

**SCHEDULE 5**

**HPTE Phase 2 Work Requirements**



Colorado High Performance  
Transportation Enterprise

***US 36 Managed Lanes Project – Toll  
Concession Project***

**SCHEDULE 5**  
**HPTE PHASE 2 WORK REQUIREMENTS**

February 25, 2014

PROJECT NO. NH 0361-103  
Code: 18907

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**1. Abbreviations**

“**AASHTO**” means American Association of State Highway & Transportation Officials.  
“**AC**” means alternating current.  
“**ADT**” means Average Daily Traffic.  
“**ALPR**” means Automatic License Plate Recognition.  
“**APCD**” means Air Pollution Control Division.  
“**APEN**” means Air Pollution Emission Notice.  
“**ATC**” means Alternative Technical Concepts.  
“**ATM**” means Active Traffic Management.  
“**ATR**” means Automatic Traffic Recorders  
“**AVI**” means Automatic Vehicle Identification  
“**BMP**” means Best Management Practices  
“**BOS**” means Bus on Shoulders.  
“**BRT**” means Bus Rapid Transit  
“**BTPD**” means black-tailed prairie dog  
“**CADD**” means computer-assisted drafting and design.  
“**CCTV**” means Closed Circuit Television  
“**CDPHE**” means Colorado Department of Public Health and Environment.  
“**CDPS**” means Colorado Discharge Permit System  
“**CDPS-SCP**” means Colorado Discharge Permit System-Stormwater Construction Permit  
“**CLOMR**” means Conditional Letter of Map Revision  
“**COC**” means Certificate of Compliance  
“**CPM**” means Critical Path Method  
“**CPW**” means Colorado Parks and Wildlife  
“**CRAL**” means Construction of Relocation Acceptance Letter.  
“**CSP**” means Colorado State Patrol  
“**CTMC**” means Colorado Traffic Management Center  
“**CTR**” means Certified Test Report.  
“**CUHP/EPA-SWMM**” means Colorado Urban Hydrograph Procedure/Environmental Protection Agency Storm Water Management Model  
“**DCS**” means Document Control System  
“**DRAL**” means Design of Relocation Acceptance Letter.  
“**DTD**” means the CDOT Division of Transportation Development  
“**EDB**” means extended detention basins.  
“**ECS**” means Erosion Control Supervisor  
“**ESAL**” means 18-kip Equivalent Single Axle Loads  
“**ETC**” means Electronic Toll Collection  
“**FCM**” means fracture critical member  
“**FHWA**” means Federal Highway Administration

“**HASP**” means Health and Safety Plan  
“**HBP**” means hot bituminous pavement  
“**HMA**” means Hot Mix Asphalt  
“**HOV**” means High Occupancy Vehicle  
“**IMP**” means Incident Management Plan  
“**INWMP**” means Integrated Noxious Weed Management Plan  
“**ITS**” means Intelligent Transportation Systems.  
“**LFD**” means load factor design  
“**LFR**” means load factor rating  
“**LOMR**” means Letter of Map Revision  
“**LRFD**” means load resistance factor design  
“**LRFR**” means load and resistance factor rating  
“**MBTA**” means Migratory Bird Treaty Act  
“**MHT**” means method of handling traffic  
“**MMP**” means Materials Management Plan.  
“**MOT**” means maintenance of traffic  
“**MSE**” means mechanically stabilized earth  
“**MTIP**” means Materials Testing & Inspection Plan  
“**MUTCD**” means FHWA *Manual for Uniform Traffic Control Devices*  
“**MVRD**” means Microwave Vehicle Radar Detection.  
“**NCN**” means nonconformance notice  
“**NCR**” means Nonconformance Report  
“**NDRD**” means CDOT New Development Redevelopment  
“**NTP1**” means Notice to Proceed 1 for the Commencement of Phase 2 Construction work and I-25 Services  
“**OSHA**” means Occupational Safety and Health Administration  
“**PCCP**” means Portland Cement Concrete Pavement  
“**PDA**” means Pile Driving Analyzer  
“**PE**” means Permanent Easement  
“**PGDH**” means AASHTO, *A Policy on Geometric Design on Highways and Streets*.  
“**PIP**” means Public Information Plan  
“**POSS**” means Point of Slope Selection.  
“**PSMP**” means Project Safety Management Plan  
“**PSQF**” means Permanent Stormwater Quality Facilities  
“**QA**” means Quality Assurance  
“**QC**” means Quality Control  
“**QMP**” means Quality Management Plan.  
“**QMS**” means Quality Management System  
“**QRD**” means Quality Records Database  
“**RAP**” means Recycled Asphalt Pavement  
“**RFP**” means Request for Proposals  
“**RHM**” means recognized hazardous materials

“**RMS**” means Ramp Meter Stations  
“**ROD**” means Record of Decision.  
“**ROW**” means Right-of-Way.  
“**RTK**” means Real Time Kinematic.  
“**SAP**” means Sampling Analysis Plan  
“**SCP**” means Stormwater Construction Permit  
“**SMA**” means stone matrix asphalt  
“**SWMP**” means Stormwater Management Plan  
“**TCP**” means Traffic Control Plan.  
“**TDM**” means Transportation Demand Management  
“**TE**” means temporary easement.  
“**TMP**” means Traffic Management Plan  
“**TTI**” means Travel Time Indicators  
“**UBC**” means Uniform Building Code  
“**UDFCD**” means Urban Drainage and Flood Control District  
“**UE**” means Utility easements  
“**UNCC**” means Utility Notification Center of Colorado  
“**URA**” means Utility Relocation Agreement(s).  
“**USFWS**” means U.S. Fish and Wildlife Service  
“**VMS**” means Variable Message Signs  
“**VTMS**” means Variable Toll Message Signs  
“**WBS**” means a Work Breakdown Structure.  
“**WDP**” means Workforce Development Plan.  
“**WQCV**” means Water Quality Capture Volume  
“**WTVI**” means Working Time Violations Incidents

## 2. **Definitions**

**“18-kip Equivalent Single Axle Loads”** means the measure used in pavement design based on the number of 18,000 pound (18 kip) equivalent single-axle loads associated with vehicular traffic on a certain road in a certain period of time.

**“Abandoned”** or **“Abandonment”** has the meaning, as related to Utilities, given to it in the Utility Relocation Agreements included with the Reference Documents.

**“Accept”** or **“Acceptance”** or **“Accepted”** means the formal conditional determination in writing by the HPTE Project Manager that a particular matter or item appears to meet the requirements of the Contract Documents.

**“Active Traffic Management”** means the requirements set forth in Section 1.2.5.

**“Activity”** means parts of the Work including finished products or functional processes required as subcomponents of the Work Breakdown Structure, as defined by the Concessionaire.

**“Aesthetic Treatment Plan”** means the plan containing the requirements set forth in Section 15.2.2.5.

**“Air Pollutant Emission Notice”** means the form by which business report their emissions to the CDPHE APCD.

**“Approve”** or **“Approval”** means the formal conditional determination in writing by the HPTE project manager that a particular matter or item is good or satisfactory for the Project. Such determination may be based on requirements beyond those set forth in the Contract Documents without payment of additional compensation or a time extension and may reflect preferences of HPTE.

**“Area of Potential Effect”** means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The Area of Potential Effect is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.

**“As-Built Documents”** means the documents to be provided by the Concessionaire as described in Section 3.3.1.

**“As-Built Schedule”** means the document containing the requirement set forth in Section 2.1.3.2.7.

**“Automatic License Plate Recognition”** means the camera-based system described in Section 19.1.15.

**“Automatic Traffic Recorder”** means the system described in Section 19.1.9.

**“Automatic Vehicle Identification Reader”** means the system described in Section 19.1.14.

**“Average Daily Traffic”** means the average total traffic in both directions in a day.

**“Basic Configuration”** shall have the meaning set forth in Section 1.2, subject to any permitted modifications thereto contained in the Proposal Documents.

**“Best Management Practices”** are practices in accordance with the CDOT Erosion Control and Stormwater Quality Guide and Sections 101, 107, and 208 of the Standard Specifications, including, but not limited to, those listed in Section 12.1.2.1.2.

**“Betterment”** has the meaning, as related to Utilities, given to it in the Utility Relocation Agreements included with the Reference Documents.

**“Bikeway”** means the commuter facility that is to be built as part of the Project and described in Sections 1.2.3, 11.1.2.1.3 and 13.2.9.

**“Black Tailed Prairie Dog Removal Permit”** means any permit the Concessionaire is required to obtain pursuant to Section 5.3.1.

**“Bridge Removal Plan”** means the plan prepared and submitted to HPTE in accordance with Section 15.2.3.7.

**“Bus On Shoulders”** means the requirements set forth in Section 19.3.

**“Bus Rapid Transit”** means the RTD bus service that is intended to be provided on the US 36 corridor following the Planned Full Services Commencement Date.

**“CDOT Office Facilities”** has the meaning set forth in Section 2.2.1.

**“CDOT Utility Permit”** means a Utility Permit that is issued by CDOT.

**“Certificate of Compliance”** means a certification, including a signature by a person having legal authority to act for the manufacturer, stating that the product or assembly to be incorporated into the Project was fabricated in accordance with and meets the applicable requirements of the Contract Documents, or verifying the quality and quantity of material delivered which shall be accepted by the Concessionaire, whichever is applicable.

**“Certified Test Report”** means a report from a component manufacturer documenting the actual results from tests performed on the material being provided.

**“Closed Circuit Television”** means the system described in Section 19.1.5.

**“Concessionaire Acquisitions”** means the ROW acquisition described in Section 8.0.

**“Concessionaire’s Project Manager”** means the person designated by the Concessionaire to supervise the Project Persons performing Work, and to receive delivery of notices to the Concessionaire.

**“Concessionaire’s Utility Tracking Report”** has the meaning set forth in Section 7.3.2.

**“Conditional Letter of Map Revision”** means the Federal Emergency Management Agency’s comment on a proposed project that would, upon construction, affect the hydrologic or hydraulic characteristics of a flooding source and thus result in the modification of the existing regulatory floodway or other regulated flood areas and standards.

**“Consent Order”** has the meaning set forth in Section 12.1.2.

**“Construction Dewatering Permit”** means the permit the Concessionaire is required to obtain pursuant to Section 5.2.5.

**“Construction of Relocation Acceptance Letter”** means the letter in the form appearing in Exhibit D to Section 7.7.

**“Construction Safety Critical Plan”** means the document containing the requirements set forth in Section 2.3.2.1.

**“Contract”** or **“Contract Documents”** means the concession agreement underlying the Phase 2 Construction Work, including all schedules, and any other agreements related to or arising out of Phase 2 Construction Work that HPTE and the Concessionaire may enter into from time to time.

**“Contract Drawings”** means the drawings included in Schedule 5B, including the ROW plans.

**“Contract Schedules”** has the meaning set forth in Sections 2.1.3.1 and 2.1.3.2.



“**Critical Activities**” has the meaning set forth in Section 2.1.3.2.8.

“**Critical Path**” means the path through the Critical Path Method which, if delayed, will cause a delay to project completion.

“**Critical Path Method**” means a scheduling method which shows the interdependencies between project activities. It is a mathematically based algorithm for scheduling a set of project activities and involves constructing a model of the project including a list of all activities required to complete the project, the time (duration) that each activity will take to complete, and the dependencies between the activities. Using these values, CPM calculates the longest path of planned activities to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are “critical” (i.e., on the longest path) and which have “total float” (i.e., can be delayed without making the project longer).

“**Cross Drain**” has the meaning set forth in Section 12.2.4.2.

“**Current Initial Schedule**” has the meaning set forth in Section 2.1.3.2.3

“**Day**” means each and every day shown on the calendar, beginning and ending at midnight.

“**Department**” means the Colorado Department of Transportation.

“**Design of Relocation Acceptance Letter**” means the letter in the form appearing in Exhibit C to Section 7.7.

“**Disadvantaged Business Enterprise**” means a business currently certified as a “Disadvantaged Business Enterprise” by the Colorado Unified Certification Program.

“**Ditch**” means an irrigation ditch company.

“**Ditch ROW**” means the real property and property interests owned by a Ditch.

“**Document Control System**” means the system established and maintained by the Concessionaire and containing the requirements set forth in Section 2.4

“**Doppler Radar**” means the system described in Section 19.1.11.

“**Drainage Report**” means the document containing the requirements set forth in Section 12.4.1.1.

“**Electronic Toll Collection**” means the Project elements containing the requirements set forth in Section 19.

“**Emerging Small Businesses**” means the CDOT Emerging Small Businesses Program, established pursuant to Colorado law and intended to provide assistance to and increase opportunities for certified small businesses, including minority-owned, women-owned and disadvantaged business enterprises.

“**Environmental Compliance Work Plan**” means the document the Concessionaire is required to prepare pursuant to Section 5.0.

“**Equipment**” means all machinery, tools and apparatus, together with supplies for upkeep and maintenance, necessary for the proper construction and acceptable completion of the Work.

“**Erosion Control Supervisor**” means the individual with the qualifications and responsibilities set forth in Section 12.1.2.1.5.

“**ETC System Integrator**” means the designer and installer of Electronic Toll Collection system components.

“**FASTER**” means the Funding Enhancement for Surface Transportation and Economic Recovery Act (S. B. 90-108).

“**Final Bikeway Criteria**” means the criteria contained in the second column of Exhibit 13-2.

“**Final Plans and Specifications Package**” has the meaning set forth in Section 15.2.7.3.1.

“**First Notice to Proceed**” means a written notice issued by HPTE following the Acceptance of the Preliminary Initial Schedule, allowing the Concessionaire to proceed with certain limited Work on the date specified therein.

“**Float**” has the meaning set forth in Section 2.1.3.2.8.

“**Governmental Approval**” means any approval, authorization, certification, consent, decision, exemption, filing, lease, license, permit, agreement, concession, grant, franchise, registration or ruling, required by or with any Governmental Person in order to design and construct the Project.

“**Governmental Person**” means any federal, state, local or foreign government and any political subdivision or any governmental, quasi-governmental, judicial, public or statutory instrumentality, administrative agency, authority, body or entity. The term includes the State of Colorado and agencies and subdivisions thereof, other than the Department of Transportation.

“**Hazardous Substances**” means any of the following:

- (a) Substance, product, waste or other material of any nature whatsoever which is or becomes listed, regulated, or addressed pursuant to the Comprehensive Environmental Response, Compensation and Liability Act, 42 USC Section 9601, et seq. (“CERCLA”); the Hazardous Materials Transportation Act, 49 USC Section 1801, et seq.; the Resource Conservation and Recovery Act, 42 USC Section 6901 et seq. (“RCRA”); the Toxic Substances Control Act, 15 USC Sections 2601 et seq.; the Clean Water Act, 33 USC Sections 1251 et seq.; the Clean Air Act, 42 USC Sections 7401 et seq.; all as amended, or any other federal, state or local statute, law, ordinance, resolution, code, rule, regulation, order or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic or dangerous waste, substance or material, as now or at any time hereafter in effect,
- (b) Any substance, product, waste or other material of any nature whatsoever which may give rise to liability under any of the above statutes or under any statutory or common law theory based on negligence, trespass, intentional tort, nuisance or strict liability or under any reported decisions of a state or federal court,
- (c) Petroleum or crude oil excluding de minimis amounts and excluding petroleum and petroleum products contained within regularly operated motor vehicles, and
- (d) Asbestos or asbestos-containing materials in structures and or other improvements on or in the Site (other than mineral asbestos naturally occurring in the ground).

“**Health and Safety Plan**” means the document containing the requirements set forth in Section 5.4.2.

“**High Occupancy Vehicle**” means a vehicle occupied by more than one person.

“**Holidays**” means New Year's Day, Dr. Martin Luther King, Jr.'s Birthday (observed), Washington-Lincoln Day, Cesar Chavez Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day, and Christmas Day. When New Year's Day, Cesar Chavez Day, Independence Day or Christmas Day falls on Sunday, the following Monday

shall be considered a Holiday. When one of these days falls on a Saturday, the preceding Friday shall be considered a Holiday. Additional legal holidays, when designated by the Governor of the State of Colorado or the President of the United States, will also be included as Holidays.

**“Hot Mix Asphalt”** means the asphalt with the design mix described in Section 10.3.7.

**“HPTE Office Facilities”** means the facilities described in Section 2.2.1.

**“HPTE Offices”** means the office space described in Section 2.2.1.

**“Incident Management Plan”** means the document containing the minimum requirements set forth in Section 16.1.1.4.

**“Independent Assurance”** means the reviews and tests described in Section 3.5.2.

**“Initial Schedule”** has the meaning set forth in Section 2.1.1.

**“In-Process Design Package”** has the meaning set forth in Section 15.2.7.3.1.

**“Inspection”** means the act of viewing or looking carefully at construction, manufacturing, design, and maintenance practices, processes, and products, including document control and shop drawing review, to ensure that the practices, processes, and products comply with the quality requirements contained in the Contract Documents.

**“Integrated Noxious Weed Management Plan”** means the document the Concessionaire is required to prepare pursuant to Section 17.1.3.

**“Intelligent Transportation Systems”** means the Project elements containing the requirements set forth in Section 19.

**“Interim Bikeway Criteria”** means the criteria contained in the fourth column of Exhibit 13-2.

**“Laboratory”** means the testing laboratory of the Concessionaire, CDOT, HPTE or any other certified testing laboratory.

**“Landscape Acceptance”** means the process described in Section 17.2.11.4.

**“Landscape Establishment Period”** is the period set forth in Section 17.2.11.3.

**“Landscape Plan”** means the plan prepared in accordance with Section 17.1.1.

**“Legal Requirements”** means all applicable federal, state and local laws, codes, ordinances, rules, regulations, judgments, decrees, directives, guidelines, policy requirements, orders and decrees of any Governmental Person having jurisdiction over the Project or Site, the practices involved in the Project or Site, any Work, or any Utility Work being performed by a Utility Owner. The term "Legal Requirements" does not include Governmental Approvals.

**“Letter of Map Revision”** means a modification to Federal Emergency Management Agency flood documents generally based on the implementation of physical measures that affect the hydrologic or hydraulic characteristics of a flooding source.

**“Local Agency”** means any local government agency other than the State.

**“Maintenance Level of Service Plan”** means the plan containing the requirements set forth in Section 18.1.2.

**“Mainline”** means the lanes and shoulders of US 36 including the managed lane, general purpose lanes, and auxiliary lanes.

**“Material”** or **“Materials”** means all components required for use in the construction of the Project.

**“Materials Management Plan”** means the document containing the requirement set forth in Section 5.4.1.

**“Materials Testing and Inspection Plan”** means the document containing the requirements set forth in Section 3.3.3.

**“Microwave Vehicle Radar Detection”** means the system described in Section 19.1.7.

**“Monthly Maintenance Progress Report”** means the document containing the requirements set forth in Section 18.1.2.

**“Monthly Progress Report”** means the document containing the requirements set forth in Section 2.1.2.1.

**“Monthly Progress Schedule”** means the schedule containing the requirements set forth in Section 2.1.3.2.5.

**“MOT Task Force”** means the group described in Section 16.1.1.1.

**“Nest Take Permit”** means a federal permit for take of a bird nest issued by the U.S. Fish and Wildlife Service.

**“Nonconformance Report”** means the report described in Section 3.4.

**“Nonconforming Work”** means Work performed that does not meet the requirements of the Contract Documents.

**“Original Initial Schedule”** has the meaning set forth in Section 2.1.3.2.2.

Pavement Design Report“

**“Person”** means any individual, corporation, company, voluntary association, partnership, trust, unincorporated organization or Governmental Person, including CDOT.

**“Phase 1 Bikeway”** means the Bikeway associated with the Phase 1 Corridor.

**“Point of Slope Selection”** has the meaning set forth in Section 13.2.5.1.

**“Preformed Plastic Pavement Marking”** means the item described in Section 627.08 of the Standard Specifications, as amended by “Revision of Section 627 and 708 – Pavement Marking with Waterborne Paint and Low VOC Solvent Base Paint,” contained in Exhibit A to Section 20.

**“Preliminary Design Package”** has the meaning set forth in Section 15.2.7.3.1.

**“Preliminary Initial Schedule”** has the meaning set forth in Section 2.1.3.2.1.

**“Pre-paving Conference”** is the conference set forth in Section 10.2.1.

**“Private Utility”** means a Utility that is owned by a private company.

**“Private Utility Owner”** means an owner of a Private Utility.

**“Progress Status Meeting”** means the meeting containing the requirements set forth in Section 2.1.2.4.

**“Project Directory”** means the document containing the requirements set forth in Section 2.2.3.

**“Project Safety Management Plan”** means the plan containing the requirements set forth in Section 2.3.

**“Project Special Provisions”** means, with regard to Schedule 5, Section 14, the provisions in Section 14.4.

**“Project Survey Coordinator”** means the individual with the responsibilities set forth in Section 9.1.2.

**“Property Management Plan”** means the plan containing the requirements set forth in Section 8.1.4.

**“Proposal”** or **“Proposal Documents”** means those documents constituting the Concessionaire’s proposal in response to the Request for Proposals, including any best and final offers or supplements to proposals as may have been requested by HPTE.

**“Public Information Officer”** means the individual with the qualifications and responsibilities set out in Section 4.1.

**“Public Information Plan”** means the plan containing the requirements set forth in Section 4.1.

**“Public Utility”** means a Utility that is owned by a public agency or political subdivision of the state.

**“Public Utility Owner”** means an owner of a Public Utility.

**“Quality Assurance”** means all those planned and systematic actions necessary for the Concessionaire to certify to HPTE that all Work fully complies with the requirements of the Contract Documents and that all materials incorporated in the Work, all equipment used, and all elements of the Work will perform satisfactorily for the purpose(s) intended.

**“Quality Control”** means the activities performed by the Concessionaire, designer, producer or manufacturer to ensure and document that a product meets the requirements of the Contract Documents. Activities may include checking, materials handling and construction procedures, calibrations and maintenance of equipment, shop drawing review, document control, production process control, and any sampling, testing, and inspection done for these purposes.

**“Quality Management Oversight Database”** means the secure web-based application for recording results of HPTE Verification reviews and responses to nonconformance notices, as described in Section 3.5.

**“Quality Management Plan”** means the plan containing the requirements set forth in Sections 3.0, 3.1, 3.2 and 3.6.1.

**“Quality Manager”** means the individual with the responsibilities set forth in Section 3.1.6.

**“Ramp Meter Stations”** means the system described in Section 19.1.6.

**“Rational Method”** means the commonly used equation for peak flow estimation known as the Rational Method.

**“Record of Decision”** means the US 36 Corridor Phase 1 Record of Decision.

**“Recovery Schedule”** has the meaning set forth in Section 2.1.3.2.6.

**“Recycled Asphalt Pavement”** has the meaning set forth in Section 10.3.5.

**“Reference Documents”** means the Concession Agreement Schedule 5D – Reference Documents.

**“Release for Construction Documents”** means the drawings (including plans, elevations, sections, details and diagrams), specifications, shop drawings, drawings, samples, reports and calculations approved by the Concessionaire for construction as required by Section 3.3.1.

**“Remediation Work”** means, after determination by the Concessionaire that a Hazardous Substance(s) exists, sampling, treatment, and/or off-Site disposal of Hazardous Substances and materials containing Hazardous Substances, as Approved by HPTE.

**“Request for Proposals”** means the request for proposals for the project issued by HPTE on July 9, 2012, including all addenda thereto.

**“Requested Relocation”** means any Private Utility relocation requested by a Private Utility Owner to be performed by the Concessionaire.

**“Revised Initial Schedule”** has the meaning set forth in Section 2.1.3.2.4.

**“Right-of-Way”** means the real property and property interests provided by HPTE necessary for ownership and operation of the Project.

**“Roadway”** means the portion of a highway within limits of construction.

**“Roadway Design Criteria Table”** means the table provided in Exhibit 13-1.

**“ROW Manager”** means the individual with the qualifications and responsibilities set forth in Section 8.1.3.

**“ROW Plans”** has the meaning set forth in Section 8.1.2.

**“Safety Edge”** has the meaning set forth in Section 13.3.6.

**“Sampling Analysis Plan”** means the document the Concessionaire is required to prepare pursuant to Section 5.4.1.

**“Section 404 Permit”** means the permit issued by the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act, 33 U.S.C. §1251 et seq.

**“Service Line”** means, as related to Utilities, a Utility line, the function of which is to directly connect the improvements on an individual property to another Utility line located off such property, which other Utility line connects more than one such individual line to a larger system. (The term “Service Line” also includes any Utility on public or private property that services structures located on such property.)

**“SPCC Plan”** means Spill Prevention Control and Countermeasures Plan.

**“Special Events”** means events expected to produce higher than average traffic on the US 36 corridor and include, but are not limited to, the University of Colorado (CU) graduation ceremony, CU home football games, the Bolder Boulder, and events at the venue originally known as Broomfield Event Center. This list shall be further developed as progress is made on the Work included in Schedule 5, Section 4 (Public Information).

**“Spill Prevention Control and Countermeasures Plan”** means the document containing the requirements set forth in Section 12.1.2.1.3.

**“Stakeholder”** has the meaning set forth in Section 4.3.

**“Standard Specifications”** means the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction 2011.

**“Storm Drain”** has the meaning set forth in Section 12.2.4.3.

**“Stormwater Construction Permit”** means the permit the Concessionaire is required to obtain pursuant to Section 5.2.1.

**“Substantial Landscape Completion”** has the meaning set forth in Section 17.2.11.2.

**“Subterranean Groundwater Permit”** means the permit the Concessionaire is required to obtain pursuant to Section 12.2.4.6.

**“Supplier”** means any Person other than employees of the Concessionaire not performing work at the Site that supplies machinery, equipment, materials or systems to the Concessionaire or

any Subcontractor in connection with the performance of the Work; Persons who merely transport, pick up, deliver or carry materials, personnel, parts, or equipment or any other items or persons to or from the Site shall not be deemed to be performing Work at the Site.

“**Surety**” means each properly licensed surety company approved by HPTE, which has issued one or more of the payment and performance bonds.

“**SWMP Site Map**” means the document described in Section 12.1.2.1.1.

“**Test**” or “**Testing**” means the procedure and method of acquiring and recording physical data and comparing it to set standards and submitting a statement to such conditions or operations as will lead to its Acceptance or rejection (deficiency, defective condition, nonconformance) of the item.

“**Traffic Control Plan**” means the plan containing the requirements set forth in Section 16.2.1.

“**Traffic Management Plan**” means the plan containing the requirements set forth in Section 16.1.1.2.

“**Transportation Demand Management**” means a program that encompasses tools to help with traffic congestion mitigation by offering alternatives to the single occupant vehicle.

“**Travel Time Indicators**” means the system described in Section 19.1.8.

“**Ultimate Configuration**” means the geometry depicted for the Preferred Alternative in the *US 36 Corridor Final Environmental Impact Statement/ Section 4(f) Evaluation* (EIS), as modified or supplemented by the horizontal geometry depicted in the Ultimate Configuration Model file in the Reference Documents.

“**Unidentified Utility**” means a Utility that is discovered during construction that was not included in the Utility Data.

“**US 36 Toll Concession Project**” has the meaning set forth in Section 1.1.

“**Use and Occupancy Agreement**” means the document described in Section 8.1.2.

“**Utility**” means a privately, publicly or cooperatively owned line, facility and/or system for producing, transmitting or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, or any other similar commodity. The necessary appurtenances to each utility facility shall be considered part of such utility. Without limitation, any Service Line connecting directly to a utility shall be considered an appurtenance to that utility, regardless of the ownership of such Service Line. The meaning of Utility does not include stormwater facilities.

“**Utility Data**” means the Utility Drawings, the Utility Matrix, and utility information from the Utility Owners included with the Reference Documents.

“**Utility Drawings**” means the Utility plan design sheets included with the Reference Documents.

“**Utility Matrix**” means the Phase 2 Construction Work Utility Matrix that lists the Utility Data included with the Reference Documents.

“**Utility No Conflict Close-Out Form**” has the meaning given to it in the Utility Relocation Agreements included with the Reference Documents.

“**Utility Permit**” has the meaning given to it in the Utility Relocation Agreements included with the Reference Documents.

**“Utility Relocation Agreement(s)”** means the executed agreement(s) between CDOT, HPTE, and Utility Owners for the Phase 2 Construction Work that is/are included with the Reference Documents.

**“Utility Work”** has the meaning set forth in Section 7.1.1.

**“Utility Work Order”** means the document described in Section 7.3.3.

**“Variable Message Signs”** has the meaning set forth in Section 19.1.4.

**“Variable Toll Message Signs”** has the meaning set forth in Section 19.1.13.

**“Verification”** (or **“Owner Verification”**) means the act of testing or inspecting performed by qualified testing or inspecting personnel employed by HPTE or its designated agent to independently establish conformity to the Contract Documents.

**“Water Quality Report”** means the document containing the requirements set forth in Section 12.4.4.

**“Water Quality Report Outline”** means the outline of the Water Quality Report as set forth in Section 12.4.4.

**“WBS Level”** shall refer to the identified Work Breakdown Structure level as set out in Table 2.1.

**“Work”** has the meaning set forth in Section 2.1.

**“Work Breakdown Structure”** means the requirements set forth in Section 2.1.1.

**“Working Day”** means any Calendar Day other than Saturday, Sunday, or a Holiday.



## 1.0 GENERAL

### 1.1 Project Description and Incorporation of ATCs

The US 36 Toll Concession Project (Project) is a multi-modal, toll-integrated project that will include the reconstruction of US 36 from Foothills Parkway in Boulder to 88<sup>th</sup> Street in Louisville. The construction portion of this project is the second phase of construction work implementing improvements to the US 36 corridor that have been environmentally cleared by the US 36 Environmental Impact Statement and Record of Decision signed on December 24<sup>th</sup>, 2009. The Phase 2 Construction Work includes widening of US 36 mainline to accommodate a new buffer-separated Managed Lane in each direction of US 36; 12-foot inside and outside shoulders; reconstruction of the McCaslin Boulevard Interchange; replacement of the US 36 over Coal Creek structure; widening of the westbound US 36 over South Boulder Creek bridge structure; construction of retaining walls; installation of Intelligent Transportation Systems (ITS); and construction of portions of a Bikeway.

Except as otherwise stated or required in the Contract Documents, CDOT roadways (US 36, SH 157, and ramps) shall be designed and constructed according to CDOT standards and requirements. Other roadways shall be designed and constructed according to the standards and requirements of the agency that controls or maintains the facility (e.g., RTD, City of Louisville, and City of Boulder).

All of the covenants, agreements, terms and conditions of the approved ATCs attached as Annex 1 to this Schedule 5 are incorporated into this Schedule 5 and made a part hereof with the same force and effect as if set forth at length in the body of this Schedule 5. In the event of any conflict, inconsistency, variance or contradiction between the provisions of the approved ATCs attached as Annex 1 and any provisions of this Schedule 5, the provisions of the approved ATCs attached as Annex 1 shall in all respects supersede, govern and control.

### 1.2 Basic Configuration

The Basic Configuration is defined as Phase 2 Construction Work required to conform to the *US 36 Basic Configuration Typical Sections*, as shown in Schedule 5B and as described in the Contract Documents. The general geographic limits and elements of the Basic Configuration are graphically shown on *Exhibit A - Basic Configuration Elements*.

Major components of the Basic Configuration are further defined in the following Sections.

#### 1.2.1 Pavements and Laneage

1. Reconstruct US 36 mainline with Portland Cement Concrete Pavement with widths and laneages as shown in the *Basic Configuration Typical Sections* in Schedule 5B, from the east ramp gore points (approximate Station 1120+00) of the Foothills Parkway interchange to the west limit of the Phase 1 Corridor construction immediately east of 88<sup>th</sup> Street (Station 1388+00).
2. Reconstruct the existing McCaslin Boulevard Interchange to a Diverging Diamond Interchange (DDI) as shown on Exhibit B, and reconfigure the west side ramps and bus plazas to provide separate grade separated bus-only ramps.

### 1.2.2 Structures

1. Widen the westbound US 36 structure over South Boulder Creek to width and laneage requirements and accommodate the Bikeway as shown on the Basic Configuration Typical Sections in Schedule 5B.
2. Widen the McCaslin Boulevard over US 36 structure to width and laneage requirements to accommodate the McCaslin Diverging Diamond Interchange as shown on the Basic Configuration Typical Sections in Schedule 5B
3. Construct west McCaslin interchange ramp structures over bus-only ramps.

### 1.2.3 Bikeway

1. Construct continuous concrete Bikeway from the Table Mesa Drive Park-n-Ride to a connection with the Bikeway constructed under the Phase 1 DB Contract, east of 88<sup>th</sup> Street.

### 1.2.4 RTD Elements

1. Construct any associated modifications to existing ramp metering to accommodate the Bus Rapid Transit/High Occupancy Vehicle (BRT/HOV) bypass lanes within the Phase 2 Construction Work limits.
2. Reconstruct any existing BRT stations, platforms, or elements that are impacted by the roadway improvements, and construct the relocated station elements in accordance with the RTD *Bus Transit Facility Design Guidelines and Criteria*.

### 1.2.5 ITS and Electronic Toll Collection (ETC) System Elements

1. Accommodate ITS backbone and associated elements being constructed and software being developed under the Phase 1 DB Contract between the RTD Operations Center, Regen 1, Regen 2, and the US 36 (28<sup>th</sup> Street) and Colorado Avenue intersection in the City of Boulder. Connect Phase 2 elements to ITS backbone and software.
2. Construct supporting infrastructure necessary to accommodate installation and operation of ETC system components. ETC system components will be designed and installed by the ETC System Integrator.
3. Construct base Active Traffic Management (ATM) elements, including Bus on Shoulders (BOS) signing and enhanced ATM elements, including lane status signs along the corridor.

### 1.2.6 Design of Future Elements

In addition to the design of all elements constructed with the Project, provide designs for additional and future elements within the limits of the Phase 2 Construction Work.

Prepare preliminary design and plans (30% level) for the ultimate roadway, Bikeway, structure, and drainage elements for US 36 from Foothills Parkway to 88<sup>th</sup> Street; the east ramps of the Foothills Parkway Interchange, the McCaslin Boulevard interchange, and any other elements which will be reconstructed in the Ultimate Configuration. Demonstrate accommodation of the Ultimate Configuration by major roadway, Bikeway, structure, and drainage elements constructed as a part of the Basic Configuration. The Ultimate Configuration of the US 36 Corridor is defined as the geometry depicted for the Preferred Alternative in the *US 36 Corridor*

*Final Environmental Impact Statement/ Section 4(f) Evaluation (EIS)*, as modified or supplemented by the horizontal geometry depicted in the Ultimate Configuration Model file in the Reference Documents.

### **1.3 Options**

HPTE has identified the following Option for the project. The Option is graphically shown on Exhibit C. Options will be evaluated in accordance with the Request for Proposals.

#### **1.3.1 Option 1 - McCaslin Pedestrian Underpass**

1. Construct a pedestrian underpass south of the eastbound ramp intersections with concrete paved connections to existing trails and parking areas as shown on Exhibit C.

### **1.4 Exhibits**

Exhibit A – Basic Configuration Elements

Exhibit B – McCaslin Boulevard Diverging Diamond Interchange

Exhibit C – Option 1 – McCaslin Pedestrian Underpass

## 2.0 PROJECT MANAGEMENT

### 2.1 Administration

The Concessionaire has the responsibility for management and performance of the Phase 2 Construction Work (“Work”). HPTE shall have the right to visit the Site and observe the Work to determine that the Work is proceeding in conformance with the requirements of the Contract Documents.

#### 2.1.1 Work Breakdown Structure (WBS)

The Concessionaire shall submit to HPTE, along with its Preliminary Initial Schedule, a detailed Work Breakdown Structure (WBS) for Acceptance. The Preliminary Initial Schedule shall include a detailed, organized hierarchical division of the WBS for completing each element of the Work. The Accepted WBS shall be the basis for organizing all Work under the Contract Documents, and shall be used as a basis for the Contract Schedules, and other cost control systems.

The WBS shall conform to the levels in Table 2.1. Table 2.1 represents Levels I through VI, the minimum levels of the WBS that all cost and Schedule information shall roll up to. However, further detail shall be provided by the Concessionaire for Levels IV, V, and VI to ensure a clear understanding of the Contract. The Concessionaire shall submit its Preliminary Initial Schedule broken down to the WBS Level V Activities. Additionally, a roll-up of Activities unique to design, construction, and maintenance shall be shown at Level IV.

The Accepted WBS shall be the basis for organizing all Work under the Contract, and shall be used to structure the Contract Documents, and other cost control systems. The Concessionaire shall submit its Preliminary Initial Schedule specifying WBS Activities and proposed Work segments 10 Days prior to NTP1.Submittal . of the Initial Schedule by HPTE shall be a condition of NTP1.

A methods statement shall be prepared for each of the Level III WBS elements listed in the Contract Schedules for all Critical Path items in the Contract Schedules, and for any feature not listed in the Contract Schedules that the Concessionaire considers a controlling factor for timely completion. The methods statement shall be completed in accordance with the *Standard Specifications*.

<b>Table 2.1 WBS LEVELS</b>	
<b>Level I:</b>	<b>US 36 CONCESSION AGREEMENT PROGRAM</b>
<u>Program Level – HPTE use only:</u> The summary of all program components	
<b>Level II:</b>	<b>MAJOR PROGRAM ELEMENTS</b>
<u>Major Program Elements:</u>	
<input type="checkbox"/> Activities of the Concessionaire. This is the Concessionaire's highest level.	

<b>Table 2.1 WBS LEVELS</b>	
<b>Level III:</b>	<b>CONTRACT COMPONENTS</b>
<p><u>Concession Contract Components:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Breakdown of major components of the Contract: <ul style="list-style-type: none"> <li>• Mobilization</li> <li>• Phase 2 Construction Work management</li> <li>• Quality Management Plan</li> <li>• Changes/construction modification orders</li> <li>• Disadvantaged Business Enterprise/Emerging Small Business Plan</li> <li>• Workforce Development Plan</li> <li>• Public involvement</li> <li>• Environmental management</li> <li>• Drainage</li> <li>• Utilities</li> <li>• Structures</li> <li>• Maintenance of traffic</li> <li>• Roadway</li> <li>• ITS</li> <li>• Warranty</li> </ul> </li> </ul>	
<b>Level IV:</b>	<b>CONTRACT SUBCOMPONENTS</b>
<ul style="list-style-type: none"> <li><input type="checkbox"/> <u>Concession Contract Subcomponents:</u> Breakdown of all major subcomponents of the Contract (i.e. Level III WBS), at a minimum, the Concessionaire shall include Level IV elements.</li> <li><input type="checkbox"/> The Concessionaire to define certain Activities at this level (e.g., Work areas)</li> <li><input type="checkbox"/> Basis for Price Proposal</li> </ul>	
<b>Level V:</b>	<b>CONTRACT SUBCOMPONENTS AND WORK ACTIVITIES</b>
<p><u>Breakdown defined by the Concessionaire:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> As-Built plans</li> <li><input type="checkbox"/> Minor subcomponents (e.g., Bridge substructures &amp; superstructures, etc.)</li> <li><input type="checkbox"/> The Concessionaire to define certain Activities at this level (Work areas, phases, etc.)</li> <li><input type="checkbox"/> Maintenance during construction (duration based)</li> </ul>	
<b>Level VI:</b>	<b>WORK SUB-ACTIVITIES</b>
<p><u>Breakdown defined by the Concessionaire:</u></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The Concessionaire to define all Activities at this level</li> </ul>	
<p><u>Schedules</u> - No specific Contract Schedules are required at this level. However, Level VI Activities are required as a component of the Monthly Progress Schedule.</p>	

## **2.1.2 Progress Reporting**

### **2.1.2.1 Progress Submittals**

The Concessionaire shall submit Progress Reports to HPTE each month. Each Monthly Progress Report shall be submitted for review within 10 Working Days following prior month's end. Draft Progress Report submittals shall be done electronically.

### **2.1.2.2 Progress Report Content**

The Progress Report shall include:

1. Cover Sheet

The Cover Sheet shall indicate the following information:

- A. Project number and title
- B. Progress Report number (numbered consecutively starting with "1")
- C. Period covered by the Progress Report (specific calendar dates)
- D. Total percent complete to date for the Phase 2 Construction Work as a whole and for each Level III WBS Activity
- E. Nonconforming Work and amount withheld identified

2. Monthly Progress Report

The Monthly Progress Report shall include the following:

- A. Brief narrative description of Level V Activity and progress for the Phase 2 Construction Work as a whole, including maintenance, design, and construction.
- B. Identification of start and completion dates
- C. Update of progress with respect to Utilities
- D. Identification of whether any completion and deadlines are achieved or revised during the period
- E. Summary of Quality Assurance and Quality Control program efforts, including results of design reviews
- F. Identification of problems and issues that arose during the period and remaining problems and issues to be resolved
- G. Summary of resolution of problems and issues raised in previous Monthly Progress Reports or resolved during the period
- H. Summary of Phase 2 Construction Work accidents (frequency and severity) and corrective actions taken
- I. Identification of critical schedule issues and proposed resolution
- J. Discussion of schedule variations from completion deadlines that have slipped or improved
- K. Monthly DBE/WDP Report and tracking

L. Progress photographs

The format and detail level required for submittal of the Monthly Progress Report shall be established by HPTE, in consultation with the Concessionaire, within 10 Working Days of NTP1. The Monthly Progress Report shall be on Concessionaire 8.5 x 11-inch letterhead.

The status date of the Monthly Progress Schedule is the last day of each month. The data date for use in calculating the Monthly Progress Schedule shall be the first Working Day of the following month.

The Concessionaire shall make all corrections to the Monthly Progress Schedule requested by HPTE and resubmit the Monthly Progress Schedule. If the Concessionaire does not agree with HPTE's comments, the Concessionaire shall provide written notice of disagreement within 5 Working Days from the receipt of the comments. The items in disagreement shall be resolved in a meeting held for that purpose, if necessary.

3. Certification by Concessionaire's Quality Manager

The Concessionaire shall submit a certification signed by its Quality Manager certifying that:

- A. All Contract Work, including that of designers, Sub-contractors, Suppliers and fabricators has been checked and/or inspected by the Concessionaire's Quality Assurance and Quality Control program staff, and that all Work, except as specifically noted in the certification, conforms to the requirements of the Contract Documents.
- B. The Quality Management Plan, and all of the measures and procedures provided therein, are functioning properly and are being followed.
- C. All safety-critical Work, in conformance with the Project Safety Management Plan (PSMP) as further described in Section 20, has been reviewed and sealed by the professional engineer of responsible charge before construction begins.

4. Monthly Maintenance Progress Report

The Concessionaire shall submit to HPTE the current Monthly Maintenance Progress Report, as required in Schedule 5, Section 18..

#### **2.1.2.4 Progress Status Meetings**

A Progress Status Meeting shall be conducted each time a monthly progress submittal is made. The meeting shall be used to verify, address and finalize the following:

- 1. Actual start dates
- 2. Actual and planned completion deadlines
- 3. Activity percent complete
- 4. Incorporation of Approved Change Orders
- 5. Status of outstanding Nonconforming Work

6. Work performance
7. Contract Schedule, including changes from previous month's Contract Schedule
8. Critical Path(s)

### **2.1.3 Schedule Management**

#### **2.1.3.1 General**

The Work specified in this subsection includes preparing, progressing, revising, and submitting of Contract Schedules.

The Contract Schedules shall represent a practical plan to complete the Work before the Planned Full Services Commencement Date and convey the intent in the manner of the prosecution and progress of the Work.

The Contract Schedules shall include the planned execution of the Work in accordance with the Contract Documents. The Contract Schedules shall include involvement and coordination, Utility Owners, Governmental Persons, engineers, architects, Sub-Contractors, and Suppliers in the development of the Original Initial Schedule, Revised Initial Schedule, and updating of subsequent Monthly Progress Schedules.

The Contract Schedules shall represent the requirements of the Contract Documents and the Work shall be executed in the sequence and duration indicated in the Contract Schedules.

All Contract Schedules shall be developed consistent with the Accepted WBS and the Planned Full Services Commencement Date.

#### **2.1.3.2 Contract Schedule and Term Definitions**

Contract Schedules shall include the Preliminary Initial Schedule, Original Initial Schedule, Current Initial Schedule, Revised Initial Schedule, Monthly Progress Schedule, Recovery Schedule, and the As-Built Schedule.

##### **2.1.3.2.1 Preliminary Initial Schedule**

The Preliminary Initial Schedule is defined as the Initial Schedule for the purpose of initiating Work on the Phase 2 Construction Work. It shall be a CPM schedule with Activity detail for the first three months, and shall be cost-loaded to WBS Level VI. The Preliminary Initial Schedule shall conform to the Accepted WBS and include all Concessionaire-defined WBS Level IV, V, and VI Activities.

##### **2.1.3.2.2 Original Initial Schedule**

The Original Initial Schedule is defined as the Concessionaire's original plan for the Phase 2 Construction Work from the commencement of design activities defined in ATC 15 through Phase 2 Work Completion. It shall be a detailed CPM schedule with Work Activities and completion deadlines included for the full term of the Phase 2 Construction Work. The Original Initial Schedule shall be developed from the Preliminary Initial Schedule and shall conform to the Accepted WBS and include all Concessionaire defined WBS Level IV, V, and VI Activities. The Original Initial Schedule shall not change after Approval.

The Original Initial Schedule shall be cost loaded to WBS Level VI.



#### **2.1.3.2.3 Current Initial Schedule**

The Current Initial Schedule is defined as the Original Initial Schedule with cost and schedule changes from Approved Change Orders incorporated. It shall be updated monthly with only Approved cost and schedule changes. The Current Initial Schedule will not show progress but shall maintain the original data date from the Original Initial Schedule as a baseline. The Current Initial Schedule shall be submitted to HPTE for Acceptance with each monthly Progress Report.

#### **2.1.3.2.4 Revised Initial Schedule**

The Revised Initial Schedule is defined as the Concessionaire's plan for the Phase 2 Construction Work which is current with progress to date. This Schedule shall reflect the planned execution of the Work for the remainder of the Phase 2 Construction Work along with a reallocation of the remaining resources and quantities to represent the estimate to complete the Work. The Revised Initial Schedule shall include all Approved Change Orders, Work Orders, and completion deadlines. A Revised Initial Schedule must be Approved by HPTE; such Approval shall only apply to the scheduled Work that is planned after the Revised Initial Schedule's Approval date.

The Revised Initial Schedule shall be prepared by the Concessionaire when requested by HPTE. The Concessionaire may request that HPTE review a Revised Initial Schedule at any time. However, such review will be undertaken if HPTE agrees with the need for that review.

#### **2.1.3.2.5 Monthly Progress Schedule**

The Approved Original Initial Schedule or Current Initial Schedule, shall be used as the basis to establish the Monthly Progress Schedule. It shall be updated every month to show the actual progress of Work, including Approved Change Orders and Work Orders.

The Monthly Progress Schedule shall be cost loaded to WBS Level VI. In addition, the Progress Schedule shall include WBS Level VI detail for the upcoming three months of design and construction on the Project as well as Level VI as-construction progress tracking including Actual Start, Actual Finish Dates, and Percent Complete.

#### **2.1.3.2.6 Recovery Schedule**

The Recovery Schedule is defined as the Concessionaire's program and proposed plan for the recapture of lost Schedule progress and to achieve Phase 2 Work Completion by the Full Services Commencement Longstop Date. The Recovery Schedule shall be based on the latest Accepted Monthly Progress Schedule and shall include equivalent detail. The Recovery Schedule shall show the proposed changes to the Schedule, include cost loading and additional detail to substantiate the recovery plan, and shall reflect all proposed changes to WBS Level VI Activities through Phase 2 Construction Work completion.

#### **2.1.3.2.7 As-Built Schedule**

The last Monthly Progress Schedule submitted shall be identified by the Concessionaire as the As-Built Schedule. The As-Built Schedule shall reflect the exact manner in which the Concessionaire executed the Work (including start and completion dates, Activities, actual durations, sequences, and logic), and shall be signed and certified by the Concessionaire's engineer and the Concessionaire's scheduler as being a true reflection of the way in which the Work was executed at the time of Phase 2 Work Completion.

### 2.1.3.2.8 Float

Float is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, for each and every Activity in the Schedule. Float shall be for the benefit of all parties to the Contract and not for the exclusive benefit of the Concessionaire. Suppression or consumption of Float by extended Activity duration, dummy Activities, or preferential sequencing will not be allowed. Critical Activities shall be defined as Activities with a total Float less than 10 Days.

### 2.1.3.3 Schedule Requirements

1. General Scheduling Constraints
  - A. All Contract Schedules shall be in the same master data file, including design, submittals, procurement, and construction schedules. These Work Activity Schedules shall all tie together logically to present a total Critical Path analysis in the same master data file.
  - B. The only constraints allowed to be included in the Contract Schedules are the Contract Completion Deadlines. No intermediate completion constraints or start constraints shall be allowed unless they are included in the Contract. Unless Approved by HPTE, all Activities must have at least one predecessor and one successor, except for the ATC 15 activity (no predecessor) and the Phase 2 Work Completion (no successor).
  - C. All Activities that start or complete out of sequence shall be rescheduled (logic corrected) to reflect the actual sequence of events.
  - D. Actual start and completion dates shall be accurately input. Prior to changing or correcting any previous actual dates, or dates required in the Contract, a narrative shall be written to HPTE requesting Approval to change such a date.
  - E. If any logic is changed after the Approval of the Original Initial Schedule or Revised Initial Schedule, if one exists, a narrative by Activity code shall accompany the Monthly Progress Schedule stating the reason the logic changed and the benefit to HPTE. If HPTE does not agree with the reason for the logic change, the Monthly Progress Schedule will not be Accepted.
  - F. All Activity identification codes for a specific Activity description created in any Contract Schedule shall remain unchanged and connected to their original Activity descriptions through Phase 2 Work Completion. An Activity description may only be changed to clarify an Activity's original scope.
2. CPM Requirements
  - A. The Critical Path shall be determined according to Critical Path Method (CPM) principles and shall be highlighted in "RED" on all Schedules to distinguish critical Activities from other Activities. A diamond, flag, or other symbol shall highlight milestones.

- B. The CPM shall have all major procurement Activities identified for any item with more than 30 Days lead time for delivery. This includes shop drawing submittal and approval, lead times for the fabrication and delivery of Materials and Equipment, and installation of Materials and Equipment.
- C. The CPM shall be sufficiently detailed to accurately depict all the Work. Activity durations shall be an estimate in Working Days of the time required to perform each Activity. No individual Activity will have a duration exceeding 30 Working Days. Activities with durations of less than 5 Working Days shall be held to the absolute minimum. For an Equipment or Material fabrication item whose duration exceeds 30 Working Days, several Activities, none exceeding 30 Working Days, shall be used. Each Activity shall have a detailed description.
- D. Contract completion deadline dates shall be shown on the CPM. These dates shall be input as finish constraint dates and shall agree with such dates specified in the Contract.

### 3. Schedule Output Format

The Concessionaire shall submit the electronic output files of the Contract Schedules (e.g., .mpx for MS Project). Its Contract Schedule charts and graphs shall be submitted in Adobe PDF. These files shall be submitted with the Monthly Progress Schedule.

#### **2.1.3.4 Execution**

##### **2.1.3.4.1 WBS Activities and Schedule Modifications**

When it becomes necessary to add, combine, eliminate or modify Contract-specified WBS Level IV, V, or VI Activities to reflect modifications to the Work, such changes shall be made through a Change Order that has been Approved by HPTE in accordance with the Contract. These changes to the WBS Level IV, V or VI Activities shall consequently be reflected in subsequent Schedule submittals. Alternately, if a proposed addition, combination, elimination, or modification of WBS Level IV, V or VI Activities would not be the subject of a Change Order, then the consequent realignment of funds between WBS Level V or VI Activities must be Approved by HPTE in accordance with the Contract and thereafter reflected in the required Schedule submittals.

##### **2.1.3.4.2 Preliminary Initial Schedule**

The Concessionaire shall submit the Preliminary Initial Schedule to HPTE for Acceptance 10 days prior to NTP1. The Preliminary Initial Schedule shall be in accordance with the Contract requirements, consistent with the Accepted WBS, and be cost loaded to WBS Level VI Activities and include Concessionaire-defined detail necessary to provide measurable Schedule progress. The Accepted Preliminary Initial Schedule shall provide an intermediate Schedule during the production of the Original Initial Schedule and shall establish a payment schedule for the duration between NTP1 and approval of the original initial schedule.

##### **2.1.3.4.3 Original Initial Schedule**

The Original Initial Schedule shall show the sequence and interdependence of Activities required for complete performance of the Work, beginning with the date of the commencement

of ATC 15 activities, and concluding with the date of Phase 2 Work Completion and shall comply with the following:

1. The actual number of Activities in the Original Initial Schedule shall be sufficient to assure adequate planning of the Work and to permit monitoring and evaluation of progress and the analysis of time impacts. Activity durations shall be expressed in Working Days. The Work calendar shall clearly identify Holidays and other non-Working Days, as well as Special Events.
2. The Concessionaire shall schedule deliverable review times by HPTE as separate tasks logically tied to the appropriate Activity. Concurrent review of multiple deliverables by one discipline, must be agreed to by HPTE, prior to inclusion in the Original Initial Schedule.
3. A graphic representation of all Activities necessary to complete the Work shall be provided.
4. All completion deadlines set forth in the Contract shall be identified.

Not later than 20 Days following issuance of the NTP1, the Concessionaire shall submit to HPTE for Approval the final Original Initial Schedule. Once Approved, this Schedule shall become the Original Initial Schedule against which all progress and revisions shall be measured.

The Original Initial Schedule will be reviewed by HPTE for purposes of determining:

1. Compliance with applicable provisions of the Contract Documents.
2. The logic of the proposed CPM schedule is sound and consistently developed and demonstrates a logical sequencing and interdependence of Activities required for the timely and orderly achievement of all Work Activities and milestones, including completion of the Work by the Planned Full Services Commencement Date.

Upon Approval by HPTE, the Original Initial Schedule shall be employed as the basis for the Monthly Progress Schedule by the Concessionaire in its scheduling and performance of the Work.

#### **2.1.3.4.4 Monthly Progress Schedule**

The Monthly Progress Schedule shall be submitted each month to HPTE for Acceptance, concurrent with the Progress Report submittal as required herein. The Monthly Progress Schedule shall include all information current as of the status date.

For the three-month look-ahead portion of the Monthly Progress Schedule that establishes the WBS Level VI Activities, the Concessionaire shall provide sufficient detail to convey a Schedule that provides weekly schedule control and shall specifically identify:

1. Completion deadlines, if any.
2. Phasing of design, construction, testing, and staging of the Work as specified shall be prominently identified. Particular attention shall be given to Release for Construction dates, Site availability, construction staging, and maintenance and protection of traffic requirements of the Contract.

3. Procurement, fabrication, preparation of mock-ups, preparation of prototypes, delivery, installation, testing of Materials, and Equipment, including factory testing and demonstration testing, and any long lead time (over 30 Days) orders for Material and Equipment.
4. Interface coordination and dependencies with preceding, concurrent, and follow-on concessionaires.
5. Work to be performed by other agencies that may affect the Monthly Progress Schedule.

#### **2.1.3.4.5 Recovery Schedule**

If the Work is lagging the late start cost curve in the Current Initial Schedule for a period which exceeds the greater of, (a) 15 Days in the aggregate or (b) that number of Days in the aggregate that equals 5 percent of the Days remaining until the Full Services Commencement Longstop Date, the Concessionaire shall prepare and submit to HPTE for Approval a Recovery Schedule within 14 Days after the Concessionaire first becomes aware of such schedule delay.

The Recovery Schedule shall demonstrate the Concessionaire's program and proposed plan to regain lost Schedule progress, as well as demonstrate how Phase 2 Work Completion shall be achieved by the deadlines specified in Exhibit B of the Contract.

HPTE will notify the Concessionaire within 14 Days after receipt of the Recovery Schedule whether the Recovery Schedule is Approved, or will describe changes that HPTE believes should be made to the Recovery Schedule. The Concessionaire shall incorporate and fully include the Recovery Schedule (including HPTE's comments) into the next scheduled Monthly Progress Schedule (or, if the next scheduled Monthly Progress Schedule is due within 7 Days after Approval of the Recovery Schedule, then the Recovery Schedule shall be incorporated into the subsequent Monthly Progress Schedule), and shall concurrently provide to HPTE a Revised Initial Schedule.

### **2.1.4 Meetings**

#### **2.1.4.1 Task Force Meetings**

At a minimum, the Concessionaire shall conduct task force meetings for the following disciplines to facilitate "over the shoulder" review of the design:

1. Drainage
2. Roadway
3. Structures
4. Traffic/ITS/tolling
5. Utilities
6. Environmental
7. Public involvement

#### **2.1.4.2 Safety Meetings**

The Concessionaire shall conduct regularly scheduled project safety meetings, tool box talks, etc., as specified in its PSMP.

### **2.1.4.3 Quality Meetings**

The Concessionaire shall conduct weekly quality meetings with representatives from Quality Control, Quality Assurance, and HPTE.

## **2.1.5 Photographs**

### **2.1.5.1 Progress Photographs**

The Concessionaire shall take aerial photographs of the Work and Site every 6 months as a minimum. Aerial photographs shall include all areas under construction, whether temporary or permanent, and all other areas impacted, each time they are taken. One series of oblique photographs shall be taken from one direction along the corridor. HPTE's confirmation shall be sought regarding views to be taken and the approximate time at which they will be taken.

The Concessionaire shall provide one complete set of aerial photographs on DVD when taken. All photographs shall be provided in high quality digital format. The file format shall be .jpg, .gif, or .tiff and be provided on DVDs.

The Concessionaire shall provide interior and exterior photographs of each buried structure just prior to burial. Provide a minimum of four internal views (as applicable) and four external views of each structure. Place the following information on the front of digital photographs:

1. Date photograph was taken
2. Title of Project
3. Description of view shown in photograph
4. Identification of photographer
5. Sequential number of photograph

### **2.1.5.2 Pre-Construction Photographs**

The Concessionaire shall take a sufficient number of pre-construction photographs and a high quality video of the Site, including roadways, structures, drainage, and all areas necessary and/or anticipated to be impacted by the Work in HD format so as to resolve any disputes which may arise regarding the conditions prior to and subsequent to construction. Such preconstruction survey shall be completed prior to the NTP1. The I-25 Bridge photos will be taken during the bridge inspection and after NTP1. If a dispute arises where no or insufficient photographic or video evidence of its existing condition is available, the disputed area shall be restored to the extent directed by HPTE at no additional cost to HPTE.

## **2.2 Office Facilities and Options**

### **2.2.1 Office**

The Concessionaire shall provide all office space, and equipment, for HPTE as required for the Project; according to the approved ATCs attached as Annex 1 to this Schedule 5.

The Concessionaire shall provide office space (the HPTE Offices) and equipment for 28 HPTE personnel, including at least 10 private offices, specified herein.

The Concessionaire shall make available its proposed facilities for inspection and Approval by HPTE prior to HPTE occupying any Concessionaire provided facilities not later than 60 Days after NTP1. . The Concessionaire shall be required to furnish HPTE's staff with offices that are in good and serviceable condition (condition comparable to the Concessionaire's office space),

within one mile of the Phase I Project office located at 500 Eldorado Boulevard, Broomfield, CO. Both parties shall participate in a facility condition inspection prior to and at the completion of occupancy. HPTE will return possession of Concessionaire-provided facilities to the Concessionaire in essentially the same condition as when HPTE initially occupied the facilities except for reasonable wear and tear.

The Concessionaire shall secure Sites; obtain all Site permits; install, set up, and provide Utility services; and maintain the facilities as part of the Work. The Concessionaire may consult with HPTE about availability of suitable local sites and office facilities.

In the event that office spaces or appurtenant facilities are stolen, destroyed, or damaged during the Work, except by fault of HPTE, the Concessionaire shall at its expense repair or replace those items provided to their original condition within 5 Working Days. If loss or damage is caused by HPTE personnel, the Concessionaire shall replace the facilities within 5 Working Days, except HPTE will be responsible for costs incurred.

The Concessionaire shall maintain the HPTE Offices until at least 90 Days following Phase 2 Work Completion unless otherwise agreed to by HPTE. HPTE may, at its option, vary the number of its staff throughout the duration of the Project. However, the Concessionaire shall maintain the initial number and size of the HPTE Offices, conference rooms, reception area, break room and filing area (the HPTE Office Facilities) until 90 Days following the Phase 2 Work Completion.

The Concessionaire shall be responsible for disposal or removal of all HPTE Office Facilities and any site restoration Work required.

The Concessionaire shall provide:

1. Telephones and telephone service with at least two lines for HPTE Offices, conference rooms, break room, and filing room, including five cordless phones.
2. High-speed Internet connection (100kbps or greater) and networking for all offices.
3. Overhead lighting meeting Occupational Safety & Health Administration (OSHA) and code requirements for office space.
4. Two color laser printer/copiers capable of 45 ppm input and output at 600 x 600 dpi and at least two paper drawers accepting 8-1/2- x 11-inch up to 11- x 17-inch paper and paper weights from 16 to 24 lb. bond, including paper, toner, service and repairs. The unit shall be capable of scanning documents to 11- x 17-inch size and transmitting the scanned file to multiple email addresses
5. Office space not less than the size indicated below:
  - A. Private offices: 150 square feet of enclosed office space (with locking door) per office.
  - B. Partitioned offices: 100 square feet enclosed office space per office (cubicles/partitions are acceptable).
  - C. One enclosed conference room with doors capable of accommodating a 30-person meeting, with at least 50 percent of seating capacity at the conference table. This can be a shared conference room between the Concessionaire and HPTE.

- D. One enclosed conference room with doors for HPTE's exclusive use capable of accommodating a 20-person meeting, with a 15-person seating capacity at the conference table. The conference room shall be in an adjacent space to the HPTE Offices.
  - E. Break room: 150 square feet with sink, counter, microwave, and 20-cubic-foot refrigerator, and drinking water and dispenser.
  - F. Filing space: enclosed, with lockable door and 15 steel, 5-drawer, locking, lateral file cabinets (approximate size = 18 inches by 42 inches). The file room shall also have two 30- x 72-inch utility tables with two chairs each. This space shall be of sufficient size to accommodate the requested equipment and accommodate four staff members (to typical industry standards). This space shall not be shared with any other room.
  - G. One reception area with common access to the HPTE Offices.
  - H. Storage room: 150 square feet, enclosed with lockable door.
6. Furnishings, as follows:
- Conference Room
    - A. Conference table and chairs
    - B. Wastebasket
    - C. Hanging, erasable white board that is six feet wide minimum
  - Offices
    - A. Desk that is minimum size 76 x 36 inches with locking drawers
    - B. Computer workstation desk capable of holding a desktop printer, monitor, keyboard, and any accessories
    - C. Worktable (private offices only)
    - D. Ergonomically correct, OSHA-approved chairs
    - E. Extra office chair
    - F. Hanging, erasable white board, minimum 4 feet wide(private offices only)
    - G. Bookshelf
- 7. Indoor restrooms suitable for number of offices and personnel.
  - 8. Hard-surfaced (paved) parking, one space per employee, plus 10 visitor spaces (38 total).
  - 9. Daily janitorial service.
  - 10. Maintenance of the exterior area of office, including access to parking and snow removal.
  - 11. Facilities that meet American with Disabilities Act (ADA) access requirements and meet all local code requirements for office space.
  - 12. Heating, ventilation and air conditioning/cooling systems adequate for office use.
  - 13. 24 hours a day, 7- days a week access with security after normal working hours.



## **2.2.2 Design-Build Field Laboratory (Owner Verification Testing)**

The Concessionaire shall provide a Field Laboratory, Class 2, as per CDOT *M & S Standard Plans*, at a location to be agreed upon by HPTE and the Concessionaire. The field Laboratory shall have a minimum of three parking spaces, all contained within a security fence. The field Laboratory shall be provided to HPTE at least 15 Working Days prior to commencement of any field Activities involving earthwork of any type, analysis of mix designs, or planned placement of Portland Cement Concrete Pavement (PCCP) or hot bituminous pavement (HBP) and shall have a forced air oven and high-speed Internet connection.

## **2.2.3 Project Directory**

The Concessionaire shall maintain and furnish to HPTE a Project Directory listing the names, addresses and telephone numbers (office, home, cellular, etc.) of the Key Personnel and critical support staff of the Concessionaire and each Sub-Contractor. The Project Directory shall be submitted to HPTE prior to issuance of the NTP1. The Concessionaire shall update the Project Directory quarterly for the duration of the Work and any time a change to key personnel is made.

## **2.3 Safety Management**

### **2.3.1 Project Safety Management Plan Submittal**

The Concessionaire's Project Safety Management Plan (PSMP) (described in Section 107.06 of the Standard Specifications) must be submitted for review and Acceptance prior to the NTP1.

The PSMP is a living document and shall be updated when a process, method, chemical or other Work criteria changes that affects the safety of a person or property. The updated portion of the PSMP must be submitted for review.

### **2.3.2 Project Safety Management Plan Criteria**

The PSMP must answer the "who, what, and how" based upon the technical requirements contained within Schedule 5 of the RFP and the 12 elements identified in the Section 107.06 of the Standard Specifications.

#### **2.3.2.1 Performance of Safety Critical Work**

The Concessionaire shall follow the provisions of Schedule 5, Section 20, Exhibit A (Revision of Section 107 *Performance of Safety Critical Work*). The Concessionaire's detailed Construction Safety Critical Plan shall include an erection plan, a Bridge Removal Plan, and a removal of portion of bridge plan, as applicable, as well as other requirements specified in Revision of 107. The detailed Construction Safety Critical Plan shall be included in the Concessionaire's PSMP specified in 2.3.2 above.

#### **2.3.3 Project Safety Management Plan Training and Communication**

Project staff must be trained on the elements of the Concessionaire's accepted PSMP submittal.

## **2.4 Document Management**

The Concessionaire shall establish and maintain its own Document Control System (DCS) to store and record all correspondence, drawings, progress reports, technical reports, specifications, Contract Documents, deliverables, calculations, and administrative documents

generated under the Contract Documents. Document control, storage, and retrieval methods shall include the use of both hard copies and electronic records. The Concessionaire's DCS shall handle all Project documents.

All correspondence of the Concessionaire to and from HPTE and its representatives with respect to the Contract shall be serialized, and the Concessionaire shall maintain separate incoming and outgoing correspondence logs. At a minimum, a serialization similar to the following is required:

Date:	(DBC Assigned No.)
Addressee:	DB-(year)
Address:	
Subject:	
Per Contract Schedule ____ Section ____:	
Version	
Submitted For:	
- Information	
- Review	
- Acceptance	
- Approval	
Copies:	

*Example Document Serialization*

All correspondence shall include the Project name, Contract name and number, along with the specific subject of the letter. All replies shall refer specifically to prior correspondence to which it relates.

The Concessionaire shall make available, when requested by HPTE, copies of its logs indicating HPTE's outstanding items and a copy of any document requested within 24 hours.

### **2.4.1 Document Management System**

The Concessionaire shall transmit all required deliverables and other documents to HPTE via HPTE's document management system.

## **2.5 Deliverables**

The Concessionaire shall submit the following to HPTE for review, Approval, or and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
Monthly Progress Report format	Acceptance	Prior to NTP1
Preliminary Initial Schedule & WBS structure	Acceptance	Prior to NTP1
Original Initial Schedule	Approval	20 Days following issuance of NTP1
Current Initial Schedule	Acceptance	Concurrent with Monthly Progress Report
Revised Initial Schedule	Approval	Upon HPTE's or Concessionaire's request
Monthly Progress Schedule	Acceptance	Concurrent with Monthly Progress Report
Monthly Maintenance Progress Report	Review	Concurrent with each Monthly Progress Report submittal
As-Built Schedule	Acceptance	Before the final acceptance of the Phase 2 Construction work
Recovery Schedule	Approval	According to Section 2.1.3.4.5
Office Facilities and Options	Approval	(see requirements in Section 2.2)
Project Directory	(none)	Prior to NTP1
Project Safety Management Plan (PSMP)	Acceptance	Prior to NTP1

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management.)

### 3.0 QUALITY MANAGEMENT

The Concessionaire shall develop a Quality Management Plan (QMP) that documents the Concessionaire's commitment to quality, and all quality requirements of the Contract. The QMP shall include the Concessionaire's quality policy, approach for Quality Control, Quality Assurance, quality improvement, quality personnel, and training in the Quality Management System (QMS). The QMP shall list procedures for meeting all requirements of the Contract Documents. The Concessionaire shall submit the QMP to HPTE for Approval prior to NTP1. HPTE's Approval of the QMP is a condition to issuance of NTP1.

#### 3.1 Administrative Requirements

##### 3.1.1 Quality Policy

The QMP shall include the Concessionaire's executive management's written definition and endorsement of the Concessionaire's policy for quality, including objectives for quality and its commitment to quality. The QMP shall delineate the procedure used by the Concessionaire's executive management to implement the Concessionaire's quality policy. The Concessionaire's executive management shall ensure that this policy is implemented at all levels of the Concessionaire's organization.

The Concessionaire shall publish and post a statement of its commitment to quality, and the organization's quality objectives, in several locations throughout the Phase 2 Construction Work. The statement shall explain the Concessionaire's commitment to quality and the responsibility the Concessionaire has for assuring that it meets the quality requirements included in this [Section 3](#).

The quality policy statement shall be made known to and understood by all Concessionaire employees, subconsultants, Sub-Contractors, and Suppliers. The Concessionaire shall conduct a formal indoctrination program for all Concessionaire employees, subconsultants, Sub-Contractors, and Suppliers on the quality policy and the QMP.

##### 3.1.2 Quality Planning

The Concessionaire's QMP shall use industry standard inspection procedures, as well as those outlined in CDOT's *Construction Manual*, *Field Materials Manual*, and the Standard Specifications.

The Concessionaire shall prepare and implement a Materials Testing & Inspection Plan (MTIP) as part of the Approved QMP that includes the appropriate criteria, tests, and inspection requirements identified in CDOT's Standard Specifications, *Field Materials Manual*; Concessionaire-developed inspection checklists; and requirements as set forth herein.

The Concessionaire shall address the following elements in the MTIP:

1. Identification - Work items included in the MTIP
2. Characteristics - What characteristics of the item(s) will be inspected

The QMP shall include procedures to be taken for Nonconforming Work. Concessionaire shall perform inspections during all phases of the Work from the commencement of ATC 15 activities

until Phase 2 Work Completion to assure that the Work meets, and is being performed in accordance with, the Contract Documents.

Concessionaire shall also conduct an examination of the quality of workmanship to confirm that all Work is being performed in accordance with all Contract requirements. Appropriate follow-up inspections, sampling, and testing of Materials shall be performed as each item of Work progresses to assure consistency in workmanship, compliance with Contract requirements, (including design and construction documents), and satisfactory performance of the Work in service.

The Concessionaire shall include in the QMP its planning methods to meet the requirements of the Contract Documents. The Concessionaire shall include the Activities below in its quality planning efforts to meet the Contract Documents requirements for the Work. The Activities specified are the minimum for the QMP.

1. Define and develop quality objectives for the Phase 2 Construction Work.
2. Identify the necessary processes, resources, and Quality Assurance personnel that are needed to assure that the Work meets the requirements of the Contract Documents, including environmental commitments, public information requirements, maintenance of traffic requirements, safety, project management processes, and the QMP.
3. Ensure the compatibility of design, construction, installation, public information, inspection, and testing procedures.
4. Develop and maintain the currency of Quality Control, Quality Assurance, and quality improvement procedures.
5. Identify and define all measurable Contract Documents requirements.
6. Identify construction Quality Assurance hold points for Concessionaire Quality Assurance testing and inspection and to allow HPTE the opportunity to perform its owner verification responsibilities.
7. Identify, define, and implement standards of workmanship for all applicable Work features (e.g., concrete finishing).
8. Identify, define, prepare, and maintain quality records and quality plans.
9. Develop a procedure for preparation, control, Approval, and distribution of the QMP.
10. Develop a procedure for Quality Assurance auditing to ensure the Concessionaire, Sub-Contractors, and Suppliers of Material understand and are effectively implementing the QMP.
11. Develop a procedure for corrective and preventative actions regarding quality compliance and implement the quality improvement plan to address corrective Work.
12. Develop a procedure and ensure the Concessionaire's executive management reviews the QMS at planned intervals to ensure its continued suitability, adequacy and effectiveness. Such reviews should include Quality Assurance/Quality Control (QA/QC) results, owner verification results, status of

corrective/preventive actions, follow-up items from previous management reviews, changes to the QMS, and recommendations for improvement.

13. Provide the following items in the QMP in regards to the Portland Cement Concrete Paving (PCCP) for the Project and submit the QMP for PCCP 30 days prior to the beginning of paving operations:
  - a. A thorough definition of pavement smoothness and quality, which shall be the same for all travel lanes and shoulders, and the identification of steps for maintaining these criteria, including defined hold points and potential corrective measures.
  - b. Detailed information on identification of potential issues affecting quality such as smoothness, dumping and batching.
  - c. Procedures for verifying sawcutting accuracy, including a requirement to remove and replace incorrectly sawcut joints.
  - d. Procedures for monitoring, minimizing and correcting for lane to lane roughness variation.
  - e. Procedures for dowel bar placement and MIT testing and auditing, including the Concessionaire's obligation to provide additional test sections for MIT testing and auditing at HPTE's discretion pursuant to Schedule 5, Section 3.4 in the event that all or part of the Work is suspended due to dowel bar placement non-conformances.
  - f. A systematic process for ensuring quality regardless of production or scheduling needs.
  - g. A PCCP quality recovery plan for addressing noted issues with performance and procedures to correct such issues.

### **3.1.3 Quality Control**

The Concessionaire shall be responsible for establishing, documenting, and implementing, a Quality Control program. The Quality Control program shall be described in the QMP and shall include all procedures necessary for the Concessionaire to control the quality of its production processes to meet the requirements of the Contract Documents. The Quality Control program shall include the testing and inspection of outside shoulders. The Concessionaire shall develop a testing and inspection schedule to control the production processes.

Construction Quality Control Activities shall utilize statistical analyses of material test results, including mean, variance, range, and running averages; measurements; clearances; and interactions between QC and QA. The results of these Activities shall be used by the Concessionaire to set up control charts to monitor and track variations in materials over time. The control charts and the analytical results on which they are based shall be provided to HPTE as requested.

Tests or inspections performed by production or Quality Control personnel as part of the Quality Control process shall not be used to satisfy the Quality Assurance requirements.

### **3.1.4 Quality Assurance**

The Concessionaire shall establish, document and implement a Quality Assurance program. The Concessionaire shall include in the QMP the methods and procedures by which the Work

will be certified by the Concessionaire as complying with the requirements of the Contract Documents.

Quality Assurance personnel shall not participate in any Quality Control Activities and shall be independent of the Quality Control personnel.

The Concessionaire shall identify in the QMP all necessary resources and personnel to perform all Quality Assurance activities required to ensure all Work meets the requirements of the Contract Documents. The QMP shall identify the construction Quality Assurance hold points for Concessionaire Quality Assurance testing and inspection and shall describe how the Concessionaire will notify HPTE so that it may have the opportunity to perform its owner verification responsibilities.

### **3.1.5 Quality Improvement**

The Concessionaire shall establish, document and implement a program for quality improvement. The Concessionaire shall include in the QMP the methods for identifying, analyzing, evaluating, and implementing solutions to continuously improve quality. The QMP shall establish and maintain specific procedures to ensure a successful quality improvement program.

The QMP shall establish and maintain documented procedures for planning and implementing Concessionaire quality audits to measure the effectiveness of the QMP and identify quality improvement opportunities. The Concessionaire shall schedule and perform internal quality audits on the basis of the status and importance of the Activity to be audited.

Personnel that are assigned to audit Work Activities shall not have direct quality responsibilities for the respective Activities they audit. The results of the audits shall be recorded and reviewed with the personnel having responsibility in the area audited not later than 3 Working Days following completion of the audit.

The Concessionaire's project management personnel shall timely implement the necessary corrective actions to improve any deficiencies found during the audit. The Concessionaire's follow-up Activities shall ensure the implementation and effectiveness of the corrective action taken. Corrective actions shall identify the root causes of deficiencies and shall be developed, implemented, and tracked to prevent the recurrence of future deficiencies. Concessionaire shall monitor corrective actions through review of documents, surveillance, or follow-up audits. Concessionaire shall keep records of corrective actions together with the respective audit records and submit those records to HPTE upon request.

The Concessionaire shall consider HPTE's auditing efforts and the overall goals of the Phase 2 Construction Work to determine where Concessionaire quality improvement audits shall be performed.

### **3.1.6 Quality Personnel**

The Concessionaire's executive management shall have overall responsibility for success of the QMP, and shall ensure that responsibilities and authority are defined and communicated within their organization.

The Concessionaire shall identify a Quality Manager for all Design Activities and a Quality Manager for all Construction Activities. The Quality Managers shall be responsible for all Quality

Control and Quality Assurance activities. The Concessionaire's Quality Managers shall develop and document procedures, instructions, and process controls to ensure the Work being produced by the Concessionaire meets the requirements of the Contract Documents. The Concessionaire's Quality Managers shall review and approve the QMP prior to submittal to HPTE. The Concessionaire's Quality Managers shall assure, certify and provide documented evidence that the Work meets the requirements of the Contract Documents. At a minimum, the Quality Managers shall report the status of the Phase 2 Construction Work's quality monthly to HPTE.

All construction Quality Assurance testing personnel and Quality Control testing personnel performing concrete and hot bituminous pavement process control tests shall meet the standards established in Section CP-10 of the CDOT *Field Materials Manual*.

The Concessionaire shall ensure that personnel performing Work shall have the education, training, skills, and experience to meet the requirements of the Contract Documents. The Concessionaire shall maintain appropriate personnel records that may be examined by HPTE upon request.

### **3.1.7 Training**

The Concessionaire shall establish and maintain documented procedures for identifying training needs and requirements and shall provide training of all personnel performing Activities affecting quality. Personnel performing specific assigned tasks affecting quality shall be trained in the specific plans, processes, and procedures as assigned in the QMP (e.g., MTIP, Concessionaire auditing procedures, etc.).

The Concessionaire shall provide training to all personnel that may interface with HPTE's oversight efforts (audit process) to ensure they understand their roles and responsibilities for cooperating and responding to audits.

## **3.2 Quality Management Plan Requirements**

The QMP shall state the Concessionaire's commitment to quality and provide a clear definition of the scope of Activities and detail the methods to ensure the Work meets the requirements of the Contract Documents.

The QMP shall list all deliverables to HPTE, as required by the Contract Documents and this Section 3.

### **3.2.1 Concessionaire Responsibility to Respond to Nonconformance Notices**

For verification purposes, HPTE will perform assessment of the Work. These efforts do not relieve the Concessionaire of responsibility for checking all Work. HPTE will forward all assessment reports and nonconformance notices (NCN) (if any) to the Concessionaire. The Concessionaire shall respond in writing to HPTE NCNs identified by importance (Level 1 or Level 2), through a Quality Management Oversight Database provided by HPTE. HPTE shall provide user accounts and training for this purpose. The Concessionaire's response shall identify how it proposes to remedy the Work identified as nonconforming and the date by which the remedy shall be completed. The Concessionaire shall describe in the QMP its approach and methodology for resolving and responding to HPTE's NCNs.



### 3.2.2 Responsibility and Authority

The Concessionaire shall include in the QMP an organizational chart that illustrates a commitment to an effective quality program to ensure all Work meets the requirements of the Contract Documents. The QMP shall describe the hierarchy of the Concessionaire's organization. The QMP shall graphically depict the principal quality participants, showing lines of responsibility, authority, communication, and interfaces with HPTE; other involved agencies; and any other team members having a significant quality role, including subconsultants, Sub-Contractors, and Suppliers. The Quality Manager and Quality Assurance staff shall be shown on the organization chart to report to the Concessionaire's executive management and be independent of the Concessionaire's Project Manager. The Concessionaire shall update the organization charts and distribute those charts to HPTE when any changes to the organization are made.

The QMP shall describe the roles and responsibilities of the Quality Managers, Quality Control and Quality Assurance staff, and other key personnel; and shall describe their authority to implement quality improvements for the Phase 2 Construction Work.

The Quality Managers and Quality Assurance staff shall have no responsibilities in the production of the Work. The Concessionaire's Quality Managers and all Quality Control and Quality Assurance staff shall have the authority to stop Work that does not comply with requirements of the Contract Documents.

The responsibilities of all personnel who manage, perform, and ensure the quality of the Work include:

1. Initiate action to prevent the occurrence of Nonconforming Work.
2. Identify, evaluate, and document quality problems.
3. Recommend or initiate quality improvement solutions through established organizational channels.
4. Ensure the implementation of quality improvement solutions.
5. When Nonconforming Work is identified, stop incorporating Work that is affected by the Nonconforming Work into the Phase 2 Construction Work until the deficiency is corrected.

The Concessionaire's Quality Managers shall have the following responsibilities defined in the QMP:

1. Facilitate compliance of Work with the requirements of the Contract Documents and the Approved QMP.
2. Approve Concessionaire quality processes and procedures.
3. Provide adequate resources and trained personnel for Quality Control and Quality Assurance Activities.
4. Ensure the adequacy and enforcement of quality procedures, processes, inspections, and tests for all Work.

5. Establish and implement procedures to control and ensure the Work performed by subconsultants, Sub-Contractors and Suppliers meet the requirements of the Contract Documents.
6. Ensure the QMP is being implemented and report in writing regularly to the Concessionaire's executive management regarding the status of the implementation of the QMP.
7. Ensure that quality records are properly prepared, completed, maintained, and delivered to HPTE, as required by the Contract Documents, to provide evidence of QC and QA activities performed and quality results achieved.
8. Ensure that Quality Assurance staff is independent of the Concessionaire's Project Manager and regularly reports to the Concessionaire's executive management.
9. Continually promote awareness of the requirements of the Contract Documents throughout the Concessionaire's entire project organization.

### **3.3 Quality Assurance**

The Concessionaire shall establish, document, and implement a Quality Assurance program. The Concessionaire shall include in the QMP the methods and procedures by which the Work shall be certified by the Concessionaire as complying with the requirements of the Contract Documents.

The QMP shall establish procedures for procuring services. The procedures shall include a review and approval process by the Concessionaire's organization for adequacy of specified technical requirements and the adherence to quality requirements. Procurement documents shall contain data clearly describing the service needed. The Proposal Documents shall describe how Sub-Contractors and subconsultants are evaluated prior to award.

The QMP shall describe the measures to be taken to ensure that Sub-Contractors and subconsultants meet, implement, document, and maintain the QMP requirements.

The selection of Sub-Contractors and the type and extent of control exercised by the Concessionaire shall be dependent upon the type of product or service and, where appropriate, on records of Sub-Contractors' and subconsultants' previously demonstrated capability and performance.

#### **3.3.1 Design Quality Assurance**

The QMP shall include procedures that address all elements of design, including architectural, civil, structural, geotechnical, survey, hydraulic, environmental, traffic, safety, and temporary Work. The Concessionaire shall identify in the QMP all applicable computer programs to develop and check designs.

The QMP shall describe how the design team schedules the design efforts, including task force meetings, design reviews, constructability reviews, design meetings, independent design checks, and a schedule for Release for Construction Documents and As-Built Documents.

The Concessionaire shall identify in the QMP design input requirements. The Concessionaire shall perform ongoing audits of the design input requirements. The Concessionaire shall

maintain an accessible, centrally controlled design manual, database, or list that contains all relevant design inputs to be used by design personnel for the Phase 2 Construction Work. The Concessionaire shall provide a process in the QMP to ensure that the design inputs are communicated to, and accessible by, the relevant designers responsible for incorporating design inputs into the design. The Concessionaire shall include in the QMP how changes to design inputs are identified, reviewed, and approved by authorized personnel prior to their implementation. The QMP shall also include:

1. Procedures to control and independently ensure that the design meets the requirements of the Contract Documents, including provisions for Subconsultant's designs and configuration management Activities.
2. Procedures to identify and track Design Document deliverables.
3. Procedures for approval, tracking and recording revisions to Release for Construction Documents. The Concessionaire shall have a formal procedure for comment resolution included in the QMP.
4. Procedures for approval of Release for Construction Documents.
5. Procedures for approval of supplier-provided design drawings (e.g. shop drawings).

The Concessionaire's design Quality Assurance program shall include:

1. Basic Configuration and Ultimate Configuration accommodation confirmation: The Concessionaire shall prepare preliminary (30% level) plan packages showing how the Concessionaire's design meets the Basic Configuration and Ultimate Configuration accommodation requirements and submit to HPTE for Acceptance. The preliminary level plan packages shall include a cover sheet, typical sections, plan and profile for mainline and ramps, bridge and major drainage structure general layouts, master drainage plan, preliminary wall layouts and roadway cross sections at 50 foot intervals. The Concessionaire shall perform periodic internal audits throughout design development and construction of the Phase 2 Construction Work to ensure compatibility with the preliminary plans.
2. Task Force Meetings: The Concessionaire shall conduct weekly task force meetings to coordinate the design development within the Concessionaire's organizations and with HPTE and other affected agencies. As a minimum, the Concessionaire shall prepare an agenda and conduct each meeting to discuss the status of the design, coordinate the design development between design disciplines, discuss constructability issues, and identify any questions associated with design requirements. The Concessionaire shall take meeting minutes for all task force meetings and provide draft minutes to HPTE for Acceptance 4 Working Days after each meeting. The Concessionaire shall provide final minutes to HPTE via the HPTE document management system on a monthly basis.
3. Design Progress Review Meetings: The Concessionaire shall hold design progress review meetings at certain stages of the design development process (e.g., 60%, 90% packages) and invite HPTE to attend. The design progress

review meetings shall be scheduled, conducted, and documented by the Concessionaire. The Concessionaire shall take meeting minutes and submit those minutes to HPTE for Acceptance within 5 Working Days after each meeting.

4. Final (100%) Plan Package: The Concessionaire shall prepare final (100% level) plan packages showing how the Concessionaire's design meets the Basic Configuration requirements and submit to HPTE for review. HPTE shall have 14 Days to review the submittal and provide comments. After the review period, the Concessionaire shall conduct a comment resolution meeting with HPTE.
5. Release for Construction Documents and revisions to Release for Construction Documents: These documents allow the Concessionaire to initiate construction in advance. The Release for Construction Documents shall include an MTIP. This plan shall give testing quantities and frequencies, and Quality Assurance inspection hold points to confirm minimum QMP requirements have been met. The Concessionaire's Quality Manager shall approve the Release for Construction Documents prior to Release for Construction. The Concessionaire shall submit one copy of the Release for Construction Documents to HPTE or make the Release for Construction Documents available electronically prior to the Concessionaire beginning construction. The Concessionaire's Quality Assurance process for the Release for Construction Documents shall be thoroughly documented in the Concessionaire's QMP.

Prior to release of Release for Construction Documents for structure construction, the following items shall be required:

- A. The independent design check shall have been completed per the current CDOT *Bridge Design Manual* and the original final structural design calculations shall be revised and corrected based on comments from the independent design check for the structural element to be constructed.
  - B. The Rating Package as defined in the CDOT *Rating Manual* shall be completed prior to release of the superstructure construction drawings.
6. As-Built Documents: As-Built Documents shall be submitted to HPTE for Acceptance. HPTE may audit As-Built Documents to ensure completeness and compliance with the requirements of the Contract Documents. HPTE shall not Accept As-Built Documents until the Concessionaire has addressed, resolved, and incorporated, to the satisfaction of HPTE, any prior Concessionaire or HPTE comments. The Concessionaire shall ensure and provide documentation to HPTE that all review comments have been addressed. The As-Built Documents submittal shall include:
    - A. All plans reflecting Release for Construction Documents or revisions to Release for Construction Documents
    - B. Resolution of noncompliance
    - C. Design calculations
    - D. Design reports

- E. Specifications
- F. Electronic CADD files, as specified elsewhere in the Contract Documents

The Concessionaire shall include in the QMP a process for a licensed engineer in responsible charge for the design to prepare, review, and approve all changes, including field design changes and changes to Release for Construction Documents and As-Built Documents. The Concessionaire shall maintain a master list of approved design changes. The QMP shall include a process to communicate design changes to the construction Site on a timely basis consistent with the progress of construction Activities.

### 3.3.2 Construction Quality Assurance

The Concessionaire shall perform and document all required construction QA/QC Activities necessary to control the Work. The QMP shall extend to both permanent and temporary Work (erosion control, traffic control, etc.). Records of inspection and testing activities shall be submitted to HPTE via HPTE's document management system. Records of materials testing shall be submitted to an HPTE-provided Quality Records Database (QRD), a secure web-based application. HPTE will provide user accounts and training. Materials test reports will also require entry of meta-data fields for analysis and comparison to HPTE verification test results.

As a minimum, the Concessionaire's construction Quality Assurance Program shall include the elements defined below:

1. Certification: The Concessionaire shall include in the QMP a process to certify to HPTE that the Work produced meets the requirements of the Contract Documents.
2. Inspection: The Concessionaire shall include in the QMP, and submit to HPTE for Approval, an MTIP that shall include detailed inspection procedures to be used in cases where inspections are to serve as the basis for verifying compliance with the requirements of the Contract Documents. The Concessionaire shall submit all records of inspection and testing to the HPTE-provided QRD. The Concessionaire shall conduct each inspection in accordance with the Approved QMP. The Concessionaire shall document whether the inspections passed or failed based on the "pass/fail criteria" established in the procedure and the requirements of the Contract Documents; (e.g., concrete depth checks on deck pours, rebar clearance/size, locations, elevations, stationing etc.). The Concessionaire shall include failing inspection results, when applicable, in the inspection documentation.
3. Testing: At a minimum, the Concessionaire shall follow the CDOT *Field Materials Manual* and its Frequency Guide Schedule for minimum Materials sampling, Testing, and Inspection requirements identified under the column titled "Phase 2 Construction Work Verification Sampling & Testing Frequency" for all Quality Assurance tests required. The Concessionaire shall document the results in the QRD and show if the test passed or failed based on the "pass/fail criteria" established in the Contract Documents. The Concessionaire shall include failing tests results in the test documentation. Independent Laboratories shall submit signed and certified test reports to the Concessionaire not more than 14 Working Days after completion of the tests for all tests which require an independent Laboratory. HPTE may witness any test conducted for Independent Assurance

purposes. The Concessionaire shall develop and maintain a current Test log for all tests required by the Contract Documents. As a minimum, the Concessionaire shall document results of tests in report format and include the following:

- A. Contract or Project identification number
  - B. Identification of items tested
  - C. Quantity
  - D. Date and time test conducted
  - E. Location of items tested
  - F. Test procedure used
  - G. Name of technician
  - H. Acceptance criteria
  - I. Results - Acceptance or rejection
  - J. Authorized signature
4. COCs / CTRs: The Concessionaire shall include in the QMP a method of handling and documenting Work/products accepted in the Work by COC or CTR. The Concessionaire shall obtain Certificates of Compliance and Certified Test Reports prior to incorporation in the Work and maintain a complete log of all COCs and CTRs. The Concessionaire shall make the log and all COCs / CTRs available for owner verification at any time during normal business hours and shall submit the COC/CTR log for Acceptance prior to Phase 2 Work Completion. The Concessionaire shall include in its COC/CTR log signed certification that all Materials represented by each COC/CTR were installed in the Work. Certification shall be according to Schedule 5, Section 20 (106.12 - Certificates of Compliance, 106.13 - Certified Test Report).
5. Quality Reviews: The Concessionaire's Quality Manager or designated representative shall document formal reviews to verify that the Approved QMP is being effectively implemented.

### **3.3.3 Materials Testing and Inspection Plan (MTIP)**

The QMP shall include an MTIP describing all of the proposed inspections and tests procedures, including products provided by Suppliers during the manufacturing, receiving, and installation process, to ensure the requirements of the Contract Documents are met. The MTIP shall identify all inspections and tests required and include, at a minimum, reference to the requirements of the Contract Documents, frequency of the inspections and tests, and the Concessionaire-developed Quality Assurance processes. Where no inspections or test standard exists in any of the CDOT manuals, the MTIP shall develop criteria in writing based upon the best-available industry standard information and technology.

The MTIP shall include procedures for delivery, handling, and storage of furnished products ensuring that they are properly handled and stored to prevent damage, deterioration, or theft. It shall also document procedures for stored items and Materials consistent with the expected duration and type of storage, and procedures for monitoring special processes utilized in fabrication, assembly, and testing of specified products. Special processes are those requiring

qualified/certified production, inspection, and test personnel to perform highly skilled Work, such as welding, brazing, soldering, non-destructive testing, machining, coating, or plating.

The MTIP shall describe all Quality Assurance inspection and test Activities to be carried out including Quality Assurance hold points, and establish authority within the Concessionaire's organization for releasing Work beyond the hold point. While the Concessionaire shall notify HPTE when Work has progressed to a hold point, it shall be the responsibility of the Concessionaire's Quality Managers (or designee(s)) to verify that all requirements have been met prior to allowing the Work to progress.

The MTIP shall include a summary of Activity-specific Material quantities to document that the minimum sampling, testing, and inspection requirements have been met. This summary shall be performed and provided to HPTE for Acceptance monthly. (The Concessionaire may follow the CDOT Form 250 as a minimum basis for their Materials documentation record.)

The MTIP shall include processes to control, calibrate, and maintain test equipment to ensure it meets industry standards and other applicable requirements. Test equipment used by the Concessionaire shall be of a quality and capacity that ensures that measurements made are to levels of accuracy and precision that are required by the test procedure. The MTIP shall:

1. Identify the test required and the accuracy required, and select the appropriate test equipment.
2. Define procedures to calibrate all test equipment prior to initial use and at prescribed maintenance intervals against certified equipment and measurement standards of the National Institute of Standards and Technology or other similar recognized technical standards customarily accepted in the industry. Where no standard exists, the basis for calibration shall be developed in writing based upon the best-available information and technology.
3. Identify test equipment with a suitable indicator to show the calibration status of the test equipment.
4. Maintain current calibration records for test equipment.
5. Define procedures to ensure that environmental conditions are suitable for calibrating test equipment.
6. Define procedures to ensure that the handling and storage of test equipment is such that the accuracy and fitness for use is maintained.
7. Define procedures to safeguard test equipment, including test hardware and test software, from adjustments that would invalidate calibration settings.

### **3.3.4 Reporting and Record-Keeping of Construction Quality Assurance Documentation**

The Concessionaire shall maintain construction workmanship and materials quality records of all inspections and tests performed per the Approved QMP. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of Nonconforming Work and causes for rejection, etc.; proposed remedial action; and corrective actions taken. These records shall cover both conforming and Nonconforming Work, and shall include a statement

that all supplies and materials incorporated in the Work are in full compliance with the Contract Documents.

The Concessionaire's Quality Managers shall ensure that quality records are properly prepared, completed, maintained, and delivered to HPTE, as required by the Contract Documents, to provide evidence of quality Activities performed and quality results achieved.

The Concessionaire shall submit all Quality Assurance test measurements and test results, including failing results, and inspection records. The Concessionaire shall submit test data and approved test results to HPTE for Acceptance using the QRD within 24 hours following the inspection or test. The responsible technician and the technician's supervisor shall sign the daily test reports.

The Concessionaire's Quality Manager shall also maintain a daily log of all inspections performed for both Concessionaire and Sub-Contractor operations. The daily inspection reports shall identify inspections conducted, dates of inspections, results of inspections, locations and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible technician and the technician's supervisor shall sign the daily inspection reports. These daily inspection reports shall document the day's events, Activities, and discussions in a format consistent with the requirements contained within CDOT's *Field Materials Manual* and *Construction Manual*.

To enhance coordination of HPTE's Independent Assurance Activities during construction, the Concessionaire shall provide HPTE with a weekly look ahead of specific scheduled construction Activities designating location and planned quantities of materials to be placed, and protocols for identifying completed Work. The Concessionaire shall provide HPTE with the actual construction Activities conducted during the previous week, designating location and quantities of materials that were placed.

### **3.4 Nonconforming Work**

The Concessionaire shall include in the QMP procedures to develop and maintain a system to identify, control, remedy and report Nonconforming Work, including Nonconforming Work identified by HPTE. The QMP shall include procedures to identify Nonconforming Work and to remedy Nonconforming Work in accordance with the Approved QMP procedures. The responsibility for review and for the disposition of Nonconforming Work shall be established in the QMP. The Concessionaire shall identify Nonconforming Work by completing a Nonconformance Report (NCR). A NCR shall include:

1. Identification of Nonconforming Work, including tagging Work products
2. Evaluation of the Nonconforming Work
3. Recommendation for "repair" or "use as is" dispositions
4. Cause of Nonconforming Work
5. Proposed corrective action to prevent recurrence
6. Responsibility for accomplishing corrective action
7. Schedule of Work with a date of remedy completion



8. Signature lines for the Quality Manager and HPTE verifying that the Nonconforming Work has been completed in accordance with the approved disposition

The Concessionaire's engineer shall approve the Nonconformance Report prior to submittal to HPTE for Acceptance. The Concessionaire shall not perform the recommended remedy prior to Acceptance by HPTE for "repair" and "use as is" dispositions.

The Concessionaire shall develop and maintain a Nonconforming Work log to track and identify the status of Nonconforming Work. The Concessionaire shall submit an updated Nonconforming Work log to HPTE weekly and shall use the log to look for Nonconforming Work trends to determine if corrective actions are needed.

If all or part of the Work is suspended due to dowel bar placement non-conformances, the Concessionaire shall provide at HPTE's discretion additional test sections for MIT testing and auditing.

The Concessionaire shall record all NCRs and shall provide them to HPTE.

The Concessionaire shall include in the QMP procedures for controlling the use of Nonconforming Work including the tagging of Nonconforming Work products. Nonconforming Work product tags shall only be removed by the originator of NCR or the originator's supervisor, and only when the Concessionaire demonstrates to HPTE that the Nonconforming Work product meets the requirements of the Contract Documents or is Approved for use by HPTE.

#### **3.4.1 Corrective and Preventative Action**

The QMP shall describe corrective and preventative action procedures that the Concessionaire shall use to identify and improve processes that produce, or may produce, systemic Nonconforming Work identified by the Concessionaire or by HPTE. The Concessionaire's corrective and preventative action procedures shall include:

1. Methods to investigate the cause of systemic Nonconforming Work and to determine what corrective action is needed to prevent recurrence
2. Methods to analyze all processes, Work operations, quality records, service reports, and HPTE audits to detect and eliminate the possibility of systemic Nonconforming Work from occurring
3. Methods to prioritize corrective and preventive action efforts based upon the level of risk to the quality of the Work
4. Controls to ensure that effective corrective and preventative actions are taken when the need is identified
5. Methods to implement and record changes in procedures resulting from corrective and preventative actions

#### **3.4.2 Punch List Work**

The Concessionaire shall develop a Punch List and Punch List log as required in the Contract. The Punch List and Punch List log shall be completed by Quality Control and Quality Assurance personnel. HPTE and other affected agencies shall be invited by the Concessionaire to attend walks of the Work to include items on the Punch List. The Concessionaire shall provide the Punch List and Punch List log for Acceptance to HPTE.

### 3.5 Verification

HPTE's owner verification will use a sampling approach to assess the Concessionaire's compliance with the requirements of the Contract Documents. HPTE reviews of sampled Work for Contract compliance are defined as verification reviews. The four types of HPTE verification reviews are:

1. Design verification reviews: HPTE will perform design verification reviews on the products of design (drawings, specifications, and other design deliverables) on an ongoing basis during the Phase 2 Construction Work. Concessionaire shall submit documents for design verification reviews to HPTE for Acceptance a minimum of 5 Days in advance of review meeting.
2. Construction verification Inspections: HPTE will perform construction verification inspections on construction Activities.
3. Construction verification Testing: HPTE will perform sampling and testing of Materials to validate the Concessionaire Quality Assurance testing program. Verification test results will be stored in the QRD.
4. Process Audits: HPTE will perform process audits on the implementation of all Concessionaire Work Activities, excluding design and construction. Such activities may include the requirements of the Contract Documents, such as public information, maintenance of traffic, environmental compliance, safety, project management processes, and meeting the requirements of the Approved QMP.

Verification reviews will entail the collection and documentation of objective evidence to determine whether the requirements of the Contract Documents have been met. The results of HPTE verification reviews will be recorded by HPTE and will be documented within the Quality Management Oversight (QMO) Database, a secure web-based application. Any NCNs identified by HPTE require a response within the QMO database.

#### 3.5.1 HPTE Verification Tests

HPTE will perform periodic Verification tests to ensure that the Concessionaire's Materials meet the requirements of the Contract Documents. HPTE will enter verification test results in the Quality Records Database (QRD). HPTE will perform a statistical analysis to ensure that the Concessionaire's Quality Assurance test results correlate statistically with the HPTE verification test results and meet the requirements of the Contract Documents. If HPTE determines that the compared test results do not correlate, HPTE will perform Independent Assurance tests to determine the cause of the differences.

#### 3.5.2 HPTE Independent Assurance

HPTE will perform Independent Assurance reviews and tests to ensure that:

1. Concessionaire Quality Assurance personnel are trained and certified and demonstrate that they understand the test procedures they are performing.
2. The test equipment used by the Concessionaire Quality Assurance personnel is calibrated.

3. Split sample test results correlate.

Independent Assurance test results will also be used as referee tests to assess statistically significant differences, determined by HPTE in its sole discretion, between Concessionaire Quality Assurance tests and HPTE verification test results.

### **3.5.3 Governmental Person Inspections**

Governmental Persons shall have the right to inspect the Work, provided that the Governmental Person has jurisdiction over the Work and as required by Applicable Law.

## **3.6 Deliverable Requirements**

### **3.6.1 Quality Management Plan**

The Concessionaire shall submit the QMP to HPTE electronically for Approval prior to NTP1.. The NTP1 will not be issued until the QMP has been Approved by HPTE.

### **3.6.2 Design Deliverables**

Unless otherwise specified in the Contract Documents, HPTE will respond to design submittals submitted for Acceptance or Approval within 14 Days. Released for Construction Documents will be responded to within 5 Days unless significant changes, as determined at HPTE's sole discretion, have been made to the plans since the 100% plan was submitted

The Concessionaire shall submit to HPTE all Release for Construction Documents, revisions to Release for Construction Documents, and As-Built Documents.

The Concessionaire shall identify on its Contract Schedules when the design deliverables identified above will be submitted to HPTE.

The Concessionaire shall provide two hard copies (11 x17 inches for plans, 8.5 x 11 inches for specifications), and one set of electronic files on CD-Rom of the design deliverables to HPTE. As-Built Documents shall show all changes. All changes shall be noted using CADD. Hand-drawn changes will not be Accepted.

The design deliverables shall be delivered to HPTE indexed and clearly marked to indicate the date of issue and stage of development (e.g., Release for Construction Documents). All design deliverables shall include a title block, consistent with the standard Phase 2 Construction Work drawing format established as part of the QMP, with the following information:

1. Date of issuance and including all prior revision dates
2. Contract title and number
3. The names of the Concessionaire, subconsultants, Sub-Contractors, Suppliers, and manufacturers as applicable
4. Subject identification by Concessionaire drawing or Contract reference

All design deliverables shall be sealed by the Concessionaire's engineer consistent with applicable Legal Requirements. All design deliverables shall include a sufficient blank space, in the lower right corner, just above the title block on the drawings, and in the lower right corner of the title page of specifications and calculations, in which the Concessionaire's Engineer may indicate the action taken, indicating his or her review and approval.

If a design deliverable requires review approval from a Local Agency or permitting authority, the Concessionaire shall gain such concurrence prior to submitting the design deliverable to HPTE.

Specifications or CDOT *Standard Special Provisions* applicable to a design deliverable shall be submitted with the design deliverable.

When calculations accompany drawings in a submittal, the body of the calculations shall contain cross-references to the individual drawing to which the pages of the calculations pertain. Calculations required shall demonstrate conformance with the requirements of the Contract Documents.

The CADD drawings and associated documents shall be organized in a logical manner, have a uniform and consistent appearance, and clearly depict the intent of the design and construction. In addition:

1. The software requirements for all submitted design deliverables shall be InRoads/Microstation, in accordance with the current CDOT standards in effect. Project files shall be organized and submitted in accordance with CDOT's ProjectWise format.
2. All design deliverables shall be in English units. The Phase 2 Construction Work coordinate system shall comply with the CDOT *Survey Manual*.
3. The Concessionaire shall prepare As-Built Documents for the Phase 2 Construction Work that shall include, but not be limited to, the following:
  - a) Title sheet
  - b) Index
  - c) Standard Plan List
  - d) Roadway design data
  - e) General notes
  - f) Pavement details
  - g) Roadway details
  - h) Drainage details
  - i) Geotechnical plans
  - j) Environmental mitigation, as necessary
  - k) Permanent signing plans
  - l) Aesthetic elements
  - m) Roadway typical sections
  - n) Roadway geometric layout plans
  - o) Roadway geometric layout tables
  - p) Roadway plan
  - q) Roadway profile
  - r) Detour construction and phasing plans
  - s) Detour construction and phasing profiles
  - t) Intersection plans
  - u) Bikeway plan and profile
  - v) Pavement plans
  - w) Drainage plans
  - x) Pavement marking plans
  - y) Utility plans
  - z) ITS plans

- aa) Landscape/seeding plans
- bb) Grading plans
- cc) Lighting plans
- dd) Bridge plans
- ee) Wall plans
- ff) BRT station plans
- gg) Roadway cross sections
- hh) Estimated material quantities
- ii) Other details, as needed
- jj) Specifications

The Concessionaire shall provide one set each of electronic files on CD-Rom of Utility As-Built Documents to HPTE and to the respective Utility Owner for Utility Work constructed by the Concessionaire, within 90 Days after the Utility Owner has accepted the Utility Work. These electronic deliverables shall conform to those requirements set forth in the Contract for CADD requirements, except as modified by the specific requirements of the individual Utility Owners. The Utility As-Built Documents shall show locations of existing Utilities, structures, trees, streets, and existing highway right-of-way limits. Additionally, the Concessionaire shall obtain from each Utility Owner, performing its own construction, Utility As-Built Documents for their Utility Work showing the foregoing information one set of electronic files on CD-Rom to HPTE. The Concessionaire shall show this information on the As-Built Documents. All As-Built Documents electronic files shall be submitted in \*.dgn and \*.pdf format.

CADD files shall be in accordance with the appropriate standards in this [Section 3](#). Highway-related files shall conform to CDOT standards. All CADD files shall be documented in a tabular format describing the path, file name, and description.

The structure of the reference drawings, Contract Drawings, and CADD files are recommended as a guideline for file setup.

### **3.6.3 Document and Data Approval**

The Concessionaire shall ensure that all deliverables include a signed and dated certification by the originator of the deliverables and that the deliverable is complete and meets the requirements of the Contract Documents.

### **3.6.4 Document and Data Changes**

The Concessionaire shall ensure that any changes to deliverables provided to HPTE as revised are in a format that can enable changes to be readily apparent and trackable (e.g., documents use the redline/strikeout method).

### **3.6.5 Product Data**

The Concessionaire shall submit to HPTE for Acceptance two hard copies of all manufacturers' warranties, guarantees, instruction sheets, parts lists, and other product data within 20 Days after installation of the items to which they relate, and in any event prior to Phase 2 Work Completion. The Concessionaire shall ensure that the product data cited in this [Section 3](#) is organized and indexed in a manner that allows easy retrieval of information. The Concessionaire shall maintain proper records of product data.

### 3.7 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
Quality Management Plan (QMP)	Approval	Prior to issuance of the NTP1
Documents for design verification reviews	Acceptance	At least 5 Days before meeting
Other Meeting Minutes (defined in QMP)	Acceptance	4 Working Days after meeting
Preliminary (30% level) plan sets	Acceptance	As defined in Contract Schedules
Task force meeting minutes	Acceptance	4 Working Days after meeting
Design progress review meeting minutes	Acceptance	5 Working Days after meeting
Quality Manager reports the status of the Phase 2 Construction Work's quality	Review	Monthly
Summary of Activity-specific Material quantities (MTIP)	Acceptance	Monthly
100% Level Plan Sets	Review	As defined in Contract Schedules
Release for Construction Documents	Acceptance	As defined in Contract Schedules
Revisions to Release for Construction Documents	Acceptance	As defined in Contract Schedules
As-Built Documents	Acceptance	As defined in Contract Schedules
Two hard copies of all manufacturers' warranties, guarantees, instruction sheets, parts lists, and other product data	Acceptance	Within 20 Days after installation of the items to which they relate, and in any event prior to Phase 2 Work Completion
COC/CTR log	Acceptance	Prior to Phase 2 Work Completion
Quality Assurance test data and approved test results	Acceptance	Within 24 hours following inspection or test
Weekly look ahead of specific scheduled construction Activities	Review	Weekly
Description of actual construction Activities conducted during the previous Week	Review	Weekly
Nonconformance Report	Acceptance	As set out in QMP

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
Nonconforming Work log	Acceptance	Weekly (as needed)
Punch List and Punch List log	Acceptance	Upon completion

## 4.0 PUBLIC INFORMATION

### 4.1. Public Information Plan

The Concessionaire shall prepare and maintain a Public Information Plan (PIP) in coordination with HPTE to develop and communicate information to and from the public regarding the Phase 2 Construction Work. This PIP shall be used throughout the duration of the Work by the Concessionaire to manage and implement the public information process.

The Concessionaire shall provide a minimum of one full-time Public Information (PI) Officer, with demonstrated experience and qualifications (e.g., degree in communications, public relations or related field and at least three years of experience in the construction industry in the management and support of the communication/public information function on high-impact, long-term transportation projects. The Concessionaire PI Officer shall provide communication support to HPTE as outlined throughout this RFP.

As significant components of the PIP, there are categories of information that shall be communicated and coordinated between HPTE and the Concessionaire. These include the following:

1. The Vision of the Project

Answers to questions such as why the Project is needed, what work will be done, how the Project will benefit customers, how the Project fits into the community, and how the Project fits into broader transportation plans, including the ongoing Phase 1 project.

HPTE and the Concessionaire will provide the Project vision information to the public, as well as the related project details (phasing, traffic, impacts, etc.). All information that is made public, must first be Approved by HPTE's public information officer.

2. The Project's Progress

HPTE and the Concessionaire shall provide ongoing messages to keep the public and other stakeholders informed about the project including the schedule, traffic impacts, major milestones, budget, etc. The Concessionaire shall work with HPTE to develop the messages and HPTE will have final approval before the messages are disseminated

3. Coping During the Phase 2 Construction Work

Coping information helps people deal with inconveniences caused by the Phase 2 Construction Work, such as details regarding detours, lane closures, closed ramps and access impacts, information resources available to people, including Travel Demand Management (TDM) strategies, and other Activities that affect residents and businesses.

The Concessionaire's Public Information Officer shall coordinate with the HPTE Project public information liaison to provide coping information to the public, including utilization of the checklist according to requirements of Schedule 5, Section 16, (Maintenance of Traffic).



The Concessionaire shall be accessible 24 hours a day, 7 Days a week, for Activities associated with public information and shall have experience in this area. The Concessionaire shall provide contact information, including home, fax and mobile numbers; and email addresses to HPTE for Acceptance (which may include directors of communication, project managers, and the appropriate Public Information Officer). The Concessionaire shall hold weekly coordination meetings with HPTE to provide Contract Schedule, accomplishments, and planned activities for the upcoming week.

The Concessionaire shall submit the final PIP to HPTE for Approval prior to NTP1.

#### **4.1.1 Public Information Task Force**

As soon as is practical, the Concessionaire shall initiate a public information task force to implement the Concessionaire's PIP and integrate with the public information efforts of HPTE. At a minimum, this task force shall include the Concessionaire's Public Information Officer, the Concessionaire's Project Manager, and HPTE. Upon the first meeting, this task force will establish a regular meeting schedule.

#### **4.1.2 Public Information Plan Updates**

The Concessionaire shall schedule and hold PIP review meetings with HPTE to review, assess input, and/or modify the Concessionaire's PIP. These meetings shall be held quarterly after the initial PIP is established and Approved by HPTE.

The draft of the proposed revisions to the PIP shall be submitted to HPTE at least 10 Working Days prior to each PIP review meeting. If changes are required as a result of the meeting, the Concessionaire shall submit the revised PIP to HPTE for Approval within 10 Working Days after the review meeting date.

### **4.2 Public Opinion Research**

HPTE may gather public and Stakeholder input from a variety of customer groups, primary research and other sources that will be affected by construction. HPTE may continue to conduct such formal and informal public opinion research regarding the Phase 2 Construction Work to ascertain the public's sentiment. The Concessionaire shall make use of this research, if available, in developing and updating the PIP quarterly. HPTE will review the PIP quarterly to ensure that it is responsive to the results of any research.

### **4.3 Stakeholders**

HPTE has identified the Stakeholders listed below as audiences requiring coordinated outreach by HPTE and the Concessionaire. The Concessionaire shall describe in the PIP its proposed approach to communicating with these Stakeholders and coordinating with HPTE. The Stakeholders include, but are not limited to:

1. Area residents
2. Property owners and property management companies
3. Commuters

4. Transportation management/advocacy organizations
5. The traveling public
6. Commercial vehicle operators, Ports of Entry and Denver Permit Office, and Colorado Motor Carriers Association
7. Local, regional, and state government officials
8. Business owners, employees, and customers
9. Neighborhood associations
10. Emergency response agencies, such as the Colorado State Highway Patrol, and the local police departments, sheriff departments, fire departments, ambulance service providers, and hospitals
11. Local community organizations
12. Tourist destinations and organizations
13. Delivery and courier services
14. HPTE employees and other internal team members, including CDOT Headquarters, the Public Relations Office and the CDOT Government Relations Office
15. Mass transit agencies/companies
16. Utility owners
17. School districts/universities

#### **4.4 Crisis Communications**

In an event of a crisis, HPTE will be the lead agency to handle communication with the media, public, HPTE staff, etc. The Concessionaire shall be available to help coordinate with HPTE and provide information necessary to respond to the crisis.

The PIP shall include a crisis communications plan for the Concessionaire's response to emergencies and incidents during the Phase 2 Construction Work. The Concessionaire shall coordinate this approach with the Concessionaire's overall Incident Management Plan described in Schedule 5, Section 16 (Maintenance of Traffic).

The Concessionaire's crisis communication approach for its public information staff shall include:

1. Designated staff to respond to the emergency
2. Types of potential emergencies
3. Approaches to addressing potential emergencies
4. Boilerplate messaging that includes:
  - A. Cause of specific disruptions (i.e., whether construction-related or not)
  - B. Actions being taken to alleviate the problem
  - C. Impact to the public and notification procedures

D. Anticipated duration of the disruption

The Concessionaire shall provide specific details on internal coordination and communication that will occur with other Concessionaire groups, HPTE, and other Stakeholders.

#### **4.4.1 Emergency Information Dissemination – Telephone Tree**

The Concessionaire shall establish and manage an emergency response telephone and/or email tree. All appropriate personnel shall be included on this telephone tree for immediate response in the event of an emergency. The telephone tree shall be divided into areas of expertise so the proper people are called for specific emergency situations. HPTE, HPTE public information staff, and the Concessionaire's Engineer shall be included on the telephone tree for notification of any emergency that may arise. The Concessionaire shall develop and maintain a contact list of emergency service providers as part of its crisis communications approach. The Concessionaire shall provide information to emergency service providers, as outlined in the communication matrix described in Section 4.6.2 below. The Concessionaire shall submit the emergency response telephone tree to HPTE prior to NTP1.

### **4.5 Data Collection and Management**

The Concessionaire's PIP shall include a data collection and management plan that outlines and provides for the ongoing information needs of the Stakeholders. For example, residents, commuters, and most other Stakeholders will need information about the construction schedule, what roads will be affected and/or closed by construction, what efforts will be taken for noise mitigation during construction, and the hours construction will take place. Likewise, commercial vehicle operators will need specific information on any conditions that would restrict or prevent commercial vehicles from using roadways under construction. Emergency response providers will need to know if designated routes for emergency vehicles are altered. All Stakeholders will require reliable, accurate, accessible, and timely information on when and where construction is taking place.

#### **4.5.1 Data Collection and Management Strategies Approach**

The Concessionaire shall develop a process to collect construction information to be provided to HPTE for use on the Phase 2 Construction Work public website and to HPTE for other uses.

The Concessionaire shall include, as part of its data collection activities that will arise during the Phase 2 Construction Work, lane and ramp closures, shoulder work, pothole repair, dust mitigation, and other maintenance work.

In all events, the Concessionaire shall be responsible for the accuracy and reliability of the information it forwards to HPTE as soon as it becomes available.

The Concessionaire shall track changes (including changes to short-term construction-related closures, unexpected construction activities, emergency closures, and scheduled construction Activities), and report on all changes as quickly as possible (see [Section 4.6.1](#) below). The Concessionaire shall update the construction information and make the information available to HPTE for its use. The Concessionaire shall update the project hotline and provide information to HPTE immediately in order to update the website and media outlets.

