffic Recorder (ATR)/Traffic Counting Stations:** There are four existing ATR/traffic counting stations along US 36. Depending on the extent of the initial phase, these locations may be impacted by the reconstruction and will need to be replaced.

12.2.2 COMMUNICATIONS

The existing communications network that provides access to the many ITS elements along the corridor is comprised of a wireless backbone with wireless laterals to each device. There is existing fiber from Node 2 to Sheridan Boulevard that will be replaced. The project will tie into this existing conduit bank from Node 2 to Federal Boulevard and extend it westward. This new fiber backbone will be Ethernet-based with a separate cable for CDOT and RTD to provide independent communications for each agency. The new backbone will accommodate all communications for the ITS and tolling components, as well as additional traffic and RTD communications. In addition, several fiber laterals will be necessary to provide communications to RTD park-n-Ride's and Bus Rapid Transit stations.

The new fiber backbone will be utilized to provide connectivity to all of the ITS and tolling elements along the corridor. This includes CCTV cameras, MVRD and TTI units, VMS displays, ATR stations, and the lane controllers connected to the AVI equipment that will be used for tolling purposes. Specifically, the CCTV, MVRD, TTI, VMS, and ATR video/data will be sent to CTMC to be used for various purposes including monitoring of the corridor, developing travel times, and obtaining data on the corridor. Calculated travel times will be displayed on CDOT's www.CoTrip.org website and may be fed back to the VMS to inform the roadway users. Tolling information collected by the AVI will be sent to HPTE and the back-office for processing and toll collection.

In the interim, all existing ITS devices and communications connectivity will need to be maintained by the design/build team during the construction period.

13 DEPLOYMENT

The initial deployment of the system will be a critical component of the Project. Close coordination between CDOT, HPTE, the design/build team, and the tolling integrator will be necessary to ensure each component of the system is installed and deployed correctly. For example, since the design/build team will be constructing all structures on which the tolling equipment will be installed, the tolling integrator will need to work with the design/build team prior to that to ensure that all structures are sufficient to accommodate the tolling equipment. Thorough testing will need to be performed to ensure that all components of the system are operating correctly before the managed lane is open to the public.

After the facility is open to the public, the following items should be considered to ensure proper and effective use of the managed lane system:

- **Public Relations and Education**: A public relations and education campaign will need to be carefully developed and implemented prior to and during the initial deployment of the facility to ensure potential users understand how to properly use the facility. This could involve broadcast and print media, online information, special mailings to existing I-25 Express Lanes customers and E-470 transponder holders as well as a wide variety of targeted strategies to reach people in the communities most likely to use the facility. Also, E-470 customer service center personnel will need to be specifically staffed and trained to deal with these start-up issues.
- **Temporary Signage**: Supplemental signage should be provided for a limited duration following the initial deployment of the managed lane system to assist users in correctly utilizing the facility. These signs should provide additional information regarding the location and proper use of the ingress/egress zones, the type of users that may utilize the system, transponder requirements, means by which tolls will be collected, and details on the types of violations that will be enforced and their respective fines. Some of this supplemental signage should be removed after a certain period when users have had sufficient time to learn how to use the facility.
- **Enforcement**: Based on the experience of other managed lane facilities in the country, violations rates tend to be highest when facilities are first open to the public. To counter this, enforcement of the managed lane should be increased for an initial period to discourage toll and buffer violations and send a clear message to potential violators that enforcement will be a key strategy in the operations of the facility.
- **Grace Period**: It is likely that some exempt users will inadvertently be tolled due to their not being familiar with the proper use of the facility. As a result, a grace period should be considered during which tolls due to incorrect usage are waived or refunded. This would pertain primarily to HOV users that do not have

transponders or do not pre-register and are therefore assessed a toll. These users might have their tolls waived for their first offense if they obtain switchable transponders or pre-register their license plates so as to avoid tolls in the future.

