



Lessons Learned

US 36 Express Lanes
CDOT Project No. NH0361-093
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Colorado Department of Transportation
US 36 Express Lanes Project
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Introduction

Any project the size of the US 36 Express Lanes Project has something to learn from its experiences. The US 36 Express Lanes Project is a \$450 million, multi-modal project that includes multiple funding partners – High-Performance Transportation Enterprise (HPTE), Colorado Department of Transportation (CDOT), Regional Transportation District (RTD) and local jurisdictions – which adds to the complexities of the project, as well as the importance of learning from past practices. Each agency brings their unique expertise to the team and has their own lessons, which are captured in this report. The Project is broken into two Phases – Phase 1 is a \$317M design-build project and Phase 2 is a \$180M Public Private Partnership (P3) project.

After the initial year of construction, CDOT decided to begin documenting lessons learned and best practices, and continue to build upon it as Phase 1 construction continues, Phase 2 begins, and project phases are completed. As of early 2016, Phase 1 is substantially complete, and the construction of most of the Phase 2 elements is also complete. This document focuses on the Lessons Learned from the Phase 1 project, many of which were applied to the Phase 2 project. Pertinent additional lessons from Phase 2 have been added though to later versions.

Lessons Learned Overview

Lessons Learned are general statements that describe good practices or innovative approaches that are shared to promote repeat application. They may also be descriptions of challenges or areas for improvement that are shared to provide continuous improvement.

Effective organizations use past experience as a guide to improve future performance. The lessons learned compiled in the report will be used as a tool for improvement on construction of the remaining project and on future CDOT projects.

US 36 Express Lanes Project Background and Overview

The US 36 Corridor was the subject of numerous studies between 2002 and 2009 conducted as a part of a Final Environmental Impact Statement (FEIS) effort. The FEIS resulted in a Preferred Alternative for the corridor. A Record of Decision (ROD) was signed in December 2009 which cleared planned improvements from Federal Boulevard to Foothills Parkway in Boulder, identified as “Phase I” of the FEIS. For construction, Phase I of the Preferred Alternative in the US 36 ROD has been separated into two phases (Phase 1 and Phase 2).

The US 36 Express Lanes Phase 1 Project is a \$317 million, multi-modal project that will build an express lane in each direction on US 36 from Federal Boulevard to 88th Street in Louisville/Superior. The lanes will accommodate High Occupancy Vehicles (HOV), Bus Rapid Transit (BRT) and tolled vehicles. In addition, the project will replace several bridges, build a commuter bikeway, add BRT improvements, and install Intelligent Transportation Systems (ITS) for tolling, transit and traveler information, and incident management. It is led by CDOT and RTD.

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CDOT selected the Ames Granite Joint Venture (AGJV) team as the design-build contractor for the Phase 1 project and they began construction in July 2012. The managed lanes opened to the public in July 2015.

Phase 2 of the US 36 Express Lanes Project is extending the express lanes to Table Mesa in Boulder. Plenary Roads Denver was selected in mid-2013 as the concessionaire to design, build and finance the Phase 2 US 36 Express Lanes. They will also operate and maintain the Phase 1, 2 and I-25 Express Lanes for 50 years. The construction and design members of the team are the same as for the Phase 1 project. Construction on Phase 2 began in late 2013 and the project is scheduled to be completed by early 2016.

Phase 1 Project Elements

- Add a buffer-separated express lane in each direction of US 36 between Federal Boulevard and 88th Street (See Figure 1) for BRT, with two or more passengers (three people total in the car), and tolled vehicles travelling with two or less people in the vehicle;
- Reconstruct and widen the highway to accommodate 12-foot-wide inside and outside shoulders;



Figure 1 - Phase 1 Location Map

- Replace the Wadsworth Parkway, Wadsworth Boulevard (at 112th Avenue), and Sheridan Boulevard bridges over US 36, and the US 36 bridges over the Burlington Northern Santa Fe Railway and Lowell Boulevard;
- Widen the US 36 bridges over West Flatiron Crossing, East Flatiron Crossing and Promenade Drive;
- Add BRT improvements, including new electronic display signage at stations and bus priority improvements at ramps;
- Install ITS for tolling, transit and traveler information and incident management;
- Install a separate commuter bikeway along much of the corridor; and
- Improve RTD stations along the corridor, including new canopies with enhanced weather protection.

Phase 2 Project Elements

- Add a buffer-separated express lane in each direction of US 36 between 88th Street and Foothills Parkway (See Figure 2) for BRT, HOV with two or more passengers (three people total in the car), and tolled vehicles travelling with two or less people in the vehicle;
- Reconstructing two general purpose lanes in each direction between 88th Street and Table Mesa;
- Widening the highway to accommodate 12-foot-wide inside and outside shoulders;
- Replacing the US 36 over Coal Creek Bridge and rehabilitating and widening the US 36 over South Boulder Creek bridge;
- Widening the McCaslin Boulevard over US 36 bridge and reconstructing the existing interchange to a diverging diamond interchange;
- Adding BRT improvements including new electronic display signage at stations and bus priority improvements at ramps;
- Installing ITS for tolling, transit and traveler information and incident management;
- Installing a separate commuter bikeway along the rest of the corridor; and
- Improving the RTD station at McCaslin Boulevard.

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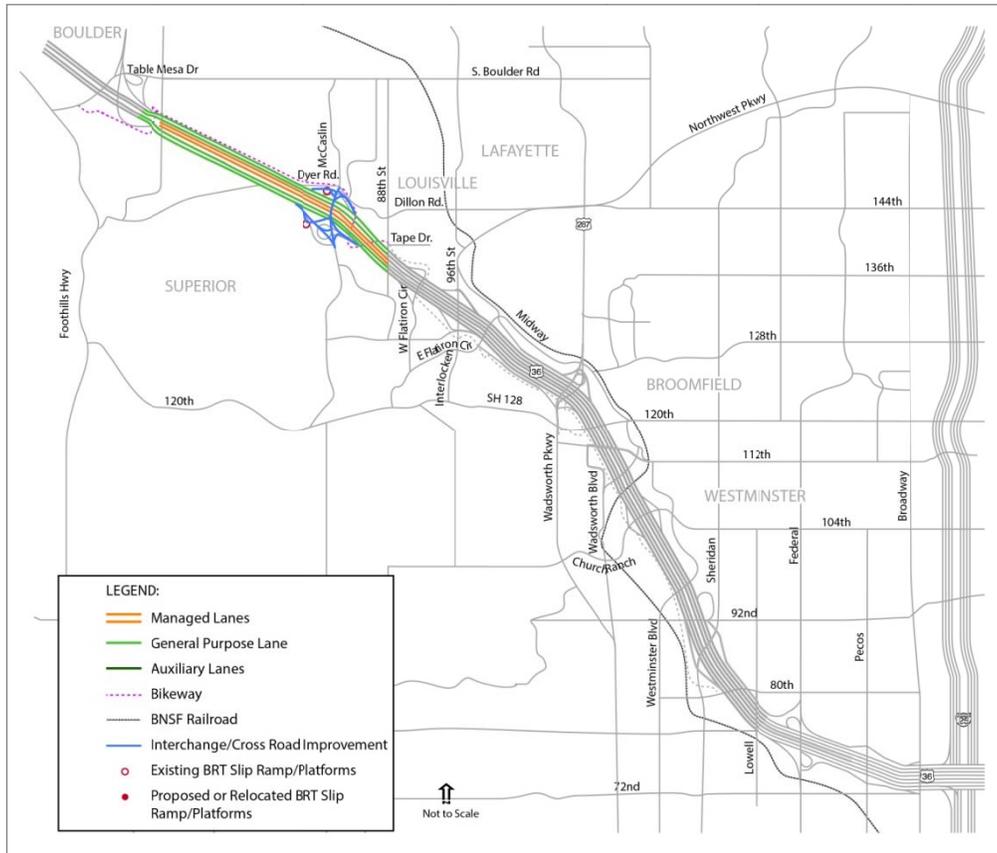


Figure 2 - Phase 2 Location Map

Phase 1 Project Goals

CDOT has made it the agency's mission to provide the best multi-modal transportation system for Colorado that most effectively and safely moves people, goods and information. For the Phase 1 project, the team set the following goals early in the project development process:

- Maximize scope and improvements within the project budget
- Minimize operating and life cycle maintenance costs and provide a quality product
- Meet or beat schedule to be fully operational by July 1, 2015
- Minimize inconvenience to the public, and maximize safety of workers and traveling public
- Maximize engagement of local workers, businesses and communities in the development, construction and sustainability of improvements

US 36 Express Lanes Project Lessons Learned – Master Contact List

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US 36 Phase 1 Lessons Learned

The following sections contain Lessons Learned for many of the disciplines and key elements of the US 36 Phase 1 Express Lanes Project. The sections are organized alphabetically, and each contain an Overview of the element, some Background and Status on the element, and Lessons or best practices for each element, generally separated into lessons learned from the RFP Development/Procurement Phase and Implementation/Construction Phase.

Disadvantaged Business Enterprises (DBE) and Workforce Development

1. Overview

The project had a DBE goal of 12 percent, which of the original \$231 million construction contract, equates to approximately \$27.7 million. In addition, the ITP required proposers to submit as a part of their proposals, their approach and commitments related to a proposed Workforce Development Program that describes the Proposer’s innovative approach to identifying and incorporating training opportunities in the Project work force. This requirement related to the fifth project goal: “Maximize engagement of local workers, businesses, and communities in the development, construction and sustainability of improvements.” The Workforce Development Program requirement was based on RTD’s “Workforce Initiative Now (WIN)” program.

2. Background/Status

A commitment to meet the 12% DBE goal was provided by AGJV prior to award of the contract. They committed to utilizing six DBE design firms and 16 DBE construction firms AGJV is expected to surpass the 12% goal at project completion. They currently have 47 DBE firms participating. Two DBE firms have been replaced – one voluntarily and the other was a performance issue. A report is submitted monthly that shows the status of all subcontractors, including DBEs, to help paint the big picture of the project.

The WFD goal was set at 10% of the total man hours. The contractor committed to 14%. Therefore, the goal was a “moving” goal. The contractor more than doubled their man hours; thus, requiring more training hours. This became more difficult for the contractor to meet as the man hours increased.

3. The Lessons

RFP Development/Procurement Phase

- Verify that federal and CDOT DBE requirements do not conflict in regards to eligible DBE participation (i.e. trucking).
- Add to requirements a report of all subcontractors including DBEs with payment information. The WFD goal on this project was based on total man hours worked on the project, because the original proposal hours were doubled the WFD goal of 14% that the contractor bid required significantly more training hours. This was difficult for the contractor to meet because of trained work force,
- When reviewing commitments, reinforce to the contractor that DBE trucking commitments are only counted for trucks that are owned and operated by DBEs. It is included in Exhibit J on Phase 1 but it wasn't pointed out till later in the project.
- Define total workforce hours to include professional and skilled craft employees (including management and supervisory positions).
- Clarify what contractor staff is included in the Workforce Development Program hours determination (all staff, or excluding project management).
- When determining the goal a total number of training hours would be better to monitor and a contractor to accomplish which would benefit the training program in general.

Implementation/Construction Phase

- Ensure that workforce development staff is doing the duties they are assigned to do through the program.