#### 4.5.2 Information Management Maintenance and Reporting

The Concessionaire shall maintain basic information, contact names, and phone numbers for other construction projects that may impact traffic conditions on the Phase 2 Construction Work or surrounding local street network. This information shall be included in the construction information maintained by the Concessionaire.

The Concessionaire shall collect, process and provide to HPTE several types of coping information that impact the Phase 2 Construction Work. Outlined below are some, but not all, of the types of information necessary to inform the public regarding the Phase 2 Construction Work. The Concessionaire shall include the following types of information and minimum performance expectations when developing the various components of the PIP:

##### 1. Construction Activities

Construction notification shall be provided to HPTE 20 Days prior to the NTP1. Construction notification shall be made available to HPTE at least 15 Days prior to the beginning of any new construction in any area of the Phase 2 Construction Work, per [Section 4.6.1](#) below. The Concessionaire shall coordinate, communicate, and address coping strategies in its PIP.

Notification of construction events shall include:

- A. Description of the Activity
- B. The anticipated starting date of the Activity
- C. The anticipated ending date of the Activity

The Concessionaire shall include any updates to the above and disseminate to HPTE at weekly meetings.

##### 2. Maintenance of Traffic

The Concessionaire shall issue information to HPTE that it can use for notices regarding the maintenance of traffic for the entire Phase 2 Construction Work for commuters, emergency services agencies, residents, and businesses within four blocks of the limits of construction, or any other stakeholders who will be impacted by the Phase 2 Construction Work at least 30 Days prior to any construction in an area that affects the residents or businesses.

The Concessionaire shall include, at a minimum, the following elements within the information:

- A. Residents and businesses impacted or affected
- B. Proposed alternative routes and detours
- C. The Concessionaire's contact for further information
- D. Public website address for further information

3. Commercial Vehicle Access and Restriction Information

The Concessionaire shall inform HPTE of information that it can use to inform CSP, CDOT Regions, and CDOT transport permit office for notification of construction events that shall include at least:

- A. Description of the Activity
- B. The anticipated starting date of the Activity
- C. The anticipated ending date of the Activity
- D. Any updates to the above

4. Bicycle, Pedestrian, Handicapped Mobility, and Access

The Concessionaire shall clearly define and communicate to HPTE information that it can use to inform the public and other associated Stakeholder groups as to its plans for maintaining bicycle access, pedestrian access, and handicapped mobility. The Concessionaire may be required to assist HPTE in the development and distribution of materials.

5. RTD Transit System

The Concessionaire shall issue information to HPTE that it can use to inform the public and other associated Stakeholder groups for any impacts to the existing RTD transit system by the Phase 2 Construction Work at least 30 Days prior to any construction. This information shall include at a minimum:

- A. Description of the Activity
- B. The anticipated start date of the Activity
- C. The anticipated end date of the Activity
- D. RTD routes, stations, and services affected by the Activity

## **4.6 Dissemination of Information**

The Concessionaire's PIP shall include an approach for providing accurate information to establish an effective working partnership with the Stakeholders and the procedures for submitting all public information dissemination elements (i.e., news releases, fact sheets, media advisories, faxes, emails, collateral materials, ads, etc.).

### **4.6.1 Schedule for Information Dissemination**

The Concessionaire shall provide construction Activity information to HPTE for review according to the following schedule:

1. Thirty Days prior to the beginning of the following Activities in any area of the Phase 2 Construction Work:
  - A. Bridge demolitions
  - B. Road or ramp closures, alley and driveway access impacts, detours, and major traffic impacts lasting seven Days or longer
2. Seven Days prior to the beginning of the other remaining types of Activities in any area of the Phase 2 Construction Work

As soon as known (must have at least 24 hours notice), the Concessionaire shall provide HPTE with construction updates (e.g., cancellation of planned closures, additional lane closures, closure removals, major traffic shifts, etc.) that directly impact the public.

#### **4.6.2 Communication Matrix**

As part of the Concessionaire's PIP, the Concessionaire shall develop and use a communication matrix listing the Stakeholders and the information tools to be used to address each group of Stakeholders' informational needs. The Concessionaire shall develop a communications matrix for Stakeholder groups, and individuals and businesses with special needs that shall identify:

The customer group(s) that requires information

1. Location or region of customer group(s)
2. What information is needed
3. When information is needed
4. Tools to be used for disseminated information
5. Results of information dissemination

#### **4.6.3 Public Contact**

The Concessionaire shall track all public contacts made from residents, businesses, and government offices, etc. At a minimum, this shall include the names, addresses, email addresses, fax and phone numbers, questions, comments, concerns, date of contact, and the response provided. Reports detailing public contacts shall be provided to HPTE on a monthly basis.

The Concessionaire shall work with the public information task force to develop a master distribution list of contacts to be used for general public information, publications, and informational flyers/newsletters. CDOT's "govdelivery.com" system shall be used as the basis for development of this list/database. This list or database shall be presented to HPTE for review prior to the NTP1. Through the Concessionaire's data gathering process, the Concessionaire shall assist HPTE in supplementing govdelivery.com.

#### **4.6.4 Telephone Hotline and Email Account**

The Concessionaire shall implement a telephone hotline and an email address prior to the NTP1 as a means of receiving community input, answering questions, and prompting possible solutions regarding Phase 2 Construction Work-related activities. The hotline shall be available to the public 24 hours a day, 7 Days a week, and shall be publicized in all project information

materials and signage throughout the Phase 2 Construction Work. The hotline must be handicap-accessible and a free call for the public. Additionally, the hotline shall be staffed during major construction Activities, such as bridge demolitions and special events. HPTE will provide the specific special events and game Days needing hotline staffing in conjunction with the Concessionaire's major construction Activities. An immediate response is preferable for all calls, although a voice mail option is permissible. However, all voice mail messages shall be replied to within 24 hours of receipt, including weekends and Holidays.

All calls and resulting actions from this hotline shall be tracked and integrated into the Phase 2 Construction Work's electronic database and made available to HPTE.

#### **4.6.5 Media Relations**

Media relations efforts will be initiated by HPTE, including news releases, traffic advisories, editorial, feature stories, etc.

During the Work, the Concessionaire shall immediately notify HPTE of any situations involving the media, and all communication requests will be tracked by HPTE. The Concessionaire shall be familiar with, and comply with, the *CDOT News Media Communications Guidelines*, which outlines required protocol when contacted by media representatives.

#### **4.6.6 Community and Business Relations**

The Concessionaire shall develop and implement community and business relations strategies that communicate coping messages to the public. Coping strategies shall focus on providing the public with the information they need to make short-term and long-term decisions about how they can deal with the Work with as little disruption as possible.

#### **4.6.7 Government Relations**

HPTE will develop and implement a comprehensive government relations program. The Concessionaire shall assist in giving timely information to HPTE regarding construction Activities, and shall participate in meetings as requested.

Throughout the Work, all communication requests received by the Concessionaire from government entities shall be immediately referred to HPTE (not including those requests related to project management or coordination for Local Agency permits, or are the Concessionaire's responsibilities under the Contract Documents).

### **4.7 Tools for Disseminating Information**

To convey a consistent identity and message throughout the Phase 2 Construction Work, the various tools for dissemination shall comply with the Project branding requirements, as set forth by HPTE.

At a minimum, the Concessionaire shall utilize the tools in the following Sections for information dissemination and minimum performance expectations when developing the various components of the PIP.

#### **4.7.1 Phase 2 Construction Work Identification Boards and Signage**

Public information and warning signage shall be maintained throughout the Phase 2 Construction Work at each construction area. All signage shall be coordinated and comply with the requirements outlined in Schedule 5, Section 16 (Maintenance of Traffic). As part of the communications matrix, the Concessionaire shall include signage as one of the communication tools to be used.

#### **4.7.2 Website Information Dissemination**

HPTE will host the project public website on the CDOT server. The Concessionaire shall provide updates to the content to HPTE on a weekly basis. The website will be used to provide construction information provided by HPTE and the Concessionaire. The Concessionaire shall provide, at minimum, construction information, Commercial Vehicle restrictions, and regular input for a community/construction calendar of events, Stakeholders' use, and other relevant information for direct input onto the public website. Information regarding TDM options shall be provided via the 36 Commuting Solutions website, with a link from the project public website. HPTE will be responsible for updating the website.

#### **4.7.3 Public Meetings and Personal Contact**

##### **1. Public Information Meetings**

The Concessionaire shall host at least two public meetings prior to the commencement of construction. The meetings shall be held in a convenient location for community and business groups. Depending upon the Concessionaire's proposed Traffic Control Plan (TCP), and areas impacted within each phase, other meetings may be required. The Concessionaire's PIP shall outline its approach to these construction information meetings.

Public meetings shall provide construction schedules, impacts, traffic management plans, and other coping information. A member of the Concessionaire's management team or Public Information team, and HPTE will attend all meetings. The Concessionaire and HPTE shall jointly organize and conduct, all meetings and extend invitations to appropriate participants. The Concessionaire shall be responsible for invitation dissemination.

##### **2. Personal Contacts**

A member of the Concessionaire's Public Information team shall manage and implement door-to-door, email, and phone contact during the duration of the Work. HPTE will assist the Concessionaire with email communications and responding to phone communications. The Concessionaire shall be responsible for all door-to-door communications. These contacts shall be necessary to keep the public aware of all issues pertaining to the Phase 2 Construction Work, such as all road and driveway closures and utility disruptions. Contact shall occur as outlined in Section 4.6.1 above and shall consist of information explaining the planned Work, impacts, the expected duration of the Work, contact information, and answering questions. These contacts shall be conducted within a minimum one-block radius of the Activity following the four-block radius initial notifications outlined in Section 4.5.3, above.



### 3. Community Forums

Building on the work of earlier efforts, HPTE may hold regular community forums. These forums will comprise various stakeholder groups, including state and local government officials and staff, neighborhood members, emergency service providers and others; and they will be a forum for community representatives to provide substantive input and feedback on the Phase 2 Construction Work. HPTE will arrange the meetings and set the agenda. HPTE will facilitate all community forum meetings. The Concessionaire shall participate with HPTE on any community forums throughout the duration of the Work (maximum of three per quarter). The Concessionaire shall provide appropriate technical staff as required.

### 4. Tours of the Phase 2 Construction Work

The Concessionaire shall provide HPTE the opportunity to give all media, businesses, government officials and residents tours of the construction areas, as HPTE deems necessary. In addition to the tours led by HPTE, a Concessionaire representative who is knowledgeable of construction activities and schedules may be requested to assist with the Phase 2 Construction Work tours. The Concessionaire's representative shall be able to describe the components of construction and why that activity is taking place at that time. HPTE will coordinate the tours with the Concessionaire. The Concessionaire shall supply personal protective equipment, including but not limited to, hard hats, glasses, and vests on all tours led by the Concessionaire.

## 4.8 Environmental Mitigation

In addition to the requirements of Section 5, Section 5 (Environmental Requirements), the Concessionaire shall coordinate any mitigation requirements, as they pertain to the public, with HPTE to ensure the public is aware of and participates in those areas where their input is required.

## 4.9 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance. or Approval</b>	<b>Schedule</b>
Project vision information	Approval	Prior to release to public
Concessionaire public information staff contact information	Acceptance	Prior to NTP1
Final Public Information Plan (Public InformationP)	Approval	Prior to NTP1
Quarterly draft of revised Public Information Plan	Review	10 Working Days prior to each Public Information Plan review meeting
Quarterly revised Public Information Plan	Approval	Within 10 Working Days following each Public Information Plan review meeting
Emergency response telephone tree	Acceptance	At NTP1
Telephone hotline	Review	Prior to NTP1
Master distribution list of contacts to be used for general public information, publication, and informational flyers/newsletters	Review	Prior to NTP1
Construction Activity information	Review	Pursuant to schedule in <u>Section 4.6.1</u>

All deliverables shall also conform to the requirements of Schedule 5, Section 3 (Quality Management).

## 5.0 ENVIRONMENTAL REQUIREMENTS

The Concessionaire shall comply with all requirements of all applicable environmental laws, Environmental Approvals, and Governmental Approvals issued thereunder, whether obtained by HPTE or the Concessionaire. The Concessionaire shall prepare an Environmental Compliance Work Plan specifically identifying all of the environmental compliance requirements for the Phase 2 Construction Work and the Concessionaire's approach for complying with those requirements. The Environmental Compliance Work Plan shall be submitted to HPTE for Acceptance prior to NTP1.

The Environmental Compliance Work Plan shall include

1. All elements of the Construction Management Plan defined in Table D-1 of Appendix D of the *US 36 Corridor Phase 1 Record of Decision (ROD)* in Schedule 5A and any additional elements included in this RFP.
2. Description of means and methods to meet all commitments defined in the 2012 US 36 NEPA Reevaluation and 2012 US 36 Phase 2 NEPA Reevaluation in Schedule 5A.
3. Description of means and methods to meet all requirements defined in the U.S. Fish and Wildlife Service's Biological Opinion ("BO" or "Biological Opinion") dated January 18, 2013.
4. Description of process for tracking environmental commitments throughout design and construction. Commitments shall be tracked in the Concessionaire's Document Control System (DCS).
5. Description of process for tracking environmental commitments and compliance throughout the post-construction maintenance periods.

The Concessionaire shall employ and utilize on the Phase 2 Construction Work an environmental manager. The environmental manager shall lead a field review with HPTE environmental staff to discuss environmental issues every month during active construction periods, and shall have the authority to stop construction if Work Activities violate environmental laws or policy, or jeopardize human health and safety.

During the design and construction phase, the Environmental Compliance Work Plan shall be updated every month, and document any pertinent discussions that occur during the environmental field reviews. The updated Environmental Compliance Work Plan shall be submitted to HPTE for Acceptance monthly. During the post-construction phase, the Environmental Compliance Work Plan shall be updated and submitted to HPTE for Acceptance annually.

### 5.1 Environmental Resources Requirements

#### 5.1.1 Air Quality

The Concessionaire shall submit an Air Pollutant Emission Notice (APEN) and receive a construction permit from the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD).

The Concessionaire shall require all construction equipment to burn ultra-low sulfur diesel fuel.

The Concessionaire shall use wind barriers and/or wind screens to minimize the spread of dust where large amounts of Material are stored; use a wheel wash station and/or large diameter cobble apron at egress/ingress areas to minimize dirt being tracked onto public streets; use street sweepers to control dust on public streets; cover all trucks hauling dirt, sand or other loose Material leaving the Site; water or cover temporary excavated Materials; and use engine pre-heater devices during wintertime construction.

## **5.1.2 Noise**

HPTE performed a preliminary noise analysis with abatement recommendations as part of the Record of Decision. The findings of this analysis are included in the Highway Noise Analysis Technical Report (Addendum), Hankard Environmental (October 2009). The noise analysis was completed using the geometry assumptions included in the *US 36 Corridor Final Environmental Impact Statement* (FEIS) plans.

### **5.1.2.1 Noise Mitigation**

No noise mitigation is required for the Phase 2 Construction Work based on the horizontal and vertical design of US 36 as shown in the plans in the Reference Documents. Locations of changes to the vertical alignment of more than 5 feet, or in horizontal alignment that result in the approximate halving of the distance between the nearest through centerline of travel (for the ultimate configuration shown in the FEIS) and existing sensitive receiver from what is shown in the plans in the Reference Documents, will require a new noise analysis if a noise-sensitive receiver is present within the study zone. The study zone is defined as a 500-foot distance in all directions from the proposed edge of traveled way throughout the extents of the Phase 2 Construction Work. The Concessionaire shall be responsible for new construction of reasonable and feasible noise barriers. Noise analysis and mitigation shall be in conformance with CDOT's *Noise Analysis and Abatement Guidelines*. This includes barrier optimization for the consideration of mitigation. The Concessionaire shall use the Traffic Noise Model v2.5 currently approved by the Federal Highway Administration. Noise analyses, final geometry, and architectural details of noise barriers shall be submitted to HPTE for Acceptance 21 Days prior to issuance of Release for Construction Documents. The Concessionaire shall make best efforts to incorporate the use of berms or combination berms/barriers for noise reduction on the Phase 2 Construction Work.

Proposed noise barrier options shall be presented as a part of the Concessionaire's design meeting open to the public.

### **5.1.2.2 Construction Noise**

The Concessionaire shall comply with all applicable local sound control and noise ordinances and regulations, including the use of variances. If permits are required, they shall be acquired prior to construction.

The Concessionaire shall prepare and submit to HPTE for Acceptance a noise control plan that outlines allowable daytime and nighttime uses, projected noise levels, and locations and types of noise abatement measures that may be required to meet specific noise limits as part of the Release for Construction Documents. There is a preference to install permanent noise barriers at the beginning phases of construction to minimize construction noise.

### 5.1.3 Historic Resources

If the Concessionaire's Work results in any changes in effects to the resources described in the Record of Decision and the subsequent reevaluation or in changes to the Area of Potential Effect, the Concessionaire shall document those changes and provide HPTE with all necessary information and reevaluations for coordination with the state historic preservation officer under Section 106 of the National Historic Preservation Act. HPTE will ensure that the necessary consultation process, as described in the stipulations of the *US 36 Corridor Section 106 Programmatic Agreement* found in Schedule 5A are carried out. Historic resources shall not be impacted until the Section 106 consultation process and the Section 4(f) Evaluation is complete.

The Section 106 consultation conducted as part of the 2012 Phase 2 NEPA Reevaluation was completed on July 26, 2012 when SHPO provided concurrence on a the recommended finding of *no adverse effect* for six properties and the recommended finding of *no historic properties affected* for two properties. The conclusions of the Section 4(f) evaluation regarding historic resources have not changed and is documented in the reevaluation.

The Concessionaire shall be responsible for the updating the Section 4(f) evaluation if necessary.

The Concessionaire shall produce Office of Archaeology and Historic Preservation Level I Documentation, including photographs printed on archival paper, for any properties that will be demolished or otherwise adversely affected. The Concessionaire shall also be responsible to mitigate for all previously unanticipated effects to historic resources.

### 5.1.4 Paleontology

Final design plans for grading and drainage shall be submitted to HPTE for review 21 days prior to Release for Construction. HPTE will determine the impact and the scope of paleontological construction monitoring that will be required. Mitigation through on-Site monitoring includes collection of any scientifically important fossils and associated data uncovered during construction or Materials excavation. HPTE will provide the on-Site paleontological monitoring. The Concessionaire shall provide 5 Working Days advance notice to HPTE prior to conducting work that may require monitoring.

### 5.1.5 Open Space Property

The FEIS/Section 4(f) Evaluation, found in Schedule 5A of this Contract, identified several open space properties that will be impacted by the Phase 2 Construction Work. The officials with jurisdiction over these resources are the City of Boulder, City of Louisville and Boulder County. The Concessionaire's Work shall not impact these resources to a higher degree than that described in the FEIS or the subsequent reevaluation.

The Concessionaire shall provide adequate trail detours (with surfacing equivalent to existing) with advanced notice and signage for any trails identified above or located within any of the properties identified above that require temporary closure during construction. The Concessionaire shall provide notification to HPTE two weeks prior to the trail closure. Following construction, trails shall be returned to their existing or comparable state.

For work that will occur on the open space lands, the Concessionaire shall submit a plan that addresses the following; public safety, security, traffic, pedestrian, and bicycle access to both HPTE and the applicable local jurisdiction for any construction. The public safety and security plans shall include all appropriate access, signing, and public information Best Management Practices (BMP).

The Concessionaire shall coordinate with HPTE and the agency/official with jurisdiction over any impacted open space lands during final design. The Concessionaire shall ensure the following requirements are met:

1. Pedestrian underpasses more than 20 feet in length shall be lighted to standards for safety and security.
2. Trailhead and trail connections to residential and commercial developments shall be preserved or alternate trail routes accomplishing a similar connection shall be provided.
3. Trails that must be relocated to a public street due to property acquisition shall be enhanced with signs and additional plantings commensurate with the impact.
4. Final design for park, recreation, and open space resources shall be consistent with future park, trail, and open spaces that have been included in adopted plans.
5. All other mitigation measures contained in the 2009 FEIS/Section 4(f) Evaluation and the subsequent reevaluation are implemented.

The Concessionaire shall also be responsible for the updating the *US 36 Corridor Section 4(f) Evaluation*, if necessary.

### **5.1.6 Vegetation and Senate Bill 40 (SB 40) Wildlife Certification**

The Concessionaire shall minimize tree removal and disturbance to native plant communities, especially wetlands, prairie dog towns, riparian areas, and upland trees and shrubs. All trees outside of Senate Bill 40 jurisdictional areas that are removed that are over 4 inches diameter at breast height shall be replaced on a 1:1 basis.

Senate Bill 40 (SB 40) Wildlife Certification will be required for construction activities that impact streams and their associated riparian areas. The Concessionaire shall not perform construction activities within SB 40 jurisdictional areas until Colorado Parks and Wildlife issues the SB 40 permit. The Concessionaire shall be responsible for preparing the SB 40 Certification application package on the behalf of HPTE. HPTE will approve the application package and submit it to Colorado Parks and Wildlife. Approval of the application package by HPTE does not constitute approval of the permit.

The Concessionaire shall comply with CDOT's Guidelines for Senate Bill 40 Wildlife Certification. In SB 40 jurisdictional areas, trees removed during construction, whether native or nonnative, shall be replaced with a goal of 1:1 replacement based on a stem count of all trees with a diameter at breast height of 2 inches or greater. Shrubs removed during construction, whether native or nonnative shall be replaced based on their pre-construction areal coverage. See Schedule 5, Section 17 (Landscaping), for additional conditions related to vegetation and SB 40 Wildlife Certification guidelines.

#### **5.1.6.1 Integrated Noxious Weed Management Plan**

6. The Concessionaire shall prepare an Integrated Noxious Weed Management Plan for the Phase 2 project to include and address the following elements and requirements as a minimum:
7.
  1. Identify and map all State and County listed A and B noxious weeds that are mandated for control.

2. Cite proven integrated management practices that include mechanical, chemical, and biological (where applicable) techniques for each noxious weed identified.
3. Contractor vehicles shall be inspected before they are used for construction to ensure that they are free of soil and debris capable of transporting noxious weed seeds or roots. Heavy construction equipment shall be cleaned prior to use on the project site.
4. Noxious weeds observed in and near the construction area at the start of construction shall be treated with herbicides or physically removed.
5. Periodic surveys shall occur during construction to identify and treat noxious weeds that have developed.
6. All noxious weeds shall be controlled throughout the duration of construction until final acceptance and through any applicable landscape establishment periods.
7. Noxious weeds shall be removed prior to stockpiling topsoil.
8. Where the BO/BA applies, the weeds shall be controlled for the duration of the required monitoring period in accordance with T&E management of said species.
9. Disturbed areas shall be reclaimed in phases throughout the project construction and seeded using a permanent native seed mixture. If areas are completed and permanent seeding cannot occur due to the time of year, mulch and mulch tackifier will be used for temporary erosion control until seeding can occur.
10. Fertilizer shall not be used in seeded areas.
11. Only certified weed-free mulch and bales shall be used on the project (Title 35, Article 27.5, Forage Crop Certification 35-27.5-101).
12. All herbicide applications shall be performed by personnel certified and licensed by the Colorado Department of Agriculture and in accordance with the product label.
13. The plan shall include specific procedures to be used in Preble's meadow jumping mouse and Ute ladies'-tresses orchid areas. Procedures in these areas shall be developed in consultation with land management agencies with jurisdiction where the designated sensitive habitats occur.
14. CDOT Standard Specifications for Road and Bridge Construction Section 217 shall be referenced.

#### **5.1.7 Visual**

The Concessionaire shall comply with the aesthetic element requirements of Schedule 5, Section 15 (Structures), Schedule 5, Section 14 (Signing, Pavement Markings, Signalization and Lighting); and Schedule 5, Section 17 (Landscaping).

Staging areas that are to remain in place longer than 90 Days shall be fenced and screened.

Temporary construction lighting shall be limited to that required for safety, security and nighttime operations. Lighting shall be shielded and directed at working areas to minimize glare and ambient light conditions in nearby areas, including adjacent travel lanes.

Bus Rapid Transit (BRT) station designs will be reviewed by HPTE. Parking at transit stations shall adhere to local parking ordinances. Entries to parking and transit stations shall be designed using local materials and colors.

Design elements are subject to HPTE Approval. Consideration shall be given to the following guidelines:

1. Retaining walls shall reflect natural appearance in textures and colors and be graffiti-resistant. Walls shall be tiered, where feasible.
2. Corridor design guidelines shall be applied using materials and colors similar to existing structures in the area. See CDOT Region 1 *Urban Design Manual* in Schedule 5A.

Lighting at transit stations shall be directional and shielded to reduce off-site light scatter and glare. Timers and sensors shall be used to minimize the time that lights are on in areas where lighting is not normally needed for safety, security, or operations.

### 5.1.8 NEPA Reevaluation

The Concessionaire shall be responsible for the requirements and conditions of the CDOT Reevaluation Form (#1399). The Form shall be submitted for HPTE Approval for changes to design, impacts, or mitigation that were not approved as a part of the ROD and 2012 US 36 Phase 1 and 2013 Phase 2 NEPA Reevaluations. The Federal Highway Administration (FHWA) must concur with any NEPA reevaluation. FHWA concurrence of the reevaluation depends on the new impacts that might occur from any proposed changes. HPTE Approval of the reevaluation must occur before the proposed change from the ROD can be performed.

## 5.2 Environmental Permits

The Concessionaire shall be responsible for obtaining all governmental and agency permits required for the Work, not otherwise obtained by HPTE, including, but not limited to, the environmental permits in Table 5.2.

<b>Table 5.2 REQUIRED ENVIRONMENTAL PERMITS</b>	
<b>Permits/Approvals</b>	<b>Permitting Agency</b>
Construction Dewatering Permit	Colorado Division of Public Health and Environment (CDPHE) Water Quality Control Division
Air Pollutant Emission Notice and construction permit	CDPHE Air Pollution Control Division (APCD)
Demolition permits	CDPHE and all applicable local jurisdictions
Construction noise permit	All applicable local jurisdictions
Colorado Discharge Permit System (CDPS) Stormwater Construction Permit	CDPHE Water Quality Control Division
Subterranean Groundwater Permit	CDPHE Water Quality Control Division



<b>Table 5.2 REQUIRED ENVIRONMENTAL PERMITS</b>	
<b>Permits/Approvals</b>	<b>Permitting Agency</b>
Black Tailed Prairie Dog Relocation or Removal Permit	Colorado Parks and Wildlife
Prairie Dog Lethal Control Permit	City of Boulder or all other applicable local jurisdictions
Construction permits	All applicable local jurisdictions
Other local permits (stormwater, railroad, building, utility, survey, tree removal, wetland ordinances, work in parks and on trails)	Local agencies or railroad company
Letter of Approval for impacts to historic resources	State historic preservation officer
New development and redevelopment programs for MS4 Phase I and II areas	Follow requirements of local jurisdiction's MS4 permits and CDOT MS4 permit
SB 40 Certification (impacts to stream banks, stream channels, and riparian areas)	Colorado Parks and Wildlife
Construction waste material and transportation of solid wastes	CDPHE Hazardous Materials and Waste Management Division
Generation of contaminated materials during construction	CDPHE Hazardous Materials and Waste Management Division
Generation of hazardous waste per the Resource Conservation and Recovery Act (RCRA)	CDPHE Hazardous Materials and Waste Management Division
Stationary Source Air Quality Permit	CDPHE APCD
Section 404 Permit amendments	U.S. Army Corps of Engineers

### **5.2.1 Colorado Discharge Permit System – Stormwater Construction Permit (CDPS-SCP)**

The Concessionaire shall be responsible for all stormwater permit requirements until the permit is closed. This includes the maintenance of all BMPs and seeded / landscaped areas until final stabilization has been achieved (see Schedule 5, Section 12, (Drainage and Hydrology), all temporary BMPs have been removed, and there is no potential for erosion. Schedule 5, Section 12 (Drainage and Hydrology), has a complete list of stormwater sediment and erosion control requirements. The Concessionaire shall review and incorporate the latest requirements from HPTE for erosion and sediment control.

### 5.2.2 Wetlands/Waters of the U.S. and Section 404 Permit

The Phase 2 Construction Work shall impact a maximum of 6.10 acres (5.92 acres of permanent impact, 0.18 acres of temporary impact) of wetlands and 0.48 acres (0.46 acres of permanent impact, 0.02 acres of temporary impact) of waters of the U.S. for construction of the Basic Configuration elements. This maximum is based on the authorized impacts outlined in the Section 404 Permit from the U.S. Army Corps of Engineers (USACE permit no. 200380602) and anticipated impacts as documented in the 2012 US 36 Phase 2 NEPA Reevaluation. The Concessionaire shall comply with the requirements and special conditions outlined in that permit (see Schedule 5A).

Prior to construction, the Concessionaire shall fence off wetlands not to be impacted during construction. Wetland and waters of the U.S. locations are shown in the *Existing Wetland Delineation* in Schedule 5B. Wetland boundaries shown on the Contract Drawings shall be used to calculate all impacts associated with the Phase 2 Construction Work. The Concessionaire shall employ all applicable avoidance and minimization measures, strategies, and BMPs to minimize impacts and protect wetlands and waters of the U.S. to the greatest extent possible. The Concessionaire shall update HPTE throughout final design on the calculations of estimated and actual wetland and waters of the U.S. impacts. If at any time estimated impacts are calculated to exceed maximums in the above paragraph established for this Work, immediate consultation with HPTE must be initiated. If unavoidable impacts to wetlands and waters of the U.S. exceed the acreage limits described above, but still fall within the boundaries of the approved Section 404 permit, the Concessionaire shall be responsible for preparation of all documentation required for the review and approval of the additional impacts. If unavoidable impacts to wetlands and waters of the U.S. fall outside of the boundaries shown in the approved Section 404 permit, the Concessionaire shall be responsible for preparation of all documentation required for the review and approval of the additional impacts, and for obtaining a permit amendment from the U.S. Army Corps of Engineers.

### 5.2.3 Wetlands Field Investigation and Identification

Wetlands field investigation and identification associated with the Phase 2 Construction Work include, but are not limited to, the following Activities:

1. Prior to construction, the Concessionaire shall identify and mark (with environmental fencing or flagging) all wetlands and waters of the U.S. that have the potential to be impacted by the Phase 2 Construction Work. The wetlands and waters of the U.S. boundaries shall be those used in the Section 404 permit. Through final design, the Concessionaire shall identify the wetlands and waters of the U.S. that will actually be impacted by the Phase 2 Construction Work, calculate the actual acreage of impacts, and submit that information to HPTE for review.
2. Prior to construction, the Concessionaire shall perform a functional assessment of all wetlands to be impacted by the Phase 2 Construction Work using the CDOT Functional Assessment of Colorado Wetlands (FACWet) methodology. The assessment documentation/forms shall be submitted to HPTE for review.
3. The Concessionaire shall report in the updated Environmental Compliance Work Plan all wetlands impacted during the previous month's Work. HPTE will utilize this information to complete annual monitoring requirements (per conditions stipulated in the Section 404 Permit).

## **5.2.4 Wetland Mitigation**

As specified in the Section 404 Permit, there are two off-Site locations designed to mitigate impacts from all phases of the Preferred Alternative: City of Boulder- Colorado Open Lands Site and enhancement of Walnut Creek. This mitigation will be conducted through an individual project separate from this Project and will be managed by HPTE. No wetland or waters of the U.S. mitigation will be required for the Phase 2 Construction Work.

## **5.2.5 Construction Dewatering Permit**

The Concessionaire shall obtain a Construction Dewatering Permit from the CDPHE for any dewatering of groundwater during construction in accordance with Water Quality Control Division (WQCD) requirements. The Concessionaire shall apply for this permit at least 30 Days prior to the start of discharge.

The Concessionaire shall provide all information needed to assist the WQCD in their evaluation and setting of a water quality standard for this permit, which may include monitoring of the discharged water.

The Concessionaire shall monitor roadways for any settlement caused by dewatering. The Concessionaire shall conduct a preliminary survey of any private property or buildings that may be affected by dewatering to establish existing conditions. The Concessionaire shall repair any damage to roadways, private property, or buildings caused by dewatering operations.

The Concessionaire shall construct settling ponds for effluent from dewatering operations, as required by the Construction Dewatering Permit.

## **5.2.6 Miscellaneous**

### **5.2.6.1 CDPHE Permits**

The Concessionaire shall contact CDPHE if groundwater monitoring wells will be disturbed.

The Concessionaire shall obtain applicable permits from all directly affected Local Agencies and any additional CDPS permits from CDPHE.

### **5.2.6.2 Boulder County Permits**

The Concessionaire shall obtain Boulder County Construction Permit(s) for work on County property outside CDOT ROW. Concessionaire will be responsible for any applicable fees, insurance, and bonding requirements associated with the permits.

### **5.2.6.3 City of Louisville Permits**

The Concessionaire shall obtain City of Louisville Construction/Right-of-Way and Open Space Access Permit(s) as applicable for work on City property outside CDOT ROW. Concessionaire will be responsible for any applicable fees, insurance, and bonding requirements associated with the permits.

## **5.3 Wildlife**

### **5.3.1 Black-Tailed Prairie Dogs**

There are existing black-tailed prairie dog (BTPD) colonies within the Phase 2 Construction Work limits that could potentially be impacted by construction Activities. City of Boulder, Boulder

County and CDOT have policies for addressing BTPD impacts and mitigation. Colorado Parks and Wildlife (CPW) also regulates certain activities associated with impacts to BTPD. The Concessionaire shall be responsible for complying with the regulations, guidelines, and requirements associated with these policies. When there are conflicting policies, the most stringent policy shall be followed.

Prior to conducting any Activities that could potentially impact BTPD, the Concessionaire shall submit a plan of action that outlines the impacts expected and how the Concessionaire shall comply with the policies mentioned. If prairie dogs are to be relocated or removed during the burrowing owl nesting season (March 15<sup>th</sup> through October 31<sup>st</sup>), the affected habitat shall be surveyed by a qualified biologist for the presence of burrowing owls. This plan will be reviewed and Approved by HPTE, and possibly by CPW, depending on the level of impact. The plan will be also be reviewed by the City of Boulder and Boulder County for activities within its jurisdiction, and by any other agencies as necessary. Approval and necessary permits from CPW and local jurisdictions shall be required before impacts to BTPD can occur.

In all jurisdictions except the City of Boulder, the Concessionaire shall obtain all necessary permits and perform all required aspects of BTPD mitigation.

In order to facilitate the project, HPTE will initiate the City of Boulder permit application process prior to the award of this contract. Within the City of Boulder's jurisdiction, HPTE shall conduct the required BTPD and burrowing owl surveys, and submit the permit application. The final determination from the City of Boulder will be obtained prior to December 31, 2013. The Concessionaire shall take over the permit after December 31, 2013 and perform any necessary BTPD removals. The Concessionaire shall follow all requirements of the permit; including the condition that no mitigation can be done between March 1 and June 1.

### **5.3.2 Wildlife Crossings**

The Concessionaire shall replace the existing structures at Coal Creek, with structures that are compatible with drainage requirements and incorporate design features and elements encouraging wildlife movement for large mammals. Required features of the large wildlife crossing elements include, but are not limited to:

1. A natural bottom culvert or bridge location that is in proximity to tree and shrub cover.
2. Wildlife crossing opening with a minimum width of 20 feet and a minimum height of 10 feet.
3. Wildlife crossing finished grade at least 1 foot above ordinary high water elevation.

The Coal Creek location shall include a shelf or raised dry ledge on each side of the low flow channel above ordinary high water for small and medium mammal wildlife crossing. Ledges shall be at least 1 foot higher than the normal water level and at least 1.3 feet wide.

The Concessionaire shall incorporate appropriate small and medium mammal wildlife crossings as follows:

1. 60"x38" HERCP dry crossings at Davidson, Goodhue, and Marshallville Ditches separate from the irrigation ditch structures.
2. 60"x38" HERCP dry crossing between South Boulder Creek and Upper Dry Creek Ditch.

3. 60"x38" HERCP crossing at the unnamed ditch west of 88th Street which will serve as a crossing for small and medium sized mammals but will also carry flow during large storm events.

The crossings for small and medium mammal wildlife shall incorporate a continuous windrow composed of sticks, brush, and grasses placed inside the pipes to provide cover for small animals.

The design of wildlife crossings shall be subject to Acceptance by HPTe and review by CPW. Concessionaire shall be responsible for the guidelines and recommendations included in the ROD except where superseded in this [Section 5](#), as well as FHWA's *Wildlife Crossing Structure Handbook: Design and Evaluation in North America* (2011). Wildlife crossings shall be compatible with drainage requirements identified in Schedule 5, Section 12 (Drainage and Hydrology).

#### **5.3.2.1 Wildlife Friendly Fencing**

The existing barbed and woven wire livestock fencing located adjacent to the City of Boulder Open Space boundary within the Phase 2 Project Area shall be replaced. The new fence shall be more wildlife-friendly per CPW's recommendations and publication- *Fencing with Wildlife in Mind* (Hanophy 2009). The new fence shall continue to contain livestock. The Concessionaire shall coordinate with the City of Boulder Open Space and Mountain Parks (OSMP) Staff as well as CPW to determine appropriate specifications for new livestock fencing.

#### **5.3.2.2 Wildlife Friendly Erosion Control Blanket**

Erosion control blanket shall be biodegradable and netless or have biodegradable netting woven in a loose "leno" weave to reduce the possibility of animal entrapment. Turf Reinforcing Mats (TRMs) shall only be used in soil filled buried applications.

### **5.3.3 Raptors and Migratory Birds**

The Concessionaire shall comply with the Migratory Bird Treaty Act (MBTA) at all times. Protection of migratory birds under the MBTA shall be in accordance with Project Special Provisions, found in [Schedule 5, Section 5.5](#).

### **5.3.4 Fisheries and Aquatic Resources**

The Concessionaire shall utilize BMPs to control erosion and sedimentation during construction and to protect water quality in streams. BMPs could include berms, brush barriers, check dams, erosion control blankets, filter strips, sandbag barriers, sediment basins, sheet mulching, silt fences, straw-bale barriers, surface roughening, and/or diversion channels.

Senate Bill 40 (33-5-101-107, CRS 1973 as amended) requires any agency of the state to obtain wildlife certification from Colorado Parks and Wildlife (CPW) when the agency plans construction in "...any stream or its bank or tributaries..." See [Schedule 5, Section 17](#) (Landscaping), for SB 40 Wildlife Certification guidelines and jurisdiction of SB 40. The Concessionaire shall be responsible for complying with the conditions of SB 40, protecting SB 40 areas, and producing SB 40 certification documentation as identified in the Reference Documents. HPTe shall submit certification documentation directly to CPW. Streams requiring channelization, realignment, or diversion shall be restored to equal to or better than pre-construction conditions. Impacts to fisheries and aquatic resources shall not occur until SB 40 certification is obtained. Requirements for stream and riparian restoration are included in [Schedule 5, Section 17](#), (Landscaping). The Concessionaire shall comply with all requirements and special conditions of the Section 404 Permit.

### 5.3.5 Special Status and Sensitive Species

Occupied habitat for two federally listed species, the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) (Prebles) and Ute ladies'-tresses orchid (*Spiranthes diluvialis*) (orchid), occurs west of Davidson Ditch and east of Foothills Parkway within the Phase 2 project area. A site specific Biological Assessment (BA) has been prepared for the Phase 2 project that details conservations and minimization measures for these two species during construction. Required conservation measures are listed below in Section 5.3.5.1. The Concessionaire shall comply with all requirements of the conservation and minimization measures outlined in the BA and Biological Opinion.

Per the conditions of the site-specific BA and BO, the Concessionaire shall maintain a project database that tracks the level of impacts, number of individuals of a species taken, number of individual orchids impacted, and acres of habitat lost, and submit this information to HPTE for review. HPTE will utilize this information to complete annual reporting requirements (per conditions stipulated in the BA and BO).

The Concessionaire shall have a qualified biologist available to support the design and construction teams. The Concessionaire shall also implement a monitoring program that tracks project effects to listed species. This will include project effects, level of incidental take, exceedance of incidental take allowed in the PBO, and effectiveness of avoidance/minimization measures and conservation actions. This information shall also be submitted to HPTE for review. The biologist shall provide information to all construction staff on the importance of avoiding impacts to vegetated habitat outside the area of construction disturbance. New employees shall be provided this information as part of their orientation when they join the project.

#### 5.3.5.1 Section 7 Conservation Minimization Measures During Construction

The Phase 2 project design, construction activities, and schedule are planned to minimize impacts to Preble's meadow jumping mouse (Preble's) and Ute ladies'-tresses orchid (orchid) habitat. Specific actions planned to minimize impacts to both Preble's and orchid include:

1. The majority of work in occupied habitat shall be scheduled during the November-May hibernation period to reduce potential impacts to Preble's during the active season. Culvert replacement in occupied habitat and disturbance to critical Preble's habitat at South Boulder Creek shall be scheduled to occur during the hibernation season. This will minimize disruption to breeding, feeding, and dispersal activities that occur during the active season.
2. The Concessionaire shall develop an erosion control plan with permanent and temporary measures (BMPs) to minimize adverse effects to water quality.
3. The Concessionaire shall be responsible for the following measures:
4. Silt fencing and sediment basins shall be used around construction areas to prevent erosion and sedimentation into Preble's and orchid habitat areas. Sediment basins shall be located outside of occupied habitat unless they have been counted as impacts for the project.
  - a. Riprap shall be covered with soil and revegetated where possible.
  - b. Chain-link or plastic (orange) fencing shall be installed to establish no-work zones around Preble's and orchid habitat as early in the project as

- possible to minimize disturbance during construction. The project biologist shall review placement of construction staging areas and document that they will not be placed in Preble's and orchid habitat.
- c. On-site construction workers shall be informed by the Concessionaire of the importance of avoiding impacts to vegetated habitat outside the area of construction disturbance.
  - d. Equipment entrance/exit areas shall be limited to a single location and shall utilize existing pathways where possible. Construction access routes will overlap with permanently disturbed areas to the greatest extent possible. The Concessionaire shall coordinate with equipment operators to find out specifically where they will drive to make last minute adjustments that can result in a further reduction of site impacts.
  - e. Impacts to vegetation shall be minimized by pruning trees rather than removal of the entire tree or cutting shrub stems to the ground and allowing sprout re-growth rather than removal of the entire root system.
  - f. In designated temporary work areas, riparian shrubs (primarily willows) shall be trimmed to ground level (not grubbed) and then covered with a geo-textile fabric and an additional layer of straw. These areas shall then be covered with a minimum of 0.61 meters (2 feet) of clean fill. As soon as possible, all temporary fill shall be removed offsite. This will protect riparian shrub rootstock and seed banks. If possible, temporary fill of wetlands shall occur during periods when plants are dormant or toward the end of the growing season.
  - g. If wetland or shrubby vegetation is removed, it shall be salvaged for replanting, or will be used on-site for other uses, such as brush piles for mouse cover, in consultation with project biologist and USFWS.
  - h. Areas temporarily disturbed by construction shall be promptly revegetated using native vegetation. Native seed mixes shall be used in all revegetation efforts, and the site shall be promptly revegetated. All revegetation plans shall be consistent with revegetation and monitoring guidelines established in the PBO. The Concessionaire shall consult with HPTe and City of Boulder OSMP staff to select an appropriate native seed mix for both dry upland areas as well as areas with higher soil moisture (i.e. irrigated meadows).
  - i. The duration of time soil is left bare shall be kept to a minimum. Vegetation cover is not only beneficial for the Preble's, but affords the site better resistance to invasion from nonnative weeds and reduces the potential for erosion.
  - j. Soil shall be stockpiled from disturbed natural areas to be used as a seed bank to reestablish native plant species.
  - k. An integrated noxious weed management plan shall be developed during final design and in consultation with land management agencies where designated sensitive habitats occur.
  - l. Noxious weeds shall be controlled as necessary. For successful noxious weed control, noxious weed cover shall be no more than 5 percent greater than that of the surrounding undisturbed area.
  - m. Herbicide use in orchid habitat or potentially occupied habitat shall be limited and used only after coordination with USFWS and appropriate land management agencies where sensitive habitats occur.

- n. Engineers and construction staff shall consult with the project biologist if there are any changes in plans or if they have any questions regarding proposed activities within Preble's or orchid habitat.
- o. Disturbances within Preble's hibernation habitat shall be mitigated by clearing such areas of shrubs and other woody vegetation in mid to late August, when practicable, to discourage mice from hibernating in these areas prior to construction.
- p. Preconstruction surveys to identify the presence or absence of the orchid shall be conducted in the construction footprint between July and August when inflorescences are visible.
- q. Temporarily impacted areas within Preble's and orchid habitat that are revegetated shall be monitored to determine the success of revegetation. Areas will be considered successfully reclaimed if 70 percent or greater of plantings have survived and 70 percent or more of the disturbed area is revegetated with favorable species, as determined by foliar cover. The Concessionaire shall conduct this monitoring until all revegetation requirements have been met.
- r. Construction of minor drainage culverts and other roadway features shall be done from the roadway itself where practicable to limit disturbance to Preble's and orchid habitat.
- s. Placement of bridge girders and related work shall take place from existing roadway pavement (from above) to the extent possible.
- t. Ditch and culvert flows in areas of Preble's and orchid habitat shall be maintained during construction.
- u. HPTE and Concessionaire's biologist shall coordinate with OSMP plant ecologist and USFWS regarding removal and transplant of orchids from the construction footprint. Removal and transplant of orchids and topsoil of occupied orchid habitat will be conducted or supervised by a botanist after tubers have formed in the fall. HPTE biologist will coordinate with OSMP and USFWS to select a suitable transplant site.
- v. Permanent demarcation signs shall be installed to delineate mowing limits for maintenance personnel. These limits shall be set in Preble's and orchid areas based on the guidance in the Biological Opinion. The project biologist shall coordinate with the design team on the type, number, and location of these signs. The Concessionaire shall include information about these mowing limits in the orientation and training sessions for maintenance staff.

#### **5.3.5.2 Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)**

The Phase 2 Construction Work shall impact a maximum of 3.72 acres (2.29 acres of permanent impact and 1.43 acres of temporary impact) of occupied Preble's Meadow Jumping Mouse habitat and 2.46 acres (1.27 acres of permanent impact and 1.19 acre of temporary impact) of critical habitat for construction of the Basic Configuration elements. This maximum is based on the impacts outlined in the BA and anticipated impacts as documented in the 2013 US 36 Phase 2 NEPA Reevaluation. The Concessionaire shall comply with the requirements of the conservation and minimization measures outlined in the site specific BA, and Biological Opinion.

#### **5.3.5.3 Ute Ladies'-Tresses Orchid (*Spiranthes diluvialis*)**

A qualified botanist will conduct surveys prior to construction to identify and map Ute ladies'-tresses orchid habitat within and adjacent to the construction footprint in the area from Davidson



Ditch to the west edge of Van Vleet Open Space. Surveys shall be done during the flowering season (July-August). HPTE will conduct the orchid surveys during the first season (July-August 2013) and remove plant material and topsoil for transplantation in accordance with Section 5.3.5.4. The Concessionaire shall have a qualified botanist conduct the orchid surveys in subsequent years during the flowering season for construction areas not impacted as of the survey date, and adjacent areas. Prior to construction, the Concessionaire shall assess the potential for avoidance or minimization of impacts to suitable orchid habitat. If orchid specimens are discovered in areas that cannot be avoided, the Concessionaire shall consult with HPTE to arrange for transplantation. The Concessionaire shall comply with the requirements of the conservation and minimization measures outlined in the site specific Biological Assessment (BA), and Biological Opinion (BO).

#### **5.3.5.4 Threatened and Endangered Species Mitigation**

HPTE is proceeding with a separate project on an offsite location to complete remaining required compensatory mitigation beyond the requirements contained in this Schedule 5, Section 5. The mitigation contractor building the offsite mitigation project will be removing plant material and topsoil from orchid areas within the Phase 2 project footprint between Davidson Ditch to the west edge of Van Vleet Open Space. The Concessionaire shall allow access and coordinate with the mitigation contractor. The Concessionaire shall protect these areas until the mitigation contractor has removed the material. The material will be removed by the mitigation contractor by April 1, 2014.

#### **5.3.5.5 Other Sensitive Plant Species**

Prior to construction, the Concessionaire shall have a qualified biologist/botanist perform presence/absence surveys for all areas that would be affected by project activities within designated sensitive habitats, including the South Boulder Creek Natural Area, Colorado Tallgrass Prairie Natural Area, and Colorado Tallgrass Prairie PCA. The surveys shall be conducted during an appropriate season for best observation and identification of the sensitive species. The Concessionaire shall assess the potential for avoidance or minimization of impacts and the potential for transplanting of individuals and seedbeds to suitable habitat on adjoining property. These mitigation measures shall be developed in consultation with the land management agencies where the impacts occur.

#### **5.3.5.6 Bobolink (*Dolichonyx oryzivorus*)**

The Concessionaire shall have a qualified biologist perform bobolink nest surveys during the bobolink nesting season (May 15 through July 30) prior to land clearing activities in irrigated hay meadows west of Davidson Ditch and east of Foothills Parkway.

Land clearing activities will be avoided in known bobolink nesting habitat (irrigated hay meadows) during their nesting season unless the habitat has been surveyed by a qualified biologist and no nests were found to be present.

#### **5.3.5.7 Burrowing Owl (*Athene cunicularia*)**

High-quality habitat for the State-threatened burrowing owl occurs in association with BTPD colonies that are located throughout the Phase 2 Construction Work area. The Concessionaire shall have a qualified biologist perform burrowing owl surveys during the burrowing owl nesting season (March 15<sup>th</sup> through October 31<sup>st</sup>) prior to the removal of any BTPDs within the Phase 2 Construction Work area. If nests are identified, the Concessionaire shall notify HPTE immediately and appropriate seasonal construction buffers shall be determined in consultation

with Colorado Parks and Wildlife. If a nest becomes occupied after the start of active construction, a seasonal buffer zone shall be required during the burrowing owl nesting season to prevent violation of the MBTA. This seasonal buffer shall be determined in consultation with Colorado Parks and Wildlife.

#### **5.3.5.8 Barn Owl (*Tyto alba*)**

This sensitive species nests in natural crevices of trees, cliffs, and cutbanks along riparian corridors and abandoned buildings. The Concessionaire shall have a qualified biologist conduct pre-construction nest surveys for the barn owl in cutbanks in suitable riparian habitat prior to construction if land clearing Activities occur between April 1 and September 30. If nests are identified, the Concessionaire shall notify HPTE immediately and construction shall be avoided within 50 yards (150 feet) of an active nest site during the barn owl nesting season, or as determined necessary by Colorado Parks and Wildlife. biologist.

### **5.4 Recognized Hazardous Materials**

Recognized hazardous materials (RHM) are defined as the presence or suspected presence of Hazardous Substances which may require management and/or disposal. Hazardous Substances may exist on the surface or subsurface, in groundwater or surface water, or on structures to be demolished; and may be mixed with soil, water, building matrices, and/or other waste materials.

RHMs have been identified within the Phase 2 Construction Work area. The Concessionaire shall review the Phase I Environmental Site Assessment (October 2004), the FEIS Hazardous Materials Technical Report Addendum (April 2009), the *US 36 Corridor Final Environmental Impact Statement* (October 2009), and the 2012 US36 Phase 2 NEPA Reevaluation, as well as other applicable Contract Documents, for information related to the RHMs. The Concessionaire shall develop a Materials Management Plan (MMP), Health and Safety Plan (HASP), and Spill Prevention Control and Countermeasures (SPCC) Plan to be submitted for Approval by HPTE prior to the NTP1. The Concessionaire shall comply with all provisions set forth within the approved MMP, HASP, and SPCC Plan.

The Concessionaire shall schedule a review meeting with HPTE prior to submittal of the MMP and HASP to discuss the MMP and HASP. The Concessionaire's environmental manager and the Concessionaire's safety manager representative shall be present at the meeting. The Concessionaire shall incorporate modifications into the submitted MMP, HASP, and SPCC agreed to during this meeting.

The Concessionaire shall maintain documentation of all Activities related to the MMP and the HASP during construction and shall make all such documentation available to HPTE upon request. The Concessionaire shall maintain records consistent with the requirements of the Concession Agreement.

The Concessionaire shall comply with all applicable requirements, including, but not limited to, all federal, state, and local laws and regulations; Section 250 (*Environmental, Health and Safety Management*) of the Standard Specifications for the management and disposal of the RHMs.

The Concessionaire shall coordinate all Remediation Work through HPTE and shall not discuss or negotiate with any regulatory agencies or third parties on behalf of HPTE. The Concessionaire shall notify HPTE within 24 hours if contacted by any regulatory agencies or third parties concerning RHM associated or potentially associated with the Phase 2 Construction Work.

The Concessionaire shall maintain documentation of all pertinent certifications of all Sub-Contractors and shall be available upon request by HPTE.

#### 5.4.1 Materials Management Plan

The Materials Management Plan shall identify potential RHMs, their locations, the extent of impact, proposed Remediation Work, waste management procedures, avoidance measures, investigation measures, and a contingency plan for addressing unforeseen conditions. The plan shall identify the Concessionaire's representative responsible for environmental compliance (environmental manager), the proposed design and construction staff, and the approach to implementing the MMP. In addition to meeting the requirements of Section 250 of the *Standard Specifications*, the MMP shall include the following provision:

1. The Concessionaire shall manage all RHMs, including soils, groundwater, surface water, and other contaminated substances to prevent exposure to Project personnel and the public, and to prevent any contamination of non-contaminated areas. The Concessionaire shall classify such wastes according to one of the following categories:
  - A. Hazardous waste as defined under the Resource Conservation and Recovery Act requiring off-Site disposal and/or treatment
  - B. Contaminated soils requiring off-Site disposal
  - C. Soils to be stockpiled for further characterization
  - D. Soils with concentrations of waste constituents below regulatory concern that can be reused without restriction
  - E. Wastewater requiring off-Site disposal and/or treatment
  - F. Impacted water to be held for further characterization
  - G. Asbestos containing material discovered during construction or demolition
  - H. Lead-based paint associated with structures, signage, light posts, etc.
  - I. Waste material to be contained for further characterization

The investigation, monitoring, characterization, and testing of RHM's shall be included in the Phase 2 Construction Work. A scope of work shall be submitted to HPTE for Approval prior to commencing any Remediation Work activities. The Concessionaire shall utilize the most cost-effective approach in the performance of any remedial action deemed necessary. Remediation Work shall include stockpiling and disposal of Materials that are determined to require off-Site disposal and/or treatment.

The Concessionaire shall not allow Hazardous Substances to be spilled or tracked off Site at any time during the Project.

The Concessionaire shall be responsible for locating storage facilities and disposal sites for RHMs that are to be removed from the Work Site.

The Concessionaire shall maintain documentation of completed waste profiles, manifest forms, and bill-of-lading forms for proper transportation and disposal of Materials off Site. This information shall be available at all times for review by HPTE. The Concessionaire shall be held responsible for ensuring that all requirements of the transporter and the receiving disposal facility and the federal, state, and local statutes, rules, regulations, and ordinances are complied with and are properly documented.

The Concessionaire shall submit RHM reports to HPTE monthly on all Activities associated with this Section 5.4. The Concessionaire shall coordinate with HPTE to determine the format of the report prior to the construction phase.

The Concessionaire shall develop a Sampling Analysis Plan (SAP) to identify and characterize potential RHMs that may be encountered during construction. The SAP shall also provide for monitoring/screening during construction Activities to provide safety controls in areas previously not identified. In addition to complying with Section 250 of the *Standard Specifications*, the SAP shall include:

1. Data quality objectives
2. Sample collection procedures (field screening, borehole drilling/abatement, monitoring well construction, soil, groundwater, and decontamination)
3. Quality Control
4. Field equipment calibration procedures/frequency
5. Quality Assurance objectives (data)
6. Provisions for corrective action, if needed

#### **5.4.2 Health and Safety Plan (HASP)**

The Concessionaire shall distribute the HASP to all employees that could be potentially exposed to RHMs. The HASP shall be displayed or made available on the Project at all times. The Concessionaire shall develop and maintain on Site all industrial hygiene information, including “right-to-know” information. In addition to meeting the requirements of Section 250 of the *Standard Specifications*, the HASP shall include the following provision:

The Concessionaire shall maintain documentation and provide information to HPTE, as requested, regarding potential or actual exposure to the public. The Concessionaire shall maintain records of all related incidents and notify HPTE and appropriate state authorities immediately.

#### **5.4.3 Spill Prevention Control and Countermeasures Plan (SPCC)**

The Concessionaire shall prepare a SPCC Plan. The Concessionaire shall perform inspections per the CDPS-SCP to assure the construction BMPs are adequate for the Site conditions of the Phase 2 Construction Work and are in good working condition. The Concessionaire shall prevent the discharge of any sediment or pollutants into any storm drains or receiving waters during the life of the CDPS-SCP.

See Schedule 5, Section 12.1.2.1.3.

## 5.5 Project Special Provisions

### PROTECTION OF MIGRATORY BIRDS BIOLOGICAL WORK PERFORMED BY THE CONCESSIONAIRE'S BIOLOGIST

Section 240 is hereby added to the Standard Specifications for this Project as follows:

#### DESCRIPTION

This work consists of protecting migratory birds during construction.

#### MATERIALS AND CONSTRUCTION REQUIREMENTS

The Concessionaire shall schedule clearing and grubbing operations and work on structures to avoid taking (pursue, hunt, take, capture or kill; attempt to take, capture, kill or possess) migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Concessionaire shall retain a qualified wildlife biologist for this Project. The wildlife biologist shall have a minimum of three years experience conducting migratory bird surveys and implementing the requirements of the MBTA. The Concessionaire shall submit documentation of the biologist's education and experience. A biologist with less experience may be used by the Concessionaire subject to HPTE Approval based on review of the biologist's qualifications.

The Concessionaire's wildlife biologist shall survey the location of each protected nest, bird species, the protection method used, and the date installed. A copy of these records shall be submitted to HPTE for Review.

- (a) *Vegetation Removal.* When possible, vegetation shall be cleared prior to the time when active nests are present. Vegetation removal activities shall be timed to avoid the migratory bird breeding season which begins on April 1 and runs to August 31. All areas scheduled for clearing and grubbing between April 1 and August 31 shall first be surveyed within the work limits for active migratory bird nests. The Concessionaire's wildlife biologist shall also survey for active migratory bird nests within 50 feet outside work limits. Concessionaire personnel shall enter areas outside HPTE right of way only if a written, signed document granting permission to enter the property has been obtained from the property owner. The Concessionaire shall document all denials of permission to enter property. The Concessionaire shall avoid all active migratory bird nests. The Concessionaire shall avoid the area within 50 feet of the active nests or the area within the distance recommended by the biologist until all nests within that area have become inactive. Inactive nest removal and other necessary measures shall be incorporated into the work as follows:
  1. *Tree and Shrub Removal or Trimming.* Tree and shrub removal or trimming shall occur before April 1 or after August 31 if possible. If tree and shrub removal or trimming will occur between April 1 and August 31, a survey for active nests shall be conducted by the wildlife biologist within the seven days immediately prior to the beginning of work in each area of tree and shrub removal or trimming. The survey shall be conducted for each phase of tree and shrub removal or trimming.

If an active nest containing eggs or young birds is found, the tree or shrub containing the active nest shall remain undisturbed and

protected until the nest becomes inactive. The nest shall be protected by placing fence (plastic) a minimum distance of 50 feet from each nest to be undisturbed. This buffer dimension may be changed if determined appropriate by the wildlife biologist and Approved by HPTE. Work shall not proceed within the fenced buffer area until the young have fledged or the nests have become inactive.

If the fence is knocked down or destroyed by the Concessionaire, HPTE will suspend the work, wholly or in part, until the fence is satisfactorily repaired at the Concessionaire's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

2. *Grasses and Other Vegetation Management.* Due to the potential for encountering ground nesting birds' habitat, if work occurs between April 1 and August 31, the area shall be surveyed by a wildlife biologist within the seven days immediately prior to ground disturbing activities.

The undisturbed ground cover to 50 feet beyond the planned disturbance, or to the right of way line, whichever is less, shall be maintained at a height of 6 inches or less beginning April 1 and continuing until August 31 or until the end of ground disturbance work, whichever comes first.

If birds establish a nest within the survey area, an appropriate buffer of 50 feet will be established around the nest by the HPTE biologist. This buffer dimension may be changed if determined appropriate by the HPTE. The Concessionaire shall install fence (plastic) at the perimeter of the buffer. Work shall not proceed within the buffer until the young have fledged or the nests have become inactive.

If the fence is knocked down or destroyed by the Concessionaire, HPTE will suspend the work, wholly or in part, until the fence is satisfactorily repaired at the Concessionaire's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

- (b) The wildlife biologist shall conduct dusk and dawn surveys of Bald Eagle roosts within seven days prior to the start of any construction during the winter season, November 15 to March 15. If a Bald Eagle roost is identified, construction activity shall not proceed within 0.25 mile of active nocturnal roost sites between November 15 and March 15.

The wildlife biologist shall conduct raptor nest surveys within 0.5 mile of the construction site prior to the start of construction and prior to each construction phase. This survey can be done with binoculars. If construction activities are located within the Colorado Parks and Wildlife (CPW) recommended buffer zone for specific raptors, "NO WORK" zones shall be established around active sites during construction according to the CPW standards or as recommended by the wildlife

biologist in consultation with the CPW. The "NO WORK" zone shall be marked with either fencing or signing. Work shall not proceed within a "NO WORK" zone until the wildlife biologist has determined that the young have fledged or the nest is unoccupied.

- (c) *Work on structures.* The Concessionaire shall prosecute work on structures in a manner that does not result in a taking of migratory birds protected by the Migratory Bird Treaty Act (MBTA). The Concessionaire shall not prosecute the work on structures during the primary breeding season, April 1 through August 31, unless he takes the following actions:
- (1) The Concessionaire shall remove existing nests prior to April 1. If the Contract is not awarded prior to April 1 and HPTE has removed existing nests, then the monitoring of nest building shall become the Concessionaire's responsibility upon Notice to Proceed.
  - (2) During the time that the birds are trying to build or occupy their nests, between April 1 and August 31, the Concessionaire shall monitor the structures at least once every three days for any nesting activity.
  - (3) If the birds have started to build any nests, they shall be removed before the nest is completed. Water shall not be used to remove the nests if nests are located within 50 feet of any surface waters.
  - (4) Installation of netting may be used to prevent nest building. The netting shall be monitored and repaired or replaced as needed. Netting shall consist of a mesh with openings that are  $\frac{3}{4}$  inch by  $\frac{3}{4}$  inch or less.
- If an active nest become established, i.e., there are eggs or young in the nest, all work that could result in abandonment or destruction of the nest shall be avoided until the young have fledged or the nest is unoccupied as determined by the wildlife biologist and Approved by HPTE. The Concessionaire shall prevent construction activity from displacing birds after they have laid their eggs and before the young have fledged.
- If the Project continues into the following spring, this cycle shall be repeated. When work on the structure is complete, the Concessionaire shall remove and properly dispose of netting used on the structure.
- (d) *Taking of a Migratory Bird.* The taking of a migratory bird shall be reported to HPTE. The Concessionaire shall be responsible for all penalties levied by the U. S. Fish and Wildlife Service (USFWS) for the taking of a migratory bird.
- (e) CDOT Form 730, *Permission to Enter Property*, must be obtained to facilitate the wildlife biologist's ground surveys within adjacent property within 50 ft. of work limits, where CDOT Region environmental personnel have determined ground nesting bird habitat may be present. If permission to enter property is denied by a property owner, record the

denial and place the record in the Project file to document that due diligence was pursued.

## **5.6 Deliverables**

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:



<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
Environmental Compliance Work Plan	Acceptance	Prior to NTP1
Environmental Compliance Work Plan updates	Acceptance	Monthly
Environmental permits	Acceptance	Per the requirements of the permit and the Contract Documents.
Migratory bird nest survey	Review	Prior to impacting existing structures that may contain active bird nests.
Noise analyses, final geometry, and architectural details of noise barriers	Acceptance	Minimum 21 Days prior to Release for Construction
Integrated Noxious Weed Management Plan	Acceptance	Prior to NTP1
Materials Management Plan (MMP)	Approval	Prior to NTP1
Health and Safety Management Plan (HASP)	Approval	Prior to NTP1
SPCC Plan	Approval	Prior to NTP1
Identification of Sub-Contractor(s) to perform Remediation Work	Review	Prior to Sub-Contractor(s) commencing Remediation Work
Functional assessment of wetlands	Review	Prior to wetland impact
Noise control plan	Acceptance	As part of the Release for Construction Documents
Remediation scope of work	Approval	Prior to commencing Remediation Work
Monthly RHM reports	Review	Monthly
SB 40 Certification application and supporting documents	Approval	Prior to submittal to Colorado Parks and Wildlife
CDOT NEPA Reevaluation Form #1399	Approval	Prior to conducting work that has not been approved under the Record of Decision or 2012 Reevaluations
Wetland Impact Documentation. (Required if impact to wetlands exceeds acreage defined in Section 5.2.2 )	Approval	Prior to wetland impact
Wetland Impact Documentation and Permit Amendment. (Required if impact to wetlands exceeds footprint defined in approved Section 404 permit.)	Approval	Prior to wetland impact

## **6.0 THIRD-PARTY AGREEMENTS**

The Concessionaire shall be responsible for obtaining all third-party approvals required to complete the Work, except as otherwise specified in the Contract Documents. Third-party coordination and approvals will be required from, but not limited to, the following agencies: Local Agencies, Irrigation Ditch Companies, Public Utility Owners and Private Utility Owners. Utility company requirements are addressed in Schedule 5, Section 7 (Utility Relocations). Coordination and approval requirements of Local Agencies and Irrigation Ditch Companies are addressed in this Section 6.

### **6.1 Local Agency**

Local Agency requirements pertaining to the Phase 2 Construction Work are detailed in Schedule 5 sections as appropriate

### **6.2 Irrigation Ditch Companies**

The Phase 2 Construction Work includes Work on the Irrigation Ditch Companies (Ditch) ROW and/or properties in or along the flow channel of the Ditch. This Section 6.2 provides requirements applicable to Work performed upon or adjacent to the Ditch ROW. Anticipated Work on or adjacent to Ditch ROW is limited to the construction of structures that carries each Ditch's flow, access modifications required to restore maintenance access for Ditch operations impacted by the Work, and the proposed highway facilities.

#### **6.2.1 Applicable Standards**

The design and construction of the Ditch Work for the Phase 2 Construction Work shall be in accordance with the Ditch's written specifications, standards of practice (which may include design format), and construction methods that are current as of the effective date of the Final RFP. The Concessionaire shall obtain all such written specifications, standards of practice, and construction methods from the Ditch. In the event of a conflict between the requirements of the Ditch and the requirements of the Contract Documents, HPTE, in its sole discretion, will determine which shall govern. The Concessionaire shall be responsible for resolution of any unresolved ambiguity prior to proceeding with any Ditch Work.

The Concessionaire shall meet the requirements included in the executed Irrigation Ditch Company agreements provided with the Reference Documents.

In performing the Ditch Work, the Concessionaire shall ensure that all Ditch Work results in the ditch being located in a manner to allow future maintenance to be performed by the relevant Ditch without disruption to the operation or maintenance of US 36.

#### **6.2.2 Administrative Requirements**

Prior to NTP1 the Concessionaire shall notify all the Ditch representatives of the status of the project and upcoming coordination planned with the Ditch representatives. The Ditch contact information is included in the Utility contact information included with the Reference Documents.

The Concessionaire shall meet with each Ditch and HPTE as soon as practical to review all Ditch points of concern and other items which may affect the schedule. The Concessionaire

shall identify critical Activities and sequences, as they affect Ditch operations, and plan to effectively mitigate Ditch impacts.

The Concessionaire shall obtain Ditch acceptance in writing, in advance, on methods and procedures covering all Work on the Ditch's property. Upon completion of the Work, the Concessionaire shall remove from the premises of the Ditch ROW all Equipment, surplus Material, and debris, leaving such premises in a neat condition satisfactory to the Ditch. The Concessionaire shall provide As-Built drawings to the Ditch and obtain Ditch acceptance in writing for all Work on the Ditch's property.

Included in the Work the Concessionaire shall reimburse the Ditch for engineering design review and inspection costs incurred by the Ditch.

### **6.2.3 Utility Crossings**

The Ditch is not responsible for Utilities on Ditch ROW. The Concessionaire shall locate all Utilities on Ditch ROW within the immediate vicinity of the Work. The Concessionaire shall certify to the Ditch that all the Utilities on Ditch ROW and within the immediate vicinity of the Work have been identified and properly located.

### **6.2.4 Design Reviews**

The Ditch will review design plans for Work on the Ditch's property. Ditch review is separate from HPTE oversight. The Concessionaire shall coordinate the required Ditch design reviews with the Ditch. All plans submitted to the Ditch for review and approval shall be in English units.

Schedule 5, Section 12 (Drainage and Hydrology) contains the hydraulic information on Ditch flow design requirements and descriptions of Work at each irrigation ditch location.

The Concessionaire shall obtain Ditch approval, in writing, of design plans for all of the design elements of the Work on the Ditch's property.

### **6.2.5 Construction Requirements**

The Concessionaire shall coordinate with the Ditch prior to beginning any construction on or adjacent to the Ditch ROW. Working windows for demolition and construction shall be coordinated with the Ditch and the Ditch inspectors.

The Concessionaire shall obtain Ditch agreement in writing, in advance, on methods and procedures covering all Work on the Ditch's property. Copies of such approvals, notices, and correspondence shall also be submitted to HPTE.

The Concessionaire shall cooperate with the Ditch where Work is within the limits of the Ditch property to expedite the Work and to avoid interference with the operation of ditch flow.

The Concessionaire shall perform the Work in such a manner and at such times as not to endanger or interfere with the continuous operation of the ditch and property of the Ditch and the flow of water at or in the vicinity of the Work. No Work shall be allowed that interferes with the schedule and volume of flow of the ditch. The Concessionaire shall be responsible to the Ditch for all damages for delays that may be sustained by the Ditch caused by any interference that could have been avoided by proper handling of the Work.

The Concessionaire shall not pile or store any materials or tools, or park any Equipment, when not in use, on Ditch property. Upon completion of the Work, the Concessionaire shall remove from the premises of the Ditch ROW all Equipment, surplus Material, and debris, leaving such premises in a neat condition satisfactory to the Ditch.

### 6.3 Deliverables

At a minimum, the Concessionaire shall submit the following for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
Notify Ditch of Phase 2 Construction Work commencement	Ditch Review	Prior to NTP1
Ditch design plans	Review and approval by the Ditch	Prior to beginning any construction on Ditch property
Construction methods on Ditch property	Review and approval by the Ditch	Prior to beginning any construction on Ditch property
Construction on Ditch property	Review and approval by the Ditch	After construction is complete on Ditch property

## **7.0 UTILITY RELOCATIONS**

This Section 7 addresses the Utility company (or Utility Owner) requirements. It does not apply to existing stormwater facilities, irrigation ditches, Intelligent Transportation Systems, Variable Message Signs, video and video detection systems, traffic signals, or street lighting, all of which shall be installed, removed, relocated and/or protected in place by the Concessionaire and/or the Utility Owners pursuant to other Sections of the Contract Documents.

### **7.1 General Utility Work Obligations**

The Phase 2 Construction Work will affect both existing and planned Utilities. The Concessionaire shall coordinate and cooperate with HPTE and the Utility Owners to ensure that all Utility Work (whether performed or furnished by the Utility Owners or by Concessionaire) is performed in accordance with the executed URAs. The physical limits of the Concessionaire's obligation for the performance of Utility Work shall extend as far as is necessary to permit construction of the Phase 2 Construction Work (taking into account the requirements of the Utility Owners, Governmental Persons with jurisdiction, and adjacent property owners), whether inside or outside the Right-of-Way.

The Concessionaire shall use reasonable efforts to anticipate and avoid Utilities, and to otherwise minimize and/or mitigate the consequences of the Utility relocations.

#### **7.1.1 Utility Work**

The Concessionaire shall carry out all Utility Work in accordance with the requirements of the Utility Relocation Agreements (URA), and this Section 7.

Utility Work includes, but is not limited to, the following:

1. Verification of all Utilities, as identified or described in the Utility Data, and the identification of all other Utilities, including in each case all necessary potholing located within the Phase 2 Construction Work limits or otherwise impacted by the Work.
2. Development and updating of the Concessionaire's Utility Tracking Report.
3. Preparation and execution of the No-Conflict Closeout Form.
4. Negotiation, preparation, and execution of the Utility Work Order for each Utility relocation, including preparing and providing such written information concerning the Phase 2 Construction Work (such as reports, plans and surveys), as requested by HPTE and the Utility Owner.
5. Preparation of Utility relocation design for each Public Utilities relocation, and obtaining the design acceptance by the form of Design of Relocation Acceptance Letter (DRAL) from the Utility Owner.
6. Construction of the Public Utilities relocations, including Service Lines and temporary relocations, and obtaining the construction acceptance by the form of Construction of Relocation Acceptance Letter (CRAL) from the Utility Owner.
7. Removal of Abandoned existing Public Utilities. If impractical to remove, flow-fill abandoned existing Public Utilities that are greater than 12-inches in diameter.

8. Review of the Utility relocation design for each Private Utilities relocation, then verification of and acceptance by the form of DRAL that each Utility relocation is compatible with the Phase 2 Construction Work.
9. Reimbursement to Private Utility Owners for design costs incurred by such Utility Owners in performing Utility Work.
10. Inspection of the Utility relocation construction for each Private Utilities relocation, then verification and acceptance by the form of CRAL that each Utility relocation is compatible with the Phase 2 Construction Work.
11. Reimbursement to Private Utility Owners for construction costs incurred by such Utility Owners in performing Utility Work within an easement owned by the Private Utility Owner.
12. Reimbursement to Utility Owners for, or acquisition of, replacement easement required for Utility Work for existing easements shown on the Right-of-Way plans in Schedule 5B pursuant to Schedule 5, Section 8 (Right-of-Way).
13. Resurfacing and restriping of streets and parking areas and reconstruction of curb and gutter and sidewalks, where necessary, due to Utility Work performed by Concessionaire or performed by a Utility Owner within the Phase 2 Construction Work limits.
14. Providing public information for Utility Work performed by Concessionaire, or performed by the Utility Owner.
15. Performing traffic control for Utility Work performed by Concessionaire, or performed by the Utility Owner.
16. Providing survey coordinates in the field for design and construction of the Utility Work performed by the Concessionaire or performed by the Utility Owner.
17. Performing Incidental Utility Work as defined in URAs.
18. Performing and coordinating As-Built plans for all Utility Work Orders.
19. Identification and removal of abandoned Private Utilities as required to complete the Work.
20. All necessary Work associated with Utility Work.

### **7.1.2 Exclusions From Utility Work**

Utility Work excludes, but is not limited to, the following:

1. Issuance of any Utility Permit to any Utility Owner.
2. Provision and maintenance of any insurance in excess of the Concessionaire's obligations in the Concession Agreement, Section 38.
3. Any work expressly required to be undertaken by HPTE or a Utility Owner in accordance with URAs or the terms of any Utility Work Order.
4. Construction of the Private Utilities relocations, including Service Lines and temporary relocations, unless identified as a Requested Relocation.

5. Abandonment of existing Private Utilities, unless identified as a Requested Relocation.
6. Utility removal work outside of the Phase 2 Construction Work limits.
7. Providing traffic control when Utility Work is outside of the Phase 2 Construction Work limits.
8. Reimbursement to Utility Owners for, or acquisition of, replacement easement required for Utility Work for existing easements not shown on the Right-of-Way plans in Schedule 5B, pursuant to Schedule 5, Section 8 (Right-of-Way).

### **7.1.3 Concessionaire's Responsibility to Perform**

The Concessionaire shall perform all Activities included in the Utility Work with respect to each impacted Utility regardless of the following:

1. Whether or not the Utility was indicated in the Reference Documents or, if indicated, whether or not the Utility was accurately indicated.
2. The type of action, if any (e.g., relocation, protection-in-place), feasibility, estimated duration of Work time, or any other characteristic of any relocation concept(s) proposed for the Utility in the Reference Documents.

The allocation of responsibility for any Utility Work to a Utility Owner pursuant to this Section 7 or to a URA shall not relieve the Concessionaire of the obligation to coordinate with the Utility Owner as necessary for such Utility Work to be timely performed, or of the obligation to perform any other Utility Work not specifically assigned to such Utility Owner. The circumstances under which the Concessionaire will be entitled to a Change Order for Utility Work are set forth in the Contract Documents.

## **7.2 Performance Standards**

### **7.2.1 Utility Owners**

Except as otherwise provided in the applicable URA, all Utility relocation designs and construction of relocations furnished or performed by the Concessionaire shall be consistent with the Utility Owner's written specifications, standards of practice (which may include design format), and construction methods that are current as of the effective date of the Final RFP. The Concessionaire shall obtain all such written specifications, standards of practice, and construction methods from the Utility Owners. In the event of a conflict between the requirements of the Utility Owner and the requirements of the Contract Documents, HPTE in its sole discretion, will determine which shall govern. The Concessionaire shall be responsible for resolution of any unresolved ambiguity prior to proceeding with any Utility Work.

Replacements for any existing Utilities shall be designed and constructed to provide service at least equal to that offered by the existing Utility, unless the Utility Owner approves a lesser replacement.

In performing the Utility Work, the Concessionaire shall ensure that all Utility Work results in Utilities being located in a manner to allow future Utility maintenance to be performed by the relevant Utility Owners without disruption to the operation or maintenance of US 36.

### **7.3 Identification of Utilities**

#### **7.3.1 HPTE-Supplied Information**

See Reference Documents for a list of all known Utility Owners within and/or adjacent to the ROW, including contact information.

HPTE has completed an initial Utility investigation and has identified the Utilities that may be impacted by the Phase 2 Construction Work. HPTE has not performed a complete investigation of Service Lines. The results of HPTE's investigations are indicated in the Utility Data that is included with the Reference Documents.

#### **7.3.2 Concessionaire's Investigations**

Without limiting its ability to negotiate a Change Order with respect to any Unidentified Utility, the Concessionaire shall take all actions reasonably practicable to identify and confirm the existence, exact location, size, and type of all Utilities within the Phase 2 Construction Work limits or otherwise potentially impacted by the Phase 2 Construction Work, whether or not such Utilities are shown in the Utility Data, including all potentially impacted Service Lines. Such actions shall include making diligent inquiry at the offices of the Utility Owners, consulting public records, and conducting field studies (such as subsurface utility engineering), as appropriate, taking into consideration the possibility that Utility Owners may provide inaccurate or inexact information with regard to their Utilities. If the Concessionaire's investigations identify Unidentified Utilities, the Concessionaire shall notify HPTE and the relevant Utility Owner in accordance with the URAs immediately upon discovery. Thereafter, HPTE, the Concessionaire, and the relevant Utility Owner shall execute a Utility No-Conflict Closeout Form, or pursuant to a Utility Work Order treat an Unidentified Utility as either a Concessionaire relocated Utility or a Utility Owner relocated Utility.

The Concessionaire shall at least monthly, and otherwise upon HPTE's reasonable request, deliver to HPTE and, in accordance with the URA, the applicable Utility Owners, a Concessionaire's Utility Tracking Report, which shall update and expand the Utility Matrix to include the following information (unless otherwise agreed between the Parties):

1. Meeting dates with Utility Owners for each draft Work Order
2. The relevant number and execution date of each executed Utility Work Order
3. Each No-Conflict Closeout Form execution date
4. Each DRAL execution date
5. Each CRAL execution date
6. Completed As-Built plans delivery date, to or by the Concessionaire, as applicable



7. Identification of all changes made since the immediately prior Concessionaire's Utility Tracking Report

### **7.3.3 Utility Work Orders**

The Concessionaire, Utility Owner, and HPTE, in that order, shall execute a Utility Work Order prior to commencement of any Utility Work. The Concessionaire may prepare a single Utility Work Order covering more than one relocation, Betterment, or Requested Relocation with the consent of HPTE and the relevant Utility Owner.

Prior to executing any Utility Work Order, the Concessionaire and HPTE shall meet with the relevant Utility Owner to negotiate the relevant draft Utility Work Order, including the following:

1. In accordance with the procedures set out in the applicable URA, the scope of work, the implementation schedule, and any exhibits
2. In accordance with the paragraphs below, cost and payment responsibility

The costs for work performed by the Concessionaire under a Utility Work Order for Betterments or Requested Relocations shall be negotiated between the Concessionaire and the Utility Owner. If the Utility Owner will be reimbursing the Concessionaire for any costs in connection with Utility Work, the Concessionaire shall provide a definitive cost estimate to the Utility Owner in accordance with the Utility Owner's standard practice and with the requirements of the applicable URAs, and shall submit such estimate to HPTE. After Acceptance by the Utility Owner and HPTE, the estimate shall be incorporated into the applicable Utility Work Order. If a Utility Owner is responsible for the payment of any amount of the cost of a Betterment or Requested Relocation pursuant to a Utility Work Order, payment must be made to the Concessionaire in accordance with the terms of the applicable URA. HPTE shall not be responsible for the payment of any amount with respect to a Betterment or Requested Relocation other than as expressly provided for in the URAs or otherwise as agreed by HPTE upon HPTE's execution of the relevant Utility Work Order.

The costs for construction of Utility relocations within a Utility Owner permanent easement, or any Utility relocation design work performed by a Private Utility Owner under a Utility Work Order for each Private Utility Owner relocated Utility, shall be negotiated between the Concessionaire and the Utility Owner. If the Concessionaire will be reimbursing a Utility Owner for any eligible costs in connection with Utility Work, the Concessionaire shall obtain a definitive cost estimate from the Utility Owner in accordance with the Utility Owner's standard practice and with the requirements of the applicable URAs, and shall submit such estimate to HPTE. After Acceptance by the Concessionaire and HPTE, the estimate shall be incorporated into the applicable Utility Work Order. If the Concessionaire is responsible for the payment of any amount of the cost of a Private Utility Owner relocated Utility pursuant to a Utility Work Order, that amount shall be paid to the Utility Owner in accordance with the terms of the applicable URA.

For Betterments and Requested Relocations, the draft Utility Work Order shall include the direct impact of such Utility Work Order on the performance of the Work and the Concessionaire's ability to follow the Initial Schedule (or, as the case may be, Revised Initial Schedule), in each case taking into account the Concessionaire's obligations under the Concession Agreement, and such other information as HPTE may reasonably require.

On the basis of the meetings held in accordance with the second paragraph under Section 7.3.3 above, the Concessionaire shall submit each draft Utility Work Order to HPTE for HPTE's review and approval.

HPTE shall provide comments or Acceptance within 14 Days after delivery of the draft Utility Work Order by the Concessionaire to HPTE, provided that the Concessionaire shall not execute or otherwise commit to enter into any Utility Work Order or perform any work in respect of any Utility Work without HPTE's prior written Approval.

If HPTE accepts the draft Utility Work Order and accepts both the cost, and the impact of such Utility Work Order on the performance of the Work, if any, then:

1. The Concessionaire shall submit the accepted Utility Work Order to the Utility Owner and HPTE for execution and shall itself execute the Utility Work Order, in each case in accordance with the applicable URA; and
2. The Concessionaire shall thereafter perform the Utility Work for which it is responsible pursuant to such Utility Work Order as part of the Work.

The Concessionaire shall revise any Utility Work Order if and when necessary in accordance with the terms of the applicable URA. Such a revised Utility Work Order shall be drafted and executed in accordance with the same procedures applicable to the drafting and execution of the original Utility Work Order under this Section 7.

#### **7.3.4 Damage to Utilities Caused by the Concessionaire**

The Concessionaire shall be responsible for any damage caused by the Concessionaire or its Sub-Contractors, employees, or agents to property, Utilities, structures, or Sub-Contractors, employees, or agents of the Utility Owners. The Concessionaire shall immediately notify the affected Utility Owner of any Utility damaged by the Concessionaire during performance of the Work.

Promptly after the Concessionaire's discovery of such damage, or the Concessionaire's receipt of notice of any such damage from the Utility Owner or from any other source: (a) the Concessionaire shall repair the damage to the Utility Owner's satisfaction; or (b) at the Utility Owner's election, the Utility Owner may make such repairs at the Concessionaire's expense. The Concessionaire shall make payment to a Utility Owner within 60 Days after receipt of the Owner's invoice.

#### **7.3.5 Multiple Moves**

The Concessionaire shall be responsible for all costs incurred by HPTE, the Concessionaire, or the Utility Owner to subsequently relocate any Utility already relocated to accommodate the Phase 2 Construction Work.

### **7.4 Utility Coordination**

#### **7.4.1 General**

The Concessionaire shall be responsible for all coordination with the affected Utility Owners to accomplish each Utility relocation in accordance with the applicable URAs. In the discharge of its coordination responsibilities, the Concessionaire shall:

1. Keep Utility Owners fully informed of schedules with regard to Utility Work. The Concessionaire shall provide to the Utility Owners, as soon as practicable, an estimated schedule for their respective Utility Work and shall notify the Utility Owners of any changes to the schedule as soon as practicable.
2. Keep Utility Owners fully informed of changes that affect their Utilities.
3. Consider, to the extent practicable, Utility Owners' needs for the allocation of resources to perform their respective Utility Work in a timely manner.
4. Keep Utility Owners involved in making decisions that affect their Utilities so Utility Owners are able to provide uninterrupted service to their customers, or to be subject to the least interruption practicable as approved by the Utility Owner.
5. Avoid multiple relocations of the same Private Utility, in accordance with the Contract Documents.

## **7.4.2 Utility Meetings**

### **7.4.2.1 Between the Concessionaire and Utility Owners**

In addition to any meetings or negotiations required under Section 7.3.3, above, and the Concession Agreement, after execution of a Utility Work Order, the Concessionaire shall schedule regular meetings with the relevant Utility Owner to complete the Utility Work pursuant to the terms of the Utility Work Order. The Concessionaire shall not unreasonably deny any request by a Utility Owner to meet regarding any Utility Work. The Concessionaire shall provide HPTE with at least 5 Days prior notice of any meeting with a Utility Owner, in each case which HPTE may attend in its discretion, unless a shorter notice period is agreed by HPTE or is reasonably necessary under the circumstances.

### **7.4.2.2 Between HPTE and the Concessionaire**

The Concessionaire and HPTE shall meet as necessary and otherwise as reasonably requested by the other Party to discuss and resolve matters relating to the Utility Work.

The Party proposing a meeting shall provide the other Party with a minimum of 5 Days prior notice of any proposed meetings, unless a shorter notice period is agreed or reasonably necessary under the circumstances.

### **7.4.2.3 Minutes**

The Concessionaire shall produce minutes of all Utility Work meetings with Utility Owners and/or HPTE and shall distribute copies of the minutes to HPTE and, when such meetings were attended by a Utility Owner, to the relevant Utility Owner, not later than 7 Days after each meeting date. The Concessionaire shall provide copies of all correspondence between the Concessionaire and any Utility Owner to HPTE no later than 7 Days after delivery.

## **7.4.3 Review Schedules**

In developing the Contract Schedule, the Concessionaire shall allow appropriate time periods for the performance of all tasks shown on each Utility Work Order.

All schedules and deadlines for the design and construction of Utility Work set forth in the Utility

Work Orders shall prevail over any estimated times noted in the Utility Matrix.

#### **7.4.4 Notices**

##### **7.4.4.1 To Utility Owners**

To maintain the Contract Schedules, the Concessionaire shall issue all notices in writing to the Utility Owners called for under the URAs, with copies submitted to HPTE.

Notice shall be given to respective Utility Owners when the Concessionaire is performing Work adjacent to their Utilities. The Concessionaire shall be solely responsible for and liable for any damage to any Utilities that are damaged due to the Work.

##### **7.4.4.2 To HPTE**

The Concessionaire shall be responsible for verifying progress of Utility Work performed by the Utility Owner and for notifying HPTE should the Concessionaire have cause to believe that the Utility Owner will not meet the specified time frame(s) in the Utility Work Order. The Concessionaire shall provide such written notice to HPTE immediately after discovery.

If the Utility Owner is performing Utility Work that requires a CDOT Utility Permit, the Concessionaire shall verify to HPTE that the CDOT Utility Permit has been obtained and is being complied with. If the Concessionaire determines that the Utility Owner does not have the required CDOT Utility Permit, or is in violation of the terms and conditions of such permit, the Concessionaire shall provide such written notice to HPTE immediately after discovery.

##### **7.4.4.3 To Utility Notification Center of Colorado (UNCC)**

The Concessionaire shall arrange for the Utility Notification Center of Colorado (UNCC) to provide software and training for the Concessionaire to order call tickets to have utility field locates performed. The Concessionaire shall contact UNCC to make arrangements for the training. This will allow the Concessionaire to order its own call tickets via e-mail.

### **7.5 Failure of Utility Owner to Cooperate or Timely Perform**

The Concessionaire shall use reasonable efforts to obtain the cooperation of each Utility Owner as necessary for carrying out the Utility Work. The Concessionaire shall notify HPTE immediately if:

1. The Concessionaire becomes aware that any Utility Owner is not cooperating in identifying Utilities, negotiating or executing Utility Work Orders, performing or approving any Utility Work, or delivering DRALs or CRALs; or
2. A Utility Owner fails to complete design and/or construction work for which it is responsible on or before the deadline established in the applicable Utility Work Order; or
3. Based on the progress made by the relevant Utility Owner, the Concessionaire believes that there is a possibility that the Utility Owner will not complete the relocation of an Utility Owner relocated Utility or any other Utility Work as required pursuant to a Utility Work Order to the extent and in the manner shown on the Utility Drawings within the time limits set out in the applicable Utility Work

Order; and

4. In each case (1), (2), or (3) advising HPTE whether the Concessionaire has complied in all respects with the requirements of this Section 7 including compliance with the applicable URA and the applicable Utility Work Order with respect to the relevant portion of the Utility Work.

After delivery of such notice, the Concessionaire shall continue to diligently pursue the Utility Owner's cooperation and shall assist HPTE in any attempts to reach a solution through the dispute resolution procedure outlined in the applicable Utility Relocation Agreement. The Concessionaire shall document any incurred costs as a direct result of the Utility Owner's failure to cooperate or perform its obligations under the applicable URA in a timely manner.

In the event that HPTE pursues legal action against a Utility Owner pursuant to Section 43-1-1411, Colorado Revised Statutes, the Concessionaire shall cooperate as reasonably requested by HPTE in connection with such lawsuits, including having the Concessionaire's staff and subconsultants act as witnesses in such lawsuits and providing information, reports, graphs, photos, plans, renderings, and similar materials to HPTE's counsel at the Concessionaire's expense.

## **7.6 Utility Work Procedure**

### **7.6.1 Utility Agreements**

The Reference Documents include the HPTE URAs with each Utility Owner whose Utilities are, or may be, affected by the Phase 2 Construction Work.

If the Concessionaire identifies Utility Work that is required from a Utility Owner without an agreement, HPTE may enter into an agreement with such Utility Owner. The Concessionaire shall not be a party to any agreement and shall not be responsible for negotiating such agreement. HPTE will be responsible for drafting and negotiating the agreement. The Concessionaire shall be responsible to coordinate with such Utility Owner as if it had an executed URA.

### **7.6.2 As-Built Plans**

Where the Utility Owner performs the Utility Work, the Utility Owner will provide As-Built plans of the relocation to HPTE and to the Concessionaire as soon as practicable, but not later than 90 Days after execution of a CRAL from the Concessionaire. The As-Built plans may be in the form of redlining changes that deviate from the approved DRAL plans or labeling the approved DRAL plans "constructed per plan." The Concessionaire shall show the Utility As-Built information on the final Phase 2 Construction Work As-Built drawings.

Where the Concessionaire performs the Utility Work, the Concessionaire shall provide As-Built plans of the relocation to HPTE and the Utility Owner as soon as practicable, but not later than 90 Days after execution of a CRAL from the Utility Owner. The As-Built plans may be in the form of redlining changes that deviate from the approved DRAL plans or labeling the approved DRAL plans "constructed per plan." The Concessionaire shall show the Utility As-Built information on the final Phase 2 Construction Work As-Built drawings.

## 7.7 Exhibits

Exhibit A - Utility No-Conflict Closeout Form

Exhibit B - Form of Utility Work Order

Exhibit C - Form of Design of Relocation Acceptance Letter (DRAL)

Exhibit D - Form of Construction of Relocation Acceptance Letter (CRAL)

## 7.8 Deliverables

At a minimum, the Concessionaire shall submit the following for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
Concessionaire's Utility Tracking Report	Review	Monthly or at HPTE's request per Section 7.3.2
Utility No-Conflict Closeout	Acceptance	Per the Contract Schedule per Section 7.1.1
Utility Work Order	Approval	Per the Contract Schedule per Section 7.3.3
DRAL	Acceptance	Per the Contract Schedule per Section 7.1.1
CRAL	Acceptance	Per the Contract Schedule per Section 7.1.1
As-Built plans	Acceptance	Per the Contract Schedule per Section 7.6.2
Meeting minutes	Acceptance	As required per Section 7.4.2.3
Written notices to Utility Owners	Acceptance	As required per Section 7.4.4.1
Written notice of Utility Owner not meeting Work Order time frame	Acceptance	As required per Section 7.4.4.2
Written notice of Utility Permit violation	Acceptance	As required per Section 7.4.4.2
Written notice of failure of Utility Owner to cooperate or timely perform	Acceptance	As required per Section 7.5

All deliverables shall also conform to the requirements of Schedule 5, Section 3 (Quality Management).

## 8.0 RIGHT-OF-WAY

HPTE will acquire Right-of-Way for this Phase 2 Construction Work. At the level of design completed at the issuance of this document, it has been determined that this Phase 2 Construction Work will be constructed on or within existing CDOT ROW and the additional ROW, as defined in the ROW Plans in Schedule 5B, being acquired. However, in the event that the Concessionaire requests additional ROW acquisition and HPTE Approves such request (Concessionaire Acquisitions), all Concessionaire Acquisitions, if needed, shall be performed by the Concessionaire in compliance with the requirements of this Section 8 and the Concession Agreement. The Concessionaire shall be responsible for completion of all steps in the ROW acquisition process for Concessionaire Acquisitions, except for condemnations (if needed). The Colorado Attorney General's Office will file and prosecute all condemnations needed for Concessionaire Acquisitions.

### 8.1 Administrative Requirements

HPTE will retain possession of each parcel and all improvements, if any, made thereon by the Concessionaire. The Concessionaire's access and use of the ROW arises solely from the permission granted by HPTE under the Contract Documents.

#### 8.1.1 Acquisition and Relocation Standards

All ROW acquisition and relocations for Concessionaire Acquisitions shall be performed in accordance with all applicable federal and state laws, including:

1. The federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, including regulations promulgated pursuant to such Act, which appear at 49 CFR Part 24, as amended.
2. Right of Way Requirements for Design/Build Projects, 23 CFR 710.313.
3. The Colorado Relocation Assistance and Land Acquisition Policies Act, Section 24-56-101, et seq., C.R.S., as amended.
4. The Colorado Eminent Domain Act, Section 38-1-101, et seq., C.R.S., as amended.
5. CDOT's Right of Way Manual, as amended.
6. CDOT's authority to acquire property and to acquire through eminent domain, if necessary, is set forth in Section 43-1-208, 210 and 43-3-106, C.R.S., as amended.
7. If the acquisition of additional ROW by the Concessionaire is Approved by HPTE (Concessionaire Acquisitions), all appraisal, acquisition negotiation, and relocation shall be done by CDOT-Approved consultants.
8. All Concessionaire Acquisitions will be acquired in CDOT's name.

#### 8.1.2 Status of Right-of-Way

The ROW Plans included in Schedule 5B (ROW Plans) show the ROW and permanent easements (PE) that CDOT owns or is acquiring for the Phase 2 Construction Work. CDOT will also acquire some temporary construction easements as shown on the ROW Plans. If the Concessionaire determines that additional temporary construction easements are needed for

the Work, the Concessionaire shall be responsible to define, value, negotiate, and pay for the acquisition of such temporary construction easements. If condemnation is needed to obtain possession of, or resolve acquisition negotiations, for any temporary construction easements, the Colorado Attorney General's Office will file and prosecute such condemnations.

Some ROW for the Phase 2 Construction Work will be obtained from the Regional Transportation District (RTD) by Use and Occupancy Agreements, which function as follows:

1. RTD retains title to the parcels needed for the Phase 2 Construction Work.
2. The Use and Occupancy Agreement define the rights and responsibilities of HPTE and RTD relevant to the Phase 2 Construction Work.

The Concessionaire shall comply with all the terms and conditions of the Use and Occupancy Agreement. The parcels that will be obtained pursuant to Use and Occupancy Agreements are shown on the ROW Plans included in Schedule 5B. A copy of a form Use and Occupancy Agreement is attached as Appendix A. It is anticipated that Appendix A will later be supplemented with the actual Use and Occupancy Agreement that is executed by HPTE and RTD. The actual Use and Occupancy Agreement may vary from the form Use and Occupancy Agreement currently attached as Appendix A.

The Concessionaire shall be allowed access to each parcel identified in Appendix B as each parcel is acquired. HPTE will provide the Concessionaire with status reports, written notice of parcel access, and any applicable restrictions that may apply. The Concessionaire shall not access any parcel on which access has not been provided.

The Concessionaire shall not trespass on private property. If HPTE discovers a trespass, the Concessionaire shall promptly vacate possession of the private property upon receipt of notice of the trespass from HPTE. If any liability occurs as a result of the trespass, the Concessionaire shall be responsible for such liability, including indemnifying HPTE for such liability. In the event that trespass occurs, and especially in instances where trespasses persist after receipt of a notice to desist from HPTE, the Concessionaire shall be liable for liquidated damages as defined in the Concession Agreement, Section 21.

### **8.1.3 Right-of-Way Manager and Compliance with CDOT *Right-of-Way Manual***

A ROW Manager shall only be retained if ROW acquisition by the Concessionaire (Concessionaire Acquisitions) is Approved by HPTE. The Concessionaire's ROW Manager shall be responsible for all ROW coordination and compliance requirements. The Concessionaire's ROW Manager shall be qualified and Approved by HPTE for both acquisition and relocation services. The Concessionaire's ROW Manager shall coordinate all acquisition and relocation activities with HPTE. In compliance with 23 CFR §710.313(d)(3), the Concessionaire shall execute a certification in its Proposal that it has reviewed the current copy of the CDOT *ROW Manual* on CDOT's website and will comply with all of the requirements of the CDOT *ROW Manual*.

## **8.2 Acquisition and Relocation Requirements**

### **8.2.1 Temporary Easements**

The temporary (construction) easements (TE) acquired by CDOT are shown on the ROW Plans that are included in Schedule 5B. Should the Concessionaire determine that additional TEs are needed for the Work, the Concessionaire shall submit a written request to purchase the Additional TEs to HPTE for Approval. Each request shall include the following documentation:



1. Identification of the TEs and an explanation of a justification for their need. An illustration of each TE superimposed on an aerial photograph with the dimensions of the requested Additional TE shall be sufficient.
2. A preliminary cost estimate for each TE that includes separate values for land and improvements, if any improvements will be affected, and appraisal (if needed) and acquisition costs.
3. Conveyance deeds showing the names of the current owners of all properties from which TEs will be needed.

HPTE will review each request and, if Approved (Concessionaire Acquisitions), will notify the Concessionaire in writing. If HPTE Approves the request, the Concessionaire, at its sole cost and expense, shall be responsible for acquiring such Concessionaire Acquisition TEs.

Once authorization is obtained from HPTE, the Concessionaire may begin the ROW Plans preparation, valuation, and acquisition negotiation process for the Concessionaire Acquisition TEs.

All aspects of the ROW process for Concessionaire Acquisition TEs must be conducted in compliance with CDOT's *Right of Way Manual*, including ROW Plans preparation and approval, appraisal and appraisal review (if required) or valuation, and acquisition negotiations. An appropriate environmental clearance, as specified in Schedule 5, Section 5, (Environmental Requirements), shall be required as a prerequisite for Approval of ROW Plans for the Concessionaire Acquisition TEs. If a Concessionaire Acquisition TE is to be acquired from a landowner with whom HPTE has an unsettled condemnation case, the same appraiser that prepared the appraisal for HPTE's condemnation case shall value the TE. HPTE must Approve all value determinations and appraisals (if needed) for any Concessionaire Acquisition TE prior to any offer being made to the landowner. The steps of the ROW acquisition process, the entity that is responsible for completion of each step (Concessionaire or HPTE), and approximate time frames for some of the steps are set forth in Appendix D of this Section 8. Note that all time frames in this table are approximate suggestions as opposed to binding agreements. As a general proposition, appropriate completion of the CDOT ROW acquisition process is subject to many variables that can create unforeseen delays. While every effort will be made by both the Concessionaire and HPTE to minimize such delays, they are common in this process.

After each TE is acquired, the Concessionaire shall submit a complete parcel acquisition file, which shall include but not be limited to, copies of offer letters, fair market value determinations or value findings, fully executed easement documents and/or agreements, the negotiator's signed diary, and a statement signed by the property owner acknowledging receipt of payment in full. Parcel acquisition files shall be submitted to HPTE for Approval no later than 2 Working Days following tender of the just compensation payment to the landowner. The Concessionaire shall not access any requested ROW parcel until HPTE provides written authorization allowing the Concessionaire access.

If the Concessionaire cannot reach an agreement with a landowner for the acquisition of the TEs, the Concessionaire may request in writing that HPTE acquire the TEs through condemnation proceedings. The Concessionaire shall prepare and submit to HPTE for Approval, a properly completed Condemnation Memorandum and Check List Form in accordance with the instructions in the CDOT *Right of Way Manual*. The condemnation request shall include two certified checks payable to the Clerk of the District Court of the appropriate

county in the amount of the required condemnation filing fee and approved fair market value or value finding.

The Concessionaire must work with the Colorado Attorney General's Office to establish a realistic schedule for filing condemnations, and for setting and holding immediate possession hearings. It usually takes at least three months from the date of submission of a condemnation request file to the Colorado Attorney General's Office for a condemnation action to be filed and an immediate possession hearing to be set and held. The Concessionaire shall not enter any properties until notified in writing that legal possession has been obtained. If a settlement is negotiated with a property owner after the filing of a condemnation, the Concessionaire will be consulted on the settlement; however, HPTE shall have authority to decide whether to accept or reject the settlement. If a settlement is agreed to, the Concessionaire must pay the full amount of the settlement. If a valuation trial is held, the Concessionaire shall be responsible for payment of the full amount of the valuation trial award, including all interest, costs and attorney's fees, if any.

If there are any cost increases or time delays as a result of condemnation proceedings, all costs associated with such cost increases and time delays shall be borne by the Concessionaire. The Concessionaire may be required to provide personnel for pre-trial and court testimony for each condemnation request.

### **8.2.2 Utility Easements**

Construction of the Phase 2 Construction Work will affect existing Utilities. Known easements for existing Utilities are shown in the ROW Plans included in Schedule 5B. It is again noted that certain parcels will be obtained from RTD pursuant to a Use and Occupancy Agreement as shown on the ROW Plans included in Schedule 5B. A copy of a form Use and Occupancy Agreement is attached to this Section 8 as Appendix A. The form Use and Occupancy Agreement includes specific provisions concerning Utilities. The Concessionaire shall comply with the requirements of such provisions.

If the Concessionaire determines that it needs Utility easements (UE) in addition to, or as replacement for the UEs shown on the ROW Plans included in Schedule 5B (Additional UEs), the Concessionaire, at its sole cost and expense, shall be responsible for acquiring such additional UEs (Concessionaire Acquisitions). The steps of the ROW acquisition process, the entity that is responsible for completion of each step (Concessionaire or HPTE), and approximate time frames for some of the steps are set forth in Appendix D of this Section 8. Note that all time frames in this table are approximate suggestions as opposed to binding agreements. As a general proposition, appropriate completion of the CDOT ROW acquisition process is subject to many variables that can create unforeseen delays. While every effort will be made by both the Concessionaire and HPTE to minimize such delays, they are common in this process.

Acquisition parcels to be acquired from irrigation ditches or ditch companies (both those acquired by HPTE and those acquired by the Concessionaire), if any, will likely not be conventional acquisitions of a fee simple interest or a UE for a limited certain purpose. Instead, ditch agreements with terms and conditions defining parties rights and responsibilities, including construction, use, and maintenance, may be negotiated. Each of these agreements may be different. The Concessionaire shall be responsible for compliance with certain of these terms and conditions during the effective time frame of this Contract.

The acquisition of Concessionaire Acquisition UEs requires prior Approval by HPTE. Acquisition of additional UEs must be conducted in compliance with Schedule 5, Section 8.2.3, below.

### 8.2.3 Request for Additional Right-of-Way and Permanent Easements

Should the Concessionaire determine that additional ROW parcels or PE parcels (including Concessionaire acquisition UEs) are necessary or desirable for the Design, the Concessionaire shall submit a written request to HPTE for Approval. If acquisition of both TEs and permanent ROW, including PEs if any, are requested, the application, Approval and acquisition requirements of this Section 8.2.3 are applicable. Schedule 5, Section 8.2.1, above, is only applicable for requests to acquire TEs only. Each request shall include the following documentation:

1. Identification of the additional parcels and an explanation of a justification for its need. An illustration of each parcel superimposed on an aerial photograph with approximate area of the parcel will be sufficient.
2. A preliminary cost estimate for each parcel that includes separate values for land, improvements, damages or benefits (if any), relocation (if applicable), and survey, ROW Plan preparation, appraisal, and acquisition costs.
3. A title commitment report for each parcel, including all supporting documentation, not more than 30 Days old. The Concessionaire shall be required to purchase title insurance for all additional ROW, PEs, and additional UEs it is allowed to purchase and, if condemnation is needed, the Concessionaire shall be responsible for providing litigation guarantees for eminent domain proceedings.
4. Any maps, deeds, or other information available to the Concessionaire that shall expedite the acquisition.
5. Acquisition stage relocation plan in accordance with the CDOT *Right of Way Manual*, Chapter 5, if additional ROW acquisition requires occupant or personal property relocation.

HPTE will review each request and, if Approved, shall notify the Concessionaire in writing (Concessionaire Acquisitions). HPTE will notify the Concessionaire of any deficiencies and may request a resubmittal of the request. The Concessionaire shall promptly correct any deficiencies and resubmit the appropriate documentation.

If authorization is obtained from HPTE, the Concessionaire may begin the ROW acquisition process for the Concessionaire Acquisitions. All aspects of the ROW process for the Concessionaire Acquisitions must be conducted in compliance with CDOT's *Right of Way Manual*, including ROW Plans preparation and approval, appraisal and valuation, and conduct and procedures for acquisition negotiations and relocation, if needed. For any fee parcels acquired, the Concessionaire shall obtain and provide appropriate release documents for any encumbrances affecting the acquisition parcels, including but not limited to releases of deeds of trust, mortgages, easements, and liens. If liens or encumbrances affect permanent easement parcels, HPTE should be notified of such liens and encumbrances and the Concessionaire will be required to take the action requested by HPTE, which may include subordination or release of the liens and encumbrances. An appropriate environmental clearance, as specified in Schedule 5, Section 5, (Environmental Requirements), shall be required as a prerequisite for Approval of ROW Plans for the additional ROW.

If the additional ROW is to be acquired from a landowner with whom HPTE has an unsettled condemnation case, the same appraiser that prepared the appraisal for HPTE's condemnation case shall value the additional ROW. HPTE must Approve the value determination for the additional ROW, or if required, issue a fair market value determination prior to any offer being

made to the landowner. HPTE must review and Approve certain administrative settlements, which are settlements over the amount of the HPTE-Approved offer to purchase that is made to the landowner. Concessionaire shall be delegated the same administrative settlement authority as the “Region” as set forth in Section 10.2.1 of the CDOT *Right-of-Way Manual*. CDOT Region 1 shall be delegated the same administrative settlement authority as “Central Office” as set forth in Section 10.2.2 of the CDOT *Right-of-Way Manual*.

The steps of the HPTE right of way acquisition process, the entity that is responsible for completion of each step (Concessionaire or HPTE), and approximate time frames for some of the steps are set forth in Appendix D of this Section 8. Note that all time frames in this table are approximate suggestions as opposed to binding agreements. As a general proposition, appropriate completion of the CDOT ROW acquisition process is subject to many variables that can create unforeseen delays. While every effort will be made by both the Concessionaire and HPTE to minimize such delays, they are common in this process.

If the additional Concessionaire Acquisitions requires occupant or personal property relocation, such relocation shall be conducted in compliance with Chapter 5 of the CDOT *Right of Way Manual*. The steps of the CDOT Relocation Process, the entity that is responsible for completion of each step (Concessionaire or HPTE), and approximate time frames for some of the steps are set forth in Appendix E of this Section 8. Note that all time frames in this table are approximate suggestions as opposed to binding agreements. As a general proposition, appropriate completion of the CDOT ROW relocation process takes longer than one would reasonably think it might. If an acquisition displaces an occupant, working through the relocation process will likely be the longest most Schedule-specific required ROW activity. As a result, prioritizing such acquisition is recommended.

After each parcel of Concessionaire Acquisitions is acquired, the Concessionaire shall submit a complete parcel acquisition file, which shall include but not be limited to, copies of offer letters, fair market value determinations or value findings, fully executed easement documents and/or agreements, the negotiator’s signed diary, a statement signed by the property owner acknowledging receipt of payment in full, and if relocation is applicable, all required relocation forms. Parcel acquisition files shall be submitted to HPTE for Approval no later than 2 Working Days following tender to the landowner. The Concessionaire shall not access any requested ROW parcel until HPTE provides written authorization allowing the Concessionaire access.

If the Concessionaire cannot reach an agreement with a landowner for the acquisition of the Concessionaire Acquisitions, the Concessionaire may request in writing that HPTE acquire the additional ROW through condemnation proceedings. The Concessionaire shall prepare and submit to HPTE for Approval a properly completed Condemnation Memorandum and Check List Form in accordance with the instruction contained in the CDOT *Right of Way Manual*. The condemnation request shall include a certified check payable to the Clerk of the District Court of the appropriate county in the amount of the required condemnation filing fee and approved fair market value or value finding.

The Concessionaire must work with the Colorado Attorney General’s Office to establish a realistic schedule for filing condemnations, and setting and holding immediate possession hearings. It usually takes at least three months from the date of submission of a condemnation request file to the Colorado Attorney General’s Office for a condemnation action to be filed and an immediate possession hearing to be set and held. The Concessionaire shall not enter any properties until notified in writing that legal possession has been obtained. If a settlement is negotiated with a property owner after the filing of a condemnation, the Concessionaire will be consulted on the settlement; however, HPTE shall have authority to decide whether to accept or reject the settlement. If a settlement is agreed to, the Concessionaire must pay the full amount

of the settlement. If a valuation trial is held, the Concessionaire shall be responsible for payment of the full amount of the valuation trial award, including all interest, costs and attorneys' fees, if any.

If authorization is obtained from HPTE for the Concessionaire to purchase Concessionaire Acquisitions, the Concessionaire's ROW Manager shall meet with CDOT Region 1's ROW Manager, or a delegee, every two weeks to review the status of the ROW acquisitions and relocations, if applicable, and check Quality Control/Quality Assurance as needed, until the completion and HPTE Approval of the acquisitions and relocations. The Concessionaire is responsible for creation and implementation of an internal status tracking and quality control system for all ROW processes.

If there are any time delays as a result of condemnation proceedings, all costs associated with such time delays shall be borne by the Concessionaire. The Concessionaire may be required to provide personnel for pre-trial and court testimony for each condemnation request.

#### **8.2.4 Permission to Enter Property**

The Concessionaire shall secure permission to enter property forms prior to entering any property outside the ROW for surveying, nonintrusive environmental investigation, and appraisal purposes. It shall be the Concessionaire's sole responsibility to obtain the forms, and the Concessionaire shall be responsible for any and all damages and claims. The Concessionaire shall submit copies of all permission to enter property forms to HPTE for Acceptance.

#### **8.2.5 Permits for Bikeway Construction on Public Properties**

Portions of the Bikeway are located on properties owned by Louisville, Boulder, and Boulder County. No ROW parcels have been defined or acquired for these portions of the Bikeway on Louisville, Boulder, and Boulder County property. The Concessionaire shall apply for and obtain permits from Louisville, Boulder, and Boulder County for this Bikeway construction. The Concessionaire shall assume that complete design plans for the Bikeway will be required before issuance of these permits. The Concessionaire is solely responsible for all aspects of the permits, including required indemnifications and insurance policies with minimum coverage amounts. The permits will only cover the construction of the Bikeway segments on these Louisville, Boulder, and Boulder County properties and shall only be effective for the construction time frame. HPTE will enter into Intergovernmental Agreements with Louisville, Boulder, and Boulder County that will define the rights and responsibilities of the entities for maintenance of the Bikeway segments on these properties after construction completion.

### **8.3 Construction Requirements**

#### **8.3.1 Restoration of Property and Landscape**

Temporary easements are temporary rental of property. At the end of the rental period, property occupied by the Concessionaire under a temporary easement shall be returned to the landowner in the same condition it was in prior to taking possession. The Concessionaire shall, at its sole cost and expense, repair and/or replace or restore any damage to TE property that may occur as a result of the Concessionaire's occupancy, to a condition reasonably equal to that existing prior to the damage. Restoration may include, but is not limited to, repair, replacing in kind, rebuilding, or replanting. Such restoration must be completed prior to the termination date of the TE rental term.

### 8.3.2 Protection of Property

Once permission to enter has been acquired for a property in accordance with the requirements herein, the Concessionaire shall manage and minimize losses to the property in accordance with the requirements of Schedule 5, Section 18, (Maintenance during Construction). This shall include the installation of temporary chain-link security fencing sufficient to contain animals, people, etc. The temporary fencing shall be installed prior to removing any ROW fencing or sound barrier in place within the Phase 2 Construction Work limits.

### 8.3.3 Prohibition Against Coercion, Impairment of Safety, and Inconvenience of Displaced Occupants Still in Occupancy

In compliance with 23 CFR §710.313(d)(3), HPTE may establish hold off zones around occupied properties whose occupants are being displaced by a ROW acquisition, but have not vacated the premises. If such zones are established, no construction-related activity will be allowed within the hold off zone until the property is vacated.

In compliance with 23 CFR §710.313(d)(4), adequate access shall be provided to occupied properties whose occupants are being displaced by a ROW acquisition, but have not vacated the premises, to ensure emergency and personal vehicle access.

In compliance with 23 CFR §710.313(d)(5), utility service must be available to all to occupied properties whose occupants are being displaced by a ROW acquisition, but have not vacated the premises, at all times prior to and until relocation is completed.

In compliance with 23 CFR §710.313(d)(6), open burning should not occur within 305 meters (1,000 feet) of occupied properties whose occupants are being displaced by a ROW acquisition, but have not vacated the premises.

## 8.4 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Parcel acquisition files	Approval	No later than 2 Working Days following tender of payment
Condemnation memorandum and check list form	Approval	Concurrent with the request to HPTE for property condemnation
Request for additional ROW (letter)	Approval	As needed
Permission to enter property form	Approval	Prior to entering private property

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management).

## 8.5 Appendices

- Appendix A Form Use and Occupancy Agreement - for HPTE's use and occupancy of property owned by RTD for the Phase 2 Construction Work
- Appendix B Right of Way Schedule
- Appendix C Steps of the CDOT Right of Way Acquisition Process, Entity Responsible for Completion of Each Step, and Approximate Time Frames
- Appendix D Steps of the CDOT Relocation Process, Entity Responsible for Completion of Each Step, and Approximate Time Frames

**APPENDIX A**

**FORM USE AND OCCUPANCY AGREEMENT**

for CDOT's Use and Occupancy of Property Owned by RTD for the Project.

**USE AND OCCUPANCY AGREEMENT**

This Use and Occupancy Agreement is entered into this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, ("Agreement") by and between the REGIONAL TRANSPORTATION DISTRICT, 1600 Blake Street, Denver, CO 80202 (hereinafter referred to as "RTD") and the STATE OF COLORADO for the use and benefit of the DEPARTMENT OF TRANSPORTATION, 4201 East Arkansas, Denver, Colorado 80222 (hereinafter referred to as "CDOT"). CDOT and RTD are referred to individually herein as a "Party" or collectively as the "Parties".