14 MAINTENANCE AND OPERATIONS ROLES AND RESPONSIBILITIES, AND STAFFING REQUIREMENTS

With the addition of the managed lanes and associated infrastructure, maintenance and operations requirements will increase. The current plans for maintenance roles and responsibilities are as follows:

- **HPTE:** HPTE has the responsibility for managing and operating the I-25 and future US 36 toll facilities. HPTE will contract other agencies to perform back office support and maintenance and operations roles along the corridor.

- **CDOT ITS:** The CDOT ITS Branch will operate and maintain the existing and proposed ITS infrastructure along US 36. This includes many of the ITS elements discussed in Section 5.5, but will not include the tolling equipment. Based on the anticipated workload, CDOT ITS foresees the need for 2 new maintenance personnel and one aerial bucket truck (4X4) to maintain all the new and proposed devices.

- **CDOT Region 4:** CDOT Region 4 will operate and perform general maintenance of the US 36 facility west of Wadsworth Boulevard.

- **CDOT Region 6:** CDOT Region 6 will operate and perform general maintenance of the US 36 managed lane facility (under an agreement with HPTE) as well as the general US 36 facility east of Wadsworth Boulevard. They will continue to be responsible for opening and closing the I-25 Express Lanes, and ensure that the existing and new VTMS are operational.

- **E-470:** Through an agreement with HPTE, E-470 will provide back-office support to HPTE for the US 36 managed lanes. In addition, they will provide, install, operate, and maintain the toll collection equipment.

It is recommended that HPTE, CDOT and E-470 develop operations, maintenance and Go Live plans that will include determination of the magnitude of impact the expanded managed lane system will have on personnel and equipment needs. These agencies should prepare a staffing plan to quantify these personnel and equipment needs. Considerations for this plan should include:

- **Go Live:** The Go Live plan should detail all up-front education and marketing, cover all issues associated with the initial opening of the facility, and address specific start-up needs.

- **Contracted Services:** New contracts or modifications of existing contracts will be necessary to address areas such as HOV enforcement and E-470 back office responsibilities**.**

- **Travel:** The travel distances from the CDOT dispatch points to the field vary greatly and may include over an hour of travel time just to arrive on-site.

- **Region Responsibilities:** Responsibilities should be designated and further defined for each CDOT Region and staff.

- **Communication Infrastructure and Equipment:** Personnel need to be trained and equipped to perform routine and emergency troubleshooting and repair.

- **System Monitoring:** The managed lanes will operate continuously and service will be of utmost importance given that drivers, especially those paying tolls, will expect a certain quality of service for the system.

- **Utility Locates:** CDOT will be responsible for locating longitudinal and latitudinal crossings through the Utility Notification Center of Colorado and will need to have resources available to perform these functions.

- **Equipment:** Additional communications infrastructure and potentially new technology may create a need for new tools to perform maintenance.

- **Vehicles:** Appropriate vehicles are needed for installation, repair and testing of equipment. Vehicles will be needed to access toll rate signs, CCTV cameras, toll readers, and related equipment (vehicles may include aerial trucks and splicing vans.)

- **On-Call Personnel:** The managed lanes will operate 24 hours per day, seven days a week. Depending upon the frequency of maintenance patrolling and equipment failures, personnel may be needed to perform dedicated or rotational shifts for on-call duties.

- **CSC Staffing and Training:** E-470 will need to address the US 36 managed lanes with specific training and staffing needs, particularly at start-up.

- **Integration of ITS Equipment:** All ITS equipment will need to be integrated into the CTMC network, including CTMS, Camera Cameleon, and www.CoTrip.org.

- **Training:** All staff must be appropriately trained to handle routine and emergency maintenance response for the system.

These maintenance considerations will require additional resources. Personnel needs may translate into full-time equivalent (FTE) or may result in a fractional increase in personnel time (e.g., ½ FTE). Staffing could come in the form of CDOT personnel, contract employees, or a combination of both.

EXHIBIT D

Tolling and Use Policy

- HPTE shall be responsible for ensuring that tolling requirements for the Project coordinate with tolling requirements for the existing North I-25 Project and are more fully described in Exhibit D. The toll rates during the Peak Period for a through trip between US36/Flatirons and Denver shall not be less than RTD Regional fares during the Peak Period for a through trip between US 36/Flatirons and Denver.