Document Control

1. Overview

The RFP Book 2 Section 2 required that “the contractor shall transmit all required deliverables and other documents to CDOT via CDOT’s Document Management System.” CDOT elected to use Aconex for document control during construction, which is the web-based system that RTD utilizes on the FasTracks program. All organizations are registered that are on the project (i.e. CDOT, Jacobs, RTD, AGJV and HDR). All documents are required to be transmitted using Aconex, as well as all responses to submittals, and documents are not considered official unless they are transmitted through Aconex.

2. Background/Status

Several processes have been documented for a variety of different submittals that are transmitted via Aconex. The project has accumulated nearly 40,000 documents and nearly 28,000 informal mails in Aconex.

3. The Lessons

RFP Development/Procurement Phase

- Be clear in RFP requirements what the CDOT expectation is for the contractor using a CDOT-provided document control system. In addition, require that all official documentation be submitted via document control system. This was easier in Phase I of the project. Phase II was more challenging because of involvement of HPTE staff that were not located at the project site. Therefore, a lot of documentation was sent directly to HPTE rather than utilizing the document control system. This required a lot of chasing of documents which made it more difficult to track all documentation.
- Be specific in the RFP on as-built drawing requirements including requiring the Contractor to maintain updated Computer-aided design (CAD) files during the life of the Project. CDOT must audit this process regularly to insure that the Contractor is using and incorporating the latest files for Notice of Design Change (NDCs) and Field Design Change (FDCs).
- Provide guidelines for the oversight of the Released for Information (RFIs) documents processed between the designer and the contractor (require signatures/necessary attachments for review).
- Require Contractor to utilize Project Instruction Manual (PIM) per Quality Management Plan (QMP).
- Developing and implementing a consistent naming convention for all project documents is key to utilizing the CDOT-provided document control system.

Implementation/Construction Phase

- Set up placeholders for documents that need to be submitted by contractor/team.
- Ensure use status field to track the document with regard to who needs to be responsible for the document.
- Document processes in the PIM in Aconex.
- Use reference column for documents that will be submitted consistently so there is a numbering mechanism.
- Perform quality checks to make sure there is consistency in title names for the same contractor/subcontractor.
- Set up process for insuring that Released for Construction (RFC) plans are transmitted and that NDCs and FDCs are incorporated into RFC sets on a regular basis (monthly/quarterly).
- Utilizing a paperless job is very efficient and decreases staff time required to update and maintain plan sets and documents.
- Using an established Internet based document control system is a must. There are more than 40,000 documents in Aconex. Managing the document control process without this system would require significant staff time. The Internet-based system also allows staff to access documents from remote locations (other offices, home, the field, etc.).

- Using the RTD Quality Management Oversight (QMO) database to log and track comments on design submittals has been very effective in organizing and recording the resolution of design issues and comments. Recommend that CDOT develop something similar for future design build projects that can be implemented statewide. See Quality Management section below for additional information.

Drainage

1. Overview

The 11-mile stretch of reconstruction along US 36 Phase 1 touched nearly every aspect of drainage design. RFP Book 2 Section 12 included specific requirements for drainage and water quality on the project. Eighteen total water quality and detention ponds are to be constructed to accommodate the ultimate roadway configuration. Eight total irrigation crossings of 4 individual companies are to be replaced. The project also includes three major FEMA crossings that required the CLOMR/LOMR process to modify floodplain boundaries.

2. Background/Status

As part of the US 36 EIS, a conceptual drainage analysis was prepared in May 2009 that encompassed the findings in the ROD. As a part of the RFP development, preliminary drainage design was taken to at least a 30 percent level to verify feasibility of on-site and off-site storm systems, preliminary pond locations and associated ROW needs. Considerable effort was put forth in identifying areas of concern during design so that those areas could be referenced in the Technical Requirements.

3. The Lessons

RFP Development/Procurement Phase

- Be more specific on what "accommodate" means for drainage and irrigation crossings because proposers see these items as value-added features rather than requirements. For example, "all ponds shall accommodate the ultimate configuration." This statement implied having the contractor build the pond to the ultimate volume such that the ponds would not need to be re-graded in the future. At the end of the day, we are getting the ponds built to the ultimate volume. Another example is, "structure lengths and headwall placement shall accommodate the ultimate configuration and shall consider other features of the work including but not limited to bikeway, guardrail, barrier, retaining walls and noise walls." What this statement implied was to build all irrigation crossings to the ultimate build-out configuration with this project such that future agreements with ditch companies and ROW needs are addressed with this project.
- For storm drains, the requirement was to convey flows from US 36 for the 10-year ultimate configuration. All flows, including the 100-year, must be conveyed to any pond that detains flows to their historic rate. The following statement was added in the Phase 2

technical requirements, "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."

- Revise Section 12.3.2 Project Special Provisions under 603.07(a) to include all joints for RCP shall be made with confined rubber gaskets to include elliptical pipe as well as circular.
- Be clearer on inlet requirements for bridges. Section 12.2.4.8 states "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 cfs for the 10-year storm." This isn't always practical on bridges since bridge shoulder widths are typically narrower than on a roadway. Statement should be revised to something like "inlets should be spaced to coincide with piers to keep the maximum allowable flow spread to within a depth two inches at the curb or shoulder plus half of the adjacent lane and limit flow across expansion joints to less than one cfs for the 10-year storm."
- Revise schedule column in the deliverable table for the Final Drainage and Water Quality Report to read "Prior to Project Acceptance."
- Revise the Drainage Report Outline to include a References Section.
- Considerable detail was added to Section 12 as to what we expect to be built rather than referring the reader to various reference manuals. This minimized the amount of interpretation and provided the contractor and CDOT a "black and white" approach. Examples include providing a rainfall table for the entire corridor, defining clogging factors for inlets and defining where water quality ponds are to be located. The addition of "Area Specific Drainage Requirements" section provided specific requirements of various locations along the corridor that were identified in preliminary design. *Definition of specific requirements needs to be balanced against potentially limiting innovation.*
- Need to have some type of threshold for spread using the Storm and Sanitary software. The software will continue to require inlets until there is a true 0.00 cfs bypass. We in turn have multiple inlets spaced closely together at the end of storm sewer runs. Need to look into this further to see if either the language for bypass flow can be changed or include a minimum allowable bypass flow.
- For temporary drainage, requirements should be added to the RFP to have the contractor track all temporary drainage that is installed and provide locations via as-built plans. A monthly report that tracks all temporary pipe and inlet installed on the project should be a requirement for future projects. The plan would need to be approved and should include location and type of pipe and connection to existing if required, and resolution for abandonment of removal after the permanent drainage is in place.
- Include a statement similar to, "CDOT will not be held accountable for schedule implications due to any third party permit processes." For example: CLOMR, LOMR, Floodplain Development Permits, etc.

- It should be required to define **one** person in the contract as the Drainage Design Manager for the contractor. Large design build projects will ultimately be split into segments, and each segment will have a lead. When there is one point of contact between CDOT and the contractor it minimizes inconsistencies and improves communication.
- If a project is using UDFCD criteria, need to be specific and address any items called out as “if required by the engineer” in the contract.

Implementation/Construction Phase

- Temporary drainage plans need to be tied into the MOT phasing plans, so there is a clear strategy for drainage until the new permanent system is online and functioning. Otherwise, the contractor starts installing pipe whenever problems arise and temp drainage becomes a piece-meal system that is often insufficient for larger storm flows.
- Acceptance of permanent drainage should include lamp testing as a requirement for acceptance. This test would require the Quality Assurance (QA) to look through the installed line for alignment issues.
- During the bedding and backfill process the contractors should be required to document compaction test on the area of the backfill from spring line (required on RCP) to the top of the pipe, if the pipe diameter exceeds 24 inches. The contractor has stated that they need to have a thicker lift above the pipe for protection, have seemed to struggle getting compaction in this zone. A solution could be that the contractor has a hold point at the backfill even with the top of the pipe.
- As-built drainage plans should have a schedule per the RFP that ensures the contractor is completing them as construction progresses and not waiting until the end of the job to get started on them.
- Need to specify minimum cover on pipe for metal/plastic/RCP. M-603-1&2 call out “adequate cover” or conform to AASHTO requirements.

Earthwork, Geotechnical, and Pavements

1. Overview

Mainline US 36 pavement is being constructed with rigid pavement (Portland Cement Concrete Pavement) while ramps and most side roads are being constructed with flexible pavements (Hot Mix Asphalt base topped with Stone Matrix Asphalt). Earthwork consists of clearing and grubbing, excavation and embankment work to build up the roadway section. This includes mitigating soils that have swell potential, placing R-value 20 material and placing Aggregate Base Course. RFP Book 2 Sections 10 and 11 included the requirements for earthwork, geotechnical and pavements on the project.

2. Background/Status

Preliminary geotechnical investigations were conducted in 2009 and 2010 for selected mainline and cross road pavement and structure areas. The preliminary reports were provided with the RFP documents. The contractor is responsible for any supplemental investigations to complete the work.

A life-cycle cost analysis (LCCA) was conducted by the RFP design team and a report prepared and approved which documented the justification for selecting concrete pavement for the US 36 mainline. Preliminary pavement design reports were also prepared by the RFP design team and minimum pavement, base, and subgrade thicknesses were specified in the RFP.

3. The Lessons

RFP Development/Procurement Phase

- Initial RFP included fairly prescriptive requirements for subgrade and select material R Values. Many proposer teams expressed desire to have more flexibility so proposed ATCs to alter the requirements, which the RFP design team had to review and decide on in a short timeframe. For future projects, try to anticipate the range of optional subgrade treatments that may be proposed and will be acceptable.
- Include specifications/requirements for temporary pavements.
- Further define the use of SMA on structures, identifying what is expected for bridge widenings as needed.
-

Implementation/Construction Phase

- Need a better tracking and documentation requirement for the different areas and types of soils-cuts, fills, swelling soils, etc., to allow for better QA and CDOT monitoring. A few options would be key maps and area or station-specific checklists.
- Improve QA acceptance documentation requirements to clearly define what areas have been satisfactorily processed at each stage – moisture treat, R20, Base, etc.
- Construction schedule needs to be accurate enough to allow for consistent and proper Owner Verification Testing and CDOT Audits.
- Allow for Quality Control (QC) to utilize GPS/UTS survey technology in place of traditional CDOT survey hub requirements, and include substantial test sections.
- Emphasize and enhance the QC material testing role to reduce the temptation of QA doubling as QC.

Environmental

1. Overview

Securing the environmental approvals for this project was a process that took more than 10 years. As part of obtaining the ROD in 2009, many commitments were made to local governments, community groups, state agencies and the federal government. In 2011, the RFP design team prepared an Environmental Reevaluation, which documented changes or refinements to the elements, impacts, and commitments included in the ROD. It is vital that the project honor its environmental commitments, not only for the success of this project, but also to assure that CDOT's credibility is maintained, allowing for approval of future projects. RFP Book 2 Section 5 included the requirements for environmental and permitting on the project.

2. Background/Status

The RFP included allowable impacts for resources such as wetlands and T&E species, which the contractor needs to track and provide evidence of compliance with. Appendix H of the ROD lists more than 100 specific Measures to Minimize Harm. To help assure these measures are implemented, the DB Contractor is required to employ an Environmental Manager. Even with this resource, keeping track of these commitments in the fast-paced Design Build environment is a challenge.

