Region 1 –West Program
425A Corporate Circle
Golden, Colorado 80401
720-497-6950

Project Delivery Selection Meeting
US 6 Bridge over Garrison Street

Project Number: FBR 0063-046 Project Code: 19478
Date: March 4, 2014

Attendees:

Steve Harelson	CDOT R1 West Program Engineer
Nabil Haddad	CDOT HQ Innovative Contracting Manager
Matt Pacheco	CDOT R1 Major Projects Resident Engineer
Andy Pott	CDOT HQ Staff Bridge PE II
Ben Acimovic	CDOT R1 I-70 Mountain Project Manager
Jana Spiker	CDOT R1 West Project Manager
Chris Paiz	CDOT R1 West Construction Manager
Chris Trujillo	CDOT R1 West Designer
Kevin Brown	CDOT R1 West Resident Engineer

Discussion:

1) **Introductions**
2) **Project Overview**
   The project consists of the replacement of the bridge that carries US 6 (MP 279.79) over Garrison Street in the City of Lakewood. This project qualifies for Colorado Bridge Enterprise (CBE) funding. Design work is done to the 30% level and the FIR meeting was held on February 24, 2014. The project is presently behind the schedule set by CBE and it was determined that innovative contracting may be utilized to recapture lost time and provide innovative methods to deliver the project that were not considered in the preliminary design. The project limits are completely within CDOT ROW, a CATEX determination is anticipated, and utility impacts are considered minor.
3) **Project Delivery Selection Overview**
   The Innovative Contracting Advisory Committee's Project Selection Matrix was employed to determine the best method for project delivery. A description of the approach used, and project specific selection documents and the decisions of the panel are attached below.
4) **Outcome**
   It was determined that the Design-Build method, specifically a Streamlined Design-Build (SBD) would be the best delivery method for this project.

Colorado Department of Transportation
Innovative Contracting Advisory Committee

Project Delivery Selection Approach

Overview

This document provides a formal approach for CDOT highway project delivery selection. The document provides generic forms for use by CDOT staff and project team members. By using these forms, a brief project delivery selection report can be generated for each individual project. The primary objectives of this document are:

- Present a structured approach to assist CDOT in making project delivery decisions;
- Assist CDOT in determining if there is a dominant or obvious choice of project delivery methods; and
- Provide documentation of the project delivery decision in the form of a Project Delivery Decision Report.

Background

The project delivery method is the process by which a construction project is comprehensively designed and constructed including project scope definition, organization of designers, constructors and various consultants, sequencing of design and construction operations, execution of design and construction, and closeout and start-up. Thus, the different project delivery methods are distinguished by the manner in which contracts between the agency, designers and builders are formed and the technical relationships that evolve between each party inside those contracts. Currently, there are several types of project delivery systems available for publicly funded transportation projects in the Colorado. The most common systems are Design-Bid-Build (DBB), Design-Build (DB), and Construction Manager/General Contractor (CM/GC). No single project delivery method is appropriate for every project. Each project must be examined individually to determine how it aligns with the attributes of each available delivery method.

DBB is the traditional project delivery method in which an agency designs, or retains a designer to furnish complete design services, and then advertises and awards a separate construction contract based on the designer's completed construction documents. In DBB, the agency "owns" the details of design during construction and as a result, is responsible for the cost of any errors or omissions encountered in construction.

DB is a project delivery method in which the agency procures both design and construction services in the same contract from a single, legal entity referred to as the design-builder. The method typically uses Request for Qualifications (RFQ)/Request for Proposals (RFP) procedures rather than the DBB Invitation for Bids procedures. The design-builder controls the details of design and is responsible for the cost of any errors or omissions encountered in construction.

SDB is a standardized form of DB intended for smaller, straight-forward, less complex projects, aimed at minimizing the procurement process by CDOT and the industry. The procurement process for SDB is a Best Value, one or two step selection process, with abridged Request for Qualification (RFQ) (if used), and Request for Proposal (RFP) phases. Best Value is defined as price plus any other factor(s), i.e. Price plus schedule, or Price plus Schedule Plus Project Approach, etc.

CM/GC is a project delivery method in which the agency contracts separately with a designer and a construction manager. The agency can perform design or contract with an engineering firm to provide a facility design. The agency selects a construction manager to perform construction management services and construction works. The significant characteristic of this delivery method is a contract between an agency and a construction manager who will be at risk for the final cost and time of construction. Construction industry/Contractor input into the design development and constructability of complex and innovative projects are the major reasons an agency would select the CM/GC method. Unlike DBB, CM/GC brings the builder into the design process at a stage where definitive input can have a positive impact on the project. CM/GC is particularly valuable for new non-standard types of designs where it is difficult for the owner to develop the technical requirements that would be necessary for DB procurement without industry input.

Overview of the Project Delivery Selection Process

The process is shown in the form of a flow chart below. It consists of the following activities:

A. Describe the project and set the project goals

B. Determine and review project dependent constraints

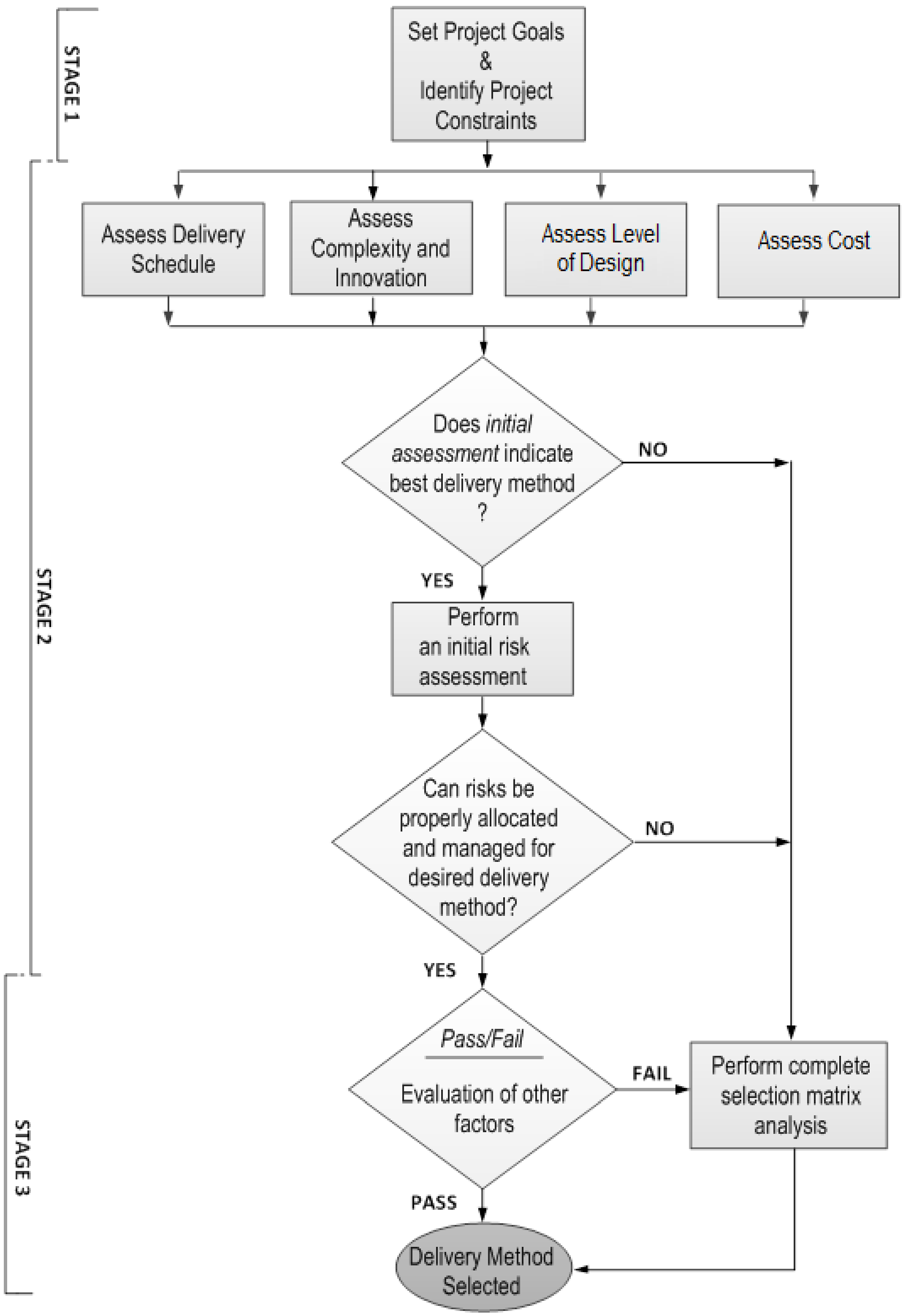
C. Assess the primary factors (these factors most often determine the selection).
   1. Delivery Schedule
   2. Complexity & Innovation
   3. Level of Design (at the time of the project delivery procurement)
   4. Cost