- HPTE shall have the authority to set toll rates and to change tolls in order to effectively manage congestion and meet the requirements of the MTI. The toll rates shall not be less than RTD Express or Regional fares during the Peak Period for an equivalent trip.

- HPTE will provide written notice to RTD of any toll rate schedule changes at least 30 days in advance. RTD shall provide written notice to HPTE if there are any changes to RTD Express or Regional fares at least 30 days in advance of such change. RTD will not require CDOT to increase Peak Period tolls based on RTD fares more than once per year.

- HPTE shall increase tolls or taker other appropriate steps when travel times for RTD buses on the North I-25 HOV lane fall below target travel times established in the North I-25 HOV IGA due to increased traffic volume from the US 36 managed lanes.

- **Tolling procedures for Special Events**
    - To be determined

- Peak Period" shall be defined as 6:45 to 8:45 A.M. and 4:30-6:00 P.M.

- Single occupancy vehicles will be allowed in the Managed Lanes at the toll rates established by HPTE to manage congestion and comply with the requirements of the MTI.

- Vehicles with two or more occupants will be allowed free of charge on the Managed Lanes HOV subject to the provisions of the MTI. Contracts will be entered into and funds provided in the operating budget to properly enforce the occupancy requirements.

- RTD Buses, RTD ADA vehicles, and RTD contractor operated buses ("RTD Buses") and ADA vehicles will be allowed to use the Managed Lanes without any charge. All designated RTD Buses will be equipped by HPTE, at HPTE's cost, with transponders.
- If Managed Lane use exceeds projections and creates congestion on I-25 HOV lane in the such that travel times for RTD Buses fall below target travel times specified in the existing North I-25 HOV IGA Parties will meet and confer on the existing North I-25 Toll Rates.

- RTD maintenance and incident support vehicles will be allowed to use the Managed Lanes only for the purpose of servicing vehicles in the lanes, without charge. Such vehicles must be predesignated and have a transponder. RTD will designate only maintenance and incident support vehicles for access at no charge. RTD employee transportation vehicles will not be provided free access

EXHIBIT E

Emergency Operations Procedures Manual

US 36 Managed Lane

Emergency Operations Procedures Manual

1. Using the Manual

The US 36 Managed Lane Emergency Procedures Manual is a multi-agency effort initiated by the Colorado High Performance Transportation Enterprise (HPTE), the Colorado Department of Transportation (CDOT), and the Regional Transportation District (RTD) to support and enhance response to incidents on US 36 between I-25 and Interlocken Boulevard. This manual provides resource information for incident responders.

The following section provides definitions of incident levels and the appropriate actions to be taken to manage traffic. The first responder should assess the scene and report the level of impact to the CDOT Traffic Operations Center (TOC at 303.512.5830. The TOC will then make the appropriate contacts for the incident level.

The remaining sections provide information for use on-scene, including scene management guidelines, resource lists, and alternate routes.

2. Incident Levels

Level	Impact to Roadway	Actions to be Taken
1	Impact to traveled roadway estimated to be **less than 30 minutes with no lane blockage.** Or Impact to traveled roadway is estimated to be **less than 30 minutes with lane blockages.**	Follow agency protocols
2	Impact to traveled roadway estimated to be **greater than 30 minutes, but less than 2 hours with lane blockages, but not a full closure of the roadway.**	• Establish Incident Command • Consider designating staging areas • Coordinate with CDOT to consider implementing alternate routes • Contact the CDOT Traffic Operation Center (TOC) The CDOT TOC will: o Update CDOT website o Activate Highway Advisory Radio (HAR) & signs o Place messages on variable message signs (VMS) o Fax out advisories to Level 2 contacts • Contact: CDOT Region 6 Maintenance Supervisors CDOT HOT Lanes Supervisors if HOT Lanes impacted (303.870.5235) E-470 TOC if HOT lanes impacted (303.537.3400)
3	Congestive impact to traveled roadway is estimated to be **greater than 2 hours or roadway is fully closed in any single direction.** **CDOT TOC** **(303) 512-5830**	• Establish Command Center or Post • Coordinate with CDOT to implement alternate routes • Consider designating staging areas • Contact the CDOT Traffic Operation Center (TOC) The CDOT TOC will: o Update CDOT website o Activate Highway Advisory Radio (HAR) & signs o Place messages on variable message signs (VMS) o Fax out advisories to Level 2 and Level 3 contacts • Contact: CDOT Region 6 Maintenance Supervisors CDOT Public Information Officer (PIO) CDOT HOT Lanes Supervisors if HOT Lanes impacted (303.870.5235) E-470 TOC if HOT lanes impacted (303.537.3400) Signal jurisdictions on alternate route