3. The Lessons

RFP Development/Procurement Phase

- See items discovered in construction phase below that may impact content of RFP or evaluation criteria.

Implementation/Construction Phase

- Note about contract requirements -- Remember in DB to frame the language in terms of meeting performance standards rather than being prescriptive. It is a tough balance. Sometimes we will need to be prescriptive, however in a perfect world we will give the DB contractor room to be innovative and exceed our minimum expectations
- Environmental Compliance Work Plan and/or Quality Assurance Process -- Add a section where the contractor's Environmental Compliance Manager reports on which design package submittals have been reviewed for compliance with the commitments on the EIS and ROD each month.
- The RFP states the "The Contractor shall employ and utilize an Environmental Project Manager." It was CDOT's intention that the contractor's Environmental Project Manager would be involved with everything that falls under the NEPA umbrella. In practice, our contractor has limited the number of areas in which the Environmental Project Manager is involved. There is no involvement on noise, landscape or water quality. The contractor is taking a risk because commitments could be overlooked without the Environmental Manager's involvement. For future contracts, consider additional language in the RFP to solidify this person's role on the contractor's team.
- Suggested language to add to the template for future DB projects: "The Environmental Project Manager shall lead a cross discipline environmental review of all major design

submittals to confirm compliance with all environmental design commitments. A summary of these cross discipline reviews shall be included in each monthly update of the Environmental Compliance Workplan. The Concessionaire shall employ and utilize on the Project an Environmental Manager. In order to get the contractor's Environmental Manager more involved add the following language:

The Environmental Manager shall actively participate in both the design and construction phases to assure compliance with contract requirements, environmental laws, permit requirements, and the commitments made in the environmental decision documents.

The contractor's Environmental Manager shall attend all public meetings and participate as needed.

During construction, the Environmental Manager shall conduct a weekly field review of the entire project. A summary of the field reviews shall be included in the monthly update of the Environmental Compliance Work Plan. The monthly field review with CDOT's staff can be counted as a substitute for the Environmental Manager's weekly field review.

The monthly update of the Environmental Compliance Work Plan shall include a narrative of special environmental compliance actions and environmental activities which have occurred during the reporting period. Examples of these activities include adjusting construction activities to avoid nesting birds, responding to fuel spills, stream diversions, stakeholder communications and regulatory agency communications. The narratives shall include enough detail fully document the environmental actions on the project and to serve as the basis of reports and articles.

- The Environmental Manager should be on the critical positions list.
- Environmental QA – Review the QA RFP requirements for environmental compliance monitoring. The contractor's QA group does not seem to be staffed to the level necessary to effectively monitor water quality and the rest of the environmental requirements. Our experience so far is that the QA group will let environmental compliance issues slide to the back burner. For future projects, emphasize the need for QA to have sufficient staff to do this and consider making it part of the selection criteria.
- Noise (and other disciplines) – What constitutes a complete “Report”? In some of the engineering disciplines, like drainage, the Contractor seems dialed into what is expected in a drainage report. In noise, the Contractor's initial and subsequent submittals have been incomplete or minimal. Their strategy has been to rebut every comment and request on their report rather than complying with the requests. CDOT's 2011 guidance has a design-build section, which is very good. Additional items that should be in the contractor's noise report which may have to be spelled out directly are:
 - Line-of-sight analysis for every location where existing mitigation is being replaced or removed.

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- Identification of the datum used for all elevations in the submitted model.
 - Statement certifying that geometry in the submitted model is the approved geometry of the DB project.
- Importance of Noise Line-of-sight Analysis – As noted above, a Line-of-sight review should be conducted in every location where an existing wall is replaced. Clarify this language in the RFP.
- Construction Noise -- This is an area where the commitments of the contractor's proposal seem to take full advantage of the wobble words (*where practicable, where feasible, etc*). Be aware that this can happen and consider stronger language to hold the contractor accountable for their commitments in this area. Add language in the contractor's requirements for their Noise Control Plan that the contractor's Public Involvement Team plays a role in the implementation of the plan.
- Noise during construction – Require Contractor to provide temporary noise protection during construction in areas where existing noise barriers exist and are being removed, relocated, or replaced. Add language to the Contract limiting work at night in sensitive areas (hotels, residential areas, etc) unless the Contractor provides temporary sound barriers.
- Wildlife Crossings I – Be aware that the irrigation companies may not accept certain features to make the culverts carrying their ditches under the highway more wildlife friendly. Specifically, one of the irrigation companies on the project objected to the idea of putting ledges in above the ordinary high water mark. Their concern was hydraulic capacity and maintenance. Since their approval of the design is required, it could be difficult getting these features approved. Consider a parallel crossing for small to medium animals in these locations.
- Wildlife Crossings II – On Phase 1, there is a have a hybrid of calling out some specific details on the wildlife crossings, but for the remaining details the contractor is directed to the FHWA guidance documents. The FHWA guidance is good for providing general guidance for individual animal species, but it does not provide the type of specific direction the contractor seems to expect. For future projects, CDOT should decide what features are wanted in each crossing and call them out, similar to what was done on Phase 2.
- Wildlife Crossings III—See note about shelves in Irrigation ditch box culverts.
- Wildlife Friendly Fencing-- We did have a conflict here where the two entities that the contractor was required to consult with had different opinions. Consider giving CPW precedence.
- Historical – ditches (even abandoned ones) need to be fenced (similar to wetlands). Even if preservation of the ditch is implied in the grading plans, contractors will feel free to alter them unless specifically prohibited. Assume that any ground within the right-of-way lines will be disturbed unless specifically prohibited.

- Water Quality – The contractor has expended considerable resources but still has not always kept up. Consider using a mechanism to link acreage disturbed with a higher-level management review. For example, if the 34-acre limit is surpassed, the contractor would have to demonstrate that they have increased their resources to match the area of disturbance.
- Consider Additional Requested Elements (AREs) for environmental elements – For example, the RFP could describe the minimum requirements for a wildlife crossing, but it could also request ARE elements that would make it a better crossing. Bidding contractors may see this as a relatively inexpensive way to make their proposals look better and commit to adding these elements.
- Require handrails or other fall protection for CDOT maintenance works at all large drainage structures and bikeway crossings in the RFP language to eliminate potential for future injuries.
- Quality Management—CDOT Environmental Staff should review the first draft of the contractor’s Quality Management Plan. This is the opportunity to get many Section 5 and Section 17 items into the plan so the QA staff will have them on their checklists. This will put additional eyes on some of the areas on concern during construction.

Intelligent Transportation System and Electronic Toll Collection

1. Overview

The purpose of the Intelligent Transportation System (ITS) and Electronic Toll Collection (ETC) elements are to inform the roadway users, collect various data to assist agencies in the maintenance and operation of the facility, and to collect the tolling revenue to support the project’s funding sources. RFP Book 2 Section 19 included the requirements for ITS, ETC, and Active Traffic Management (ATM) on the project.

The ITS system includes various devices, such as Variable Message Signs (VMS), Closed Circuit Television (CCTV), Ramp Meter Stations (RMS), Microwave Vehicle Radar Detection (MVRD), Travel Time Indicators (TTI), Automatic Traffic Recorders (ATR), Doppler Radar, Road Weather Information Systems (RWIS), Bus on Shoulders (BOS), Bicycle and Pedestrian Counters, and a Regeneration Building. 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.

2. Background/Status

The US 36 Project was to be the first project in Colorado to plan and implement a buffer-separated managed lane concept. As a part of the early design and RFP development, a Concept of Operations was prepared which described the characteristics of the managed lane system from the perspective of the operator, CDOT, HPTE, and the user. It served as a high-level conceptual guide for the design, implementation, and operation of the US 36 managed lane system.

Late in the RFP development phase, ATM elements were added to the RFP, which were expanded on via addendum during the procurement phase. The intent was to get a basic framework of an ATM system included in the project's Basic Configuration.

To date, the extent of ITS construction on the project involves installation of conduit that will house fiber optic wire that make up the ITS backbone. This backbone will run from Boulder to CDOT headquarters in Denver and will provide communication and controls for US-36 and I-25.

A number of ATM system features and enhancements have been added via change order as the use and planned operation of this system has been developed during the first two years of the project.

3. The Lessons

RFP Development/Procurement Phase

- Use performance-based requirements for any ITS elements due to rapidly changing technology, especially on multi-year projects. Do not specify specific model numbers or equipment unless including “or approved equivalent” language.
- Define what ITS elements require review and what elements require acceptance. Blanket approval requirement transfers risk to CDOT and requires significant staff time to review each minor element.
- ITS Design and Submittals:
 - Include RFP requirement to show utilities on ITS plans.
 - Include RFP requirements for deliverables that show Camera and ATM gantry line-of-sight and spacing.
 - Include a more detailed ITS deliverables list in the RFP, and require the contractor to create a list of milestone dates within a certain timeframe of NTP that shows when the deliverables will be submitted.
- If CDOT/RTD preferred vendor pricing is available for ITS elements, provide this option to the Contractor with contact information.

Implementation/Construction Phase

- ITS Design and Submittals:

US 36 Express Lanes Project Lessons Learned Report



- Enforce cross-disciplinary reviews for ITS design. Other disciplines did not consistently consider ITS, and the ITS plans consistently had conflicts with other disciplines.
- ITS Submittals and Payment:
 - Enforce the submission of a detailed ITS construction schedule before any ITS work begins (including the underground conduit and pull box infrastructure).
 - Ensure that the contractors progress payment schedule distinctly breaks out the following areas of work:
 - Procurement (Materials on Hand) – ITS devices, particularly VMS, SMVMS, LUS, have a high material cost and it is easier for progressing a schedule if this is broken out separately
 - Installation – Best to separate underground infrastructure, poles/supports, and device installation since they are typically separated by large periods of time. For the devices, it may be better to break up type of device rather than segment of roadway.
 - Integration – Once everything is installed, the configuration of devices and integration into the control system is typically a large effort and by different people than the installation. This item is usually underbid and overlooked by the contractor on the schedule. Verify that all the acceptance test periods are shown on the schedule.
 - Maintain Existing/Temporary Devices – Ensure that this item is broken out separately from the permanent construction, so it can be paid for incrementally over the life of the project. It can be a significant effort that the contractor wants to be paid for, but it is very complicated to include it with the permanent construction items.
 - Software – Any software modifications (e.g. FLIR, CTMS etc..)
- Enforce the use of watertight conduit plugs that are to be installed as soon as the conduit is installed. The plugs that twist to seal with a rubber gasket are reusable and prevent intrusion of water, soil, debris, rodents, etc... that will later cause issues with pulling microduct and/or cabling.
- Require detailed quality control checklists to be created for ITS before any ITS work begins (including the underground conduit and pull box infrastructure). Preliminary checklists were created to meet project requirements and start construction, but by the time they were updated with appropriate detail a large portion of the conduit system had been installed with components that were not in compliance with the contract.
- Include/enforce ITS experience requirements for QA inspectors
- Enforce that QA establishes the ITS hold points prior to any ITS construction beginning (including the underground conduit and pull box infrastructure).
- Maintaining Existing/Temporary Devices
 - Include timeframe requirement for response to issues that come up (what the contractor plans to do to fix it), and timeframe requirement for resolving the issue

- Include \$ penalty for not meeting timeframe requirements (without teeth, the requirements are worthless)
- Drawings shall clearly define ITS infrastructure locations on the plans, including survey data points – they shall not be conceptual in nature. During the as-built process, Contractors are very reluctant to update these plans to reflect actual conditions and locations of final infrastructure (device locations, fiber alignment, fiber splice locations, pull box and manhole locations, laterals, etc).