D. If the primary factors indicate there is a clear choice of the delivery method, then:
   5. Perform an initial risk assessment for the desired delivery method to ensure that risks can be properly allocated and managed, and

E. Perform a brief pass/fail analysis of the secondary factors to ensure that they are not relevant to the decision.
   6. Staff Experience/Availability (Owner)
   7. Level of Oversight and Control
   8. Competition and Contractor Experience

F. If steps B, C & D do not result in clear determination of the method of delivery then perform a more rigorous evaluation of all eight factors against the three potential methods of delivery (DBB, DB and CM/GC).

Typically the entire selection process can be completed by the project team in a 4 hour workshop session, if team member have individually performed assessments before the workshop.



CDOT Project Delivery Selection Flowchart

The following forms and appendices are included to facilitate this process.

Project description checklist

Provide information on the project that is using this tool. This includes size, type, funding, risks, complexities, etc. All information should be developed for the specific project.

Project Goals worksheet – including example project goals

A careful determination of the project goals is an instrumental first step of the process that will guide both the selection of the appropriate method of delivery as well as the specific delivery procurement process and implementation of the project.

Project Constraints worksheet (Go / No-Go Decisions)

Carefully review all possible constraints to the project. These constraints can potentially eliminate a project delivery method before the evaluation process begins.

Project Delivery Selection Matrix Summary

The Project Delivery Selection Matrix Summary summarizes the assessment of the eight Evaluation Factors for the three delivery methods. The form is qualitatively scored using the scoring provided in table 1 below.

Table 1 - Factor Evaluation Scoring Key

+ +	Most appropriate delivery method
+	Appropriate delivery method
–	Least appropriate delivery method
X	Fatal Flaw (discontinue evaluation of this method)
NA	Factor not applicable or not relevant to the selection

The form also includes a section for comments and conclusions. The completed Project Delivery Selection Matrix Summary should provide an executive summary of the key reasons for the selection of the method of delivery**.**

Workshop Blank Form

This form can be used by the project team for additional documentation of the process. In particular it can be used to elaborate on Evaluation Factor 4. "Initial Project Risk Assessment".

Evaluation Factor Project Delivery Method Opportunity/Obstacle Summary

These forms are used to summarize the assessments by the project team of the opportunities and obstacles associated with each delivery method relative to each of the eight Evaluation Factors. The bottom of each form allows for a qualitative conclusion using the same notation as described above. Those conclusions then are transferred to the **Project Delivery Selection Matrix Summary.**

Appendix – Opportunity/Obstacle Checklists

These forms provide the project team with guidance concerning typical delivery method opportunities and obstacles associated with each of the eight Evaluation Factors. However, these checklist include general information and are not an all-inclusive checklist. Use the checklists as a supplement to developing project specific opportunities and obstacles.

Appendix – Initial Risk Assessment Guidance

Because of the unique nature of Evaluation Factor 4. "Initial Project Risk Assessment", the Appendix provides the project team with additional guidance for evaluation of that factor including: Typical CDOT Transportation Project Risks; a General Project Risks Checklist; and a Risk Opportunities/Obstacles Checklist.

Project Description Checklist

- ❒ Project Name: US 6 over Garrison St. Bridge Replacement
- ❒ Location: US 6 over Garrison St., Lakewood, CO (Jefferson County) (MP 279.79)
- ❒ Estimated Budget:
  - o Design - $1.2M ($640k remaining)
  - o Construction: $14.2M
- ❒ Estimated Project Delivery Period: Thru December 2015
- ❒ Required Delivery Date: December 2015
- ❒ Source(s) of Project Funding: Bridge Enterprise
- ❒ Project Corridor: US 6 (6th Avenue)
- ❒ Major Features of Work – Bridge, Retaining Walls, Pavement, Signals & Signing, Water Quality Ponds
- ❒ Major Schedule Milestones: Construction Complete by December 2015
- ❒ Major Project Stakeholders: CDOT BE, FHWA, City of Lakewood, Business Owners and Residents
- ❒ Major Challenges
  - o Construct within existing CDOT ROW
  - o Maintenance of Traffic during Construction
  - o Maintaining Business Access off Garrison St.
  - o Maintaining Pedestrian Access on Garrison St. underneath US 6
- ❒ Main Identified Sources of Risk: Schedule
- ❒ Safety Issues:
  - o Worker Safety – Protection during construction
  - o Travelling Public Safety - Lanes reduced to 11 feet on US 6, pedestrian safety on Garrison St. on Frontage Roads.
- ❒ Sustainable Design and Construction Requirements:
  - o Maximize life-cycle through increased durability to achieve at least a 75 year design life.
  - o Provide water quality treatment of impervious area runoff within project limits.

- Reduce construction time and thereby energy consumption by utilizing accelerated bridge construction methods.
- Construct a bridge that easily facilitates hands-on inspection of its individual components.
- Construct sidewalks and bike-lanes along Garrison Street to better enhance the social communities.
- Utilize local materials sources

Project Goals

1. SAFETY, MOBILITY, AND OPERATIONAL CHARACTERISTICS
   a. Correct sub-standard sight distance associated with the sag vertical curves approaching Structure No. F-16-ER while limiting the increase in the vertical profile to less than 5 feet.
   b. Improve sub-standard shoulders on US 6 within project limits.
   c. Provide at least a 14.5’ vertical clearance underneath Structure No. F-16-ER.
   d. Maintain three (3) through lanes in each direction of US 6 throughout construction.
   e. Maintain all ramp traffic during construction.
   f. Maximize worker safety by reducing construction time, thus reducing exposure time.
   g. Maintain pedestrian and bicycle traffic on Garrison St. during construction.
   h. Maintain access to businesses and shopping areas.
2. SCHEDULE and BUDGET
   a. Minimize project delivery time and have construction complete by December 15, 2015 without sacrificing quality.
   b. Complete the project under budget of $14.2M.
   c. Accelerate the start of project spending to accommodate Bridge Enterprise spending requirements.
   d. Maximize innovation and improvements within project budget.
3. INNOVATION
   a. Maximize innovation to deliver the project within a limited work area, including utilization of existing retaining walls and service road.
4. ENVIRONMENTAL
   a. Adhere to all environmental compliance requirements.

