CMGC Process Report – Design Phase
Summit Park Bridge - DRAFT

Project No. F-I80-4(118)141
PIN: 6593, 8748

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For

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Purpose

This report gives a description of the design phase of F-I80-4(118)141, the Summit Park Bridge project, located in Summit County, Utah. The report is intended to fulfill the Design Phase requirements outlined in the updated Memorandum of Understanding (MOU) between the Utah Department of Transportation (UDOT) and the Federal Highway Administration (FHWA) for Alternative Contracting Process – SEP 14; Construction Manager / General Contractor (CMGC) dated January 20, 2010. The CMGC Design Phase report provides the following information:

- A discussion of how acquiring the services of a contractor during the design phase assisted the team and improved constructability and quality.
- A discussion of the selection process of the Contractor in the design phase.
- A detailed comparison of the UDOT prepared ICE and the negotiated price for construction.
- A discussion of each of the evaluation criteria.

The MOU identifies the Evaluation Criteria to be used when assessing the contractor's involvement in the design phase as follows:

- Design and Constructability
- Innovation
- Project Schedule
- Risk
- Learning opportunities
- Environmental Stewardship
- Benefit to the Public

The MOU states that "all seven criteria do not need to be considered," thus this report only focuses on the criteria most relevant the project. Furthermore, the UDOT has outlined additional information that is required in this report for internal evaluation. This information includes a comparison of schedule, cost performance and observations of those involved concerning the successes and difficulties associated with the CMGC process.

Project Overview

The RFP for Project F-I80-4(118)141; I-80; Summit Park Bridge described the project as follows:

> The purpose of this project is to remove and replace the structurally deficient bridge decks carrying I-80 eastbound and westbound over Aspen Drive near Summit Park with minimal disruption to traffic. Minor roadway work will be required to tie back into the new bridge decks. Short detours are not available for this location and impacts to traffic are a significant consideration for this project.
>
> The existing 175-foot long bridges at this location are three-span continuous, pre-stressed concrete AASHTO type III girders with composite reinforced concrete decks. Both bridges are a constant 60'-4" wide and have varying super-elevations. The clear distance between the two structures is a constant 45"-4". The project may be best served by providing complete bridge replacements rather than deck replacements only. The CMGC process is being used by UDOT to design a project that maximizes value at this location.

Table 1 summarizes the project information for the yearend report that will be provided to the Federal Highway Administration:

TABLE 1 – Project Overview Information Summary

Project Type:	Bridge
Project Number:	F-I80-4(140)141, F-I80-4(118)141
PIN:	6593, 8748
Funding Source:	Federal

Design costs

For the Independent Cost Estimation (ICE), UDOT contracted with PBS & J. UDOT conducted the design of the superstructure in-house, using a sub-consultant (Baker) to verify information on site, design temporary and permanent bridge support structures, and some roadway design work.

UDOT contracted with Ralph L. Wadsworth to provide design services listed in the RFP including:

- Perform constructability reviews of the design; and,
- Provide assistance in shaping the project scope to be within the available budget; and,
- Provide assistance to improve the project schedule; and,
- Perform design reviews to ensure that each package is complete, and without ambiguity; and,
- Finding and identifying design errors.

Table 2 below shows the breakdown of design costs for the project and the fee paid to Ralph L. Wadsworth for the aforementioned services:

Table 2 – Design Fee Breakdown

Preliminary Engineering Fee	$ 786,917.00
CMGC Design Fee	$ 108,865.00
ICE Preparer's Fee	$ 66,000.00
Total Design Costs	$ 961,782.00
CMGC fee as a Percent of Total Design Costs:	11%

Construction Costs

UDOT contracted with Ralph L. Wadsworth to provide construction services under the CMGC process for $6,676,103.08. This award was divided between two construction packages. The first award was for $1,216,400.00, and pertained to the early procurement of structural steel. The second package was awarded for $5,459,703.08, and pertained to all other construction on the project.

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Project Goals

The RFP stated that the project was expected to remain consistent with overall Department priorities including:

- Get a Good Price
- Encourage Innovation
- Accelerate Delivery
- Decrease and Minimize MOT

In addition to meeting these overarching priorities, UDOT determined that success on the Summit Park Bridge project required a balance of the following goals:

- Minimization of delays and impacts to the traveling public through an optimal construction scenario. This scenario will include accelerated bridge construction techniques that reduce impacts to the traveling public. The most appropriate scenario will balance construction dollars with user costs associated with delays.
- Maintenance of public safety, trust, and confidence. Establish open, timely, and accurate communication through an effective and engaging public information campaign aimed at all stakeholders.
- Cultivation of a professional and collaborative Project Team with the owner, UDOT Designer, and Contractor.