3. Scene Management Guidelines

4. **Emergency Access and Staging Areas**
    a. **Emergency Access Points**
    To be determined

    b. **Incident Staging areas**
    To be determined

5. Resources

6. PIO Contact List

7. Alternate Route Information

8. Toll Facility Diagram

Exhibit F

US 36 Managed Lanes Project – RTD Support Staff Scope of Work

RTD will provide staff to the US36 Managed Lanes Project as support to CDOT in the management of the Project per the terms of Intergovernmental Agreement between CDOT, RTD, and HPTE. The following RTD staff will be assigned to the project in support roles to CDOT:

RTD Project Manager

The RTD Project Manager (PM) will provide support services to the US36 Managed Lanes Project Director in the overall management of the Project. The RTD PM will provide the following services to the Project:

- Provide overall project management services for the project, including the RTD elements.
- Assist with development of the RFP
- Assist with stakeholder relations
- Assist with the procurement process
- Review contractor submittals
- Attend project meetings
- Review contract changes
- Act as a general liaison between CDOT and RTD for this project
- Other duties as necessary

RTD Construction Manager

The RTD Construction Manager (CM) will provide support services to the RTD Project Manager, as well as assist the CDOT Construction Manager with overall construction management of the project. The RTD CM will provide the following services to the Project:

- Provide construction management services for the Project, including the RTD elements.
- Support the RTD Project Manager and the CDOT staff
- Assist with development of the RFP
- Assist with the procurement process
- Review contractor submittals including schedules, pay estimates, and management plans.
- Provide support to the Project team on assessments
- Attend project meetings
- Review contract changes
- Act as a general liaison between CDOT and RTD for this project
- Other duties as necessary or assigned

RTD Office Engineer

The RTD Office Engineer will provide support services to the RTD Project Manager, as well as assist CDOT with the overall delivery of the project. The RTD Office Engineer will provide the following services to the Project:

- Provide general engineering support to the Project team
- Review and track contractor submittals
- Conduct project assessments for both design and construction activities as directed by the Project team
- Provide design and construction coordination support for Project team (tracking RFIs, design changes, updating plans sets, etc.)
- Conduct design and construction assessments as assigned by the Project team
- Attend project meetings
- Provide oversight activities for the RTD elements
- Other duties as necessary or assigned

In addition to the project staff listed above, RTD has included the procurement of two project vehicles for use by RTD staff on the Project in the staffing cost estimate.