Landscaping and Irrigation

1. Overview

Landscaping on the project involves replacing plant material in all disturbed areas on the Project. The Landscaping Plan includes the areas to be final seeded; and the locations, mitigations, removals, and replacements of Project-impacted trees, shrubs, landscapes and irrigation. RFP Book 2 Section 17 included the requirements for landscaping on the project.

The Landscape Plan documents all vegetation locations and identifies species, condition, size, health, and a recommendation for remaining undisturbed areas, pruning, removal, transplanting, or replacement. The contractor is responsible for completing all landscaping needed on the project.

2. Background/Status

Many different types of landscaping and vegetation were present within the existing and acquired project ROW, such as native seed areas, informal “volunteer” trees and shrubs, site specific formal landscaped areas at selected bridges, and significant areas of formal sodded, planted, and irrigated areas. Formal landscape areas within CDOT ROW are maintained by others (such as Westminster, Broomfield, or Interlocken).

3. The Lessons

RFP Development/Procurement Phase

See items discovered in construction phase below that may impact content of RFP or evaluation criteria.

Implementation/Construction Phase

- The contract states that trees that are not to be impacted will be marked “after the landscape plan is accepted.” (Book 2, Section 17.2.2) In the design build environment earthwork will start long before they submit a landscape plan. Subsequently, trees that could be preserved are vulnerable during this period. There should be some mechanism in the contract mark good specimen trees early, preferably right after the first grading plans are approved.

- The EIS required a 1 for 1 tree mitigation commitment which is very hard to meet if you have to stay on CDOT ROW, since there will not always be suitable/sustainable locations for planting all of the replacements. While allowed as an option, consider strengthening the language that will steer the contractor to plant a percentage of the mitigation trees on surrounding open space lands where the local governments will take over the maintenance.
- RFP Clarifications: In subsection 17.1.1, split requirement into two Landscape Plans. The first plan documents existing conditions. It will include the tree inventory, identify the formally landscaped areas, and identify any landscape features and areas to be preserved. The second plan is the planting plan for the new project.
- Consider defining the three specific Categories of landscape areas (Area Types) within the design-build project footprint. (These were in the contract, however the language addressing each is lumped together.)
 - Area Type 1: Areas within the CDOT ROW (both existing and new) that are to be revegetated with the typical CDOT low maintenance plantings. No irrigation is anticipated.
 - Area Type 2: Areas within the CDOT ROW where the local government or adjoining landowners have a formal agreement with CDOT to maintain the landscape. These areas are often irrigated and landscaped at a higher level than Area Type 1. The contractor will be required to replace any disturbed landscaping and irrigation system in kind.
 - Area Type 3: Areas of new ROW acquisition for the project where the acquired land had been formally landscape and irrigated, but in the future will be maintained as Area Type 1. In these areas, if the project impacts the adjoining landowners irrigation system, the contractor is required to perform the work necessary to repair adjust system so it functions for the adjoining landowner.
- Require Contractor to maintain irrigation during the Construction period. Numerous areas where either CDOT, local entity, or RTD landscaping died due to Contractor not maintaining irrigation during the long construction period (multiple years). Option for Contractor to hand water existing vegetation is not effective and documentation is typically not provided. Potentially add a liquidated damage for not maintaining the irrigation system during Construction.

Maintenance During Construction

1. Overview

Maintenance During Construction consists of maintaining the existing roadway and temporary roadway in a safe condition for the traveling public. This includes not only the pavement, but roadside features such as signs and guardrails, keeping drainage inlets clean and functional, and

evaluating and making repairs to bridges and structures. RFP Book 2 Section 18 included the requirements for maintenance during construction on the project.

2. Background/Status

Maintenance activities such as repairing potholes and repairing concrete barriers have been ongoing as problems arise.

3. The Lessons

RFP Development/Procurement Phase

- Enhance and modify the current Level of Service survey to make it applicable for temporary conditions.
- Include timetables for repairs in RFP and contract.
- Clearly identify the limits of maintenance responsibility- top of ramps, cross roads, etc.
- Specify acceptable timelines for temporary pavements and alignments, and closures. Specifically sidewalks and length of detours.
- Limit the amount of crossovers/phases/traffic realignments to maximize works zones and minimize traffic weaving and pavement scarring.
- Require the Contractor to identify and track maintenance during construction items and submit a log to CDOT weekly.

Implementation/Construction Phase

Maintenance of Traffic (MOT)

1. Overview

RFP Book 2 Section 16 included the requirements for Maintenance of Traffic on the project. Safe and efficient Maintenance of Traffic is important to CDOT and other stakeholders, and ties to one of the goals of the project: “Minimize inconvenience to the public and maximize safety of workers and traveling public.”

2. Background/Status

The contractor’s MOT phasing scheme in general was based on a three phase construction sequence, with numerous sub-phases:

1. Place temporary pavement widening in WB direction, shift traffic to WB side, and construct EB permanent pavement.
2. Shift EB traffic to new EB pavement, construct middle portion and median
3. Shift WB traffic to new middle portion, complete WB permanent pavement

3. The Lessons

RFP Development/Procurement Phase

- Provide stricter language in the contract with regards to the Lane Closure Report. A contractor will tend to report numerous closures that they don't end up using throughout the week. They use "blanket" closures to make up for their internal planning issues. As a consequence, the traveling public tends to take lane closures less seriously and the Traffic Control Subcontractor cannot plan for anticipated closures.
- Provide language in the contract that provides more teeth with level 2 MOT NC/NCR's. Level 2 MOT NCs (missing signs, dirty barrels, delineators, conflicting signs, etc.) do not affect the Contractor's production so they tend to take their time fixing the issue. Perhaps language stating that the NC-2 will be elevated to an NC-1 if not addressed in a week. Perhaps liquidated damages should be incurred if the NC-2 is not fixed in a certain time.
- Establish a process for safely opening new segments of roadway to the traveling public, make it very clear in the RFP. Avoid opening a new section of roadway with safety issues (blunt ends, missing delineators, poor striping, unsafe roadway transitions, poor lighting poor shouldering, etc). Require a safe-to-open checklist for both QA/QC and require that it be submitted to and accepted by CDOT prior to opening any mainline traffic switches. Require a safe to open walk that shall be attended by representatives from the Contractor, QA, and CDOT in Book 2 Section 16 RFP language.
- Require that the Contractor assess glare screens throughout the project. Provide detailed language in the contract for determining where glare screens are needed. This project requires that glare screens only need to be assessed at cross-overs, but we have found that we need glare screens throughout the corridor for vertical profile related issues.
- Define MOT clear zone in the RFP using AASHTO guidance.
- Per the CDOT specifications, the Contractor is required to pin barrier where obstructions are within 4' of the center of the barrier. Define an obstruction in the contract (drop-off, bridge piers, stockpiles, etc.). Provide details on how to connect temporary barrier with permanent barrier. Define the requirements when temporary barrier overlaps permanent or temporary barrier.
- This project RFP states, "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." This language does not make it very clear on where to measure emergency pull-out to emergency pullout. Is from midpoint to midpoint? Is it from the endpoint of the first to the starting point of the next? This needs to be clarified in the contract language and some wiggle room is needed for the Contractor to be able to fit emergency pullouts properly.
- Provide stricter requirements (application rates, mil thickness, bead gradations, etc.) for temporary pavement markings in the RFP. The project would be better served if the good temporary markings were initially placed instead of having the Contractor refresh once a month.

- Provide a measurable smoothness requirement for pavement transitions on temp pavement (e.g. 3/8” with a 4’ straight edge).
- Require that Temporary Lighting Plans are shown on the MOT plans.

Implementation/Construction Phase

- Add requirement for Contractor to repair or install signs within a specified time period after notification by CDOT or QA, to avoid delays in correcting issues because a subcontractor had to order a sign or stand or was not actively working on the Project.
- More coordination with CTMC for locations of DMS panels, including direction sign faces i.e. direction of travel affected, within and approaching the project limits. This coordination should identify panel size, number of lines and number of characters available per sign. This information should be included in the RFP, including a standardized form for the contractor to complete and send to CTMC for use of signs.
- Contractor response time: make sure that this language is clear. What is expected from the contractor for this? Recommend making it clear that the contractor will have someone on site within thirty minutes, not just “respond to an incident within 30 minutes” if that is what is expected.
- Working Time Violation Incidents - Always strictly enforce working time violations and make it clear to the contractor that CDOT will not tolerate violations regardless of length of time. The contractor is responsible for managing their work and timing the work so they can get off the road prior to the established times.
- Ensure that all sections of roadway, including ramps or sections between highways are clearly defined including allowable times for closures. If these areas are not spelled out in a Lane Closure Strategy, take time before release of the RFP to come up with times.
- Temporary Traffic Control Devices -- Specify how long a permanent sign can be on a temporary sign stand. Recommend clarifying that signs be permanently mounted within 72-hours of first use if they are not removed daily.
- Place some form of limit construction access points as appropriate.
- Include detailed requirements for traffic control inspection- QA and QC- with clear distinction of task specific vs. project wide.
- Clarify requirements for temporary conditions – distance from traveled way for relocation of existing signs, new construction signs, exit signs, etc.
- Perhaps require that a weekly MOT safety inspection report and/checklist is submitted to the project engineer on top of the section 630.11 requirements. Ensure that a qualified member of the Contractors Staff completes this report. Develop a template that can be modified throughout the project based off of input from the MOT designer, CDOT Engineers, QA, QC, etc.

Modifications to Standard Specifications

1. Overview

RFP Book 2 Section 20 set forth modifications to the CDOT Standard Specification for Road and Bridge Construction for design-build projects. The first section contained revisions to Division 100 of the Standard Specifications. The second section contained revisions to Divisions 200 through 700 of the Standard Specifications, as well as Standard Special Provisions applicable to the Project. This section was generally consistent with previous CDOT design-build projects.

2. Background/Status

Standard Special Provisions applicable to the project were selected during the preparation of the RFP, similar to typical CDOT projects. Updated SSP's as appropriate were via addendum during the procurement phase.

3. The Lessons

RFP Development/Procurement Phase

- Be cautious when modifying standard special provisions so that the entire section is not superseded or replaced by the modification, only the intended text.
- Be very specific on what is changing in the 100 section of Book 2 Section 20. If you are only changing a small portion of the Standard Specification (i.e. spec book), state that all other provisions of the spec section still apply.
- Only include minor modifications to Standard Specifications and Standard Special Provisions in Book 2 Section 20. All Project Special Provisions (e.g. for bridge, hydraulics, ITS, etc.) should be included in these specific sections of the RFP (e.g. ITS special provisions in Section 19)
- Come up with a reasonable plan for how to handle mobilization. Mobilization as specified in 626 may not be adequate.

Partner Coordination (CDOT and Contractor)

1. Overview

The RFP included CDOT's Standard Special Provision for Partnering, dated February 3, 2011.

2. Background/Status

A formal Partnering Session was conducted by the contractor at the beginning of project. No formal sessions have been conducted since then.