**FACTUAL RECITALS**

A. RTD is in possession of certain real property located in the City of Boulder, the City of Louisville, and in the County of Boulder, Colorado; and

B. CDOT will design, purchase right of way for, and construct CDOT Project No. NH 0361-103, which is a project that will construct a new Managed Lane in each direction on US 36, from Foothills Parkway in Boulder to 88<sup>th</sup> Street in Louisville . Pursuant to an intergovernmental agreement dated \_\_\_\_\_, RTD is a financial contributor and design and construction partner in this project."; and

C. CDOT has asked RTD for permission to use and occupy the portion of RTD Right of Way illustrated on the right of way plans attached hereto as Exhibit "A", consisting of the following: (i) Parcel Nos. \_\_\_\_\_ for Project No. NH 0361-103, (hereinafter collectively referred to as the "Subject Property") which CDOT needs for the Projects. Legal descriptions for the Subject Property are attached hereto as Exhibit "B"; and

D. RTD has agreed to allow CDOT to use the Subject Property. The permission instrument for CDOT's use of the Subject Property is a use and occupancy agreement. This Agreement defines the rights and responsibilities of the parties with regard to CDOT's use of the Subject Property; and

E. In consideration of the foregoing and the mutual covenants herein, this Agreement is executed by the Parties under the authority of § 29-1-203, § 32-9-119, § 43-1-106 and § 43-1-110, C.R.S., as amended, and by the RTD General Manager pursuant to the authorization by the RTD Board of Directors provided at the RTD Board meeting of \_\_\_\_\_, 2012 a copy of the minutes of which is attached hereto.

**NOW THEREFORE, it is hereby agreed that:**

1. RTD hereby consents to the perpetual use and occupancy of the Subject Property by CDOT for the construction, operation, use, and maintenance of roadways and all associated appurtenances, including but not limited to bridges and other structures, signals, culverts, sluices, drains, ditches, waterways and other drainage features, pedestrian and bicycle facilities, embankments, slopes, retaining walls, trees, shrubs and other landscaping ("CDOT Transportation Facilities") subject to the terms and conditions herein contained.

2. The Subject Property may not be used for any purposes other than the purposes described herein without the specific written prior permission of RTD. Any other use of the Subject Property shall constitute a material breach of this Agreement. Any revenue producing



operation on the Subject Property shall be permitted only subject to agreement between the Parties as to the nature of the operation and use of the proceeds.

3. CDOT acknowledges RTD's authority to grant this Agreement and RTD by its issuance represents it has the authority to do so. Except as set forth in paragraph, 6 of this Agreement, RTD shall not convey any of its interests in the Subject Property without CDOT's consent during the term of this Agreement. The right to use and occupy the Subject Property granted hereunder is granted with respect to the Subject Property in its "AS IS" physical condition without any warranty, express or implied. RTD does not warrant its title in, or right to use, the Subject Property. In the event that any third party disputes RTD's right to grant this Agreement or CDOT's right to use the Subject Property pursuant hereto, the Parties will reasonably cooperate to resolve the dispute with the third party. RTD will not be required to expend funds in order to resolve the dispute.

4. The CDOT Transportation Facilities to be constructed on the Subject Property are defined by a set of preliminary design plans sufficient for awarding a contract to a design-build Concessionaire dated \_\_\_\_\_. RTD has reviewed and approved such plans. CDOT shall not proceed with any major modifications of the CDOT Transportation Facilities or other new construction on the Subject Property, without first obtaining prior approval, including a detailed review and approval of all design plans, from RTD, which approval will not be unreasonably withheld. "Major modifications of the CDOT Transportation Facilities" shall be defined as modifications that trigger modifications to the right of way plans and/or legal descriptions of the Subject Property. Upon completion of the design-build contract, CDOT shall submit to RTD a full set of "as built" drawings for the completed CDOT Transportation Facilities. If the Parties enter into design and/or construction intergovernmental agreements ("IGAs") for the CDOT Transportation Facilities, and if the provisions of this paragraph 4 conflict with any provisions of such IGAs, the terms and conditions of the IGAs will control.

5. Operation, maintenance, and repair of the CDOT Transportation Facilities on the Subject Property will be the sole legal and financial responsibility of CDOT, including, but not limited to, landscaping, sweeping, graffiti, litter, and snow removal. CDOT operates, maintains, and repairs its transportation facilities to Colorado Transportation Commission level of service (MLOS) allocated standards. If CDOT fails to properly maintain the Subject Property to the MLOS standards so that the lack of such maintenance impairs the use, operation, maintenance, or safety of adjoining RTD properties, RTD shall make written demand on CDOT to immediately complete outstanding maintenance items. Failure to complete such outstanding maintenance item(s) following such demand shall trigger the following dispute resolution process: The Parties shall resolve disputes regarding all items in this Agreement at the lowest staff level possible. The escalation process shall be, in ascending order: 1. the RTD Manager, Real Property and the CDOT Region 4 Maintenance Superintendent; 2. RTD's Assistant General Manager, FASTRACKS/ENGINEERING and CDOT's Region 4 Transportation Director; and 3. RTD's General Manager and CDOT's Executive Director.

6. A utility, or utilities, may, ask for permission to occupy or cross the Subject Property. In the event of such an occurrence, CDOT shall be the entity authorized to issue permits for the Subject Property. If any permit application is acceptable, CDOT will issue a utility permit to allow for such use. All CDOT permits issued shall include the following provision:

The Regional Transportation District has an ownership interest in the property that is the subject of this permit. Permittee hereby indemnifies and holds harmless the Regional Transportation District for any and all liabilities arising from the uses allowed by the permit. Permittee shall name the Regional

Transportation District as an additional insured on all insurance policies required by this permit. This permit shall not be valid until copies of such insurance policies so naming the Regional Transportation District have been provided to:

Assistant General Manager, FASTRACKS/Engineering  
Regional Transportation District  
1560 Broadway  
Denver CO 80202

Each permit shall provide that the permit shall be terminable upon no more than one year's advance written notice to utility permittee, utility permittee to bear all costs of removal or relocation. RTD shall not issue a companion utility permit or license to allow for such use

7. RTD expressly reserves the right to use and enjoy the Subject Property, including but not limited to the lands beneath and the airspace above, for all purposes and uses which do not unreasonably interfere with the uses granted to CDOT herein.

8. Except as specified in paragraph 6, above, CDOT's allowed use of the Subject Property as defined herein, shall not be transferred to another party without RTD's prior approval.

9. If CDOT fails to use the Subject Property for the uses defined herein by \_\_\_\_\_, or if it abandons the Subject Property, CDOT's right to use the Subject Property shall terminate. Abandonment shall be deemed to occur for purposes of this Agreement if CDOT notifies RTD that it will cease to use the Subject Property for the CDOT Transportation Facilities, or if CDOT fails to use, operate, or maintain the CDOT Transportation Facilities for a consecutive period of 24 months after \_\_\_\_\_, during which time no use, operation, maintenance, construction or reconstruction activities are occurring.

10. The Parties intend that the general form of this Agreement shall be used in future instances in which RTD may grant CDOT use and occupancy of various RTD properties for various CDOT uses in instances where the entities facilities do not share the same space.

11. Each Party represents and warrants that it has taken all actions that are necessary or required by applicable law, to properly authorize the undersigned signatory to lawfully execute this Agreement on behalf of such Party and to bind the Party to its terms.

12. All notices and other communications provided for in this agreement shall be sent to the following:

For RTD:

Assistant General Manager, FASTRACKS/Engineering  
Regional Transportation District  
1560 Broadway  
Denver CO 80202

For CDOT:

Regional Transportation Director  
Colorado Department of Transportation  
2000 South Holly Street  
Denver, CO 80203

13. RTD and CDOT are subject to applicable provisions of the "Taxpayer's Bill of Rights" (TABOR Amendment), as may be amended, found at Article X, Section 20, Constitution

of Colorado. Their respective financial obligations hereunder beyond 2009 are subject to and contingent upon the budgeting and irrevocable pledging of funds intended to pay such obligations and sufficient therefore by their respective governing bodies.

IN WITNESS WHEREOF, the Parties hereto have caused the foregoing Agreement to be executed the day and year first above written.

**DEPARTMENT OF TRANSPORTATION  
STATE OF COLORADO**

ATTEST:

By \_\_\_\_\_  
Timothy J. Harris, P.E.  
Chief Engineer

By \_\_\_\_\_  
Ian Broussard  
Chief Clerk of Right-Of-Way

**REGIONAL TRANSPORTATION DISTRICT**

ATTEST:

By \_\_\_\_\_  
Philip Washington, General Manager

By \_\_\_\_\_

Approved as to legal form for the  
Regional Transportation District

\_\_\_\_\_  
Associate General Counsel

**APPENDIX B**  
**RIGHT-OF-WAY SCHEDULE**

<b>CDOT Parcel #</b>	<b>Segment</b>	<b>Owner</b>	<b>Access Date</b>
1	E	Superior Rock Creek, LLC	09/18/13
2	E	South Boulder and Coal Creek	09/18/13
3	E	Schuck Holdings, LLC	09/18/13
4	E	County of Boulder	09/18/13
5, 5A	E	Biella Family Limited Partnership	09/18/13
6, 6B, PE-6	E	Town of Superior	09/18/13
7, 7A,	E	FFI Co Coal Creek LLC	09/18/13
8, 8D, 8E, 8F	E	City of Louisville	09/18/13
9	E	Portercare Adv. Health Systems	09/18/13
10, PE10	E	Superior Plaza, LLC.	09/18/13
13, PE-13	E	Superior 128, LLC.	09/18/13
8A, 8B, 8C	F	City of Louisville	10/25/13
11, 11A, 11B, 11C, 11D, 11E, 11F, 11G, 11H, 11I, 11J 11K, 11L, 11M, 11N, 11O	F	City of Boulder	10/25/13
TE-11, TE-11A, TE-11B, TE-11C, TE-11D, TE-11E, TE-11F, TE-11G, TE-11H, TE-11I, TE-11J	F	City of Boulder	10/25/13
12, TE-12, TE- 12A	F	Regents of the University of Colorado	10/25/13

**APPENDIX C****STEPS OF THE CDOT RIGHT OF WAY ACQUISITION PROCESS, ENTITY RESPONSIBLE FOR COMPLETION OF EACH STEP, AND APPROXIMATE TIME FRAMES**

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Review and Approval of ROW Task	Approximate Time Frame for Completion of Review and Approval of ROW Task	Comments
Survey	Concessionaire	Variable depending on scope 2-4 weeks for smaller surveys, 2-4 months for larger surveys	CDOT Region 1 Survey Unit	2-3 weeks from submission	This is only survey of property boundary and topography needed for development of <u>ROW Plans</u>
Delivery of Engineering Design of Improvements Requiring ROW Completed to a Sufficient Level to Ensure that Location, Size and Shape of ROW Parcels Will Not Change as Design is Advanced	Concessionaire	Variable depending on scope of improvements to be designed	CDOT Design Review Team and CDOT Region 1 ROW Manager	Variable depending on scope of improvements designed	Completion of sufficient design to this level is a common cause of delay in the <u>ROW Plans</u> development process
Appraisal and Appraisal Review	Appraisal: Concessionaire  Appraisal Review: CDOT	6-8 weeks per appraisal per landowner  1-2 weeks to review an appraisal	CDOT	1-2 weeks to review an appraisal	If the estimated value of the acquisition is \$5,000 or less, a value finding can be prepared by a real estate specialist and an appraisal/appraisal review is not needed. All requests for valuation by a value finding vs. an appraisal must be Approved by CDOT.

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Review and Approval of ROW Task	Approximate Time Frame for Completion of Review and Approval of ROW Task	Comments
Acquisition Negotiation	Concessionaire	4-6 weeks for the initial negotiation. 2 weeks for a final offer letter. 2 weeks for a last and final offer letter, if given. At least 3 months from submission of request for condemnation to completing immediate possession hearing.	CDOT must review and Approve certain administrative settlements. Concessionaire shall be delegated the same administrative settlement authority as the "Region" as set forth in Section 10.2.1 of the CDOT ROW Manual. CDOT Region 1 shall be delegated the same administrative settlement authority as "Central Office" as set forth in Section 10.2.2 of the CDOT ROW Manual.	2-4 Days to review and Approve backup document-ation of completed acquisition negotia-tions	Concessionaire cannot use duress or coercion in acquisition negotiations

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Review and Approval of ROW Task	Approximate Time Frame for Completion of Review and Approval of ROW Task	Comments
Condemnation	Colorado Attorney General's Office	At least three months to file a condemnation petition, serve it on the parties, set and hold an immediate possession hearing. Valuation trials can take a year or more from the date of filing the condemnation petition.			All offers to purchase must be made in CDOT's name, so the Attorney General's Office is properly authorized to represent the CDOT as the condemning authority in the condemnation proceeding,
Certification that Acquisition was completed in compliance with State and Federal Requirements	Concessionaire		CDOT Region 1 ROW Manager		

**APPENDIX D  
 STEPS OF THE CDOT RELOCATION PROCESS, ENTITY RESPONSIBLE FOR COMPLETION OF EACH STEP, AND  
 APPROXIMATE TIME FRAMES**

Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Review and Approval of ROW Task	Approximate Time Frame for Completion of Review and Approval of ROW Task	Comments
Relocation Planning Studies Required by 49 CFR §24.205	Concessionaire	Variable depending on scope 1-2 weeks for smaller studies	CDOT HQ ROW Unit	1-2 weeks from submission	
Relocation Advisory Services Required by 49 CFR §24.205	Concessionaire	Variable. Typically continuous throughout relocation process.	CDOT Region 1 Acquisition/Relocation Supervisor. Note: Approval of a specific deliverable is not required. Rather this is general oversight.	Generally continuous throughout relocation process.	CDOT Region 1 Acquisition/Relocation personnel can assist with advisory services, as needed.
Provide Displaced Occupants Notice that They Have 90 Days to Vacate the Premises, and Later That They Have 30 Days to Vacate the Premises 49 CFR §24.203	Concessionaire	The 90-Day notice is provided at the time the written offer to purchase the property is provided to the landowner	CDOT Region 1 Acquisition/Relocation Supervisor. Note: Approval of a specific deliverable is not required. Rather this is general oversight.		90 Days for a displaced occupant to find a replacement property and move into it is the minimum required by law. As a practical matter, that is too short, especially for displaced businesses. It is desirable to lengthen this minimum time frame as much as possible. At least 6 months is a better expectation. The 30-Day notice cannot be provided until possession of the underlining property is obtained.



Description of ROW Task	Entity Responsible for Completion of ROW Task	Approximate Time Frame for Completion of ROW Task	Entity Responsible for Review and Approval of ROW Task	Approximate Time Frame for Completion of Review and Approval of ROW Task	Comments
<p><u>Business Relocation</u>                      Prepare and Submit Requests for Reimbursement of all Available Business Relocation Monetary Benefits, Including Expenses Incurred Searching for a Replacement Property, 49 CFR §24.301, Moving Expenses, 49 CFR §24.301, Reestablishment, 49 CFR §24.304, or single "In Lieu" payment, 49 CFR §24.305</p>	<p>Concessionaire</p>	<p>Variable                      Note: since these are reimbursable expenses, the displaced occupant must actually incur the expenses before a request for reimbursement can be prepared.</p>	<p>CDOT HQ ROW Unit</p>	<p>2-5 Days per submittal</p>	
<p><u>Residential Relocation</u>                      Prepare and Submit Requests for Reimbursement of all Available Residential Relocation Monetary Benefits, Including Replacement Housing Payment, 49 CFR §24.401 and Moving Expenses, 49 CFR §24.301</p>	<p>Concessionaire</p>	<p>Variable                      Note: since these are reimbursable expenses, the displaced occupant must actually incur the expenses before a request for reimbursement can be prepared.</p>	<p>CDOT HQ ROW Unit</p>	<p>5-10 Days per submittal</p>	
<p>Certification that Acquisition was completed in compliance with State and Federal Requirements</p>	<p>Concessionaire</p>		<p>CDOT Region 1 ROW Manager</p>		

## **9.0 SURVEY**

### **9.1 Administrative Requirements**

#### **9.1.1 Standards**

The Concessionaire shall meet all applicable federal, state, and local requirements related to surveys, records, and monuments.

#### **9.1.2 Project Survey Coordinator**

The Concessionaire shall designate a Colorado registered professional land surveyor as the Project Survey Coordinator. The Project Survey Coordinator shall be in responsible charge of all Concessionaire survey Activities on the Phase 2 Construction Work. The Project Survey Coordinator shall direct and review all survey Work and shall be the point of contact for all survey-related Activities. Concessionaire survey staff shall perform Work under the supervision of the Project Survey Coordinator.

#### **9.1.3 HPTE-Supplied Survey Data**

The full extent of control point information to be supplied by HPTE is provided in Schedule 5B.

The full extent of survey and mapping information supplied by HPTE for information only is provided in the Reference Documents. Information was produced by aerial mapping methods supplemented by field survey within the areas of the Phase 2 Construction Work.

The Concessionaire shall verify and confirm the accuracy of all survey and mapping information provided to the Concessionaire, regardless of the source of the information. The Concessionaire shall document all forms of data verification. Any discrepancies in control point information provided that is reported to HPTE prior to NTP1 will be resurveyed or corrected by HPTE at no cost to the Concessionaire.

#### **9.1.4 Concessionaire-Supplied Survey Data**

Except as provided by HPTE above, the Concessionaire shall provide all other surveys required for completion of the Phase 2 Construction Work.

#### **9.1.5 Preservation of Survey Monuments**

The preservation of survey markers and monuments is mandatory and affects all governmental agencies. The Concessionaire shall notify the agency affected as soon as it becomes known that a marker is in a position that will interfere with new construction or with Concessionaire operations. The marker position shall be accurately preserved prior to disturbing any such marker.

#### **9.1.6 CDOT Monuments**

If any survey monuments are at risk of being destroyed at any time within the Right-of-Way, the Concessionaire shall immediately notify HPTE. The Concessionaire may assume that the agency affected will send a new marker disk, which has been properly stamped, together with instructions for establishment of the new marker, or HPTE will provide a marker disk. The Concessionaire shall have the new marker set in accordance with the provided instructions and the requirements of the Contract. The new marker shall be set under the direct supervision and

responsible charge of the Project Survey Coordinator or other Colorado registered professional land surveyor, and where required by Colorado statute shall bear the registration number of the responsible professional land surveyor.

### **9.1.7 Other Agency Monuments**

The Concessionaire shall coordinate with all other agencies with monuments in the area of the Phase 2 Construction Work to protect and restore their monuments as required to complete the Work.

### **9.1.8 Survey Records**

The Concessionaire shall prepare and maintain supporting documentation, including but not limited to, field notes, drawings, and calculations for all survey Work.

All survey records shall conform to the formats shown in the CDOT *Survey Manual*. Such records shall be neat, legible, accurate, and maintained by the Concessionaire in a neat and orderly manner.

The Concessionaire's Project Survey Coordinator shall be required to sign and seal all survey documentation in accordance with State law. All such documentation shall be transmitted to HPTE at the completion of the Phase 2 Construction Work.

## **9.2 Design Requirements**

### **9.2.1 Design Control Surveys**

The Concessionaire shall plan, schedule, and perform all surveys and monumentation necessary to maintain and supplement the project control network for the design of the Phase 2 Construction Work.

The Concessionaire shall submit to HPTE a revised project control diagram showing all modifications to the project control network.

### **9.2.2 Design Surveys**

The Concessionaire shall arrange for all survey information and Utility locations necessary to complete the design. Surveying shall be performed in accordance with the CDOT *Survey Manual*. Traffic control and permits necessary to complete the survey shall be the responsibility of the Concessionaire.

## **9.3 Construction Requirements**

### **9.3.1 Construction Control Surveys**

The Concessionaire shall plan, schedule, and perform all surveys and monumentation necessary to maintain and supplement the project control network for the construction layout of the Phase 2 Construction Work.

### **9.3.2 Construction Layout Surveys**

The Concessionaire shall plan, schedule and perform all staking and construction layout required for the Phase 2 Construction Work.

### 9.3.3 As-Built Surveys

The Concessionaire shall plan, schedule, and perform all surveys required to document the location of As-Built features on the Phase 2 Construction Work.

The Concessionaire shall deliver the As-Built data (in InRoads TMOSS survey format) and field notes to HPTE for review upon completion of the surveys. Errors and omissions found by HPTE shall be corrected by the Concessionaire and resubmitted. All work in completing the As-Built survey shall be at the responsibility of the Concessionaire and shall be completed in accordance with the CDOT *Survey Manual*.

### 9.3.4 ROW Monumentation

The Concessionaire shall replace all ROW monumentation lost or destroyed during the progression of the Work.

The Concessionaire shall submit to HPTE for Acceptance a revised ROW monumentation sheet listing all ROW monumentation reset by the Concessionaire.

## 9.4 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Documentation for the preservation or remonumentation of any survey monument	Acceptance by the affected agency	Submit with As-Built Documents
Revised ROW monumentation sheet (9.3.4)	Acceptance	Prior to Phase 2 Work Completion

## **10.0 GEOTECHNICAL, ROADWAY PAVEMENTS AND STRUCTURE FOUNDATIONS**

### **10.1 Design Requirements**

Pavement designs shall incorporate criteria and procedures as specified in the CDOT *Pavement Design Manual*, unless otherwise specified. Flexible pavements shall be designed for a 20-year design life; rigid pavements shall be designed for a 30-year design life. All pavement designs shall utilize a base year of 2015 and a reliability of 95%. Flexible pavement designs shall be rounded up to the nearest .5-inch. Rigid pavement designs shall incorporate an extra .25-inch to accommodate future grinding and be rounded up to the nearest .5-inch.

Any pavement design conducted by the Concessionaire shall follow the requirements set forth in the 2012 CDOT *Pavement Design Manual*. Flexible pavement designs shall use the AASHTOWare DARWin pavement design program. The binder required shall be determined using LTPPBind and location-specific climate data assuming 98% reliability and slow conditions. Rigid pavement design shall follow the AASHTO *Guide for Design of Pavement Structures, 4<sup>th</sup> Edition with 1998 Supplement*. All rigid designs must pass both the faulting and corner break checks, regardless of whether it is doweled or not, using location-specific climate data. The Concessionaire shall submit pavement designs to HPTE for Approval at the Pre-paving Conference.

Mechanistic empirical methodology shall not be used for design of any permanent pavement.

The Concessionaire shall document and submit all traffic counts / calculations used to arrive at the Average Daily Traffic (ADT) and 18-kip Equivalent Single Axle Loads (ESAL) used. Construction of paved surfaces shall not commence until the pavement design has been reviewed and Approved by HPTE.

#### **10.1.1 Subsurface Investigations**

Geotechnical investigations conducted on US 36 are provided in the Reference Documents. The Concessionaire shall be responsible for any subsurface investigation necessary to complete the Work. Geotechnical investigations shall comply with the requirements of the 2012 CDOT *Field Materials Manual* and the 2012 CDOT *Pavement Design Manual*.

Geotechnical investigations for local roadways as defined in Section 10.1.2.2, below, shall conform to Local Agency requirements.

All investigations made by the Concessionaire shall be documented in a geotechnical investigation report and submitted to HPTE for Acceptance within 30 Working Days following completion of the field work, and with or prior to design submittals which utilize information and recommendations from the subsurface investigation. All investigations made by the Concessionaire for non-CDOT roadways shall be documented in separate geotechnical investigation reports according to the entity having jurisdiction of the road and submitted to HPTE for Acceptance.

#### **10.1.2 Roadway Pavement Analysis and Design**

##### **10.1.2.1 Mainline US 36**

Mainline US 36 shall be constructed in Portland Cement Concrete Pavement (PCCP). Full-depth rigid pavement designs for mainline US 36 are provided below.

The Portland Cement Concrete Pavement (PCCP) design consists of a designed thickness of PCCP (with load transfer devices and tied shoulders) over 6 inches of Aggregate Base Course Class 6 (ABC Class 6) and underlain by at least 24 inches of material with an R-value greater than or equal to 20.

<b>Roadway Segment</b>	<b>30-year Rigid Average 18-kip ESALs</b>	<b>Rigid Pavement Thickness (inch)</b>
US 36, Foothills Parkway to McCaslin Blvd.	11,338,873	10.5
US 36, McCaslin Blvd. to 88 <sup>th</sup> Street	13,074,879	10.5

**10.1.2.2 Non-CDOT Roadways Pavement Designs**

Pavement designs and sections for local roadways shall conform to Local Agency requirements, as follows:

1. City of Louisville: Marshall Drive, McCaslin Boulevard, and other affected roadways maintained by Local Agency

<b>Roadway Segment</b>	<b>Surface Type</b>	<b>Existing Daily Volume</b>	<b>2035 Daily Volume</b>	<b>Design Period ESALs</b>
McCaslin Blvd	Flexible	42,200	72,100	13,375,790
	Rigid			18,875,610
EB McCaslin Off Ramp	Flexible	8,900	15,500	2,855,030
	Rigid			4,028,870
EB McCaslin On Ramp	Flexible	8,600	31,200	4,657,400
	Rigid			6,571,460
WB McCaslin Off Ramp	Flexible	12,300	20,100	3,791,620
	Rigid			5,350,170
WB McCaslin On Ramp	Flexible	9,000	11,700	2,422,870
	Rigid			3,418,590

**10.2 Construction Requirements**

The Concessionaire shall construct the PCCP, SMA, HMA, and all other paved surfaces in accordance with the requirements of the Contract Documents. Construction of Concessionaire-designed permanent paved surfaces shall not commence until the pavement design has been Approved by HPTE.

The Concessionaire shall be responsible for constructing Safety Edge as specified in Schedule 5, Section 13.3.6.

To provide for adequate sulfate resistance in all concrete supplied, Severity of Potential Exposure shall be Class 2. The Concessionaire may, at their expense, have a certified laboratory test the subgrade as per the CDOT *Field Materials Manual*. Testing shall be at the same schedule and frequency as required for a preliminary soil survey. The Concessionaire may propose a different Class of Exposure based on the test results.

### **10.2.1 Roadway Pavement Construction Requirements**

A minimum of two weeks prior to the proposed use of any pavement on the Phase 2 Construction Work, a Pre-paving Conference shall be conducted. At the Pre-paving Conference, the Concessionaire shall present to HPTE for Approval Mix Designs for SMA, HMA, and PCCP, as well as jointing plans for PCCP.

### **10.2.2 Roadway Pavement Types and Thickness Requirements**

#### **10.2.2.1 Hot Mix Asphalt Pavement**

HMA mixes shall be subject to voids acceptance.

#### **10.2.2.2 Portland Cement Concrete Pavement**

PCCP shall be required for the entire US 36 mainline length and width of the proposed reconstruction limits as shown in the Basic Configuration, unless otherwise noted. The required PCCP pavement shall extend to the limit of the physical gore on ramps.

The Concessionaire shall be responsible for PCCP joint design. The Concessionaire's joint design shall include tied inside and outside shoulders. Outside mainline US 36 shoulders shall include transverse load transfer devices (DC joints). PCCP joint design shall comply with the requirements of Schedule 5A, including but not limited to the CDOT *M & S Standard Plans*, and the CDOT *Pavement Design Manual*. The PCCP longitudinal and transverse joint designs shall be compatible with lane and shoulder configurations. The Concessionaire shall submit the pavement joint design to HPTE for Approval at the Pre-paving Conference and at least 14 Days prior to PCCP construction. PCCP construction shall not commence until the PCCP jointing plan is Approved.

The Concessionaire shall tie mainline US 36 outside shoulders per CDOT standards. Final stamping stationing is not required.

#### **10.2.2.3 Stone Matrix Asphalt Pavement**

Full-width SMA shall be utilized as the top lift of all proposed flexible pavement and on structures, deck rehabilitations, unless otherwise Approved by HPTE. SMA shall utilize PG 76-28.

#### **10.2.2.4 Pavement Smoothness**

The Concessionaire shall construct the PCCP/flexible pavement for the Phase 2 Construction Work to the smoothness requirements as set forth in Table 10.2.

<b>Table 10.2 SMOOTHNESS REQUIREMENTS</b>	
<b>Location</b>	<b>Pavement Smoothness Category<sup>(ii)</sup></b>
Flexible Pavement	HRI Category II
Rigid Pavement	Category II
Proposed Structure	N/A
Overlay	HRI Urban Construction %I
Detour	(i)

Notes:

- (i) Refer to Schedule 5, Section 10.2.3.9, (Detour).
- (ii) The pavement smoothness for flexible pavement shall be HRI Category II, while the pavement smoothness for rigid pavement shall be Category II. Intersections constructed with PCCP are exempt from pavement smoothness requirements, except all 10-foot straightedge requirements shall be met for both longitudinal and transverse smoothness.

### 10.3 Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications.

#### 10.3.1 Plant Mix Pavement Compaction (Pneumatic Tire Rollers)

Section 401 of the Standard Specifications is hereby revised for this Project as follows:

In Subsection 401.17, first paragraph, delete the second sentence and replace with the following:

Both steel wheel and pneumatic tire rollers shall be required on this Project. If the Concessionaire can demonstrate to HPTE that all of the manufacturer's recommendations were followed and the pneumatic tire roller is detrimental to the finished surface of the HMA, the Concessionaire may request HPTE to waive the pneumatic tire roller requirement. Pneumatic tire rollers shall not be used on SMA pavement. Steel wheel rollers shall not be used in vibratory mode when compacting SMA on bridge decks.

#### 10.3.2 Conformity to the Contract of Hot Mix Asphalt

"Revision of Section 106 – Hot Mix Asphalt – Verification Testing" attached in Exhibit A to Schedule 5, Section 20, is hereby revised for this Project as follows:

Subsection 106.05 shall include the following:

Concessionaire is required to perform process control testing of HMA.

#### 10.3.3 Quality of Hot Mix Asphalt

Section 106 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 106.03 shall include the following:

Concessionaire is required to perform process control testing.

#### 10.3.4 Aggregate Base Course Class 6

Section 304 of the Standard Specifications is hereby revised for this Project as follows:



Subsection 304.02 shall include the following:

Materials for the base course shall be ABC Class 6 as shown in Subsection 703.03.

The ABC Class 6 must meet the gradation requirements and have a resistance value of at least 78 when tested by the Hveem Stabilometer method.

**10.3.5 Aggregate Base Course Class 6 Special**

Section 304 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 304.02 shall include the following:

Recycled Asphalt Pavement (RAP), the product of rotomill tailings or crushed asphalt pavement, utilized as ABC Class 6 (Special), shall be of uniform quality. The ABC Class 6 Special shall meet the gradation requirements for ABC (RAP) as specified in Section 20 (Revision of Sections 304 and 703). The material shall not contain clay balls, vegetable matter, or other deleterious substances. RAP is not required to meet the requirements of Subsection 703.03. ABC Class 6 Special shall only be allowed under PCCP.

Subsection 304.04 shall include the following:

The maximum density of RAP shall be determined in accordance with AASHTO T-180, Method A. The field moisture determination for correction to dry density shall be determined by oven or microwave drying. Moisture determination of RAP using a nuclear gauge will not be permitted.

**10.3.6 Hot Mix Asphalt Compaction (Steel Wheel Roller)**

Section 401 of the Standard Specifications is hereby revised for this Project as follows:

In Subsection 401.17, first paragraph, delete the second sentence and replace with the following:

Steel wheel rollers will be required on this Project.

**10.3.7 Hot Mix Asphalt**

Section 403 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 403.02 shall include the following:

The design mix for HMA shall conform to the following:

Table 403-1					
Property	Test Method	Value For Grading			
		S (100 )	SX (100)		Patching
Air Voids, percent at:					
N (initial) [for information only]	CPL 5115				
N (design)		3.5 – 4.5	3.5 – 4.5		3.5 – 4.5
Lab Compaction (Revolutions):					
N (initial) [for information only]	CPL 5115	8	8		8
N (design)		100	100		100

**Table 403-1**

Property	Test Method	Value For Grading			
Stability, minimum	CPL 5106	30	30		30
Aggregate Retained on the 4.75 mm (No. 4) Sieve with at least 2 Mechanically Induced fractured faces, % minimum	CP 45	70	70		70
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman), minimum	CPL 5109 Method B	80	80		80
Minimum Dry Split Tensile Strength, kPa (psi)	CPL 5109 Method B	205 (30)	205 (30)		205 (30)
Grade of Asphalt Cement, Top Layer			PG 76-28		PG 76-28
Grade of Asphalt Cement, Layers below Top		PG 64-22			PG 64-22
Voids in the Mineral Aggregate (VMA) % minimum	CP 48	See Table 403-2	See Table 403-2		See Table 403-2
Voids Filled with Asphalt (VFA), %	AI MS-2	65-75	65-75		65-75
Dust to Asphalt Ratio Fine Gradation Coarse Gradation	CP 50	0.6 – 1.2 0.8 – 1.6	0.6 – 1.2 0.8 – 1.6		0.6 – 1.2 0.8 – 1.6

Notes:

- AI MS-2 = Asphalt Institute Manual Series 2.
- The current version of CPL 5115 is available from CDOT.
- Mixes with gradations having less than 40% passing the 4.75 mm (No. 4) sieve shall be approached with caution because of constructability problems.
- Gradations for mixes with a nominal maximum aggregate size of one-inch or larger are considered a coarse gradation if they pass below the maximum density line at the #4 screen.  
Gradations for mixes with a nominal maximum aggregate size of ¾ inch or smaller are considered a coarse gradation if they pass below the maximum density line at the #8 screen.

All Mix Designs shall be run with a gyratory compaction angle of 1.25 degrees and properties must satisfy Table 403-1. Form 43 will establish construction targets for Asphalt Cement and all mix properties at Air Voids up to 1.0% below the Mix Design optimum.

<b>Table 403-2</b>			
<b>Minimum Voids in the Mineral Aggregate (VMA)</b>			
<b>Nominal Maximum Size*, mm (inches)</b>	<b>***Design Air Voids **</b>		
	<b>3.5%</b>	<b>4.0%</b>	<b>4.5%</b>
37.5 (1½)	11.6	11.7	11.8
25.0 (1)	12.6	12.7	12.8
19.0 (¾)	13.6	13.7	13.8
12.5 (½)	14.6	14.7	14.8
9.5 (¾)	15.6	15.7	15.8
<p>* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%.</p> <p>** Interpolate specified VMA values for design air voids between those listed.</p> <p>*** Extrapolate specified VMA values for production air voids beyond those listed.</p>			

As a part of the Concessionaire's Quality Management Plan, the Concessionaire shall outline the steps taken to minimize segregation of HMA. The Quality Management Plan shall define a process by which the Concessionaire shall address unacceptable segregation, but, at a minimum, the paving shall stop and the cause of segregation shall be corrected before paving operations will be allowed to resume.

HMA for patching shall conform to the gradation requirements for SMA for the top lift and HMA (Grading S) (100) (PG 64-22) for intermediate and lower lifts. All patching determinations shall be the responsibility of the Concessionaire with consultation with HPTE.

A minimum of 1% hydrated lime by weight of the combined aggregate shall be added to the aggregate for all HMA.

Subsection 403.03 shall include the following:

If liquid anti-stripping additive is added at the plant, an approved in-line blender must be used. The blender shall be in the line from the storage tank to the drier drum or pugmill. The blender shall apply sufficient mixing action to thoroughly mix the asphalt cement and anti-stripping additive.

The Concessionaire shall construct the Work such that all roadway pavement placed prior to the time paving operations end for the year, shall be completed to the full thickness required by the plans. The Concessionaire's Monthly Progress Schedule shall show the methods to be used to comply with this requirement.

### **10.3.8 Stone Matrix Asphalt Pavement**

Sections 401 and 703 of the Standard Specifications are hereby revised for this Project as follows:

Subsection 401.02 shall include the following:

Recycled Asphalt Pavement (RAP) shall not be used in Stone Matrix Asphalt (SMA) mix.

Subsection 401.09 shall include the following:

Each SMA load shall be completely covered and securely fastened with a full tarp.

Subsection 401.16 shall include the following:

The SMA mixture shall be transported and placed on the roadway without drain-down or flushing. All flushed areas behind the paver shall be removed immediately upon discovery. If more than 50 square feet of flushed SMA pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the flushing has been found and corrected. The Engineer shall designate the depth and area of all flushed areas requiring removal and replacement. All costs associated with the removal and replacement of the flushed areas shall be at the Concessionaire's expense.

Subsection 401.17 shall include the following:

Rollers shall not be used in a vibratory mode on SMA unless they are first used successfully in the demonstration control strip specified in subsection 403.03. Pneumatic wheel rollers shall not be used on SMA mix.

Stone Matrix Asphalt Pavement shall be placed and compacted in accordance with the temperatures listed in subsection 401.07 as revised for this Project.

The relative compaction for all SMA mixtures will be measured from roadway cores in accordance with CP 44, Method B, unless the SMA mixture is being placed on a structure (bridge deck) in which case the Engineer may specify that nuclear gauge measurements be used.

When cores are used, the Concessionaire shall provide all labor and equipment for the coring operation and filling the core holes. When nuclear density gauges are used, the tests will be performed in accordance with CP 81 and CP 82.

In-place density for SMA shall be 93 to 97% of the SMA mix maximum specific gravity as measured according to CP 51.

Subsection 401.22 shall include the following:

Acceptance, testing, and pay factors for SMA shall be in accordance with subsections 105.05 and 106.05 as revised for this Project for HMA. The specifications for gradation acceptance shall be applied for all SMA placed on the project.

Subsection 703.06 shall include the following:

Mineral filler for the Stone Matrix Asphalt pavement shall be limestone dust and shall meet the requirements of this subsection and the following:

Plasticity Index (AASHTO T90) 4% Maximum

The Concessionaire shall submit hydrometer analysis (AASHTO T88) for the mineral filler used in the SMA mix.

Section 403 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 403.01 shall include the following:

This work includes placing a Stone Matrix Asphalt (SMA) pavement as shown on the plans.

Subsection 403.02 shall include the following:

The SMA gradation for this Project shall be ½ inch.

Mixture design and field control testing of SMA shall be performed using either the

SuperPave (CPL 5115, 100 Gyration) or the Marshall Method (AASHTO T245, 50 Blow).

The Concessionaire shall submit a Mix Design meeting the appropriate specification requirements for the following to HPTE at the Pre-paving Conference:

The SuperPave SMA Mix Design shall conform to the requirements of Table 403-1a:

Table 403-1a		
Property	Test Method	Value for SMA
Air Voids, percent at: N(Design)	CPL 5115	3.0 – 4.0
Lab compaction (Revolutions)	CPL 5115	100
N(Design)		
Accelerated Moisture Susceptibility, tensile strength	CPL 5109, Method B	70
Ratio, (Lottman), minimum		
Minimum Dry Split Tensile Strength, psi	CPL 5109, Method B	30
Grade of Asphalt Cement		PG 76-28
Voids in the Mineral Aggregate (VMA) %, minimum	CP 48	17
Draindown at Production Temperature	AASHTO T305	0.3 maximum
% VCA <sup>1</sup> <sub>MIX</sub>	AASHTO R 46	Less than VCA <sub>DRC</sub> <sup>2</sup>

Note: The current version of CPL 5115 is available from CDOT  
 Note: Copies of AASHTO R 46 and M 325 can be obtained from CDOT  
 Note: <sup>1</sup>Voids in the Coarse Aggregate  
 Note: <sup>2</sup>Dry-rodged condition

Form 43 will establish construction targets for asphalt cement and all mix properties at air voids up to 1.0% below the Mix Design optimum.

The Marshall SMA Mix Design shall conform to the following:

Mix Properties	Value
Stability, Marshall Compactor	1400 lbs., min
% Voids in Total Mix	3 – 4%
VMA (% Voids in the Mineral Aggregate)	17 min.
Lottman, CPL 5109, Method B	70% min
Dry Tensile Strength, (CPL 5109)	30 psi, min.

Regardless of Mix Design method, a minimum of 1% hydrated lime by weight of the combined aggregate shall be added to the aggregate for all Stone Matrix Asphalt.

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The SMA Mix Design must be Approved by HPTE before any pavement is placed on the project. In addition, the Concessionaire shall provide field control testing during

production of the SMA mix and for the demonstration control strip. The Concessionaire shall perform the following tests and provide the results to HPTE during production:

If a SuperPave SMA Mix Design is used, the Concessionaire shall perform the following tests and provide the results to the Engineer during production:

Superpave Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Percent Voids in the total mix @ $N_{(design)}$	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate) @ $N_{(design)}$	1/1000 tons or fraction thereof
Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

If a Marshall SMA Mix Design is used, the Concessionaire shall perform the following tests and provide the results to the Engineer during production:

Marshall Mix Property	Frequency
Draindown (AASHTO T 305)	1/1000 tons or fraction thereof
Stability (Marshall)	1/1000 tons or fraction thereof
Percent Voids in the total mix	1/1000 tons or fraction thereof
VMA (Percent Voids in the Mineral Aggregate)	1/1000 tons or fraction thereof
Lottman, CPL 5109, Method B	1/5000 tons or fraction thereof
Dry Tensile Strength, CPL 5109	1/5000 tons or fraction thereof
Percent AC & Aggregate Gradation CP 5120	1/1000 tons or fraction thereof

Subsection 403.03 shall include the following:

The mineral filler for SMA shall be stored in a separate silo and added automatically in the correct proportion. The mineral filler addition equipment shall be electronically or mechanically interlocked to the aggregate feed sensors so that the proper amount of mineral filler is added whenever SMA is produced.

The SMA mineral filler shall be added at the same point the asphalt cement is added to the aggregate.

Tack coat between the existing pavement and Stone Matrix Asphalt pavement shall be placed at a rate between 0.03 and 0.05 gallons per square yard.

Before proceeding with SMA placement, the Concessionaire shall demonstrate the ability to produce and place a satisfactory mix in a Demonstration Control Strip (DCS). The Concessionaire will coordinate with the Quality Manager on the proposed location of the DCS. The DCS shall consist of a minimum quantity of 500 tons placed in one lane, full width. Within the last 200 tons of SMA placed in the DCS, the Concessionaire and

HPTE shall determine properties (VMA, Voids, in-place density, AC content, gradation, and Marshall Stability, if required) of the project produced SMA mix used in the DCS and provide the results to the Concessionaire's Quality Manager. The Concessionaire may proceed with full production if all mixture properties are within the specified tolerances.

To determine the in-place density and roller pattern, one core shall be taken at three random locations within the last 200 tons of the DCS. As part of the Concessionaire's QMP, the coring locations shall be determined using a stratified random sampling process. The cores shall be immediately submitted to the Concessionaire's Quality Manager and will be used for determining acceptance of the DCS. Densities of the random samples will be determined by cores according to CP 44. Coring shall be performed by the Concessionaire under the Quality Manager's observation.

The DCS will be designated as a separate process.

Subsection 403.04 shall include the following:

Stone Matrix Asphalt will be measured by the actual number of tons that are completed and accepted.

Subsection 403.05 shall include the following:

Mix design, furnishing, hauling, preparing, and placing all materials, including aggregates, asphalt cement, limestone dust, hydrated lime, tack coat, and approved demonstration control strip; labor, equipment tools, setting of lines and guides where specified, and all other work necessary to complete the item will not be paid for separately but shall be included in the work.

Stone Matrix Asphalt will be measured by the actual number of tons that are completed and accepted.

### **10.3.9 Detour**

Section 621 is hereby added to the Standard Specifications for this Project and shall include the following:

621.01 This work consists of constructing detours for all phases of construction on US 36 and all applicable side streets; maintenance of the detours; removal of the detours; and removal and replacement of appurtenances required to construct and operate the detours including but not limited to guardrail, curb and gutter, detour pavement, embankment material and unclassified excavations.

621.02 All materials required for detour shall comply with project standard specifications and special provisions.

The Concessionaire shall be responsible for quality control required to assure adequate quality of embankment material, aggregate base course, HMA used in the construction of the detour.

621.03 The detour locations and dimensions for all phases of construction shall be as shown on the plans.

If the materials and thickness furnished for the detour pavement result in an inadequate detour structure, the Concessionaire will provide additional thickness, materials, or other measures necessary to provide a satisfactory pavement for the life of the detour. These additional improvements shall be furnished at no additional cost. All necessary signs, pavement markings and other traffic control devices shall be provided in accordance with the traffic control plan.

621.04 The Concessionaire shall maintain the detour for the entire period that it is open to

traffic. Any distress that affects the ride, safety, or serviceability of the detour roadway shall be corrected to the satisfaction of the HPTE at the expense of the Concessionaire.

The Concessionaire shall have a maintenance plan for all hours of the day (7 days a week) for executing a long term patch of damaged detour pavement, and have forces available to perform this work within 2 hours of notice of such damage. The Concessionaire shall designate a person to be “on call” during all non-working hours, including no work periods as a point of contact for this work.

If HPTE determines the detour has deteriorated to the point where the safety of the traveling public is compromised (i.e. potholes), the lane(s) in question shall be closed and the Concessionaire shall be directed to execute their maintenance plan. If the Concessionaire is unresponsive to this order by HPTE, CDOT maintenance forces will be mobilized to close the lane and maintain the closure until such time as the Concessionaire is available to perform this work. CDOT Maintenance forces will be responsible for the lane closure only, and only until such time as the Concessionaire arrives on site and relieves them. CDOT Maintenance will not be responsible for repair of any of the contract installed detour. All time and expense for CDOT Maintenance work will be tracked by HPTE and deducted from money due to the Concessionaire. Any lane closures that are required outside of the allowable lane closure hours will be charged as 'working time violation' as established in this contract.

### 10.4 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Supplemental geotechnical investigation report	Acceptance	Within 30 Working Days following completion of field work
Pavement Design Report	Approval	Submitted with Preliminary Design Packages
Paving Quality Control Plan	(None)	Prior to beginning paving operations
SMA Mix Design	Approval	At the Pre-paving Conference and at least 14 Days prior to the use of any SMA pavement on the Project
HMA Mix Designs	Approval	At the Pre-paving Conference and at least 14 Days prior to the use of any HMA pavement on the Project
Detour pavement design	Acceptance	At the Pre-paving Conference and at least 14 Days prior to the use of any Detour Pavement on the Project
PCCP jointing plan	Approval	At the Pre-paving Conference and at least 14 Days prior to the use of any PCCP on the Project
PCCP Mix Designs	Approval	At the Pre-paving Conference and at least 14 Days prior to the use of any PCCP on the Project

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management).



## 11.0 EARTHWORK

### 11.1 Construction Requirements

#### 11.1.1 Clearing and Grubbing

The trees, logs, limbs, stumps, brush, trash, etc., cleared and grubbed from the Phase 2 Construction Work shall be removed from the Site to an off-Site location by the Concessionaire.

Concessionaire shall conduct a pre-clear and grub meeting with HPTE prior to the start of any clearing and grubbing. The purpose of the meeting will be to mutually agree upon the limits of clearing and grubbing, removal, replacement, or transplanting of any trees and shrubs.

#### 11.1.2 Excavations and Embankments

##### 11.1.2.1. Material Requirements

Placement of embankment material with a resistance value (R-value) of less than 10 when tested by the Hveem Stabilometer shall be restricted to locations beyond the Ultimate Configuration pavement prism (defined as a 1:1 slope down and to the outside from bottom of 24 inch R-value 20 zone at Ultimate Configuration pavement edge). All compaction shall be per Section 203 of the Standard Specifications.

##### 11.1.2.1.1 Mainline and Ramps

Flexible and rigid pavement alternatives defined in Schedule 5, Section 10, (Geotechnical, Roadway Pavements and Structure Foundations), shall be underlain by 6 inches of Aggregate Base Course (ABC) Class 6 and 2 feet of minimum R-value 20 Material. Soil in the zone 1 foot beneath the R-value 20 Material shall be treated per Section 203 of the Standard Specifications.

The mainline US 36 designs require that the soil shall have a percent swell less than or equal to 1 to a depth of 3 feet below the bottom of the proposed ABC Class 6. A percent swell less than or equal to 1 corresponds to a low probable swell damage risk.

The minimum horizontal limits for the ABC Class 6, 24 inches of minimum R-value 20 Material, and the required subgrade treatment shall be the outer limits of the pavement structure, plus two feet on each side. At locations with unprotected side slopes, the ABC Class 6, 24 inches of minimum R-value 20 material, and the subgrade treatment shall be extended to the side slope. In areas with curb and gutter, this should extend for a minimum distance of 12 inches beyond the back face of the curb or to the edge of slope in areas with unprotected side slopes as shown in the Chapter 4 of the CDOT *Design Guide*.

The Concessionaire shall utilize the provided soils information and, if necessary, conduct a Soil Survey to ascertain whether the existing soil satisfies the above conditions. This Soil Survey shall conform to the requirements as stated in the 2012 CDOT *Field Materials Manual*. Test holes are required at least every 1,000 feet.

Swell tests are required to verify the percent swell of the existing soil is less than or equal to 1 percent. If the swell index is greater than 1 percent, mitigation is required to a minimum depth of three feet below the base of the proposed ABC Class 6. The Concessionaire shall demonstrate that any proposed mitigation measures will result in a percent swell less than or equal to 1 percent when tested with a 200 psf surcharge.

The results of the Soil Survey along with any proposed mitigation measures shall be submitted to HPTE for Approval before any pavement and pavement-related work commences. The above

information shall be submitted in a report format that clearly and concisely describes the existing soil conditions, delineates areas needing mitigation, and defines the mitigation measures. The report shall include a soil profile, boring log, and the test results.

All Work shall be conducted per the 2012 CDOT *Pavement Design Manual* and the 2012 CDOT *Field Materials Manual*.

Alternative subgrade treatment shall be submitted to HPTE for Approval prior to incorporation into the Work. The Concessionaire shall provide locations where any alternative subgrade treatments are utilized on the Phase 2 Construction Project in the As-Built Documents.

#### **11.1.2.1.2 Local Streets**

The subgrade shall meet the minimum resistance values (R-value, k-value, classification) as specified by the Local Agency.

#### **11.1.2.1.3 Bikeway**

The Bikeway defined in Schedule 5, Section 13, Roadways, shall be underlain by 6 inches of ABC Class 6 and 1 foot of minimum R-value 20 material. Subgrade beneath the R-value 20 Material shall be reconditioned per Section 206 of the CDOT Standards, except the reconditioned thickness shall be a minimum of 1 foot. The ABC Class 6 / minimum R-value 20 material, and the subgrade reconditioning shall extend 1 foot to either side of the bikeway width.

#### **11.1.2.2 Compaction Requirements**

The type of compaction shall be per CDOT Standards Depth of moisture-density control as follows:

1. Full depth of all embankments
2. 6 inches for bases of cuts and fills unless otherwise specified.
3. 12 inches underneath the proposed pavement section (pavement/base course/min R-value 20 soil).

#### **11.1.2.3 Reuse of Materials**

Per Section 203 of the Standard Specifications, the Concessionaire shall be allowed to use broken concrete or broken asphalt or asphalt millings as embankment Material as Accepted by HPTE.

Any asphalt millings substituted for ABC Class 6 shall meet the grading requirements of ABC Class 6 Special. The ABC Class 6 Special may be substituted for ABC Class 6 with Approval of HPTE.

The existing subgrade will be allowed to remain in-place with the Approval of HPTE if it meets the requirements listed previously.

#### **11.1.2.4 Geotextiles**

Geotextiles shall meet the requirements for Geotextile Class I (Per AASHTO M 288) and be approved for stabilization and separation applications. The geotextile shall be selected from the New York State Department of Transportation list of approved products available at:

<https://www.nysdot.gov/divisions/engineering/technical-services/technical-services-repository/alme/pages/470-1a.html>.

Locations requiring geotextile installation shall be as directed by the Engineer and Approved by HPTE. Where geotextile installation is required, in-situ soil shall be reconditioned per Section 206 of the CDOT Standards, except the reconditioned thickness shall be a minimum of 1 foot. . Reconditioning shall not be paid for separately but shall be included in the cost of the Work.

The geotextile shall be installed per manufacturer's recommendations.

## 11.2 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
Soil Survey mitigation measures	Approval	Before any pavement and pavement-related Work commences
Alternative subgrade treatment	Approval	Prior to incorporation into the Work
Use of broken concrete or broken asphalt or asphalt millings	Approval	Prior to reuse of Materials
Existing subgrade allowed to remain in place	Approval	Before any pavement and pavement-related Work commences

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management).

## 12.0 DRAINAGE AND HYDROLOGY

The Phase 2 Construction Work shall include all Work for the modification of existing drainage facilities, construction of new drainage facilities, and construction of permanent stormwater quality facilities (PSQF) required to accommodate design flows, meet Project design criteria, and comply with the terms and conditions of the CDOT Municipal Separate Storm Sewer System (MS4) Permit and Sections 101, 107, and 208 of the Standard Specifications.

A Master Plan Drainage Report and a Master Plan Water Quality Report are included in the Reference Documents.

The Concessionaire shall design and construct a complete storm drainage system to intercept and remove surface runoff from the highway and local streets, and maintain surface, channel, and conduit flow through the Right-of-Way. The Concessionaire shall utilize the Master Plan Drainage Report as the basis for the storm drainage system, and the Master Plan Water Quality Report as the basis for water quality along the corridor. The Concessionaire shall also design and construct the storm drainage facilities to limit drainage-related hazards within and outside the ROW, while minimizing future operation and maintenance costs, public inconvenience, flood damages, and water quality impacts during construction.

The materials included in the Reference Documents provide information regarding drainage concepts and permanent detention and water quality features.

All existing Cross Drains, storm drains, and drainage appurtenances to be abandoned shall be removed in their entirety. However, existing Cross Drains, storm drains, and drainage appurtenances to be abandoned may be plugged and filled with flow-fill in accordance with Section 202 of the Standard Specifications if Accepted by HPTE.

Where the hydraulic capacity or existing condition of drainage facilities upstream or downstream of the Phase 2 Construction Work are inadequate, the drainage facilities of the Phase 2 Construction Work shall be constructed to meet Project design criteria. Flow-restriction devices shall be constructed to limit discharges to existing conditions.

The Concessionaire shall obtain approval from affected Local Agencies for any proposed on-Site drainage improvements that are connected to existing storm drains, upstream or downstream of the Phase 2 Construction Work.

The Concessionaire shall design drainage facilities to be compatible with existing or planned drainage systems on adjacent properties, and shall maintain existing drainage patterns. If the Concessionaire proposes that existing drainage patterns must be changed, the Concessionaire shall design a solution that does not adversely impact property owners outside the ROW; shall obtain Approval from HPTE prior to construction; and shall secure all other necessary approvals, permits, and easements.

### 12.0.1 Standards

The Concessionaire shall design and construct the drainage systems in accordance with the requirements of the standards listed in Table 12.0-1.

<b>Table 12.0-1 STANDARDS FOR DRAINAGE</b>	
<b>Author or Agency</b>	<b>Title</b>
CDOT	<u>Schedule 5 Section 20</u> , (Exhibit A - Standard Special Provisions)
CDOT	<u>Standard Specifications</u>
CDOT	Standard Plans, M & S Standards
CDOT	Drainage Design Manual
UDFCD	Urban Storm Drainage Criteria Manual, Volumes I, II, and III

### 12.0.2 Design Guidelines

The Concessionaire shall design and construct the drainage systems in accordance with the guidelines listed in Table 12.0-2.

<b>TABLE 12.0-2 DESIGN GUIDELINES FOR DRAINAGE</b>	
<b>Author or Agency</b>	<b>Title</b>
AASHTO	<i>A Policy on Geometric Design of Highways and Streets</i>
FHWA	<i>Hydraulic Design of Energy Dissipaters for Culverts and Channels, HEC-14</i>
FHWA	<i>Evaluating Scour At Bridges, HEC-18</i>
FHWA	<i>Stream Stability at Highway Structures, HEC-20</i>
FHWA	<i>Urban Drainage Design Manual, HEC-22</i>
FHWA	<i>Drainage of Highway Pavements, HEC-12</i>
FHWA	<i>Bridge Scour and Stream Instability Countermeasures, HEC-23</i>
FHWA	<i>Design of Roadside Channels with Flexible Linings, HEC-15</i>
FHWA	<i>Design of Riprap Revetment, HEC-11</i>
FHWA	<i>Design of Roadside Channels with Flexible Linings, HEC-15</i>
FHWA	<i>Hydraulic Design of Improved Inlets for Culverts, HEC-13</i>
FHWA	<i>Design of Bridge Deck Drainage, HEC-21</i>
FHWA	<i>Hydraulic Design of Highway Culverts, HDS-5</i>
CDOT	<i>Erosion Control and Stormwater Quality Guide</i>
CDOT	<i>Water Quality Guidance for Consultants</i>

## **12.1 Administrative Requirements**

### **12.1.1 Coordination with Other Agencies and Disciplines**

The Concessionaire shall coordinate all drainage related issues with affected regulatory agencies where appropriate. The Concessionaire shall include HPTE in all contacts with appropriate regulatory agencies.

### **12.1.2 Permits**

The Concessionaire shall be cognizant of and adhere to the requirements of the various environmental and stormwater permits that are necessary for construction and operation of the Phase 2 Construction Work. The Concessionaire shall follow the requirements of the latest Stormwater Management Plan (SWMP) template and appropriate specifications. The Concessionaire shall be responsible for complying with CDOT's MS4 Permit and Stormwater Consent Order #SC-081023-1 (Consent Order). The Concessionaire shall obtain all permits, unless otherwise indicated. The listing herein is not all-inclusive and it shall be the responsibility of the Concessionaire to determine all of the permits required to perform the Work. Because CDOT is the landowner, CDOT is partially liable for any Concessionaire negligence. Fines may be incurred upon the Phase 2 Construction Work for permit non-compliance by CDOT or other regulatory agencies. Any non-compliance fines will be passed onto the Concessionaire.

#### **12.1.2.1 Colorado Discharge Permit System, Stormwater Construction Permit (CDPS-SCP)**

Concessionaire shall obtain required permits prior to the start of any construction activities. Construction cannot begin until these items have been Accepted by HPTE. The Concessionaire shall comply with Sections 101, 107 and 208 of the Standard Specifications

The Concessionaire shall obtain a CDPS-SCP from the Colorado Department of Public Health and Environment (CDPHE) for construction of the Phase 2 Construction Work prior to Work commencing. The CDPS-SCP shall be in the Concessionaire's name. The Concessionaire shall adhere to all requirements of the CDPS-SCP and the Construction Section of CDOT's MS4 Permit and the Consent Order. Most, but not all, non-compliance issues and necessary Best Management Practices (BMP) maintenance will be noted during Consent Order monthly inspections by CDOT, CDOT Regional Erosion Control Advisory Team (RECAT) inspections, in the 1176 inspection forms by the Erosion Control Supervisor (ECS), or in the daily stormwater log, as required by the Consent Order. The Concessionaire shall prevent the discharge of any sediment or pollutants into any storm drains or receiving waters during the life of the CDPS-SCP.

##### **12.1.2.1.1 Storm Water Management Plan**

The SWMP work shall include the CDOT SWMP template and a SWMP Site Map that documents the detailed erosion/sediment control BMPs and their locations. The Concessionaire shall submit a SWMP and SWMP Site Map for Acceptance by HPTE. The Concessionaire shall submit a SWMP and SWMP Site Map for Acceptance by the Local Agency for work outside CDOT ROW. The Concessionaire shall fill out the current CDOT SWMP template, including BMP narratives. The SWMP shall clearly describe the relationship between the phases of construction and the implementation and maintenance of the stormwater management controls. Any major modifications (i.e., change modification orders or minor changes revisions) to the

CDOT SWMP template shall be submitted to HPTE for Acceptance prior to implementation of the modification. The Concessionaire shall revise the SWMP Site Map as necessary based on actual construction activities throughout the duration of the CDPS-SCP.

All documents pertaining to the CDPS-SCP shall be kept in the CDOT Stormwater Management Plan (SWMP) Notebook (provided by CDOT) to maintain compliance with the SCP. Upon permit inactivation, the SWMP Notebook shall be turned over to HPTE and become the property of HPTE Project files.

#### **12.1.2.1.2 Best Management Practices**

The Concessionaire shall install and maintain the construction BMPs for the Phase 2 Construction Work in accordance with the CDOT *Erosion Control and Stormwater Quality Guide* and Sections 101, 107, and 208 of the Standard Specifications. Construction BMPs for the Phase 2 Construction Work shall include, but are not limited to, those listed in the Standard Specifications, as well as, preservation of existing vegetation, surface roughening, tackifier or soil binder, soil retention coverings, temporary clean water diversions, storm drain and basins, protection of trees, hazardous waste and spill containment and saw water disposal, stabilized construction entrances, and pavement sweeping of the affected areas. The Concessionaire shall add a BMP narrative to the SWMP on how it is being used, and shall supply the manufacturer details to be placed in the SWMP Notebook. The Concessionaire shall have a complete supply of all necessary construction BMP Materials on Site at all times in preparation for construction water quality control emergencies.

Where permanent seeding operations are not feasible because of seasonal constraints (e.g., summer and winter months), the Concessionaire shall have mulch and mulch tackifier applied to disturbed areas to prevent erosion.

The Concessionaire shall use soil retention coverings on slopes and turf reinforcement mats in ditches according to Schedule 5 Section 17.2.9.

Slopes shall be roughened at the end of each day. Concrete washout shall be contained.

Non-structural BMPs may include litter and debris control, street sweeping, and landscaping and vegetative practices.

#### **12.1.2.1.3 Spill Prevention Control and Countermeasures Plan (SPCC Plan)**

The Concessionaire shall prepare a SPCC Plan for Approval by HPTE and prior to NTP1. The SPCC Plan will be in accordance with Section 208 of the Standard Specifications. The SPCC Plan shall establish operating procedures for handling pollutants and preventing spills. Pollutant sources include, but are not limited to, exposed and stored soils, paints, solvents, fertilizers or chemicals, vehicle tracking, management of contaminated soils, loading and unloading operations, outdoor storage activities, vehicle/equipment maintenance and fueling, significant dust or particulate generating processes, on-Site waste management practices, concrete truck/equipment washing, dedicated asphalt and concrete batch plants, and non-industrial waste sources that may be significant such as trash and portable toilets.

#### **12.1.2.1.4 Drainage**

The Concessionaire shall be responsible for temporary drainage of the Phase 2 Construction Work area during construction. The Concessionaire shall keep all existing storm drainage systems used for temporary drainage in operating condition during construction. Prior to the start of construction, the Concessionaire shall locate and clean all existing storm drainage systems in accordance with Section 202 of the Standard Specifications. Throughout the

duration of the permit, the Concessionaire shall continually protect inlets from sediment and pollutants and, if needed, shall remove any material deposited in the systems as a result of the Concessionaire's activities. All inlets shall be identified on the SWMP Site Map and shall follow the requirements of Section 208 of the Standard Specifications.

#### **12.1.2.1.5 Erosion Control Supervisor**

The Concessionaire shall assign to the Phase 2 Construction Work an employee or subconsultant to serve in the capacity of the Erosion Control Supervisor (ECS). The ECS shall be a person other than the Superintendent and shall be a person dedicated solely to erosion/sediment control. The ECS shall be experienced in all aspects of construction and have satisfactorily completed an ECS training program authorized by HPTE. Certification that this requirement has been met shall be submitted to HPTE prior to NTP1. A list of authorized ECS training programs will be provided by HPTE upon request by the Concessionaire.

The Concessionaire's ECS responsibilities shall follow the duties as laid out in Section 208 of the Standard Specifications, in addition to the following:

1. Direct the removal of sediment, trash, and debris from the construction BMPs and other drainage facilities within the affected areas of the Phase 2 Construction Work.
2. Prepare a written report documenting the adequacy of the BMPs for the Site conditions as well as the condition of the BMPs based on documented inspections. The reports shall be kept with the SWMP inspection documentation and submitted to the CDOT Region Water Quality Manager. The appropriate form for this report will be supplied by HPTE. The inspections shall be made during the progress of the Work, during Work suspensions, and for the duration of the CDPS-SCP. During Work stoppages, inspections shall take place at least once every 30 Days, and within 48 hours after each event that causes surface runoff. After construction is complete, inspections shall take place at least once every 30 Days until the permit can be closed.
3. When Work is occurring in a Local Agency's jurisdiction, conduct inspections according to the required intervals of the Local Agency.
4. Implement the necessary actions to reduce anticipated or presently existing water quality or erosion problems resulting from construction Activities. The criteria for this action shall be based on water quality data derived from any inspections and monitoring operations or by any anticipated conditions (e.g., predicted storms) that could lead to unsuitable water quality situations.

#### **12.1.2.1.6 Inspections**

Inspections shall be on the appropriate CDOT Forms and shall follow the requirements in Section 208 of the Standard Specifications. Prior to work commencing, a pre-construction conference shall be held with the CDOT's Region water quality personnel. In addition, when the first phase of BMPs has been installed, the Concessionaire shall notify CDOT's Region water quality personnel to come out and inspect the BMPs for proper installation. Earthwork shall not begin until the BMP installation inspection has occurred. CDOT's Region water quality personnel will be inspecting the Site on a monthly basis, as well as during the surprise Regional Erosion Control Assessment Team inspections. The Region water quality personnel may inspect the Phase 2 Construction Work at any time and document any non-compliance issues that need to be resolved immediately by the Concessionaire. Fines may be assessed to the Concessionaire with the potential of Phase 2 Construction Work shut downs, depending on the



severity of the non-compliance. Prior to Phase 2 Work Completion, CDOT's Region water quality personnel shall be notified to perform a final walkthrough inspection. Any items identified for maintenance, replacement, or removal shall be done immediately or liquidated damages may be incurred upon the Concessionaire.

Based on the Consent Order, the project superintendent or ECS shall perform daily inspections of all BMPs to observe, record, and determine the effectiveness of all BMPs and to order their maintenance if needed. The results of the daily inspections shall be recorded in a daily stormwater log, which will be provided by HPTE. The Concessionaire shall cooperate with Local Agencies that may perform their own stormwater inspections on the Phase 2 Construction Work.

#### **12.1.2.1.8 Colorado Discharge Permit System, Stormwater Construction Permit Closure**

The Concessionaire shall be responsible for all stormwater permit requirements until final stabilization has been achieved (see Schedule 5, Section 17, (Landscaping) and the CDPS-SCP permit can be closed. This includes the maintenance of all BMPs, maintenance of all seeded/landscaped areas, and removal of all BMPs once all erosion potential has been eliminated.

#### **12.1.2.2 Municipal Separate Storm Sewer System (MS4) Permit**

CDOT has obtained an MS4 Permit for the storm drain systems that it owns and maintains (included in Schedule 5A). The Concessionaire shall be responsible for complying with the terms and conditions of the CDOT MS4 Permit that pertain to the Phase 2 Construction Work. The Concessionaire shall follow the requirements set forth in the New Development Redevelopment portion of the MS4 Permit to comply with water quality standards. The Concessionaire shall install PSQFs in accordance with the CDOT *Erosion Control and Stormwater Quality Guide* and the Urban Drainage and Flood Control District (UDFCD) *Urban Storm Drainage Criteria Manual*. Runoff from all impervious areas within CDOT ROW within the Phase 2 Construction Work limits shall be captured and conveyed to a PSQF. Runoff from all impervious areas outside CDOT ROW shall follow the Local Agency MS4 Permit for any required PSQFs.

Equivalent Areas as defined in the CDOT MS4 Permit shall not be allowed.

The Plans included in the Reference Documents, the Master Plan Drainage Report, and the Master Plan Water Quality Report provide information regarding drainage concepts, and the location of permanent detention and water quality features that were determined to be feasible to implement PSQFs for the Phase 2 Construction Work.

The findings included in these documents shall be used as a starting point to develop and design a more detailed permanent stormwater quality improvement plan. The recommendations included in the reports describe the type and location of PSQFs to be implemented. In areas outside of CDOT ROW, property will be acquired by HPTE to facilitate construction of permanent water quality and 100-year detention for the Ultimate Configuration.

The Concessionaire shall immediately notify HPTE and the Local Agency of any suspected illicit or improper connections or discharges into any storm drain system are discovered during design or construction of the Phase 2 Construction Work. The Concessionaire shall contact the CDOT Illicit Discharge Hotline at 303-512-4426. HPTE and the Local Agencies will be responsible for investigation of the suspected illicit connection and implementing corrective action. The Concessionaire shall not maintain, reconnect, or otherwise allow discharge of improperly disposed materials into the storm drain system within the limits of the flows leaving the Phase 2 Construction Work area.

**12.1.2.3 Construction Dewatering Permit**

See Schedule 5, Section 5.2.5.

**12.1.2.4 U.S. Army Corps of Engineers (USACE) Section 404 Permit**

See Schedule 5, Section 5.2.2.

**12.2 Design Requirements****12.2.1 Drainage Design Software**

The following software (most recent versions) shall be used in performing drainage design calculations.

1. CUHP/EPA-SWMM
2. USACE, HEC-RAS
3. FHWA, HY-8
4. In Roads Storm and Sanitary
5. UD-Detention
6. UD-Inlet
7. UD-Rational

**12.2.2 Data Collection**

The Concessionaire shall identify all drainage-related issues utilizing available data, including but not limited to, requirements imposed by local, state, and federal government regulations, and official documents concerning the Phase 2 Construction Work. Drainage related issues include, but are not limited to, areas with historically inadequate drainage (as evidenced by recorded flooding or citizen complaints), environmentally sensitive areas, and known drainage-related maintenance problems.

The Concessionaire shall obtain all relevant storm drainage improvement plans, drainage planning studies, and Drainage Reports for the Phase 2 Construction Work area from all Local Agencies, UDFCD, and CDOT.

The Concessionaire shall obtain existing and projected future land uses from all Local Agencies and shall design facilities to be compatible with drainage systems, existing or proposed, on adjacent properties.

The Concessionaire shall perform detailed mapping and surveys as required to verify locations of existing drainage features necessary for the proposed drainage design. The Concessionaire shall verify or identify boundaries, flow patterns, and land uses of drainage basins based on field observations.

**12.2.3 Surface Hydrology**

The Concessionaire shall perform hydrologic analyses for all on-Site drainage basins, and for all off-Site drainage areas immediately adjacent to the Phase 2 Construction Work Site that contribute runoff to the Phase 2 Construction Work Site. The analysis shall be based on projected future land uses and the Ultimate Configuration.

The hydrologic analyses shall identify all impacts to any existing storm drainage system.

**12.2.3.1 Design Frequencies**

For all CDOT-owned facilities, the design frequency shall comply with Table 7.2, Table of Design Frequencies in the CDOT *Drainage Design Manual* except the for design frequency of minor system storm drains, which shall be the 10-year design frequency.

The design frequency for all other roadways in the Phase 2 Construction Work area shall comply with the affected Local Agency’s criteria or as stated in the Master Plan Drainage Report.

**12.2.3.2 Precipitation**

The Concessionaire shall design all on-Site drainage elements using the precipitation data given in the Table 12.2-1A.

<b>Table 12.2-1A INTENSITY-DURATION FREQUENCY DATA</b>					
Frequency	5-min	10-min	15-min	30-min	60-min
2-year	3.51	2.73	2.30	1.60	1.01
5-year	4.98	3.86	3.26	2.26	1.43
10-year	6.02	4.67	3.94	2.73	1.73
50-year	8.35	6.48	5.47	3.79	2.40
100-year	9.40	7.29	6.16	4.27	2.70

The Concessionaire shall design all off-Site drainage elements using the precipitation data given in the Tables 12.2-1B and 12.2-1C.

<b>Table 12.2-1B INCREMENTAL RAINFALL DEPTH / RETURN PERIOD</b>															
Time (min)	<i>Basins less than 5 sq. miles</i>					<i>Basins between 5 and 10 sq. miles</i>					<i>Basins between 10 and 20 sq. miles</i>				
	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)
5	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
10	0.04	0.05	0.06	0.08	0.08	0.04	0.05	0.06	0.08	0.08	0.04	0.05	0.06	0.08	0.08
15	0.09	0.13	0.14	0.12	0.12	0.09	0.13	0.14	0.12	0.12	0.09	0.13	0.14	0.12	0.12
20	0.16	0.22	0.26	0.19	0.22	0.16	0.21	0.25	0.19	0.22	0.15	0.20	0.23	0.19	0.22
25	0.25	0.36	0.43	0.36	0.38	0.24	0.34	0.42	0.35	0.36	0.23	0.32	0.39	0.32	0.34
30	0.14	0.19	0.21	0.60	0.68	0.14	0.18	0.20	0.58	0.65	0.13	0.17	0.19	0.54	0.61
35	0.07	0.09	0.10	0.29	0.38	0.07	0.09	0.10	0.28	0.36	0.07	0.09	0.10	0.26	0.34
40	0.05	0.06	0.07	0.19	0.22	0.05	0.06	0.07	0.19	0.22	0.05	0.06	0.07	0.19	0.22
45	0.03	0.05	0.07	0.12	0.17	0.03	0.05	0.07	0.12	0.17	0.03	0.05	0.07	0.12	0.17
50	0.03	0.05	0.06	0.12	0.14	0.03	0.05	0.06	0.12	0.14	0.03	0.05	0.06	0.12	0.14
55	0.03	0.04	0.06	0.08	0.11	0.03	0.04	0.06	0.09	0.11	0.03	0.04	0.06	0.09	0.11

<b>Table 12.2-1B INCREMENTAL RAINFALL DEPTH / RETURN PERIOD</b>															
Time (min)	<i>Basins less than 5 sq. miles</i>					<i>Basins between 5 and 10 sq. miles</i>					<i>Basins between 10 and 20 sq. miles</i>				
	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)	2-yr (in)	5-yr (in)	10-yr (in)	50-yr (in)	100-yr (in)
60	0.03	0.04	0.06	0.08	0.11	0.03	0.04	0.06	0.09	0.09	0.03	0.04	0.06	0.09	0.11
65	0.03	0.04	0.06	0.08	0.11	0.03	0.04	0.06	0.08	0.09	0.03	0.04	0.06	0.09	0.11
70	0.02	0.04	0.06	0.06	0.05	0.02	0.04	0.06	0.07	0.07	0.02	0.04	0.06	0.06	0.06
75	0.02	0.04	0.06	0.06	0.05	0.02	0.04	0.06	0.07	0.07	0.02	0.04	0.06	0.06	0.06
80	0.02	0.03	0.04	0.05	0.03	0.02	0.03	0.04	0.04	0.04	0.02	0.03	0.04	0.04	0.04
85	0.02	0.03	0.03	0.05	0.03	0.02	0.03	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.03
90	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
95	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
100	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
105	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
110	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
115	0.01	0.02	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
120	0.01	0.02	0.02	0.03	0.03	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.03
125											0.01	0.02	0.02	0.02	0.02
130											0.01	0.02	0.02	0.02	0.02
135											0.01	0.02	0.02	0.02	0.02
140											0.01	0.02	0.02	0.02	0.02
145											0.01	0.01	0.02	0.02	0.02
150											0.01	0.01	0.01	0.02	0.02
155											0.01	0.01	0.01	0.02	0.02
160											0.01	0.01	0.01	0.02	0.02
165											0.01	0.01	0.01	0.02	0.02
170											0.01	0.01	0.01	0.02	0.02
175											0.01	0.01	0.01	0.02	0.02
180											0.01	0.01	0.01	0.01	0.02
<b>Total</b>	<b>1.17</b>	<b>1.65</b>	<b>2.00</b>	<b>2.77</b>	<b>3.12</b>	<b>1.16</b>	<b>1.61</b>	<b>1.97</b>	<b>2.73</b>	<b>3.05</b>	<b>1.26</b>	<b>1.73</b>	<b>2.08</b>	<b>2.87</b>	<b>3.24</b>

<b>Table 12.2-1C ONE-HOUR POINT RAINFALL</b>				
2-YEAR	5-YEAR	10-YEAR	50-YEAR	100-YEAR
1.01	1.43	1.73	2.40	2.70

**12.2.3.3 Hydrologic Methods**

The Concessionaire shall perform the necessary hydrologic analyses using the following methods:

1. Areas less than 90 acres shall be evaluated using the Rational Method. The minimum time of concentration shall be 5 minutes.
2. Areas between 90 and 160 acres shall be analyzed using the CUHP/EPA-SWMM procedure for peak flow only.
3. Areas greater than 160 acres shall be evaluated using the CUHP/EPA-SWMM procedure.

The hydrologic analyses shall be based on fully developed off-site conditions and the Ultimate Configuration.

**12.2.4 Hydraulic Structures**

**12.2.4.1 Roadways**

Roadway component geometric configurations shall be designed to provide adequate drainage and minimize hydroplaning and icing problems. Cross slopes shall be in accordance with the requirements of Schedule 5, Section 13, (Roadways).

**12.2.4.1.1 Roadway Profile**

Longitudinal grades shall be in accordance with the requirements of Schedule 5, Section 13, (Roadways). Where minimum profile grades cannot be obtained in sag vertical curves, flanking inlets shall be constructed in the curb and gutter, or adjacent to the solid barrier guardrail, as required in the CDOT *Drainage Design Manual*.

**12.2.4.1.2 Allowable Flow Spreads and Depths**

The Concessionaire shall design all roadway storm drain systems including gutters, inlets, inlet spacing, catch basins, laterals, and trunk lines using the design criteria given in Tables 12.2-1.

<b>Table 12.2-2 ROADWAY STORM DRAIN DESIGN STORM AND SPREAD CRITERIA</b>			
<b>Road Classification</b>		<b>Design Frequency</b>	<b>Design Spread</b>
High Volume or Divided or Bi- Directional	< or = 45 mph	10-year	Shoulder + 3 ft
	> 45 mph	10-year	Shoulder
	> 45 mph	100-year	Shoulder + 4 ft
	Sag Point	50-year	Shoulder
	Sag Point	100-year	Shoulder + 4 ft
Collector	< or = 45 mph	10-year	½ Driving Lane
	> 45 mph	10-year	Shoulder
	Sag Point	10-year	1/2 Driving Lane
Local Streets	Low ADT	5-year	1/2 Driving Lane
	High ADT	10-year	1/2 Driving Lane
	Sag Point	10-year	1/2 Driving Lane

#### 12.2.4.1.3 Edge Treatment

In areas where the roadway pavement discharges runoff to Type 7 guardrail, Type 3 guardrail with curb, or at the end of curb returns, flows shall be collected and piped to the bottom of the embankment slope. CDOT standard Type 3 Embankment Protectors or inlets shall be used at these locations. Erosion protection shall be constructed at the outfalls. See [Section 12.2.4.5](#) below for more information.

#### 12.2.4.1.4 Roadside Ditches and Open Channels

For roadside ditches along all existing and proposed roadways, the water surface profile shall have a minimum of one foot of freeboard for the 10-year return frequency peak discharge and shall not exceed edge of pavement for the 100-year return frequency peak discharge.

All open channels within the Phase 2 Construction Work shall be designed to capture and convey the 100-year return frequency. Capacity shall be determined using Manning's Equation.

All ditches and open channels with a grade exceeding 2 percent shall be constructed with a turf reinforcement mat or other means.

Flexible channel linings shall be designed in accordance with FHWA *HEC-15, Design of Roadside Channels with Flexible Linings*. Riprap channel lining shall be designed in accordance with FHWA *HEC-11, Design of Riprap Revetment*.

The geometric layout shall be in accordance with the AASHTO *Roadside Design Guide*, and shall consider hydraulics, safety, maintenance, long-term permanent erosion control, landscaping, and aesthetics.

All abandoned concrete diversion structures in roadside ditches and open channels shall be removed unless otherwise directed by HPTE.

#### 12.2.4.2 Cross Drains

Cross drains shall be defined as pipes or culverts that convey water from one side of the road to the other. All Cross Drains shall be designed for the 100-year return frequency peak discharge for fully developed ultimate conditions with no overtopping of the US 36 mainline. All Cross Drains shall be designed to accommodate the Ultimate Configuration. Hydraulic design of Cross

Drains shall be based on the procedures included in FHWA *HDS No. 5, Hydraulic Design of Highway Culverts*. Hydraulic design data shall be listed on the final Design Plans for each Cross Drain, including drainage area, peak discharges, allowable headwater elevation, and design headwater elevation.

The minimum allowable pipe size for Cross Drains shall be 36 inches. End sections, or headwalls with beveled edges and wingwalls, shall be provided for all Cross Drains regardless of size. To reduce sizes, improved inlets may be utilized. Improved inlets shall be designed based on FHWA *HEC-13, Hydraulic Design of Improved Inlets for Culverts*.

Allowable headwater elevation for the 100-year return frequency peak discharge shall be designed as described in Chapter 9.2.2 of the CDOT *Drainage Design Manual*.

The use of sag pipes or inverted siphons shall not be allowed to convey stormwater.

In some locations, the existing Cross Drainage may be via porous, open-graded, free draining fill, rather than Cross Drains. The Concessionaire shall provide Cross Drains in these locations.

Discharge systems shall be designed to prevent scour of existing channels and embankments at the design flow rates.

The Concessionaire shall design Cross Drains for each crossing in Table 12.2-3, using analysis based on the results of a hydraulic computer model.

The Concessionaire shall provide Cross Drains for the design flows in Table 12.2-3, or as required by analysis.

Table 12.2-3 CROSS DRAIN LOCATIONS		
Location	Flow (100-yr)	
Coal Creek	3,820 cfs	Remove and Replace
All Cross drain crossings	Varies	Remove and Replace

Cross drains shall be continuous through the ROW. Bends or turns will not be permitted. Pipes connected to manholes or inlets placed in line with a Cross Drain will be referred to as a storm drain and shall follow the requirements for storm drains.

Wildlife crossings shall be designed and located in accordance with Schedule 5, Section 5.3.2, (Wildlife Crossings). Each crossing shall be evaluated hydraulically if along a drainageway.

**12.2.4.3 Storm Drains**

Storm drains shall be defined as a network of pipes that connects inlets, manholes, and other drainage features to an outfall. Cross drains connected to the storm drainage system are considered part of the system. Storm drain systems that convey flows generated from the US 36 roadway shall be designed for the 10-year return frequency discharge for Ultimate Configuration. The storm drain system shall be designed to not worsen the existing conditions for properties outside the ROW. Ponding will not be permitted within the Site, except at specifically designed stormwater detention and/or water quality facilities. At locations where 100-year detention is to be provided, the storm drain system shall capture and convey the 100-year flows to the detention pond. Hydraulic analyses and plans for storm drains that are connected to existing storm drain systems upstream or downstream of the Site must be coordinated with affected Local Agencies. The hydraulic analyses shall identify impacts to the existing storm drain systems caused by the connections and proposed combined peak-design discharges for the overall systems.

The minimum allowable pipe diameter for storm drain systems is shown in Table 12.2-4. The Concessionaire shall not decrease storm drain size in the downstream direction. All bends and turns shall occur within a manhole or inlet.

Table 12.2-4 MINIMUM ALLOWABLE PIPE DIAMETER	
Application	Minimum Diameter (inches)
Side Drain	18
Median Drain	18
Storm Drain Trunk Line	18
Connections:	
– Median drain to Cross Drain	15
– Curb inlet to trunk line	15

The use of sag pipes or inverted siphons will not be allowed.

#### **12.2.4.3.1 Hydraulic Design of Storm Drains**

Storm drain design shall be performed using hydraulic gradient analysis to account for all friction and minor losses. Friction losses shall be calculated using Manning's Equation. Minor losses at junctions, manholes, bends, and other appurtenances shall be calculated based on design procedures in the FHWA *HEC-22, Urban Drainage Design Manual*.

Storm drains under US 36 shall be designed with the hydraulic gradient below the top of pavement and inlet grates for the 10-year return frequency peak discharge. The hydraulic gradient for the 100-year return frequency shall be such that the allowable spread width per Table 12.2-2 is not exceeded. Local Agency criteria shall be followed for storm drain system design outside of CDOT ROW. The hydraulic gradient shall be plotted for all storm drains in each storm drain profile.

The flow velocity of storm drains shall not be less than 3 feet per second for the 10-year return frequency peak discharge and shall not be greater than 22 feet per second for the major storm discharge (100-year).

#### **12.2.4.3.2 Storm Drain Alignment, Profile, and Size**

Storm drain alignments shall be straight between structures.

Profiles of all storm sewers shall be straight grades between structures.

The Concessionaire shall comply with Local Agency criteria for storm drains outside CDOT ROW.

#### **12.2.4.3.3 Inlets**

Inlets are required at locations needed to collect runoff within the design controls specified in this [Section 12](#). In addition, there are a number of locations where inlets may be necessary with little regard to contributing drainage area. These locations should be marked on the plans prior to any computations regarding discharge, water spread, inlet capacity, or bypass. Examples of such locations are as follows:

1. Sag points in the gutter grade
2. Upstream of median breaks, entrance/exit ramp gores, pedestrian ramps, cross walks, and street intersections
3. Immediately upstream and downstream of bridges
4. Immediately upstream of cross slope reversals
5. On side streets at intersections
6. At the end of channels in cut sections
7. Behind retaining walls, curbs, shoulders or sidewalks to drain low areas
8. Where necessary to collect snow melt

Inlets shall not be located in a path where pedestrians are likely to walk.

CDOT *M&S Standard Plans* inlets shall be used within CDOT ROW. Type C and Type D inlets shall not be allowed within the roadway pavement limits unless used in conjunction with embankment protectors. Inlets shall be designed for HS-20 or interstate alternate live loading.



Bicycle-safe grates are required for inlets on US 36. Pedestrian-safe grates shall be used in pedestrian areas.

Concrete aprons shall be installed on all area inlets per the CDOT *M&S Standard Plans*.

Inlet hydraulic efficiency and spacing shall be determined based on design procedures in the FHWA *HEC-22, Urban Drainage Design Manual*. 100 percent of the bypass flow shall be added to the next downstream inlet.

For a continuous storm drain system, maximum inlet spacing shall be designed based on allowable flow spread or the manhole spacing criteria, whichever is less.

The sag vertical curve or sump area on a roadway requires an inlet at the lowest point and flanking inlets on each side of the lowest inlet to provide relief from debris clogging. All sumps shall be designed so that the 50-year design storm will not encroach into the travel lanes of US 36. The flanking inlets shall be located such that the design criteria for ponding are met, even if the sump inlet is completely clogged.

Inlets are required 10 feet upstream the point where the street cross slope begins to super-elevate toward the opposite side to prevent cross street flow for the 10-year return frequency.

Trench drains will not be allowed in the traveled way or transverse to traffic flow on US 36.

The use of scuppers or drainage slots in roadway barriers as a drainage element will not be allowed except within enforcement zones.

Valley gutters across connecting streets will not be allowed. Drainage runoff shall be intercepted upstream from connecting streets for subsurface conveyance.

Access holes such as inlets, catch basins, and manholes shall not be located in travel lanes of US 36 mainline.

A clogging factor of 50 percent shall be used for sizing single-unit inlet grates. A clogging factor of 10 percent shall be used for sizing single-unit curb opening inlets. For multiple-unit inlets, the clogging factor may be reduced as recommended in The UDFCD *Urban Storm Drainage Criteria Manual, Volume I*, Chapter 6, Section 3.

#### **12.2.4.3.4 Manholes and Junction Structures**

Manholes shall be incorporated into the storm drain system to provide access for inspection, cleaning, and other maintenance activities. Manholes shall be constructed at all junctions, changes in pipe size, drops, and grade changes. Manholes shall be provided at any change in horizontal alignment greater than 2 degrees. Manholes shall not be located in travel lanes of the US 36 mainline.

A lateral that is less than half the size (inside diameter) of the trunkline and no more than 75 feet long may be connected to the trunkline with a prefabricated pipe wye or tee connection. Larger laterals shall be connected to the trunkline with a manhole.

The spacing of manholes shall be in accordance with the criteria identified in the CDOT *Drainage Design Manual*. The spacing of manholes outside of CDOT ROW shall be in accordance with Local Agency criteria. For storm drain diameters 60-inch or greater, manholes shall be located considering Site conditions that provide for staging of large-scale maintenance activities.

Manhole and junction structure floors shall be shaped to fit the pipe inverts.

#### 12.2.4.4 Drain Outfalls

Cross drain and storm drain outfalls shall be designed such that the outlet elevation is as close as possible to the receiving drainageway flowline to prevent erosion. Outfalls shall be oriented in a downstream direction. Permanent erosion protection shall be provided at all outfalls and along the drainage flowlines where needed. Energy dissipaters shall be designed in accordance with the FHWA *HEC-14 Hydraulic Design of Energy Dissipaters for Culverts and Channels*, or UDFCD *Urban Storm Drainage Criteria Manual* Low Tailwater basins.

Broken back Cross Drains may be considered as a means to reduce scour potential or in combination with the above-mentioned energy dissipaters. Outfalls shall be designed to minimize all existing habitat disturbances during construction.

The effects of tailwater in the receiving drainageway on the hydraulics of the outfall shall be evaluated. The design frequency of the tailwater of the receiving drainageway shall be based on the comparison of design discharge frequencies for coincidental occurrence included in the FHWA *HEC-22, Urban Drainage Design Manual*.

#### 12.2.4.5 Scour and Erosion Control

All existing scour, rill or channel erosion issues within the Phase 2 Construction Work limits shall be addressed by the Concessionaire.

Analyze all bridges and open-bottom Cross Drains for scour, and design appropriate protection/mitigation per *HEC-18, Evaluating Scour at Bridges, Edition 3 (SI)*, and *HEC-23, Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance Second Edition*.

Analyze all channel changes, realignments and crossings for erosion and scour potential and design appropriate protection or mitigation per *HEC-20, Stream Stability at Highway Structures*.

The following criteria apply to riprap layer thickness:

1. Thickness shall not be less than the spherical diameter of the D100 stone or less than 2.0 times the spherical diameter of the D50 stone, whichever results in the greater thickness.
2. Thickness shall not be less than 12 inches for practical placement.
3. The thickness determined by either criteria 1 or 2 (above) shall be increased by 50 percent where the riprap is placed underwater to provide for uncertainties associated with this type of placement.
4. Oversized stones shall not be used.

Geotextile (Erosion Control Class 1) shall be used under all riprap per CDOT *M & S Standards*.

#### 12.2.4.6 Sub-Drainage Systems

Sub-drainage systems (e.g., underdrains) shall be designed in accordance with the CDOT *Drainage Design Manual*. Sub-drainage systems may be discharged to the stormwater system in compliance with regulations for groundwater discharge and control of water quality.

Groundwater is expected to be encountered during construction of the Phase 2 Construction Work. If groundwater is daylighted to the ground surface via storm drains (point source), a Subterranean Groundwater Permit from CDPHE will be required. Upon completion of the Phase 2 Construction Work, the permit will be transferred to HPTE. The Concessionaire shall be responsible for obtaining the permit. Refer to subsurface analysis in Schedule 5, Section 10, (Geotechnical, Roadway Pavements and Structure Foundations)

Underdrains may exist in certain locations. The Concessionaire shall preserve the capacities and functionality of all existing groundwater drains encountered during construction. Geotechnical investigations conducted on US 36 are provided in the Reference Documents.

Wells and springs may exist within the Phase 2 Construction Work limits. The Concessionaire shall protect the flow quantity, water quality, access, and availability of the wells and springs.

#### 12.2.4.7 Permanent Stormwater Quality Facilities

The Concessionaire shall consider the locations of permanent stormwater quality facilities (PSQFs) shown in the Reference Documents as the starting point for design. See the Master Plan Drainage Report for design parameters.

In locations noted in Table 12.2-5, Detention Ponds shall be designed to provide for the full WQCV plus the 10-year detention volume for the minor storm and one-half of the WQCV plus the 100-year detention volume for the major storm.

Sizing and location of PSQFs shall be built to the Ultimate Configuration. The Concessionaire shall utilize and construct all predefined pond locations for permanent water quality as part of the Phase 2 Construction Work.

The required impervious area to be treated under CDOT's current permit consists of all impervious areas within each tributary basin. The required impervious area to be treated will only extend up to the limits of disturbance.

Table 12.2-5 lists the PSQF by location.

<b>Table 12.2-5 PSQF LOCATIONS</b>			
<b>No.</b>	<b>US36 D-B Design Point</b>	<b>Station</b>	<b>PSQF</b>
1	V1	1338+00, RT	Water Quality Pond
2	V2	1333+00, RT	Hydrodynamic Sand Separator
5	V5	1330+00, LT	Water Quality & Detention
6	DRN-1	1232+00, RT	Media Filter Drain
7	DRN-2	1227+00, LT	Media Filter Drain
8	DRN-3	1227+00, LT	Street Sweep, Grass Buffer, Grass Swale
9	DAV-1	1213+00, RT	Media Filter Drain
10	DAV-2	1215+00, LT	Media Filter Drain
11	DAV-3	1215+00, LT	Street Sweep, Grass Buffer, Grass Swale
12	GDH-1	1196+00, RT	Media Filter Drain
13	GDH-2	1197+00, LT	Media Filter Drain
14	GDH-3	1197+00, LT	Street Sweep, Grass Buffer, Grass Swale
15	MVL-1	1185+00, LT	Media Filter Drain

Table 12.2-5 PSQF LOCATIONS			
No.	US36 D-B Design Point	Station	PSQF
16	MVL-2	1185+00, LT	Street Sweep, Grass Buffer, Grass Swale
17	CHY-1	1183+00, LT	Hydrodynamic Sand Separator
18	CHY-2	1163+00, LT	Hydrodynamic Sand Separator
19	CHY-3	1170+00, LT	Media Filter Drain
20	CHY-4	1170+00, LT	Street Sweep, Grass Buffer, Grass Swale
21	CHY-5	1171+00, RT	Media Filter Drain
22	SHR-1	1167+50, RT	Media Filter Drain
23	CAN-1	1163+00, LT	Hydrodynamic Sand Separator
24	CAN-2	1154+00, LT	Media Filter Drain
25	CAN-3	1154+00, LT	Street Sweep, Grass Buffer, Grass Swale
26	SBC-1	1143+00, RT	Media Filter Drain
27	SBC-2	1143+50, LT	Media Filter Drain
28	SBC-3	1143+50, LT	Street Sweep, Grass Buffer, Grass Swale
29	DRC-1	1120+00, RT	Street Sweep, Grass Buffer, Grass Swale
30	DRC-2	1120+00, RT	Media Filter Drain
31	DRC-3	1120+00, LT	Media Filter Drain

All Water Quality & Detention and Water Quality Pond PSQFs as listed in Table 12.2-5 shall be extended detention basins (EDB) with a pre-sedimentation forebay, 6-foot minimum width concrete trickle channel with mountable curb, micropool, and outlet structure with trash rack. Concrete trickle channels to convey nuisance flows shall be provided from inflow locations to the primary low-level outlet, for all PSQFs. Minimum grades within the basin shall not be less than 0.5 percent. The outlet structure used at all pond locations shall be flush with the side slope. All design calculations, geometry, and details shall conform to UDFCD's *Urban Storm Drainage Criteria Manual, Volume 3* and shall be provided to HPTE for Acceptance.

In locations where Water Quality is called out in Table 12.2-5, alternate PSQFs as defined in CDOT's *Erosion Control and Stormwater Quality Guide*, Chapter 6, may be used with Acceptance from HPTE.

All PSQFs shall be installed outside the 50-year floodplain boundary unless approved by HPTE.

The elevation of the emergency spillway or overflow structure shall be at the elevation of the routed 100-year water surface. The emergency spillway or overflow structure shall have the capacity to convey the routed 100-year peak discharge. Embankments shall provide a minimum of one foot of freeboard above the routed 100-year water surface elevation through the emergency spillway.

The Concessionaire shall identify all base flows tributary to the ponds and provide means for these flows to circumvent the EDB. Ground water seepage, off-Site, landscape irrigation, or other type of flow shall not pass through the forebay, trickle channel, or micropool.

The low-level outlet shall include a debris rack with a total opening area at least twice the area of the low-level outlet.

Detention basin slopes and bottom shall be protected against erosion from inflows and circulation within the basin. Slopes of earth embankments for detention facilities steeper than 4:1 will not be allowed. Slopes in detention facilities shall be planted with a seed mix and protected by a soil retention covering as Approved by HPTE.

Existing unintended detention storage volume at the entrance to existing Cross Drains or storm drain systems shall not be considered to reduce peak discharges downstream.

Groundwater elevations shall be determined by the Concessionaire at all EDB locations and submitted to HPTE for review. If groundwater is encountered, measures shall be taken (e.g., perimeter underdrain system or impermeable liner) to prevent groundwater seepage or a base flow into the pond.

The MFD shall not discharge storm flows directly to any irrigation ditch facility. The MFD mix shall be comprised of aggregate, horticultural grade perlite, agricultural grade dolomite, and noncalcined agricultural grade gypsum. MFD mix shall be premixed prior to placement. Aggregate shall be manufactured from ledge rock, talus, or gravel and shall meet test requirements for quality. The use of recycled material is not permitted. Geotextile material shall be Class 3 conforming to subsection 712.08. Perforated Pipe Underdrain shall be 8-inch diameter conforming to subsection 712.11. Filter material shall be Class A conforming to subsection 703.09. Delineators shall be non-reflective, and shall be placed at 100 foot increments along the MFD, parallel to the roadway surface as shown in the Plans. The MFD shall not be used as a temporary means for water quality treatment during construction and shall be protected while construction activities are present.

Final design of all PSQFs shall be Approved by HPTE.

#### **12.2.4.8 Bridges and Deck Drainage**

Deck-drainage systems are required for highway bridges when maximum allowable flow spread for the design storm is exceeded and to limit flow across expansion joints to less than 1 cubic foot per second for the 10-year return frequency peak discharge. Stormwater flowing toward the bridge shall be intercepted prior to the approach slab. Stormwater flowing away from the bridge shall be intercepted prior to leaving the approach slab. This stormwater shall be directed to an on-Site drainage system and conveyed to a PSQF. Bridge deck drainage systems shall be designed in accordance with the FHWA HEC-21 Bridge-Deck Drainage Systems.

All bridge-deck drain inlets shall be grated. The bridge-deck drainage system shall be compatible with structural reinforcement, components, and aesthetics of the bridge. Outfalls shall be positioned to avoid corrosion of structural members, and splash on vehicular traffic and pedestrian areas below the bridge. Adequate erosion protection shall be provided for all deck drains piped to the bottom of the slope. Downspouts for bridge drains shall be a minimum 10-inch diameter galvanized steel pipe. See Schedule 5, Sections 15.2.3.4.12, for more information on bridge deck drainage.

#### **12.2.4.9 Stormwater Pumping Stations**

The use of stormwater pumping stations shall not be allowed.

#### **12.2.5 Irrigation Facilities**

Existing structure dimensions shall be used as the basis for design of all irrigation canal and lateral crossing structures. Any variation in size will require approval from each individual irrigation facility owner.

All irrigation canal and lateral structures crossing US 36 shall be removed and replaced. The Concessionaire shall follow design standards required by the Irrigation Ditch Companies (Ditch). Structure lengths and headwall placement shall be built to the Ultimate Configuration and shall consider other features of the Work including but not limited to bikeway, guardrail, barrier, retaining walls, and sound walls. Any changes shall be coordinated with the individual Ditch. Schedule 5, Section 6.2, includes information regarding coordination, agreements, standards, requirements, reviews, and approvals.

Total design flow at each location shall include 100-year tributary stormwater runoff from both on-Site and off-Site basins. Irrigation canal structures shall convey the 100-year storm flows per Section 12.2.4.2 (Cross Drains). The Concessionaire shall verify that these crossings will not overtop US 36 mainline with the total decreed flow added to the 100-year storm flow. The decreed flows and any carriage flow agreements between ditch companies can be found in the Reference Documents.

Concentrated storm drainage from US 36 Right-of-Way shall not discharge directly to any irrigation structure. Concentrated flows shall be periodically released to follow historic flow patterns.

The flow for irrigation ditch facilities is included with the Reference Documents.

### **12.2.6 Floodplains**

The Concessionaire shall coordinate all impacts to FEMA-regulated floodplains and changes to bridges and Cross Drains located in FEMA-regulated floodplains with HPTE, FEMA, UDFCD, and the local city or county floodplain administrator. The Concessionaire shall comply with local floodplain development permits and other National Flood Insurance Program requirements. As required by FEMA or local floodplain administrators, the Concessionaire shall develop hydraulic models of the waterways and crossing structures to demonstrate hydraulic performance of new structures and existing structures. The Concessionaire shall apply for and obtain Conditional Letters of Map Revision (CLOMR) and Letters of Map Revision (LOMR) as required. The Concessionaire shall be responsible for all FEMA and other Agency fees. Concessionaire shall obtain floodplain development permits as required by the Local Agencies.

CLOMR and LOMR submittals are required for the following locations:

1. South Boulder Creek
2. Coal Creek

Hydraulic modeling of South Boulder Creek shall be per City of Boulder requirements using MIKE FLOOD software.

Bikeway structures crossing any of the above mentioned creeks shall be designed to convey the 10-year event with 1-foot of freeboard and shall be designed to accommodate greater than 10-year events.

### **12.2.7 Area Specific Drainage Requirements and/or Information**

#### **12.2.7.1 88<sup>th</sup> Street**

The Concessionaire shall remove the existing irrigation siphons 800 feet west of 88<sup>th</sup> Street and replace with gravity flow cross drains built to the Ultimate Configuration width.

**12.2.7.2 Overhead pipes**

The Concessionaire shall remove and replace the active overhead irrigation structure near Station 1362+50 and build to accommodate the Ultimate Configuration width.

**12.2.7.3 Cemetery Access**

The Concessionaire shall remove and replace the existing cemetery access near Station 1356+00 and build to accommodate the Ultimate Configuration width. Eliminate ponding by providing drainage away from end of box.

**12.2.7.4 Coal Creek**

The Concessionaire shall remove the existing bridge and provide a new structure at the existing bridge location built to the Ultimate Configuration width. A trail crossing with a minimum of 10-foot vertical clearance shall be provided. A large mammal wildlife crossing shall be provided per Schedule 5, Section 5 (Environmental Requirements). If the Concessionaire proposes to locate the crossing at a location other than the existing location, the Concessionaire shall be responsible for obtaining any additional required permits, ROW, and environmental clearance required at the new location.

**12.2.7.5 McCaslin Boulevard Interchange**

Existing off-site flows of  $Q_{100} = 275$  cfs from Superior Marketplace shall continue to pass through the interchange. A connection shall be made between the existing 8'x4' CBC to the double 60" RCP to separate on-site and off-site flow. This connection is to be made outside the gore and located under the existing loop ramp to be removed as part of this option. Flows from within the interchange area shall outfall to Pond V5. No onsite ponds in the gore area are allowed. Pond V5 shall be sized to accommodate detention and water quality capture volume for runoff from the high point at the Scenic Overlook to Coal Creek near Station 1336+00, east of McCaslin. Pond V5 shall also accommodate detention for off-site runoff of  $Q_{100} = 67$  cfs from a basin that is tributary to the existing roadside ditch south of US 36 and within CDOT right-of-way near Station 1227+00. Existing Pond V4 shall not receive any additional flows from these project improvements. On-site runoff between McCaslin and Coal Creek that cannot be captured and conveyed to Pond V5 shall be treated in a water quality structure prior to discharging into Coal Creek.

**12.2.7.6 CDOT Maintenance Facility Pond Outlet**

The Concessionaire shall remove and replace the existing cross drain under US 36 and under Marshall Road near Station 1289+00. The limits of the new cross drain shall contain the Bikeway and built to the Ultimate Configuration width. The Concessionaire shall convey flows to the historic outfall location.

**12.2.7.7 Pedestrian Underpass at Station 1267+00**

The Concessionaire shall provide a 14'x10' CBC connecting Marshall Road to the proposed bikeway north of US 36. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width. Eliminate ponding by providing drainage away from end of box.

**12.2.7.8 Coal Creek Ditch**

The Concessionaire shall remove and replace the existing structure crossing under US 36 near Station 1266+00. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width.

**12.2.7.9 Drainage Crossing at Station 1235+50**

The Concessionaire shall remove the undersized cross drain under US 36 near Station 1235+50. The new cross drain shall adhere to the HW/D requirements and built to the Ultimate Configuration width. Concessionaire shall not worsen impacts downstream.

**12.2.7.10 Davidson Ditch**

The Concessionaire shall remove and replace the existing structure crossing under US 36 near Station 1213+50. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width.

**12.2.7.11 Goodhue Ditch**

The Concessionaire shall remove and replace the existing structure crossing under US 36 near Station 1195+50. The limits of the new structure shall contain the Bikeway and the built to Ultimate Configuration width.

**12.2.7.12 Marshallville Ditch**

The Concessionaire shall remove and replace the existing structure crossing under US 36 near Station 1182+50. The limits of the new structure shall contain the Bikeway and the built to Ultimate Configuration width.

**12.2.7.13 Cherryvale Drainage Crossing**

The Concessionaire shall remove and replace the existing cross drain under US 36 near Station 1170+00. Connect downstream to exiting crossing under access road. The limits of the new cross drain shall contain the Bikeway and built to the Ultimate Configuration width.

**12.2.7.14 Shearer Ditch**

The Concessionaire shall remove and replace the existing structure under US 36 near Station 1167+50. Connect downstream to exiting crossing under access road. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width.

**12.2.7.15 South Boulder Canyon Ditch**

The Concessionaire shall remove and replace the existing siphon under US 36 near Station 1144+00. Siphon access points shall be outside of mainline pavement for both Phase 2 and Ultimate Configuration. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width. Replace existing irrigation lateral crossing on downstream side of siphon and connect to existing lateral outfall.

**12.2.7.16 South Boulder Creek**

The Concessionaire shall coordinate with City of Boulder regarding any impacts to the recently adopted South Boulder Creek Floodplain Study. This study used the software MIKE FLOOD to update the Digital Flood Insurance Rate Map (DFIRM) and will be officially adopted by FEMA on December 18, 2012. The proposed Phase 2 improvements reflected in the Reference



Documents within the South Boulder Creek floodplain have been modeled using MIKE FLOOD. The Concessionaire may assume that floodplain impacts due to the Phase 2 improvements reflected in the Reference Documents are acceptable to the City of Boulder or will be mitigated for separately by HPTE. If the Concessionaire proposes changes to the design of the Phase 2 improvements within the South Boulder Creek floodplain, the Concessionaire shall be responsible for having the updated design modeled using MIKE FLOOD, and shall be responsible for any subsequent mitigation resulting from worsened floodplain impacts.

#### **12.2.7.17 Dry Creek No. 2 Ditch**

The Concessionaire shall remove and replace the existing structure under US 36 near Station 1126+00. The limits of the new structure shall contain the Bikeway and built to the Ultimate Configuration width. Reconstruct existing diversion structure and provide conveyance along US 36 to existing Dry Creek No. 2 Ditch.

#### **12.2.7.18 Low Tailwater Riprap Basin**

Provide low tailwater riprap basins as defined in UDFCD Drainage Criteria at the downstream end of all cross drains under the bikeway draining the MFD.

#### **12.2.7.19 McCaslin Pedestrian Underpass (Option 1)**

Apply applicable requirements from Section 12.2.7.5 in the design of the Diverging Diamond Interchange option. Flows that cannot be captured and conveyed to Pond V5 shall be treated in a water quality structure prior to discharging into Coal Creek.

### **12.3 Construction Requirements**

Drainage facilities shall be constructed in accordance with CDOT Standard Specifications, *Standard Plans*, and *M & S Standards*.

Drainage facilities shall be designed to accommodate the construction phasing of the Phase 2 Construction Work.

The Concessionaire shall survey PSQFs according to Section 6.1.3 of the CDOT *Survey Manual* to confirm the design volume has been provided during construction and documented in the As-Built plans. This work shall be prior to Phase 2 Work Completion. The Concessionaire shall map for inclusion into CDOT's Geographic Information System, all new and existing (remaining) outfalls.

All drainage-specific Standard Special Provisions are included in Schedule 5, Section 20, (Modifications to Standard Specifications).

#### **12.3.1 Pipe Material Selection Policy**

The Concessionaire shall comply with the CDOT *Design Bulletin Pipe Material Selection Policy* which is included in Schedule 5A. The most current version as signed by the CDOT Chief Engineer at the time of the Request for Proposals (RFP) shall be utilized.

Clarifications of the CDOT Pipe Material Selection Policy are as follows:

1. Trial installations are not allowed on the Phase 2 Construction Work.
2. Concessionaire shall sample soil and water.
3. "Project Manager" implies "Concessionaire."

4. Concessionaire shall provide a sampling schedule for pipe selection for HPTE review prior to NTP1.
5. Pipe material selection shall be submitted to HPTE for Acceptance as part of the Drainage Reports.
6. Aluminum alloy pipe shall not be used.
7. Contractor shall submit specifications for HDPE pipe used in MSE wall strap zones for CDOT review.

### 12.3.2 Project Special Provisions

Subsection 603.07(a) shall include the following:

Joints for all circular reinforced pipe shall be made with confined rubber gaskets. Concrete collars shall be required at all nonstandard joints (not tongue and groove or bell and spigot), and at all connections to existing pipe.

Subsection 603.07(c) shall include the following:

All welding of HDPE pipe and fittings shall be performed by qualified and certified personnel trained in Extrusion Welding. Certifications shall be provided to CDOT prior to performing any welding for the Project

In order to limit thermal expansion, all HDPE connections made to concrete structures shall be made a minimum of 24 hours after the HDPE pipe has been installed and backfilled.

Subsection 624.03 shall include the following:

Joint systems for siphons, irrigation systems, and storm drains shall be watertight. Testing of joints shall be performed by the Concessionaire in accordance with approved methods. Should any section of siphon, irrigation system, and/or storm drains fail to meet the test requirements, it shall be corrected at the Concessionaire's expense.

## 12.4 Deliverables

### 12.4.1 Master Plan Drainage Report

The *Master Plan Drainage Report* is included in the Reference Documents.

#### 1.2.4.1.1 Interim and Final Drainage Reports

Interim Drainage Reports shall be submitted by the Concessionaire prior to over the shoulder reviews, 100% reviews, and for Acceptance prior to Release for Construction Documents for each segment as defined by the Concessionaire. .

A Final Drainage Report, incorporating all Accepted Interim Drainage Reports, shall be prepared by the Concessionaire and submitted for Approval prior to Acceptance of Phase 2 Construction Work. No addenda to the Final Drainage Report will be allowed.

The Interim and Final Drainage Reports shall follow the documentation procedure in chapter 4 of the CDOT *Drainage Design Manual*.

The Drainage Reports shall include the following:

1. Basic design data, design assumptions, hydrologic and hydraulic methodologies, assumptions, model inputs and outputs, detailed calculations, computations, and

- computer printouts, relevant design criteria, circumstances influencing design, discussion of all drainage issues and drainage facilities, appropriate maps, figures, and plans,
2. Rationale for sizing and selection of all drainage elements, including catch basins, storm drain systems, Cross Drains, ditches, swales, PSQFs, detention facilities, and pipe materials selection.
  3. Hydraulic data sheets with a summary of hydraulic design information for each Storm Drain and Cross Drain.
  4. A delineation of contributing basins, existing drainage patterns for both highway and cross-drainage flows, drainage parameters, inflow hydrographs for detention basins, detention basin sizing, discharge characteristics, discharge hydrographs for detention basins, detention times, and other information necessary for the design of the drainage system. All Drainage Reports shall include documentation of any tributary flows from areas outside of each construction segment as defined by the Concessionaire.
  5. Documentation that the proposed runoff will be controlled and treated in accordance with this Schedule 5, Section 12 and all drainage and water quality permits.
  6. Documentation of existing drainage discharge rates, outfall locations and pond release rates.
  7. Documentation of the impact of proposed drainage designs on existing drainage facilities.
  8. Documentation of compatibility with the Ultimate Configuration.
  9. Calculations, analysis, and all related information used in developing conclusions and recommendations for PSQFs in accordance with CDOT New Development Redevelopment (NDRD) requirements.

In addition to the documentation procedure in Chapter 4 of the CDOT *Drainage Design Manual*, the Concessionaire shall follow the report outline below. The section and subsection headings shall be maintained at a minimum. If a section or subsection is not used, the reason it is not applicable to the Project shall be specified. New sections or additional subsections shall be added as necessary to fully document the drainage design.

### **Drainage Report Outline**

- 1 INTRODUCTION
  - 1.1 Location of Improvements
  - 1.2 Description of Improvements
  - 1.3 Discussion of Drainage Investigation
- 2 CROSS DRAINAGE, DRAINAGEWAY, AND IRRIGATION DITCH CROSSINGS
  - 2.1 Location and General Discussion
  - 2.2 Hydrology and Design Flow Development
    - 2.2.1 Information Sources
  - 2.3 Agency Coordination (i.e. UDFCD, local agencies)
  - 2.4 Description of Structural Design (i.e. for non-CDOT standard CBCs)
  - 2.5 Hydraulic Design

- 2.6 Irrigation Ditch Crossings
- 2.7 Drainageways and Floodplains
- 2.8 Scour Analysis
- 2.9 Bank Stabilization
- 3 ROADWAY DRAINAGE SYSTEMS
  - 3.1 General Discussion
  - 3.2 Design Coordination
    - 3.2.1 Adjacent Segments
    - 3.2.2 Agency Coordination
  - 3.3 Drainage Basin Delineations & Characterization
    - 3.3.1 Existing Basins
    - 3.3.2 Proposed Basins
  - 3.4 Hydrology and Design Flow Development
  - 3.5 Pavement, Median and Roadside Drainage
    - 3.5.1 Inlet/Catch Basin Spacing Design
    - 3.5.2 Storm Drain Design
    - 3.5.3 Roadside Ditch and Channel Design
    - 3.5.4 Erosion Control Design
- 4 PERMANENT STORMWATER QUALITY FACILITIES
  - 4.1 Assumptions and Methodologies
    - 4.1.1 Allowable Release Rate Discussion
  - 4.2 Hydrology and Hydraulics
    - 4.2.1 Storage and Outlet Design Documentation
  - 4.3 Adherence to the CDOT MS4 Permit and NDRD requirements
- 5 APPENDICES
  - 5.1 Hydrologic Analysis
    - 5.1.1 On-Site Hydrology
    - 5.1.2 Off-Site Hydrology
    - 5.1.3 Precipitation Data
    - 5.1.4 Soil Survey
    - 5.1.5 Land Use
    - 5.1.6 FEMA Maps
  - 5.2 Hydraulic Analysis
    - 5.2.1 Spread width, Inlet and Storm Drain Calculations
    - 5.2.2 Roadside Ditch and Channel Calculations
    - 5.2.3 Hydraulic Grade Line Calculations
    - 5.2.4 Drain Outfalls, Scour and Erosion Control Calculations
    - 5.2.5 Sub-Drainage Systems
  - 5.3 Permanent Stormwater Quality Facilities
    - 5.3.1 Extended Detention Basin Calculations
    - 5.3.2 Stage Storage Calculations

- 5.3.3 Trickle Channel Calculations
- 5.3.4 Water Quality Structure Calculations
- 5.4 Basin Maps
  - 5.4.1 Existing and Proposed On Site Basin Maps
  - 5.4.2 Off Site Basin Maps (full size 22" x 34" sheets)

The Concessionaire shall submit 3 hard copies of all Interim Drainage Reports and 3 hard copies of the Final Drainage Report. All Drainage Reports shall be signed and sealed by a Colorado licensed professional engineer.

The Concessionaire shall submit one electronic copy of all signed and sealed Drainage Reports in PDF format.

All Drainage Reports shall include electronic copies of all computer analysis input and output files in the native file format.

#### **12.4.4 Interim and Final Water Quality Reports**

The purpose of the Water Quality Report is to document permanent water quality design decisions for compliance with the CDPHE. All decisions shall adhere to the NDRD program as part of CDOT's overall MS4 permit. A *Master Plan Water Quality Report* is included in the Reference Documents.

Interim Water Quality Reports shall be submitted by the Concessionaire prior to over the shoulder reviews, 100% reviews, and for Acceptance prior to Release for Construction Documents for each segment as defined by the Concessionaire.

A Final Water Quality Report, incorporating all Accepted Interim Water Quality Reports, shall be prepared by the Concessionaire and submitted for Approval prior to Acceptance of Phase 2 Construction Work. No addenda to the Final Water Quality Report will be allowed.

The Water Quality Reports shall reference the applicable drainage report for all technical aspects and design calculations.

The Water Quality Reports shall include the following:

1. All assumptions, circumstances influencing design, and design criteria-related decisions shall be documented.
2. Design decisions shall be documented and shall be based on sound engineering principles.
3. All related references including maps, figures, and plans shall be provided in the appendix.
4. All Water Quality Reports and maps shall include documentation of any tributary flows from areas outside of each defined construction segment.
5. An exhibit showing the Phase 2 Construction Work in relation to the MS4 boundary area.

The Concessionaire shall prepare an NDRD exhibit to be included with all Water Quality Reports. The NDRD exhibit shall include the following:

1. A delineation of each basin with a colored, solid-filled, hatch pattern. Each basin shall be tributary to a specific PSQF. Provide different colors for each PSQF

basin. These basins shall incorporate the sub-basins found in the Drainage Reports.

2. A label for each water quality basin. Include the typical basin designation circle label. Include within the circle the water quality basin ID, the basin area, and the impervious area with that basin. Provide a legend to describe the basin designation label.
3. A label for the proposed PSQFs serving each basin. The Concessionaire shall ensure that the location of the PSQF matches the proposed locations found in the construction drawings.
4. Flow direction arrows.
5. A delineation of disturbed areas for the Phase 2 Construction Work.
6. A table with six column headings. The column headings shall be; Basin Color, Basin ID, Type of PSQF used to Treat Area, Required Impervious Area to be Treated, Actual Impervious Area Treated, and Comments. At the bottom of the table sum the columns for required impervious area to be treated and the actual impervious area treated.
7. If the actual impervious area treated is less than the required impervious area to be treated, the Concessionaire shall provide a note on the NDRD exhibit describing why it could not capture and treat the required impervious area for the Phase 2 Construction Work.