RTD Staffing Estimate

8/12/2011

US 36 Managed Lanes Project - PSC Support Staff

CONTRACT PRICING PROPOSAL				
NAME OF OFFEROR	**Nadine Lee**		CONTRACT NO.	
DETAILED DESCRIPTION OF COST ELEMENTS				
1. DIRECT LABOR (Specify individuals and dates of service)	ESTIMATED HOURS	DIRECT LABOR RATE/HOUR	ESTIMATED COST ($)	TOTAL EST. COST
Project/Construction Management Support				
RTD Construction Manager - 2011	1,040	$50.02	$52,021	
RTD Construction Manager - 2012	1,920	$51.52	$98,918	
RTD Construction Manager - 2013	1,920	$53.07	$101,894	
RTD Construction Manager - 2014	1,920	$54.66	$104,947	
RTD Construction Manager - 2015	1,560	$56.30	$87,828	
TOTAL DIRECT LABOR	8,360			$445,609
2. LABOR OVERHEAD	OH RATE	X BASE=	EST COST ($)	
Overhead Rate	126.90%	$445,609	$565,478	
TOTAL LABOR OVERHEAD				$565,478
	TOTAL DIRECT LABOR AND OVERHEAD			$1,011,086
3. FIXED FEE (Based on 10% Direct Labor & Overhead)	10%			$101,109
4. SUBCONSULTANT COSTS (Attach Itemization)				$0
5. OTHER DIRECT COSTS (See Itemization)				$0
6. TOTAL ESTIMATED COST AND FEE				$1,112,195

RTD Staffing Estimate

8/12/2011

US 36 Managed Lanes Project - RTD Support Staff

CONTRACT PRICING PROPOSAL				
NAME OF OFFEROR **Nadine Lee**			CONTRACT NO.	
DETAILED DESCRIPTION OF COST ELEMENTS				
1. DIRECT LABOR (Specify individuals and dates of service)	ESTIMATED HOURS	DIRECT LABOR RATE/HOUR	ESTIMATED COST ($)	TOTAL EST. COST
Project Management				
RTD Project Manager - 2011	1,040	$52.88	$54,995	
RTD Project Manager - 2012	1,920	$54.47	$104,582	
RTD Project Manager - 2013	1,920	$56.10	$107,712	
RTD Project Manager - 2014	1,920	$57.78	$110,938	
RTD Project Manager - 2015	1,560	$59.52	$92,851	
Engineering Support				
Office Engineer - 2011	1,040	$37.00	$38,480	
Office Engineer - 2012	1,920	$38.11	$73,171	
Office Engineer - 2013	1,920	$39.25	$75,360	
Office Engineer - 2014	1,920	$40.43	$77,626	
Office Engineer - 2015	1,560	$41.64	$64,958	
TOTAL DIRECT LABOR	16,720			$800,674
2. LABOR OVERHEAD	OH RATE	X BASE=	EST COST ($)	
Overhead Rate	33.00%	$800,674	$264,222	
TOTAL LABOR OVERHEAD				$264,222
	TOTAL DIRECT LABOR AND OVERHEAD			$1,064,896
3. FIXED FEE (Based on 10% Direct Labor & Overhead)	0%			$0
4. SUBCONSULTANT COSTS (Attach Itemization)				$1,112,195
5. OTHER DIRECT COSTS (See Itemization)				$111,540
6. TOTAL ESTIMATED COST AND FEE				$2,288,631

RTD Staffing Estimate

8/12/2011

US 36 Managed Lanes Project - RTD Project Vehicle

CONTRACT PRICING PROPOSAL				
NAME OF OFFEROR	**Nadine Lee**		CONTRACT NO.	
DETAILED DESCRIPTION OF COST ELEMENTS				
1. DIRECT LABOR (Specify individuals and dates of service)	ESTIMATED HOURS	DIRECT LABOR RATE/HOUR	ESTIMATED COST ($)	TOTAL EST. COST
Project Direct Costs				
Project Vehicle 2012* - RTD PM	2,080	$6.50	$13,520	
Project Vehicle 2013* - RTD PM	2,080	$6.50	$13,520	
Project Vehicle 2014* - RTD PM	2,080	$6.50	$13,520	
Project Vehicle 2015* - RTD PM	1,560	$6.50	$10,140	
Project Vehicle 2012* - RTD CM	2,080	$6.50	$13,520	
Project Vehicle 2013* - RTD CM	2,080	$6.50	$13,520	
Project Vehicle 2014* - RTD CM	2,080	$6.50	$13,520	
Project Vehicle 2015* - RTD CM	1,560	$6.50	$10,140	
TOTAL DIRECT LABOR	15,600			$101,400
2. LABOR OVERHEAD	OH RATE	X BASE=	EST COST ($)	
Overhead Rate	0.00%	$101,400	$0	
TOTAL LABOR OVERHEAD				$0
		TOTAL DIRECT LABOR AND OVERHEAD		$101,400
3. FIXED FEE (Based on 10% Direct Labor & Overhead)	0%			$10,140
4. SUBCONSULTANT COSTS (Attach Itemization)				$0
5. OTHER DIRECT COSTS (See Itemization)				$0
6. TOTAL ESTIMATED COST AND FEE				$111,540