3. The Lessons

- Establish partnering ladder/counterparts at beginning of Project and require staff to follow it on both CDOT and Contractor sides. Discourage staff on both sides from looking for any available body to resolve issues – staff should always work through counterparts unless there are absolutely no other options.
- Partnering ladder should include all levels from Project Director to design and inspection staff.
- Partnering approach should encourage staff to resolve issues with their counterparts at the lowest level possible.
- If an issue can't be resolved at a lower level, it should be escalated immediately to the next level on the partnering ladder to avoid delays to the Project and damage to working relationships. In order for the next level to fully understand the issue, a position paper or written summary of the issue may be helpful to provide.
- Partnering sessions/activities should continue throughout the life of the Project. This maintains good communication channels among Project participants if a future issue arises.
- Remind staff to always focus on the specific issue, not other aspects (personality conflicts, etc) that are contributing to the inability for the participants to resolve the issue.

Project Controls/Scheduling

1. Overview

RFP Book 2 Section 2 included the requirements for Project Controls and Scheduling on the project. The requirements covered management of the Project Invoices, management of the Project Schedules, Reporting to TIFIA, and other Project Management tasks.

2. Background/Status

The Contractor has submitted a Preliminary Initial Schedule, an Original Initial Schedule, several Revised Initial Schedules, Monthly progress schedules and Current Initial Schedules. The Schedules are the basis for creating the Monthly Invoice as well as the Monthly Progress report and the TIFIA report.

3. The Lessons

RFP Development/Procurement Phase

- Cost loading all schedules to Level VI was not clearly required in the RFP. Include language in the RFP that requires all schedules to be Cost Loaded to level VI at a minimum. This will allow the Project's progress to be tracked much more accurately. Contractors will load their schedule to Level VI typically for their own cost projections

and tracking, therefore is not unreasonable to request the schedule submitted to CDOT be loaded to this level.

- Include additional requirements in the RFP for resource loading, which would allow for more effective schedule management, especially if schedule becomes a concern or contractor needs to submit recovery schedules.
- Strengthen the language regarding the requirement for the Contractor to provide an accurate weekly look-ahead schedule based off the current initial schedule with anticipated quantities. This schedule is critical for CDOT to manage the Owner's Verification Testing program and to plan audits.

Implementation/Construction Phase

- Meeting the monthly invoice due date has been a challenge for the contractor. Would be helpful to meet with the Contractor prior to NTP to discuss a realistic monthly date for submission. When the Contractor is continuously late with the invoice it has a negative impact on the review time for CDOT and subsequent submission to FHWA, TIFIA, etc.
- The Contractor uses a 3 week or a 5 week schedule to plan near term construction activities. This Schedule is not tied to the Project Schedule and it is not a requirement in the RFP. It would be helpful if contractor is required to show how the 3 week schedule ties back to the Project Schedule and is accurate to aid in CDOT staff resource planning (audits, owner's verification testing (OVT), and independent assurance testing (IAT)).
- The Schedule is required to be an accurate representation of how the Contractor intends to build the Project. Do not allow ambiguous or unclear activities to remain in the schedule.
- For any items that the Contractor intends to seek Stockpiled Materials/Procurement compensation, a specific activity must be included in the Schedule for each item.
- Verify that the Contractor's schedule durations for permit approvals is accurate and realistic. This includes CLOMR, Ditch Companies, etc.

Project/Contract Management

1. Overview

RFP Book 2 Section 2 included the requirements for Project Management on the project. The process for requesting, processing, and executing change orders on the project was defined in Book 1.

2. Background/Status

The US 36 Phase 1 program budget included an approximate 6% contingency to be set aside as a condition of obtaining the TIFIA loan for a portion of the project. Once the project was procured and as potential owner-risk items were eliminated or mitigated as design and construction proceeded, a portion of the contingency was allowed to be used to add elements of work via change order. In addition, the local agencies along the corridor elected to fund certain additional elements (such as enhanced structure aesthetics) through CDOT and the change order process. As a result, there have been many change orders requested by CDOT to add elements to the project.

3. The Lessons

RFP Development/Procurement Phase

- Specify Contractor mark-up on Change Orders in Contract based on value of CO or CDOT standard practice. This needs to be clearly defined and in accordance with FHWA regulations.
- Specify that Contractor Change estimates shall be submitted in CDOT standard format for easy comparison to CDOT cost data books.
- Remember to be prescriptive only when needed and focus on performance criteria in writing technical requirements.
- Require firm commitments from the Contractor in management plans and RFP. Avoid giving proposal points for commitments or accepting plans with qualifiers such as “when practicable” or “when possible”. These are not enforceable contractually.
- In order for the project to remain in compliance with the State Controller’s procurement regulations, an Intergovernmental Agreement template shall be created and executed between CDOT and all local agencies prior to the commencing the design and construction of the project to accommodate any potential local enhancements to the project scope. This document shall identify a budget cap and payment mechanisms for the local agencies to contribute to the project for these enhancements. The challenge with this approach is identifying the local enhancements during the procurement phase of the project.

Implementation/Construction Phase

- Managing contract changes requires a significant amount of staff time to track, prepare, process and negotiate. Allocate appropriate staff resources to this activity, especially if it is expected that excess project funds will be available to fund additional elements.
- Verify that the Contractor is following the as-built process throughout the Construction phase.
- Having a weekly project management meeting with the Contractor is an effective way to bring up and resolve issues. Participants should be limited to the following to maintain effectiveness: CDOT – Project Director, Design Manager, Construction Manager; Contractor – Project Manager, Construction Manager, and Design Manager.
- Prior to execution of any change orders for local enhancements, an amendment to the IGA will need to be executed by both CDOT and the local agency (per State Controller’s instructions). This may be completed via an option letter with a proposed cap amount for each enhancement. Due to the nature of design-build projects and the quick decisions required, this approach will need to be vetted with both CDOT and the local agencies to make sure all approvals (i.e. City Councils or State Controller) can be made in a timely fashion.
- Request for Change Proposals should include direction to the Contractor to develop typical sections/details rather than full design packages for ROM estimates where possible (i.e. bikeway signage). This would decrease the level effort (both time and cost) required to develop ROM estimates.
- Require strict conformance with the Contract requirements for content and review/response times on all change requests and directive letters so that these changes are completed in a timely fashion. Not following these requirements allows the Contractor to use change orders as an excuse for other delays in completing the Project.
- Utilize a tracking log to monitor all potential Project issues, including those that may result in future change requests.
- Maintaining an updated Project Management Plan and the associated Risk Matrix is useful for staff as they come and go from the Project to give them history on the project.
- Developing standard best management processes and procedures is useful for the CDOT staff during the life of the Project. This allows CDOT to perform self-audits and improve project management performance over the life of the Project.

Acceptance/Completion Phase

- Begin acceptance discussions early in Project with the Contractor, so that all parties have a common understanding of requirements and expectations.
- Develop a method to validate the Quality Assurance data developed on the Project to meet FHWA requirements for acceptance early in the Project. Recommend using an auditing approach (checking a percentage of the documents) to validate the data. This

can be time consuming and difficult to complete at later stages of the Project when CDOT staff is leaving for other Projects.

Procurement/Evaluation/Selection Phase

1. Overview

The Design-Build Procurement process utilized on the US 36 Phase 1 project included the following key elements and milestones:

- March-April 2011 – Letter of Interest request, meeting, and submittals
- May-July 2011 – RFQ issuance, SOQ submittals, SOQ evaluation, and shortlisting
- August-September 2011 – Issue Draft RFP for internal review, prepare final RFP
- September 29, 2011 – Issue RFP to proposers
- October 2011-January 2012 – 1 on 1 meetings, RFC response, ATC reviews
- January 27, 2012 – Proposals Submitted
- February 29, 2012 – Contractor Selected

The RFP included the following standard components used on most previous CDOT design-build projects:

- Book 1 – Contract
- Book 2 – Technical Requirements
- Book 3 – Applicable Standards, Data, and Reports
- Book 4 - Contract Drawings
- Reference Documents (for information only)

The ITP issued with the RFP included information about the project, the project goals, instructions for proposal preparation and submission, and evaluation criteria to be utilized by the selection teams.

2. Background/Status

The US 36 Phase 1 project evaluation and selection was based on a “Guaranteed Maximum Price, Best-Value Selection”. The GMP stated in the ITP was \$231M. The work to be included in the GMP was the “Basic Configuration” of the project (defined in RFP Book 2, Section 1) and any Additional Requested Elements (ARE) or portions of AREs that the proposer could provide within the GMP. The Basic Configuration primarily consisted of reconstructing US 36 between Federal and the Interlocken Loop interchange. Five AREs were defined for optional inclusion in the proposals, ranging from extension of the mainline further to the west, reconstructing existing bridges which were pinch points, and upgrading amenities at BRT stations.

Certain proposal elements were evaluated on a pass/fail basis. The points available for Best-Value selection were based on the Technical Proposal elements.

3. The Lessons

RFQ/RFP Development Phase

- During the RFQ phase - Need to develop a detailed proposer key personnel reference check process with clear expectations. An appropriate length of time and proper resources needs to be accounted for in the schedule, since qualifications of key personnel may likely be a significant factor for shortlisting some teams vs. others.
- Start RFP work with a good base document from a recent CDOT design-build project with similar features. Obtain documents from other projects also as appropriate and review for elements which may be applicable to your project.
- For development of contract and technical sections, implement a shared file system with defined protocols for initiating, reviewing, updating, and finalizing each document. For Phase 1, CDOT's Sharepoint system was used for all documents and the project management team coordinated, reviewed, accepted, and finalized all changes. Team members could always find the latest document version. Maintain a tracking list of proposed or pending changes to each draft document that includes a description, what the status is, who is responsible for making the change or answering the question, and when the change was incorporated.
- If multiple authors are to be preparing the technical sections, provide training on proper nomenclature, consistent organization and approach, and clarify differences needed for PPP projects vs. typical D-B.
- Draw upon previous project documents and processes for ITP and Proposal Evaluation Plan. On US 36 Phase 1, the project team had the draft ITP reviewed by an independent proposal-writer for clarity of proposal requirements and evaluation criteria. Numerous revisions were made as a result which improved the document.
- Co-location of project team key personnel during RFP development benefitted the process greatly.
- The VE Study conducted for the project was based on the team reviewing the draft RFP and ITP (rather than the preliminary design) for suggestions on how to refine the requirements to manage risk and obtain better value from the proposals. Many of the suggestions were implemented.
- For PPP type projects include all disciplines in review of the O&M sections, as their feedback may modify the approach and/or cost-benefit.

Proposal Preparation and Evaluation Phase

- Document posting for proposers: Utilize a web-based system with an area for all teams to access RFP documents read-only, with separate secure areas for each team to exchange proprietary information. System needs to be able to accommodate a file folder structure and all file types (.zip, CAD, etc.). A limited number of owner-side staff would have access to post items to the site. For Phase 1, CDOT's Sharepoint system was used to post all RFP documents and addendums and seemed to work well.