5. QUALITY

    a. Maximize the life-cycle performance of the project.

    b. Maximize quality by selecting the best team.

    c. Provide high quality design and construction constraints.

    d. Retain QA role in-house (CDOT).

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6. CONSTRUCTION

    a. Maximize schedule performance through quick turn-around of all communications requiring decision making on critical path items.

    b. Minimize the travelling public's exposure to phased conditions.

    c. Maintain mobility through the project during construction.

    d. Provide safe conditions for workers and the traveling public.

    e. Keep within existing ROW footprint.

Project Constraints

- Bridge Enterprise Funding
- Schedule constraints set by BE, direction from senior management to accelerate delivery
- No ROW required
- CATEX anticipated
- Minimal Utility impacts

Project Delivery Selection Matrix Summary

Determine the factors that should be considered in the project delivery selection, discuss the opportunities and obstacles related to each factor, and document the discussion on the following pages. Then complete the summary below.

PROJECT DELIVERY METHOD OPPORTUNITY/OBSTACLE SUMMARY			
	DBB	DB	CM/GC
Primary Evaluation Factors			
1. Delivery Schedule	–	+ +	+
2. Project Complexity & Innovation	+	+ +	+
3. Level of Design	+	+	+
4. Cost	–	+	+
5. Perform Initial Risk Assessment	–	+	+
Secondary Evaluation Factors			
6. Staff Experience/Availability (Owner)		✓	
7.Level of Oversight and Control		✓	
8. Competition and Contractor Experience		✓	

+ +	Most appropriate delivery method
+	Appropriate delivery method
–	Least appropriate delivery method
X	Fatal Flaw (discontinue evaluation of this method)
NA	Factor not applicable or not relevant to the selection

Project Delivery Selection Matrix Summary Conclusions and Comments:

Design-Build was determined to be the most appropriate delivery system for the project for the following reasons:

1) The delivery schedule is driven by the Colorado Bridge Enterprise request for accelerated project delivery and execution.. DBB could not have provided for this acceleration of design and construction. CMGC provides some acceleration benefit, but not to the extent of a Streamlined Design Build.

2) The project would benefit from contractor innovation that is inherent to the Design Build process. The project will also benefit from the integration of designer and contractor. A smaller Design Build project is certain to draw the attention of many bidders and CDOT will benefit from the many perspectives in how to best approach the project.

3) There is no ROW required and the work will be CATEX so the longer lead time for a DBB is not needed.

4) Project design is now at 30%, the optimal time to shift to innovative contracting method.

5) The iterative nature of the CMGC, and the risk of GMP negotiations could cause delays in starting the work.

1) Delivery Schedule

Delivery schedule is the overall project schedule from scoping through design, construction and opening to the public. Assess time considerations in getting the project started or funding dedicated and assess project completion importance.

DESIGN-BID-BUILD Requires time to perform sequential design and procurement, but if design time is available has the shortest procurement time after the design is complete.	
Opportunities	**Obstacles**
Predictable schedule	Will require an RFP process, adding time
	Bridge Enterprise demands acceleration that may not be possible
	GRS abutments and MSE walls presented in FIR may add time
	Current schedule for DBB not compatible with required completion date

DESIGN-BUILD Can get project under construction before completing design. Parallel process of design and construction can accelerate project delivery schedule; however, procurement time can be lengthy due to the time necessary to develop an adequate RFP, evaluate proposals and provide for a fair, transparent selection process.	
Opportunities	**Obstacles**
Some innovation	
More viewpoints from proposals	
Expedited delivery	

CM/GC Quickly gets contractor under contract and under construction to meet funding obligations before completing design. Parallel process of development of contract requirements, design, procurements, and construction can accelerate project schedule. However, schedule can be slowed down by coordinating design-related issues between the CM and designer and by the process of reaching a reasonable Guaranteed Maximum Price (GMP).	
Opportunities	**Obstacles**
Team involvement for schedule optimization	Iterative nature of design could cause schedule risk
Contractor input for phasing and traffic control may reduce schedule	GMP can delay schedule

Delivery Schedule Summary

	DBB	**DB**	**CM/GC**
1. Delivery Schedule	-	++	+

Notes and Comments:

Project delivery is dictated by Bridge Enterprise and work must be completed by December 2015. DBB is not likely to meet that date, given that an RFP process is needed for the final design, which will add 3 months to the process. CM/GC has some risk that the GMP negotiations may push back the start date, or revert to DBB. A streamlined Design Build shows the best promise for accelerating the schedule to meet BE requirements.

2) Project Complexity & Innovation

Project complexity and innovation is the potential applicability of new designs or processes to resolve complex technical issues.

DESIGN-BID-BUILD Allows CDOT to fully resolve complex design issues and qualitatively evaluate designs before procurement of the general contractor. Innovation is provided by CDOT/Consultant expertise and through traditional owner directed processes such as VE studies and contractor bid alternatives.	
Opportunities	**Obstacles**
Owner has more control of design	No contractor input to optimize costs
Consistency in maintainability	Limited flexibility
	VECP after award will impact schedule

DESIGN-BUILD Incorporates design-builder input into design process through best value selection and contractor proposed Alternate Technical Concepts (ATCs) – which are a cost oriented approach to providing complex and innovative designs. Requires that desired solutions to complex projects be well defined through contract requirements.	
Opportunities	**Obstacles**
Designer and Contractor collaborate to optimize innovation	
Constructability and VE inherent in process	
Early team integration	
Can use best value or qualification based selection	

CM/GC Allows independent selection of designer and contractor based on qualifications and other factors to jointly address complex innovative designs through three party collaboration of CDOT, designer and Contractor. Allows for a qualitative (nonprice oriented) design but requires agreement on GMP.	
Opportunities	**Obstacles**
Highly innovative process with 3rd party innovation	Process depends on contractor / designer relationship working in an “arranged marriage”
Allows owner control innovative solutions	Innovations can cost time
Allows independent selection of best design and best contractor for the project.	Single source negotiated GMP can add cost

Project Complexity & Innovation Summary

	DBB	DB	CM/GC
2. Project Complexity & Innovation	+	++	+

Notes and Comments:

Working within existing ROW expedites project delivery, but innovative solutions are needed to maximize use of existing walls and to optimize traffic phasing with constructability.

3) Level of Design

Level of design is the percentage of design completion at the time of the project delivery procurement

DESIGN-BID-BUILD 100% design by CDOT, with CDOT having complete control over the design.	
Opportunities	**Obstacles**
100% design by owner	Design errors add to project cost
Well defined scope	Minimized completive innovation opportunities
Well know industry process	Reduced constructability since contractor is not involved in design

DESIGN-BUILD Design advanced by CDOT to the level necessary to precisely define contract requirements and properly allocate risk (typically 30% or less).	
Opportunities	**Obstacles**
Design is at 30%, optimal for IC	Must have very clear definitions and requirements in the RFP as this is the basis for the contract.
Contractor involvement in early design, adding innovation and constructability	Over utilized performance specification to enhance innovation can risk quality
Plans do not require highest level of detail as the contractor understands the concept.	