*Price includes lease, gas, and maintenance and is based off Jacobs negotiated rate with CDOT of $6.50/manhour

EXHIBIT G

ITS Telecommunications Infrastructure on US-36

DEFINITIONS

The term "**Backbone**" as used herein refers to the ITS fiber optics cables that are installed longitudinally within the CDOT ROW along the general project alignment that accommodates joint use by CDOT and RTD.

The terms "**Lateral**" or "**Lateral Fiber Optics Cables**" or "**LFOC**" as used herein refer to two 2" Conduits and the enclosed fiber cable that provide connectivity from the manholes and/or pullboxes to RTD-owned devices or structures.

The term "**ITS Telecommunications Infrastructure**" or "**ITI**" as used herein refers to the Backbone, LFOCs, CDOT lateral runs, cabinets, manholes, pullboxes and all other inherent hardware for the Project.

OWNERSHIP OF ITS TELECOMMUNICATIONS INFRASTRUCTURE

CDOT Ownership

CDOT shall own the ITI within the CDOT right-of-way (ROW) with the exception of the RTD ownership described below.

Manholes within the CDOT ROW shall remain the sole properties of each Party per the identification imprinted on the manhole cover. Other than CDOT and RTD maintenance staff or their contractors, no other entity, private or public, shall be permitted to enter manholes located along the facility.

CDOT shall grant RTD an Irrevocable Indefeasible Right-to-Use (IRU) of the 3-inch conduit and the microduct cable as indicated in Exhibit B.

CDOT shall grant RTD an Irrevocable Indefeasible Right-to-Use (IRU) for the LFOC that will be installed at manholes and/or pullboxes and extend to twelve RTD stations per Exhibit B section IV to provide optical interconnectivity.

CDOT shall own the ITI contained within the node building (physically located in the basement of the Table Mesa parking garage) shown in Figure 1.

RTD Ownership

RTD shall own all communications infrastructure consisting of one 3–inch conduit along with the longitudinal 144 strand single mode fiber optic telecommunications cable, one microduct cable, LFOC cables, all manholes, hand holes (pull boxes) that have been imprinted with RTD logo, along with all inherent hardware, cabling, connectors, splice boxes, splice canisters, patch panels and other related

equipment within CDOT ROW installed with the US 36 Managed Lane project per Exhibit B.
RTD shall own the physical structure of the node building (located in the basement of the Table Mesa parking garage needed for regeneration and termination of fiber optics and telecommunications equipment).

RTD shall grant CDOT an irrevocable easement for the use of and access to the node building in the Table Mesa parking garage for the purposes of constructing, installing, operating and maintaining CDOT-owned ITS telecommunications equipment housed in the node building. RTD shall not assess any lease or fees on CDOT for the use of this facility.

PREVENTATIVE MAINTENANCE AND NORMAL REPAIR WITHIN CDOT ROW
Upon completion and CDOT acceptance of all work on this Project, the Parties agree to the following routine maintenance provisions of the ITI.

CDOT Responsibilities
Routine Facility Line Maintenance:
CDOT shall, at its own expense, provide routine Backbone line maintenance along the entire route, including visual inspection of the line, marker post maintenance, Backbone fiber line locates when required, and other maintenance items that are of a non-emergency nature. CDOT may subcontract this function if desired. RTD shall not be required to pay a prorated fee for this category of maintenance.

CDOT shall register the Backbone and LFOC that is located on CDOT ROW with the Utility Notification Center of Colorado (UNCC). CDOT shall place fiber markers which identify the Backbone and LFOC that is located on CDOT ROW.