The Concessionaire shall submit 3 hard copies of all Interim Water Quality Reports and 3 hard copies of the Final Water Quality Report. All Water Quality Reports shall be signed and sealed by a Colorado licensed professional engineer.

The Concessionaire shall submit one electronic copy of all signed and sealed Water Quality Reports in PDF format.

The Water Quality Reports shall closely follow the report outline below.

The Water Quality Report Outline as shown below shall be maintained at a minimum. If a section or subsection is not used the reason it is not applicable to the Phase 2 Construction Work shall be specified. New sections or additional subsections shall be added as necessary to fully document the design.

### **Water Quality Report Outline**

1. TABLE OF CONTENTS
2. INTRODUCTION
  - Vicinity Map. Site location, stationing, state highway number, name of receiving waters, location of existing and proposed outfalls, geographic reference (county, nearest town), and jurisdictional MS4 boundary areas.
3. DISCUSSION OF CDOT MS4 / NDRD REQUIREMENTS
  - Discussion of how proposed PSQFs satisfy CDOT's MS4 requirements
  - Site map showing locations of PSQFs
  - Relationship of PSQFs to major drainageway and outfall systems plans

- Detailed description, design criteria, and references to specifications and technical details of PSQFs as documented in the applicable Drainage Reports.
- Detailed descriptions, design criteria, and locations of stream stabilization measures to be implemented,
- Design objectives
- Treatment options
- Expected pollutant removal rates
- Existing water quality features that will be abandoned, reconfigured, or incorporated into a new design.
- ROW needs and/or concerns
- Recommended design
- Maintenance and operation requirements, inspection protocols, and maintenance schedule

The following topics shall be addressed in detail:

- a) Description of project and land disturbance in acres.
- b) What area (in acres) is required to be treated, what area (in acres) of treatment is provided, what area (in acres) is not treated, and what area (in acres) is treated in addition to what is required. Include this information in the report and as a note on the NDRD exhibit.
- c) Detailed description, design criteria, justifications (why an area is not treated), decision making process (why a permanent BMP was chosen over another), location of permanent BMPs to be implemented, and analysis as to how permanent BMPs (combination or individual) satisfy the current CDOT NDRD requirements.
- d) Provide the certification number for the CDPS Construction Permit for the Phase 2 Construction Work.

#### 4. MAINTENANCE AND OPERATION

- Narrative description of the facility  
Example: Extended detention pond with a single cell outlet structure with an orifice plate which is designed for a 40-hour drain time. Three inlets drain into the basin which has a concrete lined forebay with grouted riprap berm. The forebay is designed to drain within 5 minutes and keep out large floatable/debris.
- Narrative description of maintenance access to the facility  
Example: maintenance access off of southbound I-25 before guardrail or take ramp from southbound I-25 to westbound Speer. Parking is from the shoulder.
- Narrative description of what maintenance work will need to be done to ensure continued effectiveness of the facility.  
Example:

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- Mowing basin to keep vegetation controlled so water can continue to flow unhindered. Remove vegetation from facility to keep from re-clogging grates and orifice plate.
- Clean trash rack/grates of debris and dispose of off of PSQF site
- Clear orifice plate holes so water can continue to flow
- Remove sediment from basin when reaches lowest orifice hole or blocking forebay outlet pipe. Can use hand shovels, bob cats/skid steers. Remove sediment off of PSQF site to keep from re-polluting the pond.
- Re-seed as necessary to keep area stable of erosion
- Add additional erosion control items to keep area stable.
- Tighten/replace trash rack bolts and screens as necessary to keep structure in working order.
- Documentation of commitments from responsible agency (such as Intergovernmental Agreements, Memoranda of Understanding, etc.) or Owner to maintain the PSQF's shall be required and included with the Final Water Quality Report



## 5. APPENDIX

Phase 2 Construction Work in relation to MS4 boundary area exhibit.  
NDRD exhibit

### 12.5 Deliverables

#### 12.5.1 Drainage Design Deliverables

The Concessionaire shall prepare plans for all drainage related facilities for the Phase 2 Construction Work in a format that follows the documentation procedure in chapter 4 of the *CDOT Drainage Design Manual*, and the *CDOT CADD Manual* and *CDOT Drafting Manual*.

The Concessionaire shall submit all applicable plans with each Drainage Report.

All deliverables shall follow the Quality Management Plan for the Phase 2 Construction Work as described in Schedule 5, Section 2, (Project Management).

The Concessionaire shall include the following for all drainage plan deliverables:

##### PLAN VIEW

1. Provide the location of all existing and proposed drains. Provide a label for each proposed drain location. The Concessionaire shall establish a labeling system that is specific to each proposed storm drain system and provide a table to summarize all pertinent information. The table shall include at a minimum the drain line and sheet number where the profile can be found.
2. Provide the location of all existing and proposed inlets, manholes, end sections, and outlet protection. Provide a label for each proposed inlet, manhole, end section, and outlet protection. Include a table that summarizes all pertinent information. The table shall include, at a minimum, the Label ID, station & offset, item, length, pay depth, and notes.
3. Provide all existing and proposed grading.
4. Provide all Utility locations.
5. Provide location of ROW lines.

##### PROFILES

1. Provide profiles for all proposed storm drains. Include the label ID from plan view sheets, station and offset, invert elevations, rim elevations, structure depth, slopes, sizes, material, utility crossings, existing and proposed finished grade lines, the design flow for the 10-year and 100-year event, and the calculated hydraulic grade line for the 10-year and 100-year event.
2. Provide profiles for all proposed Cross Drains. Include the label ID from plan view sheets, station and offset, invert elevations, slopes, sizes, material, utility crossings, and existing and proposed finished grade lines. Provide the drainage area of contributing basin, 100-year discharge, and headwater elevation on all applicable profile sheets for Cross Drains.

##### DRAINAGE DETAILS

1. Include details for all non-standard CDOT items.

##### PSQF DETAILS FOR EDB

1. Provide each EDB in plan view. Provide existing and proposed contours that define limits of overall facility. Include access roads, overflow location or structure, forebay, trickle channel, micropool, and outlet structure. Include all locations of Utilities and property lines. Include point labels to define location and elevations within the facility.
2. Provide a table summarizing each point label. The table shall include at a minimum the point label, station & offset, northing, easting, elevation and notes.
3. Provide a cross section of the EDB from where flows enter the pond to the outlet structure. Label elevations for the WQCV, 10-year, and 100-year events. Include slopes and elevations of all features.
4. Provide a geometry plan of the EDB from where flows enter the pond to the outlet structure. Include access roads.
5. Provide specific details for the forebay, trickle channel, micropool, and outlet structure.

**PSQF DETAILS FOR MFD**

1. Provide each MFD in plan view. Provide existing and proposed contours that define limits of overall facility. Include all locations of Utilities and property lines. Include point labels to define location within the facility.
2. Provide a table summarizing each point label. The table shall include at a minimum the point label, station & offset, northing, easting, and notes.
3. Provide a cross section and specific details of the MFD.

**12.5.2 As-Built Documents**

Clearly label and locate all items of Work with station, offset, and elevation information based on surveys of what was actually built in the field. Provide summaries of all as-built drains with the following hydraulic information, at a minimum: pipe/culvert size, invert elevations, slope, capacity, velocity, roughness coefficient, and hydraulic grade line.

**12.5.3 Deliverable Table**

At a minimum, the Concessionaire shall submit the following to HPTE for Review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
Interim Segment Drainage Reports	Acceptance	Prior to Over the Shoulder Reviews, 100% Reviews, and Release for Construction Documents for each segment
Interim Segment Water Quality Reports	Acceptance	Prior to Over the Shoulder Reviews, 100% Reviews, and Release for Construction Documents for each segment
Final Drainage Report	Approval	Prior to Acceptance of Phase 2

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<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
		Construction Work
Final Water Quality Report	Approval	Prior to Acceptance of Phase 2 Construction Work
CLOMR	Acceptance	Prior to issuance of Release for Construction Documents for each Segment
LOMR	Acceptance	After project is constructed (will need design services after construction)
Sampling schedule for pipe selection	Review	Prior to NTP1
Groundwater elevations at pond locations	Review	Prior to NTP1
SWMP Site Map	Acceptance	Prior to Release for Construction.
SPCC Plan	Acceptance	Prior to NTP1
Stormwater Management Plan(s)	Acceptance	Prior to Release for Construction
Specifications for HDPE Pipe used in MSE Wall Strap Zones	Review	Prior to Release for Construction

## 13.0 ROADWAYS

### 13.1 Administrative Requirements

The Concessionaire shall comply with the requirements of the following manuals and standards (latest versions on the effective date of the Final RFP) for the design and construction of the Work of this Section 13.

#### 13.1.1 US 36, Interchange Ramps, Bus Facilities, and Bikeway

1. Roadway Design Criteria Table (Exhibit 13-1)
2. Bikeway Design Criteria Table (Exhibit 13-2)
3. Diverging Diamond Interchange Design Criteria Table (Exhibit 13-3)
4. CDOT, *CDOT Design Guide*
5. AASHTO, *A Policy on Geometric Design on Highways and Streets (PGDH)*
6. AASHTO, *Roadside Design Guide*
7. CDOT, *Standard Plans, M & S Standards*
8. Standard Specifications
9. RTD *Bus Transit Facility Design Guidelines and Criteria*
10. RTD *Light Rail Design Criteria*
11. RTD *Commuter Rail Design Criteria*
12. RTD *Facilities Maintenance Design Manual*
13. AASHTO, *Guide for the Development of Bicycle Facilities*
14. United States Access Board, *ADA Accessibility Guidelines for Buildings and Facilities*, current edition
15. United States Access Board, *Revised Draft Guidelines for Accessible Public Rights-of-Way*
16. State of Colorado, *State Highway Access Code*
17. AASHTO, *Guide for High-Occupancy Vehicle Facilities*

#### 13.1.2 Local Roadways

Roadways controlled or maintained by Local Agencies other than CDOT shall be designed and constructed according to the Local Agency's standards and requirements. Manuals and standards for the Local Agencies are as follows:

1. City of Boulder *Standards and Specifications* (streets within Boulder)
2. City of Louisville *Standards and Specifications* (streets within Louisville)
3. City of Superior *Standards and Specifications* (streets within Superior)

## 13.2 Design Requirements

Design of the Phase 2 Construction Work shall be in accordance with the Roadway Design Criteria Table as provided in Exhibit 13-1, as well as Schedule 5, Section 1, (General).

### 13.2.1 Design and Plan Submittals

In addition to the submittal requirements specified in this Section 13, the Concessionaire shall submit design and plan documents for HPTE Approval and Acceptance, as required in Schedule 5, Section 3, (Quality Management).

### 13.2.2 General Design Requirements by Phase 2 Construction Work Element

#### 13.2.2.1 Ultimate Configuration Accommodation

The infrastructure constructed with the Phase 2 Construction Work shall consider and accommodate the Ultimate Configuration improvements, including but not limited to horizontal and vertical geometric requirements, clearances and cover to structures, and superelevation transitions.

#### 13.2.2.2 US 36 Mainline

The Concessionaire shall reconstruct the US 36 mainline to provide two general purpose lanes and a Managed Lane in each direction on US 36 from the east side of the east Foothills Parkway interchange ramps to the beginning of the Phase 1 Corridor east of 88<sup>th</sup> Street, Station 1388+00.

The Concessionaire shall provide appropriate ramp acceleration and deceleration lanes but shall not provide continuous auxiliary lanes between interchanges or accesses.

The Concessionaire shall provide enforcement zones at each Electronic Toll Collection (ETC) point that meet the following design requirements:

1. Provide bi-directional, flared-out areas within the median with an opening to access both directions of the facility.
2. Provide a minimum width of 14 feet for the refuge area within the flared out area.
3. Provide a minimum length of 120 feet for the full-width refuge area.
4. Maintain a minimum inside shoulder width of 4 feet through the enforcement zone area.

#### 13.2.2.3 Foothills Parkway Interchange

At the Eastbound US 36 on-ramp, the Concessionaire shall match existing ramp width and provide single-lane entrance and acceleration lane with a minimum 8 foot wide shoulder.

At the Westbound off-ramp, the Concessionaire shall provide single-lane exit transitioning to ramp with lanes and widths required to match existing ramp.

#### 13.2.2.4 Scenic Overlook Access

At the Westbound on-ramp, the Concessionaire shall provide single-lane entrance and acceleration lane with a minimum 6 foot wide shoulder.

At the Westbound off-ramp, the Concessionaire shall provide deceleration lane with 12 foot wide shoulder and single-lane exit transitioning to width required to match existing access.

#### **13.2.2.5 McCaslin Boulevard Interchange**

The Concessionaire shall reconstruct the existing diamond interchange at McCaslin Boulevard to provide a Diverging Diamond Interchange (DDI) according to the following requirements:

1. Three through lanes in each direction shall be provided through the interchange along McCaslin Boulevard.
2. Yield-controlled right and left turn movements shall be provided at the interchange off ramps, with the exception of the eastbound off ramp to southbound McCaslin Boulevard right turn movement. This movement shall have three turn lanes and signal control.
3. Free-flow left and right turn movements shall be provided at the interchange on-ramps. A southbound right turn lane between Dillon Road and the westbound US 36 on-ramp shall be included in the DDI.
4. New traffic signals shall be provided at the crossover intersections.
5. Islands shall be sized to efficiently channelize traffic, provide pedestrian refuge, safely cross pedestrians at auto lanes, and allow for urban amenity treatments.
6. Five foot (5') on-street bike lanes (exclusive of gutter pan) shall be included through the DDI.
7. Eight foot (8') sidewalks shall be included on both sides of McCaslin Boulevard north and south of the DDI intersections, and a 12' sidewalk in the center median shall be included across the bridge.
8. The 12' sidewalk in the center median shall be separated from traffic lanes by a Type 7 barrier modified as shown in the McCaslin Interchange Enhancement Concepts.
9. Two RTD bus stops with RTD compliant pedestrian refuge areas shall be provided at two locations in the median islands along McCaslin Boulevard between the DDI intersections. These shall be far side stops on the median side.
10. RTD park-n-ride accessibility to the west of McCaslin Boulevard shall be enhanced through use of bus-only ramps accessing US 36 with grade separations from the west side ramps to access the existing or modified bus stops on the west ramps.
11. RTD park-n-ride bus staging area and platforms shall be reconstructed and connected to existing sidewalks, stairs and ramps. Station amenities and landscaping shall be reset or replaced in kind.

RTD's design standards shall be used for the design of the bus stops along McCaslin Boulevard, the bus access ways, and the stops, walkways, amenities and platforms at the park-n-rides. These standards can be accessed at: <http://www3.rtd-denver.com/elbert/Criteria/index.cfm> Plaza amenities shall be consistent with plaza improvements being constructed at other corridor ramp bus/BRT stations as a part of the US 36 Phase 1 project.

#### **13.2.2.6 McCaslin Pedestrian Underpass (Option 1)**

The Concessionaire shall provide a minimum 10' high by 18' wide pedestrian undercrossing of McCaslin Boulevard on the south side of the US 36 interchange eastbound ramps. The

Concessionaire shall provide 8-foot wide concrete trail connections which tie into the sidewalk connecting to the RTD park-n-Ride in the southwest quadrant of the interchange and into the private property parking lot in the southeast quadrant of the interchange approximately 300 feet east of the centerline of McCaslin Boulevard.

#### **13.2.2.7 Marshall Drive**

The Town of Superior has plans to construct improvements to the intersection at Marshall Drive and McCaslin Boulevard independent of this project. The proposed project is to principally add a third left turn lane to the eastbound approach. The Concessionaire shall coordinate designs and schedules as necessary to not preclude the construction of the proposed intersection improvements.

The Concessionaire shall not impact the existing Marshall Drive where it parallels US 36 west of the McCaslin interchange.

#### **13.2.2.8 Dillon Road**

The City of Louisville plans to begin construction of improvements to the intersection at Dillon Road and McCaslin Boulevard in 2012. The Concessionaire shall coordinate designs and schedules as necessary to not preclude the construction of the proposed intersection improvements.

#### **13.2.2.9 McCaslin Interchange BRT Improvements**

1. The Phase 1 DB Contractor is designing and constructing improvements at each bus/BRT station within the limits of the Phase 1 project. HPTE will provide Phase 1 design plans and specifications for the following items for the Concessionaire's use in designing and constructing these elements at each BRT station at the McCaslin Interchange:
  - a. Pedestrian Canopies (12 feet wide by 60 feet long)
  - b. Windscreens
  - c. Programmable Information Display Systems (PIDS)
2. The Concessionaire shall design and construct all associated support infrastructure for the items described in paragraph 1 above, including cabling and power, that meets the following criteria:
  - a. Provides adequate lighting per the minimum lighting requirements in Section 9.3 of the RTD Bus Transit Facilities Design Criteria.
  - b. Provides conduit from the fiber cabinet to the base of the canopies for the future installation of public address system under each canopy.
  - c. Places windscreens where most effective in blocking prevailing winds.
  - d. Provides minimum of one bench on lee side of the windscreens protecting from the prevailing winter wind. Reference the RTD Facilities Maintenance Design Manual for the preferred manufacturer and style.
  - e. Complies with American with Disabilities Act Accessibility Guidelines (ADAAG) for access and circulation around the wind screens.
  - f. Windscreens shall meet all criteria defined in Sections 5.6.5 and 5.6.6 of the RTD Light Rail *Design Criteria*.

3. The Concessionaire shall provide any existing RTD station amenities (benches, shelters, etc.) removed during the course of the Work to RTD as directed by RTD. The Concessionaire shall dispose of the existing station amenities not requested by RTD for reuse.

### **13.2.3 Cross Slope and Superelevation**

#### **13.2.3.1 Normal Cross Slope**

All new and reconstructed pavement sections shall have a normal cross slope of 2 percent.

For pavement widening sections, the widened section will have a normal cross slope of 2 percent.

For overlay sections where the existing cross slope is equal or greater than 2 percent, the Concessionaire shall maintain the existing pavement cross slope. For overlay sections where the existing cross slope is less than 2 percent the cross slope shall be built up through the use of a variable thickness overlay to a minimum of 2 percent except at the existing US 36 over South Boulder Creek bridge, where US 36 cross slopes shall transition to match existing cross slopes on the bridge.

#### **13.2.3.2 Superelevation Rates**

Superelevation runout and runoff lengths for US 36 shall be designed based on the Ultimate Configuration of US 36. Superelevation transition design shall comply with the design criteria and methodology of the PGDH.

### **13.2.4 Stopping Sight Distance**

Stopping sight distances and decision sight distances shall meet or exceed the requirements of Exhibit 13-1- Roadway Design Criteria Table in this [Section 13](#). Stopping sight distances shall be determined in accordance with the PGDH.

### **13.2.5 Fill and Cut Slopes and Clear Zones**

The Concessionaire shall design cut and fill slopes to obtain clear zones and avoid the need for guardrail wherever possible. Where clear zones cannot be obtained within CDOT ROW, guardrail shall be required.

Clear zones shall be designed in accordance with the recommendations of the AASHTO *Roadside Design Guide*.

Provide a traversable surface for maintenance access with a maximum 6:1 cross slope, a minimum 10 feet in width between slopes, drainage features, or faces of retaining walls and ROW line, permanent slope easement line, fence line, or other obstruction. Maintenance access width may be reduced to 5' if ROW line, easement line, fence line, or feature needing to be accessed is within 30' of the edge of roadway or bikeway pavement and slope is traversable and no steeper than 3:1.

#### **13.2.5.1 Roadside Slopes Adjacent to Pavement**

(Note: All slopes stated herein are in terms of horizontal:vertical)



The Point of Slope Selection (POSS) is defined as the location at which the roadside slope adjacent to the pavement ends, and the cut, or fill slope begins. Width and slope of the area between the edge of pavement (or sidewalk) and the POSS shall be as follows:

1. Mainline US 36: 18 feet minimum at a 6:1 slope
2. Ramps: 12 feet at a 6:1 slope
3. Curb and sidewalk areas: 2 feet at a 50:1 slope

#### 13.2.5.2 Fill Slopes

Fill slopes beyond the POSS shall be designed and constructed in accordance with the following priority.

1. Use 6:1 slopes where fill heights are less than 4 feet, and matches with existing conditions that can be obtained within the Phase 2 Construction Work limits.
2. Use 4:1 slopes where fill heights are greater than 4 feet but less than 10 feet, and matches with existing conditions that can be obtained within the Phase 2 Construction Work limits.
3. Use 3:1 slopes where fill heights are less than 10 feet and slopes steeper than 4:1 are required to match existing conditions within the Phase 2 Construction Work limits.
4. Use 3:1 slopes where fill heights exceed 10 feet, and matches with existing conditions can be obtained within the Phase 2 Construction Work limits and clear zone can be obtained within the Phase 2 Construction Work limits.
5. Where the above conditions cannot be obtained, the Concessionaire may use any of the following design approaches:
  - A. Use 3:1 to 2.5:1 slopes with guardrail protection. Slopes of 2.5:1 to 3:1 shall be limited to areas where slopes are transitioning to match slope paving at bridge abutments, or where transitioning to match existing slopes steeper than 3:1. Slopes of 2.5:1 to 3:1 shall comply with the slope stabilization requirements of Schedule 5, Section 17.2.9.
  - B. Use retaining walls as necessary, with guardrail protection.

Fill slope areas shall be designed with ditches and storm sewer as necessary to prevent untreated roadside and slope drainage from flowing onto adjacent properties.

All fill slopes shall be rounded at the toes or ties to existing ground.

#### 13.2.5.3 Cut Slopes

Cut slopes beyond the POSS shall be designed and constructed in accordance with the following priorities:

1. Cut slopes must be transitioned at the match with the 6:1 slopes adjacent to roadway pavement in such a manner to comply with the recommendations of the *AASHTO Roadside Design Guide*.
2. Use 4:1 or flatter slopes for cut slopes where matches with existing conditions can be obtained within the Phase 2 Construction Work limits.

3. Use 3:1 slopes for cut slopes where such slopes steeper than 4:1 are necessary to obtain matches with existing conditions within the Phase 2 Construction Work limits.
4. Where the above conditions cannot be obtained, the Concessionaire may use any of the following design approaches:
  - A. Use 3:1 to 2.5:1 slopes with guardrail protection if clear zone cannot be provided. Slopes of 2.5:1 to 3:1 shall be limited to areas where slopes are transitioning to match slope paving at bridge abutments, where transitioning to match existing slopes steeper than 3:1, or within the Davidson Mesa cut area between Stations 1221+00 and 1226+00, Lt., and 1221+00 and 1230+00, Rt., and from 1259+00 to 1262+00, Rt to minimize ROW impacts. Slopes of 2.5:1 to 3:1 shall comply with the slope stabilization requirements of Schedule 5, Section 17.2.9.
  - B. Use retaining walls as necessary, with guardrail protection to match existing conditions within the Phase 2 Construction Work limits.

All cut slopes shall be rounded at their matches to existing ground.

### 13.2.6 Guardrail

Guardrail shall be required wherever clear zone requirements cannot be achieved.

Median barrier is required along the entire length of US 36. Median barrier shall be concrete barrier with a concrete glare screen in accordance with CDOT Standard M-606-13.

The existing concrete median barrier from the western limit of US 36 reconstruction to 1,000 feet west of the Table Mesa Drive over US 36 bridge shall also be replaced with concrete barrier with a concrete glare screen in accordance with CDOT Standard M-606-13. Existing barrier within existing bridge piers may remain in place and no additional glare screen is needed between piers. The new barrier shall be designed and built to accommodate the existing drainage inlets.

Guardrail along outside shoulders US 36 shall be concrete barrier where inlets are required for pavement drainage. Type 3 guardrail with asphalt curb will not be allowed for drainage accommodation.

Where guardrail or bridge rail is required to separate the roadway from adjacent Bikeway, the guardrail/barrier shall have a minimum height of 42 inches.

All concrete barrier shall be cast-in-place. Precast barrier is not allowed for permanent installations.

### 13.2.7 Bikeway

"Interim Bikeway Criteria" as shown in Exhibit 13-2 may only be used in areas where bikeway is routed on existing paths or sidewalks and widening or reconstruction to the Final Bikeway Criteria is not feasible without obtaining additional ROW.

#### 13.2.7.1 Bikeway Values

The Bikeway is to be a commuter facility. The Bikeway design shall:

1. Maximize Bikeway user safety.

2. Minimize Bikeway out-of-direction travel.
3. Minimize at-grade intersection and street crossings, especially of high-volume, higher-speed roadways.
4. Provide horizontal and vertical separation from mainline US 36 that enhance the user experience and that minimizes the need for barrier separation from mainline in the initial and ultimate conditions.
5. Connect to existing adjacent on-street and off-street facilities where feasible.

### 13.2.7.2 Bikeway Options

Bikeway options that include elements that provide improved accommodation of the values in Schedule 5, Section 13.2.7.1, above, may be implemented in lieu of the Bikeway Basic Configuration described in Schedule 5, Section 13.2.7.3, below. The Concessionaire is responsible for obtaining any additional clearances, approvals, permits, and ROW required to implement alternative Bikeway options or alignments.

### 13.2.7.3 Bikeway – Basic Configuration

Provide a continuous Bikeway from the existing Table Mesa Drive RTD Park-n-Ride to a connection with the Phase 1 Corridor Bikeway east of 88<sup>th</sup> Street.

Bikeway and connections to existing trails or streets shall conform to the following requirements and Design Criteria in Exhibit 13-2:

1. Width: 12 feet
2. Pavement: 6-inch-thick concrete with sawn joints

#### Base Bikeway Alignment and Connection Requirements

1. Table Mesa Drive to South Boulder Creek: Construct new 12-foot Bikeway beginning at RTD station, continuing adjacent to eastbound US 36 Foothills Parkway on-ramp. Once adjacent to US 36, continue Bikeway parallel to US 36. Connect to existing South Boulder Creek trail on the south side of US 36.
2. Provide 12 foot wide paved trail beneath South Boulder Creek bridge with adjacent soft surface trail for equestrian use.
3. Connect to existing South Boulder Creek trail on the north side of US 36 and construct loop up to US 36 and over South Boulder Creek on the widened US 36 bridge.
4. Continue parallel to US 36 with a minimum separation between the Bikeway pavement edge and US 36 shoulder of 20 feet up to the Scenic Overlook. Modify existing terraced retaining walls to place Bikeway above lower retaining wall for crossing under existing Cherryvale bridge.
5. Provide an 8 foot wide connection to the existing field entrance on the west side of Cherryvale Road, north of US 36. Connection shall be constructed with the same pavement and subgrade section as the US 36 Bikeway.
6. Continue Bikeway along the north side of Scenic Overlook. East of Scenic Overlook, continue parallel to US 36 to approximate Station 1275+00.
7. From Station 1275+00, continue the Bikeway east along the existing Dyer Road alignment. Reconstruct existing sidewalk on south side of Dyer Road to Bikeway standards up to and through the McCaslin/Dillon Road intersection to Coal Creek

- Circle. Continue sidewalk reconstruction for Bikeway south on Coal Creek Circle, and construct Bikeway through the existing ROW to the north side of the McCaslin westbound off-ramp.
8. Continue Bikeway along the north side of the McCaslin Boulevard westbound off-ramp and connect to existing Coal Creek trail.
  9. Reconstruct existing Coal Creek trail between limits of north and south connection, and within structure under US 36.
  10. Connect to existing Coal Creek trail on south side of US 36. Provide a bridge crossing of Coal Creek.
  11. Continue Bikeway on south side of US 36. Provide underpass of US 36 at location of existing underpass at Station 1357+.
  12. Connect existing trail on north side of US 36 and continue east through Scriffiny - Boulder County Open Space as generally described in the *Scriffiny Open Space Letter* document in the Reference Documents. Minimize impacts to existing irrigation ditches and laterals.
  13. Continue south along 88<sup>th</sup> Street and under existing 88<sup>th</sup> Street bridge. Connect to Phase 1 Corridor Bikeway.

#### **13.2.7.4 Bikeway Connection Underpass at 1267+00**

Provide a 14'x10' underpass at approximate Station 1267+00 with a connection to shoulder of Marshall Drive on the south, and a connection to the US 36 Bikeway on the north. Connections and underpass crossing shall be designed and constructed to US 36 Bikeway requirements.

#### **13.2.7.5 Bikeway Warranty**

The Concessionaire shall be responsible for Concrete Bikeway materials compliance, workmanship, and warranty work as detailed in Regions of Section 608 *Warranted Concrete Bikeway* in this Section 13.

### **13.2.8 Design Exceptions**

#### **13.2.8.1 Identified Design Exceptions**

Table 13.2-2 lists design variances that have been identified by HPTE and may be required for the Phase 2 Construction Work. HPTE will obtain FHWA approval of these exceptions. Design exceptions required for the Concessionaire's design shall be identified in the Concessionaire's Proposal in accordance with RFP Section 2.1. Approval of additional or revised design exceptions required for the Concessionaire's design shall be obtained by the Concessionaire in accordance with Schedule 5 Section 13.2.8.2.

#### **13.2.8.2 Design Exception Process**

The Concessionaire shall comply with the following requirements when requesting a design exception:

1. The Concessionaire shall submit 5 copies of design exception requests in the form of a letter addressed to the HPTE project manager.
2. The design exception request submittals shall consist of the following items:

- A. A letter identifying the exception(s) by number, Project number, location, and status (new submittal, resubmittal, etc.)
- B. A completed CDOT Form 464a
- C. Supporting documentation indicating the justification for the exception. Justification shall address the following items:
  - (1) Site conditions of the exception.
  - (2) Compelling reason for the exception, including which standard is not being met, if the exception affects any other standards, and what will be done to mitigate the effects of the exception.
  - (3) Effects of the exception on safety and operation of the facility.
  - (4) Previous crash history near the location of the exception.
  - (5) Calculations estimating the cost of attaining the design standard and costs of exception as proposed.
  - (6) Effect on scenic, historical, or other environmental features.
- D. Plan and profile drawings depicting the exception.

<b>Table 13.2-2 IDENTIFIED DESIGN EXCEPTIONS</b>				
<b>No.</b>	<b>Item</b>	<b>Design Criteria</b>	<b>Design Exception</b>	<b>Comments</b>
DE-1	US 36 Maximum Profile Grade, Station 1202+00 to 1227+00	4.0%	5.17%	Steeper grade required to match existing and minimize ROW and environmental impacts.
DE-2	Eastbound US 36 shoulder widths on South Boulder Creek Bridge	12' inside 12' outside	9' inside 10' outside	Narrower shoulders required to match existing bridge.
DE-3	US 36 Cross Slope at South Boulder Creek Bridge	2%, crowned at US 3 centerline	1.5% - 2%, crowned at center of existing lanes	Existing bridges constructed with crown points at existing lanes.

### 13.3 Construction Requirements

#### 13.3.1 Removals

The Concessionaire shall be responsible for the removal of all items on the Phase 2 Construction Work found to conflict with Phase 2 Construction Work design elements. Removal items shall become the property of the Concessionaire unless designated to remain property of HPTE or RTD.

### 13.3.1.1 Roadways

The Concessionaire shall remove abandoned portions of roadways and roadway fills reconstructed as a part of the Phase 2 Construction Work. The Concessionaire shall smooth the area to blend into adjacent terrain, and topsoil and seed.

### 13.3.1.2 Water Wells

The Concessionaire shall remove and abandon any water wells within properties acquired by the Project in accordance with applicable regulations.

### 13.3.2 Guardrail

The Concessionaire shall use galvanized guardrail (Standard Plan No. M606-1) with steel posts and composite block for guardrail installations which are not required to be concrete, unless otherwise Approved by HPTE. The Concessionaire shall pave asphalt a minimum of 1 foot behind the new guardrail.

### 13.3.3 McCaslin Interchange Streetscape Enhancements

The Concessionaire shall provide streetscape enhancements at the McCaslin Boulevard interchange in accordance with the urban design details provided in the McCaslin Interchange Enhancement Concepts in the Reference Documents. This work shall include tinted patterned concrete crosswalks, raised planting beds, texture and color enhancements of median and patterned concrete median cover material.

The Concessionaire shall submit Streetscape Enhancement plans for the improvements with preliminary and final design plans of the associated interchange design elements.

### 13.3.4 Fencing

#### 13.3.4.1 Temporary Fencing

The Concessionaire shall provide temporary fencing if required by ROW acquisition agreements to protect adjacent private property. Temporary fence shall be placed to protect sensitive environmental areas, as defined in Schedule 5, Section 5, (Environmental Requirements).

#### 13.3.4.2 Permanent Fencing

Provide permanent fencing of types and at locations in Table 13.3-1.

<b>Location</b>	<b>Type</b>	<b>Remarks</b>
Right-of-Way line (adjacent to Boulder Open Space properties)	Wildlife-Friendly	Per recommendations in Schedule 5, 5.2.3.1
Right-of-Way line (other)	Combination wire with wooden posts	Per CDOT Standard M-607-1
Access control between Bikeway and US 36	Combination wire with wooden posts	Per CDOT Standard M-607-1
Water quality/detention ponds	Combination Wire with wooden posts	Per CDOT Standard M-607-1

Wildlife crossings	Fencing appropriate to wildlife type	
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### 13.3.4.3 Gates

Provide gates in fences at locations and of width and type as specified by HPTE or maintaining entities for maintenance access.

### 13.3.5 Safety Edge

The Concessionaire's design shall include Safety Edges, as defined in Schedule 5, Section 20 and as shown in the plans in the Reference Documents. Safety Edges shall be required on all mainline US 36 pavement and ramp pavement. Safety Edges shall not be required in front of guardrail, adjacent to median barrier, mainline US 36 abutting ramp pavement, or on roadways that require curb and gutter.

## 13.4 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Preliminary design plans for ultimate improvements	Acceptance	With preliminary and final design plans for related initial build elements
Design exceptions	Approval	As part of the ATC and Proposal process, and prior to issuance of applicable Release for Construction Documents
Streetscape enhancement plans for McCaslin Diverging Diamond Interchange	Acceptance	With preliminary and final design plans

<b>Exhibit 13-1 – Roadway Design Criteria</b>			
<b>DESIGN DATA</b>	<b>US 36</b>	<b>Ramps (A)</b>	<b>Remarks</b>
Roadway Classification	Freeway	-	
Location	Foothills Pkwy to 88 <sup>th</sup> Street	Various	
Design Speed (MPH)	65	45 <sup>(D)</sup>	
Posted Speed (MPH)	65	45	
<b>GEOMETRIC STANDARDS</b>			
<b><u>Horizontal Geometry</u></b>			
Min Radius (ft.)	1660	643 <sup>(D)</sup>	
Emax (%)	6%	6%	
Pivot Point	Centerline	Varies	
<b><u>Vertical Geometry</u></b>			
Minimum Profile Grade (%)	0.5% <sup>(H)</sup>	0.5%	
Maximum Profile Grade (%)	4% <sup>(I)</sup> (DE-1)	5% <sup>(B)</sup>	
Min. Rate of Vertical Curve (K) Crest	193	61 <sup>(D)</sup>	
Min. Rate of Vertical Curve (K) Sag	157	79 <sup>(D)</sup>	
<b><u>Sight Distance</u></b>			
Min. Stopping Sight Distance (ft)	645	360 <sup>(D)</sup>	
<b><u>Vertical Clearance</u> <sup>(C)</sup></b>			
Below Structure (ft)	16.5	16.5 <sup>(E)</sup>	
Below Structure (Pedestrian Bridge) (ft)	17.5	17.5	
<b><u>Horizontal Clearance</u></b>			
<b>CROSS SECTION</b>			
<b><u>Lanes</u></b>			
Lane Widths (ft.)	12	15 for single lane, 2-12 for 2-lane	



<b>Exhibit 13-1 – Roadway Design Criteria</b>			
<b>DESIGN DATA</b>	<b>US 36</b>	<b>Ramps (A)</b>	<b>Remarks</b>
Managed Lane Widths	12	-	
Managed Lane Buffer	4	-	
<b><u>Shoulders</u></b>			
Shoulder Widths - LT/ Median (ft.)	12 <sup>(F)</sup> (DE-2)	4	
Shoulder Widths - RT/ Median (ft.)	12 (DE-2)	8	
Shoulder Surface	Paved	Paved	
<b><u>Curb and Gutter</u></b>			
Curb and Gutter Required	No	No	
<b><u>Median</u></b>			
Median Width (ft)	2	-	
Treatment	Concrete Barrier	-	
<b><u>Intersection at Grade</u></b>			
Min. Curb radius (ft)	-	-	
<b><u>Design Vehicle</u></b>			
	WB-65	WB-65	

(DE-X) See [Table 13.2-2](#) for specific geometric exceptions to this criteria

(A) Ramps shall meet or exceed design criteria unless noted in Exhibit 13-1A – Acceptable Minimum Criteria for Entrance and Exit Ramps

(B) May exceed maximum grade to tie into existing ramp grades. Grades of up to 5.5% are permissible McCaslin WB On Ramp and EB Off Ramp

(C) Vertical clearance requirements must also be met for the Ultimate Configuration condition.

(D) Design Speed of ramps may be reduced approaching cross road intersections and bus pads on McCaslin bus-only ramps based on standard design practice. Minimum radii, vertical curve K values, and stopping sight distances may be reduced to corresponding Design Speed of ramp.

(E) Fourteen feet (14') of vertical clearance at the braided interchange ramps and bus access ramps at the McCaslin Diverging Diamond Interchange is acceptable.

(F) US 36 inside shoulder width may be reduced at median obstructions such as bridge piers or sign foundations per CDOT Standard M-606-13 or as allowed in enforcement areas per Section 13.2.2.2.

(H) US 36 Profile Grade may be reduced to a minimum of 0.23% between Stations 1120+00 to 1134+00 to match the existing grade at the western terminus and minimize floodplain and environmental impacts.

(I) US 36 Profile Grade may be increased to a maximum of 5.0% between Stations 1261+00 to 1274+00 and a maximum of 4.5% between Stations 1348+00 to 1352+00 to minimize ROW and environmental impacts.

<b>Exhibit 13-1A – Acceptable Minimum Criteria for Entrance and Exit Ramps</b>				
<b>DESIGN DATA</b>	<b>McCasin Blvd. Westbound Bus off-ramp</b>	<b>McCasin Blvd. Eastbound Bus on- ramp<sup>(A)</sup></b>	<b>Scenic Overlook Westbound off- ramp<sup>(B)</sup></b>	<b>Scenic Overlook Westbound on- ramp<sup>(B)</sup></b>
Design Speed (mph)	65 decelerating to 35	30 accelerating to 65	65 decelerating to 20	<10 accelerating to 65
Controlling Horizontal Curve Radius	408'	273'	650'	33'

(A) Meeting the AASHTO Recommended Minimum Ramp Terminal Spacing is not required for the McCasin Boulevard eastbound bus ramp exit and general purpose ramp exit spacing.

(B) Meeting the AASHTO Recommended Minimum Ramp Terminal Spacing is not required for the Scenic Overlook exit and entrance ramp spacing.

<b>Exhibit 13-2 – Bikeway Design Criteria</b>			
<b>Element</b>	<b>Final Bikeway Criteria</b>	<b>Source*</b>	<b>Interim Bikeway Criteria**</b>
Bikeway Width	12'	FEIS (AASHTO Bike Design Guide page 35-36 recommends 10' for two way path with 8' minimum under specifically defined conditions)	10' desirable, 8' minimum where ROW or topography constrained
Bikeway Shoulder Width (Clear Zones)	2' at 2% (minimum) 3' at up to 6:1 (desireable)	FEIS (AASHTO Bike Design Guide page 35 specifies 2' minimum and 3' desirable with a max slope of 1:6)	2' minimum
Bikeway Cut and Fill Side Slopes	3:1 Max		3:1 Max
Bikeway Material	6" Depth Concrete	FEIS	6" Depth Concrete
Minimum separation from edge of nearest US 36 travel lane to edge of concrete bike path that requires no barrier between US 36 and bike path	30'	FEIS	30'
Minimum separation from edge of on/off	Varies	AASHTO Clear zone requirements for the ramp design	Same as Final

<b>Exhibit 13-2 – Bikeway Design Criteria</b>			
<b>Element</b>	<b>Final Bikeway Criteria</b>	<b>Source*</b>	<b>Interim Bikeway Criteria**</b>
ramp travel lanes to edge of concrete bike path		speed will be applied. If the path is located within the clear zone, barrier separation shall be provided	
Cross Slope/Superelevation	2% Max	ADA Requirements	2% Max
Vertical Clearance to overhead obstructions	10'	AASHTO Bike Design Guide Page 55 (10' was shown in exhibits at EIS public meetings)	8' minimum
Underpass width	14'	AASHTO Bike Design Guide Page 55 (recommended minimum 10' path width + 2' clear zone on each side- this width was also shown in exhibits at EIS public meetings)	12' minimum
Desirable Minimum Horizontal Curvature Radii	100'	AASHTO Bike Design Guide Page 38 (based on 15 deg lean angle and 20mph design speed)	36' minimum (based on 15 deg lean angle and 12 mph design speed)
Maximum Desirable Grade	5%	AASHTO Bike Design Guide Page 39	5%
Maximum Grade	ADA Compliant where feasible	ADA Requirements	6-11% based on length: AASHTO Bike Design Guide Page 39
Minimum Stopping Sight Distance	See Figure 19 page 42	AASHTO Bike Design Guide Page 42	Same as Final
Minimum Length of Crest Vertical Curve	See Table 3 page 44	AASHTO Bike Design Guide Page 44	Same as Final
Minimum Lateral Clearance for Horizontal Curves	See Table 4 page 46	AASHTO Bike Design Guide Page 46	Same as Final
Minimum Rail Height on Structures	42"	AASHTO Bike Design Guide Page 55	42"

\*Source: *US 36 Corridor Final Environmental Impact Statement* and *AASHTO Guide for the Development of Bicycle Facilities* (1999).

\*\* Interim criteria are based on minimum AASHTO standards.

\*\*\* Radius may be reduced where bikeway is approaching intersections with other trails or where necessary due to physical constraints provided that adequate sight distance and signing notification is provided.

### Exhibit 13-3 – McCaslin Diverging Diamond Interchange Design Criteria

<b>DESIGN DATA</b>	<b>McCaslin</b>	<b>Remarks</b>
Roadway Classification	Arterial	
Location	McCaslin Boulevard at US36	
Design Speed (MPH) (desirable)	30	
Posted Speed (MPH) (minimum)	25	
Design Vehicle	WB-65	
<b>GEOMETRIC STANDARDS</b>		
Cross-slope	2%	
Superelevation	Normal Crown	Low Speed Urban Criteria
<b>CROSS SECTION</b>		
<b><u>Lanes</u></b>		
Lane Widths (ft.)	11 min – 15 max	Lane widths may vary to allow for tracking of design vehicles through the intersections while remaining in their lane (11ft. lanes will be allowed on the McCaslin bridge)
<b><u>Bike Lanes</u></b>		
Lane Width (ft)	5, on street	Exclusive of gutter pan or 2' shy distance on McCaslin bridge
<b><u>Sidewalk</u></b>		
Width (ft)	8, attached 12 when in center median	
Depth (in)	4	
<b><u>Curb and Gutter</u></b>		
Curb and Gutter Required	Type 2 Section IIB Outside; Type 2 Section IB Inside	
<b><u>Median</u></b>		
Median Width (ft)	4 min	
Treatment	Median Cover Material	
<b><u>Turning Islands</u></b>		
Width (ft)	Variable	
Treatment	Hardscape and landscape combination	
<b><u>CROSSOVER INTERSECTIONS</u></b>		
<b><u>Ramp Terminal Separation</u></b>		
Minimum (ft)	500	Distance between crossover intersections measured from center of crossover to center of crossover
Desirable (ft)	850	
<b><u>Crossing Angle</u></b>		
Minimum (degrees)	30	The acute angle between lanes of opposing traffic within the crossover
Desirable (degrees)	50	

<b>Exhibit 13-3 – McCaslin Diverging Diamond Interchange Design Criteria</b>		
<b>DESIGN DATA</b>	<b>McCaslin</b>	<b>Remarks</b>
<b><u>Tangent Length</u></b>		Length of tangent provided before and after crossover to align vehicles for next horizontal curve
Before crossover (ft)	15-20	
After cross over (ft)	10-15	

## 13.5 Project Special Provisions

### REVISION OF SECTION 608 WARRANTED CONCRETE BIKEWAY

Section 608 of the Standard Specifications is hereby revised for this project as follows:

#### DESCRIPTION

This work consists of the construction of warranted Concrete Bikeway in accordance with these specifications, and in conformity with the lines and grades shown on the plans or established.

#### MATERIALS AND CONSTRUCTION REQUIREMENTS

The materials used in the warranted Concrete Bikeway shall conform to the requirements in subsection 412.02.

The Concessionaire shall be responsible for Concrete Bikeway materials compliance, workmanship, and warranty work that shall be required under this specification for a period of two years from the acceptance date of the project.

The minimum thickness structural design shall be as shown on the plans.

Two weeks before starting paving, the Concessionaire shall provide the Engineer the proposed mix design proportions, laboratory trial mix information, all aggregate data as required in subsection 601.05, and all thickness testing methods.

The Concrete Bikeway shall be warranted for two years against the types of distress listed in (e) below.

- (a) Acceptance Date. Acceptance is defined in the Concession Agreement.
- (b) Warranty and Warranty Bond. By submission of its bid in response to this specification, the Concessionaire warrants that all of the Concrete Bikeway placed on the project shall be free of defective materials and workmanship for a period of two years from the date of pavement acceptance.

The Concessionaire further warrants that if the pavement evaluation team determines a defect in the Concrete Bikeway is due to materials or workmanship within that two year period and if warranty work is required or needed on that pavement, then the Concessionaire will ensure proper and prompt performance and completion of that warranty work. The warranty work shall include all labor performed and all equipment and materials used, in accordance with this specification.

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**REVISION OF SECTION 608  
WARRANTED CONCRETE BIKEWAY**

All warranty work shall be solely at the Concessionaire's and Surety's cost and expense.

The Concessionaire shall provide a warranty performance bond ("warranty bond") to guarantee the full performance of the warranty work described in this specification. The warranty bond shall be in the amount of \$160,000.

The warranty bond shall be a two year single term warranty bond that will be in effect for the entire warranty period. The Concessionaire shall provide a two year warranty bond that fully complies with this specification to HPTE at the Full Services Commencement Date.

The need for warranty work, and the performance of that warranty work, shall be determined in accordance with (d) below. At the end of the warranty period, the Concessionaire will be released from further warranty work or responsibility, provided all required warranty work has been satisfactorily completed.

- (c) Pavement Evaluation Team (PET). The PET will determine if distresses are due to the materials or workmanship and shall have the final decision authority for all warranty work. A majority rule of the PET will be required to determine warranty work required by the Concessionaire. The PET shall consist of three subject matter experts not affiliated with the project. One member will be a HPTE staff person. The second member will be selected by the Concessionaire. The third member shall be a representative from the Local Jurisdiction. The team shall be selected one month or more prior to first warranty period distress survey. HPTE's representative shall be responsible for scheduling the distress survey, preparing the reports, and notifying the Engineer when warranty work is required. Cost for the Concessionaire's PET member shall be the responsibility of the Concessionaire.

Members will be replaced as necessary based upon the criteria above.

- (d) Warranty work to be performed and materials to be used shall be in accordance with the remedial actions and other requirements in subsection (e) below. The Concessionaire may propose alternative actions for warranty work to the Engineer who will submit the proposal to the PET. All warranty work to repair distresses shall be done in accordance with the same standards used in the initial construction and shall be coordinated with the Engineer.

Innovative materials and techniques may be considered. The PET will render the final decision.

During the warranty period, the Concessionaire may monitor the pavement in question using nondestructive procedures. All proposed remedial actions shall be coordinated with the Engineer and the PET.

The Concessionaire shall not perform coring or other destructive procedures without prior written consent of the Engineer. The Concessionaire is not responsible for damages that are a result of coring or other destructive procedures conducted by HPTE, utility companies or other entities not under the control of the Concessionaire.



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**REVISION OF SECTION 608  
WARRANTED CONCRETE BIKEWAY**

When notified by the PET that warranty work is required, the Engineer will notify the Concessionaire and Surety, in writing. If the Concessionaire or Surety fails to respond to the PET or the Engineer in writing within fifteen days after receiving written notice from the Engineer, HPTE may make repairs or contract to have the repairs made. The Concessionaire and Surety shall be responsible for the total cost of these repairs including lane rental fees.

Warranty work of the pavement shall be completed in the year in which the distress survey was performed and shall conform to subsection 608.03. The Engineer may choose to delay the warranty work due to unfavorable seasonal restrictions or for reasons deemed to be in the public interest.

For all warranty work, the Concessionaire shall maintain traffic at all times as detailed in the Traffic Control Plan. A Method for Handling Traffic (MHT) for the warranty work shall be submitted to the Engineer for approval prior to any warranty work. The Concessionaire shall be responsible for all HPTE's direct costs associated with an emergency lane closure deemed in the public's interest due to warranted road damage as determined by the PET. The Concessionaire shall pay a daily lane rental fee for the closure of each lane or portion of a lane that constricts the normal flow of traffic within the project limits during the warranty work. For example, if a lane is closed at one section and the same lane or another lane is closed at a different section in one day, then only one day will be charged for the lane rental fee. This fee will be assessed for each calendar day or portion thereof, during the warranty work, that the traffic is restricted to less than the number of lanes in the final configuration as shown in the original construction plans.

The Concessionaire shall be responsible for the lane rental fee. The fee will be based on the applicable rates for any closure whether work is performed or not. This fee is not a penalty, but is a rental fee based upon road user cost to occupy lanes.

- (e) Pavement Distress Indicators, Thresholds and Remedial Action. Pavement distress indicators shown below shall be used as the basis for determining the distress types to be considered for repair under the warranty and as the basis for determining the methods for measuring distresses.

Pavement distress will be measured in general accordance with Industry Standards.

The PET will conduct a distress survey during the second year of the warranty period or at any other time if requested in writing by the Engineer. Costs associated with forensic studies performed by the PET in order to determine if the distress is materials or workmanship related shall be borne by HPTE. The PET will notify the Engineer in writing of the survey results within 15 days. The Engineer will immediately notify the Concessionaire.

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**REVISION OF SECTION 608  
WARRANTED CONCRETE BIKEWAY**

If the PET determines that warranty work is required the Concessionaire shall remedy the distress within one year of the date of the survey. If the Concessionaire disputes the findings of the PET that warranty work is required, the Concessionaire shall notify the Engineer in writing within 15 days after receiving notice. The notification shall describe the basis for the disagreement with the PET's decision. The Engineer will transmit the Concessionaire's notification to the PET. The PET will render a final decision and notify the Engineer in writing within 30 days after the Concessionaire's notification.

If remedial action necessitates a corrective action to the pavement markings, adjacent lanes or roadway shoulders, then such corrective action to the pavement markings, adjacent lanes and shoulders shall be performed at the expense of the Concessionaire.

When remedial action requires the removal of pavement, the pavement shall be replaced with a mix approved by the Engineer in accordance with subsection 601.02. The mix shall be placed according to the Concessionaire's Quality Control Plan (QCP). Pavement shall be removed by cutting neat lines vertically for the full depth of the pavement unless otherwise specified or approved.

Removal area shall be a rectangular shape. The deformed tie bars or smooth dowel bars shall be reset by drilling holes at mid-depth of the exposed face of the existing slab. An approved epoxy or grout anchoring material shall be used in the blown out drill holes prior to placing the new pavement. Joint resealing shall utilize the same material as used in the initial construction.

The Concessionaire will not be held responsible for distresses that are caused by factors beyond the materials and workmanship of the Concessionaire. If the Concessionaire disputes the PET's findings, the Concessionaire shall base the dispute on forensic evidence submitted to the Engineer. The evidence must show that the distress is due to factors outside the materials and workmanship of the Concessionaire. The PET will make the final determination. All costs related to the forensic investigation performed by the Concessionaire will be borne by the Concessionaire, unless the distress is determined to be due to factors outside the materials and workmanship of the Concessionaire, in which case the costs will be borne by HPTE.

Distress types to be warranted, the threshold levels indicating remedial action is needed, and the preferred remedial action to be performed by the Concessionaire shall be according to the following pavement distress indicators:

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**REVISION OF SECTION 608**  
**WARRANTED CONCRETE BIKEWAY**

<b>DISTRESS TYPE</b>	<b>THRESHOLD LEVELS</b>	<b>PREFERRED REMEDIAL ACTION</b> <b>(Actual action to be approved by the PET)</b>
Corner Breaks	Spalling $\leq$ 2 in.; faulting of the crack or joint $\leq$ 0.25 in.; width of crack $\leq$ 0.125 in.; or the corner piece is not broken into two or more pieces.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Spalling $>$ 2 in. to $\leq$ 6 in.; faulting of the crack or joint $>$ 0.25 in. to $\leq$ 0.5 in.; width of crack $>$ 0.125 in. to $\leq$ 0.5 in.; or the corner piece is not broken into two or more pieces.	Route and seal the crack and concrete patch the spalled area.
	Spalling $>$ 6 in.; faulting of the crack or joint $>$ 0.5 in.; width of crack $>$ 0.5 in.; or the corner piece is broken into more than two pieces.	Remove and replace the affected area.
Longitudinal or Transverse Cracking	Spalling $\leq$ 2 in.; faulting of the crack $\leq$ 0.25 in.; width of crack $\leq$ 0.125 in.; or the 15 ft. slab is not broken into more than two pieces.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Spalling $>$ 2 in. to $\leq$ 6 in.; faulting of the crack $>$ 0.25 in. to $\leq$ 0.5 in.; width of crack $>$ 0.125 in. to $\leq$ 0.5 in.; or the 15 ft. slab is not broken into more than two pieces.	Concrete patch the spalled location then route and seal the crack. If the crack has faulted $\geq$ 10 mm (0.4 in.), then cross stitch or retro fit tie bars in the crack.
	Spalling $>$ 6 in.; faulting of the crack $\geq$ 0.5 in.; width of crack $\geq$ 0.5 in.; or the 15 ft. slab is broken into more than two pieces	Remove and replace the slab or the affected area whichever is less.

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**REVISION OF SECTION 608  
WARRANTED CONCRETE BIKEWAY**

<b>DISTRESS TYPE</b>	<b>THRESHOLD LEVELS</b>	<b>PREFERRED REMEDIAL ACTION (Actual action to be approved by the PET)</b>
Longitudinal or Transverse Joint Seal Damage	Total length longitudinally or transversely in a 15 ft. slab $\leq$ 2 ft.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Total length longitudinally or transversely in a 15 ft. slab $>$ 2 ft. and $\leq$ 6 ft.	Clean the joint and replace the backer rod and sealant material.
	Total length in longitudinally or transversely in a 15 ft. slab $>$ 6 ft.	Remove and replace all the joint material in the slab.
Scaling	Scaling $\leq$ 2.0 ft <sup>2</sup> per 15 ft. slab.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Scaling $>$ 2.0 ft <sup>2</sup> per 15 ft. slab.	Remove partial depth and replace the affected area.
Blowups (Due to transverse joint seal deterioration)	Any blowup	Remove a minimum of 0.6 meters (2 ft.) in the longitudinal direction past the affected area on each side, reset the dowel bars and replace Concrete Bikeway.
Faulting of Dowelled Pavement. (If dowels are missing or misplaced)	Faulting $\leq$ 0.25 in.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Faulting $>$ 0.25 in. and $\leq$ 0.5 in.	Retro fit dowel bars. Grinding may be included.
	Faulting $>$ 0.5 in.	Remove and replace the slab with the required dowels and tie bars.
Lane-To-Shoulder or Lane-To-Lane Dropoff or Separation	Dropoff or Separation $\leq$ 0.5 in.	No action required if less than 50% of the surveyed slabs are at or below the indicated threshold level.
	Dropoff or Separation $>$ 0.5 in.	Clean the joint, cross stitch or retro fit tie bars, and then reset the backer rod and joint sealant.

- (f) Elective or Preventive Action. The Concessionaire or Surety shall submit a written proposal to the Engineer if it proposes to perform elective or preventive work. The Engineer will forward the proposal to the PET for a final decision. Elective or preventive action shall be a Concessionaire or Surety option subject

## EXECUTION VERSION

to the approval of the Engineer. Elective or preventive work shall be done during times set forth in the Contract for original contract work. Lane rental fees will not be assessed.

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**REVISION OF SECTION 608  
WARRANTED CONCRETE BIKEWAY**

- (g) Emergency Work. The Engineer may request, in writing, immediate action of the Concessionaire and Surety for the safety of the traveling public. The Concessionaire or Surety shall have the first option to perform the emergency work. If the Concessionaire or Surety cannot perform the emergency work within 24 hours, the Engineer may have the emergency work done by other forces and seek reimbursement from the Concessionaire or Surety accordingly. Emergency work performed by other forces shall not alter the requirements, responsibilities, or obligations of the warranty.
- (h) Traffic Control. Construction Traffic control for warranty work shall be performed in accordance with Section 630 at the Concessionaire's expense.
- (i) Process Control Testing: The Concessionaire shall perform process control testing in accordance with the Revision of Section 105, 106 and 412, Quality of Portland Cement Concrete Pavement.

**METHOD OF MEASUREMENT**

The 2 Year Warranty will not be measured for paid separately, but shall be included in the work.

**BASIS OF PAYMENT**

Facilities for testing the Concrete Bikeway will not be paid for separately, but shall be included in the work.

## 14.0 SIGNING, PAVEMENT MARKINGS, SIGNALIZATION, AND LIGHTING

The Concessionaire shall be responsible for the design and installation of the Phase 2 Construction Work permanent signing, pavement marking, signalization, and lighting elements and comply with the requirements of this Section 14.

The signing, pavement marking, signalization, and lighting elements shall have the flexibility to accommodate Phase 2 Construction Work changes that produce benefits or savings to HPTE or the Concessionaire without impairing the essential functions and characteristics of the Phase 2 Construction Work such as safety, operations, durability, maintainability, and visibility.

### 14.1 Design Requirements

The Concessionaire shall prepare signing, pavement marking, signalization, and lighting designs and plans for all areas on the Phase 2 Construction Work in accordance with the requirements of the following sections. These plans shall be a component of all Release for Construction Documents where any signing, pavement marking, signalization, or lighting element is required for the Work. No material, part, or attachment of any equipment shall be substituted or applied contrary to the manufacturer's recommendations and standard practices.

The Concessionaire shall provide permanent signing, and other traffic control devices that facilitate safe flow of traffic through the completed Phase 2 Construction Work elements and that accommodate future phases of the Phase 2 Construction Work.

The Concessionaire shall prepare lighting, electrical designs, and plans for the Phase 2 Construction Work. The electrical designs shall include the electrical and power requirements for the Intelligent Transportation Systems (ITS) and tolling components as described in Schedule 5, Section 19 (ITS & Tolling Equipment), as well as the Traffic Signal System components described in Schedule 5, Section 14.1.3. The Concessionaire shall coordinate with the electrical utility company to determine electric power requirements for the Phase 2 Construction Work and to develop the Phase 2 Construction Work lighting design and construction requirements.

The Concessionaire shall obtain approval of the power service design from the power service provider and coordinate and meet all requirements as specified by the power service provider for the complete and operational power service to all required locations. All power connections to devices shall include a quick-disconnect.

The Concessionaire shall be responsible for the coordination of power source work to be performed by Xcel Energy. The Concessionaire shall contact the Xcel Energy Builder's Call Line at 1-800-628-2121 to request, and process to completion, the required coordination to establish the power sources for lighting and other electrical devices. The Concessionaire shall perform all work necessary to maintain existing or establish new power sources for lighting and other electrical devices. All cost charges from the power service provider, and all necessary materials, including meter (if required), labor, and coordination required to maintain existing or establish new power sources shall be included in the Work.

The Concessionaire shall design and construct signing, pavement marking, and lighting elements in accordance with the requirements of the standards listed by priority in Table 14.1-1.

<b>Table 14.1-1 DESIGN STANDARDS</b>		
<b>Priority</b>	<b>Author</b>	<b>Title</b>
1	CDOT	Special Provisions included in Section 14
2	CDOT	<i>Standard Specifications</i>
3	CDOT	<i>M &amp; S Standard Plans</i> – revised June 27, 2011
4	CDOT	<i>Sign Design Manual</i> – December 5, 2011
5	CDOT	<i>Retroreflective Sheeting Materials Guide</i>
6	FHWA	<i>Manual on Uniform Traffic Control Devices</i> (Current Edition)
7	FHWA	<i>Standard Highway Signs</i> (Current Edition)
8	AASHTO	<i>A Policy on Geometric Design of Highways and Streets</i>
9	AASHTO	<i>Roadside Design Guide</i>
10	AASHTO	<i>Standard Specifications for Highway Bridges</i> , 16 <sup>th</sup> Edition
11	AASHTO	<i>Guide for Development of Bicycle Facilities</i>
12	Local jurisdiction	<i>Design Standards, Details, and Specifications</i>

### 14.1.1 Permanent Signing

#### 14.1.1.1 Signing Design

The Concessionaire shall prepare signing designs and plans for the Phase 2 Construction Work area. These plans shall include all necessary guide, warning, supplemental, and regulatory signs, and additions, removals, or modifications to existing signs and appurtenances.

The Diverging Diamond Interchange shall include necessary regulatory and warning signs, advance interchange and overhead lane use guide signs along McCaslin Boulevard, destination guide signs along each of the off-ramps, supplemental highway route signs and RTD “Bus Only” regulatory signing for the bus slip-ramps.

Signing design shall comply with the requirements of the CDOT *Standard Specifications for Road and Bridge Construction*, *M & S Standard Plans*, and *Sign Design Manual*; the FHWA *Manual for Uniform Traffic Control Devices* (MUTCD) and FHWA Standard Highway Signs. The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual. The design and plans shall address modifications to permanent signing inside and outside the Phase 2 Construction Work that is rendered inaccurate, ineffective, confusing or unnecessary by the Phase 2 Construction Work. Signing plans shall provide layouts showing the locations of ground-mounted and overhead signs, dimensions of Class III sign supports, layouts/dimensions of all special signs, and structural and foundation requirements.

The Concessionaire shall submit plans for all Class III, major overhead signs, and Managed Lane regulatory and guide signs to HPTE for Approval. These plans shall identify the location and legend for each sign. With the exception of the Managed Lane signs, sign destination messaging shall be consistent with the Phase 2 Construction Work signing concept plan in the Reference Documents. Sign legends shown in the Phase 2 Construction Work concept plan may be modified in accordance with MUTCD guidance. Sign locations in the signing concept plan are for reference only. The Concessionaire shall submit sign layouts for all special signs of any size to HPTE for Approval.



In coordination with elements described in Schedule 5, Section 19.3 (Bus on Shoulders (BOS)), the Concessionaire shall provide ground-mounted static signs that shall be consistent with the signs approved in Phase 1. The sign location in the Signing Concept Plan is for reference only.

Where CDOT sign structure standards cannot be met, the Concessionaire shall provide custom-designed monotube sign structures and foundations for approval from CDOT Staff Bridge. Permanent signage on bridges shall not be hung from or be attached to the face of bridge superstructures. Existing signs attached to bridge superstructures shall be removed and replaced with monotube sign bridges or cantilever structures if signs are to remain.

The Concessionaire shall mount all overhead signs along US 36 with a vertical clearance of 20 feet measured from the high point on the roadway surface under the sign panels to the bottom of the VMS, VTMS, or guide sign (whichever is lowest) to allow for the future installation of lane use control signals.

Sign lighting and walkways shall not be used on overhead guide signs.

Sign structures for Phase 2 shall be designed to accommodate 100 mph wind speed.

The Concessionaire shall coordinate with the Regional Transportation District (RTD) to locate wayfinding signs to RTD stations in the US 36 corridor. If existing wayfinding signs are removed by the Phase 2 Construction Work, the signs shall be replaced by the Concessionaire, as appropriate, for wayfinding continuity.

Signing shall be provided on all Bikeway elements or connections in accordance with MUTCD and the AASHTO *Guide for the Development of Bicycle Facilities*. In addition, the Concessionaire shall provide bikeway wayfinding signage in accordance with the US 36 Bikeway Wayfinding Signage document included in the Reference Documents.

#### **14.1.1.2 Materials**

The Concessionaire shall use 2.5 inch, Schedule 80 tubular steel posts per CDOT *S-Standard Plans* for all Class I and Class II ground signs. W-Type Steel Posts per CDOT *S-Standard Plans* shall be used for all Class III ground signs. Wood posts for mounting ground signs shall not be used. All ground mounted delineators shall have U-shaped steel posts per CDOT *S-Standard Plans*.

All Type I, II, and III ground signs shall include breakaway devices per CDOT *S-Standard Plans*.

Sign panel materials shall conform to Section 713 of the CDOT *Standard Specifications*. Retroreflective sheeting shall be Type IV and Type XI as defined in the CDOT Retroreflective Sheeting Materials Guide, and shall conform to Subsections 713.04 and 713.06 when applicable. For all permanent signs, the legend, borders, and background shall be Type XI.

The Concessionaire shall be allowed to reuse any of the sign structures, ground signs, and their components that comply with the requirements of this Section 14. The signing materials shall meet the requirements of the Project Special Provisions at the end of this Section.

### **14.1.2 Permanent Pavement Marking**

#### **14.1.2.1 Pavement Marking Design**

The Concessionaire shall prepare pavement marking designs and plans for roads affected by the construction of the Phase 2 Construction Work. These plans shall include, all striping required for center lines, edge lines, lane lines, channelization, gore areas, lane drops, merging lanes, transition lanes, dotted lane extensions, managed/special use lanes, bike lanes, arrows,

legends, symbols, crosswalks, stop lines, object markings, delineation, and other striping, as well as any modifications required for transitions to existing pavement markings.

Pavement marking design shall comply with the requirements of the *CDOT Standard Specifications* and *M & S Standard Plans*; and the MUTCD. The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual. Preformed Plastic Pavement Marking (Type II)(Inlaid)(contrast) used on all PCCP shall be inlaid per Section 627.08(a) of CDOT Standard Specifications. At the McCaslin DDI crossover intersections, “wrong way” arrow pavement markings shall be installed in each lane in advance of the stop bars.

Conceptual mainline, Managed Lane, and other roadway striping is shown in the Preliminary Plans in the Reference Documents and are for reference only. The Concessionaire shall comply with the Managed Lane striping specifications as provided in the Combined Access Zone Striping Memo in Schedule 5B, identifying specific striping requirements for Managed Lane ingress and egress locations.

**14.1.2.2 Materials**

The Concessionaire shall use the pavement-marking Materials at the locations specified in Table 14.1-2. The pavement-marking Materials shall meet the requirements of Section 627 of the CDOT Standard Specifications and the Project Special Provisions at the end of this Section 14.

<b>Table 14.1-2 PAVEMENT MARKING MATERIALS</b>	
<b>Location</b>	<b>Pavement Marking Type</b>
Edge lines and channelization lines	Epoxy Pavement Marking (Special)
Broken lines of any type on Portland concrete cement pavement (PCCP)	Preformed Plastic Pavement Marking (Type II)(Inlaid) (contrast)
Broken lines of any type on Hot Mix Asphalt (HMA)	Preformed Plastic Pavement Marking (Type I)
Words/symbols/cross walks/stop lines	Preformed Plastic Pavement Marking (Type I)

**14.1.3 Temporary and Permanent Traffic Signalization**

**14.1.3.1 Traffic Signal Design**

The McCaslin Boulevard Diverging Diamond Interchanges shall include new two-phase traffic signals at the crossover intersections. The eastbound US 36 to southbound McCaslin right-turn movements shall also be signalized. All traffic signals shall be interconnected and synchronized with those at the Dillon Road and Marshall Road intersections.

The Concessionaire shall prepare permanent traffic signalization plans for all intersections affected by the Phase 2 Construction Work. These plans shall include, traffic signal mast arm type poles, pedestal poles, pole footing/caisson locations and sizes, mast arm lengths, traffic signal heads, countdown pedestrian signal heads, signal head placement and alignment, controller cabinet(s), power disconnect and meter, signal phasing, lighting/luminaires, conduits, pull boxes, vehicle detection, pedestrian push buttons, emergency vehicle preemption, signal system interconnect and signing.

Temporary traffic signals shall be designed, as necessary, to facilitate re-construction of any existing signalized intersection. Span wire type installations will be allowed. Poles shall be placed at locations that will facilitate all stages of intersection reconstruction.

Traffic signalization design shall comply with the requirements of the CDOT *Standard Specifications* and *M & S Standard Plans*; and the FHWA MUTCD. The requirements of the MUTCD shall include both the standard requirements and the guidance recommendations of the manual. Applicable portions of Section 19 shall also apply to the traffic signalization design.

The Concessionaire shall develop and implement timing and phasing plans along the McCaslin corridor, from the Marshall Road signal to the Dillon Road signal.

#### **14.1.3.2 Materials**

The Concessionaire shall use the traffic signal materials specified in Section 713.11 of the CDOT Standard Specifications.

All traffic signal poles shall be factory painted with a powder coat finish. Pole color shall be specified as a part of the Aesthetic Treatment Plan and accepted by HPTE prior to ordering.

#### **14.1.4 Permanent Lighting**

##### **14.1.4.1 Lighting Design**

The Concessionaire shall prepare lighting designs and plans for US 36 ramps, bikeway, and all existing permanent lighting conditions on roadways impacted by the Phase 2 Construction Work. The plans shall address both temporary and permanent Work and shall include existing topography, ROW, Utilities and drainage facilities, structures, and all other existing and proposed facilities. The plans shall include location and orientation of standards and fixtures, wiring, conduits, pedestals, power sources, and all other lighting components required to construct the lighting on the Phase 2 Construction Work.

All permanent lighting within the Phase 2 Construction Work shall be designed and constructed to be consistent with current CDOT *M-Standard Plans* or Xcel Energy lighting standards as applicable.

Replace any existing lighting impacted by the Phase 2 Construction Work, and at a minimum provide partial interchange lighting for all ramp entrances and exits at the Foothills Parkway Interchange ramps. Roadway lighting includes underdeck lighting on the South Boulder Creek, Cherryvale Road, McCaslin, and 88<sup>th</sup> Street bridge overpasses for US36 mainline and/or Bikeway to meet the new alignments. Lighting within Coal Creek and Cemetery crossing structures for Bikeway shall be included in the Work

Existing lighting at the McCaslin Boulevard DDI shall be replaced in-kind and enhanced to provide full interchange lighting along McCaslin, ramps and at the RTD park-n-ride platforms. New under deck lighting shall be provided for the new bridges and modifications made to lighting at the McCaslin bridge widening. New pedestrian lighting shall be provided within the median barriers along McCaslin and at the bus stops in the median islands to illuminate the median walkways between the DDI crossover intersections.

New lighting shall be provided for the pedestrian box culvert and trail crossing under McCaslin Boulevard defined as (Option 1) elsewhere in these contract documents.

The Concessionaire shall submit to HPTE for Acceptance lighting calculations showing the design meets the performance criteria for roadway or Bikeway design. In addition, the Concessionaire shall submit voltage-drop calculations for each circuit.

Lighting on and underneath all bridge structures for US36 and within or under structures for Bikeway within the Phase 2 Construction Work boundaries shall comply with the design criteria for average and minimum luminance for the roadway or pedestrian/bicycle facility.

Lighting designs and plans for the Phase 2 Construction Work shall be subject to HPTE Acceptance. Lighting designs and plans within Boulder County, City of Boulder, City of Louisville, or Town of Superior shall be subject to review and comment by the appropriate local agency and Xcel Energy.

#### **14.1.4.2 Materials**

The Concessionaire shall use lighting equipment for all permanent installations as specified in the *Standard Specifications*.

The Concessionaire shall obtain approval of the lighting equipment from the agency responsible for maintenance.

For areas within incorporated municipal boundaries that Xcel Energy is responsible for maintenance, the Concessionaire shall submit the materials lists for the proposed lighting, including under deck lighting for review and approval by Xcel Energy prior to ordering material. The Concessionaire shall contact the Xcel Energy Builder's Call Line to request, and process to completion, the required coordination to review and approve the lighting equipment. All cost charges from Xcel Energy for review and approval shall be included in the Work.

## **14.2 Construction Requirements**

### **14.2.1 Permanent Signing**

The Concessionaire shall remove and dispose of the existing sign structures, ground-mounted signs, and delineators within the Phase 2 Construction Work area that do not meet the requirements of this Section 14. They shall become the property of the Concessionaire.

### **14.2.2 Permanent Pavement Marking**

New PCCP shall be sandblasted prior to placement of any primer or pavement-marking material.

### **14.2.3 Permanent Traffic Signalization**

All new traffic signal equipment shall be furnished for any and all permanent signal installations. Section 614.09 and 614.10 of the CDOT Standard Specifications shall apply. Existing signal operations shall be maintained throughout construction. The Concessionaire shall remove and dispose/salvage any existing signal equipment and structures within the Phase 2 Construction Work area that are to be replaced. They shall become the property of the Concessionaire, or upon request, delivered to the proper owner/agency.

### **14.2.4 Permanent Lighting**

Xcel Energy will remove the existing lighting as required within the Phase 2 Construction Work area that is owned by Xcel Energy. The Concessionaire shall be responsible for the coordination of lighting removal and lighting relocation work to be performed by Xcel Energy.

The Concessionaire shall contact the Xcel Energy Builder's Call Line to request, and process to completion, the required coordination for Xcel Energy lighting removal or lighting relocation Work. The Concessionaire shall remove the existing lighting as required within the Phase 2 Construction Work area that is not owned by Xcel Energy, and such lighting shall become the property of the Concessionaire.

### 14.3 Deliverables

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance, or Approval	Schedule
Class III, major overhead signs, and Managed Lane regulatory and guide signs plan – 30%, 60% and 100% Design Progress Review Meetings	Review	Prior to submittal of Released for Construction Documents for Approval
Class III, major overhead signs, and Managed Lane regulatory and guide signs plan	Approval	Prior to issuance of Released for Construction Documents
Sign layouts for all special signs of any size – 60% and 100% Design Progress Review Meetings	Review	Prior to submittal of Released for Construction Documents for Approval
Sign layouts for all special signs of any size	Approval	Prior to issuance of Released for Construction Documents
Custom-designed monotube sign structure and foundation plans - 60% and 100% Design Progress Review Meetings	Review	Prior to submittal of Released for Construction Documents for Approval
Custom-designed monotube sign structure and foundation plans	Approval	Prior to issuance of Released for Construction Documents
Median butterfly sign structure and foundation plans - 60% and 100% Design Progress Review Meetings	Review	Prior to submittal of Released for Construction Documents for Approval
Median butterfly sign structure and foundation plans	Approval	Prior to issuance of Released for Construction Documents
Traffic Signalization Plans – 60% and 100% Design Progress Review Meetings	Review	Prior to issuance of Released for Construction Documents for Review
All permanent lighting plans at intersections and local streets owned and maintained by local entities - 60% and 100% Design Progress Review Meetings	Review	Prior to submittal of Released for Construction Documents for Review
All permanent lighting plans at intersections and local streets owned and maintained by local entities	Review	Prior to issuance of Released for Construction Documents
Lighting and electrical design calculations - 100% Design Progress	Review	Prior to submittal of Released for Construction Documents

EXECUTION VERSION

<i>Review Meeting</i>		
Traffic Signal Timing Plans and associated electronic timing plan software files	Approval	28 Days prior to implementation
Lighting and electrical design calculations	Acceptance	Prior to issuance of the Released for Construction Documents

## 14.4 Project Special Provisions

(1)  
**REVISION OF SECTIONS 627 AND 713  
 EPOXY PAVEMENT MARKING (SPECIAL)**

Sections 627 and 713 of the Standard Specifications are hereby revised for this project as follows:

Subsection 627.05 shall include the following:

- (a) *Epoxy Pavement Marking (Special)*. Epoxy Pavement Marking (Special) shall be applied to the road surface according to the epoxy manufacturer’s recommendations at 20 mils minimum thickness. Bead system shall be applied into the epoxy pavement marking by means of a pressurized bead applicator at the manufacturer’s recommended application rate.

The primary and secondary beads shall be applied in a two-drop operation in accordance with the manufacturer’s recommendations. If manufacturer recommendations do not address this operation, epoxy pavement marking and beads shall be applied within the following limits:

**Application Rate or Coverage  
 Per Gallon of Epoxy Pavement Marking (Special)**

	Minimum	Maximum
20 mil marking	75 sq. ft.	85 sq. ft.
Primary Beads	5 lbs.	6 lbs.
Secondary Beads	11 lbs.	12 lbs.

The primary composite cluster shall be applied first from the bead dispenser directly behind the epoxy binder application gun followed immediately by the application of the secondary beads from a second bead dispenser. The application rates of the primary and secondary beads shall be adjusted from these starting values until the minimum retro-reflectivity values have been consistently achieved. The beads shall be applied in such a manner that the beads shall adhere and be embedded within the epoxy binder to produce a high reflective all weather pavement marking.

There shall be two types of glass and/or ceramic beads used for the Epoxy Pavement Marking (Special) reflective elements: a primary bead which is a high-performance, high-reflective all-weather bead, and a secondary glass bead. Beads will be accepted on the project by certificates of compliance (COC). The COC shall be in conformance with subsection 106.02 in addition to the following requirements:

- 1) The primary bead shall be a composite cluster comprising a core element and shall contain an outer shell containing elements surrounding it. The shell elements shall be permanently attached to the core element. The core and shell elements shall be

manufactured from glass, ceramic, or silica. The primary element shall be coated by manufacturer's recommendations for application within epoxy binder. Fifty percent of the primary elements shall have a refractive index of 2.4 and fifty percent shall have a refractive index of 1.9.

- 2) The secondary bead shall conform to the requirements of the Revision of Sections 106, 627, and 713 – Glass Beads for Pavement Marking included in Schedule 5, Section 20.
- 3) Primary and secondary glass beads shall be furnished in fully identified separate containers and shall be free of extraneous materials or clumps.

**(2)**

**REVISION OF SECTIONS 627 AND 713  
EPOXY PAVEMENT MARKING (SPECIAL)**

Applied markings shall have uniform mil thickness and bead distribution across the entire width of the line. Unless otherwise shown on the plans, typical pavement markings shall conform to the shapes and sizes as shown on Standard Plan S-627-1.

A manufacturer's representative shall be onsite at the installation of the epoxy binder, primary bead, and secondary bead materials to identify areas of the installation falling below the minimum manufacturer's recommendations and these specifications to assist in the calibration of equipment, set up of equipment and the proper adjustment of equipment during installation to achieve the minimums outlined herein. The cost of the manufacturer(s) representation will not be measured and paid for separately but shall be included in the cost of the work.

Subsection 713.17 shall include the following:

- (n) *Retroreflectivity*. The applied finish system for Epoxy Pavement Marking (Special) shall have minimum initial dry retroreflectivity values of 700 mcd/m<sup>2</sup>/lux for white and 500 mcd/m<sup>2</sup>/lux for yellow when tested in accordance with ASTM E1710.

Section 627 of the Standard Specifications is hereby revised for this project as follows:

In subsection 627.08 (a), first paragraph, delete the second sentence and replace with the following:

The depth of the grooves shall be 140 mils ± 10 mils.



**(1)**  
**REVISION OF SECTIONS 614 AND 713**  
**SIGN PANEL (CLASS III)**

Sections 614 and 713 of the Standard Specifications are hereby revised for this project as follows:

In subsection 614.04, delete the first paragraph and replace with the following:

Sign panel materials shall conform to Section 713 and to the details shown on the plans. Retroreflective sheeting shall be Type IV and Type XI as defined in the CDOT Retroreflective Sheeting Materials Guide, and shall conform to subsections 713.04 and 713.06 when applicable.

In subsection 713.06, delete the fourth paragraph and replace with the following:

For all permanent signs, the legend, borders, and background shall be Type XI.

## 15.0 STRUCTURES

### 15.1 Standards

The standards used for design and construction of the structures for this Phase 2 Construction Work shall be as indicated in the listing in Schedule 5A, or as specifically referenced in this Section 15. The latest, current version of the referenced software, standards, data, and reports at the time of the Proposal due date, including all interim revisions and updates shall be used unless specified otherwise.

#### 15.1.1 Software

The following software shall be used for this Phase 2 Construction Work:

1. VIRTIS, Bridge Load Rating (AASHTOWare)
2. BRASS-CULVERT, Culvert Load Rating

### 15.2 Design Requirements

#### 15.2.1 Materials

##### 15.2.1.1 Concrete

Type II or Type I cement shall be used for cast-in-place concrete. Type III cement may be used for precast concrete. Class B shall be used for panel noise barriers, abutments, piers, and walls. Class BZ concrete shall be used for drilled caissons. Class B, BZ shall be used for filling post holes and slope paving. Class D or H shall be used for all conventionally reinforced bridge decks and bridge rails. Class D, PS, or S40 shall be used for all pretensioned or post-tensioned concrete. The concrete used for cast-in-place bridge decks shall be dense, with low permeability, highly resistant to abrasion, and it shall resist cracking due to creep and shrinkage. The bridge deck concrete shall have a maximum water/cement ratio (w/c) of 0.45, chloride permeability of 2000 coulombs or less in 56 days as tested in accordance with AASHTO T 277, and shrinkage of 500 microstrain or less as tested per ASTM C157. If Class D is used, the Concessionaire shall use a standard Class D mix. The proposed mix design and procedures shall meet the above requirements and shall be submitted for Acceptance by HPTE. The use of lightweight concrete will not be allowed.

Minimum design concrete strengths shall meet the requirements of Section 20, Section 601 of the Standard Specifications.

Maximum design concrete strengths used for design shall be:

1. Cast-in-place:  $f'c = 6.0$  ksi
2. Precast:  $f'c = 10.0$  ksi

##### 15.2.1.2 Pre-Tensioning Steel

The maximum diameter for prestressing strands shall be 0.6-inch for a 2-inch minimum spacing and 0.5-inch for a 1.75-inch minimum spacing.

### 15.2.1.3 Post-Tensioning Steel Systems

The Concessionaire shall provide corrosion protection for the strands consisting of grout-filled galvanized or non-metallic ducts. Grout shall meet the requirements of Section 618 of the Standard Specifications. Prestressing systems shall be certified by the Post-Tensioning Institute (PTI). The diameter for strands shall be 0.6-inches or 0.5-inches.

### 15.2.1.4 Reinforcing Steel

The use of epoxy coated reinforcing steel for all bridges, walls, and box culverts shall adhere to the requirements of Table 1, Subsection No. 8.1 of the CDOT *Bridge Design Manual*. The design category for the anticipated level of de-icing salt application shall be "High". Abutments and pier columns exposed to splash from adjacent roadway shall use epoxy-coated reinforcing steel conforming to the requirements of the Standard Specifications. Splash zone is defined as anything within 10 feet horizontally of the roadway shoulder. All reinforcing shall consist only of deformed bars per ASTM A 615.

### 15.2.1.5 Structural Steel

Structural steel shall conform to AASHTO M 270, Grades 36, 36W, 50, 50W, 70 or 70W. Structural steel supplied for main load-carrying members or components in tension, and which are non-redundant, shall be designated as fracture-critical, meeting the Charpy V-notch tests for Zone 2 in AASHTO M 222/M 222M and AASHTO M 223/M 223M. All structural steel shall be painted per Schedule 5, Section 15, (Revision of Section 509), color as Accepted by HPTE, or shall be weathering steel as Approved by HPTE.

Additional structural steel grades to be used for architectural arch trusses on the McCaslin Boulevard bridge (Str. No. E-16-KZ) shall include ASTM A106 or A53 for pipe shapes or ASTM A500 (Grade B) for steel structural tubing shapes.

## 15.2.2 Design Parameters

### 15.2.2.1 General

The Concessionaire shall complete the design in accordance with AASHTO *Load Resistance Factor Design (LRFD) Bridge Design Specifications*, except as otherwise noted in this Section 15. All design calculations and plans shall be in English (Standard) units. Horizontally-curved steel bridges shall be designed in accordance with the AASHTO *Guide Specifications for Horizontally Curved Steel Girder Highway Bridges*.

Bridge superstructure types that would require falsework or shoring are allowed and shall meet all required vertical and horizontal clearances. All falsework shall be designed in accordance to the AASHTO *LRFD Guide Design Specifications for Bridge Temporary Works*.

For bridges, stain or structural concrete coating (or paint for steel structures) shall be applied to surfaces for each particular structure in accordance with the aesthetic requirements defined in this Section 15. All other visible, exposed, and accessible concrete surfaces shall have a surface treatment of concrete stain or structural concrete coating. This shall include all retaining walls, noise barriers, and slope paving.

### 15.2.2.2 Loads and Forces

The Concessionaire shall design all structures, except as otherwise noted in this Section 15, for loads and forces in accordance with the AASHTO *LRFD Bridge Design Specifications* or as stated herein.

Architectural elements and components to be constructed as part of bridges and retaining walls shall be designed using *the International Building Code*, if the design of these elements is not covered by AASHTO specification.

1. Live Loads. The Concessionaire shall design new highway bridges and walls using the AASHTO *LRFD Bridge Design Specifications*. All structures shall be designed for the Colorado Permit Truck. Impact loads for highway bridges shall be as per the AASHTO *LRFD Bridge Design Specifications*. Pedestrian bridges shall be designed per the latest AASHTO *LRFD Guide Specifications for Design of Pedestrian Bridges* and the latest AASHTO *LRFD Bridge Design Specifications*. All pedestrian bridges shall also be designed for AASHTO Standard H 10 Truck live load to account for maintenance and emergency vehicles or as defined in the CDOT *Bridge Design Manual*.
2. Dead Loads. The Concessionaire shall design all highway bridge structures for an additional 36-psf dead load for a total (future and initial) 3-inch wearing surface.
3. Uplift. The Concessionaire shall proportion bridge spans to avoid uplift at supports due to non-seismic loads.
4. Thermal Forces. The Concessionaire shall use temperature ranges for cold climates per AASHTO *LRFD Bridge Design Specifications*.
5. Seismic. The Concessionaire shall design all structures in accordance with the AASHTO *LRFD Bridge Design Specifications*.
6. Load Rating. The Concessionaire shall load rate all highway bridges accordance with the AASHTO *Manual for Bridge Evaluation* and the CDOT *Bridge Rating Manual*. LRFD bridge designs shall satisfy all of the specification requirements of the AASHTO *LRFD Bridge Design Specifications*. Structures designed in accordance to the AASHTO *LRFD Bridge Design Specifications* shall be rated by the load and resistance factor rating (LRFR). Structures that are not designed in accordance to the AASHTO *LRFD Bridge Design Specifications* shall be rated by the load factor rating (LFR). The load rating methodology shall be consistent with the design methodology.
7. Wind Loads. The Concessionaire shall design all highway bridges for the wind loads specified in the appropriate AASHTO *Bridge Design Specifications*.

### 15.2.2.3 Geotechnical Data

Geotechnical testing has been conducted for this Phase 2 Construction Work in the following areas along the Phase 2 Construction Work corridor including the bridge locations in Table 15.2-1.

<b>Table 15.2-1 COMPLETED GEOTECHNICAL TESTING FOR BRIDGE STRUCTURES</b>	
<b>Structure Location</b>	<b>Borings</b>
US 36 over South Boulder Creek	2 borings total (one at each abutment)

The Concessionaire shall determine the additional geotechnical information required and conduct supplemental investigations as necessary to complete the final design. When planning and conducting additional investigations, the Concessionaire shall refer to the referenced Project-specific geotechnical documents completed for this Phase 2 Construction Work. Additional boring logs and laboratory test results shall be presented in the formats outlined in those documents.

The soil and rock samples collected as part of this geotechnical engineering exploration are available at:

Yeh and Associates, Inc.  
5700 East Evans Avenue  
Denver, CO 80222  
Phone: 303-781-9590  
[Contact Us@yeh-eng.com](mailto:Contact_Us@yeh-eng.com)

If the Concessionaire wants to obtain these geotechnical samples, it will have 90 Days from NTP1 to take possession of them. At the end of 90 Days, if the Concessionaire has not taken possession of the samples, then the geotechnical firm will dispose of these materials at their own discretion. If the Concessionaire does take possession of these samples, then the Concessionaire shall assume full responsibility for both their storage and disposal.

If groundwater observation wells are necessary to monitor water level or water quality, it shall be the Concessionaire's responsibility to properly abandon, permit, or renew the permits of these wells in accordance with State Engineer's Office requirements.

Geotechnical testing was not performed at the McCaslin Boulevard Interchange at locations away from US 36. The Concessionaire shall determine the additional geotechnical information required and conduct supplemental investigations as necessary to complete the final design throughout this interchange. The following geotechnical information was previously developed for projects at or near the McCaslin Boulevard Interchange (for information only):

1. Supplemental Geotechnical Exploration for Soil Nail Wall Design, U.S. 36 and McCaslin Boulevard Interchange (Kumar and Associates Project No. 03-3-131.01, February 2, 2004)

2. Draft Geotechnical Engineering Study and Pavement Thickness Design, US 36 and McCaslin Boulevard Interchange (Kumar and Associates Project No. 03-3-131, 2004)

#### 15.2.2.4 Structure Foundation Analysis and Design

The Concessionaire shall perform geotechnical analysis, as required, for the design of retaining walls, bridges, and other structures foundations. Design recommendations and substantiating analysis shall be documented in foundation design reports and submitted to HPTE for Acceptance, as a part of the Preliminary Design Packages and/or the In-Process Design Packages as described in this Section 15.

#### 15.2.2.5 Structure Aesthetics

The Concessionaire shall develop a corridor Aesthetic Treatment Plan that includes the following:

1. Treatment concepts and details for all structures (bridges, retaining walls, etc.). Treatments shall meet the requirements of this Section 15, shall be consistent with and complement the existing corridor aesthetic treatments, and shall provide as a minimum the baseline aesthetic treatments approach and commitments included in the Proposal. Aesthetic Treatment Plan shall also be consistent with the *CDOT Urban Design Manual* in Schedule 5A.
2. Architectural enhancements for the bridges and retaining walls at the McCaslin Boulevard Diverging Diamond Interchange shall receive treatments as described in the McCaslin Interchange Enhancement Concepts in the Reference Documents.

#### 15.2.3 Bridges

The bridge structures and actions identified for the Phase 2 Construction Work are listed in Table 15.2-2.

Table 15.2-2 ACTIONS FOR BRIDGE STRUCTURES		
Structure No.	Structure Description	Action
TBD	Bikeway over Coal Creek	New construction
E-16-FH	US 36 eastbound over Coal Creek	Removal and reconstruction
E-16-FG	US 36 westbound over Coal Creek	Removal and reconstruction
E-16-FT	Overhead Irrigation Pipe	Removal and reconstruction
E-16-FD	US 36 over South Boulder Creek	Widening and rehabilitation
E-16-KZ	McCaslin Boulevard (SH 170) over US 36	Widening and rehabilitation
TBD	McCaslin EB Off-Ramp over Bus Ramp	New construction
TBD	McCaslin WB On-Ramp over Bus Ramp	New construction

All reconstruction and rehabilitation of structures must accommodate the ultimate configuration for US 36. It is permissible to replace the structures for US 36 eastbound and westbound over Coal Creek with buried structures. The new crossing over Coal Creek must be built to the ultimate grade, or provide provisions for future adjustment of the grade for the ultimate configuration of US 36.

Requirements for rehabilitation of bridges is outlined and addressed in Section 15.2.3.6 below.

The McCaslin Boulevard Diverging Diamond Interchange shall include modifications to the existing bridge over US 36 (Str. No. E-16-KZ) to include widening as shown in Schedule 5B and as detailed in the Reference Documents. In addition, new bridges shall be provided to allow the west ramps to US 36 to cross the braided RTD access ramps below.

### **15.2.3.1 Geometry**

All fill and cut slopes along the longitudinal axis of bridges with spill-through abutments shall not be steeper than 2:1. There shall be a 2-foot berm at the top of the slopes at the front face of abutments and a 2-foot minimum dimension from the top of this berm to the bottom of girder. Minimum vertical clearance of 16.5 feet (from traveled way and shoulders) shall be provided unless otherwise Approved by HPTE for all grade separations, allowing for future pavement overlays on the roadway below and for future widenings as shown in the Contract Documents. Existing US 36 bridges over cross roads that are to be widened shall be widened with the existing cross slope with the same or shallower superstructure depth as the existing bridge to minimize reduction of vertical clearance. Minor structures over roadways such as pedestrian bridges or utility/irrigation structures shall provide a minimum vertical clearance of 17.5 feet. Bridge deck and approach slab surface smoothness shall not deviate more than 1/8 inch in 10 feet.

For the Overhead Irrigation Pipe structure, fill and cut slopes along the longitudinal axis of the pipe structure shall not be steeper than 2.5:1. There shall be a 2-foot berm at the top of the slopes at the front face of the abutments and a 2-foot minimum dimension from the top of this berm to the bottom of the pipe.

The EB Off Ramp and WB On Ramp Bridges at the McCaslin Boulevard interchange shall have a minimum 14'-0" vertical clearance over the Bus-Only ramps below (from traveled way and shoulders).

### **15.2.3.2 Type**

Bridge type will not be restricted to those historically used by CDOT. Other types and components may be used, but will be allowed only if they have been accepted for general use by other transportation authorities and the Concessionaire can demonstrate that the design of the bridge type and components will perform well under the Phase 2 Construction Work's environmental conditions, including frequent freeze-thaw cycles, anti-icing and de-icing. Experimental bridge types, timber bridges, masonry bridges, and structural-plate arches are not permitted. Bridges shall incorporate as few joints and bearings as possible, be continuous over supports, not use intermediate hinges, and use integral or semi-integral abutments wherever possible. The Concessionaire shall submit proposed non-historic bridge types to HPTE for Approval. If not supplied in the Contract Documents, the Concessionaire shall obtain structure numbers for new structures from CDOT Staff Bridge.

### 15.2.3.3 Inspection Access

All bridge superstructures, joints, and steel-reinforced elastomeric bearing pads with sliding surfaces and high load multi-rotational (HLMR) bearings shall be made accessible for long-term inspection and shall be designed and detailed for ease of replacement, including jack locations, and required jack sizes. The bridge shall be designed to withstand the loads and forces with the superstructure jacked.

Superstructures consisting of I-girders with exposed cross frames shall be made accessible with walkways (see CDOT *Bridge Design Manual*), or by use of an A-40 inspection truck. All concrete or steel box girders with an inside depth of 5 feet or more shall be made accessible for interior inspection. All-pretensioned precast concrete box or tub girders with access shall be provided with low-point drainage through the bottom slab. Access doors shall be placed at locations that do not impact traffic under the bridge, and shall be located to be readily accessible from bridge inspection trucks. All access holes shall be accessible with ladders from the ground and shall not require access by use of a CDOT A-40 Inspection truck. Where access doors are provided above slope paving, cleats to support a ladder shall be provided in the slope paving. Location of access holes shall be submitted for Approval by HPTE. CDOT Standard Structural Worksheet B-618-2 shows typical bottom-slab access-door details. The doors shall be placed at locations that do not impact traffic under the bridge, and shall swing into the box girder. Box girders shall be protected from access by vermin. The minimum opening for access doors shall be 2 feet by 3 feet and locked by a single padlock. Access holes through diaphragms shall be 2 feet, 6 inches in diameter, minimum.

### 15.2.3.4 Components

#### 15.2.3.4.1 Bridge Rails and Pedestrian Railing

The Concessionaire shall design and construct bridge rails and pedestrian fencing (on bridges with sidewalks) that match the face, color and overall shape of barriers as defined in the Aesthetic Treatment Plan and McCaslin Interchange Enhancement Concepts in the Reference Documents. The Concessionaire shall use bridge rails on approach slabs. The Concessionaire shall design and construct pedestrian fencing/railing in accordance with AASHTO *LRFD Bridge Design Specifications*. Bridge rails and pedestrian rails not separated from vehicular traffic by bridge rails shall be designed to meet TL-4 loading in accordance with AASHTO *LRFD Bridge Design Specifications*. Pedestrian railing attached to bridge rails shall be installed behind bridge rail face, or back side of bridge rail. Cover plates shall be used over breaks in the interior and exterior bridge rail, curbs, or sidewalks to provide structural and safety shape continuity across the joint in the bridge rail and to provide face-of-curb continuity across the joint in the curb for traffic loading at these breaks in bridge rail and curb.

#### 15.2.3.4.2 Approach Slabs

Approach slabs shall be a minimum of 20 feet in length measured along the centerline of the bridge. Approach slabs shall be separate from and fit between cantilevered wingwalls or retaining-wall wingwalls so that the approach slab can freely rotate about the abutment. Bridge rails shall be connected to approach slabs. The bridge rails shall function as a barrier to keep water out of the joint between wingwall or retaining wall and along the edge of approach slab. The approach slab, for highway bridges, shall be at least the same width as the bridge deck, and provide for expansion and contraction at the approach pavement interface where required. Approach slabs shall be anchored to the abutment. The Concessionaire shall design and construct an underdrain system beneath all approach slabs to reduce water in embankment fills



at bridge abutments. Backfill behind the abutments shall be as shown in the CDOT Bridge structural worksheets Backfill Drawings B-206-F1 or B-206-M1. Bridge end drains shall be located so as to minimize the amount of water flowing across all joints.

Differential settlement across approach slabs shall be designed such that they will not produce a grade break that is noticeable to the user and shall not be more than 1-inch within one year of opening to traffic. The Concessionaire shall implement ground-improvement techniques to the approach embankment subgrade if necessary to meet this requirement.

The existing McCaslin Bridge over US 36 (Str. No. E-16-KZ) does not have approach slabs. The widened portions of this bridge will not require approach slabs. Abutment backfill and approach pavement shall be designed/detailed to limit potential settlement at the back of the bridge abutment, and avoid formations of measureable vertical bumps and cracking in the pavement at this location.

#### **15.2.3.4.3 Decks**

The Concessionaire shall provide a minimum concrete deck thickness of 8 inches. Open or filled grating decks and orthotropic decks will not be permitted. Concrete decks designed by the simplified "Ontario", or any empirical methods, will not be permitted. Full-depth precast deck slabs shall require cast-in-place joint closures and post tensioning across joints and an overlay. Pretensioned, precast concrete deck forms shall be a minimum of 3 inches thick and have a full grout or concrete bearing. Full grout is defined as a 1-inch minimum thickness by 2-inch wide grout pad. Stay-in-place metal deck forms are permitted. If stay-in-place metal forms are used, the superstructure, substructure, and foundation shall be designed for an extra 5 pounds per square foot (psf) minimum dead load applied to the superstructure. Parallel bridges shall have a minimum 1-inch (4-inch preferred) longitudinal gap between decks or parapets, or shall be tied together to make one structure. Permanent deck forms shall not be allowed between girders or stringers where the longitudinal deck joint is located. Permanent deck forms shall not be allowed for cast-in-place post-tensioned box girder or T-girder deck slabs, or cantilevered portions of decks. In order for the cast-in-place portion of concrete placed on top of the top flange of a precast double tee or precast box girder to be considered composite with the precast top flange, the minimum total laminated deck thickness shall be 8 inches, the minimum cast-in-place thickness shall be 4-3/4 inches, and the top surface of the precast top flange shall be roughened. Precast double tees or precast box girders without a cast-in-place deck placed on top shall not be allowed. If any part of a deck resists tension, the stress in the deck in this area shall not exceed 0.0948 times the square root of  $f'c$ , ( $0.0948 \times (f'c)^{1/2}$ ) where  $f'c$  is in ksi. Minimum longitudinal steel in the top mat of cast-in-place decks shall be #4s at 6-inch spacing spliced to the negative-moment steel reinforcing.

#### **15.2.3.4.4 Deck Joints**

The Concessionaire shall avoid or minimize joints wherever possible. Bridges in length up to 640 feet (steel) or 790 feet (precast or cast-in-place concrete) shall be jointless, wherever possible, according to guidelines given in CDOT *Bridge Design Manual*. A minimum 0- to 4-inch joint shall be placed at the end of approach slabs unless Approved by HPTE. Use only CDOT-Approved strip seals for joints with expected maximum 4-inch movement or modular joints for expected movements 4 inches or greater. Design and location of joints shall provide for maintenance accessibility and future replacement. Aluminum joints will not be permitted. Modular joints shall be designed by LRFD, and shall include LRFD fatigue requirements. Modular joints shall be tested for fatigue loading according to the National Cooperative Highway Research Program (NCHRP) *Report 402, Fatigue Design of Modular Bridge Expansion Joints*

(1997) Appendix A & Appendix B. Expansion devices shall be set to provide a smooth surface between the final grade into the device and the final grade out from the device. A smooth surface is defined as a maximum grade break, at or 30 feet either side of the device, of 0.3 percent. To facilitate the proper placement of expansion devices, the tabular bridge geometry shall include a bent line for the expansion devices on a bridge or approach slab. Asphaltic expansion devices and asphaltic plug joints shall not be used for any new construction.

The existing McCaslin Bridge over US36 (Str. No. E-16-KZ) does not have deck joints. The widened portions of this bridge will not require deck joints.

#### **15.2.3.4.5 Overlays**

The Concessionaire shall provide an initial bridge deck overlay for all bridge decks. Overlays shall be 3-inch asphalt over a waterproofing membrane for bridges. The asphalt overlay with a waterproofing membrane shall be used on both the bridge deck and associated approach slab. Thin-bonded overlays, such as epoxy or polyester, shall be used when widening an existing bridge with a bare concrete deck. Latex-modified overlays shall not be used. In this case, the thin-bonded overlay will be applied to both the existing deck and the widened portion.

#### **15.2.3.4.6 Superstructures**

The Concessionaire shall ensure that all superstructures meet the requirements for redundancy, fatigue, crack control, and deflection in AASHTO *LRFD Bridge Design Specifications*. Deflection criteria shall be considered. Utilities shall not be placed on structures without the Approval of HPTE and, if Approved, Utility supports and other details shall be designed by a professional engineer licensed in the State of Colorado. Utilities shall be hidden from view in superstructure elevation if they have been Approved by HPTE to be placed on the structure. Bridge deck drainage or anti-icing pipes shall not be allowed inside of box girders or embedded within concrete structural members. For structural steel, redundant-member structures are preferred. For concrete box girder structures, the Concessionaire shall consider the effects of a temperature gradient. The design of cast-in-place box girders shall include the weight of the deck formwork left in place in the design of the superstructure, substructure, and foundation.

The minimum concrete strength,  $f'c$ , shall be 4.5-ksi, if any portion of the cast-in-place concrete member forms any part of the deck.

Field connections shall not be welded, but shall be made with high-strength bolts. Slip-critical connections shall be made with 3/4-inch, 7/8-inch, or 1-inch diameter, ASTM A325 bolts.

Shear connectors shall penetrate at least three inches above the bottom of the slab. The minimum cover from top-of-deck to top-of-stud for bare decks shall be 3 inches, and for decks with an overlay and membrane shall be 2 inches.

The use of pins and hangers will not be allowed. The Concessionaire shall avoid Category D or poorer weld details in tension zones subject to fatigue stress ranges. The design life of the structure for fatigue calculations shall be 75 years.

The location of all fracture critical members (FCM) shall be clearly delineated on the plans. HPTE shall be notified of any new bridge containing FCMs. The Concessionaire shall follow CDOT procedures for identification of and requirements for FCMs.

The Concessionaire shall follow the *Shop Detail Drawing Review/Approval Guidelines* developed by the AASHTO/NSBA Steel Bridge Collaboration G1.1-2000 for preparation of steel shop drawings.

For the Overhead Irrigation Pipe Structure over US36, Structure E-16-FT, no pipe joints are permitted over US36 mainline, including the ultimate configuration.

#### **15.2.3.4.7 Bearings**

The Concessionaire shall design and locate bearings to allow maintenance accessibility and future replacement. Substructure drawings shall show locations for lifting when removing bearings. If design loadings allow, elastomeric pads and steel-reinforced elastomeric bearings with or without sliding surfaces shall be used. Sliding surfaces shall be polytetrafluoroethylene (PTFE) with a stainless-steel mating surface. Bearings shall be either elastomeric pads (CDOT Type I), steel-reinforced elastomeric bearings, with or without PTFE and stainless steel sliding surfaces (CDOT Type I or Type II), or HLMR bearings (CDOT Type III). The thickness of Type II bearings shall be designed so that the acceptable shear-deflection limits of the pad are not exceeded if, for some reason, slip does not occur. The design of elastomeric pads and steel-reinforced elastomeric bearings shall be such that pad walk-out will not occur by including pad-walkout restraints. Sole plates, when used, shall have a 3/4-inch minimum thickness. At expansion bearings, the edge of the sole plate shall not slide past the edge of the elastomeric pad, by the use of a positive stop. The Concessionaire shall provide at least 3 inches of cover between anchor bolts and the edge of the concrete pedestal. The Concessionaire shall provide reinforcement for pedestals greater than 3 inches high. Suppliers of bearings devices shall only be those on CDOT's Preapproved Product List. Only one bearing type shall be used across the width of the bridge at any given substructure location. Elastomeric pads and steel reinforced elastomeric bearing devices shall not be mixed with HLMR bearings at any one particular bridge. The minimum HLMR bearing height shall be 7 inches.

#### **15.2.3.4.8 Piers and Pier Caps**

The Concessionaire shall design a type of pier and pier cap that will be consistent with the Aesthetic Treatment Plan. Drop caps or integral caps are acceptable. Integral caps are preferred with cast-in-place concrete box section systems. The Concessionaire shall minimize the use of integral steel pier caps. Inspection access for integral steel pier caps shall be provided. Aesthetic treatments on piers shall extend below existing grade and be considered for ultimate template as necessary to accommodate future construction of US 36 and adjacent ramp improvements.

#### **15.2.3.4.9 Abutments**

The Concessionaire shall provide integral or semi-integral, end-diaphragm-type abutments for bridge structures whenever possible. See CDOT *Bridge Design Manual*, Section 7.2 - Mechanically Stabilized Earth (MSE) walls, which may serve as abutment support for bridge superstructure loads. Retaining-wall wingwalls may be used in lieu of cantilevered wingwalls at abutments for all aesthetic categories of bridges. The length of cantilevered wingwalls and/or retaining walls from the end of the abutments of a U-type abutment shall be 4 feet longer than the point of intersection of the embankment slope with the roadway finished grade. Bridge monuments shall be supported on separate foundations.

The widening of the McCaslin Boulevard Bridge over US36 (Str. No. E-16-KZ) includes architectural enhancements at the extended abutment ends, and wingwalls. Separate,

independent foundations shall be provided for the monument enhancements. Reference Section 15.2.3.8 for requirements related to the foundations of the architectural steel arch truss.

#### **15.2.3.4.10 Slope Protection**

The Concessionaire shall provide concrete slope protection for all slopes under bridges and on slopes between tiered walls. Slope protection shall conform to details contained in CDOT Standard structural worksheets Slope Paving Details, Drawings No. B-507-1 and -2. Slope protection on slopes between tiered walls and any slopes from shoulder to the top of retaining wall shall use similar detail.

#### **15.2.3.4.11 Foundations**

The Concessionaire shall ensure that differential settlement will not exceed 1/2-inch within a bent or abutment; and span length in (feet)/400 differential settlement between adjacent bents or abutments. The Concessionaire shall design for down-drag on deep foundations where required. Spread footings are acceptable if the bottom of the footing is located below frost heave. Foundations of integral abutments with skewers between the axis of the abutment and the direction of allowed movement of less than 56 degrees shall be designed to resist the unbalanced earth pressures behind the abutments.

The Concessionaire's Quality Management Plan (QMP) shall include inspection of all drilled caisson operations using non-destructive testing for non-redundant (single shaft) drilled caissons. Cross sonic log (CSL) or impact echo are acceptable methods of non-destructive testing for drilled caissons. Additional methods for non-destructive testing that are in accordance with the AASHTO/ASTM/FHWA guidelines may be considered for use on this Phase 2 Construction Work, subject to Acceptance of HPTE.

Dynamic monitoring of driven-pile foundations using the Pile Driving Analyzer (PDA) tests shall be performed at a minimum of two piles per structure, each at a separate foundation element (abutment or pier foundation), and a minimum of 2 percent of driven piles for the Phase 2 Construction Work, to verify that pile capacity, with appropriate resistance factor, meets or exceeds the design-factored load per pile. The PDA tests shall cover pile size, hammer type, and geology condition changes for structures. The PDA tests shall include the measurements for initial driving and re-strike. The Concessionaire may replace or supplement PDA tests with static load tests for piles. Static load tests shall be in accordance with ASTM D-1143 or ASTM D-3996. The exact number, type, layout and location of static and PDA tests will be per the Concessionaire's QPM, subject to Acceptance of HPTE. Static axial load tests or PDA on driven piles shall be performed in locations where driven piles will be used and the vertical loads will control the depth of the driven piles.

#### **15.2.3.4.12 Drainage**

Bridge deck drainage and end-drainage systems shall be designed in accordance with the CDOT *Bridge Design Manual*. Gutter flow at both ends of bridges shall be intercepted. Stormwater flowing toward the bridge shall be intercepted prior to the approach slab. Stormwater flowing away from the bridge shall be intercepted prior to leaving the approach slab. All stormwater shall be directed to an appropriate outfall. Permanent erosion protection shall be designed and installed at all outfall locations to prevent the occurrence of erosion. Outfalls shall have a well-defined and protected flow path. Energy dissipation in the channel shall be required.

All bridge deck-drain inlets shall be grated. The bridge deck drainage system shall be compatible with the structural reinforcement, components, and aesthetics of the bridge. Outfalls

shall be positioned to avoid corrosion of structural members, and splash on vehicular traffic and pedestrian areas below the bridge. Downspouts for bridge drains shall be minimum 10-inch diameter galvanized steel pipe, and shall meet the requirements of ASTM A53, Grade B, and Standard Weight Schedule 40. Downspout pipe shall be hot-dipped galvanized after fabrication. Galvanizing shall meet the requirements of AASHTO M111. Metal used in the manufacture of castings shall meet the requirements of ASTM A48, Class 35B. Cleanouts shall be provided for downspout systems.

Bridge deck drains shall be located so that downspouts can be taken immediately down pier columns. Bridge drain systems with "horizontal" runs shall not be used unless approved. In addition the bridge deck system shall comply with requirements listed in Schedule 5, Section 12, (Drainage and Hydrology), regarding permitting.

The bridge deck drain system shall be designed and constructed to be easily modified to accommodate future changes to the median width on the bridge. Downspout and outfall locations shall be located such that no changes are required in the future to accommodate the ultimate construction of US 36 and adjacent ramp improvements.

The existing McCaslin Boulevard Bridge over US36 (Str. No. E-16-KZ) does not have existing bridge deck drainage or approach slab inlets (there are no approach slabs or deck joints at this bridge). The drainage from the widened bridge may be collected at roadway inlets that are not directly adjacent to the bridge.

#### **15.2.3.4.13 Utilities**

The Concessionaire shall identify, maintain, and coordinate all Utility location on structures. Hanging of electrical or telephone conduits or Utilities shall not be permitted under deck overhangs or on bridge rail. Protection of the pipes from the settlement of the abutment backfill shall be provided. Utility placement on bridge structures shall be by the Approval of HPTE.

See additional requirements for Structure E-16-FT under Section 15.2.3.4.6, Superstructures.

#### **15.2.3.4.14 Median**

The concrete curb and median cover material on the bridge deck and approach slabs shall be constructed to allow removal and modification in the future without causing damage to the bridge deck concrete and reinforcement.

#### **15.2.3.5 Maintenance Plan**

The Concessionaire shall provide to HPTE for Acceptance, a maintenance plan for each bridge type used. This plan shall describe routine maintenance and items specific to each component of the specific bridge type. It shall also include a detailed list of all maintenance and rehabilitation work and the number of times each procedure is anticipated to be performed over the 75-year structure life, itemized by the year performed.

#### **15.2.3.6 Existing US 36 Bridge Repairs \ Rehabilitation**

HPTE has determined that the structures listed in Table 15.2-3 will need to be widened and rehabilitated for this Phase 2 Construction Work.

<p><b>Table 15.2-3</b> <b>BRIDGE WIDENINGS AND REHABILITATIONS</b></p>
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Structure Description - Widening	Structure No.
US 36 over South Boulder Creek	E-16-FD
McCaslin Boulevard (SH 170) over US 36	E-16-KZ

Structure widenings and replacements shall include the removal of the portions of the existing structures that interfere with the construction of the widening or rehabilitation. Existing structures shall be removed to a minimum depth of 2 feet below the proposed finished grade or any proposed Utility.

Structure Inspection Assessment (SIA) Reports from CDOT will be made available to the Concessionaire for all existing structures. All structural damage listed in Table 15.2-6 (for structures to remain) shall be repaired as part of this Phase 2 Construction Work. Within 120 Days of NTP1 the Concessionaire, along with HPTE agents, shall conduct a visual inspection of all the existing corridor structures to remain. All visible damage, concrete delamination, and concrete cracks (greater than 0.03-inch) identified during these inspections shall be repaired as part of the Contract.

On the existing highway structures requiring a new asphalt overlay and waterproofing membrane, the Concessionaire shall completely remove the old asphalt overlay and waterproofing membrane down to the bare concrete. The Concessionaire shall visually inspect the bridge deck and assess repair options prior to the completion of the asphalt overlay and waterproofing membrane removal. The Concessionaire should assume that special equipment will be required on the existing bridge decks. This special equipment shall produce a smooth finished concrete surface, required for the installation of the new waterproofing membrane.

The methods and procedures for repairs to existing structures shall be left up to the Concessionaire, with the review and Acceptance of HPTE. Proposed methods and procedures for repairs shall be submitted to HPTE, as part of the Concessionaire's Construction Quality Management Plan (CQMP).

It has been determined that the bridge decks, of the existing structures listed in Table 15.2-5 shall require some bridge deck repairs and deck replacements when these existing structures are widened and rehabilitated. Structure numbers shown include both the east- and westbound lanes.

Table 15.2-5 DECK REPAIRS AND REPLACEMENTS		
Structure No.	Structure Description	Existing Deck Area (square feet) (approximate)
E-16-FD	South Boulder Creek	9,890
E-16-KZ	McCaslin Boulevard	16,405
	<b>Total Deck Area</b>	<b>26,295</b>

The Concessionaire shall assume that 40 percent (10,518 square feet) of the existing bridge deck in Table 15.2-5 will require rehabilitation. Of this amount, assume 9,992 square feet will require Class 2 repair, and 526 square feet will require a completely removal and replacement (a full-depth CDOT Class 3 repair). HPTE reserves the right to transfer unused deck quantities from one structure to another, within the above list, until the total 40 percent (10,518 square feet) of existing deck area is used.

During the widening and rehabilitation of this structure, HPTE shall work with the Concessionaire to determine the full extent of the deck repairs required for this Project. If it appears that the damaged deck area is going to exceed the assumed 40 percent deck area, the Concessionaire shall produce a detailed bridge deck condition report, to be submitted to HPTE for Acceptance.

Removal and replacement of additional deck areas (above the initial 40 percent) shall be subject to a Change Order in accordance with the Concession Agreement.

Class 3 is defined as a complete full-depth removal and repair. The Work shall include all costs for removals, materials (concrete and reinforcing steel), forms, falsework, shoring, and labor to perform the Work.

In addition to deck rehabilitation, each of the above structures shall include the rehabilitation elements listed in Table 15.2-6.

<b>Table 15.2-6 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
E-16-FD US 36 over South Boulder Creek	<ul style="list-style-type: none"> <li>• Clean and paint girders and rocker bearings where corrosion or peeling paint exists (1700 SF)</li> <li>• Remove existing AC overlay from bridge deck (1045 SY)</li> <li>• Patch delaminated/spalled concrete on pier columns, pier caps, abutment caps, abutment backwalls, deck soffits and wingwalls; clean exposed rebar prior to patching (110 SF)</li> <li>• Repair cracks in concrete abutment and wingwall faces (90 LF)</li> <li>• Install 2-inch AC overlay and waterproofing membrane (1045 SY)</li> <li>• Remove/clean debris from seats</li> <li>• Remove and replace bridge rails with crash-tested bridge rails (278 LF)</li> <li>• Provide structural concrete coating on abutment face, wingwalls, edge of deck, and overhang soffits (520 SY)</li> <li>• Install approach slab within the limits of 1987 widening (30 CY)</li> <li>• Install expansion joint at the abutments (192 LF)</li> </ul>
E-16-KZ McCaslin Boulevard (SH170) over US 36	<ul style="list-style-type: none"> <li>• Remove existing AC overlay from bridge deck (1415 SY)</li> <li>• Patch delaminated/spalled concrete on abutment caps and diaphragms; clean exposed rebar prior to patching (8 SF)</li> <li>• Repair cracks in concrete pier wall and abutment diaphragms (20 LF)</li> <li>• Remove and replace bridge rails with crash-tested bridge rails (466 LF)</li> <li>• Remove existing sidewalks and raised median (365 SY)</li> <li>• Install 2-inch AC overlay and waterproofing membrane (1480 SY)</li> <li>• Install 6" sidewalk at center of bridge (258 SY)</li> </ul>

An existing irrigation line within the median of the McCaslin Boulevard bridge shall be relocated onto the bridge widening, if required for the final irrigation design.