Proposal Debrief Feedback

The following comments and feedback was received from proposer teams during debrief sessions after the selection:

- Was overall considered a positive that CDOT involved stakeholders in proposal evaluation.
- ITP did not require submittal of a CPM schedule. Teams have to build them anyway so one team suggested that CDOT require it to be submitted. On projects where schedule is more critical, or interim milestones are more critical and CDOT needs more detail possibly to evaluation between proposals, this could be considered.
- Requiring the contractor to develop ROW plans, acquire, and pay for the ROW for any AREs (specifically ARE #1 and #2) placed a great deal of risk on the proposers and is not the type of responsibility they are accustomed to having so may have discouraged some from looking at these areas closer. CDOT went this route since there was no additional funds for ROW in the AREs, but could consider other approaches for future projects.
- One team was surprised that including or not including specific AREs could significantly affect (positively or negatively) ratings on other sections/goals like safety or MOT. CDOT could consider stating this clearer in future ITPs.
- Adjectival ratings for evaluations should maybe be reviewed for future project to see if how they are currently defined apply to all items being rated. The current approach results in a fairly small range that most teams seem to fall within (from Good+ to Excellent-) reducing the opportunity to differentiate between teams. Approach should still be carefully weighed on future projects to weight appropriately the balance between including more scope or price vs. value added from other proposal elements.
- ITP could be clearer on how points would be distributed on items like schedule. CDOT had five points available, but due to adjectival ratings, meeting the RFP requirement resulted in "Good" 68 percent of the points, and the best schedule acceleration got "Excellent" 95 percent, only a 1.35 point difference. Since so few points were assigned to schedule to begin with, could consider saying meeting RFP is 0 points, and another point is available for every two months of acceleration (or something similar). One team said they had to really guess at how much benefit they may get from a schedule acceleration vs. the cost to do it.
- ATC Process – Proposers would prefer to get more immediate and direct feedback at ATC meetings.

Public Information

1. Overview

RFP Book 2 Section 4 included the requirements for Public Information on the project. PI elements included preparation of a Public Information Plan, which was to include strategies for communicating project progress and coping during the project work and Transportation Demand Management (TDM) strategies. CDOT's project PI team is in place as oversight, while the Contractor is responsible for development of most communication tools.

2. Background/Status

During the proposal evaluation process, CDOT PI team members reviewed the proposals that were received and rated them accordingly. Once construction began, the CDOT PI team's roles and responsibilities shifted into mainly communicating about construction impacts and overall project information. The Public Information (PI) team consists of two representatives on the CDOT side in addition to a PI Manager and a Specialist working for the contractor.

3. The Lessons

RFP Development/Procurement Phase

- Be more prescriptive in the RFP.
- Allow key stakeholders to provide input into major elements (like project logo). It ensures buy-in and comprehensive feedback.
- Provide measurable performance measures as requirement of TDM program. This will help both RTD and CDOT in future projects when locals ask for funding for these elements to see if the TDM methods are effective and worthwhile.
- Clearly define roles and responsibilities for the team (what is contractor's responsibility vs. CDOT).

Implementation/Construction Phase

- Always coordinate with RTD on items that impact them – big or small.
- All responses to public complaints drafted by the Contractor shall be approved by CDOT or RTD prior to distribution. RTD preference is to handle customer complaints with Contractor support, as necessary.
- Do not have Contractor PI issue RTD detour information as this is not always correct. Preference is for PI to provide a link to the RTD website.
- Need to make sure the Contractor is providing accurate information to RTD Bus Operations during closures (any changes to schedule, early or late opening, cancellations, etc).
- Better planning on large, impactful construction events and public meetings. Those plans should be shared with CDOT and RTD ahead of time for input.
- Make sure contractor does a quality check on items before CDOT reviews (flyers, traveler alerts, newsletters, etc.).

- Set meeting to review Strategic Communications Plan with CDOT Public Relations and revisit quarterly. Just sending for approval may mean it gets lost in inboxes.
- Develop strong internal communications. Establishing and maintaining strong internal communication helps to keep the team informed and resolve issues early.
- Establish relationships with key stakeholders early on.
- Establish bi-weekly coordination meetings with 36 Commuting Solutions in the beginning. They had a desire and a need to be involved and allowing that helped the relationship in the long run.
- Coordinate with jurisdictions on major construction activities and associated detours.
- Pair the right person with the right stakeholder.
- Meet early with large employers along the corridor.
- Be flexible when working with retail stakeholders during the holiday season. Meet early and often, and establish construction hours outside of the mall's business hours.
- Establishing a Transportation Demand Management (TDM) task force took the responsibility of CDOT and RTD. Make sure agencies are observers to ensure group heading in the right directions.
- Establish more maintenance control for communication tools like Smart Phone Applications, websites, etc.
- Weekly travel advisories are extremely effective.
- Information kiosks need to be updated frequently.
- Establishing a project brand at the beginning enables cohesiveness for all parties involved in the project – contractor, owner, elected officials, etc. . (US 36 was grandfathered in with the brand – new projects must adhere to the CDOT brand guidelines).
- Develop graphic standards manual for appropriate use of the project logo.
- Even if they aren't always used, developing key messages is a good practice that allows the team to be proactive and anticipate issues.
- Celebrate major milestones with community events to keep the momentum and keep project up and running.
- Project events are not federally funded. Set aside state funds as part of the project budget for special events.

Quality Management

1. Overview

RFP Book 2 Section 3 included the requirements and responsibilities for Quality Management on the project. The contractor is responsible for preparing a QMP addressing Quality Control (QC) and Quality Assurance (QA). During construction, CDOT performs audits to monitor the

Contractor's quality management efforts during construction of the US 36 Corridor. Auditing takes the form of surveillance of the construction operations, and the activities outlined in the Contractor's QMP to assess (and confirm) compliance with both the requirements of the Contract Documents and the QMP. Monitoring of the Contractor's Quality Control (QC) and Quality Assurance (QA) efforts is intended to confirm that the Contractor provides complete verification and documentation that products, systems, and subsystems conform to Project requirements. Quality Control efforts that are monitored include (but are not limited to) Contractor tests, inspections, checklists, and reports.

2. Background/Status

Satisfying the need for safe, efficient, cost-effective transportation services through the utilization of complex systems requires the implementation of a pro-active, systematic, authoritative quality oversight program. Early identification of conditions that affect the ability of these systems to perform satisfactorily, and timely corrective actions, are necessary to preclude problems.

The transition from Quality Assurance to Quality Oversight has demonstrated a few challenges, but is taking on the intended function over time.

3. The Lessons

RFP Development/Procurement Phase

- In the RFP, require Contractor to hold weekly quality task forces to discuss NCs, NCRS, material testing trends, etc. Better define purpose of these meetings.
- Require Contractor to identify staffing numbers for Quality Assurance and Quality Control resources on the Project in Proposal (a stated ratio of quality assurance staff to production staff is ideal). Make sure that QA resources are identified for specialty items such as traffic control, erosion control, and ITS.
- Require Contractor to define Request for Information (RFI), Field Design Change (FDC), and Notice of Design Change (NDC) processes in the QMP, including CDOT involvement and review periods.
- Define At-Risk Process in the RFP (when it can be used, communication with CDOT, liability, etc).
- Require the Acceptance Process to be defined in the QMP.
- The lack of subcontractor quality programs is always a problem on Projects (General Contractors typically require their subs to provide their own QC/QA resources). CDOT should not allow this and should provide Contract language requiring all subcontractors to follow the Contractors quality program. The language should also require the Contractor to provide all QC and QA for the subcontractors. This will provide consistency on the Project for all quality efforts (documentation, inspection, scheduling, resource allocation, etc) and puts accountability back on to the Contractor.

Implementation/Construction Phase

- Do not direct the Contractor's means and methods. Rely on the Contractual requirements.
- Need to have defined counterpart/partnering ladder to eliminate confusion with the Contractor and QA staff on who is in charge of a specific area or discipline.
- Audits should be focused on Contract requirements.
- Develop a risk matrix for each project element and use this as a priority planning tool for auditing.
- Audit frequency should be based off risk level of the particular work item to the Project.
- Require the Contractor to provide QA processes in the QMP for all foreseeable construction activities prior to CDOT approval. The Contractor may request that some of the QA processes/checklists be allowed to be submitted at a later date closer to construction. This is not recommended as the Contractor is less likely to actually develop these (a specific example is ITS elements).
- Focus should be primarily on process audits and less on construction audits.
- Establishing communication protocols and CDOT expectations early on the Project is key.
- RTD's QMO database is a good tool for tracking and resolving quality issues. Recommend CDOT develop something with similar capabilities for statewide use.
- Develop an audit schedule based on contractor's scheduled activities.
- Produce project quality report on a quarterly basis. Producing this document on a monthly basis is time consuming. The Contractor's quality report should still be produced monthly.
- Have frequent refresher courses on the auditing process to make sure all staff are following the established processes.
- Quality task force and communications should highlight both areas of good performance and those needing improvement.
- Identify quality trends and how to change or continue these, as appropriate, in the Quality Task Force Meetings.
- Develop a high level Quality Management Audit Training (example: Ashbrooke)
- Having a designated CDOT Quality Manager on the Project is a good idea as it allows many of these items above to remain a focus throughout the Project.

Right of Way

1. Overview

RFP Book 2 Section 8 included the requirements and responsibilities for Right-of-Way (ROW) acquisition on the project. For the main project's Basic Configuration elements, CDOT was responsible for definition and acquisition of ROW. Section 8 included a table of dates that acquired properties would be made available to the contractor. The contractor was responsible for the cost of ROW plans and acquisition needed for AREs included in their proposal, or any ROW or easements needed beyond the limits being provided by CDOT.

2. Background/Status

CDOT prepared ROW plans based on the RFP design and began acquisition early enough to be able to deliver the new ROW to the contractor within 6 months of NTP. A large percentage of the project improvements fell within the existing US 36 corridor ROW, so delivery of ROW for the main project areas did not end up being a constraint to the main construction activities.

3. The Lessons

RFP Development/Procurement Phase

- Having project specific personnel assigned for all functions is critical to maintaining the project schedule while addressing the numerous and ongoing issues that arise on a D-B project of this magnitude.
- Having key individuals with related expertise and past experience greatly benefits the flow of communication and coordination between the various partners working the project.
- Having sufficient, dedicated resources available to immediately address any issues that arise is an important component at least as it relates to ROW plans, survey, appraisal, and acquisition.
- A challenge from a ROW perspective is addressing the numerous revisions to the preliminary RFP design that are typical of a DB project while maintaining the project schedule. Having team members with previous DB experience greatly improved the ability to quickly ascertain the validity of administrative settlements and to provide justification to upper management when needed.
- Many areas of US 36 bordered established residential or commercial areas. The design team utilized the ROW acquisition team to help assess the cost tradeoff between acquiring portions of developed properties (parking spaces, buildings, accesses, etc.) vs. building more or taller retaining walls to avoid costly acquisitions.
- A potential risk was mitigated by the early identification and acquisition of the Advance Purchase (total acquisition) parcels. As most of these required some type of relocation assistance, the risk is that the preliminary design changes significantly enough that these

parcels are no longer required. The reward is that any relocations are cleared well in advance of the remaining parcels.

Implementation/Construction Phase

- For additional ROW or permanent easements that the contractor needs for their work, it was concluded it was more efficient for the CDOT ROW team to prepare the plans and conduct the acquisition, and just be reimbursed by the contractor for the total cost.

RTD Coordination

1. Overview

RTD currently operates a robust express and local bus service along US 36 that serves approximately 10,000 daily passengers. This bus service is critical to the TDM efforts along the corridor as it removes a number of single occupant vehicles from the roadway, thereby reducing traffic during construction. This service operates throughout the day and night, leaving only small windows of time for the contractor to close ramps and complete construction activities. The RTD bus stations are located at the US 36 off and on ramps throughout the corridor, which requires that US 36 and the affected ramps stay open during service hours.