CM/GC Can utilize a lower level of design prior to procurement of the CM/GC and then joint collaboration of CDOT, designer, and CM/GC in the further development of the design. Iterative nature of design process risks extending the project schedule.	
Opportunities	**Obstacles**
Present 30% design level is optimal for IC	Teaming may cause disputes
Early contractor involvement for constructability	Three party process may slow progression
Owner control of design	

Level of Design Summary

	DBB	**DB**	**CM/GC**
3. Level of Design	+	+	+

Notes and Comments:

4) Cost

Project cost is the financial process related to meeting budget restrictions, early and precise cost estimation, and control of project costs.

DESIGN-BID-BUILD Competitive bidding provides a low cost construction for a fully defined scope of work. Costs accuracy limited until design is completed. More likelihood of cost change orders due to contractor having no design responsibility.	
Opportunities	**Obstacles**
Competitive bidding for lowest initial cost	Construction costs not final until after design is complete
	More potential for change order cost increase due to owner design responsibility
	Cost reductions due to contractor innovation difficult to obtain in a limited time frame after award

DESIGN-BUILD Designer-builder collaboration and ATCs can provide a cost-efficient response to project goals. Costs are determined with design-build proposal, early in design process. Allows a variable scope bid to match a fixed budget. Poor risk allocation can result in high contingencies.	
Opportunities	**Obstacles**
Contractor input into design moderates cost	
Costs are set early in design process with the DB proposal	
Allows a variable scope to meet a fixed budget	
Funding can be obligated in a very short time frame	

CM/GC CDOT/designer/contractor collaboration to reduce risk pricing can provide a low cost project however non-competitive negotiated GMP introduces price risk. Good flexibility to design to a budget.	
Opportunities	**Obstacles**
3 party collaboration to reduce project risk results in lower costs	
Continuous VE process	
Can provide a cost efficient response to project goals	

Cost Summary

	DBB	**DB**	**CM/GC**
4. Cost	-	+	+

Notes and Comments:

5) Initial Risk Assessment

Risk is an uncertain event or condition that, if it occurs, has a negative effect on a project's objectives. Risk allocation is the assignment of unknown events or conditions to the party that can best manage them. An initial assessment of project risks is important to ensure the selection of the delivery method that can properly address them. An approach that focuses on a fair allocation of risk will be most successful. Refer to risk discussion and checklists in appendix B.

DESIGN-BID-BUILD Risk allocation for design-bid-build best is understood by the industry, but requires that most design-related risks and third party risks be resolved prior to procurement to avoid costly contractor contingency pricing and change orders and claims.	
Opportunities	**Obstacles**
	Design Completion
	Spend down for BE
	Uncertainty in phasing and duration

DESIGN-BUILD Provides opportunity to properly allocate risks to the party best able to manage them, but requires risks allocated to design-builder to be well defined to minimize contractor contingency pricing of risks.	
Opportunities	**Obstacles**
Survey completed	
Working within ROW	
Minimal utilities	
Drainage resolved	

CM/GC Provides opportunity for CDOT, designer, and contractor to collectively identify and minimize project risks, and allocate risk to appropriate party. Has potential to minimize contractor contingency pricing of risk, but can lose the element of competition in pricing.	
Opportunities	**Obstacles**
Survey completed	
Working within ROW	
Minimal utilities	
Drainage resolved	

Initial Risk Assessment Summary

	DBB	**DB**	**CM/GC**
5. Initial Risk Assessment	-	+	+

Notes and Comments:

6) Staff Experience/Availability

Owner staff experience and availability as it relates to the project delivery methods in question.

DESIGN-BID-BUILD Technical and management resources necessary to perform the design and plan development. Resource needs can be more spread out.	
Opportunities	**Obstacles**

DESIGN-BUILD Technical and management resources and expertise necessary to develop the RFQ and RFP and administrate the procurement. Concurrent need for both design and construction resources to oversee the implementation.	
Opportunities	**Obstacles**

CM/GC Strong, committed CDOT project management resources are important for success of the CM/GC process. Resource needs are similar to DBB except CDOT must coordinate CM's input with the project designer and be prepared for GMP negotiations.	
Opportunities	**Obstacles**

Staff Experience/Availability Summary

	DBB	**DB**	**CM/GC**
6. Staff Experience/ Availability		✓	

Notes and Comments:

High functioning staff with major project experience, ready program and region resources for support as needed.

7) Level of Oversight and Control

Level of oversight involves the amount of agency staff required to monitor the design or construction, and amount of agency control over the delivery process

DESIGN-BID-BUILD Full control over a linear design and construction process.	
Opportunities	**Obstacles**

DESIGN-BUILD Less control over the design (design desires must be written into the RFP contract requirements). Generally less control over the construction process (design-builder often has QA responsibilities).	
Opportunities	**Obstacles**

CM/GC Most control by CDOT over both the design, and construction, and control over a collaborative owner/designer/contractor project team	
Opportunities	**Obstacles**

Level of Oversight and Control Summary

	DBB	**DB**	**CM/GC**
7. Level of Oversight and Control		✓	

Notes and Comments:

High functioning staff with major project experience, ready program and region resources for support as needed. A senior Construction Manager is assigned to this work for oversight.

8) Competition and Contractor Experience

Competition and availability refers to the level of competition, experience and availability in the market place and its capacity for the project.

DESIGN-BID-BUILD High level of competition, but GC selection is based solely on low price. High level of marketplace experience.	
Opportunities	**Obstacles**

DESIGN-BUILD Allows for a balance of price and non-price factors in the selection process. Medium level of marketplace experience.	
Opportunities	Obstacles

CM/GC Allows for the selection of the single most qualified contractor, but GMP can limit price competition. Low level of marketplace experience.	
Opportunities	Obstacles

Competition and Contractor Experience Summary

	DBB	**DB**	**CM/GC**
8. Competition and Contractor Experience		✓	

Notes and Comments:

A relatively small DB project is expected to draw much interest from the contracting community

APPENDIX

Opportunity and Obstacle Checklists

(With Project Risk Assessment Discussion and Checklists)

1) Delivery Schedule Checklist

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Schedule is more predictable and more manageable ❒ Milestones can be easier to define ❒ Projects can more easily be "shelved" ❒ Shortest procurement period ❒ Elements of design can be advanced prior to permitting, construction, etc. ❒ Time to communicate/discuss design with stakeholders	❒ Requires time to perform a linear design-bid-construction process ❒ Design and construction schedules can be unrealistic due to lack industry input ❒ Errors in design lead to change orders and schedule delays ❒ Low bid selection may lead to potential delays and other adverse outcomes.