During rehabilitation of these elements, HPTE shall work with the Concessionaire to determine the full extent of rehabilitation. If determined and agreed upon that the rehabilitation quantities exceed that provided, and the Concessionaire shall produce a detailed documentation of the rehabilitation quantities, to be submitted to HPTE for Acceptance. Rehabilitation for the total quantity outlined above shall be subject to a Change Order in accordance with the Concession Agreement.

Bridge widenings shall be designed in accordance with AASHTO Design Specifications used for the existing structure, load factor design (LFD) or LRFD and the respective edition of the specifications. All rehabilitated and widened structures shall be load rated, documented and submitted to HPTE, using the Virtis software in accordance with the corresponding design specifications, LFR or LRFR. Table 15.2-7 summarizes these requirements.

<b>Table 15.2-7 STRUCTURE DESIGN SPECIFICATIONS AND LOAD RATINGS</b>			
<b>Structure No.</b>	<b>Structure Description</b>	<b>AASHTO Design Specifications</b>	<b>Load Rating</b>
E-16-FD	US 36 over South Boulder Creek	LFD	LFR
E-16-KZ	McCaslin Blvd (SH170) over US 36	LFD	LFR

### 15.2.3.7 Removal of Bridge Structure

The following existing structures shall be removed.

<b>Table 15.2-8 STRUCTURES TO BE REMOVED</b>	
<b>Structure Description</b>	<b>Structure No.</b>
US 36 Eastbound over Coal Creek	E-16-FH
US 36 Westbound over Coal Creek	E-16-FG
Overhead Irrigation Pipe Bridge	E-16-FT

Bridge removal shall consist of the complete removal of all superstructure and substructure elements for the reconstruction of new structures at these locations.

Removal of the substructure shall be taken down to at least 1 foot below the future ground surface at the lowest point of interface. Holes resulting from substructure removal shall be backfilled with structure backfill (Class 2) to the adjacent existing grades.

The Concessionaire shall submit a Bridge Removal Plan to HPTE. The Bridge Removal Plan shall detail procedures, sequences, and all features required to perform the removal in a safe and controlled manner. The Bridge Removal Plan shall provide complete details of the bridge removal process.



### 15.2.3.8 Aesthetics

Basic aesthetics for bridges and adjacent walls shall be consistent with the Aesthetic Treatment Plan, and as described below.

Aesthetics for new or widened structures shall be as follows:

1. US 36 over South Boulder Creek Bridge Widening: Aesthetic treatments for structure, barriers, walls, and other features shall match and replicate the original existing treatments.
2. McCaslin Boulevard over US36 Bridge Widening : Aesthetic treatments for structure, barriers, walls, and other features shall be in accordance with the McCaslin Interchange Enhancement Concepts in the Reference Documents.
3. McCaslin West Ramps over Bus Ramps : Aesthetic treatments for structure, barriers, walls, and other features shall be in accordance with the McCaslin Interchange Enhancement Concepts in the Reference Documents..

In all cases, proposed structure aesthetics, including all visible surfaces, shall be submitted to HPTE for review with the Concessionaire's proposed general layouts of each structure. This submittal shall include drawings illustrating form, texture, and color. The Concessionaire shall provide full-size mockups for all proposed surface treatments showing texture, color, and quality for Approval by HPTE. For Phase 2 Construction Work consistency, structures shall incorporate similar visual aesthetics. The Concessionaire shall produce and submit to HPTE for Approval a graphic of each structure to demonstrate structural consistency. This graphic shall be submitted in both hard and electronic format.

If deck overhangs exceed the limits in Section 8.2 of the CDOT *Bridge Design Manual*, a structural analysis shall be performed to determine if a lateral load distribution system is required for the wet concrete pour and screed loads.

The architectural steel arch truss installed with the McCaslin Boulevard Bridge widening shall be designed to support its self-weight and external forces on the truss as specified in Section 15.2.2.2. The architectural truss shall span the existing bridge, and shall not be attached to the widened bridge in any way. The truss shall be supported on a foundation that is isolated from the existing bridge abutments. No loads from the arch truss foundation shall influence the existing bridge abutments and foundations. The arch truss shall resemble the existing McCaslin Park-n-Ride Pedestrian Bridge spanning US 36 (Structure No. E-16-WG), but include the modifications presented in the Reference Documents.

### 15.2.3.9 Load Rating Additional Existing Bridges

There is one existing structure along the Phase 2 Construction Work limits that is not modified by this Phase 2 Construction Work and that does not have recent load ratings. As part of the Phase 2 Construction Work, the listed existing bridge will be load rated in accordance with AASHTO Design Specifications used for the existing structure, LFD or LRFD and the respective edition of the design specifications. The latest inspection report, As-Built plans, and visual inspection by the Engineer is required to load rate the bridges. The load ratings shall be documented and submitted to HPTE, using the Virtis software in accordance with the corresponding design specifications, LFR, or LRFR.

The one existing structure to be load rated is summarized in Table 15.2-9.

<b>Table 15.2-9 STRUCTURES TO BE LOAD RATED</b>	
<b>Structure Description</b>	<b>Structure No.</b>
Cherryvale Road over US 36	E-16-FE

#### **15.2.3.10 I-25 Initial Work Package**

HPTE has determined that the structures listed in Table 15.2-10 will need to be rehabilitated as part of the I-25 Initial Work Package.

<b>Table 15.2-10 I-25 BRIDGE REHABILITATIONS</b>	
<b>Structure Description</b>	<b>Structure No.</b>
US 36 over Pecos Street	E-16-RB
US 36 over SH224/Broadway	E-17-NB
HOV over I-25 SB	E-17-JK
70 <sup>th</sup> Ave (US224) over I-25	E-17-OO
HOV 70 <sup>th</sup> Ramp over I-25 Access	E-17-PU
I-25 SB and HOV over Clear Creek	E-17-PA
I-25 over 62 <sup>nd</sup> Avenue	E-17-OW
I-25 over UPRR	E-17-OX
I-25 over 48 <sup>th</sup> Ave, RR Spur	E-16-NW
I-25 over Ramps to I-25/I-70	E-16-GC
I-25 over Fox Street	E-16-FA
I-25 over RR Spur	E-16-EM
20 <sup>th</sup> St HOV Ramp over I-25 NB	E-16-OP
20 <sup>th</sup> St HOV over Roads/River/RR	D-03-V-045A
20 <sup>th</sup> St HOV/DUT Ramp over RR/Parking Lot	D-03-V-046

Current Structure Inspection Assessment (SIA) Reports from CDOT will be made available to the Concessionaire for all existing structures. Additional SIA reports will be made available to the Concessionaire when completed. The Concessionaire shall repair all structural damage listed in Table 15.2-11 as part of the Phase 2 Construction Work.

Preliminary quantities for the rehabilitation work described in Table 15.2-11 are provided in the I-25 Initial Work Package Quantities in the Reference Documents. Within 30 Days after Financial Close, the Concessionaire shall provide to HPTE, for Acceptance, unit costs, items costs, and costs per structure based on these preliminary quantities to establish an initial total cost for the I-25 Initial Work Package. These numbers shall sum to the I-25 Initial Work Package Price. These Accepted unit costs will be used as the basis for a negotiated Change Order if a change in quantities results in an increase or decrease to the initial total cost for the Initial Work Package.

Within 120 Days after Financial Close, the Concessionaire, along with HPTE agents, shall conduct a visual inspection of all the structures listed in Table 15.2-10. All visible damage, concrete delamination, and concrete cracks (greater than 0.03-inch) identified during these inspections shall be repaired as part of the Contract.

On the structures requiring a new asphalt overlay and waterproofing membrane as listed in Table 15.2-11, the Concessionaire shall completely remove the old asphalt overlay and waterproofing membrane down to the bare concrete. The Concessionaire shall visually inspect the bridge deck and assess repair options prior to the completion of the asphalt overlay and waterproofing membrane. The Concessionaire should assume that special equipment will be required on the existing bridge decks. This special equipment shall produce a smooth finished concrete surface, required for the installation of the new waterproofing membrane.

On the structures requiring deck repair, the Concessionaire shall perform Class 2 repair. If it appears that the damaged deck area is going to exceed Class 2 deck repair quantity shown in the preliminary quantities, the Concessionaire shall produce a detailed bridge deck condition report, to be submitted to HPTE for Acceptance.

If structure rehabilitation quantities vary from the preliminary quantities based on the visual inspection or actual conditions encountered, HPTE reserves the right to prioritize work elements and transfer unused quantities from one structure to another, within the above list, to remain within the initial total cost established for the I-25 Initial Work Package. If it appears that the structure rehabilitation/repair is going to exceed the preliminary quantities, the Concessionaire shall produce a detailed bridge condition report and detailed cost estimate, to be submitted to HPTE for Acceptance. HPTE reserves the right to prioritize the rehabilitation/repair items shown in the bridge condition report. Rehabilitation work above the initial total cost established for the I-25 Initial Work Package shall be subject to a Change Order in accordance with the Concession Agreement. The methods and procedures for repairs to existing structures shall be left up to the Concessionaire, with the review and Acceptance of HPTE. Proposed methods and procedures for repairs shall be submitted to HPTE, as part of the QMP.

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
E-16-RB US 36 over Pecos Street	<ul style="list-style-type: none"> <li>• Add protective concrete sealer with corrosion inhibitor to bare concrete deck and approach slabs</li> <li>• Clean joint, patch spalls and replace pourable joint seal at abutments</li> <li>• Patch concrete and seal cracks in concrete abutment faces</li> <li>• Seal cracks in concrete pier cap and columns</li> <li>• Seal cracks in concrete wingwalls</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> <li>• Repair slope paving that has settled and broken at wingwalls</li> </ul>
E-17-NB US 36 over SH224/Broadway	<ul style="list-style-type: none"> <li>• Seal cracks in concrete deck</li> <li>• Seal cracks in concrete pier columns</li> <li>• Seal cracks in concrete wingwalls</li> <li>• Clean deck drains</li> <li>• Seal joint between approach and wall</li> <li>• Repair "D" cracking, install backing material, and seal joint with a pourable seal</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>
E-17-JK HOV over I-25 SB	<ul style="list-style-type: none"> <li>• Patch concrete spalls and seal cracks in concrete box girders</li> <li>• Seal cracks in concrete pier columns</li> <li>• Seal cracks in concrete wingwalls</li> <li>• Clean deck drains</li> <li>• Clean non-expansion joints at abutments</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> <li>• Repair slope paving that has cracked and buckled at abutment 3</li> </ul>

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
E-17-00 70 <sup>th</sup> Ave (US224) over I-25	<ul style="list-style-type: none"> <li>• Repair potholes in bridge deck</li> <li>• Mill 2" asphalt overlay</li> <li>• Add new waterproofing membrane</li> <li>• Replace 2" asphalt overlay</li> <li>• Replace modular expansion joint at Pier 4</li> <li>• Seal joints at far ends of approach slabs</li> <li>• Repair "D" cracking, install backing material, and seal joint at abutment with a pourable seal</li> <li>• Seal cracks and patch spalls in concrete bridge rail</li> <li>• Clean deck drains</li> <li>• Clean and paint rust locations interior of steel box girders at modular expansion joint location and utility box locations.</li> <li>• Clean and paint exterior of steel box girders, within 10 feet at ends of bridge</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>
E-17-PU HOV 70 <sup>th</sup> Ramp over I-25 Access	<ul style="list-style-type: none"> <li>• Add protective concrete sealer with corrosion inhibitor to bare concrete deck and approach slab</li> <li>• Replace strip seal expansion joint at Abutment 1</li> <li>• Clean, seal cracks in Pier 2 strip seal expansion joint end dam and replace gland</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
<p>E-17-PA I-25 SB and HOV over Clear Creek</p>	<ul style="list-style-type: none"> <li>• Add protective concrete sealer with corrosion inhibitor to bare concrete deck and approach slabs</li> <li>• Clean deck drains</li> <li>• Replace strip seal expansion joints</li> <li>• Clean joint and replace pourable joint seal at abutments</li> <li>• Seal cracks in concrete abutment faces</li> <li>• Clean reinforcing steel and patch spalls in concrete box girders. If 30% section loss has occurred in reinforcing, add 10-20 lb reinforcing</li> <li>• Seal cracks in concrete box girders.</li> <li>• Repair damaged concrete rails</li> </ul>
<p>E-17-OW I-25 over 62<sup>nd</sup> Avenue</p>	<ul style="list-style-type: none"> <li>• Add protective concrete sealer with corrosion inhibitor to bare precast panel concrete deck and approach slabs</li> <li>• Patch spalls and seal cracks in concrete abutment faces and curtain wall</li> <li>• Add gapped joint to bridge rail at abutment/approach slab joint location</li> <li>• Patch concrete spalls and repair cracks in concrete box girders</li> <li>• Clean and seal longitudinal Construction/Non-Expansion Joint at abutments with a pourable seal</li> <li>• Replace strip seal expansion joints</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
E-17-OX I-25 over UPRR	<ul style="list-style-type: none"> <li>• Patch spalls and add protective concrete sealer with corrosion inhibitor to bare precast panel concrete deck and approach slabs</li> <li>• Seal cracks in concrete abutment faces</li> <li>• Clean reinforcing steel and patch spalls in concrete box girders. If 30% section loss has occurred in reinforcing, add 10-20 lb reinforcing</li> <li>• Seal cracks in concrete box girders.</li> <li>• Replace strip seal expansion joints</li> <li>• Add gapped joint to bridge rail at abutment/approach slab joint location</li> <li>• Clean and seal longitudinal Construction/Non-Expansion Joints at Bays J and O with a pourable seal</li> <li>• Clean joint and replace pourable joint seal at abutments</li> </ul>
E-16-NW I-25 over 48 <sup>th</sup> Ave, RR SPUR	<ul style="list-style-type: none"> <li>• Add protective concrete sealer with corrosion inhibitor to bare concrete deck and approach slabs</li> <li>• Seal cracks in concrete abutment faces and pier caps</li> <li>• Seal cracks in concrete box girders</li> <li>• Clean strip seal expansion joints</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>
E-16-GC I-25 over Ramps to I-25/I-70	<ul style="list-style-type: none"> <li>• Seal cracks in approach slabs</li> <li>• Seal cracks in concrete abutment and piers</li> <li>• Clean strip seal expansion joints</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> </ul>

<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
E-16-FA I-25 over Fox Street	<ul style="list-style-type: none"> <li>• Clean joint and replace pourable joint seal at abutments</li> <li>• Patch concrete spalls and seal cracks in pier columns</li> <li>• Seal cracks in concrete box girders</li> <li>• If necessary, replace the rusted metal access door in the end spans so inspection of abutments can take place</li> <li>• Provide structural concrete coating on columns and end walls (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on columns and end walls (splash zone)</li> </ul>
E-16-EM I-25 over RR SPUR	<ul style="list-style-type: none"> <li>• Patch concrete and repair cracks in abutment faces and pier caps</li> <li>• Clean joint, repair cracks and replace pourable joint seal at abutments</li> <li>• Clean deck drains</li> </ul>



<b>Table 15.2-11 STRUCTURE REHABILITATION ELEMENTS</b>	
<b>Structure No.</b>	<b>Rehabilitation Elements</b>
<p>20<sup>th</sup> St HOV</p> <p>(E-16-OP: 20<sup>th</sup> St HOV over I-25;</p> <p>D-03-V-045A: 20<sup>th</sup> St HOV over Roads/River/RR;</p> <p>D-03-V-046: 20<sup>th</sup> St HOV/DUT Ramp over RR/Parking Lot)</p>	<ul style="list-style-type: none"> <li>• Clean deck drains</li> <li>• Remove and replace bridge rail (steel only)</li> <li>• Remove and replace fence and fence posts</li> <li>• Provide structural concrete coating on pier columns (splash zone)</li> <li>• Provide concrete sealer with corrosion inhibitor on pier columns (splash zone)</li> <li>• Repair spalled or delaminated areas in deck and locations where reinforcing clear cover will be less than 2" after existing overlay is milled, as determined from Ground Penetrating Radar (GPR) results.</li> <li>• Remove silica fume concrete overlay.</li> <li>• Add waterproofing membrane (Units 1-5)</li> <li>• Add 2" asphalt overlay (Units 1-5)</li> <li>• Add protective concrete sealer to bare concrete deck and approach slab (Unit 6)</li> <li>• Replace modular expansion joints at Hinges 4, 7 10, 12 and Abutment 20.</li> <li>• Clean strip seal expansion joints at Abutment 1, Hinge 16A, Abutment 22, and Abutment 20 approach slab</li> <li>• Replace pourable joint seal at Abutment 22</li> <li>• Clean steel, patch concrete spalls and repair cracks in prestressed concrete box girders</li> <li>• Repair cracks in reinforced concrete box girders</li> </ul>

**15.2.4 Box Culverts**

The box culvert structures and locations along the corridor are listed in Table 15.2-10.

<b>Table 15.2-10 BOX CULVERTS</b>	
<b>Structure Description</b>	<b>Station</b>
Farm Underpass	1357+00
Louisville Pedestrian Underpass	1267+00
Louisville Reservoir Inlet	1266+00

Table 15.2-10 BOX CULVERTS	
Structure Description	Station
Davidson Ditch	1213+20
Goodhue Ditch	1195+50
Marshallville Ditch	1182+50
South Boulder Canyon Ditch	1144+00
Dry Creek #2	1126+50
McCaslin Pedestrian Underpass (Option 1)	NA*

The proposed McCaslin Pedestrian Underpass (Option 1) crosses beneath McCaslin Boulevard, south of the existing McCaslin Bridge (Str. No. E-16-KZ).

#### 15.2.4.1 Design

New box culverts, replacements, extensions, and strengthening, including corresponding head and wingwalls, shall meet the requirements of the Phase 2 Construction Work Drainage Report, Phase 2 Construction Work geometry and Site conditions. Use CDOT *M-Standards* when applicable. Culverts not covered in the CDOT *M-Standards* shall be designed in accordance with AASHTO *LRFD Bridge Design Specifications, Fifth Edition, with 2010 Interim Revisions*, CDOT *Bridge Design Manual*, and CDOT *Drainage Design Manual*. See Schedule 5, Section 12, (Drainage and Hydrology), for additional requirements.

All box culverts, new and reuse of existing, shall be load rated, documented and submitted to HPTE, using the BRASS-CULVERT software.

#### 15.2.4.2 Maintenance Plan

The Concessionaire shall provide to HPTE for Acceptance, a maintenance plan for each box culvert structure type used. This plan shall describe routine maintenance and items specific to each component of the specific structure type. It shall also include a detailed list of all maintenance and rehabilitation work and the number of times each procedure is anticipated to be performed over the 75-year structure life, itemized by the year performed.

#### 15.2.5 Retaining Walls

All retaining walls throughout the Phase 2 Construction Work area shall comply with the Aesthetic Treatment Plan, the McCaslin Interchange Enhancement Concepts, and this Section 15. The Concessionaire shall have sole responsibility for the type, material, performance and safety of temporary retaining structures.

##### 15.2.5.1 Geometry

The retaining wall layout shall address slope maintenance above and below the wall and provide returns into the retained fill or cut at retaining wall ends where possible. Final tolerances shall be 1 to 200 for level and plumb. Any residual wall batter shall be into the fill. The Concessionaire shall provide a traversable surface between the wall and the ROW line for maintenance access in accordance with Schedule 5, Section 13.2.5.

Design and construction shall consider surface and subsurface drainage. Walls that support soil and loads from outside ROW and are built with MSE soil reinforcements shall require an appropriate setback from the ROW line for the construction of the wall, or a temporary construction easement shall be required. A system shall be provided to intercept or prevent surface water from entering behind walls. Lengths of wall without relief joints shall be limited to lengths which control the differential settlement. A fence or pedestrian railing shall be provided at the top of walls over 5 feet high where access is open to the public.

#### **15.2.5.2 Type**

Metal walls, including bin walls and sheet-pile walls, recycled material walls, and timber walls shall not be permitted for permanent retaining walls. Wall types selected by the Concessionaire shall have been used successfully in similar geotechnical locations and environmental conditions.

#### **15.2.5.3 Design Requirements**

All permanent retaining walls and their associated structural support elements constructed for the Phase 2 Construction Work shall be designed to resist corrosion or deterioration for a minimum service life of 75 years. Mechanically stabilized earth (MSE) walls shall be designed in accordance with the requirements of *AASHTO LRFD Bridge Design Specifications*. Global stability, overturning, and sliding calculations shall be performed on all retaining wall systems. All retaining wall installations shall include a positive drainage system of the backfill. The design of MSE and modular walls near or in bodies of water shall account for soft saturated soils and scour and shall prevent fines washout between facing elements. All walls near irrigation lines for landscaping shall account for any additional hydrostatic load due to a waterline break. All MSE walls with drainage lines placed within the strap zone shall account for any additional hydrostatic load due to pipe leakage. The Concessionaire may consider the use of free-draining backfill material and/or leak-detection devices to reduce hydrostatic loads on retaining walls. Retaining walls shall be designed according to the Seismic Criteria from *AASHTO LRFD Bridge Design Specifications*.

Temporary retaining walls (constructed of materials not approved for permanent walls) may be abandoned and left in place. Temporary retaining walls left in place must be completely covered by soil or construction material, so they are not visible. Structural components of temporary retaining walls may be reused as part of permanent retaining wall (two-phase walls) systems, provided all of the structural-support elements and materials of the permanent retaining walls meet the requirements of this Section 15.

#### **15.2.5.4 Characteristics**

##### **15.2.5.4.1 MSE (Panel) Walls**

Wall panels shall be constructed of reinforced concrete and provide corrosion protection for prestressing or post-tensioning steel. The cover for reinforcing steel shall be a minimum of 2 inches. Wall panels exposed to splash from traffic shall use epoxy-coated reinforcing steel. Panel joints shall accommodate differential settlement. See Section 206 of the Standard Specifications for backfill requirements.

The Concessionaire shall use latest FHWA geotechnical references and guidelines, including the *FHWA Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - Volumes I and II*.

A barrier shall be provided to prevent fines washout between horizontal and vertical facing panel joints, panel wall construction joints, or relief joints.

#### **15.2.5.4.2 MSE (Block) Walls**

A mechanical connection to the wall facing shall be provided; friction connections relying on gravity alone are not permitted unless every course of block is connected to the MSE soil mass with a reinforcing layer. MSE block walls are not acceptable for walls at the bridge locations or for primary retaining walls. The Concessionaire may use MSE block walls for secondary retaining wall locations, such as landscaping. The Concessionaire shall make a list of proposed MSE block wall locations for Approval by HPTE.

The Concessionaire shall use latest FHWA geotechnical references and guidelines, including the FHWA *Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - Volumes I and II*.

A barrier shall be provided to prevent fines washout between horizontal and vertical block joints, block wall construction joints, or relief joints.

#### **15.2.5.4.3 Cast-in-Place Walls**

Cast-in-place walls shall be designed and constructed in accordance with AASHTO *LRFD Bridge Design Specifications*. Construction-joint spacing shall accommodate or limit differential settlement.

#### **15.2.5.4.4 Anchored Walls**

Design and construction shall use the following documents as guidelines: FHWA DP-90-068, FHWA RD-82-046, FHWA RD-82-047, *Design Manual for Permanent Ground Anchor Walls* FHWA RD-97-130, *Geotechnical Engineering Circular No. 4 - Ground Anchors and Anchored Systems* FHWA IF-99-015. Anchors shall be encapsulated with plastic sheathing. Proof load tests for anchors shall be provided in accordance with the above FHWA guidelines.

#### **15.2.5.4.5 Soil Nail Walls**

Soil nail walls may only be used when top-down construction is warranted. Soil nail walls shall not be used if ground water seepage will be a problem. Design and construction shall use the following documents as guidelines: FHWA-RD-89-93, *Soil Nailing Field Inspectors Manual* FHWA SA-93-068, *Manual for the Design & Construction of Soil Nail Walls* FHWA SA-96-069R, *Geotechnical Engineering Circular No. 7 - Soil Nail Walls* FHWA IF-03-017. Load testing for nails shall be provided in accordance with the above FHWA guidelines. Shotcrete surfaces shall be faced to meet the aesthetic requirements of the Aesthetic Treatment Plan.

#### **15.2.5.4.6 Caisson Walls**

Caisson walls may be used when top-down construction is warranted along areas where right of way or other obstacles are constraining, and alternatives such as soil nail wall construction is not feasible. Caisson walls shall be designed with a permanent concrete fascia, using cast-in-place or precast facing. Walls shall be designed and constructed in accordance with the AASHTO LRFD Bridge Design Specifications.

#### 15.2.5.4.7 Soil Reinforcement

Soil reinforcement for MSE and modular walls shall be galvanized or epoxy-coated steel, geogrids, or fabrics meeting creep requirements of AASHTO *LRFD Bridge Design Specifications*. Design shall account for any item projecting through the soil reinforcement. The Concessionaire shall avoid placing culverts and Utilities perpendicular to soil reinforcement within the reinforced soil mass. Soil reinforcement shall be protected from corrosion of metal due to stray electrical currents.

Structural diaphragm walls may be used when top-down construction is warranted.

#### 15.2.5.5 Wall Aesthetics

All retaining walls throughout the Phase 2 Construction Work area shall comply with the Aesthetic Treatment Plan, the McCaslin Interchange Enhancement Concepts in the Reference Documents, and this Section 15. The support structure (retaining the earth) can be any standard conventional type wall, cast-in-place wall, MSE, sheet piling, concrete caisson, or h-piles. The wall facing shall be graffiti-resistant, textured cast-in-place concrete, precast concrete, or concrete masonry units (for landscape walls only). All wall facing shall be of a consistent type (i.e., cast-in-place, precast facing, concrete masonry units, etc.) within any section of road, interchange and single viewshed. This includes surface treatment, pattern, texture, color, and jointing layout. An overall negative batter (wall face leaning outward) between the bottom and the top of the wall is not allowed. Wall facing shall be installed vertically (plus or minus .5-inch in 10 feet or as defined in CDOT Staff Bridge Branch Structure Worksheets for MSE walls) and shall be capped with a cast-in-place or precast concrete cap. Wall facing and cap shall be colored with pigmented sealer.

In all cases, proposed structure aesthetics, including all visible surfaces, shall be submitted to HPTE for Acceptance. This submittal shall include drawings illustrating form, texture and color. The Concessionaire shall provide full-size mockups (10 feet x 10 feet minimum) for all surface treatments showing texture, color, and quality for Acceptance by HPTE.

#### 15.2.6 Sign Structures

Static sign structures and supports meeting the geometric and sign layout requirements shown in the *CDOT M&S Standard Plans* shall be constructed in accordance with *CDOT M & S Standard Plans*. For static sign structures and supports that do not meet the geometric and sign layout requirements shown in the *CDOT M&S Standard Plans*, the structure shall be designed and constructed in accordance with *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5<sup>th</sup> Edition with 2010 Interim Revisions*. Use Fatigue Category I for overhead sign structures. Sign structures shall be galvanized structural steel (single) tubing. The Concessionaire shall avoid mounting major sign supports (cantilevered signs, sign bridges, etc.) on the MSE retaining walls. However, if unavoidable, the Concessionaire shall coordinate sign support design with MSE wall manufacturer to ensure wall design and details will support sign loads.

Variable Message Signs (VMS) shall be mounted on a sign bridge. The Concessionaire shall prepare a structural design for each VMS structure in accordance with above specified AASHTO requirements and provide to HPTE for Approval.

The Concessionaire shall provide minimum vertical clearance for static and dynamic sign structures in accordance with Section 14.1.1.1.

### **15.2.6.1 Components**

#### **15.2.6.1.1 Foundations**

Drilled caissons shall be used to support overhead and cantilever sign structures. The Concessionaire shall prepare one General Project Foundation Report for all sign structures for Acceptance, and shall have one foundation boring near each single caisson supporting large sign supports.

#### **15.2.6.1.1 Connections**

Connections shall be made with high-strength A325 bolts. Shop splices shall be made with full-penetration butt welds. Base connections shall be made with full-penetration shop butt welds. All sign connection hardware shall be galvanized, with strengthened structural tubing at electrical connection openings.

#### **15.2.6.1.1 Bridge-Mounted Signs**

The Concessionaire shall not mount signs on bridges.

### **15.2.7 Submittals and Reviews**

#### **15.2.7.1 Technical Concepts**

The Concessionaire shall submit a structural concept report prior to proceeding with the initial design and Release for Construction Documents, for Acceptance by HPTE, for any structure type that is proposed for the Phase 2 Construction Work. Suggested submittal contents include elevation views and cross sections depicting structure components (for bridges only, others as the Concessionaire desires). Also included shall be a maximum two-page description of type, materials, strategy for lateral loads, and design-life considerations for each proposed structure.

#### **15.2.7.2 Structural Concept Report Elements**

1. Life Cycle Cost Analysis

The Concessionaire shall:

- A. Provide a 50-year life cycle cost analysis of each proposed bridge type.
- B. Clearly state and justify (using historical data) the assumptions used in determining life cycle costs.
- C. Include construction cost and costs for scheduled maintenance and repair. The Concessionaire shall not include routine maintenance (sweeping, cleaning, graffiti removal, etc.) or demolition and salvage at the end of the 50 years. Maintenance and repair costs shall include material and labor plus an additional 10 percent for traffic control if required for the Work. Items of maintenance and repair shall include, but not be limited to steel painting, decks, railings, overlays, joints, bearings and drainage systems. The Concessionaire shall use a 5 percent discount rate and user cost of \$10.00 per vehicle-hour of delay at year one. The Concessionaire shall use the present worth method to develop a present total bridge cost. Life cycle cost analysis shall be based on

methods and procedures developed by the National Institute of Standards and Technology (NIST) Bridge LLC or the National Cooperative Highway Research Project (NCHRP) 12-43 Life-Cycle Cost Analysis for Bridges.

2. Bridges

For bridge types not historically used by CDOT, the Concessionaire shall submit, for Approval by HPTE:

- A. A minimum one-page description of each bridge type (or foundation type) not historically used by CDOT.
- B. A list of the transportation authorities that have used the proposed bridge type (include actual projects, application, performance, and references).

3. Retaining Walls

For retaining walls, the Concessionaire shall submit, for Approval by HPTE:

- A. A description of each wall type utilized on the project.
- B. A description of methods of accommodating settlement and differential settlement.
- C. A description of the type of foundation for each type of wall.
- D. The location of walls and identification of wall type.

For retaining walls not historically used by CDOT, the Concessionaire shall submit, for Approval by HPTE:

- A. A minimum one-page description of each wall type not historically used by CDOT.
- B. A list of transportation authorities that have used the proposed wall type (include actual projects and references).

4. Concept Plans

In conjunction with the bridge type Concept Report submittal, as defined above, and prior to beginning final design, the Concessionaire shall provide concept plans that include the following:

- A. Plans, elevations, and appropriate typical sections for each bridge type.
- B. Plan views of the Phase 2 Construction Work identifying each bridge location and type.
- C. Plan views of the Phase 2 Construction Work identifying each wall location and type.
- D. Description of conceptual solutions for complex structural problems identified by the Concessionaire.

- E. Description of creative or innovative ways the design, construction, and/or choice of structural types will benefit and/or enhance Contract Schedule, quality, and cost aspects of the Phase 2 Construction Work; and minimize traffic impacts.

### 15.2.7.3 Design

#### 15.2.7.3.1 Reviews

Reviews will be conducted in accordance with the Concessionaire's Approved Design Quality Management Plan. Shop drawings shall be submitted for review by the Engineer. The Concessionaire is solely responsible for shop drawing accuracy. Structure drawings shall conform to the CDOT CADD Standards. Structure drawings standards shall be addressed in the Design Quality Management Plan.

When requested by HPTE, the Concessionaire shall submit two separate structural design packages for each major structural element within the Phase 2 Construction Work (bridges, retaining walls, tunnels and parking structures). Design progress review meetings, as described in Section 3.3.1, shall be included as part of the review process. The structural design packages are defined as:

1. Preliminary Design Package. Completed general layout drawing(s) shall be submitted for each major structural element. The final geometry and proposed structural type shall have been finalized and shall be shown and detailed in the Concessionaire's Drawings. Aesthetic requirements shall have been identified and incorporated into the Concessionaire's Drawings. Additional soil borings (if required) shall have been identified and the foundation system shall be shown in the Concessionaire's Drawings. The Preliminary Design Packages are equivalent to a traditional CDOT Field Inspection Review (FIR) set.
2. Final Plans and Specifications Package. The design and the independent design check shall have been completed and the original final structural design calculations shall be revised and corrected based on comments from the independent design check. Phase 2 Construction Work aesthetic details shall have been incorporated into the Concessionaire's Drawings. All structural drawings shall have been completed, and the final independent plan check of all the drawings shall be complete. Project special specifications shall have been completed. All changes or revisions resulting from in-process design progress review meetings, as described in Section 3.3.1, shall be incorporated into the Final Design Documents. Additional soil borings required for this major structure shall have been completed and the final foundation report shall be finished and included with the package. If required by earlier review comments, the final foundation report shall be updated and resubmitted with this package.

The Concessionaire shall be required to submit only a Final Design Document package for minor structural elements, such as sign structures and noise walls.

#### 15.2.7.3.2 Released for Construction, Revisions to Released for Construction and As Built Documents.

Concessionaire Drawings and Concessionaire Specifications for each structure shall be signed and sealed by the Concessionaire's designer in accordance with laws for registration of professional engineers in Colorado. Copies in PDF and MicroStation electronic format shall be



made of all plans for all structures on the Phase 2 Construction Work and submitted to HPTE on computer disk (CD or DVD) format as stated below in Section 15.2.7.3.3.

**15.2.7.3.3 Documentation**

Design and design-check calculations shall have pages numbered and include a table of contents. All calculations shall identify which code is utilized, and reference the appropriate Section in the right-hand column. References shall be included in the calculations to computer programs used to do the calculations. Computer documentation shall include the following: name of program, vendor, version, and release date; record of software output and verification of output with manual calculations or other recognized program; clear identification of input and output values and meaning; and check of input. All calculations shall be signed and sealed by the Concessionaire’s designer in accordance with the laws for registration of professional engineers in Colorado. Copies in PDF format shall be made of all design and design-check calculations for the Phase 2 Construction Work. Rating packages for all new bridge structures and affected existing structures shall be submitted in accordance with the CDOT *Bridge Rating Manual*. Copies in PDF format for design and design-check calculations and the rating package shall be submitted to HPTE as part of the Released for Construction package. At the completion of the Phase 2 Construction Work, the Concessionaire shall submit to HPTE on computer disk (CD or DVD) format the following documents for each structure: design and design-check calculations, rating package, rating files, any calculations related to changes for Release for Construction Documents or As-Built Documents, and structure electronic CADD files.

**15.2.7.4 Construction Requirements**

The Concessionaire’s Construction Safety Critical Plan (per Section 20 Revision of 107 *Performance of Safety Critical Work*) shall include the additional requirements as shown in Section 2.3.2.1.

Falsework and shoring plans shall be signed and sealed by a professional engineer licensed in the State of Colorado. Shop drawings and working drawings shall be reviewed and approved by the Concessionaire’s structural design engineer. The Concessionaire shall submit As-Built drawings with shop drawings and working drawings for each structure in accordance with the Contract Documents. The Concessionaire shall seal shop drawings in accordance with Table 105-1 of the Standard Specifications. Copies in PDF format shall be made of all As-Built and shop drawings, and working drawings for all structures on the Phase 2 Construction Work and submitted to HPTE on computer disk (CD or DVD) format as stated above in Section 15.2.7.3.3.

The CDOT Permit Office shall be notified 2 Working Days in advance of when vertical clearances are reduced, or when lane closures, lane reductions, or lane-width restrictions are put into effect.

**15.3 Deliverables**

At a minimum, the Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance or Approval	Schedule
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Deliverable	Review, Acceptance or Approval	Schedule
Design exceptions	Approval	As part of the ATC Process, and prior to issuance of applicable Release for Construction Documents
Aesthetic Treatment Plan	Acceptance	With preliminary and final design plans for related structural elements
Structure Concept Report & Plans	Acceptance	Prior to proceeding with the initial design and Release for Construction Documents.
Proposed non-historic bridge, foundation or wall type not used by CDOT	Approval	Prior to proceeding with the initial design and Release for Construction Documents
Proposed location of wall and wall type	Approval	Prior to proceeding with the initial design and Release for Construction Documents
Proposed foundation type for wall type	Approval	Prior to proceeding with the initial design and Release for Construction Documents
Proposed methods of accommodating settlement and differential settlement for wall structures	Approval	Prior to proceeding with the initial design and Release for Construction Documents
Maintenance plan for each bridge type and box culvert structure type used	Approval	Submitted as part of the Preliminary Design Package and/or In-Process Design Packages
Methods and procedures for repairs to existing structures	Acceptance	Minimum of 14 days prior to start of rehabilitation of existing structure
I-25 Initial Work Package initial cost information	Acceptance	Within 30 days of Financial Close
Bridge Deck Condition Report	Acceptance	During rehabilitation of existing deck, if warranted as specified for the Existing Bridge Repairs \ Rehabilitation in this <a href="#">Section 15</a>
Detailed Documentation of Rehabilitation Quantities	Acceptance	During rehabilitation of existing deck, if warranted as specified for the Existing Bridge Repairs \ Rehabilitation in this <a href="#">Section 15</a>
Full-Size Mockups of surface treatments showing texture, color and quality	Acceptance	Submitted as part of the Preliminary Design Package and/or In-Process Design Packages
Proposed Locations of Access Holes	Approval	Submitted with In-Process Design or Final Plans Packages, if required and outlined in the Inspection Access in this <a href="#">Section 15</a>
In-Process Design Package	Review	Provided for information at 90% design.
Foundation Design Report	Acceptance	Submitted as part of the Preliminary Design Package and/or In-Process Design Packages

<b>Deliverable</b>	<b>Review, Acceptance or Approval</b>	<b>Schedule</b>
PDA Testing Criteria including number, type, layout and location	Acceptance	Submitted as part of the Preliminary Design Package and/or In-Process Design Packages
Final Plans and Specifications Package	Acceptance	Prior to Released for Construction documents are issued.
Structural Design for each VMS Structure to CDOT ITS	Approval	Prior to Released for Construction documents are issued.
Additional Non-Destructive methods for testing non-redundant drilled caissons	Acceptance	As required, for acceptance of construction of drilled caissons
Released for Construction and Revisions to Released for Construction	Acceptance	For Construction, per requirements of the RFP
Design calculations and design-check calculations	Acceptance	With Released for Construction Package
Bridge Load Rating	Acceptance	With Released for Construction Package for new and rehabilitated existing structures.
As-Built Documents	Acceptance	With final construction, close out of Phase 2 Construction Work.

## Section 15 Appendix A Project Special Provisions

The following pages provide the modified standard specifications that shall be applicable to the Project.

This Section sets forth modifications to the CDOT *Standard Specification for Road and Bridge Construction* for design-build projects. The first section contains revisions to Division 100 of the Standard Specifications. The second section contains revisions to Divisions 200 through 700 of the Standard Specifications, as well as Standard Special Provisions applicable to the Project.

These Contract Provisions are a revised version of CDOT's *Standard Specifications for Road and Bridge Construction*, and contain requirements generally applicable to the Work to be performed by the Concessionaire. In certain cases, provisions in Section 100 of the *Standard Specifications for Road and Bridge Construction* have been superseded by other provisions of the Contract Documents. For ease of reference, this document uses the same Section numbers as the *Standard Specifications for Road and Bridge Construction*, and identifies provisions of the Contract Documents that have replaced or modified the standard clauses.

All references to "Engineer" that are incorporated into this Section refer to the Concessionaire's Engineer, unless the context requires otherwise. Non-capitalized terms, such as "work" that are defined in The Concession Agreement, Schedule 1, shall have the meanings defined therein unless the context requires otherwise. References to "approve, approval or approved" shall mean "Approve, Approval or Approved" as defined in The Concession Agreement, Schedule 5, when the approval is by HPTE or a division of HPTE. If the interpretation(s) pursuant to this paragraph are not clear, HPTE shall decide, in its sole discretion, how these terms shall be interpreted.

When these specifications describe actions, Materials, means or methods that are required and that are qualified by phrases such as: "as directed by the Engineer", "when directed by the Engineer", "as determined by the Engineer", "with or without permission of the Engineer", "in the opinion of the Engineer", "unless authorized by the Engineer", "satisfactory to the Engineer", "as approved by the Engineer", or "unless another type is specified or is permitted with approval of the engineer", such phrases shall be disregarded. If it is not clear whether a phrase should be disregarded, HPTE will make that decision in its sole discretion.

When these specifications refer to "Department", "Resident Engineer", "Agricultural Engineer", "Bridge, Construction or Maintenance Engineer", "TMC system inspector", "Concrete Engineer", "Project Engineer", "Materials Engineer", "Commissioner", "Structural Metals Engineer", "Department's Lighting Engineer", "Geotechnical Engineer" or any other specific HPTE special engineer, such reference shall mean the HPTE Project Director.

When these specifications use the term engineer relating to the approval of any activities involving the use of explosives, such term shall mean the HPTE Project Director.

When an approval or authorization of the Engineer or HPTE is required in these specifications for the use of alternative or substituted processes or components, the Engineer shall mean HPTE. If it is not clear whether a phrase involves the use of alternative or substituted processes, HPTE will make that determination in its sole discretion.

If these specifications refer to an approval of any correction or repair that deviates from the Contract requirements, the approval must be by HPTE. If it is not clear whether a specification

involves a correction or repair that deviates from the Contract requirements, HPTE will make that determination in its sole discretion.

When these specifications provide that reports, records or other documents shall be submitted to HPTE or to the Engineer, such reports shall be made available to HPTE and do not have to be submitted unless either they are otherwise listed in the deliverables in the Contract Documents, or are required shop drawings, warranties, parts lists, instruction sheets or manufacturer's drawings or specifications. Such documents shall be submitted to HPTE as required by the specifications.

When these specifications require actions, Materials, means or methods that are "either as indicated in the Plans or as designated by the Engineer," the Concessionaire shall disregard the phrase "or as designated by the Engineer."

When these specifications refer to the "Engineer" ordering work beyond the scope of work in the Contract, "Engineer" shall mean HPTE. Whenever in these specifications the Engineer may order work that results in additional costs to HPTE, the "Engineer" shall mean HPTE.

Any acceptances on behalf of HPTE or the State shall be performed by HPTE.

Any references to other standards, codes, or criteria, or to the latest version of other standards, codes, or criteria in Schedule 5 of the Contract Documents shall mean the latest version as of September 21, 2012.

### **Section 15 – Structures Appendix A Special Provisions**

See Schedule 5, Section 20, for Standard Special Provisions.

The Project must meet the Project Special Provisions provided in this Appendix.

#### **REVISION OF SECTION 202 REMOVAL OF ASPHALT MAT (PLANING)**

Section 202 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 202.02 shall include the following:

Removal of Asphalt Mat (Planing) shall consist of removing existing asphalt from the Bridge approaches and on the Bridges as shown in the Bridge plans or as directed. Removal shall be done by the use of an approved planing machine or grinder or other equipment approved by the Engineer. Removal shall be done in such a manner as to insure a level riding surface. All methods and equipment used shall be approved by the Engineer.

#### **REVISION OF SECTION 202 REMOVAL OF EXPANSION DEVICE**

Section 202 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 202.01 shall include the following:

This work shall consist of removing existing bridge expansion devices at locations shown on the plans in accordance with the applicable portions of Section 202 of the Standard Specifications or as amended by these Special Provisions and in conformity with the plans or as directed.

Subsection 202.02 shall include the following:

Removal operations shall be coordinated with the stage construction shown on the plans, indicated in the Special Provisions, or as directed by the Engineer.

The methods and equipment used for the concrete removal shall be approved by the Engineer. The Concessionaire shall take all steps necessary to avoid damage to all reinforcing steel designated to remain in place. Any reinforcing bars damaged by the Concessionaire's operation shall be repaired or replaced at the Concessionaire's expense with no allowance for contract time extension.

Following the removal of the concrete, all exposed reinforcing steel to remain in place, shall be straightened as required and thoroughly cleaned to sound metal by sandblasting. Any structural steel (top of girders and top of diaphragms) damaged by the Concessionaire during removal, shall be repaired at the Concessionaire's expense. Exposed concrete surfaces within the removal limits shall be sandblasted to remove all fractured or loose particles in order to promote good bond with the new concrete.

**REVISION OF SECTION 202  
REMOVAL OF PORTIONS OF PRESENT STRUCTURE**

Section 202 of the Standard Specifications is hereby revised for this project as follows:

Subsection 202.01 shall include the following:

This work shall include the removal of all or portions of the following: bridge deck, abutments, piers, wingwalls, rail, curb, expansion devices approach slabs, slope paving, and light fixtures. Removal operations shall be conducted so that there will be the least interference with public traffic using the structure.

Subsection 202.02 shall include the following:

At least 10 days before beginning bridge removal the Concessionaire shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

All bridge rail shall be carefully dismantled and stockpiled at locations as designated. Haul for stockpiling shall not be paid for separately, but shall be included in the work. The Division will transport the material salvaged from the stockpile site to the maintenance yard. The Concessionaire will be required to load the material salvaged on the Division's hauling equipment.

The existing concrete shall be removed as shown on the plans or as directed by the Engineer. If additional removal of unsound concrete is required, it shall be included in the work.

All methods and equipment used to accomplish this item shall be approved by the Engineer.

Within 24 hours before new concrete is placed, the entire surface upon which new concrete bonds shall be sandblasted to roughen the surface and remove all fractured or loose particles in order to promote good bond with the new concrete.

In Subsection 202.02 delete the sixth paragraph and replace with the following:

Before beginning concrete removal operations on the existing bridge decks, a saw cut approximately one inch deep shall be made to a true line along the limits of removal. A one inch deep saw cut shall also be made along the limits of removal on all faces of monolithic concrete elements which may be visible in the completed work.

**REVISION OF SECTION 202  
SANDBLASTING REINFORCING STEEL**

Section 202 of the Standard Specifications is hereby revised for this Project as follows:

**DESCRIPTION**

Subsection 202.01 shall include the following:

Sandblasting Reinforcing Steel shall consist of cleaning exposed reinforcing steel designated to remain in place following the removal of adjacent concrete and prior to placing new concrete in accordance with the applicable portions of Section 202 of the Standard Specifications or as amended by these Special Provisions or as directed.

**CONSTRUCTION REQUIREMENTS**

Subsection 202.08 paragraph 3 shall include the following:

Rust which may form on the reinforcing steel within seven calendar days following the accepted sandblasting, will not be cause for rejection of the steel.

When acceptable reinforcing steel is exposed to the elements for more than seven calendar days prior to encasement in concrete, adequate measures shall be taken by the Concessionaire, as approved by the Engineer, to protect the steel from contamination or corrosion. Reinforcing steel contaminated as a result of the Concessionaire's failure to provide adequate protection as stipulated herein, shall be re-sandblasted at the Concessionaire's expense with no allowance for contract time extension.

**REVISION OF SECTION 210  
REBUILD PORTIONS OF PRESENT STRUCTURE**

Section 210 of the Standard specifications is hereby revised for this project as follows:

**DESCRIPTION**

This work shall consist of chipping concrete to a minimum depth of 1/8 inch, sandblasting and applying a gel mortar to the damaged area and bring the structure to its original shape.

**MATERIALS**

The material, to be approved by the Engineer, shall be a cementitious, 2-component, fast-setting mortar that is formulated for application by trowel and is especially designed for repair of overhead surfaces.

**CONSTRUCTION REQUIREMENTS**

Removal and rebuild operations shall be conducted so that there will be minimum interference to traffic below the structures.

The affected areas shall be chipped to a minimum depth of 1/8 inch into existing concrete, all loose concrete will be removed, the area shall be sandblasted and the surface preparation shall be as the product literature describes.

The material shall not be installed in the work prior to the Engineer's approval.

Two copies of the product literature containing pertinent materials and installation of the product supplied on this project shall be furnished to the Engineer at least two weeks prior to the products' installation.

Any damage to portions to remain in place by the Concessionaire in performing the work described above shall be repaired to the satisfaction of the Engineer at the Concessionaire's expense.

### **REVISION OF SECTION 502 DRILLING HOLE TO FACILITATE PILE DRIVING**

Section 502 of the Standard Specifications is hereby revised for this project as follows:

Subsection 502.06 shall include the following:

When the plans call for drilled holes filled with slurry or mud made from clay or bentonite, the diameter of the drilled holes shall be at least two inches greater than either the pile diameter or the diagonal corner to corner measurement of the pile cross section, unless otherwise designated on the plans. Oversized holes due to sloughing, drifting, over-drilling, or other causes shall be filled with the accepted slurry or mud at the Concessionaire's expense.

The following mixture will yield approximately 1.2 cubic yards of an acceptable slurry or mud:

50 lbs. dry bentonite powder

Approximately 125 gallons of water (or sufficient amount to make a pourable mix)

1 cubic yard of sand; (approximately 2800 lbs.) reasonably free of material larger than 1/2 inch.

The sand need not be clean. Local soil reasonably free of material larger than 1/2 inch may be substituted for the sand. Cement, lime, flyash, or other pozzolanic or highly alkaline materials shall not be added.

This mixture may be mixed by auger in the drilled hole, by paddle type mortar mixers, by portable or semiportable concrete mixers, or by drum type concrete mixer trucks.

If the mixture is placed or mixed in the hole prior to pile driving, the top two to three feet of the hole may be filled with loose local soil to prevent splashing of the slurry or mud.

Subsection 502.13 shall include the following:

The unit price shall include payment for all work and materials related to furnishing and placing the slurry or mud.

### **REVISION OF SECTION 502 PILING BITUMEN COATING**

Section 502 of the Standard Specifications is hereby revised for this project as follows:



Subsection 502.01 shall include the following:

This work shall consist of furnishing and applying bitumen coating and primer to steel pile surfaces as required in the plans and as specified herein.

Subsection 502.02 shall include the following:

- A. Bitumen Coating. Canal Liner Bitumen (ASTM D-2521) shall be used for the bitumen coating and shall have a softening point of 190(F to 200( F, a penetration of 56 to 61 at 25( C, and a ductility at 25( C in excess of 3.5 cm.
- B. Primer. Primer shall conform to the requirements of AASHTO M116.

Subsection 502.11 shall include the following:

All surfaces to be coated with bitumen shall be dry and thoroughly cleaned of dust and loose materials. No primer or bitumen shall be applied in wet weather, nor when the temperature is below 65(F.

Application of the prime coat shall be with a brush or other approved means and in a manner to thoroughly coat the surface of the piling with a continuous film of primer. The purpose of the primer is to provide a suitable bond of the bitumen coating to the pile. The primer shall set thoroughly before the bitumen coating is applied.

The bitumen should be heated to 300( F, and applied at a temperature between 200( F to 300( F, by one or more mop coats, or other approved means, to apply an average coating depth of 3/8 inch. Whitewashing of the coating may be required, as deemed necessary by the Engineer, to prevent running and sagging of the asphalt coating prior to driving, during hot weather.

Bitumen coated piles shall be stored immediately after the coating is applied for protection from sunlight and heat. Pile coatings shall not be exposed to damage or contamination during storage, hauling, or handling. Once the bitumen coating has been applied, the Concessionaire will not be allowed to drag the piles on the ground or to use cable wraps around the pile during handling. Pad eyes, or other suitable devices, shall be attached to the pile to be used for lifting and handling. If necessary, the Concessionaire shall recoat the piles, at his expense, to comply with these requirements.

A nominal length of pile shall be left uncoated where field splices will be required. After completing the field splice, the splice area shall be brush or mop coated with at least one coat of bitumen.

Subsection 502.12 shall include the following:

Bitumen coating will be measured by the linear foot of coating in place on the pile surfaces. No separate payment will be made for the primer or coating of the splice areas.

**REVISION OF SECTION 504  
CONCRETE PANEL FACING MSE WALL**

Section 504 of the Standard Specifications is hereby revised for this project to include the following:

## DESCRIPTION

This work consists of constructing a Concrete Panel Facing Mechanically Stabilized Earth (MSE) Retaining Wall System at the locations and to the lines and grades shown on the plans. Either metallic or geosynthetic reinforcement (woven fabrics or geogrids) as specified in this specification may be used as MSE reinforcement in the reinforced structure backfill zone. The retained structure backfill zone is the structure backfill retained by the reinforced structure backfill zone as shown on the plans.

## MATERIALS

- (a) *Shop Drawings.* The Concessionaire shall submit six sets of shop drawings and certified material test reports for review prior to construction of the wall. See subsection (f), under MATERIALS, for a complete list of submittal requirements. Shop drawings shall be submitted in accordance with subsection 105.02.

The shop drawings shall provide the details necessary to demonstrate compliance with the Contract, including:

1. Wall layouts shall conform to lines and grades on the plans including start, corner, and end stations, leveling pad step breaks, total number of panels and top and bottom of wall elevations. For walls with rail anchoring slabs, the top of panel elevations shall be within 8 inches of the elevation shown on the plans measured from the bottom of anchoring slab. The construction batter required to achieve the batter shown on the plans shall be shown on the shop drawings. If temporary walls are required for the construction of permanent wall, the permanent wall vendor shall provide the shop drawings and certified material test reports for temporary walls.
2. Unless otherwise shown on the plans, each layer of soil reinforcement shall be connected to the back of each facial panel and the panel numbering and placement sequence shall be shown. The back of each panel shall be logically numbered with its location.  
Panel to panel, panel to reinforcement connection detail, and limits of special panels at curved wall corner shall be shown.
3. Except for the top of the leveling pad, wall elevations given on the plans are based on the desirable wall height. The actual panel and reinforcement elevations shall be marked on the shop drawings by taking into account the supplied panel as well as special panel heights for matching the front and top finished grade.
4. The soil reinforcement type, Minimum Average Roll Value of the Ultimate tensile strength  $T_{ULT}$  (MARV) for geosynthetic soil reinforcement or yield strength for metallic soil reinforcement, spacing, lengths, elevations, and the corresponding wall design height shall be shown on the shop drawings. The starting and ending stations for change in grade of reinforcement material shall be shown for walls with different grade of reinforcement material at the same elevation. Material grade shall be clearly identified on each roll of reinforcement to avoid errors in placement. Elevations of the reinforcement layers shall be as specified on the shop drawings.

5. Soil Reinforcement Length (RL). The soil reinforcement length shall be measured from the back face of the concrete panel to end of the soil reinforcement as measured to the last cross member. Except for secondary reinforcements, soil reinforcement lengths shall not be less than the lengths specified on the plans.

For wall segments with a Design Height (DH) greater than or equal to 8 feet, the soil reinforcement shall be the same length from top to bottom of the wall.

For walls segments with a Design Height (DH) less than 8 feet, the length of the top layer of soil reinforcement shall be 8 feet and all other layers of soil reinforcement shall be the same length from top to bottom of the wall.

Unless shown otherwise on the plans, the soil reinforcement lengths shall be as follows:

Design Height (DH)	Reinforcement Length (RL)	Reinforcement Length Top Layer
DH ≤ 6'-0"	6'-0"	8'-0"
6'-0" < DH < 8'-0"	DH	8'-0"
DH ≥ 8'-0"	0.7 x DH but not less than 8'-0"	0.7 x DH but not less than 8'-0"

The Reinforcement Lengths shown on the shop drawings shall be the reinforcement length required for internal stability and pull-out only, but they shall not be less than those shown in the table above. External stability (bearing pressure, sliding and overturning) and global stability have already been considered and checked in the design.

6. Panel Size and Soil Reinforcement Spacing:
- A. Except for full height panels, the maximum panel size is 50 square feet and the minimum panel height shall be 30 inches.
  - B. For full height panels, the maximum panel width shall be 10 feet and the maximum panel height shall be 30 feet. Differential deflection between adjacent panels shall be limited to 1/500. The vendor shall supply design calculations regarding panel concrete crack size control during shipment and construction and estimated joint width and differential deflection limits. The use of full height panels with widths greater than 10 feet or heights greater than 30 feet shall be approved by the Engineer.
  - C. The maximum vertical spacing between layers of adjacent soil reinforcement shall not exceed 30 inches. Except the half height panel used at the top and bottom of wall, including all partial and extended height panels at the top of wall there shall be at least two layers of reinforcement per panel.
  - D. The first and bottom layers of reinforcement shall be within 15 inches measured from the top of panel and from the top of leveling

pad accordingly.

- E. Shiplap joints shall be required at horizontal and vertical joints for segmental panel walls and all vertical joints for full height panel walls. The gap between two adjacent panels shall be ½ to 1 inch. Shiplap joints are not required at the vertical joints of segmental and full height panel when a minimum of 12 inches depth of continuous crushed rock wrapped with Class 2 Geotextile is installed behind the joints as shown in the shop drawings. Geotextile (Class 2) and crushed rock will not be measured and paid for separately., but shall be included in the work. Neoprene cushions shall be provided at all horizontal joints as shown in the plans.

7. Long Term Design Strength (LTDS) of Reinforcement.

- A. The design charts on the plans define the strengths required for the zone of mechanical reinforcement of soil. Based on the total summed LTDS, the reinforcement proposed by the shop drawings for a specific wall height shall meet or exceed the total LTDS shown on the plans. This proposed reinforcement shall allow for a maximum of plus or minus 15 percent variation in each individual layer.
- B. Metallic (Inextensible) Soil Reinforcement. The net section at the soil reinforcement to panel connection shall be used for the sacrificial thickness calculation. The following minimum sacrificial thickness for reinforcement shall be used for the 75 year LTDS calculations:

Galvanization Loss	15 µm/year for first 2 years 4 µm/year for subsequent years
Carbon steel loss	12 µm/year after zinc depletion

- C. Geosynthetic (Extensible) Soil Reinforcement. Geosynthetic soil reinforcement shall be a geogrid or woven geotextile. For polyester (PET), polypropylene (PP) and high-density polyethylene (HDPE) reinforcement, the LTDS of material shall be determined using the following factors of safety to ensure the required design life. Unless otherwise specified, LTDS shall not exceed the following K percent of its ultimate tensile strength, T<sub>ULT</sub> (MARV), i.e.

$$LTDS = K * T_{ULT} (MARV),$$

(1) Geogrid reinforcement (HDPE, PET):

Products	K
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Tensor	20%
Fortrac, Miragrid, Strata, Synteen and Raugrid	24%

(2) All products not listed above:

Products	K
All geogrid or woven geotextile products meet AASHTO Standard Specifications for Highway Bridges, 16 <sup>th</sup> Edition	10%
Products not meet AASHTO Standard Specifications for Highway Bridges, 16 <sup>th</sup> Edition including Non-woven geotextile products	5%

8. Design Heights and Supplied Reinforcing Material. Unless otherwise defined on the plans, the wall design height shall be measured vertically from the top of the leveling pad to the top of the concrete rail anchoring slab for walls with railing, or to the top of the cast-in-place concrete coping for walls without railing. For walls that are in front of a bridge abutment that is founded on a deep foundation, the design height used to determine the soil reinforcement length shall be measured vertically from the top of the leveling pad to the top of the roadway carried by the bridge and the wall. Bridge approach slabs shall not be considered in the design of the MSE wall.
- For both geosynthetic and metallic reinforcement, the required reinforcement LTDS and the supplied LTDS (determined in accordance with the K factors or depletion of material as defined above) with corresponding brand and grade of material shall be marked clearly on the elevation view or in a tabulation summary. The LTDS of the supplied reinforcement grade must meet or exceed the required LTDS corresponding to the reinforcement spacing provided.
9. For the reinforcement layouts of tiered walls, the overall geometry, the reinforcement length and the sum of the LTDS provided from all layers in all tiers shall be in close conformity with the retaining wall system shown on the plans in order to ensure that local, global, and internal stability requirements have been met.
10. Details for the placement of soil reinforcement around obstructions (i.e. steel piles, concrete piers, concrete boxes, pipes, etc.) shall be shown on the shop drawings. Design calculations shall be provided showing that the internal stability of the wall meets the required safety factors in the area of the obstruction.
11. A table comparing the Structural Backfill (Class 1), Mechanical Reinforcement of Soil, Geomembrane, and Panel Facing quantities shown on the plans to the quantities shown in the shop drawings and percent difference (positive percent indicates an increase in shop drawing quantities from the plans) shall be shown on the shop drawings. Structure Backfill (Class 1), Mechanical Reinforcement of Soil, Geomembrane, and Panel Facing quantities shall be calculated in accordance with the Contract. The Concessionaire shall notify the Engineer of the difference in

plan and shop drawing quantities before wall construction begins.

12. Geomembrane placement schedule and clearances to soil reinforcements shall be shown.
  13. Locations of vertical slip joints for differential settlement relief shall be as specified in subsection (e) under CONSTRUCTION REQUIREMENTS.
- (b) Backfill. Unless otherwise specified on the plans, wall backfill material in the reinforced structure backfill zone and the associated trapezoidal retained structure backfill zone shall conform to the requirements for Structure Backfill (Class 1) of Section 206. For reinforcement tensile stress and associated pullout, a friction angle of 34 degrees shall be assumed for Structure Backfill (Class 1). Structure Backfill (Class 1) shall be considered to be non-aggressive soil for corrosion and durability computations. All reinforcing elements shall be designed to ensure a minimum design life of 75 years for permanent structures.
- (c) Leveling Pad. Concrete for the leveling pad shall be Concrete (Class D) conforming to the requirements of Section 601. Unless specified on the plans, the maximum vertical step shall be no greater than 36 inches. The leveling pad shall be reinforced only at the steps. When the toe of wall is founded on slope steeper than 1.5 (H) to 1 (V), the leveling pad shall be constructed with reinforced concrete with same reinforcing schedule as at its steps. Leveling pad concrete shall be cured for at least 12 hours before placement of the concrete panels. To avoid panel cracking from high contact points, a ¼ inch thick expansion joint material with the same thickness as the panels may be installed between the first layer of panels and the leveling pad.
- (d) Geomembrane and Joint. A Geomembrane shall be installed on all walls at the top of the reinforced structure backfill zone and retained structure backfill zone to intercept surface runoff and prevent salt penetration into the backfill of the wall as shown on the plans. The Geomembrane shall meet the requirements of subsection 712.08 for geomembrane, and shall have a minimum thickness of 30 mils. It shall be spliced with a dual track field seamed joint in accordance with ASTM D4437 or ASTM D7717. For small local coverage areas, less than 30 square feet, the membrane may be spliced using a 6 inch minimum overlap and an adhesive or a single seam portable thermal welding tool, as suggested by the membrane manufacturer and approved by the Engineer. Unless otherwise shown on the plans, the membrane shall have a minimum coverage length measured perpendicular to the wall face of at least the wall Design Height (DH) plus Soil Reinforcement Length (RL) plus 1.5 feet. The membrane shall be installed with a slope between 20:1 (minimum) and 10:1 (maximum) , as shown in the plans, from the panel facing to a drainage system located at the cut or pre-filled slope as shown on the plans.

The drainage system shall consist of a 12 inch wide Geo-Composite strip drain inserted into a slot in the Geomembrane, at 10 foot maximum spacing, that collects the water from the membrane and conveys it to a water collector system at the toe of the 1:1 slope as shown on the plans. The water collector system shall consist of a 4 inch diameter perforated collector pipe surrounded by Filter Material Class B and wrapped with Class 3 Geotextile. A 4 inch diameter non-perforated drain pipe, at 100 foot maximum spacing, shall be used to discharge the water in the water collector system out the face of the wall.

Alternatives for the drainage system shown on the plans may be used by the Concessionaire. A detailed layout of this equivalent water collection system shall be provided by the Concessionaire and approved by the Engineer.

For tiered walls, a Geomembrane shall be installed between the top of the bottom wall and the toe of the top wall as shown on the plans.

- (e) Pre-Cast Concrete Panel Facing Unit and Panel Joint Material. The pre-cast concrete panels shall conform to the requirements shown on the plans and these specifications including the color, texture, dimensions and pattern. These facing units shall be factory made with Class B Concrete with the following additional requirements:
- (1) Minimum Cementitious Content: 610 lb./cu. yd.
  - (2) No more than 50 percent fine aggregate (AASHTO M6) by volume of total aggregate.
  - (3) Ambient temperature: shall be a minimum of 40° F and rising when casting panels.
  - (4) Pre-cast panels shall be cured in accordance with AASHTO M170.

Reinforcing steel shall conform to the requirements of Section 602 of the specifications. The concrete in the pre-cast units shall be compacted using a vibrating table, grid vibrator, or screed vibrator. All panels shall be cast face down on flat level surface.

Panel dimensions and facing treatment shall conform to the architectural requirements shown on the plans. Width of panel from center to center of joint shall be an even whole increment of the pattern dimensions selected to match the architectural treatment. Thickness shall be a minimum of 6 inches plus the depth of rustication. Panel shall be cast to the dimension that accommodates the architectural treatment.

Panels may be longer than 5 feet provided their section strength can be shown to accommodate handling and erection without cracking. Soil reinforcement attachment devices shall be within 1 inch of shop drawing locations. All unit dimensions shall be within ¼ inch of plan. Concrete surface for the front face of the wall shall match the architectural treatment requirements and structural concrete color shown on the plans. Squareness determined by the difference between two diagonals, shall not exceed ½ inch. Surface defects on the front face textured surface, shall not exceed  $\frac{3}{16}$  inch when measured with a 5 foot straight edge, except when intentionally roughened.

The Engineer shall be allowed access to the manufacturer's facilities to inspect and sample units from lots prior to delivery with a minimum of 2 working days advance notice. The Engineer will reject any concrete panels, which do not meet the requirements of this specification. Panels shall not be shipped until the concrete strength, at the time of shipping, is greater than 0.9 times  $f'_c$ . The Concessionaire shall notify the Engineer in writing at least 3 working days before shipment of panels begins.

Cover on the back face of the wall for horizontal and vertical joints is required between panels and shall be a drainage geotextile conforming to Subsection

712.08, a minimum of 12 inches wide, nailed or glued in place prior to placing backfill.

At horizontal joints, a cellular type or molded expansion joint material shall be placed and shall be a size suggested by the supplier and approved by the Engineer.

- (f) Certifications, Calculations and Testing Reports. The Concessionaire shall provide the following reports, certifications, calculations and checklists as needed to accompany the shop drawing submittal. All engineering calculations, as stated in subsections (a) 6 B, (a) 7 B, (a) 10 (a) 11, (f) 5, (f) 6, (f) 7, and (f) 9 under MATERIALS shall be certified and stamped by a Professional Engineer licensed in the State of Colorado.
1. Certification of  $T_{ULT}$  (MARV). For geo-synthetic reinforced system only, the Concessionaire shall submit a certification letter from the manufacturer which provides the  $T_{ULT}$  (MARV) and certifies the  $T_{ULT}$  (MARV) of the supplied materials have been determined in accordance with ASTM D4595 or ASTM D6637 as appropriate.
  2. Mill report for metallic reinforcements and connectors. This includes, but is not limited to mill certifications on weldability, ultimate tensile and yield strength.
  3. Report of the panel-reinforcement connection test. The test report shall be prepared and certified by an independent laboratory. The panel to reinforcement connection test method shall conform to the industrial standards. The report shall provide data on the ultimate as well as service limit state.
  4. Report for soil to reinforcement interface pullout test. The test report shall be prepared and certified by an independent laboratory. The soil to reinforcement interface pullout test method shall conform to the requirements of ASTM D6706. Tests shall include the full range of overburden pressures defined by wall design heights.
  5. Certification of facial panel to reinforcement long-term connection strength. Certification shall include calculations to demonstrate that the facial panel to reinforcement connection meets or exceeds current AASHTO 75 years design life requirements.
  6. Certification of reinforcement pullout. Certification shall be provided with detail calculations to demonstrate that reinforcement pullouts meet or exceed current AASHTO requirements. For metal reinforcement breakage and pullout, calculations shall include a combination of 75 years material depletion of carbon steel and galvanization loss.
  7. Report and certification for the initial concrete compression strength, shipping and handling stress. Cylinder compressive test is acceptable to verify the initial concrete strength of panel at time of shipping. Concrete tensile stress shall not exceed the modulus of rupture. Report shall include calculations of panel cracking stress according to the proposed method of lifting and shipping. Before panel shipping from precast yard to wall site, the Engineer will approve the time of shipping, method of lifting



and supporting condition during shipping as well as storage condition at the site before panel installation.

8. Calculations. Calculation of the LTDS of reinforcement shall conform to the 17th edition of the AASHTO Standard Specifications for Highway Bridges.  
Efflorescence and Air Content Test. Panel shall be visually efflorescence free. Efflorescence control agent shall be used in concrete mix design. When fly ash is used as the efflorescence control agent, the fly ash shall be ASTM C618 Class F fly ash and shall be a minimum of 20 percent by weight of the total cementitious material content. Air Content shall be determined in accordance with AASHTO T152. Concrete shall be tested a minimum of the first three batches each day and then once per five batches for the rest of the day to assure specified air entrainment.
9. Submittal Checklist. The Concessionaire shall submit the Panel Faced MSE Wall Submittal Checklist, Form 1402 with the Certifications, Calculations and Testing Report submittal package included with the shop drawing submittal.

(g) *Hybrid MSE Wall Systems.*

A hybrid system is one which combines elements of both externally and internally stabilized systems.

An externally stabilized system uses a physical structure to hold the retained soil. The stabilizing forces of this system are mobilized either through the weight of a shape stable structure or through the restraints provided by the embedment of wall into the soil, if needed, plus the tieback forces of anchorages.

An internally stabilized system involves reinforced soils to retain fills and sustain loads. Reinforcement may be added to either the selected fills as earth walls or to the retained earth directly to form a more coherent stable slope. These reinforcements can either be layered reinforcements installed during the bottom-to-top construction of selected fills, or be driven piles or drilled caissons built into the retained soil. All this reinforcement must be oriented properly and extend beyond the potential failure mass.

Hybrid MSE wall systems may be used unless otherwise noted on the plans. Hybrid MSE wall systems are subject to the same design requirements for MSE walls and this specification. The shop drawings for the Hybrid MSE wall system shall include a combination of design calculations and appropriate test results to demonstrate that it meets or exceeds the regular system. Hybrid MSE wall systems shall have a facing area of 3.5 square feet and be stabilized by a counterfort. The Certifications, Calculations and Testing Reports in subsection (f) 5 under MATERIALS is not required for Hybrid MSE wall systems. The facing to soil reinforcement connection test, subsection (f) 3 under MATERIALS, may be waived only if the soil reinforcing spacing is less than or equal to 8 inches or the facing is secured and stabilized by hybrid components with primary reinforcement spacing less than 24 inches.

The Concessionaire shall provide the following additional reports, certifications and calculations to accompany the shop drawing submittal for Hybrid MSE wall systems:

The facing to counterfort long-term connection test.

The Concessionaire shall submit the Block Faced MSE Wall Submittal Checklist, Form 1401 and the Panel Faced MSE Wall Submittal Checklist, Form 1402, with the Certifications, Calculations and Testing Report submittal package included with the shop drawing submittal.

#### CONSTRUCTION REQUIREMENTS

- (a) Approval and Qualifications of MSE Wall Installer. The job site wall foreman shall have experience in construction of at least five transportation related MSE walls within the last three years. Transportation related MSE walls are walls that carry or are adjacent to vehicular traffic and are constructed with MSE reinforcement in the reinforced structure backfill zone. The foreman must have prior experience or adequate training on the products that the Concessionaire elects to use in the project. The resume and credentials of the foreman shall be submitted to the Engineer for approval prior to the pre-construction meeting. The foreman shall be on the site for 100 percent of time during which the work is being done.
- (b) Wall Test Segment. The wall test segment shall be the first segment of the wall constructed. The wall test segment shall be constructed in the presence of the Technical Representative and the Engineer and shall include construction of each of the 5 elements listed in (c) below. The minimum length of the wall test segment shall be 40 feet or the full length of the wall if less than 40 feet. A wall test segment shall be constructed for the first wall constructed from each wall product used on the project.
- (c) Technical Representative of Wall Product Supplier. The Concessionaire shall arrange for a technical representative (Tech Rep) of the manufacturer of the selected wall products to be present during the construction of each wall test segment. If the selected wall products are supplied from different manufactures, a Tech Rep from each wall product shall be present. The Tech Rep shall be present for construction of the wall test segment and each of the following elements:
  - (1) Placement of a minimum of the first four layers of primary soil reinforcement and backfill,
  - (2) If obstructions (i.e. steel piles, concrete piers/abutments, concrete boxes, pipes, etc.) exist, placement of primary soil reinforcement and backfill at obstructions,
  - (3) Placement of a minimum of the first two rows of panels or a minimum of a four foot wall height,
  - (4) If a vertical slip joint is required, construction of the vertical slip joint in a minimum of a two row portion of panels or a minimum of a four foot wall height, and
  - (5) If corners are required, construction of a corner representative of the corners in the wall in the project in a minimum of a two row portion of panels or a minimum of a four foot wall height.

Before construction of the wall test segment the Tech Rep shall provide the Concessionaire and the Engineer the following:

- (1) Technical instructions as required in the construction of the earth retaining wall system.
- (2) Product specific specifications in the placement of the soil reinforcement and backfill in accordance with the wall system.
- (3) Guidelines in placing the facing units and attaching them to the soil reinforcement in accordance with the system requirements.
- (4) Provide technical assistance to the facing unit fabricator.

At the completion of the wall test segment the Tech Rep shall provide the following:

- (1) Documentation that the wall test segment was constructed in accordance with the product specific specifications. This documentation shall include a location description (starting and ending stations and elevations) of the wall test segment.
- (2) Documentation that the job site wall foreman is familiar with the wall products used to construct the walls on the project.

After completion of the wall test segment the Tech Rep shall be available whenever there is any special field condition such as change of geological condition, when there are equipment or personnel changes, or when requested by the Engineer.

- (d) Facial Panel Quality Control, Placing Plan and Daily Placement Logs. Before the start of wall construction, the Concessionaire shall provide a panel-placing plan and shall supply daily placement logs to the Engineer weekly and at the completion of the wall. The daily placement log shall consist of an elevation view of the wall showing the dates, number of panels placed, and the serial numbers of the panels placed. The panel quality control shall contain multiple submittals if required by subsections (f) 7 and 8 under MATERIALS. Panels shall be labeled with serial number for each panel and corresponding certification with one set of random samples tested for each 220 panels or 5500 square foot of wall face. At least one certification with supporting test results is required for each wall. Test results will be reviewed and pre-approved by the Engineer before shipment. The Concessionaire shall coordinate and mark the panel and backfill placing sequence on the daily placement logs. The log serves as means for the Engineer to identify where each panel was placed.
- (e) Wall With Curved Alignments, Tight Curved Corners, and Sections Adjacent To Bridge Abutment. The Concessionaire shall provide a placement plan that shows curved layouts, special corner panel, sequence of panel placement, and construction off-sets as recommended by the manufacture. For tight curved corners, 8 foot radius or less, and dissimilar foundations such as bridge abutment, to avoid panels with random cracks, the Concessionaire shall install vertical slip joints as shown on the shop drawings.
- (f) Excavation and Backfill. The base of leveling pad shall receive the same compaction as cut area required by subsection 203.07. The Concessionaire shall report to the Engineer in writing density test results for any unsatisfactory bearing material that does not meet the minimum 90 percent compaction for walls less than 16 feet high and 95 percent of T-180 for walls higher than 16 feet. If the

excavation for the placement of the leveling pad exposes an unsatisfactory bearing material, the Engineer may require removal and replacement of that material. The removed material shall be replaced with Structure Backfill (Class 1) compacted in conformance with subsection 206.03. The Engineer with the assistance of the geotechnical engineer of record will provide the limits including the depth of removal. As directed by the Engineer, and if required, Structure Backfill (Class 1) shall be reinforced with soil reinforcements in conjunction with wick drains and outlet pipes

The Concessionaire shall grade the foundation for the bottom of the wall for a width equal to or exceeding the limits of the Reinforcement Length (RL) plus 18 inches as shown on the plans. This graded area shall be compacted with an appropriate vibratory roller weighing a minimum of 8 tons for at least five passes or as directed by the Engineer. For cut wall with continuous seepage, phasing of foundation construction or a different drainage and foundation improvement plan may be necessary.

The reinforced structure backfill zone and the retained structure backfill zone portion immediately behind the wall as defined on the plans shall be Structure Backfill (Class 1). Recycled asphalt, recycled concrete and flow-fill material shall not be substituted for Structure Backfill (Class 1). Each compacted layer of backfill within a distance equal to the reinforcement spacing away from the back of the panels shall not exceed 4 inches. The triangular or trapezoidal portion behind the concrete panels and above the spill of backfill, as shown on the plans, shall be filled with  $\frac{3}{8}$ " crushed rock, filter aggregates with filter fabric, or wall system specific fill as approved by the Engineer. Density tests behind and parallel to the wall in the triangular or trapezoidal portion above the backfill spill zone are not required. Each compacted layer of backfill shall be in even increments up to 8 inches thick. The fill and compaction operation shall start 3 feet from the wall back face and progress toward the end of the reinforcement. All Structure Backfill (Class 1) including fill material under the wall and on-site material as allowed by subsection (b) under MATERIALS shall be compacted to a density of at least 95 percent of the maximum density according to AASHTO T 180. For on-site foundation material containing more than 30 percent retained on the  $\frac{3}{4}$  inch sieve, a method of compaction consisting of a conventional heavy vibratory roller starting with minimum 5 passes shall be used to establish the number of passes required to exceed the 95 percent T180.

At least 6 inches of material shall be in place prior to operation of tracked vehicles over soil with reinforcement. Only power operated roller or plate compaction equipment weighing less than 1,000 pounds is allowed within 3 feet of the front of the wall face. The reinforcement shall not be connected to the wall until the compacted fill is at or slightly higher than the location of the connector.

Backfill containing frost or frozen lumps shall not be used. Backfill that has been placed and becomes frozen shall be removed and replaced at the Concessionaire's expense. If cold weather conditions prevent the placement of Structure Backfill (Class 1), the Concessionaire may use Filter Material Class B as backfill without compaction at the Concessionaire's expense and approved by the Engineer. The Concessionaire shall provide a test report, prepared and certified by an independent laboratory, that the internal friction angle of soil for the Filter Material Class B meets or exceeds that shown on the plans.

The Concessionaire shall place additional panels including partial height panels and properly compacted fill material to return the finished grade to the plan elevations if settlement, as determined by the Engineer, has occurred. A final inspection before the installation of rail anchoring slab will be made after construction settlement, if any, has occurred or 30 days after the completion of the wall. The Concessionaire shall provide immediate temporary storm water protection and wind erosion control at the end of each day during construction. If settlement occurs as the result of loss of backfill due to wind or water erosion, non-conforming backfill such as frozen fill or over-saturated fill, or if the backfill does not meet compaction requirements, the Concessionaire shall remove the backfill, wash the soil reinforcement, and bring the elevation to the finished grade at the Concessionaire's expense. Before final project acceptance, the Concessionaire shall repair any backfill losses due to wind and water erosion.

To avoid the foundation of the leveling pad being washed out by rain, the area in front of the wall and around the leveling pad shall be backfilled as soon as practicable.

- (g) Reinforcement. Steel reinforcement shall be slack free and geosynthetic reinforcement shall be slightly pre-tensioned. The minimum coverage ratio for geogrid reinforcement shall be 67 percent and the spaces between rolls shall be staggered between layers of soil reinforcement. The minimum coverage ratio for woven fabric reinforcement shall be 100 percent and an overlap between rolls is not required. Soil reinforcement shall not be cut to avoid obstruction unless shown on the shop drawings.
- (h) Leveling Pad. The foundation of the leveling pads shall meet the requirement of subsection (f) immediately above. The leveling pad shall be level within the tolerance of  $\frac{1}{8}$  inch for any two points along the length of a panel, and within  $\frac{1}{4}$  inch for any two points 10 feet apart. If the wall is not level, the panels will bind against each other causing spall of the edges and corners.  
Cushion or shimming material (Expansion Joint Material, Concrete Mortar Grout, Roofing Felt or Geosynthetic Reinforcement) shall be used to support panels directly founded on the leveling pad. Before starting a new course of panels, the Concessionaire shall take steps to ensure that the wall elevations are matched at the neighboring panels. Cushion or shimming material shall be used to obtain necessary panel elevations at next leveling pad step. No more than 2 shims (each  $\frac{3}{16}$  inch thick) should be required to level the panels on the leveling pad.
- (i) Wooden Wedges. Wooden wedges are used to help to hold the panels at the correct batter during the backfill operation. The wooden wedges shall be made from hard wood (such as oak, maple or ash). Wooden wedges shall be removed as soon as the precast panels above the wedged panels are completely erected and backfilled. There shall not be more than three rows of wooden wedges in place at one time. Panels that crack or spall due to failure to remove the wooden wedges shall be repaired or replaced.
- (j) Panel Facing. For walls that support a roadway, the wall layout line at the leveling pad shall be setback and pre-measured with appropriate batter (5 to 8 percent) from the top of the panels according to the offset with respect to the centerline of the road. For walls adjacent to a roadway, the wall layout line at the leveling pad shall be directly offset from the centerline of the road. An overall negative batter

(wall face leaning outward) between the bottom and the top of the wall is not allowed. Unless otherwise noted on the plans for battered walls, the final wall face shall be vertical, or have a positive batter of not greater than 5 percent for construction control purpose. The surface of the wall face shall be tested with a 10 foot straightedge laid along the surface in horizontal and vertical directions. Except as necessary for horizontal alignment of the wall, convex deviation of the wall face from the straightedge (belly wall) shall not be allowed, and concave deviation from the straightedge shall be less than ½ inch.

Walls without a rail-anchoring slab, cast-in-place reinforced concrete coping with uniform exposed height is required to match the required finished elevations as well as to retain the panels' lateral deformation.

For walls with rail anchoring slabs, the top of panel elevations shall be within 8 inches of the bottom of the anchoring slab. Cast-in-place concrete or sawcut partial height panels may be used to accomplish this.

Where the Geomembrane for drainage interferes with the continuation of reinforcement, the panels beyond the termination shall be reinforced with the same grade of additional soil reinforcing material to maintain the total amount of reinforcement per panel. To avoid leaking or soil erosion through the joint, a filter fabric at least 12 inches wide shall be glued to the panels behind all vertical joints.

As shown on the plans, facing panels directly exposed to spray from deiced pavements and indirect windborne spray shall have three coats of water resistant or repellant concrete sealer applied to the front face of the wall before the wall is opening to traffic.

For completed wall or parts of completed wall, before final payment any damages including blemish and discoloring of panel shall be replaced or repaired. Sand blasting may be used if accepted by the Engineer.

- (k) Fill under Leveling Pad. For walls requiring fill under the planned elevation of the leveling pad, the Concessionaire may lower the elevation of the leveling pad as approved by the Engineer, except that the finished elevation at the top of the wall shall not be altered. As requested by the Concessionaire, and with the Engineer's approval, the higher wall shall be redesigned with longer reinforcement length and revised reinforcement schedule.

#### METHOD OF MEASUREMENT

MSE retaining walls will not be measured for payment in the field, but will be paid for by the calculated quantities shown on the plans for the five major components of the wall: structure excavation, structure backfill, concrete panel facing, mechanical reinforcement of soil, and geomembrane. The Concessionaire's construction of a system that requires increased or decreased quantities of any of the components to complete the wall to the dimensions shown will not result in a change in pay quantities. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies on the plans in an amount of at least plus or minus five percent of the plan quantity.

- (1) The panel facing quantity was calculated for the square foot of wall front face area from the top of the leveling pad (or average pad elevations) as shown on

the plans to the top of the anchoring slab for walls with railing, or to the top of the cast in place coping for walls without railing.

- (2) The structure excavation quantity was calculated for the total volume of earth to be removed before the installation of the reinforced zone as shown on the plans.
- (3) The structure backfill quantity was calculated for the total volume behind the wall (the retained structure backfill zone) including the material in the reinforced zone as shown on the plans.
- (4) The mechanical reinforcement of soil quantity was calculated for the total volume of the reinforced zone as shown on the plans.
- (5) Geomembrane was calculated as the design height (DH) plus soil reinforcement length (RL) plus 1.5 feet, disregarding the slope of the membrane.

The square foot and cubic yard quantities computed for payment are the wall plan quantities based on the height measured at 20 foot maximum intervals along the wall layout line.

#### BASIS OF PAYMENT

Rail anchoring systems (slabs) at the tops of walls and leveling pads at the bottom of wall will be measured and paid for separately under the Section 601 Pay Item Concrete and the Section 602 Pay Item Reinforcing Steel.

Payment will be full compensation for all work and materials required to construct the concrete panel facing MSE wall. Miscellaneous items such as dual track welding of Geomembrane, drainage ditches, rundowns, filter material, filter fabric, grout, pins, shimming material, ¼ inch thick expansion joint material, concrete coating and providing a technical representative will not be measured and paid for separately but shall be included in the work.

Panel Facing Payment Reductions. In this subsection, a "panel" refers to either a concrete panel or a hybrid unit. Each of the following shall be considered a defect:

- (1) Dislocated Panel. A dislocated panel is an individual panel or its corner located outward more than ¼ inch from the adjacent panels.
- (2) Cracked Panel. A cracked panel is an individual panel with any visible crack when viewed from a distance equal to the wall height in natural light.
- (3) Corner Knock Off. A corner knock-off is a panel with any missing facial corners or architectural edges.
- (4) Substandard panel. Substandard panels are concrete panels installed in any wall segments that do not meet the certified values for compressive strength. Each substandard panel counts as one defect.
- (5) Oversize Joints. Panels with oversize joints are two adjacent panels that do not meet the required values in subsection (a) 6 E under MATERIALS.
- (6) Panels Failing the 10 Foot Straightedge Test. Straightedge test failures are joints that deviate from even by more than ¼ inch when measured by placing a 10 foot straightedge across the joint.

Defects shared by two adjacent panels such as oversized joint, dislocated panel and panels not passing 10 foot straight edge test will be count as one defect.

In the completed wall, or completed portion of the wall the number of defects, as described above, in each 40 foot section (horizontal or arc length) will be counted. If there are defects, the number of defects in the 40 foot section will be considered for price reduction according to the table below. For panels subjected to price reduction, if the defects are repairable or the overall quality of wall can be improved, with the consent from the Engineer, the Concessionaire may elect to repair and reduce the percent of price reduction. A walkthrough inspection shall be made as requested by the Concessionaire before final payment.

No. of Defects in 40 Foot Section	2	3	4	5	> 5
% Of Price Reduction for that section	3	9	15	21	Rejection

When the number of defects exceeds 5, the Engineer will reject the entire wall or portions thereof. The Concessionaire shall replace the rejected wall at his own expense.

**REVISION OF SECTIONS 509 & 708  
PAINTING OF ALUMINUM ACCESS DOORS FOR STEEL STRUCTURES**

Sections 509 & 708 of the Standard Specifications are hereby revised for this project as follows:

Subsection 509.24 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease, oil, etc. (SSPC-SPI) followed by a brush blast to provide a profile similar to the structural steel. The access doors shall receive one coat of primer as described in the Revision of Section 708.03.

Subsection 708.03 shall include the following:

If Alternate 1, Alkyd System, is to be used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors will be painted the same as the structural steel (one field coat of primer followed by the top coat). Coating thicknesses shall be the same as specified for the structural steel.

If Alternate 2, Inorganic Zinc-Rich Polyurethane System, is used on the structural steel, the aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following application of the vinyl wash primer, the same polyurethane top coat as used on the structural steel shall be applied to the access doors (minimum 3.0 mils dry film thickness).

The manufacturer of the primer shall certify in writing, that the primer used is compatible with the cleaned aluminum access doors and the polyurethane top coat to be used on the structural steel.



**REVISION OF SECTION 509  
LOCK-PIN AND COLLAR FASTENERS**

Section 509 of the Standard Specifications is hereby revised for this project as follows:

Subsection 509.01 shall include the following:

High strength steel lock-pin and collar fasteners shall be used in unit #5N for all high strength bolts (those required to conform to the required to conform to the requirements of AASHTO M164 (ASTM A325)) specified.

Subsection 509.08 shall include the following:

The steel lock-pin and swaged collar fastener system shall conform to the materials, manufacturing, chemical composition and mechanical requirements (in full size tests) of AASHTO M164 (ASTM A325). The shank diameter and the bearing area under the head and swaged collar shall not be less than those provided by a bolt and nut of the same nominal dimensions prescribed in the requirements for "Heavy Hexagonal Structural Bolts" and for "Heavy Semi-Finished Hexagonal Nuts" given in ANSI Standard B 18.2.1 and B 18.22, respectively. Each fastener shall provide a shank body of sufficient diameter to provided tensile and shear strength equivalent to or greater than the bolt specified; shall have a cold forged head on one end of the type and dimensions specified, a shank length suitable for material thickness fastened, locking grooves (all annular rings) on the opposite end. Each fastener shall provide a steel locking collar of proper size for shank diameter used, which by means of suitable installation tools, is cold swaged into the locking grooves forming a head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collar (the collar shall be of the flanged type) shall be a standard product of an established manufacturer of lock-pin and collar fasteners. The pin shall be specifically marked to identify the manufacturer.

The fasteners after installation shall conform to the following hardness requirements:

Hardness Number

<u>Brinell</u>		<u>Rockwell C</u>	
Min.	Max.	Min.	Max.
248	311	24	33

All washers shall be hardened steel washers conforming to the requirements of AASHTO M293 (ASTM F436). The washers shall be specifically marked to identify the manufacturer.

Pin proof load tests (ASTM F606 Method 1) are required. Minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A325) paragraph 9.2.4.

Wedge tests on full size pins (ASTM F606 paragraph 3.5) are required. If pins are to be galvanized, tests shall be performed after galvanizing. Minimum frequency of tests shall be as specified in AASHTO M164 (ASTM A325) paragraph 9.2.4.

Subsection 509.13 shall include the following:

The Concessionaire shall provide the engineer with:

- (1) Mill Test Reports for all mill steel used in the manufacture of the lock-pin, flanged collars and hardened washers. The Mill Test Reports shall indicate where (city and state) the steel was melted and manufactured. (All materials shall be of domestic origin as well as all subsequent processing.)
- (2) The lock-pin and collar Manufacturer's Certified Test Report with the following:
  - (a) The location where all of the lock-pin, collars and hardened washers were manufactured.
  - (b) A statement that all the fasteners provided meet the requirements of this specification and the applicable requirements of AASHTO M164.
  - (c) Results of the tests required in Subsection 509.08.

Delete subsection 509.28(d) and replace with the following:

- (d) All field connections shall be made with high-strength bolts which include direct tension indicators. Direct tension indicators shall be either washer type direct tension indicators, tension control bolts or high strength steel lock-pin and collar fasteners.

Subsection 509.28(f) shall include the following:

The Concessionaire shall require a representative of the lock-pin and collar manufacturer to be on the project to train the steel erector's personnel in the proper installation of the fastener system. This representative shall be thoroughly familiar with the lock-pin and collar system and the required installation procedures and equipment.

Installation and tightening of each connection shall be done in the following manner:

- (1) Splice connections shall not be tightened until the entire continuous length of girder is in place on the substructure. One half the holes shall be filled with lock-pins and collars. Field splice elevations shall be verified prior to tightening. A hardened washer per ASTM F436 maybe used under the pin head for joint thickness adjustment so that the installed fastener conforms to the Dimension "B", (See attached table).
- (2) Fasteners in all holes of the connection shall be initially brought to a snug tight condition (as defined in the attached table) progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize realization of previously tightened fasteners. The snug tight condition shall be verified on the calibration device prior to achieving the required final clamping force when testing for acceptance.
- (3) After all fasteners in the connection are snug tight, they shall be fully tightened, progressing systematically from the center most rigid part of the connection to its free edge.

After installation and tightening is completed each installed fastener shall be pinged with a hammer for soundness. Loose or rejected fasteners shall be removed and replaced with a new fastener. Each fastener shall be visually inspected in accordance with the attached table.

Subsection 509.28(h) shall include the following:

The Concessionaire shall provide a direct tension measurement device (Skidmore-Wilhelm Calibrator or an acceptable equivalent) for acceptance testing of the fasteners on the project and it shall have been certified by a testing laboratory within the last 6 months.

A representative sample (randomly selected by the engineer) of three fasteners of each diameter, length and lot shall be tested by the Concessionaire in the tension measuring device.

The assemblies shall be snug clamped to approximately the value indicated in the following table prior to final clamping. If any fastener fails to meet the required minimum tension (a pin tail breaks off before achieving the final clamping force) listed in the following table, the lot shall be rejected.

<u>PIN DIAMETER</u> <u>(Inches)</u>	<u>SNUG CLAMPING(1)</u> <u>(Kips)</u>	<u>FINAL CLAMPING(2)</u> <u>(Kips)</u>
3/4	5	29
7/8	7	41
1	9	54
1 1/2	14	108

- (1) Partially swaged collar, pintail still attached to pin.  
 (2) Fully swaged collar, pintail pulled off.

Subsection 509.33 shall include the following:

All costs for lock-pins, flanged collars, hardened washers, testing, reports, technical representative, installation tools and hydraulic power supplies shall be included in Item 509, Structural Steel.

### **REVISION OF SECTION 509 STEEL STRUCTURES**

Section 509 of the Standard Specifications is hereby revised for this project as follows:

Replace subsection 509.08 with the following:

509.08 High Strength Bolts. All bolts used in fastening structural steel connections shall conform to the requirements of AASHTO M 164 (ASTM A 325), commonly known as High Strength Structural Bolts (HS). Heavy Hex Structural or Tension Control Bolts with suitable Heavy Hex Nuts and Plain Hardened Washers shall be provided. Type 1 bolts shall be provided for painted and Type 3 bolts for weathering (AASHTO M 222) structural steel. The length of bolts shall be such that the end of bolt will be flush with or outside the face of the nut when properly installed. Sufficient thread shall be provided to prevent the nut from encountering thread runout.

When the plans require bolts for structural steel connections to conform to the requirements of AASHTO M 164M (ASTM A 325M), bolts shall be substituted as outlined in the following table:

AASHTO M 164M	AASHTO M 164
Bolt Diameter, mm	Bolt Diameter, Inch (mm)
M16	5/8 (15.9)
M20	7/8 (22.2)
M22	7/8 (22.2)
M24	1 (25.4)

The hardness for bolt diameters of 1/2 inch (12.7 mm) to 1 inch (25.4 mm) inclusive shall conform to the following:

BRINELL		ROCKWELL C	
Minimum	Maximum	Minimum	Maximum
248	311	24	33

Bolt proof load tests (ASTM F 606, Method 1) and wedge tests (ASTM F 606) on full size bolts are required. Minimum frequency of testing shall be as specified in AASHTO M 164.

All nuts shall be Heavy Hex and conform to the requirements of AASHTO M 292 (ASTM A 194), heat treated grade 2H, or AASHTO M 291 (ASTM A 563), heat treated grade DH. Proof load tests of all nuts in accordance with the requirements of ASTM F 606 are required. Minimum frequency of testing shall be as specified in AASHTO M 291 or AASHTO M 292.

All washers shall conform to the requirements of AASHTO M 293 (ASTM F 436).

Compressible-Washer-Type Direct Tension Indicators, if used, shall conform to the requirements of ASTM F 959.

Rotational capacity (Lubrication) tests are required and shall be performed on all bolt, nut, and washer assemblies by the manufacturer or distributor prior to shipment to the project. Washers are required as part of the test. The rotational capacity tests shall be performed in accordance with the procedure defined in AASHTO M 164 and the following:

- (a) Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly.
- (b) A rotational capacity lot number shall be assigned to each combination of lots tested.
- (c) The minimum frequency of testing shall be two assemblies per rotational capacity lot.
- (d) The bolt, nut, and washer assembly shall be tested in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device.
- (f) The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be:
  - (1) 240 degrees (2/3 of a turn) for bolt lengths less than 4 diameters.

- (2) 360 degrees (1 turn) for bolt lengths greater than 4 diameters and less than 8 diameters.
- (3) 480 degrees (1 1/3 turns) for bolt lengths greater than 8 diameters.
- (g) The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below:

Diameter	Inch (mm)	Installation Tension (kN)	Kips	Turn Test Tension (kN)	Kips
	1/2 (12.7)		12 (56.5)		14 (62.3)
	5/8 (15.8)		19 (84.5)		22 (97.9)
	3/4 (19.1)		28 (124.5)		32 (142.3)
	7/8 (22.2)		39 (173.5)		45 (200.2)
	1 (25.4)		51 (226.8)		59 (262.4)

- (h) After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

$$\text{Torque} \leq 0.25 \text{ PD}$$

Where:

Torque = Measured Torque (foot-pounds)

P = Measured Bolt Tension (pounds)

D = Bolt Diameter (feet)

Bolts which are too short to be tested in the Skidmore-Wilhelm Calibrator may be tested in a steel joint. The Installation Tension requirements need not apply. The maximum torque shall be computed using a value of P equal to the Turn Test Tension.

Bolts, nuts, and washers (where required) from each rotational capacity lot shall be shipped in the same container. Each container shall be permanently marked with the rotational capacity lot number such that identification is possible at any stage prior to installation.

The Division's QA Inspector shall be provided with the following documents prior to shipment of structural steel to the project:

- (a) Certified Mill Test Reports for all mill steel used in the manufacture of the bolts, nuts, and washers. The mill test report shall indicate where the material was melted and manufactured.
- (b) Certified Laboratory Test Reports for the following:
  - (1) Bolt Hardness tests.

- (2) Bolt proof load tests.
- (3) Bolt wedge tests.
- (4) Nut proof load tests.
- (5) Rotational capacity tests.

Subsection 509.10 shall be replaced with the following:

509.10 Anchor Bolts. All anchor bolts with suitable hex nuts and plain hardened washers shall conform to the requirements of ASTM A 449 and shall be galvanized in accordance with the requirements of AASHTO M 232 (Class C) or zinc coated in accordance with ASTM B 695, Class 50.

Subsection 509.19(c) shall include the following:

Stiffeners shall not be mechanically forced into position.

Subsection 509.20(a) shall include the following:

Trapezoidal steel box girder fabrication:

- (1) The exterior web to flange welds on trapezoidal box members, in which the included angle is less than 90 degrees, shall be welded using the flux cored arc welding process (FCAW).
- (2) The interior web to flange welds, which have included angles greater than 90 degrees, may be welded by either the submerged arc welding process (SAW) or the flux cored arc welding process.

Subsection 509.21 shall include the following:

The field connections of all members (girders and diaphragms) of plate girder systems with a radius of less than 800 feet and steel box girder systems shall be assembled in the shop and the holes match drilled while the connections are assembled.

Shop assembly may be complete structure assembly or progressive structure assembly at the fabricator's option:

- (a) Complete structure assembly shall consist of assembling all of the structural steel for the superstructure of the bridge.
- (b) Progressive structure assembly shall consist of initially assembling part of two adjacent girder lines simultaneously. Each girder line shall consist of at least three girders. While blocked in position, the diaphragm and girder field splices shall be fitted and match drilled. At least one shop section shall be added at the advancing end of a girder line and the next girder line started before any section is removed from the rearward end.

All girders shall be oriented upright and blocked simultaneously in the position they will occupy on the bridge's substructure. All holes shall be drilled while the girders are blocked in this position. Marking holes to be drilled after the girders are moved is not allowed.

After the holes are drilled, all splice plates shall be positioned in their respective locations and pinned/bolted to demonstrate that the hole alignment through the multiple plate thicknesses is in accordance with the specifications. The Division's QA inspector

shall be notified prior to disassembly to verify splice hole alignment. Verification of splice hole alignment shall not relieve the Concessionaire of the responsibility for proper fit up of the structural steel.

Quality Control shall measure flatness of the bottom flange at the bearing area. The bottom flange shall conform to the requirements of the Subsection 509.19(j). The Concessionaire's Quality Control Report shall list each bearing measurement.

Connecting parts assembled in the shop for field connections shall be match-marked, and two copies of a diagram showing each match-marked piece and defining how to use the marking system shall be provided to the Engineer 10 days prior to beginning structural steel erection.

The gap of abutting joints between members in a connection shall not exceed 3/8 of an inch.

Subsection 509.22 shall include the following:

The QA Inspector will perform Rotational Capacity and Verification Tests in accordance with the procedures outlined in the Report " High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, revised April 1992) on all lots used for shop connections. Any rotational capacity lot that fails to conform to the requirements shall be rejected. Rotational capacity lots that fail may, at the Concessionaire's option, be reprocessed and submitted for retest.

Bolt assemblies shall be installed in accordance with the procedures defined in Report No. FHWA-SA-91-031 May 1991, as revised April 1992.

Delete subsection 509.24 (c) and replace with the following:

- (c) Paint System. All structural steel, with the exception of weathering (AASHTO M 222), shall be painted with the two coat system defined in Subsection 708.03. Painting shall include a coat of primer on splice plates, faying surfaces of girders and diaphragms, and the interior surfaces of steel box girders. The primer and top coat shall be applied in the structural steel fabrication shop prior to shipment of the steel to the project site. The primer and top coat, color as defined in the plans, shall have a dry film thickness of 3.0 mils each. The Volatile Organic Content (VOC) of the paint shall not exceed 2.8 pounds per gallon (340 gm per liter). The QA Inspector shall be provided with a materials data sheet for all paint used on the project.

Paint shall be stored, mixed, strained, and applied in accordance with the manufacturers application instructions. Quality Control inspections and tests shall be performed in accordance with the listed test. The Quality Control Inspector shall maintain a checklist of the pieces tested. Only deficiencies require measurement records. These records shall be forwarded to the QA Inspector.

The Concessionaire shall perform the test procedure ASTM D 4285 once every four operating hours to assure the absence of oil and moisture in the compressed air lines used to blast and paint.

The profile of surfaces to be painted shall be tested once every 2000 square feet (185 square meters). The procedure shall conform to ASTM D 4417.

The thinner used shall be that indicated in the Manufacturer's Technical Data Sheet. No material shall be substituted without approval. The maximum volume

used in dilution shall not exceed the amount specified in the Technical Data Sheet.

The dry film thickness shall be measured to the frequency and using the procedure listed in The Structural Steel Paint Council Specification SSPC PA-2, with exception of diaphragms, bearings, and ancillary items. Ten percent of internal diaphragms in box girders, external diaphragms on all bridge girders, and ancillary items shall be spot measured (average to three readings). The Quality Control Inspector shall maintain a checklist of the members tested.

Replace subsection 509.28 with the following:

509.28 Connections Using High Strength Bolts.

- (a) Field Connections. Only Heavy Hex Structural Bolts with Compressible-Washer-Type Direct Tension Indicators or Tension Control Bolts conforming to the requirements of Subsection 509.08 shall be used in structural steel connections.
- (b) Bolted Parts. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. All joint faying surfaces, when assembled, shall be free of scale; dirt; burrs; drilling/cutting lubricants; other foreign material; and other defects that may prevent solid seating of the parts. Contact surfaces within joints shall be free of oil, paint (except primer coat), lacquer, or rust inhibitor.
- (c) Rotational Capacity and Verification Tests. The Division will perform Rotational Capacity and Verification Tests in accordance with the procedures outlined in the Report " High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, revised April 1992) on all lots used for field connections. Any rotational capacity lot that fails to conform to the requirements shall be rejected. Rotational capacity lots that fail may, at the Concessionaires option, be reprocessed and submitted for retest.
- (d) Installation. Bolt assemblies of appropriately assigned lot numbers shall be assembled together when installed in a joint. Fasteners and contact surfaces of splices shall be protected from dirt, moisture, and oil at the project site. Only as many fasteners as are anticipated to be installed and tightened during a work shift shall be taken from protected storage. Fasteners not used shall be returned to protected storage at the end of the shift. Fasteners shall not be cleaned of lubricant that is required to be present in as-delivered condition. Bolt assembly lots which are improperly stored, lack lubrication, or accumulate rust, dirt, or other contaminants shall be cleaned, relubricated, and submitted for retest as defined in Subsection 509.28(c).

Bolt assemblies shall be installed in and tensioned to the minimum tension specified in the following table:

Bolt Diameter	Inch (mm)	Required Minimum Bolt Tension (kN)	Kips
	1/2 (12.7)		13 (57.8)
	5/8 (15.8)	20 (89.0)	
	3/4 (19.1)	29 (129.0)	



7/8 (22.2)	41 (182.4)
1 (25.4)	54 (240.2)

Bolt assemblies shall be installed in accordance with the procedures defined in the Report "High-Strength Bolts for Bridges" (Report No. FHWA-SA-91-031 May 1991, as revised April 1992.

- (e) Inspection. The Concessionaire shall provide an acceptable platform from which the Engineer can inspect the bolt tension and determine whether the work meets the specification requirements. The Engineer will inspect a sufficient number of fasteners to assure that the minimum bolt tension has been attained. All undertensioned bolt assemblies shall be brought into compliance.
- (f) Painting of Connections. Structural steel connections in which all bolt assemblies have been satisfactorily tensioned shall be cleaned to remove the lubricant from the exposed portions of the fasteners and any other contaminants. The bolts and splice plates shall then be painted as defined in Subsection 509.24.
- (g) Repair of Painted Surfaces. The Concessionaire shall repaint "touch up", all areas in which the paint has been damaged. Tie downs and dunnage shall be cushioned to protect painted surfaces during transit. Repainting shall include all damage incurred during transit, handling, erection of structural steel, and forming and casting the deck. Paint shall conform to Subsection 708.03. Repainting will not be measured and paid for separately, but shall be included in the work.

#### **REVISION OF SECTION 509 WELDING**

Section 509 of the Standard Specification is hereby revised for this project as follows:

Subsection 509.20 shall include the following:

For field welding A7 steel, electrodes used shall be E7015, 16, 18, or 28.

For welding A7 steel with low-hydrogen electrodes by any process, the minimum preheat and interpass temperature shall be 150°F for thicknesses of metal up to 1-1/2 inches.

Subsection 509.26 shall include the following:

The Concessionaire shall not commence any field welding on the girders until the Division's Materials Branch has been notified and their inspector is on the site. The preheating process shall be approved by the Division's inspector.

Subsection 509.20(h) shall include the following:

Base metal shall be preheated to 150°F on the surface prior to welding studs.

#### **REVISION OF SECTION 513 BRIDGE DRAIN**

Section 513 is hereby added to the Standard Specifications for this project as follows:

## DESCRIPTION

513.01 This work shall consist of furnishing and placing bridge drains in accordance with the details shown on the plans and the specifications.

## MATERIALS

513.02 Pipe for bridge drains shall meet the requirements of ASTM A53 and shall be standard weight.

Down spout pipe shall be hot dipped galvanized after fabrication. Galvanizing shall meet the requirements of AASHTO M111.

Metal used in the manufacture of castings shall meet the requirements of ASTM A48 Class 35B.

## CONSTRUCTION REQUIREMENTS

513.03 Bridge drains shall be placed and secured at the locations shown on the plans prior to placement of concrete.

Prior to fabrication of this item, two sets of working drawings which comply with the requirements of Section 105 shall be submitted to the Engineer for information only. The working drawings will not be approved or returned.

## **REVISION OF SECTION 515 CONCRETE SEALER (CALCIUM NITRITE)**

Section 515 of the Standard Specifications is hereby revised for this project as follows:

Subsection 515.01 shall include the following:

This work consists of applying a penetrating corrosion inhibitor to finished surfaces of existing concrete or to cut surfaces of existing concrete prior to placement of new concrete. The corrosion inhibitor shall be placed under the direction of a manufacturer's representative in accordance with the manufacturer's instructions and as described herein.

Subsection 515.02 shall include the following:

The corrosion inhibitor shall consist of calcium nitrite and liquid carriers or penetrating vehicles, or organic inhibitors such as amino alcohols. The corrosion inhibitor shall conform to AASHTO M194, except for the requirements in tables 1, and 2, and sections 11 through 17. The corrosion inhibitor shall be one on the approved products list of the Division. If there are no approved products on the list the corrosion inhibitor shall be a product approved by the Engineer. If the plans specify the use of a calcium nitrite inhibitor, the inhibitor shall be calcium nitrite, if the plans specify the use of an organic inhibitor, an organic inhibitor shall be used. If the plans do not specify the type of inhibitor, either or both types of inhibitor may be used either individually or in

combination, provided that the combination use is in accordance with the manufacturers recommendations.

Subsection 515.05 (a) shall include the following:

Prior to the application of the corrosion inhibitor, surfaces to be treated shall be cleaned by air, sand, or water blasting and flushed with water until all material and contaminants which may interfere with the inhibitor's penetration have been removed.

Subsection 515.05 (b) shall include the following:

The corrosion inhibitor shall be applied when the surface to be treated has been dry for at least 24 hours and above a temperature of 40F, or within a more restrictive temperature range if recommended by the manufacturer.

Subsection 515.05 (c) shall include the following:

After the exposed surfaces have been prepared and allowed to dry, coats of corrosion inhibitor shall be applied in accordance with the manufacturer's recommendations. Each coat shall be evenly applied. Each application shall be allowed to dry prior to making the next application. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the penetrating inhibitor. Traffic shall not be allowed on the treated surface until the corrosion inhibitor has penetrated the concrete and the liquid corrosion inhibitor is no longer visible on the surface. The Concessionaire shall follow all manufacturer's recommendations, including penetration time, prior to opening treated surfaces to traffic or completing the work.

Enough coats shall be applied so that each square yard of treated surface shall have absorbed 0.12 lb. of calcium nitrite or organic inhibiting agent. When treating areas from which deteriorated concrete has been removed, lap the treated area onto the adjacent surface at least 2' beyond the removal.

Subsection 515.06 shall include the following:

Concrete sealer will be measured for by the number of square yards of concrete surface covered, except when the corrosion inhibitor is used only under patches. The area measured under patches shall be the area of the patches and shall not include the treatment required for 2' around the patch in 515.05 (c). The pay area for each discrete location (a contiguous treated area not touching other treated areas) shall be rounded up to the next whole square yard.

Subsection 519.07 Basis of Payment, shall include the following:

**REVISION OF SECTION 601  
PAINTING OF ALUMINUM ACCESS DOORS FOR CONCRETE STRUCTURES**

Section 601 of the Standard Specifications is hereby revised for this project as follows:

Subsection 601.14(b)4 shall include the following:

Aluminum access doors shall receive a solvent cleaning to remove grease and oil (SSPC-SPI) followed by a brush blast.

The aluminum access doors shall receive one coat of vinyl wash primer conforming to Mil-P-15328. Following the application of this primer, the doors will be coated with

Structural Concrete Coating conforming to Revision of Section 601 Structural Concrete Coating.

The manufacturer of the primer shall certify in writing, that the primer used is compatible with the cleaned aluminum access doors and the Structural Concrete Coating to be used on the Structural Concrete.

**REVISION OF SECTION 601  
STRUCTURAL CONCRETE (GROOVED PATTERN FINISH)**

Section 601 of the Standard Specifications is hereby revised for this project as follows:

Subsection 601.09 shall include the following:

An approved elastomeric form liner that will produce a grooved pattern finish shall be used in the designated portions of retaining walls. The form liner shall be furnished with a coating of an approved, non-petroleum base, factory-applied form release agent. After fastening the form liner to the form, an additional coat of manufacturer's recommended (only approved non-petroleum base may be used) form release agent shall be applied to the liner prior to and for each pour of concrete. Adjacent sections of the form liner shall be butted together to produce a good mortar tight joint. All grooves shall line up in the vertical direction. The form liner shall be securely fastened to the forms with staples or nails, or other approved methods.

Form ties shall be inserted through the form liner by cutting a cross-shaped slit in the liner. Prior to reuse of the form liner on adjacent wall sections, slits in the form liner that do not coincide with new tie spacing shall be sealed with a plastic tape which will adhere securely to the surface of the form liner.

The Concessionaire will be responsible to assure that whenever any discontinuances of the grooved pattern, or whenever any lines interrupting or intersecting the grooved pattern, are called for on the plans, that the resulting lines, horizontal, diagonal, vertical or otherwise, are neat and true, and that the form liner is not unduly deflected in any direction, including the form liner at the interface between the form liner and any other interrupting or intersecting line.

Subsection 601.09(f) shall include the following:

Forms to which a form liner is to be attached shall not be treated with oil.

Section 601.14(a) shall include the following:

A grooved pattern surface finish as designated on the plans shall be used on the designated portions of concrete walls.

The Concessionaire shall furnish samples at the job site measuring 4 feet by 10 feet for approval, at least two weeks prior to use. The final samples must receive the Engineer's written approval before the finish can be incorporated into the work. These samples are to remain undisturbed on the project until project acceptance.

For all walls or panels requiring a grooved pattern on the exposed surface which are less than 10 feet in height, the form liner producing the pattern shall be one continuous piece extending the full height of the wall or panel. For all other walls, no section of the form liner may be less than 10 feet in height except for one section which may be required to extend the form liner to full height.

Horizontal joints in adjacent form liner sections shall be offset by no less than one foot vertically. The form liners shall be properly aligned to limit visible horizontal and vertical joints in the concrete.

The required groove pattern finish shall extend from the bottom of wall or top of wall footing to the top of wall or bottom of wall coping or cap, or as otherwise shown on the plans. Grooves shall be continuous with no apparent curves or discontinuances. Variation of the groove from true vertical shall not exceed 1/4 inch for each 10 feet of wall height.

Concrete for such walls shall be poured monolithically vertically unless otherwise provided in the plans or permitted in writing by the Engineer. Concrete finish shall be in accordance with Revision of Section 601 - Structural Concrete Coating and shall be required for the full height of the grooved pattern finish to one foot below ground line.

Subsection 601.18 shall include the following:

Construction of grooved pattern surface finish on concrete walls will not be paid for separately but shall be included in the work.

#### **REVISION OF SECTION 601 CONCRETE CLASS DT (DECK TOPPING)**

Section 601 of the Standard Specification is hereby revised for this project as follows:

Subsection 601.16 shall include the following:

Concrete bridge deck overlays shall be cured according to the Revision of Section 601, Bridge Deck Concrete.

Subsection 601.17 shall include the following:

In the event that plastic shrinkage cracking has occurred, any cracks greater than 0.02 mm (0.010 inch) in width that develop within the first 5 days of overlay placement shall be assumed plastic shrinkage cracks. The cracks will be measured by the Engineer by the insertion of a wire gage at any time or temperature at 5 days. The Concessionaire shall make repairs by filling the cracks, concrete removal and replacement, or other methods approved by the Engineer at no additional cost to the project.

A low viscosity two-part methacrylate or approved equal shall be used to fill cracks in accordance with the recommendations of the manufacturer of the crack filling material.

Those portions of the structure that have been overlaid with the Concrete Class DT shall not be opened to traffic, including construction traffic, for at least 5 days after overlay placement and until the concrete has reached compressive strength  $f'c$ .

Subsection 601.19 shall include the following:

Saw-cutting and sealing construction joints in bridge decks shall be included in the work.

#### **REVISION OF SECTION 607 CONCRETE MASONRY SOUND BARRIER**

Section 607 of the Standard Specifications is hereby revised for this project to include the following:

#### DESCRIPTION

This work consists of constructing a Concrete Masonry Sound Barrier in accordance with the plans and specifications.

#### MATERIALS

- (a) *General.* References to the Uniform Building Code (UBC) shall refer to the 1997 Edition. Laboratory technicians involved in masonry testing shall be certified by the National Concrete Masonry Association as a "Certified Laboratory Technician for Concrete Masonry". Technicians shall possess records of certification at all times when on site, during sampling of materials, preparation of test specimens, and while conducting tests.
- (b) *Concrete Masonry Units.* Concrete masonry units (CMU) shall conform to the requirements of ASTM C 90 and the following:
  - 1. Provide units that are Type II (non-moisture controlled), hollow, and normal weight.
  - 2. The compressive strength of CMU'S shall be as defined in ASTM C 90 or greater as required to attain f'm.
  - 3. Units shall be integrally and uniformly colored as defined in the plans.
  - 4. Units shall be the size and surface texture defined in the plans.
  - 5. Provide an approved water repellent additive in accordance with the manufacturers recommendations.
  - 6. The Concessionaire shall sample and test CMU's in accordance with ASTM C 140 and provide the Engineer with complete test reports as outlined in Section 10 of C 140.
- (c) *Mortar.* Mortar for concrete masonry construction shall conform to the requirements of the ASTM C 270 and the following:
  - 1. Provide Type S in accordance with the Proportion Specifications for Portland Cement, lime, and sand. Masonry cement will not be allowed.
  - 2. Quantities of sand, cement, and lime shall be accurately measured, shovel counts shall not be used.
  - 3. Mortar shall be integrally and uniformly colored to match the CMU's.
  - 4. Provide an approved water repellent additive in accordance with the manufacturers recommendations.
- (d) *Grout.* Grout shall conform to the requirements of UBC Standard 21-19 and the following:
  - 1. A 28 day compressive strength of 2000 psi or greater as required to attain f'm. The Concessionaire shall sample and test the grout for every 5000 square feet of wall as construction progresses in accordance with the

requirements of UBC Standard 21-18. Test reports shall be submitted to the Engineer as outlined in Section 21.1806 of UBC Standard 21-18.