2. Background/Status

The Contract requires the contractor to maintain access to the RTD bus stations at all times or provide a temporary station location.

3. The Lessons

RFP Development/Procurement Phase

- Revise RFP language to require Contractor to notify RTD of any detours or route interruptions at least 1 week prior to implementation. For major closures or station relocations, require 2 weeks of notice. For closures or detours that are cancelled at the last minute, require the Contractor to pay for the additional buses that were scheduled by RTD Bus Operations – these additional resources can't be cancelled without 24 hours notice.
- Need realistic schedule dates for closures, detours, construction impacts, etc. from the Contractor. RTD distributes this information to the public via the RTD website and can cause major issues if it is not accurate.
- Add language to RFP requiring Contractor to notify RTD Facilities Management 24 hours in advance prior to impacting existing RTD facilities. This aids in utility locations (many of the RTD utilities are not on UNCC) and eliminates security concerns.
- Require Contractor to use RTD standard detour signage for temporary stations and stops.
- Include working time violations incidents for RTD impacts into the Contract to cover RTD costs if a station is closed due to Construction. Recommend a minimum of \$3,000

per day to cover the additional impacts to Bus Operations associated with a closure or major detour.

- Clearly define RTD scope elements in the RFP, including ADA criteria and temporary facility minimum requirements. Need to clearly define the requirements for a temporary station and consider the duration that the temporary facility will be in service (if for multiple weeks or months, the temporary station should provide equivalent facilities to the permanent station).
- Station design requirements should be strengthened in the Contract documents. Recommendations from RTD FM include:
 - Windscreens should provide better protection from the wind. Potentially add another set of glass panels staggered on the loading side of the windscreens to add more protection when prevailing winds come from that side of the platform.
 - Combining the canopy and the windscreens into one structure would provide additional protection for patrons.
 - Use standard or easily available components for all station elements: Lexan panels instead of glass, standard shapes and sizes, standard materials, paint, etc.
 - Recommend that RTD FM and RTD Engineering groups work together to develop a RTD Standard Specifications document for use on all Projects. This would reduce long term construction and maintenance costs associated with custom station elements. FM would only have to stock specific paints, glass panels, furniture, replacement parts, etc. FM believes that some of the commercially available station components (Toler, etc.) can be combined in different ways to provide unique architectural features at each station without requiring custom parts.
- Need to involve RTD FM and Bus Operations in the scoping phase of the Project.

Implementation/Construction Phase

- Having RTD staff on the project construction team aids in coordination and improves resolution time for issues, design reviews, etc.
- RTD has worked with the contractor to provide the current bus service schedules that detail time slots when stations have breaks between services. This allows the Contractor to perform some work activities during these breaks.
- The contractor has agreed to provide flagging services at ramp closures, detouring the traveling public but allowing RTD buses to continue to use the ramps to access stations. Need to very clear to contractor that RTD bus access to the stations must be maintained at all times during operations unless approved otherwise.
- The contractor has also provided temporary stations at some locations so that work can be completed on the ramps in phases.

US 36 Express Lanes Project Lessons Learned Report



- The contractor and US 36 project staff also provide regular updates to RTD bus operations informing them of upcoming closures and detours, so that bus operators and passengers know what to expect on the corridor.
- Require Contractor to perform safe to open walk with RTD bus operations and facilities groups prior to opening temporary or new stations. This will reduce the number of complaints by RTD patrons and allow bus operations and facilities to become familiar with the new facilities. This also provides verification that everything is safe for the public and that bus operations will be able to function correctly.
- The contractor is also providing 24-hour notices to the RTD Facilities Maintenance group of any upcoming work at the stations. This allows the Facilities Maintenance group and RTD Security to aid in identifying unidentified utilities and to be made aware of any construction activity at the stations.
- Keeping RTD Bus Operations and Facilities Management notified of construction activities is challenging. Identify point of contact for each group early in process to improve communication and issue resolution.
- Involve RTD FM group in the design review process to assist in identifying long term maintenance problems prior to construction. This also allows FM to become familiar with the Project prior to turn over.
- Including Working Time Violation Incident charges or Liquidated Damages for impacts to RTD facilities would encourage the Contractor to plan station work more effectively and compensate RTD for operations impacts associated with detours.
- Need to clarify ADA criteria during design process. Numerous instances where the designer specified an ADA slope that left no room for typical construction tolerances resulting in removal and replacement of the concrete. Also need to define process for verifying ADA compliance of constructed work at the beginning of the Project (surveying on a defined grid instead of using a level over small distances).
- Set up a way for RTD FM to identify ownership and maintenance of shelters and station amenities on the Project in case of damage. This will save FM a lot of staff time trying to determine this and will speed up the repair process.
- Need to establish a process for removal of amenities and furniture from stations during construction (a tracking system or chain of custody process). Numerous instances where RTD property was supposed to be salvaged or stored by FM, but Contractor could not find it once it was removed (either picked up by RTD and stored mistakenly or Contractor lost it).
- Need to develop a better utility location process on RTD property. RTD FM has done this as a courtesy for Contractors in the past, but liability and the quick turnaround requested by the Contractors is making this unfeasible. RTD is planning on joining the state utility registration database in the near future, so this issue may be mitigated.
- Access to RTD secure facilities needs to be addressed. RTD FM provided master keys to the Contractor for the station electrical and computer rooms along the corridor. The Contractor has not done a good job of returning these keys and these keys provide access

to RTD facilities throughout the RTD District (not just the US 36 corridor). RTD will need to re-key many of the rooms in the district (this is time consuming and costly). RTD FM recommends that temporary lock cylinders be installed at the beginning of a project and FM will switch them back to permanent at the end of the Project. The supply of the temporary locks should be something that RTD can include in future Contract language.

- Need to make sure that the Contractor has a good understanding of the RTD system when working on utilities. Many instances when the Contractor knocked out emergency systems at stations when tying into the existing utilities. Potential to mitigate this risk would be to provide the Contractor with better as-builts and to hold pre-activity meetings at each station prior to the start of construction activities. In general the Contractor response to outages was not prompt – potentially add contract language requiring utilities to be restored within 24 hours of an outage.
- BRT project team activation meetings (internal to RTD) where all departments were present were very helpful. Typically RTD FM and Bus Operations are not included until the very end of the Project. Both parties thought that having all departments involved from the beginning of the project to close out was beneficial and a good way to inform everyone on what was occurring on the project.
- Provide project staff out at any station that is detoured, closed, or modified for the first day to aid in guiding the bus operators and the public.
- Detour and closure signage for RTD stations should be provided by the RTD Sign Shop to guarantee consistency with RTD standard practices throughout the district.
- RTD Bus Operations is open to discussing closures at stations if construction work can be done more quickly and efficiently, rather than a prolonged construction period with daily impacts. These instances need to be identified at the beginning of the Project and must be precisely scheduled and executed. RTD Bus Operations retains the right to approve or reject any proposals from the Contractor.
- Recognize that, along with the traveling public, RTD FM and Bus Operations are the end customers of the Project. Need to keep that in mind when making decisions on the Project.
- Value engineering proposals should be vetted with both RTD FM and Bus Operations for long term impact evaluation prior to acceptance. These may sound good in the short run, but can cause long term service and maintenance impacts to RTD.
- Include RTD FM in design review to minimize long term maintenance issues.

Signing, Striping, Signals, and Lighting

1. Overview

RFP Book 2 Section 14 included the requirements and responsibilities Signing, Striping, Signals, and Lighting on the project. The contractor is required to prepare traffic designs and plans for the Project area. These plans include all necessary guide, warning, supplemental, and regulatory signs, and additions, removals, or modifications to existing signs and appurtenances.

2. Background/Status

At this point in the project, no permanent signage or lighting has been installed.

3. The Lessons

RFP Development/Procurement Phase

- At the present time, there are no lessons learned, as very little permanent work has been completed on the job

Implementation/Construction Phase

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Structures

1. Overview

RFP Book 2 Section 15 included the requirements and responsibilities for Structures on the project and Section 15A included revisions or additions to the Standard Specifications for Structures on the project.

2. Background/Status

US36 Phase 1 includes five bridge replacements, three bridge widenings, and eleven box culverts (major and minor structures combined). At this time, three bridges have been fully completed: Structure E-16-YB Wadsworth Pkwy (SH 121) over US 36, Structure E-16-YC 112th Avenue over US 36, and E-16-HK West Flatiron Crossing Dr over US 36. All other bridges are still being constructed by phased construction for traffic access.

The project includes about 50 major walls and several minor walls. Wall types include Mechanically Stabilized Earth (MSE) walls, Soil Nail walls, Cast-in-place (CIP) cantilever walls, Post-and-Panel (PP) walls and landscape walls. The walls are either for retaining fill or providing a noise wall.

The project also includes sign structures for new signage, VMS or ITS equipment. The sign structures were both standard (meeting CDOT S-standard limitations) and non-standard (designed by the contractor). The contractor utilized Cantilever, Sign Bridge, M-Sign Bridge, Sign Bridge with Cantilever, and Butterfly type sign structures.

3. The Lessons

RFP Development/Procurement Phase

- Precast Box Culverts as Pedestrian Underpasses – Generally, the contractor is able to choose between cast-in-place or precast box culverts. If they choose precast, there are a lot of joints in the floor where the precast sections fit together. These tend to be bumpier than the floor of a cast-in-place box. The management team needs to decide if this is acceptable. If not, the RFP should call for a leveling surface or some other smoothness specification.
- The RFP Section 15.2.4.2 requires load rating for all box culverts. This was added to the RFP based on discussions with Staff Bridge that this may become an FHWA requirement in the future. (in late 2015, FHWA no requires rating all culverts greater than or equal to 4’ span.) CDOT M-standards (July 2012) for precast box culverts less than 20’ span meet ASTM C1433, which is AASHTO Standard Specifications. To meet AASHTO LRFD Specifications as required per RFP, the contractor used ASTM Precast box culverts designed by the contractor to meet ASTM C1577. Current CDOT M-standard does not have this requirement updated, which requires a statement in the RFP to be clear.
- Similarly, ASTM C1577 tables are designed using thrust per AASHTO LRFD Chapter 12 for Reinforced Concrete Pipes, which includes circular, elliptical, and arch shapes. However, when this thrust load is considered in programs, it will not rate above 1.0 within VIRTIS (BrR). The RFP shall state $LF = 0.0$ for thrust on box culverts when rating through VIRTIS (BrR).
- BOXCAR was used by the precast box culvert designer. In discussion with Staff Bridge, this is not a CDOT-approved program. However, this approved program list is not published outside of Staff Bridge for the contractor. The RFP shall state any unapproved programs, or require program verification for any programs that are not included on the approved program list.
- Cross-reference and review other RFP sections to verify duplicate or contradictory information does not exist. For example, vertical clearance for VMS sign structures was written in both Section 15 and Section 19 (ITS & Tolling), with contradictory information. Section 10 calls for SMA mixture on bridge decks, while Section 15 provides overlay options.
- For Non-Standard Sign Structures: 1) Cantilever sign structures require seamless pipe per 2012 CDOT S-standard. Seamless pipe is only available up to 24” diameter when manufactured in the USA, which required thicker pipe sections for non-standard designs. 2) Bend radii for non-standard designs should not be smaller than those shown in CDOT S-standards.
- There was ambiguity with how “Revision to Section 628 Bridge Deck and Girder Unit” was written. Items to be added to future Section 628 specifications: whether Section 628 precludes conformance with Section 509, QA requirements by referencing Section 509 or written as required for Section 628, whether this section applies to all prefabricated

bridge or just prefabricated pedestrian bridges, etc. In particular, Sections 509.14, 509.17, 509.18, 509.19, 509.21, 509.22, 509.27 and 509.28 should be included as reference or part of the specification.