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Potential to accelerate schedule through parallel design-build process ❒ Shifting schedule risk to DB team ❒ Encumbers construction funds more quickly ❒ Industry input into design and schedule ❒ Fewer chances for disputes between agency and design-builders ❒ More efficient procurement of long-lead items ❒ Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design) ❒ Allows innovation in resource loading and scheduling by DB team	❒ Request for proposal development and procurement can be intensive ❒ Undefined events or conditions found after procurement, but during design can impact schedule and cost ❒ Time required to define technical requirements and expectations through RFP development can be intensive ❒ Time required to gain acceptance of quality program ❒ Requires agency and stakeholder commitments to an expeditious review of design

CM/GC	
Opportunities	**Obstacles**
❒ Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design) ❒ More efficient procurement of long-lead items ❒ Early identification and resolution of design and construction issues (e.g., utility, ROW, and earthwork) ❒ Can provide a shorter procurement schedule than DB ❒ Team involvement for schedule optimization ❒ Continuous constructability review and VE ❒ Maintenance of Traffic improves with contractor inputs ❒ Contractor input for phasing, constructability and traffic control may reduce overall schedule	❒ Potential for not reaching GMP and substantially delaying schedule ❒ GMP negotiation can delay the schedule ❒ Designer-contractor-agency disagreements can add delays ❒ Strong agency management is required to control schedule

2) Project Complexity & Innovation Checklist

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❐ CDOT can have more control of design of complex projects ❐ CDOT& consultant expertise can select innovation independently of contractor abilities ❐ Opportunities for value engineering studies during design, more time for design solutions ❐ Aids in consistency and maintainability ❐ Full control in selection of design expertise ❐ Complex design can be resolved and competitively bid	❐ ❐ Innovations can add cost or time and restrain contractor's benefits ❐ No contractor input to optimize costs ❐ Limited flexibility for integrated design and construction solutions (limited to constructability) ❐ Difficult to assess construction time and cost due to innovation

DESIGN-BUILD	
Opportunities	**Obstacles**
❐ Designer and contractor collaborate to optimize means and methods and enhance innovation ❐ Opportunity for innovation through draft RFP, best value and ATC processes ❐ Can use best-value procurement to select design-builder with best qualifications ❐ Constructability and VE inherent in process ❐ Early team integration ❐ Sole point of responsibility	❐ Requires desired solutions to complex designs to be well defined through technical requirements (difficult to do) ❐ Qualitative designs are difficult to define (example. aesthetics) ❐ Risk of time or cost constraints on designer inhibiting innovation ❐ Some design solutions might be too innovative or unacceptable ❐ Quality assurance for innovative processes are difficult to define in RFP

CM/GC	
Opportunities	**Obstacles**
❐ Highly innovative process through 3 party collaboration ❐ Allows for owner control of a designer/contractor process for developing innovative solutions ❐ Allows for an independent selection of the best qualified designer and best qualified contractor ❐ VE inherent in process and enhanced constructability ❐ Risk of innovation can be better defined and minimized and allocated ❐ Can take to market for bidding as contingency	❐ Process depends on designer/CM relationship ❐ No contractual relationship between designer/CM ❐ Innovations can add cost or time ❐ Scope additions can be difficult to manage ❐ Preconstruction services fees for contractor involvement ❐ Cost competitiveness – single source negotiated GMP

3) Level of Design Checklist

DESIGN-BID-BUILD	
Opportunities	Obstacles
❒ 100% design by owner ❒ Agency has complete control over the design (can be beneficial when there is one specific solution for a project) ❒ Project/scope can be developed through design ❒ The scope of the project is well defined through complete plans and contract documents ❒ Well-known process to the industry	❒ Owner design errors can result in a higher number of change orders, claims, etc. ❒ Minimizes competitive innovation opportunities ❒ Can reduce the level of constructability since the contractor is not bought into the project until after the design is complete

DESIGN-BUILD	
Opportunities	Obstacles
❒ Design advanced by the owner to level necessary to precisely define the contract requirements and properly allocate risk ❒ Does not require much design to be completed before awarding project to the design-builder (between ~ 10% - 30% complete) ❒ Contractor involvement in early design, which improves constructability and innovation ❒ Plans do not have to be as detailed because the design-builder is bought into the project early in the process and will accept design responsibility	❒ Must have very clear definitions and requirements in the RFP because it is the basis for the contract ❒ If design is too far advanced it will limit the advantages of design-build ❒ Potential for lacking or missing scope definition if RFP not carefully developed ❒ Over utilizing performance specifications to enhance innovation can risk quality through reduced technical requirements ❒ Less agency control over the design ❒ Can create project less standardized designs across agency as a whole

CM/GC	
Opportunities	Obstacles
❒ Can utilize a lower level of design prior to selecting a contractor then collaboratively advance design with owner, designer and contractor ❒ Contractor involvement in early design improves constructability ❒ CDOT controls design ❒ Design can be used for DBB if the price is not successfully negotiated. ❒ Design can be responsive to risk minimization	❒ Teaming and communicating concerning design can cause disputes ❒ Three party process can slow progression of design ❒ If design is too far advanced it will limit the advantages of CMGC or could require design backtracking

4) Cost Checklist

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Competitive bidding provides a low cost construction to a fully defined scope of work ❒ Increase certainty about cost estimates ❒ Construction costs are contractually set before construction begins	❒ Cost accuracy is limited until design is completed ❒ Construction costs are not locked in until design is 100% complete. ❒ Cost reductions due to contractor innovation and constructability is difficult to obtain ❒ More potential of cost change orders due to owner design responsibility

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Contractor input into design should moderate cost ❒ Design-builder collaboration and ATCs can provide a cost-efficient response to project goals ❒ Costs are contractually set early in design process with design-build proposal ❒ Allows a variable scope bid to match a fixed budget ❒ Potential lower average cost growth ❒ Funding can be obligated in a very short timeframe	❒ Risks related to design-build, lump sum cost without 100% design complete, can compromise financial success of the project.

CM/GC	
Opportunities	**Obstacles**
❒ Owner/designer/contractor collaboration to reduce project risk can result in lowest project costs. ❒ Early contractor involvement can result in cost savings through VE and constructability ❒ Cost will be known earlier when compared to DBB ❒ Integrated design/construction process can provide a cost efficient strategies to project goals ❒ Can provide a cost efficient response to the project goals	❒ Non-competitive negotiated GMP introduces price risk ❒ Difficulty in GMP negotiation introduces some risk that GMP will not be successfully executed requiring aborting the CM/GC process. ❒ Paying for contractors involvement in the design phase may increase total cost

5) Initial Risk Assessment

Three sets of risk assessment checklists are provided to assist in an initial risk assessment relative to the selection of the delivery method:

A. **Typical CDOT Transportation Project Risks**
B. **General Project Risks Checklist**
C. **Opportunities/Obstacles Checklist (relative to each delivery method)**

It is important to recognize that the initial risk assessment is to only ensure the selected delivery method can properly address the project risks. A more detailed level of risk assessment should be performed concurrently with the development of the procurement documents to ensure that project risks are properly allocated, managed, and minimized through the procurement and implementation of the project.

A. TYPICAL CDOT TRANSPORTATION PROJECT RISKS

Following is a list of project risks that are frequently encountered on CDOT transportation projects and a discussion on how the risks are resolved through the different delivery methods.

A.1: Site Conditions and Investigations How unknown site conditions are resolved. For additional information on site conditions, refer to 23 CFR 635.109(a) at the following link: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=91468e48c87a547c3497a5c19d640172&rgn=div5&view=text&node=23:1.0.1.7.23&idno=23#23:1.0.1.7.23.1.1.9)

DESIGN-BID-BUILD
Site condition risks are generally best identified and mitigated during the design process prior to procurement to minimize the potential for change orders and claims when the schedule allows.