2. Air is not required.
  3. Up to 20% by weight of the cement may be an approved fly ash.
  4. Fine aggregate shall conform to the requirements of AASHTO M 6 as defined in Section 703.
  5. The coarse aggregate shall conform to the requirements of AASHTO M 43, Size 7 or 8, as defined in Section 703 and shall be a minimum of 50% of the total aggregate.
  6. Sufficient water (or a combination of water and water reducer) shall be added to the grout to attain a slump of 8 to 10 inches prior to placement.
  7. Provide an approved water repellent additive in accordance with the manufacturers recommendations.
- (e) *Prism Testing.* The Concessionaire is responsible for providing a concrete masonry assemblage (a composite of CMU's, mortar, and grout) with a strength, f'm, of at least 2000 psi. *Prism* tests shall be conducted by the Concessionaire prior to starting and during construction to verify design compressive strength. Compressive strength of prisms shall be based on tests at 28 days and each set of prisms shall equal or exceed f'm. Compressive strength at seven days or three days may be used provided a relationship between seven-day and three-day and 28-day strength has been established for the project prior to the start of construction. Verification by masonry prism testing shall be as follows:
1. A set of five masonry prisms (grouted solid) shall be built and tested in accordance with U.B.C. Standard 21-17 prior to the start of construction. Materials used for the construction of the prisms shall be taken from those specified to be used for the project.
  2. A set of three prisms (grouted solid) shall be built and tested during construction in accordance with UBC Standard 21-17 for each 5000 square feet of wall area, but not less than one set of three masonry prisms for the project. Prisms shall be constructed from materials randomly selected on the project site.
  3. Test reports shall be submitted to the Engineer as outlined in Section 21.1708 of UBC Standard 21-17.
  4. Those portions of the wall represented by tested prisms that do not attain f'm shall be removed and replaced with a wall that meets the requirements of this specification at the Concessionaires expense.
- (f) *Masonry Reinforcement.* Reinforcing Steel (Deformed Bars) shall conform to the *requirements* of Section 602 and shall be Grade 60.
- Joint reinforcement shall be provided every other course or as shown on the plans and shall be hot dipped galvanized in accordance with ASTM A 153-Class B-2, ladder type with 9 gage side and cross rods. Lap splices for joint reinforcement shall be a minimum of 6 inches.

- (g) *Concrete Cap.* Reinforcing Steel shall conform to the requirements of Section 602 and shall be Grade 60. Concrete shall conform to the requirements of Section 601 and the following:
  - 1. Concrete shall be Class DT with a minimum cement content of 565 pounds per cubic yard.
  - 2. Concrete shall be integrally and uniformly colored as defined in the plans.
  - 3. The concrete cap can be either precast or cast-in-place.
- (h) *Water Repellent.* An approved polymer water repellent shall be provided in all CMU's, mortar, and grout in accordance with the manufacturer's recommendations. The *following* polymer water repellent additives are approved:
  - 1. Dry-Block by W.R. Grace.
  - 2. Addiment Block Plus.
- (i) *Control Joints.* Control joint material shall conform to the requirements of ASTM D 2000 2AA-805, ASTM D 1751 or as approved by the Engineer.

#### CONSTRUCTION REQUIREMENTS

- (a) *General.* Construction of the concrete masonry walls shall conform to the requirements of the Uniform Building Code (UBC) Section 2104 (1997 Edition), the plans and specifications.
- (b) *Sample Approval.* The Engineer shall approve in writing the following before concrete *masonry* wall construction begins:
  - 1. Color and texture of concrete masonry units.

Four weeks before construction begins provide the Engineer with two concrete masonry units of each color and texture required on the project.

#### REVISION OF SECTION 607 FENCE CHAIN LINK SPECIAL

Section 607 of the Standard Specifications is hereby revised for this project as follows:

Subsection 607.02 shall include the following:

All materials shall meet the requirements specified in AASHTO M181 except as otherwise noted in the plans and these specifications. The Concessionaire shall provide certification from the manufacturer that all materials used are in compliance with the requirements of the plans and these specifications.

All material shall be galvanized. When required by the plans the fence shall also be vinyl coated. The color shall be as noted in the plans. All exposed materials shall have a uniform coloration. Temporary members and attachments that are to be removed need not be vinyl coated. The inside of pipes shall not be vinyl coated. When the fence is vinyl coated bolts and nuts shall be either vinyl coated or painted to match fence coating.



Anchor bolts, threaded rods, anchor studs, post dowels, and other unexposed portions of anchorage assemblies shall be galvanized and not vinyl coated or painted.

The Concessionaire shall furnish to the Engineer for approval a 300 mm X 300 mm (12" X 12") sample of the fabric (showing the exact coating and fabric construction to be used) and manufacturer's literature covering all aspects of the system he intends to install before ordering or fabricating any parts.

The fabric shall be AASHTO M181 Class C; or, when vinyl coating is specified in the plans, Class B. The mesh and wire sizes shall be as specified in the plans. When 10 mm (3/8") mesh with 2.7 mm (12 gauge) wire is specified in the plans the following properties shall apply.

For other mesh and wire sizes the properties shall be as specified by AASHTO M181.

Mesh	10 mm (3/8") clear opening
Core wire breaking strength	2891 N (650 lbs) (minimum)
Core wire diameter	2.7 mm +/- 0.125 mm (0.105 inch +/-0.005")
Galvanizing, Class C fabric	366 g/sq. m. (1.2 oz./sq. ft.)
Galvanizing, Class B fabric	92 g/sq. m. (0.30 oz./sq. ft.)
Vinyl Coating Class B Fabric	0.20 mm +/-0.05 mm (0.008 inch +/-0.002 inch)

Tension wires shall be AASHTO M181 Type 1 Class 2; or, when vinyl coating is specified in the plans, Type 4.

Tension wires and their fittings shall have a minimum breaking strength of 8540 newtons (1920 pounds).

Truss rods and their fittings shall have a minimum breaking strength of 17080 newtons (3840 pounds) for fences without horizontal members and with a minimum prestress force given by the plans.

Posts and horizontal members shall be standard or extra strong steel pipe, as noted in the plans, satisfying ASTM A53 Type E or S, Grade B ( $F_y = 242 \text{ Mpa}$  (35000 psi)); or, at the Concessionaire's option, ASTM A466 Grade D pipe (345 Mpa (50000 psi)) minimum yield strength) conforming to the following table may be substituted for both the standard and extra strong pipe of the same outside diameter called for in the plans. All fittings and connections dependent on the pipe's inside diameter shall be modified as necessary for proper fit-up, as approved by the Engineer.

#### Alternative Pipe

Nominal Diameter <u>mm (In.)</u>	Outside Diameter <u>mm (In.)</u>	Kg. (Lb.) per <u>Meter (Ft.)</u>	Wall Thickness <u>mm (In.)</u>
32 (1.25)	42 (1.660)	2.73 (1.836)	2.82 (0.111)
38 (1.50)	48 (1.900)	3.40 (2.281)	3.05 (0.120)
50 (2.00)	60 (2.375)	4.64 (3.117)	3.30 (0.130)

63 (2.50)

73 (2.875)

6.91 (4.640)

4.06 (0.160)

Stretcher bars, truss rods, tension wires, post tops, and other required fittings and hardware shall be commercial quality steel, or better, or cast or malleable iron as appropriate to the article. A pair of two tension wires with appropriate turnbuckles or other adjustment devices, may be substituted for each truss rod.

Post clips, wire ties, or hog rings shall be galvanized 4.2 mm (9 gauge) or 1.9 mm (14 gauge) (before galvanizing) steel wire, and vinyl coated when specified by the plans. Wire ties shall be given at least one complete turn. Ends of wire ties shall be directed away from traffic.

Subsection 607.03 shall include the following:

For fences without permanent horizontal members and with a minimum prestress force given by the plans, the following shall apply.

The total pretension force in the tension wires and the mesh combined shall not be less than the value shown in the plans. Each tension wire, truss rod, and the mesh should have some pretension and shall not be slack. This is to assure the strength and stiffness of the fence system under the anticipated loads.

The Concessionaire shall control the quality of the fence tensioning by checking that the deflection of the fence does not exceed the value shown in the plans when the test load described in the plans is applied. The Engineer may choose to assure this quality by observing these tests, or by performing tests of his own. If the deflection is excessive, the Concessionaire shall retension the fence components.

The temporary horizontal members shall be removed after the tensioning of the fence is accepted.

Subsection 607.04 shall include the following:

Fence Chain Link (Special) ( ) and Fence Chain Link Special will be measured by the meter (linear foot). Measurement will be along the base of the fence from center to center of the extreme end posts.

Payment per meter (linear foot) shall include all costs for a complete installation of anchorages, posts, horizontal members, truss rods, tension wires, fabric, stretcher bars, and ties as required by the plans. All other incidental hardware required will not be measured and paid for separately, but shall be included in the work.

### **REVISION OF SECTION 618 PRESTRESSED CONCRETE**

Section 618 of the Standard Specifications is hereby revised for this project as follows:

In subsection 618.04 replace the last sentence with:

The friction losses shall be determined in accordance with the plans and as provided for in the AASHTO *LRFD Specifications for Highway Bridges*.

Revise 618.06(b)(9) to read:

(9) Copies of all concrete mix designs to be used, including mix design computations and test data, and acceptable specific gravities for mud balance tests, provided by the grout manufacturer.

Add 618.06(b)(14):

(14) Post-tensioning system. Duct and anchorage inspection schedule, duct splices at closure pour inspection schedule, and duct pressure testing schedule, including name(s) of the of the responsible representative of the post-tensioning system supplier who will conduct inspections and testing.

Revise 618.06(c) to read:

(c) *Frequency*. QC inspection and testing at all intervals of duct anchorage, duct splice operations, forming, tensioning, steel and concrete placement, curing, and storage operations shall be performed in accordance with the accepted QCP. The QCP shall contain provisions for increased frequencies of inspection and testing when operations or products do not conform to the Contract.”

Add 618.06(d)(8):

8. Post-tensioning Ducts. The responsible representative of the post-tensioning system supplier shall submit to the QA Representative a letter certifying that the ducts, duct splices, and anchorages are installed according to the Contract and that they have been inspected by the responsible representative of the post-tensioning system supplier and adequately held an air pressure test of 45 psi.

Revise 618.07(a)(7) to include:

The presence of rust on strand shall not necessarily be cause for rejection. Light rust and rust that does not result in visible pitting of the prestressing steel with the unaided eye shall be acceptable. Prior to evaluation, rust shall be removed from representative lengths of prestressing strand by heavy duty scouring pads, such as Scotchbrite by 3M. After rust removal, visual comparisons shall be made to picture sets in the article “Evaluation of Degree of Rusting on Prestressed Concrete Strand” published in the 1992 May-June edition of the PCI Journal. Surface conditions comparable to picture sets 1 through 3 shall be acceptable, while surface conditions comparable to picture sets 4 and greater shall be cause for rejection of the prestressing strand.

Revise 618.07(c)(1)(4) to read:

(4) A grout manufacturer’s field representative, who is a full-time employee of the grout manufacturer, will provide technical product assistance to the grouting crew, and will be present during start-up of grouting operations and be able to be present, at the request of the Engineer, should problems with the grout occur.

Revise 618.07(c)(1)(5) to include:

- (iv) Be a full-time employee of the post-tensioning system supplier.
- (v) A holder of a current Grouting Training Certificate from the American Segmental Bridge Institute.

Revise 618.07(c) Item (9) of grouting plan to read:

(9) Procedures for handling blockages, procedures and equipment required for flushing ducts of grout if necessary, and how and when it will be decided whether or not to flush ducts.

Add 618.07(c) Item 12 to grouting plan as follows:

- (12) List of production testing along with acceptable values.

Subsection 618.07(c)2 (1) shall include:

Alternative anchorages must be submitted and approved by the Engineer prior to the bid date. Alternatives submitted after this date will not be accepted.

Subsection 618.08 shall include:

Permanent anchorage grout caps are required and shall be installed before grouting begins. Anchorage devices shall have a minimum clear concrete or grout coverage of 2 inches in every direction unless otherwise shown in the drawings.

Replace the second paragraph of Subsection 618.09 (a) with:

The time from installing the prestressing steel in the ducts in an unstressed condition to grouting after stressing shall not exceed thirty days. The exceptions to the thirty day grouting requirement is during cold weather when heating would be required to allow the ducts to be grouted in accordance with (e) below, or if it is anticipated that a duct may not be grouted within 30 days after installing the tendon strands in the duct the Concessionaire will be allowed to place a 40 ft test strand into the sealed duct as a corrosion test strand that can be removed and evaluated for corrosion per subsection 618.08(a)7. If the test strand method is used the Concessionaire shall install a test strand into a representative duct for each installation stage of tendons on the project. The test strand should pass through a local low point of the duct. If the Concessionaire chooses not to heat the structure, and the ducts have not been grouted within thirty days of installation of the prestressing steel in the ducts, the ducts shall be grouted the first day weather permits in accordance with (e) below.

Subsection 618.09 (b) shall include:

The grout manufacturers lot definition in writing shall be included with the grouting plan.

Table 618-1 Fluidity Test shall be revised as follows:

The minimum Efflux Time from Flow cone shall be 11 Seconds Minimum per ASTM C 939 test method.

The minimum Efflux Time from Flow cone shall be 5 Seconds Minimum per ASTM C 939 test method Footnote 3.

Revise Subsection 618.09 (d) to include:

- (d) *Grouting*. All grouting operations shall be performed under the immediate control of the representative of the post-tensioning system supplier.

The Concessionaire shall perform, or contract a commercial testing entity experienced with the following tests, in the presence of the Inspector/Engineer, and report the results to the Engineer:

- (1) One pressure bleed test per day in accordance with the requirements of Appendix C of the "Specification for Grouting of Post-Tensioned Structures" by the Post-Tensioning Institute. The Gelman filtration funnel shall be secured vertically plump in a stand and shall be pressurized to 50 psi and the maximum percent bleed shall be zero when the vertical rise of ducts is greater than 6 ft, shall be pressurized to 30 psi and the maximum percent bleed shall be 2% when the vertical rise of ducts is greater than 2

ft and equal to or less than 6 ft, and shall be pressurized to 20 psi and the maximum bleed shall be 4% when the vertical rise of ducts is equal to or less than 2 ft.

- (2) Two mud balance tests per day or when there is a visual or apparent change in the characteristics of the grout in accordance with the API Recommended Practice 13B-1 "Standard Procedure for Field Testing Water-Based Drilling Fluids". Acceptable specific values for the grout shall be provided by the grout manufacturer and included with the grouting plan."

Replace the last sentence in Subsection 618.09 (d)(4) with:

The efflux time shall be as shown in Table 618-1.

### **REVISION OF SECTION 618 SEGMENTAL PRESTRESSED CONCRETE STRUCTURES**

Section 618 of the Standard Specifications is modified for post-tensioned elements for this project and replaced with the following:

Subsection 618.01 shall include the following:

This work shall consist of the construction of post-tensioned concrete members in accordance with these specifications and in conformity with the plan details.

This work shall include the stressing, furnishing and installation of any items necessary for the particular prestressing systems to be used, including but not limited to ducts, prestressing steel, anchorage assemblies, reinforcing for prestressing, and grout used for pressure grouting ducts.

The term "segment" refers to a modular section of the superstructure consisting of the cross-section detailed on the plans. The lengths of the segments are detailed on the contract plans.

The weight of each precast segment shall be as permitted for handling and transporting subject to Engineer's approval. The length of cast-in-place segments shall be the length between construction gaps shown.

The term "match cast" refers to a fabrication procedure whereby a segment is cast against the preceding segment. Match casting may be accomplished by either the short line casting method or the long line casting method.

Subsection 618.02 shall include the following:

All Duct splices shall use Shrink Sleeves or as approved by the Engineer.

Subsection 618.03 shall include the following:

Post-tensioned members will be of the type, shape, and dimensions as shown on the plans.

The minimum strength of the concrete at the time of post-tensioning shall be 3500 psi or as given on the plans, whichever is greater.

Welds or grounds for welding equipment shall not be made on the forms or on the steel in the member after the prestressing steel has been installed, unless otherwise indicated on the plans.

The Concessionaire will not be allowed to deviate from the erection method or erection sequence, as shown on the plans. However, the Concessionaire may add temporary post-tensioning for purposes of erection or supporting construction loads.

The Concessionaire may request and receive copies of all design information (calculations, computer output, etc.) submitted for this project. This request shall be made through the Project Engineer.

The Concessionaire shall submit drawings and calculations for the construction loading, if any, to which the bridge will be subjected during construction. These drawings and calculations shall:

1. Be prepared by an Engineer who is thoroughly knowledgeable in the design of post-tensioned concrete bridges.
2. Be in accordance with the current edition of the AASHTO LRFD Specifications for Highway Bridges.
3. Illustrate the configuration and magnitude of the construction loads. If the loads will vary during the phases of construction, then the details shall show the critical loads at each phase.
4. Verify that the stresses on the plans or contained in the specifications are not exceeded. In addition, joints with well distributed bonded reinforcing crossing them (as is typical in precast segmental construction) shall have no tension across them during construction or under service load after the structure is completed. The tension in any part of the prestressed concrete during construction shall not exceed  $6(f'_{ci})/2$  or  $3(f'_{ci})/2$  for the top of the deck. The tension in any part of the prestressed concrete under service load after the structure is completed shall not exceed  $6(f'_{c})/2$  or  $3(f'_{c})/2$  for the top of the deck.
5. Verify that the foundation or pier column capacities are not exceeded.
6. If the Concessionaire intends to add temporary post-tensioning he shall submit complete details and calculations in accordance with subsection 618.03 (d) "Shop Drawings and Calculations" of this specification, for approval by the Engineer. The calculations shall meet the following requirements:
  - A. The calculations shall show that any stresses indicated on the plans or contained in these specifications are not exceeded, at any phase of construction.
  - B. The calculations shall consider all effects due to dead load, prestressing, and construction loads.
  - C. The calculations shall be prepared by an Engineer who is thoroughly knowledgeable in the design of post-tensioned, concrete bridges.

- D. The calculations shall be prepared in accordance with the AASHTO Standard Specifications for Highway Bridges.
7. Temporary post-tensioning details shall meet the following requirements:
- A. The temporary prestressing steel shall be clearly identified on the shop drawings.
  - B. The method, procedure, and sequence of tensioning and de-tensioning the temporary prestressing steel shall be shown. The sequence shall be related to the permanent post-tensioning.
  - C. Details shall show any ducts, blockouts, or buildouts necessary for the temporary prestressing steel. Ducts or voids internal to the member for temporary prestressing steel shall not be left void but shall be grouted in accordance with these specifications.
  - D. Stressing blocks for any temporary prestressing systems anchorages may be located within the slabs, in partial diaphragms within box girders, in external systems temporarily anchored to the girders and removed after used, or a combination of any of the above methods. All construction added outside a girder for temporary prestressing shall be subsequently removed to restore the girder to the designed cross-section shown on the plans or as approved by the Engineer.
  - E. The detail requirements for the temporary post-tensioning shall be in accordance with 618.03 (d) "Shop Drawings and Calculations".
8. The Engineer will have 5 weeks to review and approve the Concessionaire's construction loading and temporary post-tensioning details and calculations. If the details are not approved, they will be returned for corrections and resubmitted by Concessionaire, in the same manner as the first submittal.

The time required for approval of resubmittals will not be more than 5 weeks per submittal. It is the intent of these specifications that not more than two resubmittals will be required. If additional submittals are required by actions of the Concessionaire, the additional time required for review and approval will be borne by the Concessionaire.

9. Only after the Concessionaire's construction loading and temporary post-tensioning details and calculations are approved will the Division review final shop drawings for post-tensioning, bearing devices, falsework, or expansion devices for the superstructure. Approval of these details and calculations will not relieve the Concessionaire of the responsibility for the structural adequacy of the bridge, or the performance of the temporary post-tensioning, under construction loading.

Subsection 618.10 shall include the following:

Post-Tensioned Members. The quantities of prestressing steel will not be measured but shall be the quantities shown on the plans, completed and accepted, which are required jacking forces (in thousands of KIPS) times their required lengths.

Payment will be full compensation for all work necessary to complete the designated Pay Item in accordance with Section 109. This Pay Item shall include but not be limited to all anchorage devices, prestressing steel, ducts, grout, and miscellaneous hardware. Concrete and reinforcing steel not shown on the plans but required by the Concessionaire's alternate will not be paid for separately but shall be included in the work. Concrete quantities will not be reduced for the volume occupied by ducts, prestressing steel, anchorages, blockouts for tensioning, etc., and will not include web flares, projections, warts, etc., required to accommodate the prestressing system used.

**REVISION OF SECTION 628  
BRIDGE GIRDER AND DECK UNIT**

Section 628 is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

628.01 This work consists of the design, fabrication, and erection of a simple span, welded self weathering steel, truss pedestrian bridge (with a timber or concrete deck) in accordance with the specifications and plan details.

Potential bridge suppliers are:

1. Continental Bridge  
8301 State Highway 29 N  
Alexandria, Minnesota 56308  
1-800-328-2047, FAX 320-852-7067
  
2. Steadfast Bridges  
4021 Gault Ave. South  
Fort Payne, Alabama 35967  
1-800-749-7515, FAX 256-845-9750
  
3. Excel Bridge Manufacturing Company  
12001 Shoemaker Avenue  
Santa Fe Springs, California 90670  
562-944-0701, FAX 562-944-4025
  
4. Big R Manufacturing LLC  
P.O. Box 1290  
Greeley, Colorado 80632-1290  
1-800-234-0734, FAX 1-970-356-9621
  
5. Wheeler Lumber, LLC  
9330 James Avenue South  
Bloomington, Minnesota 55431-2317  
1-800-328-3986, FAX 952-929-2909



## MATERIALS

628.02 Structural Steel. All structural steel shall be new (unused) material. The Concessionaire shall provide the Engineer and the Staff Bridge Branch Fabrication Inspection Unit with copies of all certified mill test reports for all structural steel and bolts. Floor beams, stringers, and members of each Half-through truss (upper and lower chords, diagonals, end posts and vertical posts) utilized in the bridges shall meet a longitudinal Charpy V-notch (CVN) value of 25 ft. lbs. at 40 degrees Fahrenheit. Testing shall be in accordance with AASHTO T 243 (ASTM A 673). The H frequency of heat testing shall be used. The Concessionaire shall provide the Engineer and the Staff Bridge Branch Fabrication Inspection Unit with certified copies of all CVN test reports.

All square and rectangular structural steel tubing shall conform to the requirements of ASTM A 847, Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing With Improved Atmospheric Corrosion Resistance.

All structural steel shapes and plates shall conform to the requirements of ASTM A 588, High-Strength Low-Alloy Structural Steel.

All anchor bolts and nuts shall conform to the requirements of ASTM A 307, Grade A, Carbon Steel Bolts and Studs, and shall be galvanized in accordance with the requirements of ASTM A 153. Each anchor bolt shall be provided with two nuts for jamming.

All structural steel field connections shall be bolted with high strength bolts. High strength bolts, including suitable nuts and plain hardened washers, shall conform to the requirements of ASTM A 325. Bolts shall be Type 3.

628.03 Timber. All timber shall be new (unused) material and conform to either of the following:

1. Southern Pine, No. 1 or better quality, Graded in accordance with Southern Pine Inspection Bureau (SPIB) rules.
2. Douglas Fir-Larch, No. 1 or better quality, Graded in accordance with West Coast Lumber Inspection Bureau (WCLIB) rules.

All lumber shall be manufactured and inspected in accordance with the latest edition of Product Standard 20-70 as published by the Department of Commerce, and shall be grade marked or have an accompanying certificate from a certified grading agency. The grading agency shall be certified by the Board of Review of the American Lumber Standards Committee.

All timber shall be pressure treated, conforming to the requirements of the American Wood Preserver's Association (AWPA) Standards, Section C1 and C2 (Soil Contact). Either Ammoniacal Copper Arsenate (ACA) or Chromated Copper Arsenate (CCA) preservatives conforming to the requirements of Section P5 (Standards For Waterborne Preservatives) of the AWPA Standards shall be utilized and treatment shall be to a total absorption of 0.40 pounds per cubic foot of timber. A certified treatment report shall be provided to the Engineer and the Staff Bridge Branch Fabrication Inspection Unit.

## CONSTRUCTION REQUIREMENTS

628.04 Design. The *AASHTO Guide Specifications for Design of Pedestrian Bridges* and Division I (design) of the *AASHTO Standard Specifications for Bridges* shall govern the design.

The superstructure of the pedestrian bridge shall consist of two parallel Half-through trusses, or Pony trusses, with at least one diagonal per panel. The trusses shall be the main load-carrying members of the bridge.

The members of each Half-through truss, or Pony truss, (upper and lower chords, diagonals, end posts, and vertical posts) shall be fabricated from square and rectangular structural steel tubing.

Floor beams and stringers shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.

The structure shall conform to the clear span, clear width, and railing requirements shown on the plans.

Each pedestrian bridge shall be designed for the following loads and loading conditions:

1. Dead load shall be as defined in Section 3.3 of the AASHTO Standard Specifications.
2. Live load shall be as defined in the AASHTO Guide Specifications. Distribution to the stringer and floor beams shall be in accordance with Section 3 of the AASHTO Standard Specifications. Deflection and vibration limits as per the AASHTO Guide Specifications shall apply.

Pedestrian live load shall be as defined by the AASHTO Guide Specifications, and used in load group I of the AASHTO Standard Specifications, Section 3.

Vehicle live load shall be as defined by the AASHTO Guide Specifications, and used in load group IB of the AASHTO Standard Specifications, Section 3. When required by the plans, the vehicle live load shall be the Colorado Legal Load Type 3 Vehicle. This is a 27 ton, three axle, vehicle with 13.5' front axle spacing and 4' rear spacing. The axle loads are 7 tons on the front axle and 10 tons on each of the rear axles.

3. Wind load shall be as defined by the AASHTO Guide Specifications, and used in load group V of the Standard Specifications, Section 3.
4. Distribution of wheel loads on timber flooring shall be in accordance with Section 3 of the AASHTO Standard Specifications.

Allowable loads in the structural steel members and weld metal shall be in accordance with Section 10 of the AASHTO Standard Specifications.

Minimum thickness of structural steel shall be 3/16 of an inch.

½ inch diameter weep holes shall be drilled (flame cut holes will not be allowed) at all low points of all steel tubing members as oriented in the in-place, completed structure. In members that are level, or flat, a total of two weep holes shall be drilled, one at each end. Weep holes and their locations shall be shown on the Shop Drawings.

Allowable stresses for timber decking, when required on the plans, shall be in accordance with Section 13 of the AASHTO Standard Specifications.

All metallic fasteners utilized in attaching timber to structural steel shall be galvanized.

All welded tubular connections shall be designed in accordance with Section 2, Parts A and D (Delete Subsection 2.36.6), of the Structural Welding Code-Steel ANSI/AWS/D1.1 (Latest Edition).

When timber decking is used it shall be placed transverse to the trusses and have a minimum nominal thickness of 3 inches. Decking shall be securely fastened to each stringer and at each end to prevent warping.

Concrete and reinforcing steel, when used for the deck, shall conform to Sections 601 and 602, respectively.

The Concessionaire shall submit seven sets of Design Calculations and Shop Fabrication Details (Shop Drawings) to the Engineer for each pedestrian bridge separately. This submittal shall be in accordance with Subsection 105.02. The Design Calculations and Shop Drawings shall contain the endorsement seal of the Professional Engineer registered in the State of Colorado responsible for the design.

628.05 Shop Fabrication. Welding and fabrication of weathering steel pedestrian bridges shall conform to the requirements of the Structural Welding Code-Steel ANSI/AWS D1.1 (Latest Edition) as amended by the following:

1. As required in Subsection 4.7.3, a welding procedure shall be established by qualification in accordance with the requirements of Subsection 3.3 for the ASTM A 847 material used on the bridge. The results of the Procedure Qualification shall be recorded on Form E-1 in Annex E of AWS D 1.1.
2. The Concessionaire shall submit a Quality Control Plan. The Plan shall include personnel qualifications, certifications, and a Written Practice in accordance with ASNT SNT-TC-1A.
3. The quality of all welds shall be in accordance with Section 6, Table 6.1. In Table 6.1, Undercut 7(B), the criteria for primary members shall apply to the bottom chord members.
4. All Complete Joint Penetration Groove Welds in butt joints in the bottom chord members shall be 100% Magnetic Particle tested in accordance with ASTM E 709. Acceptance shall be determined in accordance with Section 6.10 and Table 6.1, using Alternating Current. In addition, complete joint penetration groove butt welds welded from one side without backing of bottom chord members shall be examined by ultrasonic testing in accordance with Section 6.11.1.
5. Magnetic Particle Testing shall be performed on 100% of all attachment welds to the bottom chord, using Alternating Current, in accordance with Section 6.10 and Table 6.1.
6. All Procedure Qualification Records and Welder Qualification Test Records shall be current within three years of the date of beginning fabrication.
7. A copy of all Procedure Qualification Records, Welder Qualification Test Records, Quality Control Plan and all visual and nondestructive test reports shall be provided to:
  - a. The Engineer.  
Staff Bridge Branch  
Fabrication Inspection Unit  
4201 E. Arkansas Ave., Room 330

Denver, Colorado 80222

All weathering steel shall be blast cleaned, Steel Structures Painting Council Surface Preparation No. 6 (SSPC-SP6, Commercial Blast Cleaning), to remove mill scale and foreign material which would prohibit rusting to a uniform color.

628.06 Field Construction. The substructure shall be constructed in accordance with the details shown in the plans and the pedestrian bridge shop drawings. Before construction begins on the substructure, the Concessionaire shall determine the anchor bolt requirements and substructure dimensions needed to properly erect the structure which will be provided. The Engineer shall be provided with two copies of detail sheets delineating these requirements before work begins.

## 16.0 MAINTENANCE OF TRAFFIC

The Concessionaire shall conduct all Work necessary to meet the requirements associated with Maintenance of Traffic (MOT), including provisions for the safe and efficient movement of people, goods, and services through and around the Phase 2 Construction Work while minimizing impacts to local residents and business and commuters.

### 16.1 Administrative Requirements

#### 16.1.1 Traffic Operations

##### 16.1.1.1 Maintenance of Traffic Task Force

1. The Concessionaire shall establish a MOT Task Force to assure proper coordination with affected agencies. The MOT Task Force shall include, at a minimum, the Concessionaire's Public Information Officer, Traffic Control Supervisor, Superintendent, HPTE, RTD, US 36 Commuting Solutions, and Local Agency representatives. The Concessionaire shall submit the proposed list of task force members to HPTE for Acceptance prior to NTP1.
2. The MOT Task Force shall meet weekly during the design and construction phases, and shall be an integrated element of the PIP.

Within 14 Days after Acceptance of the MOT Task Force members, the Concessionaire shall convene a TMP kick-off meeting. The meeting will be used to discuss the level of detail required for the TMP as identified in this [Section 16](#).

##### 16.1.1.2 Traffic Management Plan (TMP)

1. The Concessionaire shall prepare a TMP that defines the plan for traffic management on the Phase 2 Construction Work. The TMP shall address major aspects of the Work for individual construction areas, phases, and stages. The Concessionaire shall use the TMP as a planning and policy guide to develop and execute the project MOT program.
2. These major aspects shall include, but are not limited to:
3. An overview and description of the proposed construction, subdivided as applicable, into the following components:
  - A. Area: A specific grouping of Work along the Phase 2 Construction Work defined by the Concessionaire that creates segments of the Phase 2 Construction Work for the purpose of planning and executing the Work.
  - B. Phase: A specific sequence of the construction Work in an area during which a major traffic movement is undertaken (e.g., a detour) and left in place until the Work is complete and traffic is redirected to another location. This shall require development of a specific Traffic Control Plan (TCP). In some cases, multiple TCPs may be necessary.

- C. Stage: A subdivision of Work within a phase that combines similar components of Work to maintain efficiency.
4. A detailed approach to the development of TCPs and MHTs on the Phase 2 Construction Work
  5. A list of known or potential roadway, ramp, and lane closures, including the following information
    - A. Description of traffic shift
    - B. Description of detour
      - i. Identification of detour limits to be used in each construction phase.
      - ii. Concessionaire's identification and coordination with other construction projects, within the vicinity of the proposed detour route. The impact of these construction projects shall be incorporated into the detour route planning and scheduling.
    - C. Number of shifts expected
    - D. Duration of shifts and detours
  6. A description of proposed detour routes, including:
  7. An approach to Travel Demand Management (TDM) strategies
  8. An approach to the use of Intelligent Transportation System/Variable Message Sign (ITS/VMS) boards and traffic signals, including coordination with the affected Local Agency's traffic management center or Colorado Transportation Management Center (CTMC), and the Concessionaire's representative.
  9. The Concessionaire's plan for coordinating the TMP Activities with those Activities required under Schedule 5, Section 4, (Public Information).
    - A. A checklist identifying specific items that shall be provided both to the Concessionaire's Public Information Officer and to the HPTE Public Information Officer every Thursday by 10:30 a.m. for public information data collection and management activities on the Phase 2 Construction Work. The checklist shall provide the inclusion of supporting information relevant to coping messages and public awareness and shall be included in the Public Information Plan (PIP) required in Schedule 5, Section 4, (Public Information).
  10. Additional Elements
    - A. An approach to coordination and cooperation with construction being performed by projects adjacent to the Phase 2 Construction Work limits.
    - B. An approach to coordination with RTD.

- C. An approach to traffic access management, including restrictions, bicycles, pedestrians, and potential impacts to handicapped mobility.
  - D. Relevant portions of the Incident Management Plan (IMP), described below.
  - E. An approach to special event coordination.
11. Typical section requirements
  12. Emergency requirements
    - A. Pull-out locations
    - B. Emergency access
    - C. Courtesy patrol
  13. Temporary closure scenarios
    - A. Location
    - B. Time and duration
  14. Access
    - A. Pedestrian/bike
    - B. Business
    - C. Work Site(area)
    - D. Bus/transit

The TMP shall be submitted to HPTE for Acceptance at least 30 Days prior to NTP1. No Work that impacts traffic shall commence until the TMP is Accepted.

#### **16.1.1.3 Colorado Traffic Management Center (CTMC) Coordination**

Routine requests for use of the CTMC VMS boards shall be submitted to HPTE by 10:30 a.m. on Thursday of the week prior to when the VMS boards will be needed (Monday through Sunday of the following week). Requests for routine use of the VMS will be reviewed by noon Friday of the same week of the submittal. The Concessionaire shall coordinate directly with the CTMC following review by HPTE.

For after-hours operations only, the Concessionaire shall coordinate directly with the Colorado Traffic Management Center (CTMC). The CTMC is available to the Concessionaire to modify VMS messages 24 hours a day, 7 days a week.

The Concessionaire shall coordinate with HPTE and the CTMC for emergencies in accordance with the Accepted Incident Management Plan (IMP)

#### **16.1.1.4 Incident Management Plan**

The Concessionaire shall develop a detailed Incident Management Plan (IMP) as a companion to the TMP to manage traffic incidents and emergency operations on the Phase 2 Construction

Work Site. The IMP shall, comply with the CDOT *Guidelines for Developing Traffic Incident Management Plans for Work Zones* and be consistent with the existing US 36 Incident Management Plan included in Schedule 5A.

At a minimum, the IMP shall include the following components:

1. Coordination with the Public Information Plan (PIP)
2. Incident detection and identification
3. Incident response
4. Incident site management
5. Incident clearance
6. Dissemination of traveller information regarding incidents
7. Courtesy patrol
8. Emergency services notification, including local area police departments, CSP, local area fire departments, ambulance services, and any other emergency response providers.
9. Notification of local school districts about possible impacts to school bus routes, student drop-offs, and/or pedestrian facilities
10. Geographic and other special constraints
11. Available resources
12. Operational procedures

The IMP shall be submitted to HPTE for Acceptance at least 30 Days prior to NTP1. No Work that impacts traffic shall commence until the IMP is Accepted.

#### **16.1.1.5 Travel Demand Management Program (TDM)**

The Concessionaire shall develop a TDM program to reduce travel demand and improve traffic operating conditions during the construction period. The TDM program shall specify:

1. Coordination with 36 Commuting Solutions.
2. A TDM marketing plan.
3. A plan to evaluate the effectiveness of the TDM program.

Additional TDM strategies which would complement current corridor and regional strategies facilitated by 36 Commuting Solutions and Denver Regional Council of Governments.

The Concessionaire shall submit the TDM program to HPTE for Acceptance within 30 Days after NTP1.

#### **16.1.1.6 Business and Private Access**

The Concessionaire shall maintain public and private access to the local street system.

TCPs and MHTs shall incorporate stakeholder information from the PIP, available surveys, and other pertinent studies relating to business and private access to the local street system and the



highway facility. At a minimum, the Concessionaire shall communicate and document the following information relevant to business and private access:

1. Access points impacted by a particular construction phase or stage
2. All notifications of affected businesses and land owners
3. Schedule of closures and estimated durations
4. Site-specific access or delivery requirements for local businesses (deliveries, wide load vehicles, etc.)
5. Proposed mitigation efforts

#### **16.1.1.7 Maintenance of Traffic Variance Process**

The Concessionaire may request a MOT variance for any closure, detour, or other restriction beyond the specified limits defined herein. The following information shall be included in each MOT variance request:

1. Summary of the variance request
2. Justification for the variance request, including a list of the criteria that cannot be met and the reasons for not being able to meet the criteria
3. Public notification methods and schedule
4. List of affected emergency services and the schedule for notification
5. List of affected agencies or private owners and the method(s) and schedule for notification
6. Description of additional public information surveys to be performed, if required
7. List of any potential safety hazards to which the public may be exposed
8. Proposed revisions to the Accepted TCP or current MHT
9. Proposed duration of closure, detour, or phasing change for which a variance is requested

The Concessionaire shall allow HPTE a minimum of 14 Days for review and Approval of any MOT variance requests. The Concessionaire shall obtain Local Agency approval for detours utilizing non-State owned facilities. If Local Agency approvals are necessary, they shall be obtained prior to submittal of the MOT to HPTE.

#### **16.1.1.8 Concessionaire Response Time**

The Concessionaire shall have at least one employee on call, via cellular phone, that can respond to an incident within 30 minutes. Upon arrival at the incident site, that employee shall assess the situation and immediately notify the appropriate personnel to implement the IMP. Upon notification of the incident, the Concessionaire shall immediately undertake actions necessary to restore traffic operations to the maximum extent practicable in coordination with law enforcement and emergency personnel.

**16.1.1.9 Special Events**

The Concessionaire shall coordinate with HPTE, the local agencies, and the Public Information Officer as specified in Schedule 5 Section 4 to develop a list and schedule of special events. The Concessionaire shall update the list as events are identified/scheduled. The special event calendar shall be a standing agenda item at the MOT Task Force meetings.

The Concessionaire shall identify and implement necessary changes in Work progress to accommodate traffic to and from special events. No lane closures shall be permitted on the day of the event unless Approved by HPTE. Work outside the travel lanes, ramps and shoulders will be permitted during special events.

**16.1.1.10 RTD Transit System**

The Concessionaire shall coordinate with RTD to minimize any impacts to the RTD transit system including bus routes, station access, bus stop locations, and other RTD services.

The Concessionaire shall maintain access to all RTD stations within the Phase 2 Construction Work limits during construction. Any modifications to RTD station access or bus stop locations shall be submitted to HPTE for Approval.

**16.1.1.11 Coordination with Adjacent Projects**

The Concessionaire shall coordinate with HPTE, RTD, local agencies, and their contractors to coordinate construction traffic and detour impacts and minimize simultaneous closures or impacts to adjacent or alternate routes.

**16.2 Design Requirements**

The Concessionaire's professional engineer in responsible charge of the MOT design shall prepare, Review, and Approve: field design changes; Release for Construction documents; and TCP and MHT plans.

**16.2.1 Traffic Control Plans (TCP)**

The Concessionaire shall prepare a TCP to control traffic on the Phase 2 Construction Work. The TCP shall conform to the requirements specified herein and the Standard Specifications. The TCP shall generally describe all lane and shoulder configurations, including widths, traffic control signing, pavement markings, traffic control devices, temporary signalization, construction access, construction parking, emergency access, work areas, and pedestrian/bicycle requirements necessary for each construction phase. Temporary traffic signals shall be installed in conformance with standards set forth in Schedule 5, Section 14, (Signing, Pavement Marking, Signalization and Lighting).

The TCPs shall be submitted to HPTE for Acceptance 14 Days prior to implementation of the particular TCP.

Any major revision to the TCP, as determined by HPTE, shall require submission of a new TCP for Acceptance.

**16.2.2 Method of Handling Traffic (MHT)**

The Concessionaire shall prepare MHT plans in accordance with CDOT standards.

Temporary traffic signals shall be installed in conformance with standards set forth in Schedule 5, Section 14, Signing, Pavement Marking, Signalization and Lighting.

### 16.2.3 Design Vehicle

The design vehicle shall be as described in Schedule 5, Section 13, (Roadways), Exhibit 13-1.

### 16.2.4 Design Speed and Posted Speed

Minimum design and posted speeds for Work zones shall conform to Table 16.2.

<b>Table 16.2 MINIMUM DESIGN AND POSTED SPEEDS FOR WORK ZONES</b>		
<b>Location</b>	<b>Design Speed (mph)</b>	<b>Posted Speed (mph)</b>
US 36 mainline	65	55
Ramps and collector-distributor roads	25	25
Local streets	25*	25*

\* The Concessionaire shall provide existing design and posted speed whenever it can be reasonably maintained on the local system.

### 16.2.5 Minimum Lane Requirements

#### 16.2.5.1 Lane Restrictions

Before any travel lanes or shoulders are closed, the Concessionaire shall submit an appropriate MHT or TCP to HPTE for Acceptance. The MHT/TCP shall be developed in accordance with CDOT Region 1 Lane Closure Strategy and Local Agency guidelines.

Lane restrictions must be submitted to HPTE by the Concessionaire by Thursday 10:30 a.m. of the week in advance of the work (for work Sunday through Saturday), unless required by construction emergencies or other reasonably unforeseen events.

The Concessionaire shall not carry on construction operations on Saturdays, Sundays, or holidays unless previously arranged and approved by HPTE. The Concessionaire shall not perform work on any day of a three or four day holiday weekend when the holiday is New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, or Christmas Day. The Concessionaire shall only make emergency repairs, and provide proper protection of the work and traveling public on these days.

##### 16.2.5.1.1 US 36 Lane Restrictions

Minimum lane widths for travel lanes on US 36 shall be 11 feet. Minimum outside shoulder widths on US 36 shall be 8 feet.

Outside shoulder widths of less than 8 feet may be used, to a minimum shoulder width of 2 feet, provided that emergency pullouts are provided. Inside shoulder widths shall be a minimum of 2 feet. Shoulder widths of less than 2 feet may be submitted to HPTE for approval.

When US 36 mainline laneage is reduced to a single lane in one direction, the Concessionaire shall provide a minimum clear width of 16 feet to accommodate oversized vehicles. HOV and Auxiliary lanes shall be considered General Purpose Lanes, as described in the Region 4 Lane Closure Strategy.

#### **16.2.5.1.2 Ramps and Frontage Roads**

Minimum lane widths for ramps and frontage roads shall be 11 feet. Minimum shoulder width is 2 feet. Lane closures on all ramps and frontage roads shall be consistent with the Region 1 Lane Closure Strategies, including but not limited to detour requirements. Lane closures on all ramps shall also comply with the Region 1 Detour Signing and Public Notification Policy for Exit Ramp Closures.

#### **16.2.5.1.3 Local Roads**

For the purpose of this Section 16, local roads are defined as any portion of roadway excluding US 36, its ramps, or frontage roads.

Minimum lane widths for local roads shall be 11 feet. Minimum shoulder width is 2 feet. Existing through lanes in each direction shall remain open at all times. Lane closures shall be approved in advance by HPTE.

#### **16.2.5.2 Queue Lengths During Construction**

The Concessionaire shall monitor queue lengths on all roads within the Phase 2 Construction Work limits whenever a lane closure is in effect. The Concessionaire shall adjust the traffic control devices, including advance signing, to provide advance warning to motorists, of stopped traffic.

#### **16.2.5.3 Working Time Violations Incidents (WTVI)**

If there is a violation of the working time limitations for traffic control as allowed for in this Section 16, a written notice to stop Work will be imposed on the Concessionaire at the start of the next Working Day. Work shall not resume until the Concessionaire assures HPTE, in writing, that there will not be a reoccurrence of the working time violation.

A WTVI is any violation up to 30 minutes in duration. Each 30 minutes or increment thereof will be considered as a WTVI. A price reduction will be assessed for each successive or cumulative 30-minute period in violation of the working time limitations, as determined by HPTE. A 15-minute grace period will be allowed at the beginning of the second WTVI on the Phase 2 Construction Work before the price reduction is applied. This 15-minute grace period applies only to the second WTVI.

WTVI charges shall be as follows:

1. US 36 - \$4,600 per WTVI
2. Foothills Parkway - \$4,600 per WTVI
3. All local street WTVI charges will be consistent with the Local Agency policy

### 16.2.6 Interchange Closures

Temporary or permanent interchange closures will not be allowed without advance approval by HPTE.

#### 16.2.6.1 Interchanges

1. Construction at all interchanges shall be consistent with the CDOT Region 1 Lane Closure Strategies and the Region 1 Detour Signing and Public Notification Policy for Exit Ramp Closures.
2. The Concessionaire shall coordinate and develop phasing for the construction of the McCaslin Boulevard interchange, which demonstrates the ability to provide:
  - a. Continuous (uninterrupted) signal operations,
  - b. Unrestricted traffic movements to all quadrants of the interchange,
  - c. Two through lanes in each direction along McCaslin Boulevard with approved off-peak lane closures only,
  - d. Safe pedestrian accessibility across US 36, along either side of McCaslin Boulevard,
  - e. Continuous (unrestricted) RTD bus operations, movements and pedestrian accessibility,
  - f. Continuous access to adjacent businesses.

#### 16.2.6.2 Ramp Closures

The CDOT Region 4 Lane Closure Strategy does not provide information for the US 36 at McCaslin Boulevard westbound on/off-ramp and eastbound on/off-ramp. The ramp closure times shall follow the mainline closure times provided in the CDOT Region 4 Lane Closure Strategy.

### 16.2.7 Detour Routes

Unless otherwise approved in advance by the appropriate Local Agency, only State highways shall be used for detour routes. All detour routes shall be the shortest length possible.

### 16.2.8 Trail and Pedestrian Impacts

Existing trail systems, temporary trails, sidewalks, and pedestrian routes must be maintained at all times. The Concessionaire shall meet all requirements of ADA as specified in Schedule 5, Section 13 (Roadways). The following restrictions shall apply to existing trail systems in the vicinity of the Phase 2 Construction Work:

1. No trail closures shall be allowed from 5:00 a.m. to 8:00 p.m. any day of the week.
2. Temporary trail detours will be allowed under the following conditions:

- A. PIP requirements shall be identified and appropriate public notifications provided.
- B. The Concessionaire shall comply with the CDOT *Construction Detour Standards for Multi-Use Trails*.

### 16.2.9 Emergency Pullouts

The Concessionaire shall provide emergency pullouts on US 36 for disabled vehicles, staging of incident management, and law enforcement vehicles when shoulder widths are less than 8 feet. Emergency pullouts shall be provided between each interchange or at .5-mile spacing, whichever is less. Interchange distance shall be measured from ramp gore to ramp gore in the same direction of travel. The minimum pullout length shall be 150 feet, not including transitions. Transitions shall be made at 15:1 or greater. The minimum pullout width shall be 12 feet measured from 2 feet beyond the travel lane. The pullouts shall be signed for emergency parking only, shall have a paved surface, shall include advance signing in compliance with the *Manual on Uniform Traffic Control Devices (MUTCD)*, and shall not be subject to ponding or other weather-related conditions that could render them unsafe or ineffective.

### 16.2.10 Courtesy Patrols

The Concessionaire shall provide courtesy patrols within the Phase 2 Construction Work limits as part of the implementation of the IMP. The Concessionaire shall coordinate with the Phase 1 courtesy patrol operator in providing service for the Phase 2 Construction Work in areas and time periods as defined below. The Concessionaire's courtesy patrol shall comply with all terms of the Mile High Courtesy Patrol Scope included in the Reference Documents, in performing this work.

The following measures shall be required for the courtesy patrol element of the IMP, in addition to the approved ATCs attached as Annex 1 to this Schedule 5:

1. Courtesy patrol coverage shall be on US 36 and its ramps within the Phase 2 Construction Work limits.
2. Service shall include one tow truck and one pick-up. The pick-up shall be equipped with all of the supplies and equipment required in the MHCP that are used for non-towing Activities. The tow truck and the pick-up shall be on-Site and provided for the duration of the project during the following times:
  - A. Monday thru Friday, from 6:30 AM to 9:00 AM and 3:30 PM to 6:30 PM for the limits of the Phase 2 Construction Work.
  - B. When the Concessionaire is actively working in or near lanes of traffic and when the travel lanes and shoulders are reduced in width to a point that disabled vehicles cannot be safely accommodated, in addition to the work hours described in A above, the Concessionaire shall provide courtesy patrol during the following hours for the entire project limits:
    - (1) Monday thru Friday, from 9:00 AM to 3:30 PM
    - (2) Monday thru Friday, from 6:30 PM to 8:00 PM

- (3) Saturdays and Sundays, from 8:00 AM to 6:00 PM
  - (4) During anticipated high volume traffic Special Events as defined in Schedule 5, Section 16.1.1.9, above.
- C. The pickup currently being used within the Phase 1 project limits shall remain in service until the completion of the Phase 2 project.
- 3. The courtesy patrol operator shall be in contact with the CTMC and the Concessionaire via cellular phone during all hours of courtesy patrol operation.
  - 4. The courtesy patrol shall respond immediately upon discovery of a disabled vehicle.
  - 5. The courtesy patrol shall tow, at no cost to the vehicle operator, the disabled vehicle to a location identified in the IMP. Courtesy patrol hours shall be communicated as part of Concessionaire's coping messages as required in Section 4.

## **16.3 Construction Requirements**

### **16.3.1 Temporary Traffic Control Devices**

#### **16.3.1.1 Construction Signing**

Construction signing within the Phase 2 Construction Work limits and all detours shall comply with the Standard Specifications, the MUTCD and all other applicable standards set forth herein.

Wood signposts conforming to the Standard Specifications will be allowed for installation of temporary signs.

#### **16.3.1.2 Temporary Traffic Signals**

Temporary traffic signals shall comply with Schedule 5, Section 14, (Signing, Pavement Marking, Signalization and Lighting). The Concessionaire shall be responsible for maintaining continuous signal operations throughout construction. Upon discovery of a signal malfunction, the Concessionaire shall immediately notify the agency responsible for signal operations.

#### **16.3.1.3 Temporary Marking Paint and Signs**

The Concessionaire shall furnish, apply and remove temporary pavement marking paint in accordance with the Standard Specifications. Temporary paint striping shall meet the conformity of lines (including no overspray), dimensions, patterns, locations and details established in the Concessionaire's TCP and MHT.

- 1. Temporary pavement paint striping shall be re-striped once a month, or as required to maintain safe traffic operations.
- 2. Epoxy-based paint shall not be allowed on concrete pavement surfaces for temporary striping.

3. Hydro blasting, or other methods that do not result in scaring of permanent pavements shall be used for removal of temporary striping.

#### **16.3.1.4 Glare Shields**

The Concessionaire shall evaluate the applicability of glare shields in all crossovers and install where warranted.

#### **16.3.2 Maintenance of Temporary Traffic Control Devices**

The Concessionaire shall be responsible for the maintenance of all temporary traffic control devices within the Phase 2 Construction Work limits, including the local street system.

#### **16.3.3 Detour Pavement**

The Concessionaire shall provide a paved surface for all detours. Detour pavement locations shall be generally described in the Concessionaire's TMP and detailed in the Accepted TCP. The Concessionaire shall determine the type and thickness of pavement that shall be used to accommodate existing traffic loadings.

The Concessionaire shall maintain the detour pavement for the entire period that it is open to the traveling public, including all temporary approaches, accesses, crossings, and intersections with adjacent roads and streets. Detour pavements shall be maintained in good operating condition devoid of potholes, uneven surfaces, and rutting. HPTE may direct the Concessionaire to repair or replace detour pavements if, in HPTE's sole discretion, detour pavements are determined to be in poor condition. Detours that use existing streets pavements shall be subject to pavement repair or replacement where it is determined that the condition of the existing pavement has noticeably deteriorated over the duration of its use as a detour. The Concessionaire shall obtain written approval from the affected Local Agency prior to use of any local streets for detours.

The Concessionaire shall be responsible for the complete removal and disposal of all temporary detour pavement.

#### **16.3.4 Temporary Lighting**

The Concessionaire shall maintain temporary lighting at a level equivalent to existing lighting provided within the Phase 2 Construction Work limits.

The Concessionaire shall evaluate the applicability of temporary lighting at all crossovers and install where warranted.



## 16.4 Deliverables

The Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
List of MOT Task Force members	Acceptance	Prior to NTP1
Traffic Management Plan (TMP)	Acceptance	Prior to NTP1
Requests to HPTE CTMC and Local Agencies for modifications to traffic signals, timing, and VMS messages	Review	14 Days prior to the requested date for modifications
Incident Management Plan (IMP)	Acceptance	Prior to NTP1
TDM Program	Acceptance	Within 30 Days after NTP1
MOT variance request	Approval	14 Days prior to the requested date for the change
Traffic Control Plan (TCP)	Acceptance	At least 14 Days prior to implementation of the TCP
Method of Handling Traffic (MHT)	Acceptance	At least 2 Days prior to implementation of the MHT requiring a lane closure

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management).

## 17.0 LANDSCAPING

### 17.1 Design Requirements

#### 17.1.1 Landscape Plan

The Concessionaire shall prepare a Landscape Plan for all disturbed and reconfigured areas of the Phase 2 Construction Work. The Landscape Plan shall address both temporary and permanent work. The Landscape Plan shall include; the areas to be final seeded; and the locations, mitigations, removals, and replacements of Phase 2 Construction Work-impacted trees, shrubs, landscapes and irrigation.

The Landscape Plan shall be required for any area of the Work where construction disturbance occurs including permanent Right-of-Way, temporary easements, staging, haul road, locations of borrow, or other areas that are disturbed as part of the Phase 2 Construction Work.

The Landscape Plan shall identify the locations of protected areas. The Concessionaire shall save, protect, and maintain all existing vegetation in the Phase 2 Construction Work, except for that vegetation that must be removed to accommodate construction of the Phase 2 Construction Work. All construction operations shall be performed in such a manner that will avoid these Protected Areas.

The Landscape Plan shall be developed in conjunction with erosion control requirements, as defined in Schedule 5, Section 12, (Drainage and Hydrology). The Landscape Plan shall be phased to promote the protection of existing vegetation and working-an-area-to-completion for final stabilization.

The Landscape Plan shall document the vegetation location and identification. This shall include species, location, condition, size, health, and a recommendation for remaining undisturbed, pruning, removal, transplanting, or replacement.

The Landscape Plan shall include photo documentation of the vegetation, including grass coverage for the extent of the Phase 2 Construction Work limits.

The Landscape Plan shall include the proposed locations of replacement or proposed transplanted vegetation within Phase 2 Construction Work boundaries.

The Landscape Plan shall make recommendations for tree species based on the species and conditions as outlined by the State of Colorado portion of *The Roadside Use of Native Plants*, August 2000 USDOT, FHWA publication as edited by Bonnie Harper-Lore and Maggie Wilson.

All non-Colorado Senate Bill 40 (SB 40) trees removed shall be replaced within the Phase 2 Construction Work boundaries on a 1:1 basis. Replacement species shall match existing except for elms or Russian olive species. The Concessionaire shall comply with Local Agency planting requirements for both size and species for trees impacted or planted on Local Agency property.

No plantings shall include any noxious weed species.

Replaced materials shall comply with Section 214 of the Standard Specifications and be equal or better to the existing materials in type and function.

Phase 2 Construction Work-impacted trees/shrubs within a riparian area (i.e., SB 40 trees and shrubs) shall be mitigated in accordance with Section 5.1.6.

The Landscape Plan shall identify the landscapes and irrigation systems impacted by the Phase 2 Construction Work.

The Landscape Plan shall include a schedule of when Work shall take place.

A watering schedule listing the calendar days chosen to complete the required watering shall be included as part of the Landscape Plan to facilitate inspections by HPTE. A field review with HPTE shall be necessary as part of the Acceptance of the Landscape Plan.

The Concessionaire shall prepare and submit drawings and narrative as part of the Landscape Plan.

The Integrated Noxious Weed Management Plan described in Section 17.1.3 below shall be included in the Landscape Plan.

All work shall be completed by a registered landscape architect in the State of Colorado.

The Concessionaire shall develop an independent Landscape and Irrigation Plan for the McCaslin Diverging Diamond Interchange that reflects the general locations and configuration of landscape /streetscape features as defined in the McCaslin Interchange Enhancement Concepts included in the reference documents. Impacts to existing landscaping and irrigation at the RTD park-n-rides west of McCaslin Boulevard shall be replaced in kind and detailed in the Landscape and Irrigation Plan.

Irrigation systems installed or replaced by the Concessionaire shall avoid direct spray onto the bikeway and pedestrian facilities.

### **17.1.2 Seeding**

All disturbed areas within the ROW that are not surfaced shall be revegetated to replicate or enhance native vegetative communities.

Slopes shall be designed to be 3:1 or flatter as typical except where allowed by Schedule 5, Section 13.2.5.3. All areas to be seeded shall be accessible to maintenance activities as Accepted by HPTE.

Native grass seed mix shall contain low-growing or slow-growing, cool and warm season grass seed mix appropriate for the Colorado, Denver metropolitan area. Noxious weeds and revegetation species that attract wildlife to the Phase 2 Construction Work shall not be used. The proposed native seed mix shall be included in the Landscape Plan.

Seed mixes for areas within riparian areas and temporary T&E impact areas shall be suitable for these areas and coordinated with the owners/managers of the adjacent open space areas where applicable. The proposed seed mixes for these areas shall be included in the Landscape Plan.

Slopes in detention facilities shall be planted with a grass mix that has been successfully implemented for similar use on CDOT projects.

### **17.1.3 Integrated Noxious Weed Management**

The Concessionaire shall use industry standard protocol for weed management, including the development of an Integrated Noxious Weed Management Plan (INWMP) to mitigate the potential adverse effects of earth disturbance. Noxious weeds lists from CDOT, the State of Colorado, and the local county and city shall be used.

The INWMP shall include a component to eradicate Tamarisk on the Phase 2 Construction Work. The INWMP shall also incorporate appropriate methods, such as herbicides, mechanical removal, and (potentially) biological controls. Appropriate control methods shall be selected

carefully, especially in sensitive areas, such as wetlands and riparian and habitat corridors. See Schedule 5, Section 5.1.6.1 for additional elements to be included in the INWMP.

## **17.2 Construction Requirements**

### **17.2.1 Landscape Plan**

Once the Landscape Plan is Accepted, the Concessionaire shall clearly tag all existing plant material that will remain undisturbed, pruned, removed or transplanted per the Accepted Landscape Plan prior to the start of all construction activities.

### **17.2.2 Clearing and Work Area Limits Identification and Protection**

The Concessionaire shall delineate in the field the clearing and work limits in areas adjacent to existing wetlands, trees, and significant vegetation for Acceptance by HPTE. Upon Acceptance, the Concessionaire shall install temporary orange fencing in these areas to identify the clearing boundary. The Concessionaire shall flag those trees adjacent to the boundary that are to remain in place. The Concessionaire shall use all appropriate care to avoid damage or removal of the flagged trees. Flagged trees that are damaged shall be replaced in-kind. Trees that are damaged and assessed as salvageable by HPTE shall be promptly repaired, pruned, wrapped, and protected from further damage. All replacement trees and shrubs shall be native species per the State of Colorado portion of FHWA's *The Roadside Use of Native Plants*, August 2000.

The Concessionaire shall repair or replace in-kind all landscape material and vegetation that is disturbed by the Work. Replaced materials shall be equal or better than the existing materials in size, type and, condition. Revegetation plans for these areas shall be coordinated with the maintaining entity.

The Concessionaire shall repair, replace, relocate, or adjust all irrigation system components that are disturbed by the Work. Replaced materials shall be equal or better than the existing materials in type and function. Irrigation system modifications for these areas shall be coordinated with the maintaining entity.

### **17.2.3 Protection Areas**

Upon Acceptance of the Landscape Plan, the Concessionaire shall install temporary fencing for the protection of all existing vegetation that is designated to remain undisturbed. Fencing shall be placed at twice the drip line for trees.

Construction Activities, such as earth disturbance, storage, staging, or parking inside the drip line shall be prohibited. No chemicals shall be applied or used around or near these areas that would be detrimental to vegetation health.

The Concessionaire shall immediately report damage to any tree within the Work area designated to remain undisturbed to HPTE, for assessment of the damage and survivability. Trees that are damaged which, at the sole discretion of HPTE, are determined will not survive, shall be replaced. Trees that are damaged and are assessed as salvageable shall be promptly repaired, pruned, wrapped, and protected from further damage.

Irrigated areas to remain shall be designated in the Landscape Plan and secured to prevent access for parking, staging, or other related Work elements, to ensure there is no damage to the system. Existing irrigated landscapes, not impacted by construction, shall be kept operable during construction. Some retrofitting and stubbing-off of existing systems may be needed. This

work shall be coordinated with the local affected landscape maintenance staff.

#### **17.2.4 Trees and Shrubs**

##### **17.2.4.1 Plant Materials**

The Concessionaire shall provide the following minimum sizes for plantings to be provided and planted as a part of the Phase 2 Construction Work:

1. Deciduous trees: 2-inch caliper
2. Evergreen trees: 8 feet in height
3. Deciduous shrubs: 5 gallon
4. Evergreen shrubs: 5 gallon
5. Ground covers, ornamental grasses: No. 1 container

All trees shall be balled and burlapped in accordance with M-Standard M-214-1 and Section 214 of the Standard Specifications. The Concessionaire shall be responsible for delivery and storage of trees per Section 214 of the Standard Specifications. Trees shall be protected from damage and deterioration during delivery and storage.

Trees will not be Accepted if the ball of earth surrounding the roots is cracked or broken during delivery and planting. Plants that have been cut back from a larger size to meet specifications (not the specified size), were improperly pruned, or have disease or insect infestation, shall not be Accepted.

All replacement tree/shrubs shall receive wood chip mulch per *M-Standard M-214-1* and Section 213 Mulch of the Standard Specifications.

The Concessionaire shall comply with the local jurisdiction's planting requirements for plantings on local jurisdiction's property.

##### **17.2.4.2 Removal of Trees and Shrubs**

Tree stumps within the roadway prism or within 10 feet of the edges of roadway pavements shall be completely removed and disposed off the Phase 2 Construction Work Site. All other tree stumps within the Phase 2 Construction Work shall be ground 3 feet below finished grade.

All trees or shrubs removed from the Phase 2 Construction Work shall become the property of the Concessionaire and shall be completely disposed of off-Site by the Concessionaire.

##### **17.2.4.3 Tree and Shrub Transplanting**

The Concessionaire shall transplant trees and shrubs impacted in existing landscaped areas to adjacent landscaped areas, if requested by HPTE. The Concessionaire shall coordinate with the HPTE and maintainers of existing landscaped areas to determine if transplanting trees or shrubs is desired and to determine acceptable transplanting methods. Transplanted trees and shrubs will not be subject to the warranty applicable to newly planted material. Trees and shrubs not transplanted shall be replaced on a 1:1 basis in adjacent landscape areas.

##### **17.2.3.4 Pruning**

The Concessionaire shall have all root and branch pruning that interfere with the Work completed by a licensed and certified tree surgeon. All Work shall be in accordance with American National Standard Institute – ANSI A300-1995, Section 5.3.3.2.

Root Pruning: Tree roots 2 inches or greater in diameter shall not be removed. The Concessionaire shall not prune roots at a depth greater than the excavation.

Branch Pruning: The Concessionaire may prune branches that will interfere with the Work per the Approved Landscape Plan.

The Concessionaire shall remove weak or dead branches on trees that are to remain within the ROW.

#### **17.2.4 Removal**

All trees and shrubs removed from the Phase 2 Construction Work shall be completely disposed of off Site by the Concessionaire.

Tree stumps within the roadway prism and 10 feet of the edges of roadway pavements shall be completely removed. All other tree stumps within the Phase 2 Construction Work shall be ground to a depth of 3 feet below the finished surface.

#### **17.2.5 Transplanting**

Transplanting shall not take place in those times where it is detrimental to the plants health. Evergreen species shall not be transplanted in the fall. All transplanted plant material shall receive wood chip mulch per *M-Standard* M-214-1 and Section 213 Mulch of the Standard Specifications.

#### **17.2.6 Planting Locations**

The Concessionaire shall place replacement trees and shrubs according to the following:

1. Trees and shrubs impacted at existing formal landscaped areas shall be replaced at the same area or in same general vicinity as Approved by HPTE and owning or maintaining agency.
2. Trees and shrubs impacted at existing riparian areas shall be replaced at the same area or in same general vicinity.
3. Additional trees impacted in other areas of the Phase 2 Construction Work shall be replaced in the areas listed in items 1 and 2 if required by HPTE.
4. Remaining replacement trees shall be placed outside CDOT ROW in public lands within 1 mile of the project corridor in locations designated by adjacent local agencies.

#### **17.2.7 Staking and Watering**

New replacement and transplanted trees shall be guyed in accordance with *M-Standard Plans* M-214-1 and Section 214 of the Standard Specifications. Trees shall be staked for two growing seasons. Guying material shall be removed at completion of warrantee by the Concessionaire. Plants should be fully established at the end of three years.

The Concessionaire shall water new, transplanted, and protected trees on the Phase 2 Construction Work until the Project has completed the warrantee period. The Concessionaire shall water the plant material once a week at the rate of 50 gallons per tree per watering for the months May through October, and shall be watered twice per month at the rate of 70 gallons per tree for the months November through April, or as needed.

### **17.2.8 Topsoil**

All topsoil, either imported or salvaged on Site, shall be treated with an herbicide for noxious weeds prior to final seeding.

### **17.2.9 Seeding**

Placement of soil conditioner, fertilizer, seeding, mulching (weed free), and mulch tackifier shall not be done in a single operation, but shall be completed immediately (but no longer than 48 hours) following each area that is to final grade per Sections 101, 107, 208 of the Standard Specifications.

Fertilizer shall not be used in areas where runoff may enter wetlands and waterways.

Seeding shall be drilled .25-inch to .5-inch into the soil. In areas where machine seeding is impossible, the Concessionaire shall hand seed at double the rate and rake into the soil per Section 212 of the Standard Specifications.

Hydromulching is an acceptable method of stabilization.

All native seeding areas shall be mulched and mechanically crimped with weed free hay per Section 213 of the Standard Specifications.

Soil retention blanket shall be used for slopes steeper than 3:1. Soil retention coverings shall be used on all slopes within permanent stormwater quality facilities and detention ponds. If soil retention coverings are used, mulching (weed free) and mulch tackifier are not required. Turf reinforcement mats shall be used in swales steeper than 2%. Soil retention coverings shall be per Schedule 5, Section 17.3, (Revision of Section 216 – Soil Retention Covering).

The Concessionaire shall apply native seed, mulch (weed free), and mulch tackifier after each construction phase and prior to any winter shutdown Work.

Native seed areas shall contain a minimum of 90 percent grass species and no noxious weeds. Native seed areas shall have 80 percent coverage prior to Phase 2 Work Completion. Any native seed areas having poor germination (less than 80 percent coverage) shall be reseeded until establishment is reached. No bare spots within the area to be vegetated greater than 6 feet by 6 feet shall be accepted.

### **17.2.10 Integrated Noxious Weed Management Plan (INWMP)**

Noxious weeds shall be spot sprayed. In locations where spot application is not practicable, a wildlife biologist will inspect the area prior to spraying to ensure crucial habitat will not be impacted.

### **17.2.11 Landscaping Inspection, Establishment, Acceptance, and Warranty Period**

#### **17.2.11.1 Interim Landscape Inspections**

The following inspection points shall be completed and the Work shall meet the requirements of the Contract Documents prior to proceeding:

1. Completion of the sub-grade preparation
2. Completion of finished grade preparation

3. Layout of planting beds
4. Layout of all plant materials
5. Completion of planting operations

Nonconforming Work shall be replaced or repaired promptly by the Concessionaire. When damage endangers public safety, or traffic, remedial action shall be taken immediately to ensure safety and prevent further disruption of traffic.

#### **17.2.11.2 Substantial Landscape Completion**

Substantial Landscape Completion is defined as when all plant materials have been planted and all irrigation items are completed in compliance with the requirements of the Contract Documents. Plants shall be healthy and in flourishing condition and be free of dying branches and branch tips, and shall bear foliage of normal density, size, and color. All mulch beds shall be completely mulched.

Prior to Substantial Landscape Completion, a landscape inspection shall be held with HPTE to determine Acceptance of plant material, seeding areas, and irrigation systems. Upon Acceptance HPTE will issue a "Notice of Substantial Landscape Completion."

#### **17.2.11.3 Landscape Establishment**

The Landscape Establishment Period will commence at Phase 2 Work Completion which will be contingent upon receipt of a written "Notice of Substantial Landscape Completion" from CDOT in accordance with the requirements of Section 214 of the Standard Specifications and herein. The Landscape Establishment Period will last for 12 months, and will begin the following spring if Notice of Phase 2 Work Completion is issued in the fall.

All landscape installations shall be completely maintained by the Concessionaire during the Landscape Establishment Period. The Concessionaire shall submit a detailed Landscape Maintenance Plan in accordance with the requirements of Section 214 of the Standard Specifications prior to submitting an Affidavit of Phase 2 Work Completion. HPTE will audit the landscape installations on at least a monthly basis to determine the acceptability of the maintenance Work. Nonconforming maintenance will be brought up to acceptable levels within 5 Days after receipt of notice of maintenance deficiencies.

#### **17.2.11.4 Landscape Acceptance**

Upon completion of the Landscape Establishment Period, at the Concessionaire's request, HPTE will inspect the landscaping to determine compliance to the requirements of the Contract Documents. All landscape installations shall be fully established, weed-free, clean, smooth, properly graded, and without plant mortality to be Accepted. The Landscape Establishment Period and Concessionaire maintenance will terminate after Landscape Acceptance is reached. Should HPTE identify any areas of Nonconforming Work, the Concessionaire shall correct the deficiencies and extend the Landscape Establishment Period for a minimum of one additional growing season at no additional cost to the Phase 2 Construction Work. If Landscape Acceptance occurs in the fall, the Concessionaire shall continue to maintain the landscaped area (including irrigation system) until the following spring. Any dead plant material or any damaged irrigation components shall be replaced or repaired at no additional cost to the Phase 2 Construction Work. The Concessionaire shall perform a spring startup on the irrigation system, at no additional cost to the Phase 2 Construction Work, ensuring all irrigation components are in working order.



### 17.2.11.5 Landscape Warranty Period

All trees, shrubs, and ground covers shall be completely warranted by the Concessionaire for one calendar year from the date of Landscape Acceptance. Any plant material deemed deficient following this one-year warranty period shall be replaced in-kind by the Concessionaire at no additional cost to the Phase 2 Construction Work, and shall be warranted for one additional year by the Concessionaire. Any additional one-year warranty period beyond the initial one-year warranty period will be considered an extended warranty period. Another inspection will be conducted at the request of the Concessionaire at the end of the extended warranty period to determine Acceptance or rejection.

If access to a completed landscaped area is required by the Concessionaire after Landscape Acceptance, landscape materials will be considered existing and shall be protected in accordance with the requirements of the Contract Documents.

Trees or shrubs transplanted at HPTE's direction are not required to be warranted.

### 17.3 Project Special Provisions

The following specifications modify and take precedence over the Standard Specifications.

#### REVISION OF SECTION 107

#### PROTECTION OF EXISTING VEGETATION

Section 107 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 107.12 shall include the following:

The Concessionaire shall save all existing vegetation (including trees, shrubs, ground covers, grasses, wetlands & riparian) in this area, except for that vegetation, which must be removed to accommodate construction of the project, per the plans. Specific areas of vegetation to be protected shall be as directed by the Engineer and shall be protected by using orange construction fencing, wire fencing with metal posts or silt fence. Fencing for trees shall be installed at the drip line of the tree or as approved by the Engineer. Equipment shall not be installed or stockpile material within 15 feet of existing trees to remain.

The Concessionaire shall perform all the work in such a manner that the least environmental damage will result. All questionable areas or items shall be brought to the attention of the Engineer for approval prior to removal or any damaging activity.

The Concessionaire shall promptly report any vegetation damaged or scarred during construction to the Engineer for assessment of damages. Damaged or destroyed fenced vegetation, shall be replaced at the expense of the Concessionaire. Vegetation of replaceable size shall be replaced at the Concessionaire's expense. When trees, shrubs beyond replaceable size or wetlands have been damaged or destroyed, the Concessionaire shall be liable for the appraised value based upon the official current publications. For trees and shrubs use the International Society of Arboriculture, Guide for Plant Appraisals. The Concessionaire shall pay any fines or jail time should a wetland be damaged, at no cost to the project. The value of disturbed vegetation shall be calculated according to the following formula:

(Vegetation size) x (Species) x (Location) x (Condition) x (arborist or Wetland Specialist)  
= Vegetation value

A consulting arborist retained by the Department will determine the value of the trees and shrubs. A consulting Wetland Specialist shall determine the value of the wetland or wetland species. This value will be deducted from any money due to the Concessionaire.

The determination as to whether a plant is of replacement size or beyond will be made by the Department's Landscape Architect or Wetland Specialist.

If the fence is knocked down or destroyed by the Concessionaire, the Engineer will suspend the work, wholly or in part, until the fence is repaired to the Engineer's satisfaction at the Concessionaire's expense. Time lost due to such suspension will not be considered a basis for adjustment of time charges, but will be charged as contract time.

### **REVISION OF SECTION 202 REMOVAL AND TRIMMING OF TREES**

Section 202 of the Standard Specifications is hereby revised for this Project as follows:

Subsection 202.02 shall include the following:

This work includes the removal and the trimming of trees as directed by the Engineer. This work includes the preservation from injury or defacement of all vegetation and objects designated to remain.

The Engineer will establish environmental limits. All trees, shrubs, plants, grasses, and other vegetative materials shall remain, except as designated by the Engineer.

Prior to beginning any bridge construction, removal, trimming, and pruning of encroaching vegetation (as determined by the Engineer) shall be completed.

Once all directed clearing, trimming, and pruning is completed and Accepted, no additional clearing, trimming, cutting, or pruning will be allowed unless approved, in writing, by the Engineer.

This work shall be done by a Concessionaire or sub-Contractor who is a qualified tree surgeon and a member of the National arborist Association. The firm's or individual's name and qualifications shall be submitted at the preconstruction conference for the Engineer's approval. A list of references and other clients shall be included with the qualifications statement. A written description of work methods and time schedules shall be submitted and approved in writing by the Engineer prior to work commencing.

Access for the removal or pruning of trees will be extremely limited. Trees shall be felled at the risk of the Concessionaire. Strict limits of disturbance will be defined and shall be adhered to.

Branches on trees or shrubs shall be removed as directed by the Engineer. All trimming shall be done by skilled workmen. All work shall be done according to the following requirements:

1. Pruning shall be done with proper, sharp, clean tools in such a manner as to preserve the natural character of the tree.

All final cuts shall leave no projections on or off the branch and shall not be cut so close as to eliminate the branch collar.

To avoid bark stripping, all branches 50 mm (2 inches) in diameter and larger shall be cut using the 3-cut method. These branches shall be lowered to the ground by proper ropes.

Tools used on trees known or found to be diseased, shall be disinfected with alcohol before they are used on other trees.

Structural weaknesses, decayed trunk or branches, or split crotches shall be reported to the Engineer.

When cutting back or topping trees, the Concessionaire shall use the drop-crotch method and avoid cutting back to small suckers. Smaller limbs and twigs shall be removed in such a manner so as to leave the foliage pattern evenly distributed.

2. When reducing size (cut back or topping) not more than one-third of the total area shall be reduced at a single operation.

Climbing spikes shall not be used on trees not scheduled for removal.

All brush, branches, limbs, and foliage smaller than 75 mm (3 inches) in diameter shall be chipped into mulch and stockpiled at a designated site. The trunks and limbs 75 mm (3 inches) and larger shall be cut into less than 2 m (6 foot) lengths and hauled to a designated site. Stumps shall be left no higher than 0.5 m (2 feet) above the ground surface and shall not be removed when within the areas to be excavated. When trees being cut off are outside the excavation limits, the stumps shall be cut so that no more than 75 mm (3 inches) remains above the ground surface. Stump grinding is not required in any circumstances.

Subsection 202.12 shall include the following:

Chipping, stockpiling mulch, and hauling and stockpiling trunks and limbs will not be paid for separately but shall be included in the work. Removal of trees less than 75 mm (3 inches) in diameter will not be paid for separately but shall be included in the work.

All clearing and grubbing directed by the Engineer will be paid for as lump sum under the clearing and grubbing item.

### **REVISION OF SECTIONS 207 AND 212 TOPSOIL**

Sections 207 and 212 of the Standard Specifications are hereby revised for this Project as follows:

Subsection 207.01 shall include the following:

This Work includes importing or salvaging on site topsoil that is to be placed on disturbed areas within the Project.

Subsection 207.02 shall include the following:

The source of topsoil for this Project is undesignated. This imported topsoil is subject to Acceptance by HPTE before use. The Concessionaire shall submit a 1 pound sample of the product four (4) weeks before its use on the Project Site for the Acceptance. The

Concessionaire may salvage existing on site topsoil and/or import topsoil and/or prepare soil using soil preparation. If imported topsoil is used the Concessionaire shall submit a written notice to HPTE at least 30 days before hauling soil to the site. The Concessionaire shall supply a sample of the topsoil to Colorado State University Testing Laboratory for analysis. A Certificate of Compliance shall be submitted to the Engineer and to HPTE to verify the organic matter content, pH, sodium absorption ratio, electrical conductivity, and nutrient requirements.

Concessionaire supplied topsoil shall meet the following criteria:

Property	Minimum Value	Maximum Value
pH	6.5	7.8
Sodium Absorption Ratio	-	10.0
Salts (electrical conductivity)	-	4.0 mmhos/cm
Organic matter	3.0%	10%

The area where imported topsoil is excavated and/or stored shall be free of noxious weeds.

Topsoil shall contain the following minimum ammonium DPTA (chelate) extractable nutrients (the extracting solution used by CSU Soil Testing Laboratory).

Nitrogen	5 ppm air dried basis
Phosphorus	5 ppm
Potassium	30 ppm
Iron (Fe)	5 ppm

Topsoil shall not include any minerals or elements detrimental to plant growth. All rocks and debris larger than 4 inches in diameter, that are visible after topsoil is spread, shall be removed and disposed of in an appropriate manner on the Project site.

At the Concessionaire's option soil preparation as described below may be used instead of topsoil.

**REVISION OF SECTION 212  
ORGANIC AMMENDMENT**

Subsection 212.01 shall include the following:

The Work shall consist of incorporation of an organic amendment into the top 6 inches of the soil to be seeded. Work shall also consist of fertilizer consisting of 90% fungal biomass

(mycelium) and 10% potassium-magnesia with a grade of 6-1-3 or approved equal and humate, which shall be hydraulically applied.

Subsection 212.02 shall include the following:

1. Sixty Five cubic yards of organic amendment per acre.
2. 600 pounds of fertilizer consisting of 90% fungal biomass (mycelium) and 10% potassium-magnesia with a grade of 6-1-3 or approved equal per acre.
3. 200 pounds of humate per acre in accordance with Section 212.

The organic amendment shall include the following:

An organic product containing a mixture of composed cow or sheep manure and wood residue that has been aerobically and naturally processed in such a manner as to maintain a consistent temperature of 140 degrees Fahrenheit or greater for a period of time that is long enough to accomplish the following specifications:

1. The windrows of composted organic amendment (cow or sheep manure) have to be composed for 70 to 90 days. Certification shall be submitted to HPTE to verify that the product has gone through this process.
2. Eradicate harmful pathogens, including coliform bacteria.
3. Create a carbon to nitrogen ratio of 15/1 to 25/1.
4. Contain no solid particle greater than 1/2 inch in diameter.
5. Have a non-offensive smell similar to fresh turned soil.
6. Contain no significant level of dirt or soil and contain a maximum of 30% composted wood residue (pine or aspen wood).
7. The pH after composting shall be between 5.0 and 7.5 with an organic matter content of not less than 30%.
8. Soluble salts (electrical conductivity) shall not be greater than 2.3 mmhos/cm.

The Concessionaire shall submit to HPTE for Approval a 2-pound sample of the product four weeks before its use on the Project site. A Certificate of Compliance shall be submitted to HPTE to verify the organic matter content, pH, and carbon matter to nitrogen ratio.

Subsection 212.03 shall include the following:

All seeded areas shall be amended with composted organic amendment as shown on the plans, which shall be tilled or ripped, to a depth of 6 inches into the soil. After ripping, remove all debris such as concrete, rocks (greater than 3 inches in diameter), and other deleterious or undesirable material from the area.

All soil to be seeded shall be amended with the humate and fertilizer product. The method of incorporation of amendments shall result in a uniform application of material as approved. Humate shall be applied at a rate of 200 lb per acre. The fertilizer product shall be applied at a rate of 600 lb per acre.

## 17.4 Deliverables

The Concessionaire shall submit the following to the HPTE for review, Approval, and/or Acceptance:

<b>Deliverable</b>	<b>Review, Acceptance, or Approval</b>	<b>Schedule</b>
Landscape Plan	Acceptance	At least 30 Days prior to disturbance of existing vegetation
Integrated Noxious Weed Management Plan	Acceptance	Prior to NTP1
Notification of use of imported topsoil	(none)	At least 30 Days prior to hauling topsoil to the Site
Landscape Maintenance Plan	(none)	Prior to Notice of Substantial Landscape Completion
Certificate of Compliance for Imported Topsoil	Acceptance	Prior to hauling topsoil to the Site

## **18.0 MAINTENANCE DURING CONSTRUCTION**

### **18.1 Maintenance Administration**

#### **18.1.1 Responsibilities for Maintenance**

The responsibility for performing maintenance of the highway during the Phase 2 Construction Work will be shared by HPTE and the Concessionaire. The requirements herein define those maintenance Work responsibilities that shall be performed by the Concessionaire and those that will remain the responsibility of HPTE. All Work shall conform to the CDOT *Highway Maintenance Level of Service Manual* in Schedule 5A.

##### **18.1.1.1 Initiation of Concessionaire Work-related maintenance responsibilities**

HPTE will be responsible for the highway maintenance until the issuance of NTP1. Once this occurs, the Concessionaire shall assume the Work-related maintenance responsibilities required herein.

##### **18.1.1.2 Termination of Concessionaire Work-related maintenance responsibilities**

All responsibilities assigned to the Concessionaire shall remain as defined until Phase 2 Work Completion.

#### **18.1.2 Maintenance Level of Service Plan**

The Concessionaire shall develop and submit to HPTE a Maintenance Level of Service Plan. The plan shall define the Concessionaire's complete strategy for the implementation, coordination, scheduling, and monitoring of maintenance Activities during the Phase 2 Construction Work. The Maintenance Level of Service Plan shall conform to the CDOT *Highway Maintenance Level of Service Manual* and be updated every six months to reflect changes in the Concessionaire's construction Activities. The Maintenance Level of Service Plan shall also address the following components:

1. Maintenance Condition Survey

Every six months, the Concessionaire shall perform a detailed survey of maintenance conditions for the Highway and any Road provided for construction phasing until all of the Concessionaire's Work-related maintenance responsibilities are complete (Phase 2 Work Completion). The results of the survey shall be documented by the Concessionaire and submitted to HPTE for Acceptance.

2. Monthly Maintenance Progress Report

Monthly Maintenance Progress Reports shall be required for the full term of the Concessionaire's Work-related maintenance responsibilities. These reports shall detail all maintenance Activities performed, monitored maintenance condition of existing facilities, identification of any deficiencies from minimum standards, and an action plan for correcting the deficiencies. Monthly Maintenance Progress Reports shall be submitted to HPTE each month with the Monthly Progress Report as required in Schedule 5, Section 2, (Project Management).

The Maintenance Level of Service Plan shall be submitted to HPTE for Approval prior to NTP1.

### **18.1.3 Work-related maintenance responsibilities of the Concessionaire**

Except as specifically assigned to HPTE in Section 18.1.4 below, the Concessionaire shall perform all required maintenance Activities, including, but not limited to:

1. Patching and repair of existing pavements
2. Patching and repair of all existing structures included as a part of the Phase 2 Construction Work
3. Repair of shoulder drop-offs
4. Replacement and repair of existing HBP shoulders
5. Snow and ice removal for lanes closed to traffic and behind all temporary barrier
6. Maintenance of delineators, signing and pavement markings
7. Drainage maintenance
8. HBP overlays of existing pavements and structures utilized as detours or as a part of the concessionaire's Maintenance of Traffic (MOT) plans
9. Replacement of damaged guardrail, bridge rail, barriers, and glare screens
10. Repair of impact attenuators
11. Pest control for buildings acquired within the CDOT Right-of-Way
12. Vegetation control in conformance with local agency ordinances
13. Litter control
14. Graffiti removal (graffiti shall be removed within 24 hours of notification and surface shall be the same color as the original)
15. Activities described in Appendix A, Maintenance Performance Specifications (During Construction).
16. Debris removal responsive to providing the minimum lane requirements in Schedule 5, Section 16, (Maintenance of Traffic).

Snow removed from the facility shall not be placed on lanes open to traffic. Snow must be removed far enough from the edge of travel lane that runoff from melting snow will not enter into the travel lanes.

Any items (debris) of value discovered by the Concessionaire in the highway shall be held by the Concessionaire no longer than 30 Days in consideration of claim by the original owner. This includes temporary advertisement signs. If the original owner does not claim these items within



30 Days, the Concessionaire shall then relinquish the items (debris) of value to CDOT's Maintenance Staff for storage and the Concessionaire may dispose of all advertising material at its discretion.

If repair or removal of items illegally dumped on any ROW or easement is required, the Concessionaire shall perform such services within 3 Working Days from the date discovered or reported.

#### **18.1.4 Work-related maintenance responsibilities of HPTE**

HPTE will perform the following maintenance Activities:

1. Inspection of structures
2. Patching and repair of all existing structures excluded from the Phase 2 Construction Work
3. Snow and ice control for all lanes open to traffic, prior to and during a snow event.

#### **18.1.5 Limits of Work-related maintenance responsibilities**

1. The longitudinal limits of the Concessionaire's Work-related maintenance responsibilities on the Phase 2 Construction Work shall conform to the limits of the Phase 2 Construction Work, including all portions of the Work.
2. The lateral limits shall be the ROW limits along mainline, cross roads, and ramps within the Phase 2 Construction Work Site. Any other areas disturbed by Concessionaire Activities, outside of these limits, shall be the sole maintenance responsibility of the Concessionaire.
3. At the completion and final acceptance of the Phase 1 Managed Lanes, the Concessionaire shall assume the maintenance responsibilities for all portions of work and limits described in the O&M Agreement included in Schedule 6. The Concessionaire shall be responsible for coordinating with the contractor responsible for the Phase 1 work and HPTE/CDOT to ensure that the Maintenance Level of Service specified in the O&M Agreement are fulfilled.

#### **18.1.6 Excluded Areas**

There are no exclusions within the Phase 2 Construction Work limits.

### **18.2 Performance Specifications**

In performance of maintenance on the Phase 2 Construction Work, the Concessionaire shall comply with the CDOT *Highway Maintenance Level of Service Manual*. Specifically, the Concessionaire shall adhere to the requirements for data collection and measurement for equating level of service (LOS) on the Highway and incorporate these requirements into its performance of all maintenance Work according to the maintenance of LOS plan.

## 18.3 Right-of-Way Construction Requirements

### 18.3.1 Risk of Loss, Obligation to Maintain and Repair

The Concessionaire shall maintain improvements and provide reasonable safety and security measures to preserve any acquired ROW or easements (temporary or permanent). The Concessionaire shall prevent, minimize, or correct problems such as vandalism, trespassing, rodent infestation, weed control (in accordance with any local agency ordinances), illegal dumping or disposal of rubble, and other debris on all areas of the Phase 2 Construction Work that are under the Concessionaire's maintenance responsibility.

#### 18.3.1.1 Loss Prevention Methods

Once the Concessionaire permission to enter has been acquired, in accordance with Schedule 5, Section 8, (Right of Way), the Concessionaire shall manage and minimize losses to the property by utilizing some or all of the following loss prevention methods:

1. Daily site inspections
2. Installation of chain link security fencing along property boundaries
3. Installation of locking devices, accessible by Phase 2 Construction Work personnel only on buildings, structures, and other improvements located on a parcel
4. Monthly inspection and application of pest/rodent control measures on each parcel
5. Coordination with local law enforcement agencies and neighborhood watch groups to increase awareness about vandalism, illegal dumping, or indication of trespass or other illegal Activity on any parcel
6. Any other means and method determined necessary by HPTE or the Concessionaire to manage and minimize loss to the property or improvement

## 18.4 Deliverables

The Concessionaire shall submit the following to HPTE for review, Approval, and/or Acceptance:

Deliverable	Review, Acceptance or Approval	Schedule
Maintenance Level of Service Plan	Approval	Prior to NTP1, then update every 6 months
Maintenance condition surveys	Acceptance	Concurrent with the Maintenance Level of Service Plan update
Monthly Maintenance Progress Reports	Review	Concurrent with each Monthly Progress Report submittal

All deliverables shall also conform to the requirements of Schedule 5, Section 3, (Quality Management).

## **18.5 Appendices**

Appendix A Maintenance Performance Specifications (During Construction)

## APPENDIX A

### MAINTENANCE PERFORMANCE SPECIFICATIONS (DURING CONSTRUCTION)

The following is an item Activities listing from CDOT's *Highway Levels of Service Manual*, for which the Concessionaire shall be responsible during construction.

#### Maintenance Program Area: Roadway Surface (150)

Survey Item	CDOT Activities Number
Patching/Minor Surface Repair	152
Patching-Machine, Overlay and Leveling	154
Blading – Existing Unpaved Surface/Shoulder	162
Building / Restoring Unpaved Surface/Shoulder	163
Base Stabilization and Repair	164

#### Maintenance Program Area: Roadside Facilities (200)

Survey Item	CDOT Activities Number
Drainage Structures Clean, Repair or Replace	202
Maintenance of Ditches and Streambeds	206
Slope Repair	210
Fence, Gate Cleaning & Maintenance	216
Litter Barrel and Trash Cleanup	218
Sweeping – Machine	220
Sweeping – Hand	222

#### Maintenance Program Area: Roadside Appearance (250)

Survey Item	CDOT Activities Number
Vegetation Control – Dry Land	252
Vegetation Control – Bluegrass	253
Vegetation Control – Hand Mowing, Weeding	254
Vegetation Control – Herbicide & Pesticide App	256
Vegetation Control – Irrigation	258
Tree Planting, Removal, Trimming	260

**Maintenance Program Area: Traffic Services (300)**

<b>Survey Item</b>	<b>CDOT Activities Number</b>
Traffic Signs	302, 303
Delineators, Mile Markers	304
Metal Guardrail	306
Concrete Guardrail	307
Pavement Striping, Pavement Markings	308, 310
Roadway, Sign Lighting	312
Traffic Signals	314
Energy Attenuators	316
Electrical Wiring	320
Interconnect Systems	326

**Maintenance Program Area: Structure Maintenance (350)**

<b>Survey Item</b>	<b>CDOT Activities Number</b>
Bridge Decks	353
Bridge Superstructure	354
Bridge / Structure Painting	355
Bridge Curbs, Railings	356
Bridge Structure Bearings	357
Bridge Substructure	358
Bridge Approaches, Slopes	360
Bridge Deck Expansion Devices	364

**Maintenance Program Area: Snow and Ice Control (400)**

<b>Survey Item</b>	<b>CDOT Activities Number</b>
Snow Removal (Lanes Closed to Traffic)	402
Ice Control – Drainage Related	403

## 19.0 ITS & TOLLING EQUIPMENT

The Concessionaire shall provide the Intelligent Transportation System (ITS) and Electronic Toll Collection (ETC) infrastructure elements for the Project. The purpose of these elements is to inform the roadway users, collect various data to assist agencies in the maintenance and operation of the facility, and collect the tolls.

The ITS system includes various devices, such as Variable Message Signs (VMS), Side Mounted variable Message Signs (SMVMS) Closed Circuit Television (CCTV), Ramp Meter Stations (RMS), Microwave Vehicle Radar Detection (MVRD), Travel Time Indicators (TTI), Road Weather Information Systems (RWIS), Lane-Use Signals (LUS), Automatic Traffic Recorders (ATR), Doppler Radar, Bus on Shoulders (BOS), and Active Traffic Management (ATM). In addition, the ITS system includes the various components that make up the communication system, such as conduit, fiber optic cable, and Ethernet switches.

The ETC system includes additional items such as Variable Toll Message Signs (VTMS), Transponders, Automatic Vehicle Identification (AVI) Readers, Automatic License Plate Recognition (ALPR) Cameras, Loop Detectors, Lane Controller Cabinets, and Transaction Status Indicator Beacons. The ETC system will rely on the communications network to link the ETC field devices to the ETC back-office.

The Concessionaire shall be responsible for designing, furnishing, and installing all ITS devices, the communications network from the existing backbone to the field equipment, and the supporting infrastructure that is necessary to install and operate the ETC system components. The actual ETC system components shall be designed and installed by the ETC System Integrator. All elements of the Project, both ITS and ETC, shall comply with the requirements of this [Section 19](#).

All design and construction shall comply with the relevant requirements and standards listed in [Schedule 5A](#). Use the most current version of each listed standard as of the final issue date of this RFP, unless modified by Addendum or Change Order. In addition, use the references listed in the Reference Documents as supplementary information.

The ITS and ETC elements shall have the flexibility to accommodate Project changes that produce benefits or savings to HPTE or the Concessionaire without impairing the essential functions and characteristics of the Project, such as safety, traffic operations, toll collection, enforcement, durability, desired appearance, maintainability, environmental protection, functionality, drainage, and other permitted constraints.

### 19.0.1 List of Abbreviations

AC	Alternating Current
ALPR	Automatic License Plate Recognition
ARE	Additional Requested Element
ATR	Automatic Traffic Recorder
ATM	Active Traffic Management
AVI	Automatic Vehicle Identification
CDOT	Colorado Department of Transportation
CCTV	Closed Circuit Television
CTMC	Colorado Transportation Management Center
CWDM	Coarse Wavelength Division Multiplexing
CTMS	Colorado Transportation Management Software
DTD	Division of Transportation Development
ETC	Electronic Toll Collection

IP	Internet Protocol
ITS	Intelligent Transportation System
LED	Light Emitting Diode
LUS	Lane Use Signal
<b>MMFO</b>	<b>Multi-Mode Fiber Optic</b>
MVRD	Microwave Vehicle Radar Detection
NEC	National Electric Code
NTCIP	National Transportation Communications for ITS Protocol
OCR	Optical Character Recognition
OSHA	Occupational Safety and Health Administration
PIDS	Programmable Information Display System
PoE	Power over Ethernet
RMS	Ramp Meter Station
ROW	Right-of-Way
RTD	Regional Transportation District
RWIS	Road Weather Information System
SMFO	Single-Mode Fiber Optic
<b>SMVMS</b>	<b>Side Mounted Variable Message Signs</b>
TTI	Travel Time Indicator
UPS	Uninterrupted Power Supply
VMS	Variable Message Sign
VTMS	Variable Toll Message Sign

## 19.0.2 List of References

Author	Title
CDOT	2011 <i>Standard Specifications for Road and Bridge Construction</i>
CDOT	<i>M &amp; S Standards</i> – June 27, 2011
CDOT	<i>CDOT Sign Design Manual</i> – May 21, 2010
RTD	Design Guidelines and Criteria
AASHTO	<i>A Policy on Geometric Design of Highways and Streets</i>
AASHTO	<i>Roadside Design Guide</i>
ASTM	American Society for Testing and Materials
EIA	Electronic Industries Alliance
FHWA	<i>Manual on Uniform Traffic Control Devices</i> (Current Edition)
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
ITU	International Telecommunications Union
NFPA	<i>National Electric Code</i> (Current Edition)
RUS	Rural Utilities Service
Telcordia	Telcordia Technologies
TIA	Telecommunications Industry Association

## 19.1 Design Requirements

The Concessionaire shall design the ITS and ETC infrastructure components in accordance with the requirements in the following Sections. No part or attachment of any equipment shall be

substituted or applied contrary to the manufacturer's recommendations and standard practices. The Concessionaire shall submit ITS device and material project sheets for Approval to HPTE prior to installation. Infrastructure locations need to meet the requirements of HPTE and the ETC System Integrator.

### **19.1.1 Electrical Power**

The Concessionaire shall provide alternating current (AC) power service to every ITS and ETC device and cabinet within the project limits that does not have existing metered service. This includes all existing devices or cabinets that are relocated by the Concessionaire. The Concessionaire shall obtain (from the power service provider[s]) approval of the power service design and coordinate and meet all requirements as specified by the power service provider for the complete and operational power service to all required locations. All power connections to devices shall include a quick-disconnect.

The Concessionaire shall be responsible for the coordination of power source work to be performed by Xcel Energy. The Concessionaire shall contact the Xcel Energy Builder's Call Line to request, and process to completion, the required coordination to establish the metered power sources for ITS and ETC devices. The Concessionaire shall perform all work necessary to maintain existing or establish new metered power sources for ITS and ETC devices. All cost charges from the power service provider, and all necessary materials, including meter, labor, and coordination required to maintain existing or establish new metered power sources shall be included in the Work.

### **19.1.2 Location and Protection of ITS and ETC Elements**

The Concessionaire shall locate all ITS and ETC infrastructure elements within the public Right-of-Way (ROW) such that routine maintenance will not require a lane closure, affect traffic operations, or require complex traffic control. Whenever possible, ITS and ETC elements shall not be located in the highway median, except the center support of freeway VMS, VTMS, TTI related to the Managed Lane; and AVI, ALPR, and transaction status indicator beacon support structures.

All existing underground utilities shall be identified, and all ITS and ETC infrastructure elements shall be designed to avoid or minimize conflicts with these facilities. The Concessionaire shall be responsible for all repairs to facilities damaged during construction. The Concessionaire shall be responsible for maintaining and keeping operational all existing ITS devices during construction.

The Concessionaire shall ensure that all equipment, devices, interconnect wiring, communications devices, communications lines, power supplies, antennas, operator controls, and power service are protected to eliminate damage by external and internal sources (including power surges), lightning, induced voltages, and static discharge. A grounding system and protection devices that are suitable for the specific installation and equipment shall be designed.

### **19.1.3 Communications System**

The communications system is used to transmit data to and from all existing and proposed ITS devices. In addition, the system is responsible for transmitting all ETC tolling data to and from the back-office for processing, issuing of tolls, and updating of information in the lanes.

#### **19.1.3.1 Design Requirements**

The US 36 Phase 1 project is installing the communications backbone within the limits of the Phase 2 Construction Work. The Concessionaire shall design the fiber optic communication



system lateral connections from the communications backbone to the field devices and end equipment. The system shall be capable of transporting data and video signals between field devices and support the following functional requirements, at a minimum:

- Provide CDOT fiber optic communications connectivity between the field devices, end equipment, and Node 2 and the Table Mesa regeneration buildings. The Node 2 regeneration building is located in the northeast corner of I-25 and 70<sup>th</sup> Avenue while the Table Mesa regeneration building is located in the basement of the Foothills Parkway/Table Mesa RTD park-n-Ride.
- Provide Internet Protocol (IP) Ethernet communication to all devices. CDOT ITS will provide IP addressing.
- Support full-color, real-time video images at a data rate of 4 MB/s from all CCTV cameras to a communications hub.
- All fiber allocations, splicing diagrams, and network drawings shall be prepared by the Concessionaire and submitted to CDOT for Acceptance.
- Splicing of fiber optic cable shall be performed in cable vaults only, except at specific pull box locations approved by HPTE.

#### 19.1.3.2 Material Requirements

The Concessionaire shall furnish all components required to achieve a fully-functioning communications system. The communications system shall be designed based on the following material requirements, at a minimum:

- The communications backbone being installed on the US 36 Phase 1 project will consist of a 288-strand SMFO backbone cable for the CDOT network and a separate 144-strand micro-duct fiber optic cable for the RTD network.
- The RTD and CDOT fiber optic backbones being installed as part of the US 36 Phase 1 project will be housed in separate conduits, pull boxes or manholes, and splice closures.
- Provide 12-strand SMFO cable laterals from the CDOT backbone to all ITS and ETC field devices, except Doppler Radar units.
- Provide fiber quick disconnects at all unprotected ITS devices and equipment locations where new fiber optic lateral cables are installed and spliced to the main backbone cable. The fiber quick disconnects shall allow the fiber laterals to be disconnected to prevent damage to the fiber backbone in case any of the devices or equipment along the corridor are damaged. The fiber quick disconnect shall be installed in areas where they will not be submerged in water and per the manufacturer's recommendations. Bend insensitive (ITU-T G.657 A) tactical fiber optic cable with a polyurethane jacket shall be used for all patch cables and shall be fully compatible with all fiber optic laterals.
- Provide hardened, Extended Temperature roadside Carrier Grade field Ethernet switches with 8 10/100 Ethernet ports in addition to two Small Form-Factor Pluggable (SFP) based 1 Gigabit Ethernet ports. Each switch shall provide ITU-T G.8032 Ethernet Ring Protection Switching, S-VLAN Priority based on C-VLAN ID, Internet Group Management Protocol v2 (IGMP) snooping/filtering, and

security access control lists (ACLs) and SNMPv1, SNMPv2, and SNMPv3 management protocols. The switches shall also include sufficiently sized optics for transmitting and receiving data from the node building aggregation Ethernet switches. Per the Project Special Provision in Section 19.5, all switches shall meet 100M/1 GIG, SM SFP OPTIC, LC CONNECTOR, 80 KM EXT. TEMP and 100M/1GIG, SM SFP OPTIC, LC CONNECTOR, 10 KM, EXTENDED TEMPERATURESFP specification.

- All existing and proposed ITS and ETC field devices to be connected to the fiber optic backbone shall communicate via Ethernet switches, unless otherwise stated.
- Coarse Wavelength Division Multiplexing (CWDM) utilizing 1430 NM, 1450NM, 1470NM, 1490NM, 1510NM, 1530NM, 1550NM, 1570NM, 1590NM and 1610 NM SFPs shall be used as the CWDM transport mode, 1310 NM SFPs shall be used as the resilient path transport with ITU-T G.8032 ring protection configuration in both the roadside Carrier Grade field Ethernet switches and the Carrier Grade aggregation Ethernet switches to transport CDOT field device data to minimize fiber usage and maximize fault tolerance.
- All roadside Carrier Grade field Ethernet switches shall be fully compatible with the backbone Ethernet switches and aggregation switches in communication node buildings 2 and 3 (Table Mesa) as well as all field Ethernet switches that will be installed in Phase 1 of the US-36 Project.
- Passive CWDM Thin Film Filter mux filters shall be used at each roadside field Ethernet switch splice location to split out the appropriate wavelengths. The mux filters and mux filter splices shall be contained in a separate splice enclosure from the splice enclosure containing the lateral fiber cable to backbone fiber cable splices.
- Management System software tool shall be provided to manage Carrier Grade Ethernet and Transport product portfolios.
- Passive 1U rack mount 32-channel Optical Splitter Shelf shall be used in the regeneration building to demux (split) CWDM optical signals out to the paired SFP in the core aggregation switch.

Refer to the Project Special Provision listed in [Section 19.5](#) below for additional requirements.

#### **19.1.4 Variable Message Signs (VMS)**

The VMS are large dynamic displays that are used for a wide range of purposes, including providing driver information regarding weather advisories, travel times, amber alerts, and construction and incident notifications. These VMS along US 36 will not be used for tolling purposes.

##### **19.1.4.1 Design Requirements**

The Concessionaire shall design a complete VMS system at the approximate locations listed below:

1. Eastbound US 36 between McCaslin Boulevard and West Flatiron Circle, approximate milemarker 44.3.
1. Reset the existing VMS along westbound US 36 between Flatirons and McCaslin.

VMS shall have a minimum of 21.0 feet of vertical clearance above the roadway to ensure that a minimum clearance of 17.5 feet above the roadway is maintained with the installation of any lane-use signals mounted underneath.

These new VMS shall be mounted on a sign bridge and may be co-located with the static guide signs. They shall be centered over the general purpose travelled lanes but be visible to all roadway users. Where ROW permits, an 8-foot-wide paved area shall be provided, outside of the shoulder, for maintenance access. The sign bridge shall have a locked, secured ladder and walkway so that maintenance personnel can maintain every portion of the sign bridge without the use of a bucket truck. The walkway shall have a mesh with a maximum diameter of 0.5 inches to prevent dropped tools and debris from falling onto the travelled way. In addition, the walkway shall be OSHA compliant with side rails and toe kicks. The Concessionaire shall prepare a structural design for each VMS structure and provide to HPTE for Approval prior to Release for Construction.

#### **19.1.4.2 Material Requirements**

The Concessionaire shall furnish, install, integrate, and test all new or reset all existing VMS signs and any and all associated equipment necessary to achieve a fully-functioning system. The new VMS signs shall be designed based on the following material requirements, at a minimum:

1. The sign shall utilize Light Emitting Diode (LED) displays.
2. The sign shall be equipped with the ability to display three lines of text with a character height of 18 inches.
3. The sign shall utilize a full-color, full-matrix display.
4. The sign shall have a walk-in cabinet.
5. The sign shall have a minimum design life of 20 years.
6. The VMS controller and sign must be NTCIP compliant, provide an Ethernet interface, and must be compatible with the Colorado Transportation Management Software (CTMS).

Refer to the Project Special Provision listed in [Section 19.5](#) for additional requirements.

#### **19.1.5 Closed Circuit Television (CCTV)**

The CCTV 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](http://www.CoTrip.org)) and television news agencies.

##### **19.1.5.1 Design Requirements**

The US 36 Phase 1 project will provide full CCTV coverage of the entire US 36 corridor, including the Phase 2 project limits. The CCTV coverage within the Phase 2 project limits will be provided via a combination of existing analog CCTV cameras and new Ethernet-based cameras meeting the material requirements outlined in [Section 19.1.5.2](#). For the US 36 Phase 2 project, no additional CCTV locations will be necessary but the Concessionaire shall replace all existing CCTV cameras that do not meet the material requirements outlined in [Section 19.1.5.2](#). These include the CCTV at the following locations:

1. McCaslin Boulevard

2. Scenic Overlook
3. Foothills Parkway
4. Baseline Road

These existing CCTV cameras within the US 36 Phase 2 project limits are not mounted on 50 foot steel poles (40 foot steel poles at the interchange intersections). As a result, they will need to be relocated to a new pole that meets the requirements outlined below in Section 19.1.5.2.

#### **19.1.5.2 Material Requirements**

All CCTV cameras installed as part of the Project shall meet the following minimum requirements:

1. Digital and Ethernet-based
2. All-in-one color surveillance dome camera unit
3. Pan, 220 degree tilt, zoom operation
4. -35X optical zoom
5. Minimum illumination no less than 0.5 lux
6. H.264 video stream
7. Compatible with Camera Cameleon ITS client

The CCTV camera shall also include a weatherproof dome housing, steel pole, lowering device, mount adapter, camera transformer, attachment hardware and all other hardware, cables, and test equipment necessary for a complete installation. Poles shall be 40 feet in height at interchange locations and 50 feet in height at mainline locations, and shall include the proper foundation. The poles shall also include a lowering device that allows CCTV cameras to be lowered to the ground for maintenance purposes without interfering with any other pole-mounted devices or cabinets.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.1.6 Ramp Meter Stations (RMS)**

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

##### **19.1.6.1 Design Requirements**

The Concessionaire shall replace all existing RMS detection with Microwave Vehicle Radar Detection (MVRD) (also see 19.1.7) for mainline detection and wireless in-pavement sensors for on-ramp detection. If the Concessionaire impacts any of the existing RMS along the corridor, the Concessionaire shall design and reconstruct a new fully functioning RMS in accordance with the latest CDOT guidelines on ramp metering stations and the CDOT ITS Standard Details included in the Reference Documents.

There are currently two RMS within the project limits and are located at:

1. Eastbound on-ramp at the Foothills Parkway interchange
2. Westbound on-ramp at the McCaslin Boulevard interchange

In addition, new two-lane RMS shall be designed and constructed at any and all eastbound on-ramps at the McCaslin Boulevard interchange.

#### **19.1.6.2 Material Requirements**

The Concessionaire shall furnish all the elements of the RMS necessary to achieve a fully-functioning system. All RMS shall utilize the following components:

1. MVRD to collect mainline data for each lane, and associated loop emulation cards
2. Wireless in-pavement sensors to provide on-ramp detection
3. Where impacted, install new or reset existing 334 controller cabinets and controllers on new fiberglass porch-style foundations
4. Pull boxes, conduit, communications, signal equipment, advance flashers, wiring, and all other items necessary to provide a complete and functioning RMS

Saw cut loops are not allowed in new pavement areas for RMS. Existing RMS controllers and cabinets may be salvaged and reused.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.1.7 Microwave Vehicle Radar Detection (MVRD)**

The MVRD, also referred to as side-fire radar, are used to collect point data of volume, occupancy, speed, and classification in each lane of travel. The data is used primarily for measuring and analysis of traffic conditions, both real-time and for studies.

##### **19.1.7.1 Design Requirements**

The Concessionaire shall prepare a design to locate side-fire MVRD units with an approximate spacing of one-half mile east of McCaslin Boulevard and one mile west of McCaslin Boulevard. Each location shall be accessible by CDOT bucket trucks to provide device maintenance and other functions without performing lane closures, affecting traffic operations, or requiring complex traffic control; and cannot be placed in the median.

##### **19.1.7.2 Material Requirements**

The Concessionaire shall furnish all new MVRD units and any and all associated equipment necessary to achieve a fully-functioning system. The MVRD units shall detect all individual lanes of travel, including the general purpose and Managed Lanes in both directions. Data collection shall include volume, occupancy, speed, and classification.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.1.8 Travel Time Indicators (TTI)**

TTI sites are comprised of Sirit 5204 antennas and readers that detect toll tag transponders in vehicles. 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.

##### **19.1.8.1 Design Requirements**

The Concessionaire shall prepare a design to locate TTI units that will read only the General Purpose Lanes with an approximate spacing of no more than one mile and located before and after each interchange (including the Foothills Parkway interchange). Additional TTI units shall be installed in between the off-ramp and on-ramp at each interchange to allow users exiting the

facility for a short period of time to be excluded from the travel time calculations. For the Managed Lanes, one set of TTI units shall be located between each ingress/egress point to obtain directional travel times for each segment.

Each location shall be accessible by Department bucket trucks to provide device maintenance and other functions without performing lane closures, affecting traffic operations, or requiring complex traffic control; and cannot be placed in the median except for managed lanes data collection points.

#### **19.1.8.2 Material Requirements**

The Concessionaire shall furnish all new TTI units and any and all associated equipment necessary to achieve a fully-functioning system. The TTI units must be Sirit 5204 multi-protocol readers and antennae and be able to read both Title 21 and ISO 18000-6C transponder tags. Any existing TTI units along the new CDOT fiber optic backbone shall be replaced with new multi-protocol units.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.1.9 DTD Automatic Traffic Recorders (DTD ATR)**

The CDOT Division of Transportation Development Automatic Traffic Recorder (DTD ATR) stations continuously collect vehicle volume and functional classification data using in-pavement loops and piezoelectric sensors. Currently, there is a DTD ATR stations at milemarker 44.4 (east of McCaslin Boulevard).

##### **19.1.9.1 Design Requirements**

The Concessionaire shall design the replacement DTD ATR counting station for those locations that are impacted by the Project. Each new DTD ATR must collect data for all lanes of travel, including the General Purpose Lanes and Managed Lanes in both directions. Communications to the DTD ATR station shall be provided via the existing telephone line. In addition, a 6-strand SMFO lateral for future use shall be provided from the CDOT fiber optic backbone to the DTD ATR cabinet.

##### **19.1.9.2 Material Requirements**

The Concessionaire shall furnish all equipment necessary to achieve a fully-functioning DTD ATR system. The DTD ATR stations consist of loop detector wires and piezoelectric axle sensors (piezo). The loops shall be 6 feet by 6 feet, in size and the piezos shall be Class II and be 6 feet in length. The existing cabinets may be reset at the new locations.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.1.11 Doppler Radar**

These are self-contained, solar-powered units that collect point travel data and transmit it wirelessly to the device manufacturer SpeedInfo and to HPTE. These devices are owned by SpeedInfo, and data is provided to other entities.

##### **19.1.11.1 Design Requirements**

Because the SpeedInfo Doppler radar units are self-contained (including wireless communications), all existing units that need to be relocated shall be installed per the manufacturer's recommendations. All Doppler radar units shall be co-located with other sign structures and therefore shall not require separate structures to be installed by the Concessionaire.

### 19.1.11.2 Material Requirements

The existing self-contained SpeedInfo DVSS-100 Doppler radar units shall be reset in the same vicinity as the current devices. No additional units shall be provided as part of the Project.

### 19.1.12 Road Weather Information System (RWIS)

Road Weather Information Systems (RWIS) are used for traveler information systems and highway maintenance operations by providing on-Site weather information.

#### 19.1.12.1 Design Requirements

A RWIS will be installed at the overlook west of McCaslin Boulevard as part of the US 36 Phase 1 project. If any portion of the RWIS system is impacted by the Project, the Concessionaire shall replace the impacted portion with the material requirements listed in Section 19.1.12.2.

#### 19.1.12.2 Material Requirements

The Concessionaire shall replace any impacted RWIS components with the equipment necessary to achieve a fully-functioning system. The RWIS shall include the following material requirements:

1. Fold-over tower
2. Weather monitoring system including a Remote Processing Unit, Precipitation Type Sensor, Air Temperature/Relative Humidity Sensor, Ultrasonic Wind Sensor, Wired Road Surface Sensor, Non-Intrusive Pavement Condition Sensor, and a CCTV camera.
3. Concrete pad and chain link fence

### 19.1.13 Enhanced Active Traffic Management (ATM) Elements

At a minimum, the following enhanced ATM elements shall be included:

1. Provide lane status information via Lane-Use Signals (LUS) over each lane (both general purpose and managed) to roadway users along the US 36 corridor to notify drivers of lane closures, restrictions, or merge conditions. This system shall be consistent with the LUS system being constructed as part of US 36 Phase 1, specifically that the lane status information is displayed at least every half mile throughout the corridor, starting at the eastern Project limit and ending approximately one mile west of McCaslin Boulevard. They shall provide continuous visibility of the sequential LUS which can be mounted and combined with other sign structures. The LUS shall be a full-color, full-matrix VMS with a 48 by 48 pixel matrix. The viewable area within should be maximized by reducing the bezel width. Refer to the Project Special Provision listed in Section 19.5 for the specific requirements for each component.
2. At all LUS locations where full, overhead VMS are not provided, side-mounted VMS shall be installed. These side-mounted VMS shall be full-color, full-matrix, with a minimum pixel matrix of 80 by 80 pixels. The viewable area within should be maximized by reducing the bezel width. Refer to the Project Special Provision listed in Section 19.5 for the specific requirements for each component.
3. All devices, software, and hardware shall be NTCIP-compliant and compatible with the CTMS. All devices shall be compatible with the ATM software developed as part of US 36 Phase 1. The Concessionaire shall verify that the device is collecting accurate data, that the device is properly communicating with

CTMS, that CDOT can control the device using CTMS, and verify that the device is powered and functioning properly. The Concessionaire shall integrate the ATM devices into CTMS. This work shall be performed by a software developer familiar with the CTMS application and shall include all programming, design, testing and integration into the software to achieve all the functionality being developed within the Phase 1 project.

4. LUS must be able to be removed and replaced for maintenance and repair purposes within a reasonable timeframe.

#### **19.1.14 Variable Toll Message Signs (VTMS)**

The VTMS is a combination of a static sign with one electronic VMS inserts that is utilized to display the specific tolls for each segment of the corridor. All mainline VTMS shall be located upstream of the Managed Lane ingress/egress point. This will allow the roadway users sufficient time to read the toll rate and then make their decision whether to enter, or continue to use, the Managed Lanes.