RTD Responsibilities
RTD, at its own expense, shall maintain its LFOC runs, to the BRT stations specified in Exhibit B Section iv.

Register LFOC with UNCC, Fiber Markers and Locates:
RTD shall register the LFOC that is located on RTD ROW with the Utility Notification Center of Colorado (UNCC). RTD shall allow CDOT to place fiber markers, which identify the LFOC that is located on RTD ROW. If such CDOT fiber markers are unacceptable to RTD, RTD shall place fiber markers at its sole expense, at intervals along the LFOC as directed by CDOT, which identify the LFOC that is located on RTD ROW. RTD shall perform, or cause to be performed, all locates on the LFOC on RTD ROW that result from UNCC notification and/or any construction activity of which RTD has knowledge that may affect the LFOC.

EMERGENCY REPAIR COSTS AND INVOICES

CDOT shall perform emergency repair on the ITS telecommunications backbone and invoice RTD based on the rates therein. CDOT agrees to invoice RTD in accordance with its normal business process for all maintenance activities. The invoice shall be itemized to identify the costs for each repair item for each specific repair activity. The cost of the repair will be based on ownership of the damaged conduit/fiber. CDOT will pay the initial amount of the emergency restoration cost with RTD reimbursing CDOT its pro rata share based on the total quantity of the damaged conduits and fiber strands. In the event that only one Party's backbone infrastructure is damaged CDOT will still initiate the repair activities and seek reimbursement from the owner of the fiber.

RELOCATION

In the event that any of the ITI may need to be relocated due to a transportation project in CDOT ROW, each party shall be responsible for their respective share of the total amount of those relocation costs.

NOTIFICATION AND ACCESS TO FACILITIES

The Parties shall have access to one another's property to perform maintenance, repair or modifications to their ITS Infrastructure. For all non-emergency work, they shall notify one another in advance of any maintenance and/or repair that they intend to perform concerning any equipment, power source, etc. on one another's property. Such notice shall be provided via electronic mail to the Party's representative identified in CONTACTS a minimum of three (3) working days in advance of the performance of the maintenance and shall provide the other party with a reasonable description of the nature, location and duration of the work, timeframe and extent of the maintenance activity, except for emergency maintenance which notice shall be provided as soon as possible to the same representative. Each Party shall require its contractors performing work on the other Party's property to provide insurance in an amount subject to agreement by both parties for incidents, damages or claims that may arise out of performance of the work and naming the other party as an additional insured. Each party shall require its contractors to indemnify and hold harmless the other Party for all injuries, damages, loses or and/or claims arising out of any work performed on the other party's property and/or to the other Party's property and equipment.

CDOT may enter into subsequent IGA with other governmental or educational entities to share use of its fiber. However, work performed within the manhole must be performed by the Parties or their qualified contractor, and adhere to the guidelines noted herein.

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must be performed by the Parties or their qualified contractor, and adhere to the guidelines noted herein.

Manhole Access:
Whenever the Parties or their contractors desire to enter a manhole for a non-emergency reason, the Parties shall first notify the CDOT ITS Office at (303) 512-5800 a minimum of 3 business days prior to the entrance. Proper safety equipment and/or traffic control shall always be used for manhole access. CDOT reserves the right to review and accept or reject any Method of Handling Traffic (MHT) that may be required for manhole or Facility access by the Parties or their contractors. It is expressly understood that RTD does not require approval from CDOT before proceeding with manhole entrance. The notification mechanism required herein is for security and coordination purposes.

CDOT and RTD Contractors:
All Contractors must obtain a CDOT utility permit prior to commencement of any work.

Annual Permit:
Upon completion of construction on US-36, CDOT will grant a Permit to RTD that gives RTD the right to perform work on its LFOC runs in CDOT ROW provided that RTD and its Contractor complies with all applicable provisions in this Agreement and the permit(s). CDOT may require renewal of the Permit on a not more than annual basis provided that all terms and conditions with respect to application for and issuance of such Permit are completely satisfied.