DESIGN-BUILD
Certain site condition responsibilities can be allocated to the design-builder provided they are well defined and associated third party approval processes are well defined. Caution should be used as unreasonable allocation of site condition risk will result in high contingencies during bidding. CDOT should perform site investigations in advance of procurement to define conditions and avoid duplication of effort by proposers. At a minimum CDOT should perform the following investigations: 1) Basic design surveys 2) Hazardous materials investigations to characterize the nature of soil and groundwater contamination 3) Geotechnical baseline report to allow design-builders to perform proposal design without extensive additional geotechnical investigations

CM/GC
CDOT, the designer, and the contractor can collectively assess site condition risks, identify the need to perform site investigations in order to reduce risks, and properly allocate risk prior to GMP.

A.2: Utilities

DESIGN-BID-BUILD

Utility risks are best allocated to CDOT, and mostly addressed prior to procurement to minimize potential for claims when the schedule allows.

DESIGN-BUILD

Utilities responsibilities need to be clearly defined in contract requirements, and appropriately allocated to both design-builder and CDOT:

Private utilities (major electrical, gas, communication transmission facilities): Need to define coordination and schedule risks as they are difficult for design-builder to price. Best to have utilities agreements before procurement. Note – by state regulation private utilities have schedule liability in design-build projects, but they need to be made aware of their responsibilities.

Public Utilities: Design and construction risks can be allocated to the design-builder, if properly incorporated into the contract requirements.

CM/GC

Can utilize a lower level of design prior to contracting and joint collaboration of CDOT, designer, and contractor in the further development of the design.

A.3: Railroads (if applicable)

DESIGN-BID-BUILD

Railroad risks are best resolved prior to procurement and relocation designs included in the project requirements when the schedule allows.

DESIGN-BUILD

Railroad coordination and schedule risks should be well understood to be properly allocated and are often best assumed by CDOT. Railroad design risks can be allocated to the designer if well defined. Best to obtain an agreement with railroad defining responsibilities prior to procurement

CM/GC

Railroad impacts and processes can be resolved collaboratively by CDOT, designer, and contractor. A lengthy resolution process can delay the GMP negotiations.

A.4: Drainage/Water Quality Best Management Practices (construction and permanent)

Both drainage and water quality often involve third party coordination that needs to be carefully assessed with regard to risk allocation. Water quality in particular is not currently well defined, complicating the development of technical requirements for projects.
Important questions to assess:

1) Do criteria exist for compatibility with third party offsite system (such as an OSP (Outfall System Plan))?
2) Is there an existing cross-drainage undersized by CDOT Criteria?
3) Can water quality requirements be precisely defined? Is right-of-way adequate?

DESIGN-BID-BUILD
Drainage and water quality risks are best designed prior to procurement to minimize potential for claims when the schedule allows.

DESIGN-BUILD
Generally, CDOT is in the best position to manage the risks associated with third party approvals regarding compatibility with offsite systems, and should pursue agreements to define requirements for the design-builder.

CM/GC
CDOT, the designer, and the contractor can collectively assess drainage risks and coordination and approval requirements, and minimize and define requirements and allocate risks prior to GMP.

A.5: Environmental: Meeting environmental document commitments, (noise, 4(f) and historic, wetlands, endangered species, etc.)

DESIGN-BID-BUILD
Risk is best mitigated through design prior to procurement when the schedule allows.

DESIGN-BUILD
Certain environmental approvals and processes that can be fully defined can be allocated to the design-builder. Agreements or MOUs with approval agencies prior to procurement is best to minimize risks.

CM/GC
Environmental risks and responsibilities can be collectively identified, minimized, and allocated by CDOT, the designer, and the contractor prior to GMP

A.6: Third Party Involvement: Timeliness and impact of third party involvement (funding partners, adjacent municipalities, adjacent property owners, project stakeholders, FHWA, PUC)

DESIGN-BID-BUILD
Third party risk is best mitigated through design process prior to procurement to minimize potential for change orders and claims when the schedule allows.

DESIGN-BUILD
Third party approvals and processes that can be fully defined can be allocated to the design-builder. Agreements or MOUs with approval agencies prior to procurement is best to minimize risks.

CM/GC
Third party approvals can be resolved collaboratively by CDOT, designer, and contractor.

B. GENERAL PROJECT RISK CHECKLIST (items to consider when assessing risk)

Environmental Risks	External Risks
❒ Delay in review of environmental documentation ❒ Challenge in appropriate environmental documentation ❒ Defined and non-defined hazardous waste ❒ Environmental regulation changes ❒ Environmental impact statement (EIS) required ❒ NEPA/ 404 Merger Process required ❒ Environmental analysis on new alignments required	❒ Stakeholders request late changes ❒ Influential stakeholders request additional needs to serve their own commercial purposes ❒ Local communities pose objections ❒ Community relations ❒ Conformance with regulations/guidelines/ design criteria ❒ Intergovernmental agreements and jurisdiction
Third-Party Risks	**Geotechnical and Hazmat Risks**
❒ Unforeseen delays due to utility owner and third-party ❒ Encounter unexpected utilities during construction ❒ Cost sharing with utilities not as planned ❒ Utility integration with project not as planned ❒ Third-party delays during construction ❒ Coordination with other projects ❒ Coordination with other government agencies	❒ Unexpected geotechnical issues ❒ Surveys late and/or in error ❒ Hazardous waste site analysis incomplete or in error ❒ Inadequate geotechnical investigations ❒ Adverse groundwater conditions ❒ Other general geotechnical risks
Right-of-Way/ Real Estate Risks	**Design Risks**
❒ Railroad involvement ❒ Objections to ROW appraisal take more time and/or money ❒ Excessive relocation or demolition ❒ Acquisition ROW problems ❒ Difficult or additional condemnation ❒ Accelerating pace of development in project corridor ❒ Additional ROW purchase due to alignment change	❒ Design is incomplete/ Design exceptions ❒ Scope definition is poor or incomplete ❒ Project purpose and need are poorly defined ❒ Communication breakdown with project team ❒ Pressure to delivery project on an accelerated schedule ❒ Constructability of design issues ❒ Project complexity (scope, schedule, objectives, cost, and deliverables are not clearly understood)
Organizational Risks	**Construction Risks**
❒ Inexperienced staff assigned ❒ Losing critical staff at crucial point of the project ❒ Functional units not available or overloaded ❒ No control over staff priorities ❒ Lack of coordination/ communication ❒ Local agency issues ❒ Internal red tape causes delay getting approvals, decisions ❒ Too many projects/ new priority project inserted into program	❒ Pressure to delivery project on an accelerated schedule. ❒ Inaccurate contract time estimates ❒ Construction QC/QA issues ❒ Unclear contract documents ❒ Problem with construction sequencing/ staging/ phasing ❒ Maintenance of Traffic/ Work Zone Traffic Control

C. RISK OPPORTUNITIES/OBSTACLES CHECKLIST (relative to each delivery method)

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Risks managed separately through design, bid, build is expected easier ❒ Risk allocation is most widely understood/used ❒ Opportunity to avoid or mitigate risk through complete design ❒ Risks related to environmental, railroads, and third party involvement are best resolved prior to procurement ❒ Utilities and ROW best allocated to CDOT and mostly addressed prior to procurement to minimize potential for claim ❒ Project can be shelved while resolving risks	❒ Owner accepts risks associated with project complexity (the inability of designer to be all-knowing about construction) and project unknowns ❒ Low-bid related risks ❒ Potential for misplaced risk through prescriptive specifications ❒ Innovative risk allocation is difficult to obtain ❒ Limited industry input in contract risk allocation ❒ Change order risks can be greater ❒ Contractor may avoid risks