##### **19.1.14.1 Design Requirements**

The Concessionaire shall design a complete VTMS system so that the following requirements are met:

1. VTMS shall be provided prior to each Managed Lane ingress/egress point on the mainline, and the VTMS shall be mounted overhead and visible to both Managed Lane and general purpose lane users, including roadway users that have just entered the facility via on-ramps.
1. Each VTMS shall be of the same manufacture and model type as those being installed on US 36 Phase 1. This includes one VMS insert capable of displaying the toll rates to the next interchange. All VTMS shall be mounted overhead with the exception of VTMS at on-ramps and at the end of the Managed Lane segments.

##### **19.1.14.2 Material Requirements**

The Concessionaire shall furnish all new VTMS signs and any and all associated equipment necessary to achieve a fully-functioning system. The VTMS signs shall be designed based on the following material requirements, at a minimum:

1. The sign shall be the same manufacturer type and model as those being installed on US 36 Phase 1.
2. The sign shall utilize Light Emitting Diode (LED) displays.
3. The overhead signs shall be equipped with the ability to display a minimum of 7 characters, including the toll rate (the \$ sign, the numerical value of toll rate, and decimal) or the word "CLOSED"; all with a character height of at least 18 inches.
4. The VTMS shall have a minimum design life of 20 years.
5. The VTMS cabinet shall be installed on a concrete foundation to the right of the travelled way and shoulder so that maintenance can be performed without the need for lane closures. UPS shall be provided for each VTMS to ensure that each sign is operational for 24 hours in the event of a power failure. The Concessionaire shall purchase and install the UPS in the controller cabinet.

Refer to the Project Special Provision listed in [Section 19.5](#) below for additional requirements.



### **19.1.15 Automatic Vehicle Identification (AVI) Reader**

An AVI reader and antennas shall be installed at each tolling point and used to read the tag information stored inside each transponder.

#### **19.1.15.1 Design Requirements**

The AVI reader shall be installed by the ETC System Integrator in the lane controller cabinet, and the antennas that will read the tag information shall be mounted directly above the Managed Lane. The Concessionaire shall be responsible for providing a structure at each tolling point (either dedicated or shared with another installation) to allow the ETC System Integrator to mount the AVI antennas in the correct positions.

The AVI reader that shall be utilized is anticipated to be a Sirit Model 5204, which shall be provided by the ETC System Integrator. Each tolling point will require a structure upon which two antennas, per direction, can be mounted 17.5 feet above the Managed Lane. The AVI antenna shall be mounted on a 2-inch diameter pole spanning the Managed Lane that allows for 6-inches of clearance between the pole and the bottom of the structure for angling and installation of the supporting hardware. In addition, the AVI antenna shall have 4 feet of lateral clearance. The Concessionaire shall coordinate with the ETC System Integrator to ensure that the proper installation equipment is provided at each AVI antenna installation location.

In addition to the structure, the Concessionaire shall also provide two 2-inch conduits between the lane controller cabinet and the base of the structure supporting the AVI antenna. All cabling shall be installed internal to the structure. Communications to the AVI antenna shall be provided by coaxial cable installed by the ETC System Integrator. The Concessionaire shall ensure that the lane controller cabinet and the structures used to support the AVI antenna equipment be as close together as possible to ensure that the maximum coaxial cable length does not exceed 100 feet.

#### **19.1.15.2 Material Requirements**

The Concessionaire shall be responsible for providing a bracket upon which the ETC System Integrator can mount the AVI antenna. The exact type of bracket will depend on the type of structure that the AVI antenna shall be mounted on. The Concessionaire shall coordinate with the ETC System Integrator to determine the type and number of brackets that shall be necessary.

### **19.1.16 Automatic License Plate Recognition (ALPR) Cameras**

The ALPR cameras shall be used to obtain an image of the vehicle's license plate if a transponder is not detected. In-pavement loops shall be used to signal to the ALPR camera that a vehicle is present. Once the image is taken, the Optical Character Recognition (OCR) system inside the camera unit (or the lane controller) will process the image to identify the vehicle's license plate. This information will then be sent to the lane controller.

#### **19.1.16.1 Design Requirements**

The ALPR cameras shall be mounted by the ETC System Integrator on break-away sign supports mounted on the concrete median barrier. The Concessionaire shall be responsible for providing these supports at the locations determined by the ETC System Integrator. It is anticipated that four of these structures shall be needed at each tolling point (either dedicated or shared with another installation).

In addition to the structure, the Concessionaire shall also provide two 2-inch conduits between the ALPR camera structure and the lane controller. Communications to the ALPR cameras shall be provided and installed by the ETC System Integrator.

As previously mentioned, the ALPR cameras shall require an in-pavement loop detection system to signal to the cameras that a vehicle is present. Two 6 by 11-foot loops shall be saw cut into the Managed Lane. The ETC System Integrator shall perform the loop installation, but the Concessionaire shall provide the necessary pull boxes and conduit. The locations of the pull boxes and conduit shall be coordinated with the ETC System Integrator. In addition, the pavement surface temperature must be 50 degrees and rising in order for the ETC System Integrator to properly install the in-pavement loop sealant. As a result, the Concessionaire shall coordinate with the ETC System Integrator to ensure the correct seasonal climate for the in-pavement loop installation.

#### **19.1.16.2 Material Requirements**

The Concessionaire shall design the support system for the ALPR cameras to meet the following material requirements:

1. The break-away sign supports used to mount the ALPR cameras shall be CDOT Standard S-614-5 break-away sign supports mounted on the concrete median barrier.
2. Each structure shall include "U" bolt mountain brackets and hardware to allow for the installation of the ALPR cameras.

#### **19.1.17 Electronic Tolling Lane Controller**

The lane controller shall be located in the enforcement area of each tolling point and shall be connected to the rest of the electronic tolling equipment using two 2-inch conduits. The lane controller will be used for all data processing and transmittal of transponder tag and license plate information via the fiber optic communications network to the ETC back-office for processing.

##### **19.1.17.1 Design Requirements**

Although the ETC System Integrator shall be responsible for the installation and configuration of the lane controller, the Concessionaire shall be responsible for the design of the cabinet and associated foundation, the conduit to connect the lane controller to the AVI antenna, ALPR cameras, and transaction status indicator beacon, and the conduit to provide communications and power to the cabinet. One lane controller cabinet will be provided for each tolling point location. The locations of the cabinets, foundations, and conduits shall be coordinated with and approved by the ETC System Integrator. However, the maximum conduit length between the lane controller and the ETC devices (AVI antennas, ALPR cameras, and transaction status indicator beacon) shall not exceed 100 feet.

##### **19.1.17.2 Material Requirements**

The Concessionaire shall have the following responsibilities at each tolling point where a lane controller is required:

1. Provide a 4X NEMA rated cabinet with a minimum size of 48 inches high x 48 inches wide x 24 inches deep. In addition, the Concessionaire shall provide the required foundation on a level surface within the median enforcement area that shall be protected from general traffic but easily accessible for programming and maintenance purposes.

2. Provide a 12-strand SMFO fiber optic communications lateral between the cabinet and the CDOT fiber optic backbone. The fiber optic lateral shall terminate at a patch panel that shall be installed inside the communications cabinet.
3. Provide power to the cabinet to power the lane controller and all associated equipment.

### **19.1.18 Enforcement Zones**

The enforcement zones will provide a location for enforcement personnel to perform tolling enforcement at each tolling point.

#### **19.1.18.1 Design Requirements**

The Concessionaire shall provide enforcement zones at each tolling point that meet the following design requirements:

1. Be located at each tolling point.
2. Provide bi-directional, flared-out areas within the median with an opening to access both directions of the facility.
3. Provide a minimum width of -14 feet for the refuge area within the flared out area. In areas where a sign structure is required for the tolling equipment, the minimum width of the refuge area may be reduced to 11 feet, provided that the lane controller cabinet is located on the downstream side of the barrier notch out. The reduced refuge area shall not obstruct visibility of the transaction status indicator beacon or vehicle occupants by law enforcement personnel.
4. Provide a minimum length of 120 feet for the full-width refuge area.
5. Maintain a minimum shoulder width of 4 feet through the enforcement zone area.

#### **19.1.18.2 Material Requirements**

Each enforcement zone shall be equipped with a transaction status indicator beacon to signal to the enforcement personnel whether or not each vehicle was recorded as a SOV or HOV. This beacon shall be furnished by The Concessionaire and meet the following material requirements:

1. Provide a blue LED beacon that shall be activated when a user is identified as an HOV by the tag status file.
2. Provide 2-inch conduit between the beacon and the lane controller for the Concessionaire to connect the two devices.
3. Shall be outdoor-rated and weatherproof.
4. Shall be visible to enforcement personnel in the adjacent enforcement zone.

### **19.1.18A Programmable Information Display Systems (PIDS)**

#### **19.1.18A.1 Design Requirements**

The Concessionaire shall install two RTD PIDS at the following transit centers (one per bus loading platform in each direction) and all associated support infrastructure, including cabling, power, and mounting equipment. The exact locations shall be approved by RTD.

- McCaslin Station

### **19.1.18A.2 Material Requirements**

The Concessionaire shall furnish all new PIDS and the additional equipment necessary to achieve a fully-functioning system. The PIDS shall be designed to meet the following material requirements:

1. All PIDS shall have a 47-inch diagonal screen size.
2. All PIDS support equipment (including mounting hardware) shall be compatible with existing RTD equipment and approved by RTD.
3. A 24-strand SMFO lateral in a 2-inch conduit shall be installed from the fiber optic backbone and terminated at each PIDS mounting station. All PIDS shall be connected to the fiber optic backbone via Ethernet switches.
4. The Concessionaire shall provide a roof canopy above each PIDS. The roof canopy shall be of adequate size to protect against adverse weather conditions and direct sunlight. The canopy design shall match materials and architectural style of existing RTD standards and shall be submitted to RTD for approval.

Refer to the Project Special Provision listed in Section 19.5 below for additional requirements.

### **19.1.19 Pull Boxes and Manholes**

#### **19.1.19.1 Design Requirements**

The Concessionaire's design shall utilize fiberglass reinforced, polymer concrete pull boxes and pre-cast concrete manholes with a cast iron frame ring and cover. Pull boxes shall be 24 inches x 36 inches for intermediate locations and manholes shall be used for splice locations. 100 feet of fiber optic cable shall be coiled inside each manhole, and 50 feet of fiber optic cable shall be coiled inside each pull box. Pull box and manhole spacing shall be as follows:

1. CDOT and RTD manholes shall be spaced every 1.5 miles and clustered in a group in common areas to accommodate future utility locates, provided that all fiber optic splicing of ITS devices are performed in manholes. No fiber optic splicing shall be performed in pull boxes.
2. CDOT pull boxes shall be placed between 500 and 1,500 feet at device locations
3. RTD pull boxes shall be placed every 3,000 feet and at Station locations.

#### **19.1.19.2 Material Requirements**

All pull boxes shall be constructed of fiberglass reinforced, polymer concrete and have a detachable cover with a skid-resistant surface and have the words "CDOT COMM" or "RTD COMM" cast into the surface. Painting of words shall not be allowed. All pull boxes shall be verified by a third-party nationally recognized Independent Testing Laboratory as meeting all test provisions of ANSI/SCTE 77 2007 Specification for Underground Enclosure Integrity, Tier 22 rating.

Refer to the Project special provision listed in Section 19.5 for additional requirements.

### **19.1.20 Cabling and Conductors**

The Concessionaire shall design conductors and cables utilizing a minimum of #12 AWG for all electrical conductors. All video-device control cables and connectors shall be designed in accordance with the manufacturer's recommendation and the CCTV manufacturer's signal attenuation requirements.

## **19.1.21 Conduit**

### **19.1.21.1 Design Requirements**

The Concessionaire shall design new and separate conduit systems (including all hardware, fasteners, and accessories) for communication and power control systems. Longitudinal conduits for the communications network shall be installed within the ROW and as close to the ROW line as practical.

Lateral conduits shall be 2 inches in diameter, and installed per the NEC requirements, such as separate conduits for power and communications and fill ratio.

### **19.1.21.2 Material Requirements**

All conduits shall meet CDOT specifications. The conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin Schedule 80 high-density polyethylene resin. Conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation, without affecting its properties or performance.

Refer to the Project special provision listed in [Section 19.5](#) below for additional requirements.

## **19.2 Construction Requirements**

The Concessionaire shall be responsible for furnishing and installation of all ITS devices, the communications network, and the supporting infrastructure that is necessary to install and operate the ETC system components.

### **19.2.1 Electrical Power**

The Concessionaire shall make appropriate arrangements with the power service provider for installation or relocation of power service. The Concessionaire shall also be responsible for all costs of installing or relocating power sources, including involvement with the power service provider at locations for new services throughout the Project. Finally, The Concessionaire shall be responsible for all ongoing monthly electricity costs of all new ITS and ETC equipment installed under this Project until Phase 2 Work Completion. CDOT will be responsible for ongoing electricity costs of existing ITS equipment. The Concessionaire shall ensure the transition and reassignment of electrical service with the appropriate CDOT office so that there is no disruption in service.

### **19.2.2 Location and Protection of ITS and ETC Elements**

The Concessionaire shall be responsible for locating all underground existing facilities to avoid or minimize conflicts with these facilities. If any facilities are damaged during construction, the Concessionaire shall be responsible for all repairs.

The Concessionaire shall install a grounding system and protection devices that are suitable for each specific ITS and ETC element.

### **19.2.3 Communications System**

The Concessionaire shall furnish and install the fiber optic communications system and connect all ITS and ETC field elements to the system.

Prior to performing any work that may impact existing ITS communications systems, the Concessionaire shall coordinate with the owner of the affected system.

Fiber optic conduit shall not be located in the travelled way or the Bikeway (with the exception of crossings).

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.2.4 Variable Message Signs (VMS)**

The Concessionaire shall be fully responsible for the furnishing and installation of all VMS signs to the installation Site. The VMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on Site to ensure proper installation and testing. The installation shall include a 30-day burn-in of the complete system.

Each VMS system shall be connected to the communication system using fiber optic laterals extended into the VMS controller cabinet. The Concessionaire shall notify CDOT ITS upon installation of each VMS and complete a CDOT data sheet. The Concessionaire shall be responsible for the integration of all VMS back to the CTMC. CDOT ITS shall be responsible for modifying the Colorado Traffic Management System (CTMS) software to incorporate the new devices.

The Concessionaire shall submit a "VMS acceptance test procedure" for Acceptance by CDOT ITS. The test procedure shall be performed in the presence of CDOT ITS and the manufacturer's representative. The Concessionaire shall notify CDOT ITS at least 14 Days prior to the test date.

The test shall include all items addressed in the Project Special Provisions per Section 19.5 and all other requirements from the Project plans or Engineer. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VMS system, including spare software copies, shall be provided. Additional copies may be requested by CDOT ITS. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401 c/o Matthew Becker.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.2.5 Closed Circuit Television (CCTV)**

The Concessionaire shall furnish any new CCTV cameras and carry out all installation, field-testing, burn-in of the system, and connection of each device to the communication system. Existing analog CCTV cameras in the corridor may not be reused and shall be salvaged and returned to CDOT ITS.

The Concessionaire shall notify CDOT ITS upon installation of each CCTV camera and complete a CDOT data sheet. The Concessionaire shall be responsible for the integration of each new CCTV back to the CTMC. CDOT ITS shall be responsible for modifying the Camera Cameleon software to incorporate the new devices.

Refer to the Project Special Provision listed in Section 19.5 for additional requirements.

#### **19.2.6 Ramp Meter Stations (RMS)**

The Concessionaire shall furnish all RMS-related equipment and carry out all installation, field-testing, and burn-in of the system. The testing shall demonstrate that the detection systems operate per the manufacturer's specifications.

New RMS shall be connected to the communication system using fiber optic laterals. The Concessionaire shall notify CDOT Region 4 upon installation of each RMS system and complete a CDOT data sheet. The Concessionaire shall be responsible for the integration of

each new RMS back to the CTMC. CDOT ITS shall be responsible for modifying the CTMS software to incorporate the new RMS system.

Refer to the Project Special Provision listed in [Section 19.5](#) for additional requirements.

#### **19.2.7 Microwave Vehicle Radar Detection (MVRD)**

The Concessionaire shall furnish all MVRD and carry out all installation, field-testing, and burn-in of the system per the manufacturer's recommendations and CDOT standards. Each device shall be connected to the communication system using fiber optic laterals. Existing MVRD units may be reused as long as they meet the appropriate material requirements outlined herein. Incompatible units shall be salvaged and returned to CDOT ITS. The Concessionaire shall notify CDOT ITS upon installation of each MVRD device and complete a CDOT data sheet. The Concessionaire shall be responsible for the integration of each new MVRD to the CTMC. CDOT ITS shall be responsible for modifying the CTMS software to incorporate the devices.

Refer to the Project Special Provision listed in [Section 19.5](#) for additional requirements.

#### **19.2.8 Travel Time Indicators (TTI)**

The Concessionaire shall furnish all TTI units and carry out all installation, field-testing, and burn-in of the system per the manufacturer's recommendations and CDOT standards. Each device shall be connected to the communication system using fiber optic laterals. Existing units shall be salvaged and returned to CDOT ITS. The Concessionaire shall notify CDOT ITS upon installation of each TTI device and complete a CDOT data sheet. The Concessionaire shall be responsible for the integration of each new TTI to the CTMC. CDOT ITS shall be responsible for modifying the CTMS software to incorporate these devices.

Refer to the Project Special Provision listed in [Section 19.5](#) for additional requirements.

#### **19.2.9 DTD Automatic Traffic Recorder (DTD ATR)**

The Concessionaire shall furnish all DTD ATR-related equipment and carry out all installation, field-testing, and burn-in of all DTD ATR counting stations being replaced. All Work shall be inspected by the Traffic Data Collection Unit (TDC) during installation. The Concessionaire shall test and operate the piezos and loops under actual traffic conditions. A minimum of one week of actual data shall be collected. The volume and vehicle class shall be within  $\pm 10$  percent for the Site compared to historical data for the test period. There shall be no more than 1 percent sensor misses in any one lane for the test period. The Concessionaire shall submit all testing and operational data for Acceptance.

Refer to the Project Special Provision listed in [Section 19.5](#) below for additional requirements.

#### **19.2.10 Doppler Radar**

The Concessionaire shall coordinate with SpeedInfo (408-446-7660) if any of the existing Doppler radar units currently installed along the corridor need to be relocated to new structures during construction.

#### **19.2.11 Road Weather Information System (RWIS)**

The Concessionaire shall be responsible for replacing any portions of the RWIS system impacted by the Project.

#### **19.2.12 Variable Toll Message Signs (VTMS)**

The Concessionaire shall be fully responsible for the furnishing and the installation of all VTMS signs to the installation Site and all damages that occur in the installation and delivery process.

The VTMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on Site to ensure proper installation and testing. The installation shall include a burn-in of the complete system.

The Concessionaire shall be responsible for the integration of each new VTMS into Camera Cameleon. The Concessionaire shall be responsible for modifying the Camera Cameleon (HOV Client) software to incorporate the VTMS.

The Concessionaire shall submit a "VTMS acceptance test procedure" for Acceptance by CDOT ITS. The test procedure shall be completed in the presence of CDOT ITS, the ETC System Integrator, the Engineer, and the manufacturer's representative. The test shall include all items addressed in the Project Special Provision contained in Section 19.5, and all other requirements from the Project plans or Engineer. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Concessionaire shall notify CDOT ITS at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VTMS system, including spare software copies, shall be provided. Additional copies may be requested by CDOT ITS. One copy of the manual shall remain inside the sign housing or control cabinet. Remaining copies shall be mailed to CDOT ITS.

Refer to the Project Special Provision listed in Section 19.5, for additional requirements.

#### **19.2.12A Programmable Information Display System (PIDS)**

The Concessionaire shall furnish and install the PIDS based on the following requirements:

1. The PIDS may be mounted on a canopy pole.
2. The PIDS shall be mounted at an angle of 17-20 degrees with a mounting height of 9 feet above final grade measured to the bottom of the screen.
3. The PIDS shall be positioned under the canopy to allow future installation of TVM and PA systems.
4. The PIDS shall be installed facing north, if possible, and away from oncoming highway traffic.

The Concessionaire shall be responsible for providing power and communications to each PIDS location. RTD IT staff will be responsible for the integration of each PIDS.

All existing VMS signage located in each transit center bus shelter shall be removed by the Concessionaire and returned to RTD. The Concessionaire shall coordinate with RTD prior to removal of any existing signage.

#### **19.2.13 Pull Boxes**

The Concessionaire shall furnish and install all pull boxes based on the latest CDOT Standard Specifications. Each location shall be easily accessible for maintenance purposes. Pull boxes shall not be placed in a known flood-prone area or drainage ditch. A fiber optic cable label shall be attached to each fiber optic cable located within a pull box.

Refer to the Project Special Provision listed in Section 19.5, for additional requirements.



#### **19.2.14 Salvaging of Materials**

The Concessionaire shall salvage all existing ITS elements that are affected by the Project but are not reused. Salvaged equipment shall be returned to CDOT ITS.

#### **19.2.15 Cabling and Conductors**

All cables shall be installed per the manufacturer requirements for each device or the requirements found in the Project Special Provisions in Section 19.5. The maximum conduit fill ratio for both new and existing conduits shall be in accordance with the NEC, latest version.

#### **19.2.16 Conduit**

For bores that contain more than one conduit, the conduit shall be bundled together and contained in a single bore.

Refer to the Project Special Provisions listed in Section 19.5, for detailed construction requirements for all conduit installations.

#### **19.2.17 Integration and Testing**

Integration and testing shall be conducted for all components that meet any of the following criteria:

1. A new device and/or cabinet supporting the device has been installed.
2. A device and/or cabinet supporting the device has been relocated.
3. The communications path between the devices and the local cabinet has been disturbed and/or relocated.
4. A new communication path to a device has been established

The Concessionaire shall be responsible for the installation and integration of all ITS devices. This includes all VMS, CCTV cameras, RMS, MVRD, TTI, ATR, RWIS, ATM elements, LUS, VTMS, and SMVMS. The integration of each ITS device to the CTMC shall be done by the Concessionaire. All modifications to the CTMS will be performed by CDOT ITS. The Concessionaire shall be responsible for the installation and integration of all ETC elements, including the AVI, ALPR and communications components located in the lane controller cabinet.

For all devices connected to the fiber optic communication network, integration shall include field site integration and subsystem integration.

CDOT has testing procedures for certain devices as outlined in the Project Special Provision listed in Section 19.5. For all other elements, the Concessionaire shall develop a test plan for conducting system and subsystem testing and submit it to CDOT ITS for Approval. No testing shall be performed until CDOT ITS has approved the test plan. CDOT ITS may adjust the proposed testing schedule by up to 7 Days, at no cost to CDOT ITS, to accommodate availability of personnel. A CDOT ITS staff member or an authorized CDOT ITS representative will witness and sign off on all tests.

At a minimum, the test plan shall include the following tests:

1. The fiber optic cable testing shall be performed based on the requirements found in the Project Special Provision listed in Section 19.5, below.
2. A local field operations test shall be performed for all devices such as for each VMS, SMVMS, RWIS, CCTV, RMS, MVRD, TTI, ATR, ATM, and LUS to demonstrate that all hardware, cables, and connections furnished and installed

by the Concessionaire operate correctly and that all functions are in accordance with the requirements described herein. Verify the power supply voltages and the functionality of the cabinet fans and heaters. Provide CDOT ITS a 5-day pretest notification and test completion notification. In addition, the Concessionaire shall prepare a Device Data Sheet for each installed device and submit to CDOT ITS.

3. A subsystem communication throughput test over the communication path between each field device and the communications hub. The testing shall occur after all communication installation for a particular site has been completed, the communication paths between the device and the communications hub have been functional for at least 48 hours, and all fiber optic tests have been successfully passed. Notify CDOT ITS at least 7 Days prior to beginning testing.  
After successful completion of all subsystem test procedures and after all mainline lanes as well as ramps are open, test each site for proper communication operation for 30 consecutive Days. During the testing period, all equipment at the site that was provided, installed, or relocated by the Concessionaire shall operate without failures of any type. If any component malfunctions or fails to provide the capabilities specified herein during the 30-Day test period, within 48 hours of notification by CDOT ITS, troubleshoot to find the exact cause of the failure. The cost of correcting equipment malfunctions shall be the responsibility of the Concessionaire. After the component malfunction has been corrected to the satisfaction of CDOT ITS, restart the 30-Day test period.
4. For all components which integrate with the toll system, a Toll System Connectivity Test shall be conducted in coordination with the ETC System Integrator.
5. A 30-Day device burn-in test.

Documentation indicating successful passing of each test shall be submitted to CDOT ITS for Approval prior to Phase 2 Work Completion.

### **19.2.18 Maintenance Period**

The Concessionaire shall maintain the CDOT ITS equipment and communications infrastructure the Concessionaire installs for a period of one year after Project Completion.

For the duration of the 1-year maintenance period, the Concessionaire shall appoint a contact qualified in installing, maintaining, troubleshooting, and repairing the ITS equipment and communications infrastructure. That person's credentials shall be presented to CDOT ITS staff for approval or rejection.

The Concessionaire shall repair the malfunctioning or damaged devices and equipment within 24 hours of being notified of the problem by HPTE, with the exception of backbone communication and VTMS failures, which shall be repaired and restored within four hours of being notified of the problem by HPTE. The Concessionaire shall furnish all devices, equipment, and materials necessary to complete the repairs. If the devices and equipment are not repaired within the specified timeframe, HPTE will mobilize maintenance forces to fix the problem(s). The costs associated with such mobilization, labor and equipment, will be calculated and deducted from the HPTE funds owed to the Concessionaire.

### **19.2.19 Training and Documentation**

The Concessionaire shall provide HPTE personnel with instruction in the operation and maintenance of the hardware and software associated with the ITS equipment and infrastructure. The Concessionaire shall also provide documentation for all ITS equipment.

## **19.3 BUS ON SHOULDERS**

This Bus On Shoulders system shall allow RTD buses to travel on the US 36 shoulders during congested travel periods to bypass the congested General Purpose Lanes.

### **19.3.1 Design and Construction Requirements**

The Concessionaire shall design and construct a Bus on Shoulders (BOS) system that allows buses to travel safely and efficiently in both directions of travel from Interlocken to Foothills Parkway.

The design and signage shall be the same as the US 36 Phase 1 BOS system. Specifically, the Concessionaire shall design a BOS system that utilizes pole-mounted, static signage that is consistent with the US 36 Phase 1 BOS system and clearly communicates to the traveling public, and bus drivers, the status of the shoulder. The design and construction of the BOS system shall allow for the safe mix of buses and all other vehicles in the traffic flow along the shoulders and through interchange on-ramps and off-ramps. The BOS system shall be designed specific to the characteristics of each interchange and the associated operations.

## **19.4 Deliverables**

At a minimum, the Concessionaire shall submit the following to CDOT ITS for review, Approval and/or Acceptance:

EXECUTION VERSION

Deliverable	Review, Acceptance, or Approval	Schedule
ITS and ETC plan sheets and details	Acceptance	Prior to Release for Construction
Network topology and design diagrams	Acceptance	Concurrent with design plan submittals
Supporting reports and design calculations	Acceptance	Concurrent with design plan submittals
ITS infrastructure product sheets	Acceptance	Prior to ordering and installation
Splicing details	Acceptance	4 weeks prior to splicing
Integration and testing plan	Approval	4 weeks prior to testing and integration
Testing results	Acceptance	Following test period of each component
CDOT device data sheets	Acceptance	4 weeks prior to device integration
ITS equipment manuals and associated documentation	Acceptance	Prior to Phase 2 Work Completion
As-built CAD documentation	Acceptance	Prior to Phase 2 Work Completion
Management System software tool for Carrier Grade Ethernet and Transport product portfolios	Approval	Prior to Phase 2 Work Completion

## 19.5 Project Special Provisions

Appendix A to this Section 19 includes the Project Special Provisions that shall be applicable to the Project.

This Section sets forth modifications to the CDOT *Standard Specification for Road and Bridge Construction* for design-build projects. The first section contains revisions to Division 100 of the Standard Specifications. The second section contains revisions to Divisions 200 through 700 of the Standard Specifications, as well as Standard Special Provisions applicable to the Project.

These Contract Provisions are a revised version of v's *Standard Specifications for Road and Bridge Construction*, and contain requirements generally applicable to the Work to be performed by the Concessionaire. In certain cases, provisions in Section 100 of the *Standard Specifications for Road and Bridge Construction* have been superseded by other provisions of the Contract Documents. For ease of reference, this document uses the same Section numbers as the *Standard Specifications for Road and Bridge Construction*, and identifies provisions of the Contract Documents that have replaced or modified the standard clauses.

All references to "Engineer" that are incorporated into this Section refer to the Concessionaire's Engineer, unless the context requires otherwise. Non-capitalized terms, such as "work" that are defined in Schedule 1 or Schedule 5 shall have the meanings defined therein unless the context requires otherwise. References to "approve, approval or approved" shall mean "Approve, Approval or Approved" as defined in the Concession Agreement, Schedule 5, when the approval is by CDOT ITS or a division of CDOT ITS. If the interpretation(s) pursuant to this paragraph are not clear, CDOT ITS shall decide, in its sole discretion, how these terms shall be interpreted.

When these specifications describe actions, Materials, means or methods that are required and that are qualified by phrases such as: "as directed by the Engineer", "when directed by the Engineer", "as determined by the Engineer", "with or without permission of the Engineer", "in the opinion of the Engineer", "unless authorized by the Engineer", "satisfactory to the Engineer", "as approved by the Engineer", or "unless another type is specified or is permitted with approval of the engineer", such phrases shall be disregarded. If it is not clear whether a phrase should be disregarded, CDOT ITS will make that decision in its sole discretion.

When these specifications refer to "Department", "Resident Engineer", "Agricultural Engineer", "Bridge, Construction or Maintenance Engineer", "TMC system inspector", "Concrete Engineer", "Project Engineer", "Materials Engineer", "Commissioner", "Structural Metals Engineer", "Department's Lighting Engineer", "Geotechnical Engineer" or any other specific CDOT ITS special engineer, such reference shall mean the CDOT ITS Project Director.

When these specifications use the term engineer relating to the approval of any activities involving the use of explosives, such term shall mean the CDOT ITS Project Director.

When an approval or authorization of the Engineer or CDOT ITS is required in these specifications for the use of alternative or substituted processes or components, the Engineer shall mean CDOT ITS. If it is not clear whether a phrase involves the use of alternative or substituted processes, CDOT ITS will make that determination in its sole discretion.

If these specifications refer to an approval of any correction or repair that deviates from the Contract requirements, the approval must be by CDOT ITS. If it is not clear whether a specification involves a correction or repair that deviates from the Contract requirements, CDOT ITS will make that determination in its sole discretion.

When these specifications provide that reports, records or other documents shall be submitted to CDOT ITS or to the Engineer, such reports shall be made available to CDOT ITS and do not have to be submitted unless either they are otherwise listed in the deliverables in the Contract Documents, or are required shop drawings, warranties, parts lists, instruction sheets or manufacturer's drawings or specifications. Such documents shall be submitted to CDOT ITS as required by the specifications.

When these specifications require actions, Materials, means or methods that are "either as indicated in the Plans or as designated by the Engineer," the Concessionaire shall disregard the phrase "or as designated by the Engineer."

When these specifications refer to the "Engineer" ordering work beyond the scope of work in the Contract, "Engineer" shall mean CDOT ITS. Whenever in these specifications the Engineer may order work that results in additional costs to CDOT ITS, the "Engineer" shall mean CDOT ITS.

Any acceptances on behalf of CDOT ITS or the State shall be performed by CDOT ITS.

Any references to other standards, codes, or criteria, or to the latest version of other standards, codes, or criteria in Schedule 5 of the Contract Documents shall mean the latest version at the Proposal due date.

**Appendix 19-A**  
**PROJECT SPECIAL PROVISIONS FOR ITS AND ETC ELEMENTS**

The CDOT 2011 *Standard Specifications for Road and Bridge Construction* controls construction of this Project. The following special provisions supplement or modify the *Standard Specifications* and take precedence over the *Standard Specifications* and plans.

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Revision of Section 613 – Electrical Conductor Identification  
Revision of Section 613 – Electrical Conduit  
Revision of Section 613 – Pull Box  
Revision of Section 614 – Closed Circuit Television  
Revision of Section 614 – Variable Message Sign and VTMS Uninterruptable Power Supply  
Revision of Section 614 – Variable Message Sign (Color LED)(Overhead)  
Revision of Section 614 – Variable Message Sign (Color LED)(Side-Mounted)  
Revision of Section 614 – Lane Use Sign (Color LED)(Overhead)  
Revision of Section 614 – Communications Cabinet (CDOT)  
Revision of Section 614 – Ethernet Switch (CDOT)  
Revision of Section 614 – Fiber Optic Cable (Single Mode)  
Revision of Section 614 – Fiber Optic Splice Closure  
Revision of Section 614 – Fiber Optic Termination Panel  
Revision of Section 614 – Intelligent Transportation System Pole  
Revision of Section 614 – Lane Controller Cabinet  
Revision of Section 614 – Traffic Loops and Piezos at Automatic Traffic Recorder (ATR) Sites  
Revision of Section 614 – Microwave Vehicle Radar Detection (MVRD)  
Revision of Section 614 – Optical Transceiver  
Revision of Section 614 – Programmable Information Display System (PIDS)  
Revision of Section 614 – Test Fiber Optic Cable  
Revision of Section 614 – Travel Time Indicator (TTI)  
Revision of Section 614 – Variable Toll Message Sign (VTMS)  
Revision of Section 614 – Wireless Vehicle Detection System  
Revision of Section 614 – Controller Cabinet Foundation

**REVISION OF SECTION 613  
ELECTRICAL CONDUCTOR IDENTIFICATION**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

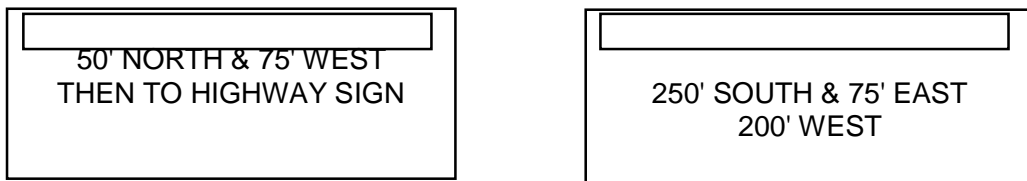
Section 613.08 shall include the following:

All electrical conductors shall be tagged as follows:

Electrical conductor cable tags shall be located below the termination in the base of the street light, in the pull box, in the pedestal and at the point of termination to existing facilities of the Local Utility Company supplying electrical service. The tags shall be attached with a cable tie. The information written on the tag shall include the direction and approximate length of cable feeds running from where to, etc.

Each incoming conductor shall be individually color coded with 1 tape mark, while outgoing conductors shall have 2 tape marks.

Example:



Uniform tags are available in a Tag Kit. The Tag Kit consists of: 100 tags, 3 part yellow with 1 hole, 100 black nylon ties and 1 black sharpie pen.

Size	2-1/2" X 5"
Standard Package	Kit
Weight, Kit, Approx.	1.5 Pounds
Color	Yellow



**REVISION OF SECTION 613  
ELECTRICAL CONDUIT**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

**DESCRIPTION**

This work includes furnishing and installing either (HDPE) High Density Polyurethane or PVC electrical conduit. All materials furnished, assembled, fabricated and installed under this item shall be new, corrosion resistant and in strict accordance with the plan sheets and these Special Provisions.

**MATERIALS**

All conduits shall be Schedule 80 in diameter and shall be compliant with all ASTM and Bellcore TW-NWT-000356 requirements.

All HDPE conduit shall be factory lubricated, low friction, high-density conduit constructed of virgin high-density polyethylene resin. Conduit shall be capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation, without affecting its properties or performance.

PVC conduit shall be certified by the manufacturer as meeting ANSI/UL 6 and 651. The manufacturer shall be ISO 9000 compliant.

**CONSTRUCTION REQUIREMENTS**

Electrical Conduit (Bored) shall be HDPE and installed using a trenchless technology of either jacked conduit or directional boring.

Electrical Conduit (Plastic) shall be PVC or HDPE and installed by direct burial methods such as plowing, open trenching, or other excavation methods. When PVC is used, expansion fittings shall be installed at 100' intervals.

One conduit per bundle shall have a copper tracer wire of at least 12-gauge in a single conduit. In trenches containing multiple conduits, the tracer wire shall not be installed in the same conduit as the fiber.

Each individual conduit shall be equipped with a pull tape of 1250 pounds tensile strength and be of a design to prevent cutting or burning of conduit walls during cable installation.

The Concessionaire has the option of using pull tape in all conduit installations, irrespective of length.

The installation of conduit shall be performed in such a manner as to avoid unnecessary damage to streets, sidewalks, utilities, landscaping, and sprinkler systems. Excavations and conduit installation shall be performed in a continuous operation. All trenches shall be backfilled by the end of the work day. The material from trenching operations shall be placed in a location that will not cause damage or obstruction to vehicular or pedestrian traffic or interfere with surface drainage.

The Concessionaire shall take all necessary precautions to avoid heaving any existing asphalt/concrete mat or over-excavating a trench, whether caused by equipment directly or by dislodging rocks and boulders. Any such heaving or over-excavation shall be repaired or replaced at the Concessionaire's expense. The Concessionaire shall bear the cost of backfilling all over-excavated areas with the appropriate backfill material as approved by the Engineer.

The Concessionaire shall restore all surface materials to their preconstruction condition, including but not limited to pavement, sidewalks, sprinkler systems, landscaping, shrubs, sod, or native vegetation that is disturbed by the conduit installation operation. All repairs shall be included in the cost of the conduit.

Any coupling technology shall allow the conduit to be connected without the need for special tools, and shall form a watertight, airtight seal. Breaking force between segments shall exceed 250 pounds of force. No metal fittings shall be allowed. No elevation difference between the conduit run and the splice location will be allowed. Conduit splices shall be kept to a minimum and all locations shall be approved by the Engineer. Additional pull boxes shall not be substituted for splices.

Conduit plugs shall be supplied and installed in all conduit ends as soon as the conduit is installed. Conduit shall be plugged at all termination points such as pull boxes, manholes, controller cabinets, and regen building. Conduits containing cable shall be plugged with durable and reusable split type plugs, fabricated without metallic parts, and allow easy removal and reinstallation around in-place cables. Split type plugs shall provide a water and air-tight seal of at least 50 psi and shall be installable by hand without using special tools and without damaging the cable. All plugs shall be correctly sized to fit the conduit being plugged. Empty conduits shall be sealed with removable type duct plugs that provide a watertight barrier.

All conduits shall use sweeps to elevate the buried conduits to within 4 inches of the bottom of the pull box or manhole, as shown in project details. The sweeps shall be terminated within the pull boxes and manholes to allow for easy installation and removal of the conduit plugs. The sweeps shall be set above the ground surface within the pull box at a height that does not interfere with the coiling of the fiber optic cable.

All conduit runs containing fiber optic cable shall have a limited number of bends. The sum of the individual conduit bends on a single conduit run between two pull boxes shall not exceed 360°. The preferred limit is 270°. No individual bend shall be greater than 90°. All conduit bends shall have a minimum acceptable radius. The minimum radius for 90° bends is 48 inches, and the minimum radius for all other bends is 24 inches.

If new conduits are installed in existing pull boxes, manholes or cabinet bases the Concessionaire shall carefully excavate around the pull box or manhole and install the new conduit as shown in the plans. The Concessionaire shall not damage the existing pull box, manhole or their contents. If the existing pull box, lid, or the concrete collars are cracked or damaged during conduit installation, the Concessionaire shall restore the damaged section to preconstruction condition at no additional cost.

**REVISION OF SECTION 613  
PULL BOXES**

Section 613 of the Standard Specifications is hereby revised for this project as follows:

**DESCRIPTION**

Concessionaire shall furnish and install fiberglass reinforced, polymer concrete pull boxes.

**MATERIALS**

Pull boxes installed in dirt or landscaped areas shall have a concrete apron with 3 sides, 12 inches wide by 6 inches deep and a top side of 18 inches wide by six inches deep for marker installation. Pull boxes shall not be installed above the grade of the apron. Concrete apron shall have a 1% slope away from the top of pull box. All concrete aprons shall be Class B and shall be in accordance with Section 601. Pull boxes 24 inches and wider shall have split lids with a removable support brace. Each pull box shall have either a locator disk manufactured into the lid that operates at the frequency of 101.4 kHz or a Tracer Ball for communication line locating. The locator disk shall be compatible with a Dynatel cable locator.

Pull boxes shall have a detachable cover with a skid-resistant surface and have the words "CDOT COMM" cast into the surface. Painting of words shall not be accepted. The cover shall be attached to the pull box body by means of stainless steel hex head bolts and shall have two (2) lift slots to aid in the removal of the lid.

Wire mesh shall be installed in a manor to completely surround the box. The wire mesh shall meet the material standard ANSI/ASTM A555-79 and made of T-304 stainless steel, 0.025 inch wire diameter minimum and shall have a mesh spacing of ¼ " or ½".

Pull boxes shall be verified by a 3<sup>rd</sup> Party Nationally Recognized Independent Testing Laboratory as meeting all test provisions of ANSI/SCTE 77 2007 Specification for Underground Enclosure Integrity, Tier 22 rating.

**CONSTRUCTION**

A minimum of 12 inches of ¾ inch granite-gravel shall be installed as a base for the pull box to aide in drainage. The ¾ inch granite-gravel shall be free of dirt and debris and spread evenly to facilitate a level base for the pull box. The Concessionaire shall ensure that sufficient compacting is made prior to the installation of ¾ inch granite-gravel to help alleviate future settling.

Wire mesh shall be installed in a manor to completely surround the box. The wire mesh shall be installed prior to the installation of the pull box above the bed of 3/4" granite-gravel and extending one foot past the outer edges of the concrete apron. The wire mesh shall be gently cut to allow only the entrance of the conduit at the bottom of the box. Any openings cut in the wire mesh larger than the diameter of the conduit shall be remedied by the installation of additional wire mesh to obtain a completely sealed pull box enclosure.

Pull Box (Surface Mounted) shall be aluminum type with a hinged front door and have at least a NEMA 3R rating. The hinged door shall be provided with both a weather tight seal and an aluminum hasp. Surface mounted pull boxes shall be of the dimensions shown in the plans, and shall be mounted on or embedded into hard surfaces such as bridge decks, concrete barriers, retaining walls, or buildings, as shown on the plans. Surface mounted pull boxes shall be attached using  $\frac{3}{8}$ -inch epoxy anchors or other methods, as approved by the Engineer. Surface mounted pull boxes shall not be used for ground installations.

## **REVISION OF SECTION 614 CLOSED CIRCUIT TELEVISION**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

This work consists of furnishing and installing an Internet Protocol (IP) Closed Circuit Television (CCTV) camera at the locations shown on the Plans.

### **MATERIALS**

The CCTV camera shall include the camera, weatherproof dome housing, pole mount adapter, 120 – 240 VAC PoE midspan injector module, Management Software, Cat-6 Ethernet cables and all attachment hardware to complete installation.

Camera Specifications –

The camera shall utilize Ethernet protocol for native communications and be capable of sending multiple individually configurable video streams in H.264 and MJPEG format up to 30fps and capable of gathering a minimum of 50 preset color video still frame images with a minimum 176x120 resolution and maximum 704x480.

The pan-tilt-zoom camera shall be of dome type construction and shall be enclosed in a sealed, heated, pressurized environmental video dome housing to operate in 100% humidity at a minimum operating temperature of -40° to 122°F carrying both IP66 and NEMA 4x ratings. Power for the camera shall be by means of a High Power over Ethernet midspan module with a pass through port for all Ethernet video and Ethernet Communications.

The camera shall have an internal web interface for configuration with security functionality allowing multiple user access levels with password protection.

The camera shall support Ipv4/v6, HTTP, HTTPS, SSL/TSL, QOS Layer 3 DiffServ, FTP, SMTP, SNMP v1/2/3, UpnP, DNS, DynDNS, NTP, RTSP, TCP, UDP, IGMP, RTCP, ARP, SOCKS.

Technical specifications for the camera shall be as follows;

- The lens shall be f=3.4 to 119mm, F1.4 to 4.2, autofocus; focus range of 35 mm (wide) to 800 mm (telephoto) to infinity. The angle of view shall be 2.8°- 48° horizontal with minimum zoom capability of 35x optical and 12x digital
- Minimum illumination color 0.5 lux at 30 IRE and B/W 0.005 lux at 30 IRE
- The camera shall provide dual mode, day (color) and night (monochrome) video down to 0.008 lux
- Shutter speed shall be variable from 1/30000 to 0.5 seconds at 60Hz.

- The pan function shall provide 360° of continuous rotation at 0.05 – 450°/s and a 220° tilt range allowing for 20° view above the horizon at 0.05 – 450°/s

#### Pole Mount Adapter Arm and Adapter Bracket -

The adapter shall have a minimum 33 lb load rating.

The adapter arm shall have provisions that allow mounting directly to the weatherproof dome housing without modification to the housing.

The adapter bracket shall have slots for a minimum of 2 straps or banding material for mounting to the pole. The adapter bracket shall mount to poles of diameters from 3 inches to 6 inches without modification to the pole or adapter bracket. The bracket shall have the ability of securing the Ethernet cable in at least two locations on the reverse side, (between the bracket and the pole).

As part of the project, a current version of camera management software shall be provided. Using standard network protocols, this software shall have the ability of giving the user remote access to all cameras on the local or remote network. Included shall be the ability to configure the camera, monitor the cameras status, set IP address and manage firmware updates.

The software shall also allow connection to the video camera using HTTPS encryption.

### **CONSTRUCTION REQUIREMENTS**

The CCTV camera shall be installed in accordance with these specifications, the details shown in the Plans, and in accordance with manufacturer's recommendations. The Concessionaire shall make all arrangements for a qualified manufacturer's representative to be on-site to ensure proper installation of the CCTV camera.

The weatherproof dome housing shall be attached to the pole mount adapter using the materials supplied from the manufacturer.

For the attachment of the adapter bracket to the pole, a ¾ inch type 201 stainless steel strap used in conjunction with type 201 stainless steel buckles at a mounting height shown on the Plans. The attachment shall be banded to the pole at an orientation to achieve the optimal view of both the main roadway and crossroad or as directed by the Engineer.

A maximum 1 inch hole shall be drilled in the mounting pole to allow passage of the Ethernet cable. The hole shall be free of burrs and sharp edges prior to the installation of the Ethernet cable. The Ethernet cable shall be attached to the reverse side of the mounting bracket to ensure proper strain relief or damage caused to the camera or housing. The Ethernet cable shall run down the interior of the pole and exit through non-metallic flexible conduit to the communication cabinet. The non-metallic flexible conduit shall be weather sealed on each end to eliminate exterior liquid entry. The Concessionaire shall also provide a weather seal for the adapter bracket at the 1 inch hole at the top of the pole per the manufacturer's recommendations.

The PoE midspan injector module shall be securely mounted in the communications cabinet and plugged into the communications power outlet. The Ethernet cable attached to the camera shall be connected to the PoE midspan output jack. A separate Cat 6 Ethernet cable shall be provided for connection to an Ethernet switch. The PoE midspan injector shall have both IEEE 802.3at and 802.3af compliance and operate at temperature of -40°F to +122°F. The Ethernet cable shall be a UTP cable, Category 6 rated and constructed of 24 AWG stranded copper wires. The outer jacket shall be UV resistant PVC insulation. The Ethernet cable shall be terminated with male 8P8C connectors as a 'straight through' cable using the Telecommunications Industry Association / Electronic Industries Alliance (TIA/EIA) T- 568B pin/pair assignments.

**REVISION OF SECTION 614  
VARIABLE MESSAGE SIGN AND VTMS UNINTERRUPTABLE POWER SUPPLY**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

The Variable Message Sign and VTMS shall include a rack mounted Uninterruptable Power Supply (UPS), batteries, transfer switch, disconnect switch, and power connections installed in a Concessionaire supplied NEMA 3R ground mount traffic controller style cabinet with dual sided access and polycarbonate base. The ground cabinet shall be large enough to house both the UPS and battery system. The Variable Message Sign UPS shall be capable of running essential sign control electronics, communication equipment, and half of the LED sign face allowing messaged display, and sign communication/control for at least 8 hours.

The UPS shall be designed for a hot swap of components and shall not compromise existing Variable Message Sign wiring. The unit shall provide for RS232 communication and contact closures for alarm functions.

**MATERIALS**

The Variable Message Sign UPS shall provide "On-Line" dual conversion control.

The UPS shall be rated per the following:

Input Voltage	85 VAC to 135 VAC
Input Frequency	48 to 62 Hz
Output Voltage	120 VAC +/- 3%
Output Frequency	60 Hz
Power	VA required to run color VMS sign control electronics, communication equipment, and half of the LED sign face, allowing for sign functionality during a power outage.

The unit shall be temperature rated to operate from -40 degree C to +74 degree C.

The Variable Message Sign UPS shall be capable of producing simultaneously-fully regenerated, conditioned power with true sine wave and continuous AC outputs with stand by capability.

The unit shall have a re-settable power event counter to record the number of power utility failures, a battery run-time counter and temperature compensated battery charging.

The Variable Message Sign UPS shall be capable of providing continuous, fully conditioned (both voltage and frequency), regulated, sinusoidal (AC) power to selected devices such as controllers, modems, and 5 volt power supplies, and sign face drivers.



Wiring shall comply with NEC standards and approved wiring methods. Properly rated SO/SJO cords shall be allowed to allow easy replacement of the Variable Message Sign UPS.

The interconnect cable shall be protected with abrasion-resistant nylon sheathing.

The UPS shall consist of two major components, the Electronics Module and the Battery System.

- A. The Electronics Module shall consist of the following:
  - 1. True Sine wave, high frequency inverter.
  - 2. Minimum 3-stage, temperature compensated, battery charger.
  - 3. For connection from the Electronics Module to the Battery System, a dedicated harness shall be provided with quick-release, keyed, circular connectors, and braided nylon sleeving over all conductors.
  - 4. Local and remote control of UPS functions
  - 5. Local and remote communications capabilities
  
- B. The Battery System shall consist of the following:
  - 1. Shall meet the continuous 8 hour requirement to run sign electronics, communication equipment, and half of the sign face with all LEDs illuminated at daytime brightness levels.
  - 2. The batteries shall be composed of extreme temperature, deep cycle AGM/VRLA (Absorbed Glass Mat/Valve Regulated Lead Acid) batteries that have been field proven and tested by the U.S. military.
  - 3. Batteries shall be certified to operate at extreme temperatures from -40°C to +74°C.
  - 4. The batteries shall be provided with appropriate interconnect wiring and a corrosion-resistant mounting trays and/or brackets appropriate for the location into which they will be installed.
  - 5. Battery construction shall include heavy-duty, inter-cell connections for low-impedance between cells and heavy-duty plates to withstand shock and vibration.

The Variable Message Sign UPS shall come standard with software, RS232 interface via a DB-9F connector, and Ethernet interface via RJ-45 connector allowing full, interactive, remote computer monitoring and control of the UPS functions. The software shall allow the user to set up all operational parameters either locally or remotely and test the functionality of the unit. The unit shall be capable of sending SNMP alarm traps upon alarm conditions and also be configurable via built in web page interface.

The Variable Message Sign UPS Alarm Function Monitoring shall come standard with a DB-9F connector with open collectors (40 V @ 20 mA) indicating:

- Loss of Utility Power
- Inverter Failure
- Low Battery

The Variable Message Sign UPS Front Panel Controls shall come standard with Power ON, Cold (DC) Start, Alarm Silence, Battery Test, Bypass Breaker and DC/Battery Breaker.

Reliability shall be calculated with MTBF as 100,000 hours based on component ratings.

Concessionaire shall provide detailed design and installation plans for CDOT ITS approval prior to installation. Power feeding the sign shall first terminate in the ground mounted cabinet. Non-UPS power shall pass through the cabinet to power non-UPS loads. Power required for sign backup shall feed through the UPS system. A bypass switch, rated for the designed system, shall be installed to bypass the UPS in the event of UPS failure or for system maintenance. A disconnect switch shall also be installed to disconnect UPS and line power from the sign. The Concessionaire shall install the VMS UPS output into the VMS power distribution panel per sign manufacture recommendations. Serial and Ethernet cables shall be installed from the UPS system ground cabinet to the sign communication device location. All wiring shall conform to the latest version of the NEC.

The UPS equipment shall include a minimum two year warranty on parts and labor. Batteries shall include a minimum two year pro rated warranty. Vendor shall be responsible for processing warranty repairs.

A repair option shall be available for UPS equipment no longer covered by the warranty period. Repair cost shall include all labor and materials necessary to complete the repair. Vendor shall be responsible for processing non-warranty repairs.

**REVISION OF SECTION 614  
VARIABLE MESSAGE SIGN (COLOR LED) (OVERHEAD)**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of furnishing and installing a Color Light Emitting Diode Variable Message Sign (Color LED VMS) and associated equipment cabinets at locations as shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The Color LED VMS shall be equipped with the ability to display 3 lines of text at a height of 18-inch tall characters and shall have a display made up of a full-matrix, full-color configuration. The Color LED VMS shall be equipped to display 24 bit color messages and graphics using red green and blue LEDs. The sign shall have 32-35 mm pixel spacing. The Color LEDs shall have a viewing angle of 30 degrees. The sign shall include a main service power shut off mounted to the sign structure near the controller interface cabinet. The sign shall be capable of operating without any decrease in performance over a temperature range of -40° F to +158° F with a relative humidity of 0 to 100 percent, condensing. The sign shall have a minimum design life of 20 years. The VMS shall be 26' wide x 8' tall x 4' deep (+/- 6 inches). The VMS shall have a minimum display area of at least 24' x 6'-2".

**MATERIALS**

- a) *Certifications:* Prior to start of the installation of the LED VMS the Concessionaire shall provide the following certifications to CDOT ITS for review and approval:
- (1) Certification showing that the manufacturer of the LED VMS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LED VMS. The facility where this company actually designs and manufactures the LED VMS shall be ISO 9001:2000 certified a minimum of one year prior to the bid date for this project.
  - (2) Working drawings showing the sign housing and tilting brackets shall be sealed by a Professional Engineer of Record. The sign housing shall be capable of withstanding a wind loading of 120 mph without permanent deformation or other damages. The sign housing shall also be designed and PE sealed to withstand current AASHTO specified group loading combinations.
  - (3) Certification showing that welding of the LED VMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED VMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.
  - (4) Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605.

- (5) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.
  - (6) Documentation and information on software as described in Appendix A of this document.
  - (7) Documentation verifying the VMS is listed by an accredited 3<sup>rd</sup> party testing organization for conformance to UL48 and UL 1433.
  - (8) All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",
  - (9) Documentation providing proof PCB silicon conformal coating conformance to MIL-I-46058C Type SR and IPC-CC-830.
  - (10) Documentation that the sign's structural integrity is in Conformance to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (Third Draft).
  - (11) Documentation that the VMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.
- b) *Sign Housing:* The back and all four sides of the housing shall be aluminum. All component parts shall be easily and readily accessible by a single person for inspection and maintenance. There shall be room for a technician to work. Access shall be made by entering both sides of the housing. The housing shall be weather tight, and compliant to the NEMA 3R Standard. The bottom panel of the housing shall have a minimum of four drain holes, with snap-in, drain filter plug inserts.

The sign housing shall be capable of withstanding a wind loading of 120 mph without permanent deformation or other damages. The sign housing shall also be designed, stamped and signed by a Professional Engineer to withstand current AASHTO specified group loading combinations including: sign weight, repair personnel and equipment, ice and wind loads. It shall also meet strength requirements for truck-induced gusts as specified in NCHRP Report 412. The sign housing shall be engineered to withstand snow loading of 40 pounds per square foot, as well as the ability to be mounted in a manner that prevents the buildup of snow and creates a natural means by which snow can run off without impeding flow of traffic. The performance of the sign, including the visibility and legibility of the display, shall not be impaired due to continuous vibration caused by wind, traffic or other factors. The housing shall be designed to accommodate mounting on the rear vertical plane and shall be structurally sufficient to be mounted to the sign support structure. The sign housing and structural components for the tilting system including bolts and welds, shall be structurally sufficient to perform under all applicable loading conditions including gravity, wind, traffic, weather, roadway deicers, maintenance, and other environmental factors.

All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte

black. The main body of the sign housing shall be constructed of aluminum. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.

Each panel shall have a single polycarbonate sheet attached securely to the inside of the aluminum panel. The polycarbonate sheet shall cover all of the pixel openings. The polycarbonate shall be sealed to prevent water and other elements from entering the VMS. The polycarbonate shall contain UV inhibitors that protect the LED display matrix from the effects of ultraviolet light exposure and prevent premature aging of the polycarbonate itself. The use of a plastic lens system will not meet the requirements and will be cause for rejection. No louvers shall be allowed.

Polycarbonate sheets shall have the following characteristics:

- Tensile Strength, Ultimate: 10,000 PSI
- Tensile Strength, Yield: 9,300 PSI
- Tensile Strain at Break: 125%
- Tensile Modulus: 330,000 PSI
- Flexural Modulus: 330,000 PSI
- Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 PSI at 270F and 66 PSI at 288F
- Coefficient of Thermal Expansion:  $3.9 \times 10^{-5}$  in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

LED display modules shall mount to the inside of the VMS front face panels and be accessible from the inside of the sign housing only. No tools shall be needed for removal and replacement of LED display modules.

The coating shall meet or exceed the AAMA Specification No. 2605.

The external front face panels shall have the following minimum dimensions: The perimeter panels shall be a minimum of 12 inches wide. The external front face panels shall be thermally insulated from the rest of the sign housing. The glazing, aluminum mask and the external front face panels shall be easily replaceable from within the sign housing.

The ventilation system shall be forced air. The system shall be designed to adequately cool the pixels from all sides along with the front and rear of the display module and all other internal components. The ventilation system shall have the following properties:

- (1) Positive pressure (exhaust fans are not acceptable).
- (2) The fans shall have ball or roller bearings, shall be permanently lubricated and shall require no periodic maintenance. The fans are to be positioned in such a manner so as to provide a balanced air flow to the ventilation system in the event of failure of any fan.

If internal components in the sign are capable of operating within manufacturer's recommended temperature range without ventilation, no ventilation system is required.

Each access door shall be mounted to an integral doorframe, which mounts to the VMS housing using non-corrosive hardware. A continuous vertical stainless steel hinge shall support each door, and all doors shall open outward towards the monotube structure. In the closed position, each door shall latch to its frame with a three-point draw-roller mechanism. The latching mechanism shall include an internal handle and release lever. Door release levers shall be located so that a person with no key and no tools cannot become trapped inside the housing.

Access doors shall be framed and swing open and lock in-place open at a 90 degree angle and 110 degree angle from the VMS housing end wall. The bottom edge of each door shall be at least 3.5-inches from the bottom edge of the VMS housing. This will provide clearance for the doors to swing open over external access platform.

The door will be fitted with an interior and exterior lockable heavy duty handle. Each Exterior door shall be furnished with a handle that is pad lock ready. Each door shall close around its flanged frame and compress against a closed-cell foam gasket, which adheres to the door. All doors shall contain a stop that retains the door in a 90 and 110-degree open position. When a door is open, the door and its stop shall with stand damaged by a 60 mph wind gust.

The VMS must be equipped with an OSHA compliant safety rail assembly, which when closed across an open access door, prevents service personnel from falling out of the VMS. VMS shall have a rail assembly to be provided for each door in the display. The rail assembly shall require no tools to open and close.

The door shall incorporate an open/closed sensor that is detectable by the sign controller and notifies the Central system control software whenever the door is accessed.

Minimum headroom of 72-inches shall be provided in the VMS housing. This free space shall be maintained across the entire width of the VMS housing, with the exception of structural frame members. Structural members shall be designed not to obstruct the free movement of maintenance personnel throughout the VMS interior.

A level aluminum walkway shall be installed in the bottom of the VMS housing. The walkway shall be a minimum of 24-inches wide and it shall run the entire length of the housing, from access door to access door. The walkway's top surface shall be non-slip and shall be free of obstructions that could trip service personnel. The walkway shall support a load of 300 pounds per linear foot.

The internal structural members shall be extruded aluminum and shall accommodate both the display module mountings while allowing air distribution. The display modules shall be removed and replaced without the use of tools and without disturbing adjacent modules. A fold down aluminum shelf shall be provided in the sign housing next to the controller for laptop use. The sign shall have heaters that are sufficient to elevate the temperature within the sign to 30° F above the temperature outside the sign. These heaters shall be controlled by a manually operated automatic shut-off timer in the sign and remotely from the controller interface cabinet and central computers. The angular alignment of the sign housing shall be adjustable in the vertical direction from (0 to 10 degrees) down in one-degree increments to optimize the viewing angle.

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Also, communication lines shall be protected by two stages of transient voltage suppression devices as required in the Sign Controller Communication Interface section of this specification. In both cases, tripping of each stage (or both if tripped simultaneously) of the surge protection and shall report the error condition (for dialup operation) or report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

c1) Sign controller: The sign controller and associated communication equipment shall be installed inside the VMS housing and shall have a pole-mounted access control cabinet attached to the VMS support structure.

Each VMS shall be controlled and monitored by its own sign controller. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VMS control software in order to perform most VMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein
- Contain a minimum of two (2) NTCIP-compliant serial communication ports, one of which has an RJ45 connector.

- Contain a minimum of one or two (2) NTCIP-compliant Ethernet port with RJ45 connector
- Have the ability to play volatile messages
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the VMS controller. External protocol converter or translator devices shall not be allowed.

The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer.

The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface.

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

c2) Access Control Cabinet: The VMS shall include a pole mounted cabinet containing:

There shall be an outside controller interface box that shall be made of aluminum or stainless steel, be weather tight, corrosion resistant, and meet NEMA 3R standards. The separate controller interface box shall be mounted as indicated on the plans. This typically will be on the sign support structure pole furthest from traffic.

The VMS shall include an auxiliary control panel that will provide a secondary user interface panel for VMS control, configuration and maintenance. The auxiliary control panel shall meet the same electrical, mechanical and environmental specifications as the VMS controller. The access control cabinet shall contain a 120 VAC outlet powered from a dedicated circuit.

The auxiliary control panel shall have one NTCIP compatible RS232 communication port and one RJ-45 Ethernet port that meet the same specifications as the VMS controller and allow access to the sign controller for configuration, message activation, and maintenance. It shall also contain a local/remote switch, a reset switch, status LEDs.



The auxiliary control panel shall be located in an access pole mounted cabinet approximately 5' above the stand able surface.

The VMS manufacturer shall supply the cables required from the access cabinet to the VMS controller for installation by the Concessionaire.

The auxiliary control panel shall be capable of operating up to 200 feet from the VMS controller.

Each VMS shall be controlled and monitored by its own sign controller. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VMS control software in order to perform most VMS control functions.

The controller interface cabinet shall contain the following assemblies:

- (1) Power-on indicator
- (2) Waterproof local/remote switch
- (3) Local control LED indicator
- (4) RS-232 cable a minimum of 4 feet long to connect the controller interface to a laptop computer.
- (5) 120 VAC GFI outlet
- (6) For dialup installations, an RJ-11 jack for connecting the dialup phone line shall be installed with in-line surge protection.

The following shall be mounted inside the main sign housing:

- (1) NTCIP compliant VMS controller
- (2) Fold-down laptop shelf and document holder for maintaining sign.
- (3) Modem/or communication device
- (4) Display system interface circuits
- (5) Local/remote control switch
- (6) RS-232 cable (a minimum of 4 feet long to connect the controller interface to a laptop computer)
- (7) A.C. surge protection and communication surge protection.

- d) *Electronics*: All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

All printed circuit boards shall be sealed with a silicone conformal coating.

Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

The VMS shall contain an automatically controlled defog system that warms the VMS front face when the internal VMS relative humidity is near condensation levels. This system shall keep the front face polycarbonate panel free of fog and condensation. The heat generated by the defog system shall not damage any part of the VMS.

The sign and the controller shall be capable of operating with 120/240 VAC, 50 amp per leg, 60 Hz, single phase power. The sign shall have a 50-amp two-pole breaker (common trip) main, 120/240 VAC, single phase, four wire load center with 20 circuit capability. Each circuit in the sign shall be powered from a circuit breaker. Inside the sign housing, all 120 VAC service lines shall be independently protected by a thermo magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet. There shall be a minimum of three GFI Duplex outlets installed inside the sign housing.

The VMS housing shall contain a minimum of one (1) compact fluorescent light (CFL) fixture for every eight (8) feet of VMS housing width. The lamps shall be evenly spaced across the housing ceiling and provide uniform light distribution for maintenance purposes. The light provided by the lamps shall meet the requirements of *ANSI/IESNA RP-7-01, Lighting Industrial Facilities*. Each lamp shall be rated for at least 10,000 hours of operation, have a minimum 30-watt rating, be self-ballasted, and be rated for cold weather operation down to -20° F. Lamp housing shall be heavy duty and enclosed to protect the lamps from damage. The lamps shall and have a color temperature of at least 4100°K.

The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1100 feet in all lighting conditions.

Sign brightness shall meet NEMA TS4-2005, Section 5, (12,400 cd/m<sup>2</sup> minimum white brightness). The LED drive current shall be less than 30mA for Red & less than 15mA for Blue and Green.

The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-1997, Technical Report: Measurement of LEDs.

Each LED module shall contain a printed circuit board to which LED pixels are soldered. The LED pixel matrix shall conform to the following specifications:

- Each LED module shall contain approximately 256 LED pixels configured in a two dimensional array. The pixel array shall be approximately sixteen (16) pixels high by sixteen (16) pixels wide.
- The distance from the center of one pixel to the center of all adjacent pixels, both horizontally and vertically, shall be 32-35 mm.
- Each pixel will contain a Red, Green, and Blue LED, each being independently driven.
- The failure of an LED string or pixel shall not cause the failure of any other LED string or pixel in the VMS.

- The base of the discrete LEDs shall be soldered such that the 30 degree field of view is consistent with field of view for the entire set of LEDs on the sign.
- All LED pixel boards shall be identical and interchangeable throughout the VMS.

### **Discrete LEDs**

VMS pixels shall be constructed with discrete LEDs manufactured by a reputable manufacturer such as Avago Technologies (formerly Agilent Technologies), Nichia

Corporation, OSRAM or EOI. Discrete LEDs shall conform to the following specifications:

- All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone.
- Color LEDs shall utilize AlInGaP semiconductor technology and shall emit light that has a peak wavelength of  $590 \pm 5$  nm. Color LEDs shall utilize Red AlInGaP 626 nm, Green InGaN 525 nm and Blue InGaN 470 nm.
- 
- The LED packages shall be fabricated from UV light resistant epoxy.
- The LED manufacturer shall perform intensity sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive luminous intensity "bins" as defined by the LED manufacturer.
- The LED manufacturer shall perform color sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive color "bins" as defined by the LED manufacturer.
- The various LED color and intensity bins shall be distributed evenly throughout the sign and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- The LED manufacturer shall assure color uniformity and consistency on the LED display face within the 30 degree cone of vision and shall not have inconsistent color shifts.
- LED package style shall be surface-mount or through-hole with or without standoffs.
- All LEDs used in all VMS provided for this contract shall be from the same manufacturer and of the same part number, except for the variations in the part number due to the intensity and color.
- The LEDs shall be rated by the LED manufacturer to have a minimum lifetime of 100,000 hours of continuous operation while maintaining a minimum of 70% of the original brightness.

### **Pixel Drive Circuitry**

Each LED display module shall contain electronic driver circuitry that shall individually control all pixels on that module. The driver circuitry shall conform to the following specifications:

- Each LED module shall be microprocessor-controlled and shall communicate with the sign controller on a wire or fiber optic communication network. The microprocessor shall process commands from the sign controller to display data, perform diagnostic tests, and report pixel and diagnostic status.
- The LED driver shall compensate for color based on temperature and LED color changing characteristics.
- Constant current LED driver ICs shall be used to prevent LED forward current from exceeding the LED manufacturer's recommended forward current whenever a forward voltage is applied. To maximize LED service life, LED drive currents will not be allowed that exceed the manufacturer's recommendations for the 100,000-hour lifetime requirement.
- The LED driver shall utilize PWM (Pulse Width Modulation) of the drive current to vary the output intensity of each LED. The drive current pulse shall be modulated at a frequency high enough eliminate visible flickering from zero to full-brightness.
- The LED driver circuitry shall receive updated display data at a minimum rate of ten (10) frames per second from the sign controller. Each LED driver circuit shall be powered by external regulated DC power supplies.
- The voltage of each power input shall be measured to the nearest tenth of a volt and reported to the sign controller upon request. Each driver circuit shall also contain a status LED for the power source that indicates if the power source is present or not.
- The LED driver circuitry shall be able to detect that individual LED strings or pixels are stuck off and shall report the pixel status to the sign controller upon request.
- The LED driver circuit shall contain a seven segment numeric LED display that indicates the functional status of the LED pixel display module. At a minimum, it shall indicate error states of the LED pixels and communication network. The indicator shall be positioned such that a maintenance technician can easily view the status code for diagnostic purposes. The LED display module shall report the status, including pixel errors, voltage levels, etc to the sign controller upon request.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of three photocells shall be installed on the sign. These devices shall permit automatic light intensity measurement of light conditions at each sign location. These photocells shall be mounted in a manner to measure front, rear and ambient light conditions.

Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The sign shall be configured such that a UPS will be able to run all necessary control electronics, communication equipment, and the left half of the sign display in the event of a power failure.

Power supplies for the sign display shall be configured such that the failure of any one supply does not degrade functionality of the display and the display remains 100% functional.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line. The Concessionaire shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the LED VMS. The Concessionaire shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

- e) *Communication:* The sign controller shall be capable of being controlled from the central system control software and the controller interface cabinet via RS-232 serial and Ethernet communications.

The sign controller shall include separate interfaces for communication with the central system control software and the controller interface cabinet.

The communications between the sign controller and the central system control software and controller interface cabinet shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Dial-up or hardwire multi-drop communication lines shall be protected by two stages of transient voltage suppression devices including MOVs and spark gap arrestor.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign shall provide a minimum of four (4) input and four (4) output contact closures able to receive digital and or analog signals that allow at least 15 message activations upon contact closure events. These message activations shall permit standard NTCIP operations to occur and also permit contact closure messages to occur without message activation collisions and or message activation errors. Contact closures shall be remotely accessible using standard NTCIP MIB objects. Contact closures shall be capable of issuing NTCIP traps.

The sign controller shall provide software modules that will allow integration with CDOT WIM systems.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

- (1) Pixel operational status that includes the state of every pixel
- (2) Sign and ambient temperature
- (3) DC power supply status
- (4) The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.
- (5) Cooling fan status
- (6) Access door alarm
- (7) Communication failure log
- (8) UPS status
- (9) AC surge protector status

The controller software shall be capable of displaying the following types of messages:

- (1) Static messages capable of displaying any character or set of characters
- (2) Full Graphic capabilities.
- (3) Flashing messages with the following ranges of adjustable timing:
  - (a) Message time on from 0.5 to 5.0 seconds in 0.1 second increments.
  - (b) Message time off from 0.5 to 5.0 seconds in 0.1 second increments.
- (4) Alternating messages capable with the following ranges of adjustable timing:
  - (a) Primary message time on from 0.5 to 5.0 seconds in 0.1 second increments.
  - (b) Primary message time off from 0 to 5.0 seconds in 0.1 second increments.
  - (c) Alternate message time on from 0.5 to 5.0 seconds in 0.1 second increments.
  - (d) Alternate message time off from 0 to 5.0 seconds in 0.1 second increments.
- (5) Capability to do Text rectangles, Background colors, Foreground Colors, Support 24 Bit Color Scheme as specified by NTCIP 1203 v2

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message.

The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.

### **MANUFACTURER QUALIFICATIONS**

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing Interstate COLOR LED Variable Message Signs for a minimum of 5 years; and that the manufacturer has in operation a minimum of 50 walk-in VMSs 1 of which being COLOR LED VMSs and NTCIP compliant.

### **CONSTRUCTION REQUIREMENTS**

Concessionaire shall be fully responsible for the delivery of the sign to the installation site and any damages that occur in the installation delivery process.

The LED VMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The LED VMS shall be mounted on a sign bridge and co-located with the static interchange advance guide signs. They shall be centered over the general purpose travelled lanes but be visible to all roadway users. Where ROW permits, an 8-foot wide paved area shall be provided for maintenance access. The sign bridge shall have a locked, secured ladder and walkway so that maintenance personnel can maintain every portion of the sign bridge without the use of a bucket truck. The walkway shall have a mesh of adequate size to prevent dropped tools from falling onto the travelled way. The Concessionaire shall prepare a structural design for each VMS structure and provide to CDOT ITS for approval.

The Concessionaire shall submit a "VMS acceptance test procedure" for Acceptance by the Department and perform the test in the presence of CDOT ITS and the Manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Concessionaire shall notify the CDOT ITS at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VMS system, including spare software copies, shall be provided.

Additional copies may be requested by CDOT ITS. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

**WARRANTY**

The Concessionaire shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all VMS related equipment problems and maintenance issues.

**TRAINING**

The Manufacturer shall provide 8 hours of class room training for CDOT ITS at the CTMC in Golden, CO. The Manufacturer shall supply 8 hours of on-site training in the sign for the CTMC staff.

**Appendix A****NTCIP Requirements**

This portion of the specification defines the detailed NTCIP requirements for the Variable Message Signs covered by the project specifications.

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard. Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of January, 01, 2011, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

**General Requirements:****Subnet Level**

Each NTCIP Component shall support NTCIP 2104 v01.11 over both a null-modem connection and a Concessionaire-provided external dial-up modem connection. The dial-up modem shall support data rates of 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. The null-modem shall support the same speeds with a maximum of 19.2 kbps.

Additionally, the NTCIP Component shall be able to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT Command Set
- MNP5
- MNP10
- V.42bis

NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profiles shall be active on a given serial port of the NTCIP Component. If the NTCIP Component has a serial port that supports multiple Subnet Profiles, the NTCIP



Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

#### **Transport Level**

Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3. Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

#### **Application Level**

Each VMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

#### **Information Level**

Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below or approved by CDOT. The maximum Response Time for any object or group of objects shall be 100 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:

- Configuration Conformance Group – Section 3.1
- Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:

- Time Management Conformance Group – Section 3.3
- TimeBase Event Schedule Conformance Group – Section 3.4
- Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203 v0239b (NEMA TS 3.6) Object Definitions for Variable Message Signs:

- Sign Configuration Capability Objects – Section 5.2
- VMS Configuration Objects – Section 5.3
- Font Definitions Objects – Section 5.4

- Multi Configuration Objects – Section 5.5
- Message Objects – Section 5.6
- Sign Control Objects – Section 5.7
- Illumination/Brightness Objects – Section 5.8
- Scheduling Action Objects – Section 5.9
- Auxiliary I/O Objects - Section 5.10
- Sign Status – Section 5.11
- Graphic Definitions Objects – Section 5.12

The vendor's software shall implement the following optional objects defined in NTCIP 1203 v0239b, (NEMA TS 3.6):

- dmsMessageBeacon – Section 5.6.8.6
- dmsSWReset – Section 5.7.2
- dmsMessageTimeRemaining – Section 5.7.4
- dmsShortPowerRecoveryMessage – Section 5.7.8
- dmsLongPowerRecoveryMessage – Section 5.7.9
- dmsShortPowerLossTime – Section 5.7.10
- dmsResetMessage – Section 5.7.11
- dmsCommunicationsLossMessage – Section 5.7.12
- dmsTimeCommLoss – Section 5.7.13
- dmsPowerLossMessage – Section 5.7.14
- dmsEndDurationMessage – Section 5.7.15
- dmsMultiOtherErrorDescription – Section 5.7.20
- dmsStatDoorOpen – Section 5.11.1.6
- fanFailures – Section 5.11.2.3.1
- fanTestActivation – Section 5.11.2.3.2
- tempMinCtrlCabinet – Section 5.11.4.1
- tempMaxCtrlCabinet – Section 5.11.4.2
- tempMinAmbient – Section 5.11.4.3
- tempMaxAmbient – Section 5.11.4.4
- tempMinSignHousing – Section 5.11.4.5
- tempMaxSignHousing – Section 5.11.4.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in Section 6.0 of NTCIP 1203 v0239b, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

### **MULTI Tag**

1. Field – Section 6.4.5
2. Flash – Section 6.4.6
3. Font – Section 6.4.7
4. Hexadecimal Character – Section 6.4.9
5. Justification Line – Section 6.4.10
6. Justification Page – Section 6.4.11
7. Moving Text – Section 6.4.13
8. New Line – Section 6.4.14
9. New Page – Section 6.4.15
10. Page Time – Section 6.4.16
11. Spacing – Character – Section 6.4.17
12. Color Background – Section 6.4.1
13. Page Background Color – Section 6.4.2
14. Color Rectangles – Section 6.4.4
15. Color Foreground – Section 6.4.3
16. Graphic Tags – Section 6.4.8
17. Text Rectangles – Section 6.4.18

The Field Tag shall support the following field ID's:

	<b><u>Field Tag ID</u></b>	<b><u>Description</u></b>
1	1	Time, 12-hour format (no AM/PM indicator)
2	2	Time, 24-hour format
3	3	Temperature in degrees Celsius
4	4	Temperature in degrees Fahrenheit
5	7	Day of week
6	8	Day of month
7	9	Month of year
8	10	Year, 2-digits
9	11	Year, 4-digits

### **Sizes and Ranges**

All objects required by these procurement specifications shall support all values within its standardized range, unless otherwise approved by CDOT ITS. The standardized range is defined by a size, range, or

enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

<b>Object</b>	<b>Reference</b>	<b>Minimum Project Requirements</b>
<b>NTCIP 1201 (TS 3.4)</b>		
moduleTableEntry	2.2.3	Shall contain at least one row with moduleType equal to 3 (software). The moduleMake shall specify the name of the manufacturer, the moduleModel shall specify the manufacturer's name of the component and the modelVersion shall indicate the model version number of the component.
communityNamesMax	2.8.2	Shall be at least 4.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1
<b>NTCIP 1203 v0239b (TS 3.6)</b>		
dmsNumPermanentMsg	5.6.1	100
dmsMaxChangeableMsg	5.6.3	100
dmsFreeChangeableMemory	5.6.4	500 MB
dmsMaxVolatileMsg	5.6.6	100
dmsFreeVolatileMemory	5.6.7	500 MB
dmsMsgMultiString	5.6.8.3	See attached table
dmsControlMode	5.7.1	2,4,5
numFonts	5.4.1	10
maxFontCharacters	5.4.3	127
DMSCharacterHeightPixels	5.3.1	7
DMSCharacterWidthPixels	5.3.2	5
DMSSignHeightPixels	5.3.3	27
DMSSignWidthPixels	2.3.1.1.1.4	105
DMSHorizontalPitch	5.3.5	32 - 35 mm
DMSVerticalPitch	5.3.6	32 - 35 mm
defaultBackgroundColor	5.5.1	0 (black)
defaultJustificationLine	5.5.9	2,3,4
defaultJustificationPage	5.5.11	2,3,4
defaultFlashOn	5.5.3	0.5 to 5.0
defaultFlashOff	5.5.5	0.5 to 5.0
defaultPageOnTime	5.5.13	0.5 to 5.0
defaultPageOffTime	5.5.15	0.5 to 5.0
defaultCharacterSet	5.5.21	eightBit (2)
dmsMaxNumberPages	5.5.24	6
dmsColorScheme	5.5.22	4 (Color24bit)
dmsSupportedMultiTags	5.5.23	See Section 614 more Multi Tags details.
dmsGraphicMaxEntries	5.12.1	100

dmsGraphicMaxSize	5.12.3	65,535 Bytes
dmsGraphicBlockSize	5.12.5	65,535 Bytes

**Documentation**

The Software shall be supplied with full documentation and a CD-Rom containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format: relevant version of each official standard MIB Module referenced by the device functionality.

If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the

- associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension “.man”.
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT ITS for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

**REVISION OF SECTION 614  
VARIABLE MESSAGE SIGN (COLOR LED) (SIDE-MOUNTED)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

This work consists of furnishing and installing a pole-mounted Light Emitting Diode Variable Message Sign (LED VMS) and associated equipment cabinets at locations as shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The LED VMS shall be equipped with a minimum 80x80 pixel matrix with a 20mm pitch, provide a minimum of 32,000 colors and shall have the ability to display text and graphics. The sign shall include a power shut off mounted to the sign structure near the controller interface cabinet. The sign shall be capable of operating without any decrease in performance over a temperature range of 30° F to +140° F with a relative humidity of 0 to 99 percent, non-condensing. The sign shall have a minimum design life of 20 years. A uninterruptable power supply sufficiently sized to operate the VMS for 8 hours shall be provided.

**MATERIALS**

- a) *Certifications:* Prior to start of the installation of the LED VMS the Contractor shall provide the following certifications to CDOT for Approval:
- (1) Certification showing that the manufacturer of the LED VMS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LED VMS. The facility where this company actually designs and manufactures the LED VMS shall be ISO 9001:2000 certified a minimum of one year prior to the bid date for this project.
  - (2) Working drawings showing the sign housing and tilting brackets shall be sealed by an Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02.
  - (3) Certification showing that welding of the LED VMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED VMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.
  - (4) Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605.
  - (5) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.
  - (6) Documentation and information on software as described in Appendix A of this document.
  - (7) Documentation verifying the VMS is listed by an accredited 3<sup>rd</sup> party testing organization for conformance to UL48 and UL 1433.

- (8) All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",
  - (9) Documentation providing proof PCB silicon conformal coating conformance to MIL-I-46058C Type SR and IPC-CC-830.
  - (10) Documentation that the sign's structural integrity is in Conformance to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (Third Draft).
  - (11) Documentation that the VMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.
- b) *Sign Housing:* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. The housing shall be weather tight, and compliant to the NEMA 3R Standard.

*All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.*

*The glazing shall be constructed of clear polycarbonate sheets with surfaces that resist hazing from UV light. coated 0.090 inch the glazing shall be protected by an aluminum mask with apertures punched directly in front of each pixel. The coating shall meet or exceed the AAMA Specification No. 2605.*

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to call central and report the error condition (for dialup operation) or report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

- c) *Sign controller:* The sign controller shall be located in a pole or ground mounted cabinet. Each LED VMS shall have its own IP address. The controller for the signs shall be NTCIP-compliant and capable of controlling multiple SMVMSs co-located on the structure sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VMS control software in order to perform most VMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein
- Contain a minimum of three (3) NTCIP-compliant RS232 communication ports
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Contain a minimum of one (1) NTCIP-compliant RS422 communication port with RJ45 connector
- Have the ability to play volatile messages
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the VMS controller. External protocol converter or translator devices shall not be allowed. The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer. The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

- d) *Electronics:* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

All Printed Circuit Boards (PCBs) shall be completely conformal coated with a silicone resin that meets the IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.



All integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

Provisions shall be made to prevent face fogging and condensation. The sign controller shall read the internal temperature sensors, external ambient temperature sensor and the humidity sensor. The sign controller shall use these readings in an algorithm that turns on the heating or ventilation system to reduce both frost on the face of the sign and condensation on the display modules and other electronic circuitry. If the sign does not require a heating or ventilation system, third party NEMA TS4 testing results shall be submitted that document this.

The sign and controller power conductors shall be engineered to accommodate the maximum operational load, with spare capacity. Each circuit in the sign shall be powered from a circuit breaker. Inside the sign cabinet, all 120 VAC service lines shall be independently protected by a thermo-magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet. There shall be a minimum of one GFI Duplex outlet installed inside the sign housing.

The pixels shall be full red/green/amber in color and utilize precision optical performance AlInGaP II LEDs constructed of aluminum indium gallium phosphide. The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1,100 feet in all lighting conditions. Each pixel shall be 40 candelas at 20mA as measured by the sum of the brightness of the individual LEDs in each pixel. The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-1997, Technical Report: Measurement of LEDs. All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone.

Each pixel shall contain two strings of LEDs. The pixel strings shall be powered from a regulated DC power source and the LED current shall be maintained at 25 plus or minus three milliamperes per string to maximize life of the pixel. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel. The LEDs shall be capable of operating in a temperature range of 30 degrees to +85 degrees C. The LEDs shall be moisture resistant epoxy with UV-A and UV-B inhibitors.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of one photocell shall be installed on the sign. This device shall permit monitoring of light conditions at each sign location and automatic selection of light intensity levels. The method of algorithm used to calculate the intensity

level shall be determined by the manufacturer and tested under real world conditions.

Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The power supplies shall be paralleled in a diode OR configuration such that one supply may completely fail and the sign will still be supplied with enough power to run 40% of all pixels.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

The Contractor shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the LED VMS. The Contractor shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

- e) *Communication:* The sign controller shall be capable of being controlled from the central system control software and the controller interface cabinet via RS-232 serial and Ethernet communications.

The sign controller shall include separate interfaces for communication with the central system control software and the controller interface cabinet.

The communications between the sign controller and the central system control software and controller interface cabinet shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Dial-up or hardwire multi-drop communication lines shall be protected by two stages of transient voltage suppression devices including MOVs and spark gap arrester.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign shall provide a minimum of four (4) input and four (4) output contact closures able to receive digital and or analog signals that will allow up to 15 message activations upon contact closure events. These message activations shall permit standard NTCIP operations to occur and also permit contact closure

messages to occur without message activation collisions and or message activation errors. Contact closures shall be remotely accessible using standard NTCIP MIB objects. Contact closures shall be capable of issuing NTCIP traps.

The sign controller shall provide software modules that will allow integration with CDOT CTMS systems.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

- (1) Pixel operational status that includes every string of every pixel
- (2) Sign and ambient temperature
- (3) DC power supply status
- (4) The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.
- (5) Communication failure log
- (6) UPS status
- (7) AC surge protector status

The controller software shall be capable of displaying the following types of messages:

- (1) Static messages capable of displaying any character or set of characters
- (2) Full Graphic capabilities.

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message.

The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.

### **MANUFACTURER QUALIFICATIONS**

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing Interstate LED Variable Message Signs for a minimum of 5 years; and that the manufacturer has in operation a minimum of 100 LED VMSs. These 100 VMS shall be from 5 separate projects and operational for a minimum of 5 years.

## CONSTRUCTION REQUIREMENTS

Contractor shall be fully responsible for the delivery of the sign to the installation site and any damages that occur in the installation delivery process.

The LED VMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Contractor shall submit a "VMS acceptance test procedure" for acceptance and shall perform the test in the presence of CDOT and the manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Contractor shall notify CDOT at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VMS system, including spare software copies, shall be provided. Additional copies may be requested by CDOT. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

## WARRANTY

- a) *Standard Warranty.* The contractor shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all VMS related equipment problems and maintenance issues.

## Appendix A

### NTCIP Requirements

This portion of the specification defines the detailed NTCIP requirements for the Variable Message Signs covered by the project specifications.

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard.

Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of Sunday, April 03, 2001, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

**General Requirements:****Subnet Level**

Each NTCIP Component shall support NTCIP 2103 v01.05 over both a null-modem connection and a contractor-provided external dial-up modem connection. The dial-up modem shall support data rates of 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. The null-modem shall support the same speeds with a maximum of 19.2 kbps. Additionally, the NTCIP Component shall be able to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT Command Set
- MNP5
- MNP10
- V.42bis

NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profiles shall be active on a given serial port of the NTCIP Component. If the NTCIP Component has a serial port that supports multiple Subnet Profiles, the NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

**Transport Level**

Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3.Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

**Application Level**

Each VMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMf), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

**Information Level**

Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:

- Configuration Conformance Group – Section 3.1
- Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:

- Time Management Conformance Group – Section 3.3
- TimeBase Event Schedule Conformance Group – Section 3.4
- Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203, (NEMA TS 3.6) Object Definitions for Variable Message Signs:

- Sign Configuration Conformance Group – Section 4.1
- Message Table Conformance Group – Section 4.6
- Sign Control Conformance Group – Section 4.7

The vendor's software shall implement all mandatory objects of the optional conformance groups defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

- GUI Appearance – Section 4.2
- Font Definition – Section 4.3
- VMS Sign Configuration – Section 4.4
- MULTI Configuration – Section 4.5
- Default Message – Section 4.8
- MULTI Error – Section 4.10
- Illumination/Brightness – Section 4.11
- Scheduling – Section 4.12
- Auxiliary I/O – Section 4.13
- Sign Status – Section 4.14
- Status Error – Section 4.15
- Pixel Error Status – Section 4.16
- Fan Error Status – Section 4.18
- Temperature Status – Section 4.17

The vendor's software shall implement the following optional objects defined in NTCIP 1203, (NEMA TS 3.6):

- dmsMessageBeacon – Section 2.6.1.1.1.8.6

- dmsSWReset – Section 2.7.1.1.1.1
- dmsMessageTimeRemaining – Section 2.7.1.1.1.4
- dmsShortPowerRecoveryMessage – Section 2.7.1.1.1.8
- dmsLongPowerRecoveryMessage – Section 2.7.1.1.1.9
- dmsShortPowerLossTime – Section 2.7.1.1.1.10
- dmsResetMessage – Section 2.7.1.1.1.11
- dmsCommunicationsLossMessage – Section 2.7.1.1.1.12
- dmsTimeCommLoss – Section 2.7.1.1.1.13
- dmsPowerLossMessage – Section 2.7.1.1.1.14
- dmsEndDurationMessage – Section 2.7.1.1.1.15
- dmsMultiOtherErrorDescription – Section 2.7.1.1.1.20
- dmsStatDoorOpen – Section 2.11.1.1.1.6
- fanFailures – Section 2.11.2.1.1.8
- fanTestActivation – Section 2.11.2.1.1.9
- tempMinCtrlCabinet – Section 2.11.4.1.1.1
- tempMaxCtrlCabinet – Section 2.11.4.1.1.2
- tempMinAmbient – Section 2.11.4.1.1.3
- tempMaxAmbient – Section 2.11.4.1.1.4
- tempMinSignHousing – Section 2.11.4.1.1.5
- tempMaxSignHousing – Section 2.11.4.1.1.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

**MULTI Tag**

- |    |                       |
|----|-----------------------|
| 1  | Field                 |
| 2  | Flash                 |
| 3  | Font                  |
| 4  | Hexadecimal Character |
| 5  | Justification Line    |
| 6  | Justification Page    |
| 7  | Moving Text           |
| 8  | New Line              |
| 9  | New Page              |
| 10 | Page Time             |

## 11 Spacing – Character

The Field Tag shall support the following field ID's:

<b>Field Tag ID</b>	<b>Description</b>
1	1 Time, 12-hour format (no AM/PM indicator)
2	2 Time, 24-hour format
3	3 Temperature in degrees Celsius
4	4 Temperature in degrees Fahrenheit
5	7 Day of week
6	8 Day of month
7	9 Month of year
8	10 Year, 2-digits
9	11 Year, 4-digits

**Sizes and Ranges**

All objects required by these procurement specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

<b>Object</b>	<b>Reference</b>	<b>Minimum Project Requirements</b>
<b>NTCIP 1201 (TS 3.4)</b>		
moduleTableEntry	2.2.3	Shall contain at least one row with moduleType equal to 3 (software). The moduleMake shall specify the name of the manufacturer, the moduleModel shall specify the manufacturer's name of the component and the modelVersion shall indicate the model version number of the component.
communityNamesMax	2.8.2	Shall be at least 4.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1
<b>NTCIP 1203 (TS 3.6)</b>		
dmsNumPermanentMsg	2.6.1.1.1.1	50
dmsMaxChangeableMsg	2.6.1.1.1.3	50
dmsFreeChangeableMemory	2.6.1.1.1.4	50KB
dmsMaxVolatileMsg	2.6.1.1.1.6	50
dmsFreeVolatileMemory	2.6.1.1.1.7	50KB
dmsMsgMultiString	2.6.1.1.1.8.3	See attached table



dmsControlMode	2.7.1.1.1.1	2,4,5
numFonts	2.4.1.1.1.1	4
maxFontCharacters	2.4.1.1.1.3	127
vmsCharacterHeightPixels	2.3.1.1.1.1	5
vmsCharacterWidthPixels	2.3.1.1.1.2	7
vmsSignHeightPixels	2.3.1.1.1.3	3
vmsSignWidthPixels	2.3.1.1.1.4	10
vmsHorizontalPitch	2.3.1.1.1.5	70mm
vmsVerticalPitch	2.3.1.1.1.6	70mm
defaultBackgroundColor	2.5.1.1.1.1	0 (black)
defaultForegroundColor	2.5.1.1.1.2	9 (amber)
defaultJustificationLine	2.5.1.1.1.6	2,3,4
defaultJustificationPage	2.5.1.1.1.7	2,3,4
defaultFlashOn	2.5.1.1.1.3	0.5 to 5.0
defaultFlashOff	2.5.1.1.1.4	0.5 to 5.0
defaultPageOnTime	2.5.1.1.1.8	0.5 to 5.0
defaultPageOffTime	2.5.1.1.1.9	0.5 to 5.0
defaultCharacterSet	2.5.1.1.1.10	eightBit (2)
numActionTableEntries	2.9.1.1.1.1	15

## Documentation

Software shall be supplied with full, electronic documentation containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension “.man”.
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

**REVISION OF SECTION 614  
LANE USE SIGN (COLOR LED)(OVERHEAD)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

This work consists of furnishing and installing a Light Emitting Diode Lane Use Sign (LUS) and associated equipment cabinets at locations as shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The LED LUS shall be equipped with a 48x48 pixel matrix with a 20mm pitch, provide a minimum of 32,000 colors, and have the ability to display text and graphics. The sign shall include a power shut off mounted to the sign structure near the controller interface cabinet. The sign shall be capable of operating without any decrease in performance over a temperature range of 30° F to +140° F with a relative humidity of 0 to 99 percent, non-condensing. The sign shall have a minimum design life of 20 years.

**MATERIALS**

- a) *Certifications:* Prior to start of the installation of the LUS the Contractor shall provide the following certifications to CDOT for Approval:
- (1) Certification showing that the manufacturer of the LUS is fully compliant with ISO 9001 as of the bid date for this project. The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LUS. The facility where this company actually designs and manufactures the LUS shall be ISO 9001:2000 certified a minimum of one year prior to the bid date for this project.
  - (2) Working drawings showing the sign housing and tilting brackets shall be sealed by an Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02.
  - (3) Certification showing that welding of the LUS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED VMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.
  - (4) Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605.
  - (5) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.
  - (6) Documentation and information on software as described in Appendix A of this document.
  - (7) Documentation verifying the LUS is listed by an accredited 3<sup>rd</sup> party testing organization for conformance to UL48 and UL 1433.

- (8) All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",
  - (9) Documentation providing proof PCB silicon conformal coating conformance to MIL-I-46058C Type SR and IPC-CC-830.
  - (10) Documentation that the sign's structural integrity is in Conformance to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (Third Draft).
  - (11) Documentation that the VMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section 2.
- b) *Sign Housing:* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. The housing shall be weather tight, and compliant to the NEMA 3R Standard.

*All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.*

*The glazing shall be constructed of clear polycarbonate sheets with surfaces that resist hazing from UV light. The glazing shall be protected by an aluminum mask with apertures punched directly in front of each pixel. The coating shall meet or exceed the AAMA Specification No. 2605.*

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to call central and report the error condition (for dialup operation) or report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

- c) *Sign controller:* The sign controller shall be located in a pole or ground mounted cabinet. Each LUS shall have its own IP address. The controller for the signs shall be NTCIP-compliant and capable of controlling multiple LUSs co-located on the structure. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with LUS control software in order to perform most LUS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein
- Contain a minimum of three (3) NTCIP-compliant RS232 communication ports
- Contain a minimum of one (1) NTCIP-compliant Ethernet port with RJ45 connector
- Contain a minimum of one (1) NTCIP-compliant RS422 communication port with RJ45 connector
- Have the ability to play volatile messages
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the VMS controller. External protocol converter or translator devices shall not be allowed. The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer. The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

- d) *Electronics:* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.

All Printed Circuit Boards (PCBs) shall be completely conformal coated with a silicone resin that meets the IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.

All integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

Provisions shall be made to prevent face fogging and condensation. The sign controller shall read the internal temperature sensors, external ambient temperature sensor and the humidity sensor. The sign controller shall use these readings in an algorithm that turns on the heating or ventilation system to reduce both frost on the face of the sign and condensation on the display modules and other electronic circuitry. If the sign does not require a heating or ventilation system, third party NEMA TS4 testing results shall be submitted that document this.

Power conductors engineered to accommodate the maximum operational load, with spare capacity. Each circuit in the sign shall be powered from a circuit breaker. Inside the sign cabinet, all 120 VAC service lines shall be independently protected by a thermo-magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet. There shall be a minimum of three GFI Duplex outlets installed inside the sign housing.

The pixels shall be red/green/amber in color and utilize precision optical performance AlInGaP II LEDs constructed of aluminum indium gallium phosphide. The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1,100 feet in all lighting conditions. Each pixel shall be 40 candelas at 20mA as measured by the sum of the brightness of the individual LEDs in each pixel. The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-1997, Technical Report: Measurement of LEDs. All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone. Each pixel shall contain two strings of LEDs. The pixel strings shall be powered from a regulated DC power source and the LED current shall be maintained at 25 plus or minus three milliamperes per string to maximize life of the pixel. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel. The LEDs shall be capable of operating in a temperature range of -30 degrees to +85 degrees C. The LEDs shall be moisture resistant epoxy with UV-A and UV-B inhibitors.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of one photocells shall be installed on the sign. This device shall permit monitoring of light conditions at each sign location and automatic selection of light intensity levels. The method or algorithm used to calculate the intensity level shall be determined by the manufacturer and tested under real world conditions.

Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The power supplies shall be paralleled in a diode OR configuration such that one supply may completely fail and the sign will still be supplied with enough power to run 40% of all pixels.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

The Contractor shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the LUS. The Contractor shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

- e) *Communication:* The sign controller shall be capable of being controlled from the central system control software and the controller interface cabinet via RS-232 serial and Ethernet communications.

The sign controller shall include separate interfaces for communication with the central system control software and the controller interface cabinet.

The communications between the sign controller and the central system control software and controller interface cabinet shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Dial-up or hardwire multi-drop communication lines shall be protected by two stages of transient voltage suppression devices including MOVs and spark gap arrestor.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign shall provide a minimum of four (4) input and four (4) output contact closures able to receive digital and or analog signals that will allow up to 15 message activations upon contact closure events. These message activations shall permit standard NTCIP operations to occur and also permit contact closure messages to occur without message activation collisions and or message

activation errors. Contact closures shall be remotely accessible using standard NTCIP MIB objects. Contact closures shall be capable of issuing NTCIP traps.

The sign controller shall provide software modules that will allow integration with CDOT CTMS systems.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

- (1) Pixel operational status that includes every string of every pixel
- (2) Sign and ambient temperature
- (3) DC power supply status
- (4) The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.
- (5) Communication failure log
- (6) UPS status
- (7) AC surge protector status

The controller software shall be capable of displaying the following types of messages:

- (1) Static messages capable of displaying any character or set of characters
- (2) Full Graphic capabilities.

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message.

The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.

### **MANUFACTURER QUALIFICATIONS**

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing Interstate LUS for a minimum of 5 years; and that the manufacturer has in operation a minimum of 100 LUSs. These 100 LUS shall be from 5 separate projects and operational for a minimum of 5 years.

### **CONSTRUCTION REQUIREMENTS**

Contractor shall be fully responsible for the delivery of the sign to the installation site and any damages that occur in the installation delivery process.

The LUS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Contractor shall submit a "LUS acceptance test procedure" for acceptance and shall perform the test in the presence of CDOT and the manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Contractor shall notify CDOT at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the LUS system, including spare software copies, shall be provided. Additional copies may be requested by CDOT. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

## **WARRANTY**

- b) *Standard Warranty.* The contractor shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all LUS related equipment problems and maintenance issues.

## **Appendix A**

### **NTCIP Requirements**

This portion of the specification defines the detailed NTCIP requirements for the Variable Message Signs covered by the project specifications.

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard.

Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of Sunday, April 03, 2001, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

### **General Requirements:**



**Subnet Level**

Each NTCIP Component shall support NTCIP 2103 v01.05 over both a null-modem connection and a contractor-provided external dial-up modem connection. The dial-up modem shall support data rates of 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. The null-modem shall support the same speeds with a maximum of 19.2 kbps. Additionally, the NTCIP Component shall be able to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT Command Set
- MNP5
- MNP10
- V.42bis

NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profiles shall be active on a given serial port of the NTCIP Component. If the NTCIP Component has a serial port that supports multiple Subnet Profiles, the NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

**Transport Level**

Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3.Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

**Application Level**

Each VMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

**Information Level**

Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:

- Configuration Conformance Group – Section 3.1
- Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:

- Time Management Conformance Group – Section 3.3
- TimeBase Event Schedule Conformance Group – Section 3.4
- Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203, (NEMA TS 3.6) Object Definitions for Variable Message Signs:

- Sign Configuration Conformance Group – Section 4.1
- Message Table Conformance Group – Section 4.6
- Sign Control Conformance Group – Section 4.7

The vendor's software shall implement all mandatory objects of the optional conformance groups defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

- GUI Appearance – Section 4.2
- Font Definition – Section 4.3
- VMS Sign Configuration – Section 4.4
- MULTI Configuration – Section 4.5
- Default Message – Section 4.8
- MULTI Error – Section 4.10
- Illumination/Brightness – Section 4.11
- Scheduling – Section 4.12
- Auxiliary I/O – Section 4.13
- Sign Status – Section 4.14
- Status Error – Section 4.15
- Pixel Error Status – Section 4.16
- Fan Error Status – Section 4.18
- Temperature Status – Section 4.17
- 

The vendor's software shall implement the following optional objects defined in NTCIP 1203, (NEMA TS 3.6):

- dmsMessageBeacon – Section 2.6.1.1.1.8.6
- dmsSWReset – Section 2.7.1.1.1.1

- dmsMessageTimeRemaining – Section 2.7.1.1.1.4
- dmsShortPowerRecoveryMessage – Section 2.7.1.1.1.8
- dmsLongPowerRecoveryMessage – Section 2.7.1.1.1.9
- dmsShortPowerLossTime – Section 2.7.1.1.1.10
- dmsResetMessage – Section 2.7.1.1.1.11
- dmsCommunicationsLossMessage – Section 2.7.1.1.1.12
- dmsTimeCommLoss – Section 2.7.1.1.1.13
- dmsPowerLossMessage – Section 2.7.1.1.1.14
- dmsEndDurationMessage – Section 2.7.1.1.1.15
- dmsMultiOtherErrorDescription – Section 2.7.1.1.1.20
- dmsStatDoorOpen – Section 2.11.1.1.1.6
- fanFailures – Section 2.11.2.1.1.8
- fanTestActivation – Section 2.11.2.1.1.9
- tempMinCtrlCabinet – Section 2.11.4.1.1.1
- tempMaxCtrlCabinet – Section 2.11.4.1.1.2
- tempMinAmbient – Section 2.11.4.1.1.3
- tempMaxAmbient – Section 2.11.4.1.1.4
- tempMinSignHousing – Section 2.11.4.1.1.5
- tempMaxSignHousing – Section 2.11.4.1.1.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

**MULTI Tag**

12	Field
13	Flash
14	Font
15	Hexadecimal Character
16	Justification Line
17	Justification Page
18	Moving Text
19	New Line
20	New Page
21	Page Time

## 22 Spacing – Character

The Field Tag shall support the following field ID's:

<b>Field Tag ID</b>	<b>Description</b>
1	1 Time, 12-hour format (no AM/PM indicator)
2	2 Time, 24-hour format
3	3 Temperature in degrees Celsius
4	4 Temperature in degrees Fahrenheit
5	7 Day of week
6	8 Day of month
7	9 Month of year
8	10 Year, 2-digits
9	11 Year, 4-digits

### Sizes and Ranges

All objects required by these procurement specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

<b>Object</b>	<b>Reference</b>	<b>Minimum Project Requirements</b>
<b>NTCIP 1201 (TS 3.4)</b>		
moduleTableEntry	2.2.3	Shall contain at least one row with moduleType equal to 3 (software). The moduleMake shall specify the name of the manufacturer, the moduleModel shall specify the manufacturer's name of the component and the modelVersion shall indicate the model version number of the component.
communityNamesMax	2.8.2	Shall be at least 4.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1
<b>NTCIP 1203 (TS 3.6)</b>		
dmsNumPermanentMsg	2.6.1.1.1.1	50
dmsMaxChangeableMsg	2.6.1.1.1.3	50
dmsFreeChangeableMemory	2.6.1.1.1.4	50KB
dmsMaxVolatileMsg	2.6.1.1.1.6	50
dmsFreeVolatileMemory	2.6.1.1.1.7	50KB
dmsMsgMultiString	2.6.1.1.1.8.3	See attached table

dmsControlMode	2.7.1.1.1.1	2,4,5
numFonts	2.4.1.1.1.1	4
maxFontCharacters	2.4.1.1.1.3	127
vmsCharacterHeightPixels	2.3.1.1.1.1	5
vmsCharacterWidthPixels	2.3.1.1.1.2	7
vmsSignHeightPixels	2.3.1.1.1.3	3
vmsSignWidthPixels	2.3.1.1.1.4	10
vmsHorizontalPitch	2.3.1.1.1.5	70mm
vmsVerticalPitch	2.3.1.1.1.6	70mm
defaultBackgroundColor	2.5.1.1.1.1	0 (black)
defaultForegroundColor	2.5.1.1.1.2	9 (amber)
defaultJustificationLine	2.5.1.1.1.6	2,3,4
defaultJustificationPage	2.5.1.1.1.7	2,3,4
defaultFlashOn	2.5.1.1.1.3	0.5 to 5.0
defaultFlashOff	2.5.1.1.1.4	0.5 to 5.0
defaultPageOnTime	2.5.1.1.1.8	0.5 to 5.0
defaultPageOffTime	2.5.1.1.1.9	0.5 to 5.0
defaultCharacterSet	2.5.1.1.1.10	eightBit (2)
numActionTableEntries	2.9.1.1.1.1	15

## Documentation

Software shall be supplied with full, electronic documentation containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension “.man”.
- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

**REVISION OF SECTION 614  
COMMUNICATIONS CABINET (CDOT)**

Section 614 of the Standard specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

Communications cabinet shall be furnished and installed at designated Intelligent Transportation System (ITS) field device sites to house and protect electrical power components, DIN rails, field equipment, serial servers, communications telemetry equipment and fiber optic termination panels.

Subsection 614.08 (c) shall be deleted and replaced with the following:

Communications cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type 4X<sup>1</sup> rating. Communications cabinets shall be constructed of 0.125 inch Type 5052 H-32 aluminum conforming to the requirements of ASTM B209 *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*. The dimensions shall be as shown in Table 1 below.

**Table 1 - Communications Cabinet Types**

Communications Cabinet	Dimensions	Maximum Weight (w/o back panel)
Type 1	30" (h) x 24" (w) x 8" (d)	30 lb
Type 2	30" (h) x 24" (w) x 12" (d)	35 lb

All fabricated materials and added components must be free from burrs and sharp edges. Exterior seams of the cabinet shall be continuously welded with edges ground smooth to a 0.03 inch radius. All welding shall be done with gas tungsten arc welds that comply with AWS B2.1-22-015 *Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Aluminum* and C5.6 *Recommended Practices for Gas Metal Arc Welding*. All welds shall be neatly formed and free of blisters, blowholes, cracks and other irregularities. All bolts, clamps, fasteners, hinges, latches, nuts and screws shall be stainless steel, unless an alternative corrosion proof material is approved in writing by the Department.

The cabinet door opening shall be designed to prevent dust and moisture intrusion in conformance to NEMA 4X requirements. All flange joints shall be welded or continuously formed. The door shall have an adequately sized, oil-resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 4X requirements and shall be permanently bonded to the door. The door shall utilize a continuous stainless steel hinge that allow for door removal from the hinge side. Hinges shall be mounted such that the cabinet door opens out to the left, unless otherwise specified on the Plans, Project Details or as specified by

<sup>1</sup> Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

the Department. Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking. As an option, the Department prefers that a Corbin #2 key lock be utilized in place of the hasp and staple if the NEMA 4X rating can be maintained. A document holder constructed of high-impact thermoplastic shall be provided for each communications cabinet and permanently mounted to the lower portion of the inside door. The Concessionaire shall insert a copy of the communications cabinet Bill of Materials (BOM), individual communications cabinet component specification sheets and an asbuilt electrical/low-voltage wiring diagram of the communications cabinet in the document holder.

Each communications cabinet, designated for mounting on a pole, shall include a pole mounting kit suitable for pole diameters ranging from 7-12 inches. Each pole mounting kit shall include channel bars (for attachment to factory mounting holes on the back of the communications cabinet), pole shims (to prevent cabinet movement against pole), stainless steel straps and all other associated mounting and sealing hardware. The channel bars, pole shims and associated mounting hardware shall be manufactured from either galvanized steel or stainless steel. Mounting holes on the back of the communications cabinet shall be installed at the factory (communications cabinet Manufacturer) to assure NEMA 4X integrity along with all factory-recommended mounting and sealing hardware. Field installation or modification of mounting holes shall be prohibited.

Each communications cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein.

Two conduit access holes shall be made on the bottom of the communications cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, as applicable for each communications cabinet application. The conduit access holes shall be sized and positioned at locations shown in the Project Details to ensure the proper, safe routing of cabling entering the cabinet. The holes shall be free of burrs and sharp edges prior to the installation of LFMC, fittings and nipples. Conduit access holes and appropriate sealing strategies to maintain a NEMA 4X integrity shall be performed at the factory and no field installation or modification of the conduit access holes shall be permitted.

### **Back Panels**

Back panels shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the Department. One back panel and associated mounting hardware shall be included with each communications cabinet and be rated for use in NEMA 4X cabinets. The back panel shall be not less than 27 inches (h) x 21 inches (h) and protected on one side with a plastic film. The back panel shall be mounted within the communications cabinet with a minimum of four screws.

### **Outlet Box**

Each communications cabinet shall contain a 4 inch square junction box attached to the back panel as shown in the Project Details. Each junction box shall be constructed of drawn or welded steel and have a minimum depth of 1.25 inches. Each junction box shall include knockouts and clamps for conduit and cables, as appropriate. Steel box covers shall be provided with each junction box as appropriate for the specific communications cabinet application, e.g., duplex receptacles and/or duplex GFCI receptacles.

Duplex NEMA 5-15R receptacles shall be provided within the outlet box as specified in the Project Details. NEMA 5-15R receptacles shall be rated for 125 VAC, 0.5 HP and 15 A. It shall be of commercial grade quality and be manufactured from high strength nylon. NEMA 5-15 receptacles shall have two poles, three wires and include a self grounding strap to insure ground contact.

Duplex NEMA 5-15R GFCI receptacles shall be provided within the outlet box as specified in the Project Details. NEMA 5-15R GFCI receptacles shall be rated for 125 VAC, 0.5 HP and 15 A. It shall be of commercial grade quality and manufactured from high strength nylon. NEMA 5-15R GFCI receptacles shall have two poles, three wires, a manual reset button and a self-test button.

Both duplex NEMA 5-15R and duplex NEMA 5-15R GFCI receptacles shall be UL listed.

### **Power Strip**

Furnish and install one back panel mounted power strip with six front facing NEMA Type 5-15R outlets. Mounting location shall be as shown in the Project Details. The power strip shall be rated for 15 A at 120 VAC. It shall have an energy rating of 630 Joules, clamping voltage of 500 V and EMI/RFI noise filter of 150 KHz to 100 MHz at up to 43 dB. The power strip shall have a recessed power switch and a power cord of not less than 2.5 feet.

### **Power Conditioner**

The power conditioner shall be designed for outdoor use, support an operating temperature range of -40°F to +165°F, be operational in humidity levels of 0% to 95% (non-condensing) and operate at an altitude ranging from sea level to two miles above sea level. It shall utilize an input voltage of 120 VAC, 40 to 70 Hz and an output voltage of 120 VAC ( $\pm 3\%$ ), user selectable 50 to 60 Hz ( $\pm 0.25\%$ ). The power conditioner shall support an output current of 4.8 A (400 W/570 VA). It shall have a total harmonic distortion not exceeding 3.0%. The power conditioner shall utilize input and output electrical connectors conforming to the IEC 60320-1 *Appliance Couplers for Household and Similar General Purposes* specification. Its dimensions shall not exceed 1.7 inches (h)  $\times$  11 inches (w)  $\times$  8.5 inches depth and its weight shall not exceed 5 lbs. One power conditioner shall be provided with each communications cabinet.

### **DIN Rails**

Each communications cabinet shall utilize standard 1.38 inch DIN rails. The DIN rails shall be of steel construction with a coating for corrosion resistance. The DIN rails shall utilize 0.25 inch  $\times$  0.71 inch slots for fastening to the back panel located in each communications cabinet. The spacing of the DIN rail slots shall be 0.98 inch center-to-center. DIN rails and associated mounting hardware for attachment to the back panel shall be provided with each communications cabinet in the lengths and quantities specified in the Project Details.

### **12 VDC Power Supply**

The 12 VDC power supply shall support an input voltage range of 85-264 VAC and frequency range of 47-63 Hz. It shall have a typical efficiency of at least 76% and typical AC current of 1.6 A at 115 VAC. The 12 VDC power supply shall provide an output voltage of 12 VDC and have a current rating of 6.3 A. It shall support an output current range of 0 to 6.3 A and have a rated power of 75 W. The 12 VDC power supply shall have overload protection of 105-150% for its



rated output power and overvoltage protection for voltages of 15-16.5 VDC. It shall be designed for an operating temperature of +14°F to +140°F and humidity levels of 20% to 90% (non-condensing). The 12 VDC power supply shall conform to the following standards: IEC 60068-2-6 *Environmental Testing (Vibration)* and UL 508 *Industrial Control Equipment*. It shall be DIN rail mountable, have dimensions not exceeding 5 inches (h) x 2.25 inches (w) x 4 inches (d) and a weight of not more than 1.5 lb. One 12 VDC power supply shall be provided with each communications cabinet.

### **Foundation**

Controller foundation shall be manufactured of fiberglass reinforced polymer concrete. A minimum of 4 - ½ inch x 13 Unified Coarse Thread (UNC) inserts shall be installed for mounting of the controller cabinet to the foundation. Placement of the mounting inserts shall match the mounting configuration of the controller cabinet. The foundation shall be provided with an opening to accommodate access of underground conduit into the controller cabinet. Foundation opening shall match the controller cabinet opening as closely as possible. A minimum of 4 – ½ inch x 13 UNC lifting inserts shall be installed at each corner of the controller cabinet foundation. Lifting inserts shall be designed to support the full weight of the foundation to aid in the moving and placing of the foundation. The foundation shall include a porch on at least 3 sides to facilitate access to each controller opening. The walking surface of the foundation shall have a skid resistant surface.

### **Warranty**

The communications cabinet manufacturer shall affix a permanent label on the inside of the door that identifies the cabinet type, date of manufacture, warranty expiration date and manufacturer's name. The warranty expiration date shall be expressed in the (mm/dd/yyyy) format. The warranty shall cover all communication cabinet materials and workmanship, including pole mounting kits, for two (2) years after delivery of each communication cabinet.

**REVISION OF SECTION 614  
ETHERNET SWITCH (CDOT)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

For this project, the CDOT Ethernet Switches shall be consist of the following:

- Ciena 3930 and 3931 service delivery switches to be installed at roadway Intelligent Transportation System (ITS) device for data communication from the field device to Ciena 5150 service aggregation switches located in the regeneration nodes.

**MATERIALS**

The Concessionaire shall furnish and install the Ciena 3930 and 3931 service delivery switches for the transport of Ethernet data from roadside devices from the device cabinet locations to the proposed aggregation Carrier Grade Ethernet switches installed in the communications node buildings. The switch shall be configured with **two redundant, hot swappable power supplies that are accessible from the front of the chassis. Each AC power supply shall be rated for 100-240 VAC, 50/60 Hz, and 1.0 to 0.5 A. The combining of one AC and one DC power supply in the same switch chassis shall not be permitted. One power cord shall be included with each AC power supply used in the service delivery switch chassis. The power cords shall be of sufficient length and wire gauge for the voltage and load of each switch. For the Ciena 3931, one power cord retaining clip shall be included for each power supply since the power supplies will be installed in a vertical configuration with the input side facing downward. Four 10/100/1000 Mbps SFP transceivers with RJ-45 connectors shall be provided for each service delivery switch to increase the availability of copper ports from four to eight. All SFP optic modules provided shall be sufficient for the distance and attenuation associated with each cable segment's unique link loss budget. All components, including SFPs, shall be manufactured by Ciena. .**

All applicable licenses shall be provided with each Ethernet switch proposed as part of the ITS network.

The Concessionaire shall furnish and install the proper service delivery switch configuration using items listed in the table below.