- Section for Structure Foundation Analysis and Design: Based on the comments received from CDOT Geotech Branch during report review, this section should any CDOT-specific requirements or preferences that are not currently spelled out within existing Specs/Manuals. (CDOT is currently writing a Geotechnical Manual, which may clear up some requirements.) CDOT Geotech Branch requested all methodology to be defined in the reports, including all applicable factors and results.
- Further define the use of “architectural elements and components” in the RFP, particularly when defining what code requirements are applicable.
- Reconsider minimum deck thickness requirement of 8” if pedestrian/bikeway structures are expected. Contractor consistently argued for 6” deck thickness on these structures.
- Modify structure rehabilitation section to indicate that structure damage listed must be verified by visual inspection, which may or may not modify the scope. Innovation towards rehabilitation should not be hindered by providing a prescriptive list.
- Based on a risk analysis with Staff Bridge, determine whether a detailed bridge inspection beyond that shown in current SIA is required for bridges to remain. (Reference South Boulder Creek and 20th St HOV as examples of this scenario.)
- Consider eliminating concept plans, as this is a duplicate or hybrid of what was shown in Reference Drawings of RFP and the upcoming Preliminary Design Package by the contractor.
- Consider what variance requests or changes during design require an update to the final and approved Aesthetic Treatment Plan.

Implementation/Construction Phase

- Procedure for shop drawing review and requirements for CDOT involvement should be either added to the RFP or discussed early in the project. Because some wall types and precast elements are designed by a vendor, the details shown in shop drawings are not included in the plan sets sent to CDOT for review.
- All soil nail walls shall have a project standard specification written.
- Existing soil nail walls shall have appropriate soil nail survey or location verification prior to any work within the reinforced zone.
- Ensure CVN testing (as applicable) has been done prior to steel shipment.
- Consistently monitor the structure damage of existing structures to verify list of rehab work to be performed. Work performed during widenings may present additional rehab work to include.

Survey

1. Overview

RFP Book 2 Section 9 included the requirements and responsibilities for Survey on the project. CDOT provided existing topographic information based on a combination of field survey (Federal to US 287) and aerial mapping supplemented with field survey (US 287 to western project limit). A control diagram was also provided.

2. Background/Status

The contractor was able utilize the CDOT-provided survey information for the proposal phase; during the D/B phase they have supplemented with additional field survey where needed for increased detail or extents.

3. The Lessons

RFP Development/Procurement Phase

- Be clear in RFP what the basis and methods are of topo survey provided by CDOT so there is no misunderstanding.
- For utility surveys, be clear in RFP (via separate files, etc.) which utility information is based on actual locates and surveys, and which are based on best available information from key maps, owner files, etc.
- The accuracy of the RFP topo and survey was not guaranteed, but the RFP stated that any discrepancies in control point information provided that is reported to CDOT within 60 Days of NTP1 will be resurveyed or corrected by CDOT at no cost to the Contractor.

Implementation/Construction Phase

- Ensure that project QA holds a pre-survey conference and that contractor's survey equipment is in good working order and have been certified per CDOT Survey Manual.
- Allow for option of using Universal Total Station for fine grading/blue topping, providing they meet specified tolerances.

Third-Party Agreements

1. Overview

RFP Book 2 Section 6 included the requirements and responsibilities related to Third-Party Agreements on the project. Third-party coordination and approvals were required from Local Agencies, Railroad, Irrigation Ditch Companies, Public Utility Owners and Private Utility Owners. In addition, CDOT entered into IGAs with local agencies along the corridor related to agency-funded enhancements or additions to the project, and for local agency maintenance of the Bikeway or selected interchange features.

2. Background/Status

Initial coordination with most entities was started during the development of the RFP, and current status or draft agreements were included in the RFP documents, especially for items which would affect the design-build proposals.

3. The Lessons

RFP Development/Procurement Phase

- Although coordination with the Railroad was started by CDOT very early in the RFP process to put a crossing under the railroad for the Bikeway, a concept that looked promising at the start and was supported by the Railroad ultimately had to be discarded and a change order issued during construction to put the bikeway over the railroad on the US36 bridge. Approvals from railroads will always be a challenge; assign appropriate risk to these items, especially if they are critical path items, and have a contingency plan in place if the original concept becomes infeasible.
- If local agencies request betterments which they will fund, work to agree on a cost for these features ahead of time and then just include the work in the basic project configuration. For some features, the local agency requested we include their betterments as a bid option hoping to get a lower price than the CDOT estimate, but the resulting option prices were much higher.
- See discussion on IGAs in the Contract Management section of this document for local enhancement process.

Implementation/Construction Phase

- The IGA process is time consuming and lengthy for negotiation and 3rd party approval. Account for this time in your project schedule.
- Verify that CDOT accounting is billing 3rd parties per the payment schedule defined in the IGA.

Utility Relocations

1. Overview

RFP Book 2 Section 7 included the requirements and responsibilities for Utilities on the project. In addition, Book 1 included sections and definitions applicable to utility work. The project identified six private utility owners and five public utility owners in the corridor. To work with these entities, four utility relocation agreements were executed with private utility owners, and four more with public utility owners. During project development, 329 utility identification numbers were identified in the utility matrix.

2. Background/Status

The utilities impacts in the corridor are 25 percent wet utilities and 75 percent dry. Xcel Energy has the majority of the dry utility impacts. As of September 2013, the contractor has identified 353 utility conflicts or resolution impacts on the project. Working on such a vast amount of utilities has proven to be a challenge, especially on a corridor of this size.

4. The Lessons

RFP Development/Procurement Phase

- When doing preliminary utility investigation, mapping is schematic at best, which makes it difficult to properly identify the utility and understanding the complexity of the potential utility relocation.
- A more detailed Utility Matrix, with many more utility identification numbers at logical breaks would be beneficial.
- During the development/procurement stage, it would be beneficial to have more detailed discussions with the utility owners as to how/when the potential utility would be relocated and potential schedules and costs, and identify it on the Utility Matrix.
- Consider providing the ability (schedule and budget) to pothole more key utilities during the RFP development process. The more detailed the Utility Matrix is, the lower the risk is for CDOT during the selection process. This would also provide more assurance to the utility owners and possibly have them more receptive to a timely response when a facility needs to be relocated during construction. The utility owner could also appropriately budget for the utility relocation, or relocate the utility prior to the project.
- Educate utility owners during the development stage about D-B. It is very difficult for utility owners to understand CDOT's D-B procurement process, and that it typically takes 2- 3 years to get a project to physical construction.

Implementation/Construction Phase

- There seems to be a misconception that a utility identification number could only have one work order or one no-conflict form associated with that utility. A utility identification number can have multiple work orders and no-conflicts associated to address the potential utility conflicts (grading, pipes, foundations, etc.) to assure that the entire length of the utility has been appropriately avoided or relocated. As the particular separate RFC plans (storm pipes, bridge, retaining walls, grading, lighting) are developed, a review of potential utility impacts with each utility needs to be processed. In addition, multiple work orders and no-conflict forms would provide a complete explanation of the utility avoidance/impact process, and have more retrievable documentation for CDOT in the future (i.e. Can CDOT retrieve project documentation (work order and no-conflict forms) in 10 years and understand what decisions were made during construction?)
- When grouped in a single work order, it is very difficult to identify all of the potential work elements associated with the one work order. Utilities are a reaction to design, and the RFC process is segmented with multiple potential impacts from multiple project

elements. Additional work orders/no-conflicts would also assist in defining the type of work associated with the impacted utility (i.e. manhole adjustment vs. total relocation on wet utilities).

- There are new requirements for Buy America and utility relocation's. Any future Utility Relocation Agreements (URA) will need to have language in the URA's that includes Buy America language and requirements.
- Book 2 Section 7.6.1 (Utility Agreements) states *“If the Contractor identifies Utility Work that is required from a Utility Owner without an agreement, CDOT may enter into an agreement with such Utility Owner. The Contractor shall not be a party to any agreement and shall not be responsible for negotiating such agreement. CDOT shall be responsible for drafting and negotiating the agreement. The Contractor will be responsible to coordinate with such Utility Owner as if it had an executed Utility Agreement.”* On the US 36 D/B project we have ran into instances where a URA has not been executed and a utility has been identified on the utility matrix. The RFP is written to have the Contractor coordinate with the utility owner as if a utility agreement has been executed. The Contractor has tried to coordinate with the Utility Owner, and the Utility Owner refuses to sign the No Conflict/Work Order/DRAL and CRAL because they have not entered into an executed URA. Suggest including exhibits (No-Conflicts/ Work Orders/DRAL and CRALs) that refer to accommodation of utilities within CDOT ROW by permit and that any protections under C.R.S. 43-1-1401 are no longer applicable. There are circumstances where the procurement deadlines do not allow for the lengthy contract process when executing URA's with Utility Owners. There have been instances where a URA can take up to two years to execute with various utility owners. By developing exhibits that refer to provisions of the CDOT permit when a URA is not applicable this would allow for the Contractor to provide proper project documentation/justification to document control with regards to schedule and billings associated with the utility matrix.
- The US 36 project has had difficulty getting the contractor to update the utility base file once subsurface investigation has been completed. There have been some challenges when reviewing design package submittals and determining if a utility is shown correctly to understand the potential impacts to utilities, design, project schedule, etc. Section 14.1.4.1 (Permanent Lighting Design) is the only section that specifically states what is required to be shown on the plans. *“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.”* May want to consider including similar language under other Book 2 Section's to assure utilities are being shown accurately and cross disciplinary review is occurring.

Acronym List

ARE Additional Requested Elements

US 36 Express Lanes Project

Lessons Learned Report



ATC	Alternative Technical Concept
ATM	Active Traffic Management
BOS	Bus on Shoulders
BRT	Bus Rapid Transit
CDOT	Colorado Department of Transportation
CLOMR	Conditional Letter of Map Revision
CPM	Critical Path Method
DB	Design-Build
DBE	Disadvantaged Business Enterprise
EIS	Environmental Impact Statement
ETC	Electronic Toll Collection
FDC	Field Design Change
HMA	Hot Mix Asphalt
HPTE	High-Performance Transportation Enterprise
HOV	High Occupancy Vehicles
ITP	Instructions to Proposers
ITS	Intelligent Transportation Systems
MHT	Method of Handling Traffic
MOT	Maintenance of Traffic
NDC	Notice of Design Change
NEPA	National Environmental Policy Act
PI	Public Information
PCCP	Portland Cement Concrete Pavement
QA	Quality Assurance
QC	Quality Control
QMO	Quality Management Oversight
RFC	Released for Construction
RFI	Request for Information
RFP	Request for Proposals
ROD	Record of Decision
ROW	Right-of-Way
RTD	Regional Transportation District
TDM	Transportation Demand Management