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Performance specifications can allow for alternative risk allocations to the design builder ❒ Risk-reward structure can be better defined ❒ Innovative opportunities to allocate risks to different parties (e.g., schedule, means and methods, phasing) ❒ Opportunity for industry review of risk allocation (draft RFP, ATC processes) ❒ Avoid low-bid risk in procurement ❒ Contractor will help identify risks related to environmental, railroads, ROW, and utilities ❒ Designers and contractors can work toward innovative solutions to, or avoidance of, unknowns	❒ Need a detailed project scope, description etc., for the RFP to get accurate/comprehensive responses to the RFP (Increased RFP costs may limit bidders) ❒ Limited time to resolve risks ❒ Additional risks allocated to designers for errors and omissions, claims for change orders ❒ Unknowns and associated risks need to be carefully allocated through a well-defined scope and contract ❒ Risks associated with agreements when design is not completed ❒ Poorly defined risks are expensive ❒ Contractor may avoid risks or drive consultant to decrease cost at risk to quality

CM/GC	
Opportunities	**Obstacles**
❒ Contractor can have a better understanding of the unknown conditions as design progresses ❒ Innovative opportunities to allocate risks to different parties (e.g., schedule, means and methods, phasing) ❒ Opportunities to manage costs risks through CM/GC involvement ❒ Contractor will help identify and manage risk ❒ Agency still has considerable involvement with third parties to deal with risks ❒ Avoids low-bid risk in procurement ❒ More flexibility and innovation available to deal with unknowns early in design process	❒ Lack of motivation to manage small quantity costs ❒ Increase costs for non-proposal items ❒ Disagreement among Designer-Contractor-Owner can put the process at risk ❒ If GMP cannot be reached, additional low-bid risks appear ❒ Limited to risk capabilities of CM/GC ❒ Designer-contractor-agency disagreements can add delays ❒ Strong agency management is required to negotiate/optimize risks ❒ Discovery of unknown conditions can drive up GMP, which can be compounded in phased construction

6) Staff Experience/Availability Checklist

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Agency, contractors and consultants have high level of experience with the traditional system ❒ Designers can be more interchangeable between projects	❒ Can require a high level of agency staffing of technical resources ❒ Staff's responsibilities are spread out over a longer design period ❒ Can require staff to have full breadth of technical expertise

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Less agency staff required due to the sole source nature of DB ❒ Opportunity to grow agency staff by learning a new process	❒ Limitation of availability of staff with skills, knowledge and personality to manage DB projects ❒ Existing staff may need additional training to address their changing roles ❒ Need to "mass" agency management and technical resources at critical points in process (i.e., RFP development, design reviews, etc.)

CM/GC	
Opportunities	**Obstacles**
❒ Agency can improve efficiencies by having more project managers on staff rather than specialized experts ❒ Smaller number of technical staff required through use of consultant designer	❒ Strong committed owner project management is important to success ❒ Limitation of availability of staff with skills, knowledge and personality to manage CMGC projects ❒ Existing staff may need additional training to address their changing roles ❒ Agency must learn how to negotiate GMP projects

7) Level of Oversight and Control Checklist

DESIGN-BID-BUILD	
Opportunities	Obstacles
❒ Full owner control over a linear design and construction process ❒ Oversight roles are well understood ❒ Contract documents are typically completed in a single package before construction begins ❒ Multiple checking points through three linear phases: design-bid-build ❒ Maximum control over design	❒ Requires a high-level of oversight ❒ Increased likelihood of claims due to owner design responsibility ❒ Limited control over an integrated design/construction process

DESIGN-BUILD	
Opportunities	Obstacles
❒ A single entity responsibility during project design and construction ❒ Continuous execution of design and build ❒ Getting input from construction to enhance constructability and innovation ❒ Overall project planning and scheduling is established by one entity	❒ Can require high level of design oversight ❒ Can require high level of quality assurance oversight ❒ Limitation on staff with DB oversight experience ❒ Less owner control over design ❒ Control over design relies on proper development of technical requirements

CM/GC	
Opportunities	Obstacles
❒ Preconstruction services are provided by the construction manager ❒ Getting input from construction to enhance constructability and innovation ❒ Provides owner control over an integrated design/construction process	❒ Agency must have experienced staff to oversee the CM/GC ❒ Higher level of cost oversight required

8) **Competition and Contractor Experience**

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❐ Promotes high level of competition in the marketplace ❐ Opens construction to all reasonably qualified bidders ❐ Transparency and fairness ❐ Reduced chance of corruption and collusion ❐ Contractors are familiar with DBB process	❐ Risks associated with selecting the low bid (the best contractor is not necessary selected) ❐ No contractor input into the process ❐ Limited ability to select contractor based on qualifications

DESIGN-BUILD	
Opportunities	**Obstacles**
❐ Allows for a balance of qualifications and cost in design-builder procurement ❐ Two-phase process can promote strong teaming to obtain “Best Value” ❐ Increased opportunity for innovation possibilities due to the diverse project team	❐ Need for DB qualifications can limit competition ❐ Lack of competition with past experience with the project delivery method ❐ Reliant on DB team selected for the project ❐ The gap between owner experience and contractor experience with delivery method can create conflict

CM/GC	
Opportunities	**Obstacles**
❐ Allows for qualifications based contractor procurement ❐ Agency has control over an independent selection of best qualified designer and contractor ❐ Contractor is part of the project team early on, creating a project “team” ❐ Increased opportunity for innovation due to the diversity of the project team	❐ Currently there is not a large pool of contractors with experience in CMGC, which will reduce the competition and availability ❐ Working with only one contractor to develop GMP can limit price competition ❐ Requires a strong project manager from the agency ❐ Teamwork and communication among the project team

US 6 over Garrison Goals and Risk List

1. **CORE VALUES AND PURPOSE**

The purpose of the US 6 over Garrison Street project is to replace a poor bridge structure within the Bridge Enterprise completion schedule while maintaining full serviceability of US 6, providing access to local businesses, correcting horizontal curve deficiencies on US 6, providing a safe work environment and safe travel for the public. Key elements include:

- *Safety*
- *Mobility*
- *Budget*
- *Schedule*

2. **GOALS AND GOAL CATEGORIES**

7. SCHEDULE and BUDGET
   a. Meet the BE project schedule and budget to have the project constructed by the end of December 2015 for $12 million without sacrificing quality.

8. PUBLIC COMMUNICATION
   a. Provide accurate, meaningful, and timely communication.

9. SAFETY, MOBILITY, AND OPERATIONAL CHARACTERISTICS
   a. Improve safety, mobility, and operational characteristics in the project limits.

10. ENVIRONMENTAL
    a. Adhere to all environmental compliance requirements, including those documented in US 6 and Wadsworth EA/ROD commitments as modified for this project.

11. QUALITY
    a. Design and construct a quality project that is consistent with the overall vision and commitments approved by the EA.
    `

12. CONSTRUCTION
    a. Maintain mobility through the project during construction.
    b. Provide safe conditions for workers and the traveling public.
    c. Look for innovative methods to reduce construction time and cost.