CONTACTS

For CDOT HOV related issues:
Steve Sperry
CDOT Region 6
303-757-9511

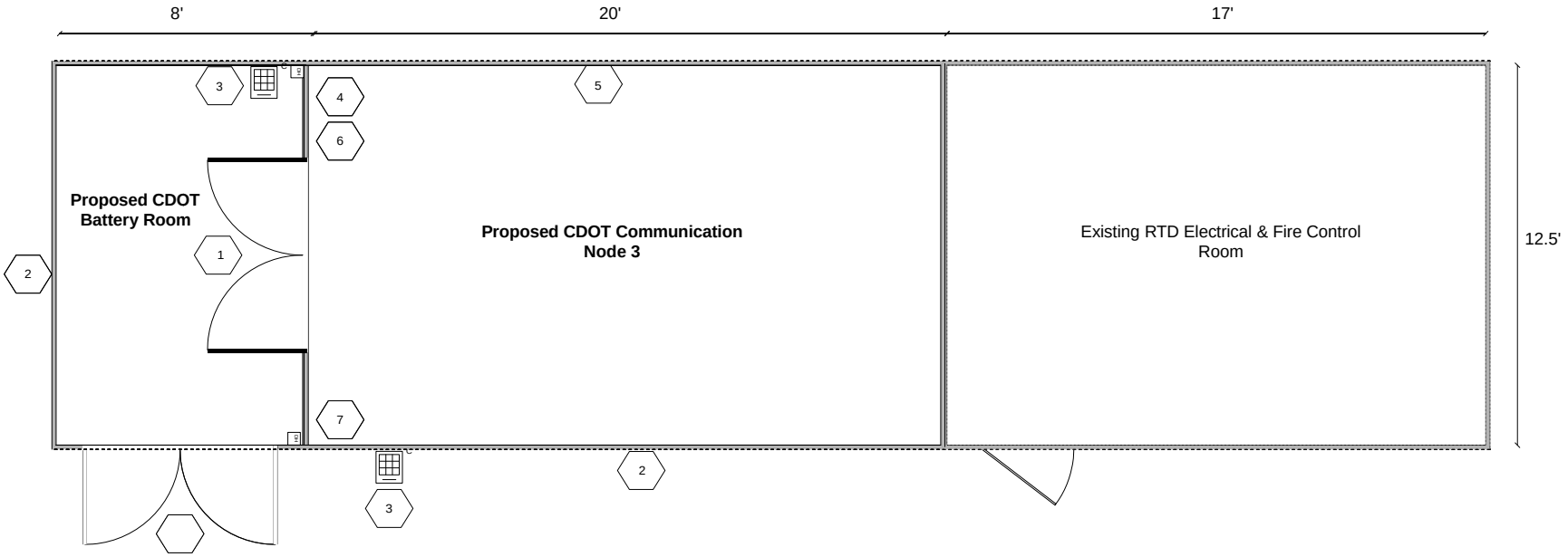
For CDOT ITS Telecommunications Infrastructure issues:
Matt Becker
CDOT ITS
303-512-5800

For RTD BRT issues:
Nadine Lee
Project Manager
RTD FasTracks
303-299-6978

For RTD IT/Communications issues:
Neal Mondschein
Telecom/Network Analyst
RTD Information Technology
303-299-6134

FIGURE 1. PROPOSED CDOT COMMUNICATIONS NODE BUILDING AT TABLE MESA PARKING STRUCTURE

Proposed CDOT Communications Node 3 at Existing Table Mesa PnR Parking Structure



NOTES:

1. Proposed 6' double doors to facilitate bulky equipment installation or removal.
2. Wall construction to match existing CMU used for RTD Electrical & Fire Control Room.
3. CDOT card reader with keypad entry for secure access.
4. Conduit access from US-36 TBD.
5. Fireproof plywood backboard along west wall.
5. Electrical service from existing Xcel 3Ø 277Y/480 VAC transformer 2075 238 099 039.
6. UPS size TBD. Generator to be located on roof with a piped natural gas supply vs. fuel tank.
7. Single or redundant HVAC sizing TBD