CIENA Carrier Grade Ethernet Switch (Field)

ITEM DESCRIPTION	ITEM NUMBER	QUANTITY
ITEM DESCRIPTION	ITEM NUMBER	
Hardware		
3930, (4) 100M/1000M SFP, (4) 100/1000M SFP/RJ-45, (2) 1G/10G SFP+, ext temp, (2) slots AC/DC pwr sup	170-3930-900	

ITEM DESCRIPTION	ITEM NUMBER
3930, AC pluggable power supply, wide range 120/240V	170-0014-900
AC power cord, IEC C13, North America	CABL-PW01NA
3931, pluggable system module, (2) 1/10G SFP+, (4) 100/1000M SFP, (4) 10/100/1000M RJ-45	170-3931-900
3931, enclosure, (1) slot for pluggable system module, (2) slots for AC or DC pluggable power supply	120-3931-900
Misc, 5/32 secure hex driver for use w/inner access door on hardened service delivery switch	MISC-04XHSD
Cable entry seal, outside plant fiber, ½ inch, for 3931	170-0074-900
CN 3931, (3) band clamps for use with UAM pole mount kit	MISC-BCPM01
CN 3931, UAM, pole mount kit	MISC-MKPM01
AC power cord, IEC C15, 10 ft, outdoor, North America	170-0019-902
3931, AC pluggable power supply, wide range 120/240V	170-0042-900
Console serial adapter, RJ45 EIA to Cisco RJ45 pinout, 6 inch (3930/3931)	170-0062-900
1Gig, SM SFP optic, LC connector, 10 km, 1310 nm, extended temperature	XCVR-A10Y31
1Gig, SM SFP optic, LC connector, 40 km, 1310 nm, extended temperature	XCVR-A40Y31
10/100/1000M, SFP transceiver, RJ45 connector, SGMII, 100 meters, extended temperature	XCVR-A00CRJ
Software	
SAOS advanced Ethernet perpetual software license for 3930	S70-0001-900
SAOS advanced OAM perpetual software license for 3930	S70-0001-901
SAOS advanced Ethernet perpetual software license for 3931	S70-0006-900
SAOS advanced OAM perpetual software license for 3931	S70-0006-901

ITEM DESCRIPTION	ITEM NUMBER
SAOS advanced security perpetual software license for use with SAOS 6.x	170-0204-900
ESM carrier ED right to manage perpetual software license for 3930	S70-0005-900
ESM carrier ED right to manage perpetual software license for 3931	S70-0007-900
Maintenance	
SmartSupport, 3930, 3 years	80M-3930-SM3
SmartSupport, 3931, 3 years	80M-3931-SM3
Hardware repair service 10 day maintenance, 3930, 2 years	80M-3930-HW2
Next business day managed spares, CN 3930, 3 years	80M-3930-NA3
Hardware repair service 10 day maintenance, 3931, 2 years	80M-3931-HW2
Next business day managed spares, CN 3931, 3 years	80M-3931-NA3

This Carrier Grade Ethernet switch is proposed as an aggregation switch for the transport of Ethernet data for roadway devices on this project. Connections to the switch shall be both to the proposed roadside Carrier Grade field Ethernet switches and to the proposed Carrier Grade core Ethernet backbone switches installed in the communications node buildings. The switch shall be configured with the ability to accept up to thirty three (33) 1G Small Form-Factor Pluggable (SFP) Course Wave Division Multiplexed (CWDM) optic modules in addition to two (2) 10G Small Form-Factor Pluggable (XFP) based Ethernet ports. The switch will have a maximum capacity of forty eight (48) 1G ports and four (4) 10G ports.

All optic modules, (both CWDM ranging from 1430NM to 1610NM in 20NM increments and 1310nm) shall be extended temperature and compatible with selected type and manufacturer of the carrier grade Ethernet switch .

All applicable licenses shall be provided with each Ethernet switch proposed as part of the ITS network.

All Ethernet switches shall be installed with a basic configuration in conformance with Manufacture recommendations or by a certified Manufacturer partner either prior to installation or at the installation site. Final configuration for data transport will be conducted by CDOT personnel after installation, basic configuration approval and final acceptance has been given.

If field changes are made which would affect the original Concessionaire order of the Carrier Grade Ethernet switch, and would require any reconfiguration of the Ethernet switch order, the Concessionaire shall ensure that the Ciena representative is contacted and made aware of such changes in order to alleviate any possible delays in the delivery.

All associated hardware not listed in the item table is considered subsidiary and is required for a complete installation and shall be included as part of the work.

If for any reason the switch or any associated device modules are defective or are damaged at the time of installation by either the Contractor or Ethernet switch Manufacture, the item shall be removed and replaced at no additional cost to the project. Items shall also be replaced if any failures occur do to by manufacture defects, at no additional cost to the project prior to the final acceptance.

The Concessionaire shall provide bend insensitive (ITU-T G.657 A) tactical fiber optic patch cables with polyurethane jackets for the connection of the Ethernet switch to the fiber optic patch panel. These cables shall be a single mode-duplex cable, in lengths sufficient to span from the switch to the patch panel with a maximum of 2 feet of slack. Connectors shall match both the switch SFP/SFP+/XFP module and the proposed fiber optic patch panels.

**REVISION OF SECTION 614  
FIBER OPTIC CABLE (SINGLE MODE)**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of furnishing and installing single mode fiber optic cable for CDOT communications.

12-strand SMFO cables shall be used for laterals that connect to equipment field cabinets. Lateral fiber cables shall be terminated using fan-out kits in a termination patch panel in the field equipment cabinet.

All fiber optic cables shall be suitable for outdoor conduit installation.

**MATERIALS**

All fiber optic cable shall have compatible chromaticistics with proposed and existing cables.

All optical cables furnished on this project shall meet the following fiber optic industry standards:

- a) Electronic Industries Alliance (EIA) Telecommunications Industry Association (TIA)
- b) International Organization for Standardization (ISO)
- c) International Electronics Commission (IEC)
- d) Telecommunication industry Association (TIA)
- e) International Telecommunications Union (ITU)
- f) Insulated Cable Engineers Association (ICEA)

All cables shall be new and unused non-armored outdoor cable consisting of dispersion-unshifted, low water peak single-mode fiber strands free of surface imperfections and inclusions. Each single mode fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be of matched clad design.

- (a) Fiber Strands
  - 1) Typical core diameter of 8.3 $\mu$ m
  - 2) Cladding Diameter of 125.0 $\mu$ m
  - 3) Core-to-Cladding Offset:  $\leq 0.5 \mu$ m
  - 4) Cladding Non-Circularity:  $\leq 1 \%$
  - 5) Coating Diameter (Colored): 245  $\pm$  10  $\mu$ m.
  - 6) Maximum Attenuation (Loose Tube): 0.35 dB//km at 1310 nm wavelength and 0.22 dB/km at 1550 nm wavelength

- 7) Mode-Field Diameter:  $9.20 \pm 0.30 \mu\text{m}$  at 1310 nm wavelength and  $10.40 \pm 0.50 \mu\text{m}$  at 1550 nm wavelength
- 8) Attenuation at the Water Peak: 0.32 to 0.34 dB/km at  $1383 \pm 3 \text{ nm}$  wavelength
- 9) Cutoff Wavelength:  $\leq 1260 \text{ nm}$ .
- 10) Zero Dispersion Wavelength: 1300nm to 1322 nm
- 11) Zero Dispersion Slope:  $0.090 \text{ ps} / (\text{nm}^2 \cdot \text{km})$
- 12) Polarization Mode Dispersion:  $0.06 \text{ ps} / \sqrt{\text{km}}$
- 13) Maximum Fiber Dispersion:  $3.5 \text{ ps}/(\text{nm} \cdot \text{km})$  for 1285 nm through 1330 nm and shall be  $< 18 \text{ ps}/(\text{nm} \cdot \text{km})$  at 1550 nm.
- 14) Fiber Curl:  $\geq 4.0 \text{ m}$

All optical fibers shall be proof tested by the manufacturer to a minimum load of  $0.7 \text{ GN/m}^2$  (100 ksi).

The fibers shall not adhere to the inside of the buffer tube.

The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be capable of being mechanically stripped with a force of 0.3 – 2.0 lbf (1.3 – 8.0 N).

Each single mode fiber strand shall be color coded with distinct and recognizable colors in accordance with the most recent version of EIA/TIA-598, Optical Fiber Cable Color, as shown in the plans.

(b) Buffer Tubes

Each buffer tube shall contain 6 or 12 fibers as appropriate for the respective size cable.

Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm

Each buffer tube shall be color coded with distinct and recognizable colors in accordance with the most recent version of EIA/TIA-598, Optical Fiber Cable Color, as shown in the plans.

In buffer tubes containing multiple fibers, the coloring shall be stable during temperature cycling as stated under "Fiber Specification Parameters" and shall not be subjected to fading or smearing onto each other or into the buffer tube gel filling material. Colorings shall not cause fibers to stick together.

Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester.

Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member of the cable using a reverse oscillation stranding process.

The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink requirements of EIA/TIA standards.

(c) Fiber Cable

Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.

The central anti-buckling member of the cable shall consist of a glass reinforced plastic rod. The purpose of the central member shall be to prevent buckling.

For single layer cables, a water blocking tape shall be applied longitudinally around the outside of the strand tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus, electrically non-conductive homogenous. It shall also be free from dirt and foreign matter. Gel filled water-blocking compound shall not be allowed in the cable core interstices in either the backbone cable or the lateral cables.

Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

The cable shall contain at least one ripcord under the sheath for easy sheath removal.

Tensile strength shall be provided by high tensile strength dielectric yarns and shall be helically stranded evenly around the cable core.

Outer cable jacket shall have a consistent thickness throughout the entire cable length and shall be sheathed with medium density polyethylene, (MDPE). The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The MDPE shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The cable jacket shall be free of holes, splits and blisters.

Cable jackets shall be marked with sequential foot markings, year of manufacture and a telecommunication handset symbol, as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within 0 to 1% of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be easily readable.

(d) Environmental Parameters

- 1) Shipping, storage and operating temperature range of the cable as defined by Bellcore GR-12 shall be;  
-40°C to +75°C (-40°F to +167°F)



- 2) Operating temperature range of the cable as defined by Bellcore GR-12 shall be; -40°C to +70°C (-40°F to 158°F)
  - 3) Installation temperature range of the cable as defined by Bellcore GR-12 shall be; -30°C to +60°C (-22°F to +140°F)
- (e) Quality Assurance
- 1) All optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.
  - 2) The cable manufacturer shall be ISO 9001 registered.
- (f) Packaging
- 1) The complete cable shall be packaged for shipment on non-returnable wooden reels.
  - 2) Top and bottom ends of the cable shall be available for testing.
  - 3) Both ends of the cable shall be sealed to prevent the ingress of moisture.
  - 4) Each reel shall have a weatherproof reel tag attached identifying the reel and cable.
  - 5) Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.

The Concessionaire shall provide the CDOT ITS with two copies of the cable manufacturer's installation instructions for all fiber optic cable. All installations shall be in accordance with the manufacturer's recommendations except as otherwise directed by CDOT ITS. All additional costs including fiber optic cable associated to damages caused by the Concessionaire's neglect of recommended procedures shall be the Concessionaire's responsibility.

The Concessionaire shall submit a Method Statement to the CDOT ITS indicating cable routing, splice points and cable end splicing locations. Installation of the cable will not be permitted until the schematic diagram has been approved by CDOT ITS.

Fiber optic cable including both backbone cables and lateral cables shall be installed in continuous runs. Under no conditions shall fiber optic cable be cut or spliced at intermediate points without express written direction from CDOT ITS.

Blowing cable is an acceptable alternative to pulling cable. If the Concessionaire chooses to use this method, submittals for cable installation shall be submitted along with complete information on fiber installation equipment.

The maximum pulling tension shall be 2700 N (600 lbs) during installation (short term) and 890 N (200 lbs) long term installed.

All cables shall have a minimum bending radius based on the diameter of the cable and shall meet the following;

- a) Pulled under tension, (Short Term) – 20 (Twenty times the cable diameter)
- b) Pulled not under tension, (Long Term) – 10 (Ten times the cable diameter)

The fiber optic cable shall be installed in the conduit with a split-mesh cable grip to provide a firm hold on the exterior covering of the cable.

The manufacturer's recommended limits for cable pull lengths shall not be exceeded. The Concessionaire shall use a pulley system with a numerical readout indicating the cable tension. The pulley system shall be capable of alerting the installer when the cable pulling tension approaches the manufacturer's maximum allowable tension. The Concessionaire may supplement this procedure with a breakaway tension limiter set below the lowest recommended tensile limit of the cables being pulled. Intermediate pulleys shall be used at all pull boxes or manholes along the installation run to prevent cable damage.

If cable installation limits are met and the entire length cannot be installed completely from the shipping reel, installation shall be continued from the mid-point of the run. The Concessionaire shall first pull one-half of the cable from the reel at the mid-point through the conduit to one end of the run. The other half of the cable shall be removed from the reel and carefully placed on the ground in a figure eight pattern with a minimum loop diameter of 10 feet. While installing the remaining cable, care shall be taken to avoid any dragging against the ground resulting in damage or excess bending of the cable. The Concessionaire shall not kink, twist or bend the cable during installation coiling or uncoiling.

The cable shall be continuously lubricated as it enters the conduit. The Concessionaire shall only use pulling lubricants recommended by the cable manufacturer. Liquid detergent shall not be used.

If the Concessionaire must install new cable in conduits which contain existing fiber or electrical wiring, the Concessionaire shall be responsible for any damage to the existing cables or wires. After this installation the Concessionaire shall perform a functional test of all the equipment connected by the existing fiber cables or electrical wiring to ensure proper working conditions.

Concessionaire shall perform a functional test of all the equipment connected by the existing fiber cables or electrical wiring to ensure proper working conditions.

If an existing fiber optic cable is damaged during construction, it shall be removed from both points of termination and replaced, at no cost to the project. In no case shall the fill of any new conduit exceed the requirements of the National Electrical Code. The Concessionaire shall provide documentation to CDOT ITS supporting the conduit fill. All costs associated with equipment testing and repairs shall be included in the cost of the Fiber Optic Cable.

Lateral cables shall be installed in continuous runs from the backbone splice location to the field equipment cabinet. Odd length cables and reel ends are acceptable for lateral cables provided they are pre-tested and free of defects and are of sufficient lengths to archive continuous runs.

Lateral cables shall have slack and include a maximum of three locations of appropriate strain relief within all field equipment cabinets.

All fiber optic cables shall include identification labels attached to the cable in each pull box, manhole or field equipment cabinet. The label shall be provided with information as shown on the Project Detail Sheet.

All splices shall be enclosed within a splice closure as approved by CDOT ITS. Following successful splicing, the splice closure shall be placed inside the pull box or manhole. The Concessionaire shall use tools and hardware recommended by the cable manufacturer.

Only proposed active (lit) fibers shall be spliced in the closure and terminated in the field communications cabinet. All unused (dark) fibers of both the backbone and lateral cables shall remain uncut and be neatly coiled in the splice tray within the closure. All unused buffer tubes shall remain uncut and neatly coiled along with the buffer tubes used for splicing in appropriate location in the splice closure.

Lateral buffer tubes and fiber strands shall be labeled on the splice tray prior to sealing of the closure as shown on the Project Detail Sheet.

The Concessionaire shall coil 25 feet of lateral cable in pull boxes.

The Concessionaire shall ensure that all cable coils and splice canisters are attached to the cable management hardware in all pull boxes and manholes.

The Concessionaire shall terminate the lateral cable at the field equipment cabinet using a buffer tube fan-out kit. Fanned-out fiber strands shall be terminated in a termination block with ST connectors.

The Concessionaire shall submit a final documentation package to CDOT ITS. The final documentation package shall include the cable manufacturer's installation procedures, technical support documentation and material documentation. These documents shall match the original submittals provided to CDOT ITS.

## **REVISION OF SECTION 614 FIBER OPTIC SPLICE CLOSURE**

Section 614 of the Standard Specifications is hereby revised for this project as follows:

### **DESCRIPTION**

Fiber optic splice closures shall be used to enclose spliced fiber optic cable strands from both backbone and lateral cables at locations shown in the plans.

### **MATERIALS**

The fiber optic splice canister shall be furnished and installed by the Concessionaire. It shall be sized to provide capacity for splicing the total number of strands in all cables entering the canister.

The splice closure shall be a stand-alone closure that does not require an outer closure and shall meet the following minimum requirements:

- (a) The closure shall seal, anchor and protect fiber optic cable splices.
- (b) The closure shall provide for a minimum of two (2) spare entries in addition to the required number of cables being spliced. Manufacturer approved grommets may also be used to provide additional cable entries as needed.
- (c) The closure shall be suitable for underground applications and shall be water and airtight.
- (d) The closure shall be dome type.

The closure shall be sized to provide the capacity equal to the total number of strands in all cables entering the closure. All fiber optic cables shall be secured per the manufacturer's recommendations. All remaining access holes not utilized shall be plugged to prevent water from entering closure.

### **CONSTRUCTION REQUIREMENTS**

All splices shall be performed using the fusion splicing method. The fusion splicer shall be calibrated and certified within one year previous to splicing on this project. All certification documentation shall be presented to CDOT ITS prior to start of splicing.

The only fibers to be cut are those shown to be spliced on the splicing schematic in the plans. All unused buffer tubes and fiber strands shall remain uncut. After splicing is complete, the fiber strands shall be coiled and secured in splice trays. All remaining uncut strands from the buffer tube shall also be coiled in the tray. Remaining buffer tubes shall be neatly coiled and secured within the closure per the manufacturer's recommendations. Buffer tubes shall be secured to the splice tray per manufacturer's recommendations.

If an existing closure, or a closure provided by the Concessionaire requires reentry and resealing, it shall be conducted per the manufacturer's recommendation for re-entry. The Concessionaire shall use caution not to damage the fiber strands or buffer tubes existing inside.

The Concessionaire's shall ensure that the fiber optic splice enclosure and associated fiber cable coils fit adequately within the pull box or manhole specified on the plans. No additional payment shall be made for replacement of pull boxes, and no pull box modifications shall be allowed.

The optical fibers shall be fusion spliced and shall meet the following minimum requirements:

- (a) Splice loss <0.15 dB
- (b) Reflection <50 dB
- (c) Completed splice shall be stable from -40° F to +185° F (-40°C to +85°C)

The Concessionaire shall label each individual splice and buffer tube in all splice trays per the Project Detail Sheet included in the plans.

In the event that the CDOT ITS representative cannot be on site, eight (8) digital pictures shall be taken at varying angles showing all completed splice work within the splice closure. These pictures shall include exposed fiber stands, (both spliced and uncut) in all splice trays, and remaining buffer tubes showing appropriate coiling. One picture shall also include the complete re-assembly of all interior parts prior to final re-assemble and sealing. Once the canister and fiber coil are installed in the pull box or manhole, two (2) pictures shall be taken of the installation utilizing the fiber management hardware.

## **REVISION OF SECTION 614 FIBER OPTIC TERMINATION PANEL**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

### **DESCRIPTION**

This work consists of furnishing and installing modular type fiber optic termination panels in field communications cabinets for single mode fiber.

### **MATERIALS**

The unit shall meet the design requirements of ANSI/TIA/EIA-568 and the plastics flammability requirements of UL 94 V-0.

Splice housings shall be manufactured using 16-gauge aluminum or equivalent and shall be finished with powder coat for durability. The splice housings shall provide individual tray access while minimizing disturbance to neighboring trays and fibers.

Connector housings shall be provided with ST modular connector panels that minimize space. The entire panel shall be populated with fiber connector bulkheads. The unit shall have patch cord cable guides that allow a transition and segregation point for jumpers exiting from both sides of the housing to alleviate all patch cable entry on a single side.

Fiber jumper management designed specifically for fiber optic cable shall be included. The jumper management panels shall have removable front covers to conceal and protect the jumpers when installation is complete. The jumper management panels shall be designed to maintain a 1.5" minimum bend radius.

The panels shall have a hinged door to protect the fiber patch cable connector. The panel shall be sized to accommodate the entry of the lateral fiber optic cable.

### **CONSTRUCTION REQUIREMENTS**

All hardware shall be installed in accordance with manufacturer's recommendations. The Concessionaire shall provide CDOT ITS with documentation and all manuals. All connector housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606.

**REVISION OF SECTION 614  
FOLD-OVER TOWER (ITS)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

This work consists of the installation of a heavy duty fold-over tower, base assembly, concrete footing, concrete pad and chain link fencing with perimeter at the locations shown on the plans to support a Roadway Weather Information System (RWIS). In addition to the footing, a concrete pad shall be poured and formed with the following dimensions, 7' 6" x 7' 6" x 4" deep. This concrete pad will be poured after the footing has been installed. The pad will be poured separately from the footing. The footing shall be located in the very middle of the pad. All incoming conduits shall be cast directly in this concrete and/or footing. Around the outside perimeter of the concrete pad, Concessionaire shall install chain link fencing. This chain link fencing shall be installed within 6" to 2' of the edge of concrete all along the perimeter. The height of the perimeter fence shall be a minimum of 5' tall and no more than 7' feet tall measured from ground level. A 3' 6" to 4' gate shall be added along with locking hasps and end-caps. This gate shall be centered opposite the hinged side of the tower to allow access for the fold down tower to retract and be maintained. Tower should be mounted in a direction that will not impede traffic when folded down.

**MATERIALS**

The heavy duty fold-over tower and base assembly shall be a Glen Martin Engineering, Heavy Duty Fold-Over Tower – Model MF 1333, 30 feet in length as supplied by Glen Martin Engineering, Inc., 13620 Old Hwy 40, Boonville, MO., 65233, (660) 882-2734. (www.glenmartin.com)

**CONSTRUCTION REQUIREMENTS**

The heavy duty fold-over tower and base assembly shall be installed in accordance with the details shown in the plans and in accordance with manufacturer's recommendations. The Concessionaire shall make all arrangements for a qualified manufacturer's representative to be on-site to ensure proper installation.

The Concessionaire shall perform an acceptance test procedure for Acceptance by the Department in the presence of CDOT ITS. The acceptance test shall include demonstrating the tower raises and lowers according to the manufacturer's design and is fully functional at completion.

**REVISION OF SECTION 614  
INTELLIGENT TRANSPORTATION SYSTEM POLE**

Section 614 of the Standard Specification is hereby revised for this project as follows:

**DESCRIPTION**

Subsection 614.01 shall include the following:

ITS poles are to be used for the mounting of various Intelligent Transportation Systems devices and communications cabinets along the highway, excluding CCTV cameras which shall be mounted on steel poles. The Concessionaire shall furnish and install poles shall be made of composite fiberglass material and be of breakaway design. They shall be direct burial type which requires no base plate or concrete foundation. Poles shall be 30 feet in height and shall include all work for installation.

**MATERIALS**

Subsection 614.08 shall include the following:

- (a) ITS Pole. The pre-fabricated, non conductive, non-corroding composite fiberglass poles shall be designed for installation directly into the ground including a breakaway device which meets the Federal Highway Administrations safety guidelines.

The poles shall be constructed per the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic SIGNALs standards with a 30% gust factor.

The breakaway design shall also comply with current AASHTO LTS-2 Street Lighting Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic SIGNALSs by the same manufacturer as the pole.

The poles shall not be painted. Coloring shall be by pigment in the composite fiberglass resin during the manufacturing process. The poles shall be coated with polyurethane which includes ultraviolet inhibitors to help prevent fading.

Subsection 614.10 shall include the following:

- (b) ITS Pole. The pole shall be tapered round and be constructed by the filament winding process from thermosetting polyester resin and contain a minimum of 65 percent "E" type fiberglass by weight. The filament windings shall be continuously applied with uniform tension and shall be placed on the pole helically at low angles to provide axial strength. Additional windings shall be placed on the pole in a circular manner to provide compressive strength.

The resin used to make the pole shall be ultraviolet resistant and pigmented approximately the same as the final coating to be applied. The color shall be brown and uniform throughout the entire wall thickness. A weather resistant, pigmented, polyurethane coating shall be applied to the pole and have a dry film thickness of 1.5 mils.



The pole shall be flame resistant in accordance with ASTM D635. In tests, samples must cease to burn before the gauge mark of 3.9 inches is reached.

All surface and ends shall have a smooth finish with no burs or blemishes. The top of the pole shall be supplied with a cap to match the color and diameter of the pole.

The pole surface shall be tested for a minimum of 2500 hours of accelerated testing in accordance with ASTM G53-84 (UV-B Lamp 313 NM wavelength 130° F, cycle lamp 4 hour on, 4 hours off) with no fiber exposure, no crazing, no calking and with only minor color variations.

Stabilization of the pole shall be by a two-part polymer material recommended and provided by the manufacturer. This material shall be environmentally safe to the worker and the surrounding area. The Concessionaire shall use care while combining the material on site so no overspill occurs. All remaining material not used in the installations of the poles shall be cleared from the site by the Concessionaire, and surrounding area returned to pre-installation conditions.

**REVISION OF SECTION 614  
LANE CONTROLLER CABINET**

Section 614 of the Standard specifications is hereby revised for this project as follows:

Subsection 614.01 shall include the following:

Lane controller cabinet shall be furnished and installed at designated Intelligent Transportation System (ITS) field device sites to house and protect ETC components.

Lane controller cabinets shall be UL 508A *Industrial Control Panels* listed and conform to a NEMA Type 4X<sup>2</sup> rating. They shall be constructed of 0.125 inch Type 5052 H-32 aluminum conforming to the requirements of ASTM B209 *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate*. The dimensions shall be a minimum of 48 inches wide, 48 inches tall, and 24 inches deep.

All fabricated materials and added components must be free from burrs and sharp edges. Exterior seams of the cabinet shall be continuously welded with edges ground smooth to a 0.03 inch radius. All welding shall be done with gas tungsten arc welds that comply with AWS B2.1-22-015 *Standard Welding Procedure Specification for Gas Tungsten Arc Welding of Aluminum* and C5.6 *Recommended Practices for Gas Metal Arc Welding*. All welds shall be neatly formed and free of blisters, blowholes, cracks and other irregularities. All bolts, clamps, fasteners, hinges, latches, nuts and screws shall be stainless steel, unless an alternative corrosion proof material is approved in writing by the Department.

The cabinet door opening shall be designed to prevent dust and moisture intrusion in conformance to NEMA 4X requirements. All flange joints shall be welded or continuously formed. The door shall have an adequately sized, oil-resistant gasket that provides a uniform seal with the door frame surface in conformance with NEMA 4X requirements and shall be permanently bonded to the door. The door shall utilize a continuous stainless steel hinge that allow for door removal from the hinge side. Hinges shall be mounted such that the cabinet door opens out to the left, unless otherwise specified on the Plans, Project Details or as specified by the Department. Hinges shall be mounted with appropriately sized stainless steel hardware. The door shall be equipped with a hasp and staple for padlocking. As an option, the Department prefers that a Corbin #2 key lock be utilized in place of the hasp and staple if the NEMA 4X rating can be maintained. A document holder constructed of high-impact thermoplastic shall be provided for each lane controller cabinet and permanently mounted to the lower portion of the inside door. The Concessionaire shall insert a copy of the lane controller cabinet Bill of Materials (BOM), individual cabinet component specification sheets and an asbuilt electrical/low-voltage wiring diagram of the lane controller cabinet in the document holder. Each lane controller cabinet shall have tapped pads to provide for the mounting of a back panel as specified herein.

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<sup>2</sup> Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dust); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure.

Two conduit access holes shall be made on the bottom of the lane controller cabinet for electrical wiring, specific field device low-voltage control cabling, waveguides and fiber optic cabling, as applicable for each lane controller cabinet application. The conduit access holes shall be sized and positioned at locations shown in the Project Details to ensure the proper, safe routing of cabling entering the cabinet. The holes shall be free of burrs and sharp edges prior to the installation of LFMC, fittings and nipples. Conduit access holes and appropriate sealing strategies to maintain a NEMA 4X integrity shall be performed at the factory and no field installation or modification of the conduit access holes shall be permitted.

#### *Back Panels*

Back panels shall be constructed of 0.10 inch Type 5052-H32 aluminum alloy, unless otherwise specified by the Department. Two back panels and associated mounting hardware shall be included with each lane controller cabinet and be rated for use in NEMA 4X cabinets. The back panel shall be approximately 1-inch less than the inside dimensions and protected on one side with a plastic film. The back panel shall be 1-inch thick, with air space to allow for mounting screws to be used from either side without protrusion through the opposing face. The back panel shall be mounted within the lane controller cabinet with a minimum of four screws.

#### *Outlet Box*

A minimum of 10 NEMA 5-20R receptacles shall be provided per toll point within outlet boxes opposing the external service disconnect. At the combined tolling point, 20 NEMA 5-20R receptacles shall be provided. NEMA 5-20R receptacles shall be rated for 125 VAC, 0.5 HP and 20 A. It shall be of commercial grade quality and be manufactured from high strength nylon. NEMA 5-20 receptacles shall have two poles, three wires and include a self-grounding strap to insure ground contact. Receptacles shall be UL listed.

#### *Power Strip*

Furnish and install one back panel mounted power strip with six front facing NEMA Type 5-15R outlets. Mounting location shall be as shown in the Project Details. The power strip shall be rated for 15 A at 120 VAC. It shall have an energy rating of 630 Joules, clamping voltage of 500 V and EMI/RFI noise filter of 150 KHz to 100 MHz at up to 43 dB. The power strip shall have a recessed power switch and a power cord of not less than 2.5 feet.

#### *12 VDC Power Supply*

The 12 VDC power supply shall support an input voltage range of 85-264 VAC and frequency range of 47-63 Hz. It shall have a typical efficiency of at least 76% and typical AC current of 1.6 A at 115 VAC. The 12 VDC power supply shall provide an output voltage of 12 VDC and have a current rating of 6.3 A. It shall support an output current range of 0 to 6.3 A and have a rated power of 75 W. The 12 VDC power supply shall have overload protection of 105-150% for its rated output power and overvoltage protection for voltages of 15-16.5 VDC. It shall be designed for an operating temperature of +14°F to +140°F and humidity levels of 20% to 90% (non-condensing). The 12 VDC power supply shall conform to the following standards: IEC 60068-2-6 *Environmental Testing (Vibration)* and UL 508 *Industrial Control Equipment*. It shall be DIN rail mountable, have dimensions not exceeding 5 inches (h) x 2.25 inches (w) x 4 inches (d) and a weight of not more than 1.5 lb. One 12 VDC power supply shall be provided with each lane controller cabinet.

#### *Warranty*

The lane controller cabinet manufacturer shall affix a permanent label on the inside of the door that identifies the cabinet type, date of manufacture, warranty expiration date and manufacturer's name. The warranty expiration date shall be expressed in the (mm/dd/yyyy)

format. The warranty shall cover all lane controller cabinet materials and workmanship, including pole mounting kits, for two (2) years after delivery of each lane controller cabinet.

**REVISION OF SECTION 614  
TRAFFIC LOOPS AND PIEZOS AT AUTOMATED  
TRAFFIC RECORDER (ATR) SITES**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of the removal and replacement of loop detector wires, or loops and piezoelectric axle sensors (piezo) for the Automatic Traffic Recorder (ATR), where the loops, piezos or both have been removed within a project site. Work shall be in accordance with this specification and as shown on the plans.

**MATERIALS**

Loop detector wire shall consist of specified loop wire encased in ¼ inch OD, 3/16 inch ID vinyl or polyethylene tubing. (14-1/C Loop detector cable 19 STR. PVC/Nylon/PVC Tube 600v IMSA 51-5)

Loops shall be sealed with a two-part self-curing, self-bonding weatherproof epoxy approved for sealing loops. Loops shall be 6 feet by 6 feet.

The piezo shall be class II and 6 feet in length. The piezo shall have sufficient lead in cable, so the lead in cable can be pulled in to the cabinet without splicing.

Grout or epoxy for the installation of the loops and piezos shall conform to manufacturer's recommendations.

Pull boxes shall be in accordance with Section 613.

**CONSTRUCTION**

- (a) *General.* A minimum of five days prior to installation, the Concessionaire shall submit a schedule of installation activities including alternative scheduling to the CDOT DTD Project Manager and the Traffic Data Collection (TDC) Manager (Mike DelCupp 303-757-9816 robert.delcupp@dot.state.co.us). The installation instructions from the manufacturer shall also be submitted for approval. Installation of loops and piezos shall not begin until approval has been received from CDOT DTD.

The Concessionaire shall install the loops and piezos as close to the locations shown on the plans as possible. Exact locations, dimensions, and configurations may vary based on site conditions, and shall be as approved by CDOT DTD.

All work will be inspected by the Traffic Data Collection Unit (TDC) during installation. Acceptance will be based on the testing and operation of the piezos and loops under actual traffic conditions, in which one week of actual data will be collected. The volume and vehicle class shall be within ±10 percent for the site

compared to historical data for the same time period. There shall be no more than 1 percent sensor misses in any one lane for the same time period.

- (b) *Installation of loops.* Loops shall be centered in the travel lane with two sides parallel to lane striping. The saw cut for the loops shall be made 3/8 inch wide and 3-½ inches deep. The saw slot shall be as straight as possible and shall not vary more than ½ inch when checked with a straightedge. No more than one set of loop lead wires shall be placed in one saw slot. Saw cuts shall be hydro-blasted with a mixture of water and air and then blown free of water and debris with compressed air, using a large capacity air compressor of at least 150 CFM. The cuts shall be dry prior to placement of loop wire.
- (c) The Concessionaire shall locate all buried utilities, which may interfere with the planned location of the ATR site. The Concessionaire shall contact the Utility Notification Center of Colorado (UNCC) at 811 or 1-800-922-1987 for location of member utilities at least three working days prior to any excavation, not including the day of actual notice.

The Concessionaire shall also locate non-member utilities, such as storm sewer and ditch. Any utility conflicts encountered with the proposed installation shall be brought to the attention of the Engineer

After the saw slot is cleaned of debris and dried, the wire shall be placed for the loop by pushing it into the slot with a blunt non-metallic object. A screwdriver or other sharp tool will not be permitted. Care shall be used to avoid abrading or damaging the insulation.

All loop corners shall be rounded using a 1-½ inch hole drilled to a minimum depth of 3-½ inches. Loop leads shall be drilled when leaving the roadway surface at a 45 degree angle 8 inches from pavement edge out through the side or bottom of roadway, the drilled hole shall be no larger than ¾ of an inch. All holes shall be spaced a minimum of three inches from one another. No more than one set of loop lead wires shall be placed in one drill hole.

One continuous length of loop wire shall be used for each loop from pull box or cabinet around the loop with 4 turns and back to the pull box or cabinet with no splices. The wires shall be seated in the bottom of the saw slot. A ½-inch backer-rod shall be installed to insure wires do not float to the surface during grouting. Backer-rod shall be installed in 4 to 6 inch pieces with 1 to 2 foot gaps in-between, to insure the sealant will come in contact with the loop wire. One continuous piece of backer-rod will not be allowed.

Prior to sealing the loop, loop lead and feeder slots, a loop continuity test will be performed. The test will be performed by the TDC representative. Loop continuity shall be no higher than 1 ohm. Loop continuity higher than 1 ohm shall be cause for replacement of the loop. Replacement shall be at the Concessionaire's expense.

After the loops are properly seated and tested, the slots shall be filled with a two-part self-curing, self-bonding epoxy or grout, as recommended by the

manufacturer. Excess epoxy shall be removed to avoid unnecessary high spots, and level with the roadway surface.

Loop leads shall be pulled into cabinet without splices to match original installation when applicable.

All detector loops shall measure six feet by six feet.

Installation at an ATR count or classification site shall consist of one loop or one loop set (two loops) within a single lane. The loop sets shall be separated by 10 feet, plus or minus 1 inch, resulting in a distance of sixteen feet from the leading edge of the first loop in the direction of travel to the leading edge of the second loop.

Loop and loop leads shall be installed directly into the pavement, to pavement edge, pull box or cabinet. If loops are installed during asphalt paving, the loops shall be installed before the final lift is placed.

Loop lead wires from pavement edge to pull box shall be enclosed in ¾ inch PVC conduit or ¾ inch rubber hose to protect wire from abrasion. Loop lead-in pairs from pavement edge, to pull box, shall be symmetrically twisted 5 turns per 1 foot. Pull boxes or cabinet shall contain a minimum of 3 feet of loop lead wire for splicing. All loop and loop leads shall be clearly labeled in all pull boxes and or cabinet. The Concessionaire shall be responsible for all trenching and digging from pavement edge to pull box.

All splices shall be made with approved waterproof pressure connector. All splices shall be capable of satisfactory operation under continuous submersion in water.

(d) *Piezo Installation*

The piezo shall be permanently installed by grouting into the roadway, flush to 1/16 of an inch above the roadway surface by grouting into a concrete roadway or the final lift of asphalt.

Piezo sensors shall be installed in compliance with the manufacturer's recommendations.

The piezo shall be tested for capacitance and dissipation factor, prior to and after installation using a LCR meter. Capacitance and dissipation shall be within ±20 percent of the data sheet supplied with the piezo.

Prior to acceptance of the site, the TDC will test the piezo for voltage and signal quality with live traffic. Voltage shall be no lower than 80 millivolts on the front axle of a class II vehicle (car).

At an ATR axle classification site, one 6 foot piezo sensor per lane shall be installed at the exact midpoint between the two loops and to the right or left side of the line, centered in the wheel path.

The saw cut shall be as straight as possible and shall not vary more than  $\frac{1}{2}$  inch when checked with a straightedge. The size of the saw cut shall be to the manufacturer's specifications and not vary more than  $\frac{1}{8}$  of an inch in width. The slot for the piezo lead wire shall be 3 inches deep and  $\frac{3}{8}$  of an inch wide. Only one piezo lead wire shall be placed in the saw slot.

Piezo lead shall be drilled when leaving the roadway surface at a 45 degree angle 8 inches from the pavement edge out through the side or bottom of the roadway, the drilled hole shall be no larger than  $\frac{3}{4}$  of an inch. All holes shall be spaced a minimum of 3 inches from one another. No more than one piezo lead wires shall be placed in one drill hole.

Saw cuts shall be hydro-blasted with a mixture of water and air and then blown free of water and debris with compressed air, using a large capacity air compressor of at least 150 cubic feet per minute. The cuts shall be dry and cleaned with acetone prior to placement of the piezo.

The piezo shall not be installed if roadway surface temperature is not above the manufacturer's recommended minimum temperature, or cannot be maintained above this temperature for a minimum of two hours after installation. The piezo shall not be installed if roadway surface temperature is above the manufacturer's highest recommended temperature for grout installation.

The piezo lead wire shall be placed in the saw slot with a blunt non-metallic object.  $\frac{1}{2}$  inch backer-rod shall be installed to insure the wire does not float to the surface during grouting. Backer-rod shall be installed in 4 to 6 inch pieces with 1 to 2 foot gaps in-between, to insure the sealant will come in contact with the piezo lead wire. One continuous piece of backer-rod will not be allowed.

The sealant for the piezo lead wire shall be the same as used for loops.

Piezo lead wire shall be pulled into the cabinet without splices, unless the length exceeds 300 feet.

Only one lead wire shall be placed in a saw slot.

Piezo lead wires from pavement edge to pull box shall be enclosed in  $\frac{3}{4}$  inch PVC conduit or  $\frac{3}{4}$  inch rubber hose, to protect wire from abrasion. Pull boxes or cabinet shall contain a minimum of three feet of piezo lead wire for splicing. Lead wire shall be clearly labeled as approved by the Engineer and the TDC.

All splices in piezo wiring shall be soldered and enclosed in a resin filled splice kit.

- (e) *Pull Boxes* All pull boxes on the shoulder of the roadway surface shall be raised to finished grade or level with the surrounding ground. If the shoulder has been raised to the point that the *conduit* is below the bottom of the pull box, then the conduit shall be raised. All wiring splices for existing wiring shall be a minimum of 12 inches in length above the conduit.



All existing pull boxes that are found to be damaged shall be replaced.

- (f) *Water Valves. A minimum of two feet of slack shall be provided on the loop and piezo wires that are contained in water valves.*
- (g) *No splices shall be allowed in water valves.*
- (h) *Pull Rope. A 1/8 inch nylon pull rope shall be installed in all new conduits and all existing conduits where a wire or cable is added or an existing wire or cable is replaced.*
- (i) *Conduit. The Concessionaire shall seal all conduits with a sealing compound where a wire or cable is added or an existing wire or cable is replaced. The sealing compound shall be UL tested and approved for use. Sealing compound shall be a permanently soft, fibrous, non-staining sealer that can be easily applied and removed by hand at all working temperatures. Sealing compound shall be designed to seal out weather, moisture, dust rodents and atmospheric conditions both indoors and outdoors. No foam sealant will be allowed.*

**REVISION OF SECTION 614  
MICROWAVE VEHICLE RADAR DETECTOR (MVRD)**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work shall consist of furnishing and installing Microwave Vehicle Radar Detectors (MVRDs) in accordance with these Special Provisions at the locations shown on the Plans.

**MATERIALS**

The MVRD shall be Wavetronix SmartSensor HD model WX-SS-125 or WX-SS-126. The MVRD shall include the radar detection unit, sensor mount, sensor connector cable, communications cabinet, attachment hardware, and all other hardware, cables, and test equipment necessary for a complete installation.

In addition to the items listed above, the MVRD includes all associated power supplies, surge suppressors, and power and communications cabling. The Concessionaire shall furnish and install all other related hardware, including but not limited to double-gang electrical box, GFCI and 5-15 receptacles, mounting hardware, power strip, and data interconnection cables. Concessionaire shall be responsible for prefabrication of the communications cabinet before installation.

The radar detection unit shall include a non-intrusive device using frequency modulated continuous wave radar technology for the gathering of vehicle information including traffic volume, lane occupancy, individual and average speed, vehicle classification, and presence. It shall have auto configuration capabilities to simultaneously identify up to ten highway lanes with the ability to detect over center median barriers and accurately detect partially occluded vehicles. Weather shall not impact the radar detection of the unit. Wind or temperature change shall not cause the device's original field installation configuration to alter over time. The radar detection unit shall include the manufacturer's recommended power/communication cable for the length shown on the plan sheets.

The power supply shall be a DIN rail mountable AC to DC power converter. The power supply shall accept input voltage from 100 to 240 VAC at 45 to 65 Hz and provide 24 VDC output at 1A. The power supply shall have a minimum operating temperature range of -29 to 165°F up to 95 percent relative humidity. The power supply shall provide for 100 percent power reserve for a minimum of 20 milliseconds to protect against static voltage dips, transient failures of supply voltage, or continuous phase failures. One DIN rail shall be mounted within the communications cabinet on the device pole and a second DIN rail shall be mounted within the 332 cabinet shown on the plans.

The surge suppressor shall be DIN rail mountable with hot swappable protected busses. The surge suppressor shall provide protection for RS-232, RS-485, and DC power to the radar detection unit. Wiring for the surge suppressor shall be by means of pluggable screw terminals and include unprotected RS-232 and RS-485 communications connectors. The surge suppressor shall have a minimum operating temperature range of -29 to 165°F up to 95 percent relative humidity.

The communications cabinet shall be of aluminum construction, measure 14" x 14" x 11" (H x W x D), and have a hinged door with a police type lock and weather proof seal to prevent the ingress of wind and water. The communications cabinet shall include the installation of an internal backplane with a 10A single phase DIN rail mountable circuit breaker, 8 position surface mount terminal block, surface mounted double gang metal electrical box with one duplex NEMA 5-15R and one duplex ground-fault circuit interrupter (GFCI) receptacle, and a six outlet 5-15R power strip rated at a minimum of 500 joules. The communications cabinet shall include an internal DIN rail.

All cables shall be provided per the manufacturer's recommendations according to the length and application.

### **CONSTRUCTION REQUIREMENTS**

The Concessionaire shall mount the 10A circuit breaker, power supply, surge suppressor, 8 position terminal block, double gang metal electrical box with one duplex NEMA 5-15R and one duplex (GFCI) receptacle on the communications cabinet backplane. The 10A circuit breaker shall be used to supply power to the power supply and both duplex receptacles. The duplex GFCI receptacle shall be wired such that in the event of a ground fault, both the power supply and duplex NEMA 5-15R receptacle remain energized.

One conduit access hole not to exceed 1.5 inches shall be made on the bottom of the communications cabinet for power wiring and radar detection unit power/communication cabling. The access hole shall be positioned at a location to ensure the proper, safe routing of wiring entering the cabinet. 3/4 inch Type 201 stainless steel strap used in conjunction with Type 201 stainless steel buckles shall be used to mount the communications cabinet to the structure so that the top of the cabinet is approximately 5-7 feet above surrounding grade and all shall be located by Matthew Becker with CDOT ITS at 303-435-8288. The communications cabinet shall be oriented such that anyone working in the cabinet has direct line of sight with oncoming traffic. The Concessionaire shall be responsible for any necessary modifications or additions needed to mount the communications cabinet to the structure.

0.75 inch Type 201 stainless steel strap used in conjunction with Type 201 stainless steel buckles shall be used to mount the radar detection unit at a height and angle determined by roadway off-set and detection distance in accordance with manufacturer's recommendations.

The manufacturer's recommended power/communication cable shall run on the interior of the mounting structure from the radar detection unit to the communications cabinet. A hole not to exceed 1.5 inches shall be made 12 inches below the radar detection unit to allow passage of the power/communications cable into the structure. The Concessionaire shall ensure strain relief and drip loops in the power/communication cable before the cable enters the structure in accordance with manufacture's recommendations. A hole not to exceed 1.5 inches shall be made below the communications cabinet to allow the power/communications cable and communications cabinet supply power cable to pass from the interior of the structure to the interior of the communications cabinet. Flexible conduit shall be used to run cables from the structure to the communications cabinet.

The Concessionaire shall run and connect existing power from the interior of the structure to the 10A circuit breaker in the communications cabinet. The communications cabinet power shall be connected through a 10A in-line waterproof fused disconnect and shall be labeled "Radar Detector Power". The Concessionaire shall wire supply power, power supply, surge suppressor,

and radar detection unit in accordance with the manufacture's recommendations. The radar detection unit shall be wired to support RS-232 serial communications. The 6 outlet power strip shall be plugged into the duplex NEMA 5-15R.

All holes shall be free of burs and sharp edges prior to the installation of all cable, conduit, and conduit nipples. All cable entrances in structures, conduits, and cabinets shall be sealed and waterproofed. All wiring and electrical connections shall be performed in conformance with the latest version of the NEC.

## REVISION OF SECTION 614 OPTICAL TRANSCEIVER

Subsection 614.08(n) *Optical Transceiver*, is hereby added to the Standard Specifications and shall include the following:

The Concessionaire shall furnish and install an Optical Transceiver (OTR) American FiberTek (model 913SL -MT and model 913SL-RR) that interfaces the designated controllers over SMFO cable. The OTR shall provide an electrical signal interface for three user configurable serial ports (RS-232, RS-422, 2 or 4 wire RS-485, or Manchester data), NTSC video, and one FC SMFO interface that supports point-to-point optical communication.

The Concessionaire shall furnish and install all other related hardware, including but not limited to: mounting hardware, fiber jumpers and electrical connections.

The OTR will be used to transmit video and/or data on one SMFO cable.

### MATERIALS

Concessionaire shall install the following:

- A. The OTR shall be interconnected to a camera video SIGNAL via an RG-59 coaxial cable utilizing BNC terminations. The OTR shall be interconnected to a camera RS-485 serial control on data channel 2 via an RJ-25 jack (wired to camera manufacturer specifications) to bare wire adapter. The OTR shall be interconnected to an RS-232 telemetry master device on data channel 3 via a Cat5 cable. The Concessionaire shall provide compatible RS-232, RS-485, and coaxial, cables between the OTRs and the attached equipment.

- B. Grounding Provisions

There shall be no internal connection between SIGNAL ground and chassis ground. Provisions to prevent damage to OTR electronics from lightning via any metallic cable interconnect with the OTR shall be included in the design.

- C. Optical Interface

The optical interface to the OTR shall be single mode fiber, with a  $9.0 \pm 0.5$  micron core diameter, via FC/PC connector. Mode fields of either depressed cladding or matched cladding shall be accommodated by the connector. Female connectors shall be provided on the OTR device as follows:

- 1 Optical I/O

The OTR shall include interfaces for single mode point-to-point fiber communication. Video and serial data transmission over the OTR pair shall be transparent to connected equipment, requiring no special communications software.

## CONSTRUCTION REQUIREMENTS

The OTR shall be free of sharp edges. Power input requirements (i.e., voltage and current) shall be marked on the OTR case. All power interconnections shall be protected against inadvertent contact by maintenance personnel. Any safety handling related instructions shall be plainly marked on the OTR case. Bellcore TR-NWT-001089 safety and National Electrical Safety Code (NESC) requirements shall apply to installation of the OTR. The OTR shall comply with FCC Class A requirements. Bellcore TR-NWT-001089 electromagnetic compatibility requirements also shall apply.

The OTR's data channels shall be configured as: Data 1 – RS-232, Data 2 – RS-485 4 wire, Data 3 – RS-232 (dip switch selectable). If the OTR is replacing a VOTR in an existing CCTV installation, the Concessionaire shall notify HPTE at least one day prior to OTR installation. The Concessionaire shall remove existing VOTR (where applicable) and install the OTRs in field equipment cabinets per plans providing:

- Power interconnection and surge protection
- Any fiber jumper cables in the field and in the regeneration nodes as required
- RJ-25 female to bare wire adapter for RS-485 camera control, RS-232 interface cable

## TESTING REQUIREMENTS

### 1. General

#### A. Stand-Alone Test

The Concessionaire shall test all optical paths prior to interfacing the OTRs using an Optical Time Domain Reflectometer (OTDR) in accordance with EIA/TIA-455. The optical path attenuation shall be verified to be less than the link budget by a 20% margin. Where link budgets do not meet these criteria, HPTE shall be notified prior to "hook-up" of the OTR. Under no circumstances shall the OTR be "hooked-up" where the link budget is equal to or less than the measured optical path loss. Records of all fiber installation attenuation measurements shall be maintained in the equipment cabinet and at the regen building to be used as a future reference. Upon approval of CDOT ITS, the OTDR test may be skipped if the OTR is replacing an VOTR at an existing CCTV installation.

#### B. Subsystem Test

As part of the subsystem test the Concessionaire shall verify the following:

- Communications between each CCTV and the video switcher.
- Communications between each telemetry master device and the receiving OTR.

**REVISION OF SECTION 614  
PROGRAMMABLE INFORMATION DISPLAY SYSTEM (PIDS)**

Section 614 of the Standard specifications is hereby revised for this project as follows:

**DESCRIPTION**

This work shall consist of furnishing and installing Programmable Information Display System (PIDS) in accordance with RTD Design Criteria.

**MATERIALS**

The PIDS shall consist of a Panasonic TH-47LFP30W Weatherproof LCD display.

**Display**

The Panasonic display shall have a diagonal screen size of 47 inches. The refresh rate shall be a minimum of 120 Hz. The brightness shall be a minimum of 700 nit and the display shall have a color gamut of at least 72 percent.

**Canopy**

The PIDS canopy shall be designed based on the criteria found in Section 5 of the RTD Light Rail Design Criteria. In addition, The Concessionaire shall provide a product that meets or exceeds the quality, materials, workmanship, and finish of similar recently completed RTD projects.

**CONSTRUCTION REQUIREMENTS**

The PIDS, canopy, and all associated support infrastructure including cabling, power, and mounting equipment shall be installed by The Concessionaire per the manufacturer's recommendations. All installation locations shall be approved by RTD.

PIDS support equipment (including mounting hardware) shall be compatible with existing RTD equipment and approved by RTD. All PIDS shall be mounted 9 feet above finished grade measured to the bottom of the screen and tilted down at a 17-20 degree angle. If possible, all PIDS shall be installed facing north and away from oncoming highway traffic.

The Concessionaire shall install conduit and a fiber lateral line to all PIDS locations and terminate at the PIDS mounting station. All PIDS shall be connected to lateral fiber line via Ethernet connection.

The Concessionaire shall furnish and install a canopy above each PIDS to protect against adverse weather conditions and direct sunlight.

**REVISION OF SECTION 614  
TEST FIBER OPTIC CABLE**

Section 614 of the Standard specifications is hereby revised for this project as follows:

**DESCRIPTION**

Subsection 614.01 shall include the following:

Test fiber optic cable shall include an OTDR test on all fiber optic cable strands install on the project by the Concessionaire. In addition, an optical power meter test shall be conducted on fiber strands from all device locations to the regen buildings.

### TESTING

Subsection 614.08 shall include the following:

- (a) Test Fiber Optic Cable. For this project this work shall consist of the testing of either multimode or Single Mode fiber optic cable as shown and tabulated in the plans. The testing procedures involve an OTDR test and an Optical Power Meter Test.

Guidelines for fiber optic cable testing include:

- (1) Test jumpers and patch cords must be of the same fiber core size and connector type as the cable system:
 

Multimode fiber	62.5/125 $\mu\text{m}$
Single Mode fiber	8.3/125 $\mu\text{m}$
- (2) The light source and OTDR must operate within the range of 850 $\pm$ 30 nm or 1300 $\pm$ 20 nm for multimode testing in accordance with ANSI/EIA/TIA-526-14.
- (3) The light source and OTDR must operate with the range of 1310 $\pm$ 10 nm or 1550 $\pm$ 20 nm for Single Mode testing in accordance with ANSI/EIA/TIA-526-7.
- (4) The power meter and the light source must be set to the same wavelength during testing.
- (5) The power meter must be calibrated and traceable to the National Institute of Standards and Technology (NIST).
- (6) All system connectors, adapters and jumpers must be cleaned as per manufacturer's instructions before measurements are taken.
  - A) Fiber Optic Cable Testing Equipment. The following is required to perform fiber optic cable tests:
    - (1) An OTDR
    - (2) A test reel, if necessary
    - (3) A light source at the appropriate wavelength
    - (4) Optical Power Measurement Equipment
    - (5) Test Jumpers as specified below

#### *Multimode Fiber Testing*



CPR Test Jumper-1 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.

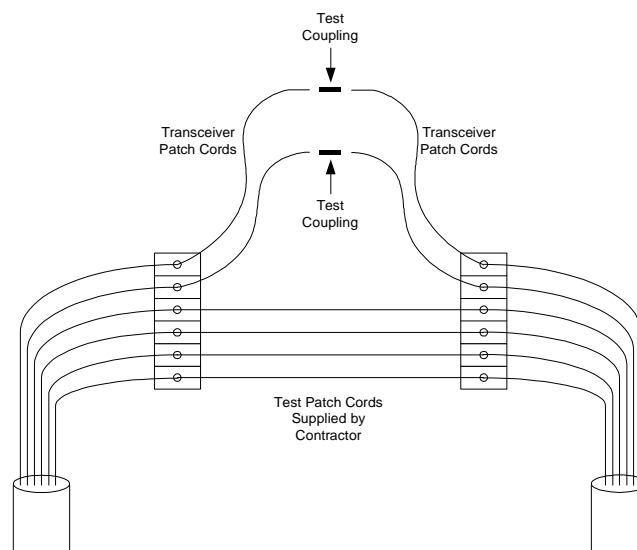
CPR Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter. Test Jumper-2 shall contain Class IV a single-mode fiber for tests on 1300 nm light sources and from which is single-moded at 850 μm for tests on 850 nm light sources.

*Single Mode Fiber Testing*

CPR Test Jumper-1 and Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.

- B) Optical Fiber Cable Testing with OTDR. The Concessionaire shall perform an OTDR test of all fibers in all tubes on the reel prior to installation of the fiber. The test results shall be supplied to CDOT ITS prior to installation of the cable.

All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end-to-end OTDR trace performed per TIA/EIA-455-61. The system margin loss measurements shall be provided at 850 and 1300 nm for multimode fibers and 1310 and 1550 for Single Mode fibers. If the Plans require installation of a fiber optic patch panel, the Concessionaire shall supply patch cords to patch all terminated fibers through the panel for all fiber testing. If patch cords are specified in the Plans for final equipment installation, these patch cords shall be connected using a test coupling for the end-to-end test.



OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant, generally, more accurate or reliable values will be obtained by using an Optical Power Meter. For fibers that are identified in the Plans to be left unterminated, an OTDR shall be used to test end-to-end attenuation.

Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

The Concessionaire shall use an OTDR that is capable of storing traces electronically and shall save each final trace.

To ensure the traces identify the end points of the fiber under test and the fiber designation, the Concessionaire shall use a test reel, if required, to eliminate the "dead zone" at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results.

If the fiber designation is not indicated on the trace itself, the Concessionaire shall provide a cross-reference table between the stored trace file name and the fiber designation.

In compliance with EIA/TIA-455-61 "Measurement of Fiber or Cable Attenuation Using an OTDR" the Concessionaire shall record the following information during the test procedure:

- (1) Names of personnel conducting the test.
  - (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
  - (3) Date test is being performed.
  - (4) Optical source wavelength and spectral width.
  - (5) Fiber identification.
  - (6) End point locations.
  - (7) Launch conditions
  - (8) Method of calculation for the attenuation or attenuation coefficient.
  - (9) Acceptable link attenuation.
- C) Optic Fiber Cable Testing with Optical Power Meter. The Concessionaire shall conduct an Optical Power Meter Test for each fiber installed.

Multimode segments shall be tested in one direction at both the 850 nm and the 1300 nm wavelength.

Single Mode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

In compliance with TIA/EIA-526-14A "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant" and TIA/EIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant," the following information shall be recorded during the test procedure:

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength, spectral width, and for multimode, the coupled power ratio (CPR).
- (5) Fiber identification.
- (6) End point locations.
- (7) Test direction.
- (8) Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- (9) Measured attenuation of the link segment.
- (10) Acceptable link attenuation.

The minor attenuation differences due to test direction are on par with the accuracy and repeatability of the test method. Lateral segments within a building are limited to 90 meters. Therefore, attenuation differences caused by wavelength are insignificant, and as a result, single wavelength testing is sufficient.

- D) Acceptable Attenuation Values. Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.
- 1) Multimode Fiber. The general attenuation equation for any multimode link segment is as follows:
 

Acceptable Link Attn.=Cable Attn.+Connection Attn.+Splice Attn.+CPR Adj.

62.5  $\mu$ m Multi-mode Attenuation Coefficients:

Cable Attn.=Cable Length (km) x (3.40 dB/km@850 nm or 1.00 dB/km@1300 nm)

Connection Attn. (ST or SC connectors)=(No. of Connections x 0.39 dB)+0.42 dB.  
 Connection Attn. (LC connectors)=(No. of Connections x 0.14 dB)+0.24 dB.  
 Splice Attn. (Mechanical or Fusion)=Splices x 0.30 dB.  
 CPR Adj.=See table below.

A connection is defined as the joint made by mating two fibers terminated with re-mateable connectors (e.g. ST, SC, LC).

Multi-mode Light Source CPR Adjustment					
	Cat. 1 Overfilled	Cat. 2	Cat. 3	Cat. 4	Cat. 5 Underfilled
Links with ST or SC Connections	+0.50	0.00	-0.25	-0.50	-0.75
Links with LC Connections	+0.25	0.00	-0.10	-0.20	-0.30

The Coupled Power Ratio of a light source is a measure of the modal power distribution launched into a multimode fiber. A light source that launches a higher percentage of its power into the higher order modes of a multimode fiber produces a more over-filled condition and is classified as a lower category than a light source that launches more of its power into just the lower order modes producing an under-filled condition. Under-filled conditions result in lower link attenuation, while over-filled conditions produce higher attenuation. Therefore, adjusting the acceptable link attenuation equation to compensate for a light source's launch characteristics increases the accuracy of the test procedure.

- 2) Singlemode Fiber. The general attenuation equation for any Single Mode link segment is as follows:

$$\text{Acceptable Link Attn.} = \text{Cable Attn.} + \text{Connector Attn.} + \text{Splice Attn.}$$

8.3 μm Single-mode Attenuation Coefficients:

$$\text{Cable Attn.} = \text{Cable Length (km)} \times (0.34 \text{ dB/km@1310 nm or } 0.25 \text{ dB/km@1550 nm})$$

$$\text{Connection Attn. (ST or SC connectors)} = (\text{No. of Connections} \times 0.39 \text{ dB}) + 0.42 \text{ dB.}$$

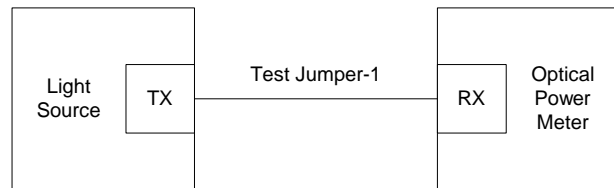
$$\text{Connection Attn. (LC connectors)} = (\text{No. of Connections} \times 0.14 \text{ dB}) + 0.24 \text{ dB.}$$

$$\text{Splice Attn. (Mechanical or Fusion)} = \text{Splices} \times 0.30 \text{ dB.}$$

- E) Test Procedures. All fiber testing shall be performed on all fibers in the completed end-to-end system.

- (1) Multimode Fiber. The multimode fiber cable test shall be conducted as follows:

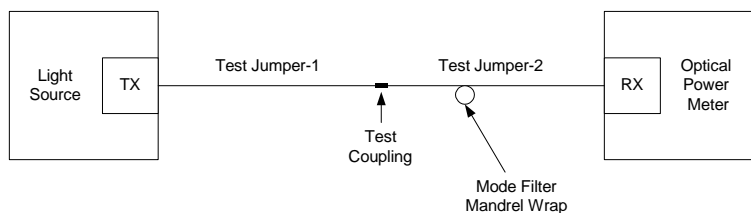
Clean the test jumper connectors and the test coupling per manufacturer's instructions. Follow the test equipment manufacturer's initial adjustment instructions. Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.



If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement ( $P_{ref}$ ). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.

Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.

Connect Test Jumper-2 between the power meter and Test Jumper-1 using the test coupling. Test Jumper-2 should include a high order mode filter. This can be accomplished by wrapping the jumper three times around a 30 mm (1.2 inches) diameter mandrel.



Record the Power Measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the CPR value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:

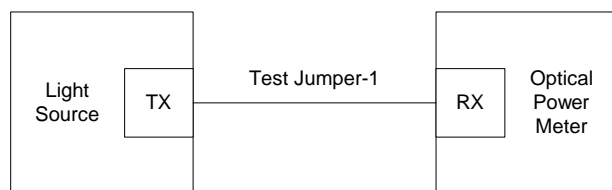
If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc.):

$$CPR (dB) = P_{sum} - P_{ref}$$

If  $P_{sum}$  and  $P_{ref}$  are in watts:  
 $CPR (dB) = 10 \times \log_{10} [O_{sum}/P_{ref}]$

- (2) Single Mode Fiber. The Single Mode Optical Power Meter fiber test shall be conducted as follows:

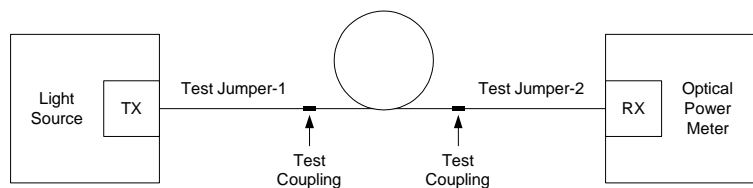
Clean the test jumper connectors and the test coupling per manufacturer's instructions. Follow the test equipment manufacturer's initial adjustment instructions. Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.



If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement ( $P_{ref}$ ). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.

Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.

Attach Test Jumper-1 to one end of the cable plant to be measured and Test Jumper-2 to the other end.



Record the Power Measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the true value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:

If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc.):  
 $CPR (dB) = P_{sum} - P_{ref}$

If Psum and Pref are in watts:

$$\text{CPR (dB)} = 10 \times \log_{10} [\text{Osum/Pref}]$$

- F) Test Acceptance. The Concessionaire shall demonstrate that each Optical Power Test results in acceptable attenuation values.

The Concessionaire, solely at the Concessionaire's cost, shall remake any fusion splices that have test results exceeding acceptable attenuation values.

The Concessionaire, solely at the Concessionaire's cost, shall retest any fiber links that have been re-spliced.

The Concessionaire, solely at the Concessionaire's cost, shall bring any link not meeting the requirements of this specification into compliance.

- G) Submittals. The Concessionaire shall submit test results documentation as both a hard copy and electronic copy.

After each reel test, the Concessionaire shall submit four (4) hard copies of the OTDR trace for every fiber on the reel. After installation, the Concessionaire shall submit four (4) hard copies of the OTDR trace for every spliced fiber. Hard copy traces shall be organized and bound in logical order in an 8 ½" x 11" 3 ring hard cover binder in addition to other documentation listed in this Special Provision and other splicing documentation listed in the project Special Provision package.

The Concessionaire shall submit, after approval of the hard copy traces, electronic copies of all traces and appropriate software to allow reading the traces.

The Concessionaire shall submit, four (4) copies of all Optical Power Test results.

The Concessionaire shall submit four (4) copies of the complete contract Plans, including additional drawings issued as part of any change orders, with any deviations clearly marked in color. Deviations to be noted and shall include but not be limited to the following:

- (1) Fiber Splice location
- (2) Fiber Splice configuration
- (3) Termination layout

**REVISION OF SECTION 614  
TRAVEL TIME INDICATOR (TTI)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

This work shall consist of furnishing and installing a Travel Time in accordance with the Plans, these Modified Special Provisions, and manufacturer's recommendations.

**MATERIALS**

For this project Travel Time Indicator shall include furnishing and installing a four channel multi-protocol IDentity 5204 Reader with power supply. The IDentity 5204 reader with power supply shall be part number ID5204-001 as manufactured by Federal Signal (Sirit Inc.), 1321 Valwood Parkway, Suite 620, Carrollton, Texas 75006, Phone: 972.243.7208, Fax: 972.243.8034. The IDentity 5204 Reader shall be compatible with existing hardware and software protocols currently in use by The Department. Travel Time Indicator shall include furnishing and installing one IDentity 5100, directional 42 degree antenna per read direction, corresponding antenna mounts, antenna signal cable, waterproofing mastic, related mounting hardware, device configuration software, and any other associated cabling and adaptors. The antenna shall be Sirit part number ANTENNA-013-K which includes a mount bracket. The Concessionaire is responsible for installing and aligning the ANTENNA-013-K directional antennas and antenna mounts as shown on the plans and per manufacturer's recommendations. Concessionaire shall contact Matthew Becker at 303-435-8288 for field location of each pair of antennas at each site. Mounting heights will vary per location.

Travel Time Indicator shall also include:

- 1) 0.75 inch Type 201 stainless steel strap with Type 201 stainless steel buckles.
- 2) Liquid tight flexible conduit with compatible connectors
- 3) Water-proofing mastic
- 4) Communication Cable, 6 meter (20') length, RJ-45 terminated, Sirit Part Number S3114-021 or, alternatively Communication Cable, 2 meter (7') length, RJ-45 terminated, Sirit Part Number: S3114-20, whichever length is required.
- 5) Connector kit, Sirit part number CONN-5200-K which includes 2 Male N-Type Connectors. One kit to facilitate one antenna.
- 6) Antenna signal cable and terminations.
  - a. The antenna signal cable type is determined by the cable distance from the reader to the antenna. Signal loss at 900 Mhz must be less than 4db per run. The following outdoor rated cable shall be used.
    - i. For runs 100 feet or less- LMR-400.
    - ii. For runs from 101-155 feet- LMR-600
    - iii. For runs from 156-230 feet- LMR 900

Signal cable shall be terminated with weatherproof male N-type crimp on straight plugs that have the following properties:

- i. Ferrule-Copper with Albaloy plating
- ii. Contact pin- Brass with minimum 15µm gold plating
- iii. Retaining ring-304 stainless



- iv. Gasket- Silicone
  - v. Insulator - Teflon
  - vi. Shell/Body- Brass with Albaloy plating
  - vii. Impedance- 50 Q
  - viii. Insulation resistance- Greater than 5,000 MQ
  - ix. Peak operating Voltage- 1,500 V
- 7) One pole mounted IDentity -5100, directional 42 degree antenna per direction of detection.

(ANTENNA-013-K)

- a. The antenna shall weigh 3 kg or less and have dimensions (17.7 x 17.7 x 1.4 in.). The antenna shall have a wind survival rating of 150 mph as defined in EIA-222-F and/or ETS 300 019-I-4. The antenna shall accommodate a male N-type coaxial connection. The antenna shall have a 902-928 MHz frequency range with 13.0 dBi gain and 50 ohm (nominal) input impedance. The antenna shall have a front to back ratio of -24db with a VSWR 1.7:1 or less.

### CONSTRUCTION REQUIREMENTS

The Travel Time Indicator reader shall be mounted inside the communications cabinet allowing room for all communication cable connections. A hook & loop fastening system shall be used to mount the reader to the cabinet for ease of removal.

The power supply shall be mounted to the DIN rail inside the communications cabinet. All wiring shall conform to the most current version of the NEC.

The Concessionaire shall supply and install one-inch type 201 stainless steel strap used in conjunction with type 201 stainless steel buckles shall be used to band the antenna mount to the structure at the mounting height directed by CDOT ITS per guidance from Matthew Becker at 303-435-8288. The Antenna shall be mounted horizontally polarized using the included stainless hardware. The antenna shall be oriented such that it intersects with the oncoming traffic at a 45 degree angle, and is aimed to the center of lane 2.

The Concessionaire shall install flexible conduit from the communication cabinet enclosure to the structure for signal cable and/or power cable installation as shown in the plans. Holes made in mounting structures shall be the minimum size necessary to secure the conduit connectors and shall not exceed 2 inches in diameter.

All holes shall be free of burs and sharp edges prior to the installation of all cable, conduit, and conduit nipples. All cable entrances in structures, conduits, and enclosures shall be sealed and waterproofed. All wiring and electrical connections shall be performed in conformance with the latest version of the NEC.

The signal cable shall connect RF input/output channels from the telemetry master (toll tag reader) to the telemetry (antenna) units- one cable per antenna. The Concessionaire shall route signal cable through existing structures or through new flexible or rigid PVC conduit mounted to existing structures as shown on the plans. Each signal cable shall be a continuous cable, with no splices, terminated with male N-type crin1p on straight plugs on both ends. Installed length of any one signal cable shall not exceed 100 ft.

Installations that require lengths in excess of 100 ft should utilize lower loss cable as to not exceed 3-4dB of loss per run. All signal cables shall be labeled on both ends with UV resistant colored tape before installation. The same color label shall be used on both ends of one cable and label colors shall not repeat at the same installation site. Labels shall be installed such that they are distinguishable from the ground.

The Concessionaire shall ensure strain relief and drip loops in coaxial antenna cable. The Concessionaire shall provide full support to all coaxial cable not in conduit and/or wiring trays. All cable entrances in conduits, conduit entrances in structures and cabinets shall be sealed and waterproofed. Conduit/signal cable shall not enter the top of the cabinet housing the telemetry master device. Entering through the bottom of the cabinet is preferred, although side entrances will be permitted. It is suggested that the signal cables be cut longer than needed and installed with the terminated end on the telemetry (antenna) side. Cables can then be re-labeled, cut to length, and terminated once they are run into the telemetry master enclosure. Waterproofing mastic shall be applied at all antennas to signal cable connections following manufacturer's recommendations.

The Concessionaire shall connect antenna signal cables to the Travel Time Indicator such that:

Northbound vehicle detection corresponds to Port 1,  
Southbound vehicle detection corresponds to Port 2,  
Eastbound vehicle detection corresponds to Port 3, and  
Westbound vehicle detection corresponds to Port 4.

The Concessionaire shall configure the Travel Time Indicator in accordance with manufacturer's recommendations. The unit shall have CalTrans Title 21 and 18000-6C protocols enabled for tag detection with only active antenna channels enabled and power levels set to the minimum needed for reliable transponder detection.

The unit shall be configured for serial communication with the following:

19,200 bits per second  
8 data bits  
No parity  
1 stop bit  
No flow control

The following shall be set to run in the TPS script:

- 1) Interval: 60s
- 2) Reader ID: as per plan sheet
- 3) Heartbeat: 10s

**REVISION OF SECTION 614  
VARIABLE TOLL MESSAGE SIGN (VTMS)**

Section 614 of the Standard Specifications is hereby revised to include the following:

**DESCRIPTION**

This work consists of furnishing and installing a Light Emitting Diode Variable Toll Message Sign (LED VTMS) and associated equipment cabinets at locations as shown in the plans. The sign shall be fully compatible with the mounting hardware and support structure shown on the plans. The LED VTMS shall be equipped with the ability to display 7 characters of text at a height of 18-inch tall characters for overhead installations or 12-inch tall characters for ground-mounted installations. The sign shall include a power shut off mounted to the sign structure near the controller interface cabinet. The sign shall be capable of operating without any decrease in performance over a temperature range of -34° F to +140° F with a relative humidity of 0 to 99 percent, non-condensing. The sign shall have a minimum design life of 20 years. A uninterruptable power supply sufficiently sized to operate the VTMS for 8 hours shall be provided.

**MATERIALS**

- a) *Certifications:* Prior to start of the installation of the LED VTMS the Concessionaire shall provide the following certifications to CDOT ITS for Approval:
- (1) The ISO 9001 Certification shall apply to the facility, and to the design, fabrication, installation, and maintenance of the LED VTMS. The facility where this company actually designs and manufactures the LED VTMS shall be ISO 9001:2000 certified a minimum of one year prior to the bid date for this project.
  - (2) Working drawings showing the sign housing and tilting brackets shall be sealed by an Engineer registered in the State of Colorado and shall be submitted in accordance with subsection 105.02.
  - (3) Certification showing that welding of the LED VTMS housing is in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED VMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.
  - (4) Certification that all aluminum face materials have a coating that meets or exceeds the requirements of the American Architectural Manufacturers Association (AAMA) Specifications Publication No. 2605.
  - (5) Certification that the LEDs were tested and binned in accordance with the CIE Test Method A.
  - (6) Documentation and information on software as described in Appendix A of this document.
  - (7) Documentation verifying the VTMS is listed by an accredited 3<sup>rd</sup> party testing organization for conformance to UL48 and UL 1433.

- (8) All workmanship shall comply with IPC-A-610C, Class 2 titled "Acceptability of Electronic Assemblies",
  - (9) Documentation providing proof PCB silicon conformal coating conformance to MIL-I-46058C Type SR and IPC-CC-830.
  - (10) Documentation that the sign's structural integrity is in Conformance to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals (Third Draft).
  - (11) Documentation that the VMS conforms to the Transient Protection and Vibration of the NEMA Standard TS4, Section2.
- b) *Sign Housing:* All component parts shall be easily and readily accessible by a single person for inspection and maintenance. The housing shall be weather tight, and compliant to the NEMA 3R Standard.

*All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish. All exterior seams shall be continuously welded by an inert gas process, except for the coated fascia material.*

*The glazing shall be constructed of 0.25 inch thick clear polycarbonate sheets with surfaces that resist hazing from UV light. The glazing shall be protected by a coated 0.090 inch aluminum mask with apertures punched directly in front of each pixel. The coating shall meet or exceed the AAMA Specification No. 2605.*

For surge protection, the system power shall be protected by two stages of transient voltage suppression devices. Also, communication lines shall be protected by two stages of transient voltage suppression devices as required in the Sign Controller Communication Interface section of this specification. In both cases, tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to call central and report the error condition (for dialup operation) or report the error condition to central on the next poll (for multi-drop operation). There shall be an option that is either enabled or disabled and is selected and downloaded from the central system control software to the sign controller. When this option is enabled, tripping of the second stage of surge protection shall prevent power from reaching any components of the sign until the surge protection has been replaced. When this option is disabled, the sign will continue to function normally after the second stage of surge protection is tripped.

- c) *Sign controller:* The sign controller shall be located in a pole or ground mounted cabinet. Each VTMS shall be controlled and monitored by sign controller. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VTMS control software in order to perform most VTMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with graphical VFD or LCD and keypad for direct operation and diagnostics as described herein
- Contain a minimum of two (2) NTCIP-compliant communication ports, one of which has an RJ45 connector
- Contain a minimum of two(2) NTCIP-compliant Ethernet port with RJ45 connector
- Have the ability to play volatile messages
- Contain VMS-specific control firmware (embedded software) that shall monitor all external and internal sensors and communication inputs and control the display modules as directed by external control software and the front panel interface
- Ability for remote firmware upgrades that error check to eliminate firmware corruption

NTCIP shall be natively supported in the VMS controller. External protocol converter or translator devices shall not be allowed. The sign controller shall be programmed to receive and transmit NTCIP compliant sign control commands from the central system control software and laptop computer. The controller shall have power-up and auto-restart capabilities with programmable default actions when recovering from a power off condition. A hardware watch dog circuit shall provide automatic reset of the controller and communications device. Central control shall have ability to perform a remote command for the controller and communications device reset. The controller shall be able to accept standard UPS shutdown commands via Ethernet or serial interface

The Controller shall perform all communication, control and feedback functions and shall not require an intermediate control device and be the only sign controller. Communication and control lines between the sign controller and the system interface circuits shall be opto-coupled.

- d) *Electronics:* All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods.  
All Printed Circuit Boards (PCBs) shall be completely conformal coated with a silicone resin that meets the IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.

All discrete components, such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

Provisions shall be made to prevent face fogging and condensation. The sign controller shall read the internal temperature sensors, external ambient temperature sensor and the humidity sensor. The sign controller shall use these readings in an algorithm that turns on the heat tape to reduce both frost on the face of the sign and condensation on the display modules and other electronic circuitry.

The sign and the controller shall be capable of operating with 120/240 VAC, 50 amp per leg, 60 Hz, single phase power. The sign shall have a 50-amp two-pole breaker (common trip) main, 120/240 VAC, single phase, four wire load center with 20 circuit capability. Each circuit in the sign shall be powered from a circuit breaker. Inside the sign housing, all 120 VAC service lines shall be independently protected by a thermo-magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways, or control cabinets as required by the National Electrical Code (NEC). No 120 VAC wiring shall be exposed within or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet. There shall be a minimum of three GFI Duplex outlets installed inside the sign housing.

The pixels shall be amber in color and utilize precision optical performance AllnGaP II LEDs constructed of aluminum indium gallium phosphide. The brightness and color of each pixel shall be uniform over the entire face of the sign within the 30-degree cone of vision from minimum of 200 feet up to and including 1,100 feet in all lighting conditions. Each pixel shall be 40 candelas at 20mA as measured by the sum of the brightness of the individual LEDs in each pixel. The brightness of each LED shall be measured in accordance with CIE Test Method A, as described in CIE 127-1997, Technical Report: Measurement of LEDs. All LEDs shall have a nominal viewing cone of 30 degree angle of 15 degrees measured from the center of the longitudinal viewing cone.

Each pixel shall contain two strings of LEDs. The pixel strings shall be powered from a regulated DC power source and the LED current shall be maintained at 25 plus or minus three milliamperes per string to maximize life of the pixel. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel. The LEDs shall be capable of operating in a temperature range of -40 degrees to +100 degrees C. The LEDs shall be moisture resistant epoxy with UV-A and UV-B inhibitors.

Pixel power drawn from the DC supplies shall not exceed 1.5 watts per pixel, including the driving circuitry.

A minimum of one photocell shall be installed on the sign. This device shall permit monitoring of light conditions at each sign location and automatic selection of light intensity levels. The method or algorithm used to calculate the intensity

level shall be determined by the manufacturer and tested under real world conditions.

Provisions shall be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

The power supplies shall be paralleled in a diode OR configuration such that one supply may completely fail and the sign will still be supplied with enough power to run 40% of all pixels.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

The signs shall be capable of displaying ASCII characters 32 through 126 (including all upper and lower case letters and digits from 0 to 9) at any location in a message line.

The Concessionaire shall be responsible for locating the nearest electrical power and telephone sources and connecting those sources to the appropriate terminations with the LED VTMS. The Concessionaire shall cooperate with the local electrical and telephone utilities to establish a service accounts at the direction of the Engineer.

- e) *Communication:* The sign controller shall be capable of being controlled from the central system control software and the controller interface cabinet via RS-232 serial and Ethernet communications.

The sign controller shall include separate interfaces for communication with the central system control software and the controller interface cabinet.

The communications between the sign controller and the central system control software and controller interface cabinet shall comply with the NEMA National Transportation Communications for ITS Protocol (NTCIP). The sign controller shall support all NTCIP conformance levels, conformance groups, objects, and minimum storage sizes and ranges as specified in APPENDIX A.

In addition to the standard Management Information Base (MIB) objects, the sign shall include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined in this specification and in APPENDIX A.

Dial-up or hardwire multi-drop communication lines shall be protected by two stages of transient voltage suppression devices including MOVs and spark gap arrestor.

The sign controller shall be capable of being remotely reset from the central system control software.

The sign shall provide a minimum of four (4) input and four (4) output contact closures able to receive digital and or analog signals that will allow up to 15

message activations upon contact closure events. These message activations shall permit standard NTCIP operations to occur and also permit contact closure messages to occur without message activation collisions and or message activation errors. Contact closures shall be remotely accessible using standard NTCIP MIB objects. Contact closures shall be capable of issuing NTCIP traps.

The sign controller shall provide software modules that will allow integration with Camera Cameleon HOV software.

The sign controller shall allow user-configuration of maximum and minimum temperature in which to turn fans on and off.

The sign shall have polling capability and at a minimum shall be capable of reporting the status of the following:

- (1) Pixel operational status that includes every string of every pixel
- (2) Sign and ambient temperature
- (3) DC power supply status
- (4) The current state (on or off) of each pixel, including any pixel errors, in the actual, currently displayed message without disturbing the message in any way. This shall be real time and shall not be based on a previous pixel test.
- (5) Communication failure log
- (6) Heat tape status
- (7) UPS status
- (8) AC surge protector status

The controller software shall be capable of displaying the following types of messages:

- (1) Static messages capable of displaying any character or set of characters
- (2) Full Graphic capabilities.

It shall be possible to flash any character or set of characters in an alternating message at the adjustable frequencies listed above for flashing messages. The flashing period shall be a sub-multiple of the associated alternating on time. It shall also be possible to flash any character or set of characters in a static message.

The sign controller shall monitor the photo cell circuits in the sign and convert the measured light intensity into the desired pixel brightness.



## **MANUFACTURER QUALIFICATIONS**

The manufacturer shall supply experience documentation showing that the manufacturer has been in business, under the current corporate name, designing and manufacturing Interstate LED Variable Toll Message Signs for a minimum of 5 years; and that the manufacturer has in operation a minimum of 100 LED VTMSs. These 100 VTMS shall be from 5 separate projects and operational for a minimum of 5 years.

## **CONSTRUCTION REQUIREMENTS**

Concessionaire shall be fully responsible for the delivery of the sign to the installation site and any damages that occur in the installation delivery process.

The LED VTMS shall be installed in accordance with manufacturer's recommendations. A qualified factory representative shall be available on site to ensure proper installation and testing.

The Concessionaire shall submit a "VTMS acceptance test procedure" for acceptance and shall perform the test in the presence of CDOT ITS and the manufacturer's representative. The test shall also include the use of the latest version of the NTCIP Exerciser, or equivalent, to demonstrate that no proprietary protocols have been used and that the local and central software are NTCIP compliant. The Concessionaire shall notify CDOT ITS at least two weeks prior to the test date.

A minimum of five copies of the operations manual detailing the electrical schematics, operation and maintenance of the VTMS system, including spare software copies, shall be provided. Additional copies may be requested by CDOT ITS. One copy of the manual shall remain inside the sign housing or control cabinet. One copy shall be mailed to the Colorado Transportation Management Center at 425 C Corporate Circle, Golden, Colorado 80401.

## **WARRANTY**

- c) *Standard Warranty.* The Concessionaire shall ensure that the manufacturer can warranty the product for a minimum of 3 years for all parts returned to the factory, and full telephone technical support at no additional charge to the Department. The technical support shall include access to a trained service representative who can respond within 24 hours to questions related to all VTMS related equipment problems and maintenance issues.

## **Appendix A**

### **NTCIP Requirements**

This portion of the specification defines the detailed NTCIP requirements for the Variable Message Signs covered by the project specifications.

This specification references several standards through their NTCIP designated names. The following list provides the full reference to the current version of each of these standards. In many cases, the standard is more widely known by its original NEMA assigned number, in these cases, the NEMA number is also identified. The content of the NEMA standard is identical to that of the NTCIP standard.

Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is at the stage of Recommended or higher as of Sunday, April 03, 2001, including any and all Approved or Recommended Amendments to these standards as of the same date. It is the ultimate responsibility of the vendor to monitor NTCIP activities to discover any more recent documents.

### **General Requirements:**

#### **Subnet Level**

Each NTCIP Component shall support NTCIP 2103 v01.05 over both a null-modem connection and a Concessionaire-provided external dial-up modem connection. The dial-up modem shall support data rates of 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, 600 bps, and 300 bps. The null-modem shall support the same speeds with a maximum of 19.2 kbps. Additionally, the NTCIP Component shall be able to make outgoing and receive incoming calls as necessary and support the following modem command sets:

- Hayes AT Command Set
- MNP5
- MNP10
- V.42bis

NTCIP Components may support additional Subnet Profiles at the vendor's option. At any one time, only one Subnet Profiles shall be active on a given serial port of the NTCIP Component. If the NTCIP Component has a serial port that supports multiple Subnet Profiles, the NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile and shall provide a visual indication of the currently selected Subnet Profile.

#### **Transport Level**

Each NTCIP Component shall comply with NTCIP 2202, (NEMA TS 3.Internet). NTCIP Components may support additional Transport Profiles at the manufacturer's option. Response datagrams shall use the same Transport Profile used in the request. Each NTCIP Component shall support the receipt of datagrams conforming to any of the identified Transport Profiles at any time.

#### **Application Level**

Each VMS shall comply with NTCIP 2301, (NEMA TS 3.AP-STMF), as a Managed Agent and shall meet the requirements for Conformance Level 1 (NOTE – See Amendment to standard). SNMP shall be required and STMP shall not be required. An NTCIP Component may support additional Application Profiles at the manufacturer's option. Responses shall use the same

Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

### **Information Level**

Each NTCIP Component shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications, unless otherwise indicated below. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

The vendor's software shall implement all mandatory objects of the mandatory conformance group defined in NTCIP 1201, (NEMA TS 3.4) Global Object Definitions:

- Configuration Conformance Group – Section 3.1
- Security Conformance Group (new in Amendment 1)

The vendor's software shall implement the mandatory objects of the optional conformance groups defined in NTCIP 1201, (NEMA TS 3.4), Global Object Definitions:

- Time Management Conformance Group – Section 3.3
- TimeBase Event Schedule Conformance Group – Section 3.4
- Report Conformance Group – Section 3.5

The vendor's software shall implement all mandatory objects of all mandatory conformance groups defined in NTCIP 1203, (NEMA TS 3.6) Object Definitions for Variable Message Signs:

- Sign Configuration Conformance Group – Section 4.1
- Message Table Conformance Group – Section 4.6
- Sign Control Conformance Group – Section 4.7

The vendor's software shall implement all mandatory objects of the optional conformance groups defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

- GUI Appearance – Section 4.2
- Font Definition – Section 4.3
- VMS Sign Configuration – Section 4.4
- MULTI Configuration – Section 4.5
- Default Message – Section 4.8
- MULTI Error – Section 4.10
- Illumination/Brightness – Section 4.11
- Scheduling – Section 4.12
- Auxiliary I/O – Section 4.13

- Sign Status – Section 4.14
- Status Error – Section 4.15
- Pixel Error Status – Section 4.16
- Fan Error Status – Section 4.18
- Temperature Status – Section 4.17

The vendor's software shall implement the following optional objects defined in NTCIP 1203, (NEMA TS 3.6):

- dmsMessageBeacon – Section 2.6.1.1.1.8.6
- dmsSWReset – Section 2.7.1.1.1.1
- dmsMessageTimeRemaining – Section 2.7.1.1.1.4
- dmsShortPowerRecoveryMessage – Section 2.7.1.1.1.8
- dmsLongPowerRecoveryMessage – Section 2.7.1.1.1.9
- dmsShortPowerLossTime – Section 2.7.1.1.1.10
- dmsResetMessage – Section 2.7.1.1.1.11
- dmsCommunicationsLossMessage – Section 2.7.1.1.1.12
- dmsTimeCommLoss – Section 2.7.1.1.1.13
- dmsPowerLossMessage – Section 2.7.1.1.1.14
- dmsEndDurationMessage – Section 2.7.1.1.1.15
- dmsMultiOtherErrorDescription – Section 2.7.1.1.1.20
- dmsStatDoorOpen – Section 2.11.1.1.1.6
- fanFailures – Section 2.11.2.1.1.8
- fanTestActivation – Section 2.11.2.1.1.9
- tempMinCtrlCabinet – Section 2.11.4.1.1.1
- tempMaxCtrlCabinet – Section 2.11.4.1.1.2
- tempMinAmbient – Section 2.11.4.1.1.3
- tempMaxAmbient – Section 2.11.4.1.1.4
- tempMinSignHousing – Section 2.11.4.1.1.5
- tempMaxSignHousing – Section 2.11.4.1.1.6

The vendor's software shall implement the following tags (opening and closing where defined) of MULTI as defined in NTCIP 1203, (NEMA TS 3.6), Object Definitions for Variable Message Signs:

**MULTI Tag**

23	Field
24	Flash
25	Font
26	Hexadecimal Character
27	Justification Line
28	Justification Page
29	Moving Text
30	New Line
31	New Page
32	Page Time
33	Spacing – Character

The Field Tag shall support the following field ID's:

<b><u>Field Tag ID</u></b>	<b><u>Description</u></b>
1	1 Time, 12-hour format (no AM/PM indicator)
2	2 Time, 24-hour format
3	3 Temperature in degrees Celsius
4	4 Temperature in degrees Fahrenheit
5	7 Day of week
6	8 Day of month
7	9 Month of year
8	10 Year, 2-digits
9	11 Year, 4-digits

**Sizes and Ranges**

All objects required by these procurement specifications shall support all values within its standardized range. The standardized range is defined by a size, range, or enumerated listing indicated in the object's SYNTAX field and/or through descriptive text in the object's DESCRIPTION field of the relevant standard. The following provides the current listing of known variances for this project:

<b><u>Object</u></b>	<b><u>Reference</u></b>	<b><u>Minimum Project Requirements</u></b>
<b>NTCIP 1201 (TS 3.4)</b> moduleTableEntry	2.2.3	Shall contain at least one row with moduleType equal to 3 (software). The moduleMake shall specify the name of the manufacturer, the moduleModel shall specify the manufacturer's name of the component and the modelVersion shall indicate the model version number of the component.

communityNamesMax	2.8.2	Shall be at least 4.
maxTimeBaseScheduleEntries	2.4.3.1	7
maxDayPlans	2.4.4.1	7
maxDayPlanEvents	2.4.4.2	7
maxEventLogConfigs	2.5.1	50
eventConfigMode	2.5.2.3	2,3,and 4
maxEventLogSize	2.5.3	200
maxEventClasses	2.5.5	7
maxGroupAddress	2.7.1	1

**NTCIP 1203 (TS 3.6)**

dmsNumPermanentMsg	2.6.1.1.1.1	50
dmsMaxChangeableMsg	2.6.1.1.1.3	50
dmsFreeChangeableMemory	2.6.1.1.1.4	50KB
dmsMaxVolatileMsg	2.6.1.1.1.6	50
dmsFreeVolatileMemory	2.6.1.1.1.7	50KB
dmsMsgMultiString	2.6.1.1.1.8.3	See attached table
dmsControlMode	2.7.1.1.1.1	2,4,5
numFonts	2.4.1.1.1.1	4
maxFontCharacters	2.4.1.1.1.3	127
vmsCharacterHeightPixels	2.3.1.1.1.1	5
vmsCharacterWidthPixels	2.3.1.1.1.2	7
vmsSignHeightPixels	2.3.1.1.1.3	3
vmsSignWidthPixels	2.3.1.1.1.4	10
vmsHorizontalPitch	2.3.1.1.1.5	70mm
vmsVerticalPitch	2.3.1.1.1.6	70mm
defaultBackgroundColor	2.5.1.1.1.1	0 (black)
defaultForegroundColor	2.5.1.1.1.2	9 (amber)
defaultJustificationLine	2.5.1.1.1.6	2,3,4
defaultJustificationPage	2.5.1.1.1.7	2,3,4
defaultFlashOn	2.5.1.1.1.3	0.5 to 5.0
defaultFlashOff	2.5.1.1.1.4	0.5 to 5.0
defaultPageOnTime	2.5.1.1.1.8	0.5 to 5.0
defaultPageOffTime	2.5.1.1.1.9	0.5 to 5.0
defaultCharacterSet	2.5.1.1.1.10	eightBit (2)
numActionTableEntries	2.9.1.1.1.1	15

**Documentation**

Software shall be supplied with full, electronic documentation containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a vendor specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the

associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module, except that it will have the extension “.man”.

- A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

The vendor shall allow the use of any and all of this documentation by any party authorized by CDOT ITS for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

**REVISION OF SECTION 614  
WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM**

Section 614 of the Standard Specifications is hereby revised as follows:

Subsection 614.01 shall include the following:

This work includes furnishing and installing wireless battery-powered magnetometer vehicle detection systems in accordance with these specifications at the locations shown on the plans. These systems shall be used at all RMS and CDOT Region 1 ATR stations.

Add subsection 614.08(m) which shall include the following:

- (m) *Wireless Magnetometer Vehicle Detection System.* The Wireless Magnetometer Vehicle Detection System (WVDS) shall consist of one Access Point (AP), one or more battery-powered wireless Vehicle Sensor Nodes (VSN) per detection zone, one or more battery powered Wireless Repeaters (RP), one Access Box (AB), one Contact Closure (CC) card, the required number of Extension Interface (EX) cards, and installation materials for each detection zone.

One WVDS is required for each ramp or intersection as indicated on the plans.

The VSN shall detect a vehicle by measuring a change in the earth's magnetic field near the VSN caused by the vehicle (i.e. magnetometer type detection).

The VSN shall transmit detection information within 125 ms of a detected event.

The VSN shall automatically recalibrate in the event of a detector lock.

The wireless radio frequency (RF) communications link between the AP, RP, and VSN shall utilize an IEEE-approved wireless communications protocol.

Communications shall use an unlicensed band.

The VSN and RP shall be reconfigurable by a user over the wireless interface to avoid interference from other users of the communications band. A minimum of 16 channels shall be provided for this purpose.

The RF link budget shall be 93dB or greater.

The AP to VSN (or RP to VSN) RF range shall be at least 150 feet for an AP/RP installed at 24 feet above the roadway and at least 100 feet at 18 feet above the roadway.

The RP to AP RF range shall be at least 750 feet when both units are installed 18 feet above the roadway.

Each VSN shall transmit a unique identifying code.

The VSN shall respond within 100 seconds when the AP is powered on.



The AP shall have the capability to transmit detection information to a 170E-HC11 traffic controller to provide real time detection information via a standard contact-closure based input shelf.

The VSN, RP and AP shall be capable of accepting software and firmware upgrades.

1. Vehicle Sensor Node Hardware:

The vehicle sensor node (VSN) shall consist of a 3 Axis magnetometer, a microprocessor, a wireless transmitter and receiver, and a battery.

The VSN shall have the following characteristics:

- (1) components shall be contained within a single housing meeting NEMA 6P and IP68 standards;
- (2) components shall be fully encapsulated within the housing to prevent degradation from moisture;
- (3) operate in a temperature range from -37 °F to +176 °F;
- (4) housing shall be capable of being installed in a 4 inch diameter 2-1/4 inch deep cored hole;
- (5) be designed to operate from its battery for a period of 10 years of life under normal traffic conditions after it is put into operation;
- (6) be able to transmit the complete X-Y-Z magnetic signature of a vehicle, sampled at a minimum of 128 samples per second. In this mode, the VSN shall be designed to operate from its battery for a minimum of 1 year.

2. Access Point Hardware:

The access point (AP) shall be the communication hub of the sensor network.

The AP shall have the following characteristics:

- (1) capable of communicating with up to 24 VSN's;
- (2) be powered via 48 V DC, 3W or via non-isolated external 10 to 15 V DC, 2 W power. Power shall be provided by the CC Card;
- (3) have at least one powering option that provides 1500 V isolation and 5 KV surge protection;
- (4) operate in a temperature range of -37 °F to +176 °F;
- (5) meet NEMA 4X and IP67 standards;
- (6) weigh 3 pounds or less.

The AP shall communicate to the controller via the CC and optional EX Contact Closure Board(s).

3. Repeater Hardware:

If required, one or more wireless repeaters (RP) shall be provided.

The RP shall have the following characteristics:

- (1) extend the effective communication range of the sensor to the AP an additional 750 feet;
- (2) be powered by a field-replaceable battery;
- (3) operate in a temperature range of -37 °F to +176 °F;
- (4) meet NEMA 4X and IP67 standards;
- (5) weigh 3 pounds or less.

4. Contact Closure and Extension Interface Contact Closure Cards:

The CC and EX cards shall provide detector outputs to the controller.

The CC card shall communicate with the access point via an outdoor rated Cat5e Ethernet cable.

The CC and EX cards shall have the following characteristics:

- (1) directly plug into standard 170/2070 Input Files and NEMA detector racks;
- (2) provide up to 4 channels of detection;
- (3) be capable of providing pulse or presence detection outputs;
- (4) provide for up to 31 seconds of delay;
- (5) provide up to 7.5 seconds of extension;
- (6) be powered by 11 to 26 V DC;
- (7) be surge protected to GR-1089 standards;
- (8) operate within a -37° F to +176 °F temperature range;
- (9) operate in up to 95 percent humidity (non-condensing).

The front panel of the CC and EX cards shall provide:

- (1) status LEDs displaying detection channel status, line quality, fault monitor;
- (2) ten configuration DIP switches to enable presence or pulse mode, delay and extension;
- (3) a rotary switch to program time functions for delay and extension functions; and
- (4) two Ethernet-style RJ45 connectors.

The CC card shall provide power to the AP over the Ethernet cable.

5. Access Box:

The Access Box shall provide a communication link between the AP and the CC card.

The Access Box shall have the following characteristics:

- (1) provide the ability for remote communications;
- (2) have 3 Ethernet style RJ45 connectors.
- (3) not exceed 2-3/8 inches by 1-1/2 inches by 7/8 inch in size.

6. Configuration Software:

The WVDS shall include the software necessary to configure the vehicle sensor nodes, wireless repeaters, and access point. The WVDS shall include the software necessary to store and retrieve detection data.

Add subsection 614.10(k) which shall include the following:

- (k) *Wireless Magnetometer Vehicle Detection System Installation.* WVDS shall be installed in the configuration shown on the plans.

The vehicle sensor node pavement core shall be circular and shall be made 2 ¼ inches deep and 4 inches in diameter.

The vehicle sensor nodes, access point, repeater, and access box shall be installed in accordance with the manufacturer's guidelines.

**REVISION OF SECTION 614  
CONTROLLER CABINET FOUNDATION**

Section 614 of the Standard Specifications is hereby revised for this project to include the following:

**DESCRIPTION**

This work consists of furnishing and installing a fiberglass porch-style traffic signal controller base in the field for 334 traffic signal controller cabinet foundations at ramp meter and automatic traffic recorder locations.

**MATERIALS**

Section 614.10 (e) shall include the following:

Controller foundations shall be preformed type and shall meet the following requirements:

Controller foundation shall be manufactured of fiberglass reinforced polymer concrete. Foundation dimensions shall conform to the detail in the plans. A minimum of 4 - ½ inch x 13 Unified Coarse Thread (UNC) inserts shall be installed for mounting of the controller cabinet to the foundation. Placement of the mounting inserts shall match the mounting configuration of the controller cabinet. The foundation shall be provided with an opening to accommodate access of underground conduit into the controller cabinet. Foundation opening shall match the controller cabinet opening as closely as possible. A minimum of 4 - ½ inch x 13 UNC lifting inserts shall be installed at each corner of the controller cabinet foundation. Lifting inserts shall be designed to support the full weight of the foundation to aid in the moving and placing of the foundation. The walking surface of the foundation shall have a skid resistant surface encompassing three sides of the controller cabinet so field personnel can walk on the foundation from the front door to the back cabinet door.

## 20.0 MODIFICATIONS TO STANDARD SPECIFICATIONS

### 20.1 Construction Requirements

This Section 20 sets forth modifications to the CDOT *Standard Specification for Road and Bridge Construction*. The first section contains revisions to Division 100 of the Standard Specifications. The second section contains revisions to Divisions 200 through 700 of the Standard Specifications, as well as Standard Special Provisions applicable to the Project.

These Contract Provisions are a revised version of CDOT's *Standard Specifications for Road and Bridge Construction*, and contain requirements generally applicable to the Work to be performed by the Concessionaire. In certain cases, provisions in Division 100 of the *Standard Specifications for Road and Bridge Construction* have been superseded by other provisions of the Contract Documents. For ease of reference, this document uses the same Section numbers as the *Standard Specifications for Road and Bridge Construction*, and identifies provisions of the Contract Documents that have replaced or modified the standard clauses.

All references to "Engineer" that are incorporated into this RFP refer to the Concessionaire's Engineer in Responsible Charge, unless the context requires otherwise. Non-capitalized terms, such as "work" that are defined in The Concession Agreement, Schedule 1, shall have the meanings defined therein unless the context requires otherwise. References to "approve, approval or approved" shall mean "Approve, Approval or Approved" as defined in The Concession Agreement, Schedule 1, when the approval is by HPTE or a division of HPTE. If the interpretation(s) pursuant to this paragraph are not clear, HPTE shall decide, in its sole discretion, how these terms shall be interpreted.

When these specifications describe actions, Materials, means or methods that are required and that are qualified by phrases such as: "as directed by the Engineer", "when directed by the Engineer", "as determined by the Engineer", "with or without permission of the Engineer", "in the opinion of the Engineer", "unless authorized by the Engineer", "satisfactory to the Engineer", "as approved by the Engineer", or "unless another type is specified or is permitted with approval of the engineer", such phrases shall be disregarded. If it is not clear whether a phrase should be disregarded, HPTE will make that decision in its sole discretion.

When these specifications refer to "Department", "Resident Engineer", "Agricultural Engineer", "Bridge, Construction or Maintenance Engineer", "TMC system inspector", "Concrete Engineer", "Project Engineer", "Materials Engineer", "Commissioner", "Structural Metals Engineer", "Department's Lighting Engineer", "Geotechnical Engineer" or any other specific HPTE special engineer, such reference shall mean the HPTE Project Director.

When these specifications use the term engineer relating to the approval of any activities involving the use of explosives, such term shall mean the HPTE Project Director.

When an approval or authorization of the Engineer or HPTE is required in these specifications for the use of alternative or substituted processes or components, the Engineer shall mean HPTE. If it is not clear whether a phrase involves the use of alternative or substituted processes, HPTE will make that determination in its sole discretion.

If these specifications refer to an approval of any correction or repair that deviates from the Contract requirements, the approval must be by HPTE. If it is not clear whether a specification

involves a correction or repair that deviates from the Contract requirements, HPTE will make that determination in its sole discretion.

When these specifications provide that reports, records or other documents shall be submitted to HPTE or to the Engineer, such reports shall be made available to HPTE and do not have to be submitted unless either they are otherwise listed in the deliverables in the Contract Documents, or are required shop drawings, warranties, parts lists, instruction sheets or manufacturer's drawings or specifications. Such documents shall be submitted to HPTE as required by the specifications.

When these specifications require actions, Materials, means or methods that are "either as indicated in the Plans or as designated by the Engineer," the Concessionaire shall disregard the phrase "or as designated by the Engineer."

When these specifications refer to the "Engineer" ordering work beyond the scope of work in the Contract, "Engineer" shall mean HPTE. Whenever in these specifications the Engineer may order work that results in additional costs to HPTE, the "Engineer" shall mean HPTE.

Any acceptances on behalf of HPTE or the State shall be performed by HPTE.

Any references to other standards, codes, or criteria, or to the latest version of other standards, codes, or criteria in Schedule 5 to the Concession Agreement shall mean the latest version at the Proposal Due Date.

### **20.1.1 Modifications to Division 100 of the Standard Specifications for Road and Bridge Construction**

Division 100 is incorporated herein except as otherwise provided in the Contract Documents, with the following exceptions. Any reference to a specific section of Division 100 in this Schedule 5 shall be deemed to be a reference to that section as modified by this Section 20 and any other part of Schedule 5 where that section is modified.

#### 101 - Definitions

Definitions of terms used herein are set forth in Schedule 1 of the Concession Agreement of the Contract Documents.

#### 104.05 - Rights In and Use of Materials Found on the Work

The provisions regarding rights in and use of Materials found on the Work are replaced with the following:

The Concessionaire shall not excavate or remove any Material from within the roadway, which is not within the grading limits, as indicated by the slope and grade lines, without written authorization from HPTE.

#### 105.03 - Conformity to the Contract

The provisions regarding conformity to the Contract are revised as follows:

1. No incentive payments will be made under this Contract.
2. When the Engineer or HPTE finds that the Materials furnished, the Work

performed, or the finished product does not conform with the Contract Documents, but HPTE determines, in its sole discretion, that reasonably acceptable Work has been produced, HPTE will determine the extent the Work will be Accepted and remain in place. If accepted, the Concessionaire shall (a) document the basis for Acceptance based on HPTE's determination by Change Order which will provide for an appropriate reduction in the Contract price for such Work or Materials not otherwise provided for in this Subsection or (b) HPTE will notify the Concessionaire in writing that the agreed-upon unit price will be reduced in accordance with this Subsection when P is 25 or less, or (c) HPTE may notify the Concessionaire in writing if there should be no reduction in the Contract Price; or in lieu of a price reduction, HPTE may permit correction or replacement of the finished product, provided the correction or replacement does not adversely affect the Work.

3. For purposes of Nonconforming Work, the Concessionaire shall propose a unit price for determining the reduction in the Contract price, with supporting documentation. The unit price is subject to Approval of HPTE. The reduction in Contract price shall take place as provided in this Section 105.03, based upon the Approved unit price. The Change Order shall be prepared in accordance with this Section 105.03.
4. When the Engineer or HPTE finds the Materials furnished, Work performed, or the finished product are not in conformity with the Contract Documents, and HPTE determines, in his sole discretion, that it has resulted in an inferior or unsatisfactory product, the Work or Materials shall be removed and replaced or otherwise corrected by and at the expense of the Concessionaire.
5. Materials will be sampled and tested by the Concessionaire in accordance with the sampling and testing schedules and procedures contained in the Contract Documents. The quantity represented by five consecutive random samples will constitute a lot whenever production schedules and Material continuity permit. The Engineer may establish a lot consisting of the quantity represented by any number of consecutive random samples from one to seven inclusive when it is necessary to represent short production runs, significant Material changes, or other unusual characteristics of the Work. Tests that are determined to have sampling or testing errors will not be used.
6. Materials or Work will be evaluated for price reduction only when deviations from the requirements of the Contract Documents occur on any of the several individual tests for the lot. The several individual test values will be averaged and the percent of price reduction for the lot will be determined by applicable formula and table as shown in Section 105.03.

Price reduction for those elements, which are not included in the Table of Price Reduction Factors as shown in Section 105.03 will be proposed by the Concessionaire for Approval by HPTE.

The Concessionaire will not have the option of accepting a price reduction in lieu of producing Material that complies with the Contract Documents. Continued production of nonconforming Material will not be permitted. Material, which is obviously defective, may be isolated and rejected by HPTE without regard to sampling sequence or location within a lot.

105.05 Conformity to the Contract of Hot Mix Asphalt

The provisions regarding conformity to the Contract of Hot Mix Asphalt is revised as follows:

No incentive payments will be made under this Contract.

105.06 Conformity to the Contract of Portland Cement Concrete Pavement

The provisions regarding conformity to the Contract of Portland Cement Concrete Pavement is revised as follows:

No incentive payments will be made under this Contract.

105.07 Conformity to Roadway Smoothness Criteria of HMA

The provisions regarding conformity to Roadway Smoothness Criteria for HMA is revised as follows:

Pavement Smoothness Category of HMA shall be HRI Category II (see Schedule 5 Section 10 Table 10.2)

No incentive payments will be made under this Contract.

105.08 Conformity to Roadway Smoothness Criteria of Portland Cement Concrete Pavement

The provisions regarding conformity to Roadway Smoothness Criteria for Portland Cement Concrete Pavement is revised as follows:

Pavement Smoothness Category of PCCP shall be HRI Category II (See Schedule 5 Section 10 Table 10.2).

No incentive payments will be made under this Contract.

105.18 - Load Restrictions

The provisions regarding load restrictions are incorporated herein except that the fourth and fifth paragraphs are replaced with the following:

If a scale ticket from an overweight vehicle is inadvertently accepted and the Material incorporated into the Project, HPTE will adjust the price for the overweight load as follows:

The Contract price will be reduced by an amount based upon the pay item quantity represented by the amount of Material in excess of the legal weight according to a unit price to be proposed by the Concessionaire, with supporting documentation, and Approved by HPTE. 106.09 - Handling Materials

Provisions regarding the handling of Materials are set forth in the Quality Section, Schedule 5 to the Concession Agreement of the Contract Documents.

106.11 – Buy America

Provisions regarding Buy America are incorporated with the following exception:



Delete the first paragraph and replace with the provisions contained in the Federal Requirements exhibit to the Concession Agreement.

106.12 - Certificates of Compliance

Provisions regarding Certificates of Compliance are incorporated with the following exception:

The second paragraph shall be deleted and replaced with the provisions established in Schedule 5, Section 3.3.2 (4)

106.13 - Certified Test Report

Provisions regarding Certified Test Reports are incorporated with the following exception:

The second paragraph shall be deleted and replaced with the provisions established in Schedule 5, Section 3.3.2 (4)

107 - Legal Relations and Responsibility to Public

107.05 - Federal Aid Provisions

Provisions regarding Federal Aid Provisions are contained in the Federal Requirements exhibit to the Concession Agreement.

107.08 - Railroad-Highway Provisions

The railroad-highway provisions are incorporated herein with the following revision:

Delete the first paragraph and replace with the following:

If the Contract requires Materials to be hauled across railroad tracks, the Concessionaire shall make arrangements with the Railroad for any new crossings required or for the use of any existing crossings.

107.16 - Opening Sections of Project to Traffic

The Provisions regarding opening sections of Project to traffic are deleted except as follows:

Opening certain sections of the Work for traffic use shall not constitute acceptance of the Work, or provide a waiver of any provision of the Contract Documents.

107.20 - Personal Liability of Public Employees

The employees of HPTE or authorized representatives are acting solely as agents and representatives of HPTE when carrying out and exercising the power or authority granted to them under the Contract Documents. There shall not be any liability on them either personally or as employees of HPTE.

**20.1.2 Modifications to Divisions 200 to 700 of the Standard Specifications for Road and Bridge Construction and Standard Special Provisions**

**20.1.2.1 Modifications to Divisions 200 to 700 of the Standard Specifications for Road and Bridge Construction**

Divisions 200 through 700 are incorporated herein except as otherwise provided in the Contract Documents, with the following exceptions: (1) in Divisions 200 through 600, the method of measurement and basis of payment provisions are superseded by the provisions set forth in the Concession Agreement. Any reference to a specific section of Divisions 200 to 700 in this Schedule 5 shall be deemed to be a reference to that section as modified by this Section 20 and any other part of Schedule 5 where that section is modified.

**20.1.2.2 Standard Special Provisions**

The following Standard Special Provisions are attached hereto as Exhibit A and incorporated herein as revisions or modifications to the *Standard Specifications*. Any reference to "Contractor" in this section 20.1.2.2 and in the Standard Special Provisions included in Exhibit A shall be understood to mean Concessionaire.

**EXHIBIT A**  
**STANDARD SPECIAL PROVISIONS**

	<b>Date</b>	<b>No. of Pages</b>
Revision of Section 105 – Contractor Submittals Traffic Signal Pedestal Pole	(Feb 3, 2011)	1
Revision of Section 105 – Disputes and Claims for Contract Adjustments	(May 5, 2011)	21
Revision of Section 105 – Violation of Working Time Limitation	(Feb 3, 2011)	1
Revision of Sections 105 and 106 – Conformity to the Contract of Hot Mix Asphalt (Voids Acceptance)	(Feb 3, 2011)	10
Revision of Sections 105, 106, 412 and 601 – Conformity to the Contract of Portland Cement Concrete Pavement And Dowel Bars for Transverse Weakened Plane Joints	(Jun 16, 2011)	13
Revision of Section 106 – Certificates of Compliance and Certified Test Reports	(Feb 3, 2011)	1
Revision of Section 106 – Hot Mix Asphalt – Verification Testing	(Jul 29, 2011)	2
Revision of Sections 106, 627 and 713 - Glass Beads for Pavement Marking	(May 5, 2011)	2
Revision of Section 107 - Responsibility for Damage Claims, Insurance Types, and Coverage Limits	(Feb 3, 2011)	1
Revision of Section 108 - Critical Path Method	(Aug 19, 2011)	1
Revision of Section 109 - Compensation for Compensable Delays	(May 5, 2011)	1
7. Revision of Section 109 – Measurement of Quantities	(Feb 3, 2011)	1
8. Revision of Section 203 – Imported Material for Embankment	(Feb 3, 2011)	2
9. Revision of Sections 206 and 601 – Backfilling Structures that Support	(Jul 29, 2011)	1
10. Lateral Earth Pressures		1
Revision of Sections 304 and 703 – Aggregate Base Course (RAP)	(Feb 3, 2011)	1
Revision of Section 401 – Compaction of Hot Mix Asphalt	(Feb 3, 2011)	1
Revision of Section 401 – Compaction Pavement Test Section (CTS)	(Feb 3, 2011)	1
Revision of Section 401 – Composition of Mixtures – Voids Acceptance	(Feb 3, 2011)	1
Revision of Section 401 – Plant Mix Pavements	(Feb 3, 2011)	1
Revision of Section 401 – Reclaimed Asphalt Pavement	(Feb 3, 2011)	2
Revision of Section 401 – Temperature Segregation	(Feb 3, 2011)	1
Revision of Section 401 – Tolerances for Hot Mix Asphalt (Voids Acceptance)	(Feb 3, 2011)	1
Revision of Sections 401 and 412 – Safety Edge	(Sep 23, 2011)	2
Revision of Sections 412 – Portland Cement Concrete Pavement Finishing	(Feb 3, 2011)	1
Revision of Sections 412, 601, and 711 - Liquid Membrane-Forming Compounds for Curing Concrete	(May 5, 2011)	1
Revision of Sections 412 and 705 – Preformed Compression Seals	(Feb 3, 2011)	2

EXECUTION VERSION

Revision of Section 504 – Concrete Block Facing MSE Wall	(Feb 3, 2011)	13
Revision of Section 504 – Concrete Panel Facing MSE Wall	(Feb 3, 2011)	12
Revision of Section 510 – Structural Plate Structures	(Feb 3, 2011)	1
Revision of Section 601 – Concrete Batching	(Feb 3, 2011)	1
Revision of Section 601 – Concrete Finishing	(Feb 3, 2011)	1
Revision of Section 601 – Concrete Form and Falsework Removal	(Jul 29, 2011)	2
Revision of Section 601 – Concrete Slump Acceptance	(Jul 29, 2011)	1
Revision of Section 612 – Delineators	(Feb 3, 2011)	1
Revision of Section 620 – Field Laboratories with Forced Air Convection Oven	(Feb 3, 2011)	1
Revision of Section 620 – Field Laboratories with Ignition Furnace	(Feb 3, 2011)	1
Revision of Section 627 and 708 – Pavement Marking with Waterborne Paint and Low VOC Solvent Base Paint	(Feb 3, 2011)	1
Revision of Section 630 – Construction Zone Traffic Control	(Feb 3, 2011)	1
Revision of Section 630 - Emergency Pull-off Area (Temporary)	(May 5, 2011)	1
Revision of Section 630 – Mobile Pavement Marking Zone (Group 1 without Attenuator)	(Feb 3, 2011)	1
Revision of Section 630 – Retroreflective Sheeting	(Feb 3, 2011)	1
Revision of Section 630 – Retroreflective Sign Sheeting	(Feb 3, 2011)	1
Revision of Section 630 - Rolling Roadblock	(May 5, 2011)	2
Revision of Section 630 - Temporary Portable Rumble Strip	(May 5, 2011)	1
Revision of Section 703 – Aggregate for Hot Mix Asphalt	(Jun 16, 2011)	1
Revision of Section 703 – Aggregate for Stone Matrix Asphalt	(Feb 3, 2011)	1
Revision of Section 703 – Concrete Aggregate	(Jul 29, 2011)	1
Revision of Section 703 – Mineral Filler	(Feb 3, 2011)	1
Revision of Section 712 – Geotextiles	(Feb 3, 2011)	1
Revision of Section 712 – Water for Mixing or Curing Concrete	(Feb 3, 2011)	1
Partnering Program	(Feb 3, 2011)	1
Disadvantaged Business Enterprise	(Feb 3, 2011)	14
FASTER Monthly Employment Report	(Feb 3, 2011)	1