3. **Risk List**

Generic List of Uncertainties, Risks and Opportunities

As shown, the items on this list do not form a formal risk register (i.e., this is not a comprehensive list of items for any particular project, and the listed items are *not* non-overlapping). The list is only intended to serve as a supplemental "checklist" to identify items missed during brainstorming. Identified items then need to be redefined/recast to ensure a comprehensive, non-overlapping set of events in the risk register (adequately considering relationships among items in the list, if any).

Some items shown are really "base uncertainty" (i.e., uncertainty within the base project/estimate assumptions), while the remainder are truly risk and opportunity events (i.e., uncertain conditions and events outside the base assumptions).

GREEN – LOW
YELLOW – MEDIUM
RED – HIGH RISK

Uncertainty in "Soft" Costs and / or Schedule (other than identified through other items, and *excluding additional costs that result from project delays*, which are accumulated directly and additionally through simulation). Fundamental question: Is the base estimate for each in terms of a percentage of construction cost? or a detailed line-item estimate?

- Design completion
- PS&E completion
- Spending draw down for BE porjects
- Administration costs (owner)
- Oversight costs (regulator)
- Construction management and construction inspection (CEI)
- Project management
- Design support during construction / construction engineering
- Mobilization
- Surety capacity and bonding
- Annual inflation rates (construction, right-of-way, engineering, other)
- Unable to reach CAP

Construction and Constructability

- Additional pavement resurfacing
- Additional geometry re-alignment
- Uncertainty in construction unit costs
- Uncertainty in construction quantities
- Inadequate staging areas identified for construction
- Dewatering issues during construction
- Issues related to bridge foundation
- Issues related to other construction procedures
- Problems with or uncertainty in construction sequencing / staging / phasing / construction duration
- Maintenance of Traffic / Work Zone Traffic Control Issues
    - Access to work area
    - Issues related to detours
- Uncertainty in structure demolition sequence and method
- Force Majeure during construction (earthquake, tornado, etc.)
- Safety issues
- Material reuse, removal, restoration
- Material, labor, and/or equipment procurement delays
- Condition of existing structures (repair required?)
- Accidents/incidents during construction (traffic/collapse/slope failure/vandalism)
- Critical equipment failure
- Other difficult or specialized construction issues
- Tie-ins with existing facilities/roadways/structures/local access
- Failure prior to replacement (e.g., bridges)
- Utility conflicts (anticipated or unanticipated)
- Work-window restrictions
- Other third-party delays during construction
- Schedule risks
- Public Information and Public Relations Outreach

Design

- Uncertainty in, or risk or opportunity related to, the “base” design elements (e.g., due to early design, project definition, or development), including type, size, and location (TS&L) and unit prices and quantities. Consider related impacts to design, ROW, environmental documentation, permitting, utilities, and construction. Consider relationships to other issues in this list (conditionality/correlation). Example items include:
    - horizontal alignment (e.g., geometry / grade)
    - vertical alignment
    - bridges

  - walls
  - earthwork
  - stormwater collection and treatment
  - paving
  - right-of-way (e.g., full vs. partial takes; uncertain parcels/quantities)
  - maintenance of traffic / traffic control
  - Traffic Demand Management (TDM) / Intelligent Traffic Systems (ITS)
  - construction staging/phasing
  - electrical (systems, signals, illumination)
- Design errors and omissions or errors in plans/specs/estimates (discovered during construction)
- Changes in design standards (e.g., increased seismic criteria for structures)
- Design deviations (e.g., design speeds, vertical clearances, turn radii)
- Additional aesthetics requests from local agency
- Allowances for miscellaneous items (known pay items not yet itemized in the estimate)

Environmental

- Uncertainty related to changes in design, ROW, or other circumstances and the subsequent need for re-evaluated environmental documentation.
- Delay in review and/or approval of environmental documentation
- Supplemental environmental documentation or Re-evaluation required that is time consuming
- Additional mitigation required, on- or off-site (e.g. solid waste disposal, wetlands, hazardous materials disposal)
- Noise mitigation trigger when correcting the sag in the horizontal curve
- Uncertain stormwater treatment standards or quantities
- Uncertain stormwater discharge criteria (e.g., Receiving body exemptions)
- Uncertain groundwater treatment standards or quantities
- Additional noise mitigation required (permit for night work)
- Unanticipated Section 106 issues (archaeological, cultural, or historical finds)
- Other Regulatory/Permitting Issues (CDPHE fugitive dust, CDPHE solid waste disposal, CDPHE groundwater disposal, CDPHE hazardous materials, etc.)

External Influences (e.g., Political, Regulatory, Municipalities, Economic)

- Difficulty obtaining other agency approvals/agreements (Municipalities)
- Conflicts with other projects (Municipalities, Counties)
- Coordination with other entities (e.g., Railroads)
- Funding shortfall (and related delay or increased financing cost)
- Legal challenges (other than environmental)
- Intergovernmental agreements and jurisdiction
- Labor issues (contract negotiations/strike)
- Claims related to clarity of bid and contract documents (other than captured elsewhere)
- Program Management / executive oversight issues
- Project management issues / workload management
- Cash flow constraints

Geotechnical and Structural

- Uncertainty in bridges or culverts (including type/size/location (TS&L) – foundations and superstructure)
- Uncertainty in retaining walls (including type, length, height – foundations and superstructure)
- Poor ground/subsurface conditions
- Adverse groundwater conditions
- Slope stability issues
- Compatibility of new structures when placed adjacent to existing structures

Permitting

- Difficulty obtaining permit approval (by permit type; e.g., 401, 404, NPDES, USCG, shoreline)
- Uncertain permit requirements (current and in the future)
- Air quality permitting issues
- Noise evaluation

Project Delivery and Procurement

- Project delivery method (D/B, D/B/B, CM/GC, PPP), including new or unique method to owner
- Construction market conditions (cyclic market, and location within cycle at time of bid; number of viable bidders), including the potential for delay to the procurement process and/or re-bidding
- Bid protests
- Unclear contract documents (identified during either procurement or later during construction)
- Other delays to procurement process
- Owner approach to specifications (e.g., prescriptive versus performance-based)

Right-of-Way / Real Estate

- Global Right of Way (ROW) problems (for widening, drainage, pipelines, detention, staging, etc.)
- Difficult or additional condemnation (either globally or for particular parcels)
- Additional relocation required (either globally or for particular parcels – business vs. residential)
- Additional demolition required (including unanticipated remediation) (either globally or for particular parcels)
- Manpower shortages
- Process delays (e.g., ROW plan development by team; plan approval process)

Scope Issues (other than identified through other items elsewhere in this list, such as design)

- Additional capacity required (e.g., lanes, shoulders)
- Additional local improvements required (e.g., additional paving or signals on local connections)
- Other additional structures required (e.g.,water quality ponds)
- Scope reduction opportunity / Value Engineering)
- Note on scope changes: scope changes can occur during design and/or construction, and can be due to:
  - Incomplete design
  - Stakeholder influences leading to additional scope (e.g., aesthetics; political pressure)
  - Errors in design
  - Construction problems
  - Regulatory changes

Traffic and Access Issues

- Uncertainty in Traffic Management Costs (ITS, TDM)
- Access to site during construction
- Business or economic disruption mitigation

Utilities Issues

- Utility relocations to be completed by others (Utility companies, municipalities) are not completed on time
- Encounter unexpected utilities during construction
- Utility integration with project and/or utility betterments not as planned
- Cost sharing with utilities not as planned