Key project elements affect the balance of these goals including overall constructability, project construction phasing, and impacts to motorists. UDOT recognized that achieving balance of the project goals required that the Contractor work closely with the design team during the design phase. There were several sensitive issues on this project that added to the complexity of the design, including the following:

- Geotechnical issues related to Accelerated Bridge Construction (ABC) methods.
- Schedule issues such as local events and a required construction duration of one construction season.
- Maintenance of Traffic issues such as the requirement to provide 3 lanes of traffic in both directions for most hours of the day, and two lanes of traffic at all other times.

The majority of the selection process involved determining which proposer could best meet these project goals for a reasonable price. To help make this determination the RFP required each proposer to submit a technical proposal, as well as a price proposal.

Selection Committee Members

Proposals were scored and evaluated by a selection committee comprised of the members shown in tables 3 and 4.

TABLE 3 – CMGC Oversight Committee

Name	Title	Organization/Firm
Cory Pope	Region Director	UDOT Region 2
Randy Park	Project Development Director	UDOT Project Development
Ahmad Jaber	Systems Planning & Programming Director	UDOT Systems Planning & Programming

TABLE 4 – Selection Committee Members

Name	Title	Organization/Firm
Ritchie Taylor	Project Manager	UDOT Region 2
Lisa Baird	Traffic Engineer	UDOT Region 2
Joshua Sletten	Structures Engineer	UDOT Structures
Rudy Alder	Innovative Contracting Engineer	UDOT Project Development
Kris Peterson	Construction Engineer	UDOT Project Development
Michael Lasko	Vice President	ACEC (CH2M HILL)
Tim Muller	Southwest Regional Manager	AGC (Austin Bridge and Road LP)

Evaluation/Selection Criteria

The contractors were compared on the following criteria, which were scored individually as outlined below. The Request for Proposals required that each participant provide required information for the selection criteria so that the panel could compare the proposals on an equal basis. The selection criteria included:

- Project Team/Capability of the Contractor
- Project Approach
- Project Innovations
- CMGC Design Process

- Interviews

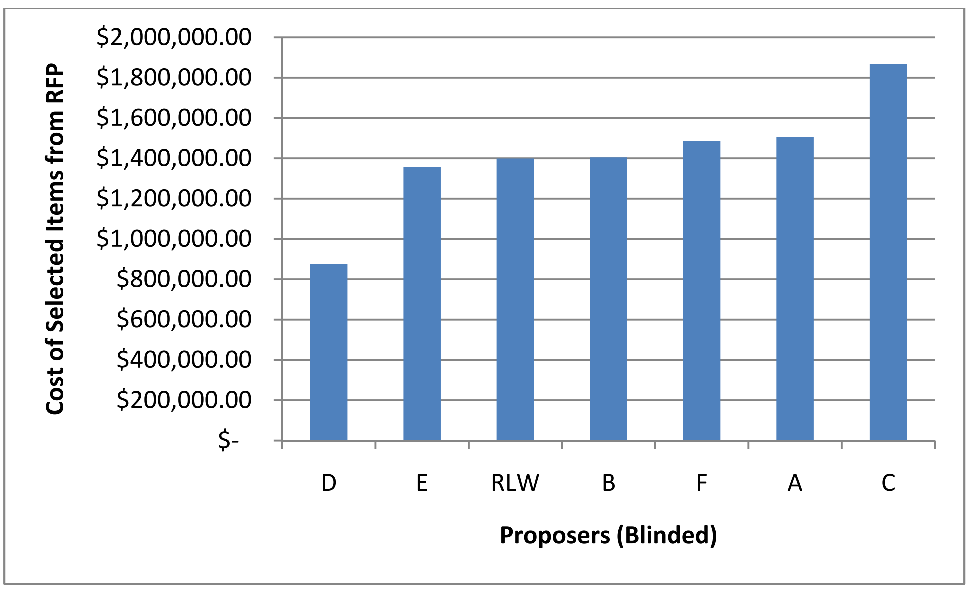
Ultimately, Ralph L. Wadsworth scored the highest on its technical proposal, and was selected to participate in the CMGC process. Wadsworth's technical proposal provided 7 construction options, and recommended the best option; offered a full structure replacement; offered no I-80 full closures; provided detailed cost modeling; contained an insightful discussion of the approach to price; designated a CMGC design coordinator who was familiar with the delivery method; listed an excellent history of past innovations.

In addition to these technical criteria, the team also scored proposers based on the following two price criteria:

- Contractor Price Submittal
- Approach to Price Proposal

Further information on the pricing criteria for selection is found in the "Price Component" section of this report. Although Ralph L. Wadsworth's proposal was not the lowest priced, their price was below the average price of all proposers and they offered a lower life cycle cost than the low price deck replacement proposals.

Figure 1 – Comparison of Pricing Proposals



Price Component

The project team identified key materials and project elements that had the greatest influence on the overall project price. The RFP listed these items, and provided estimated quantities for them. Proposers were then asked to provide a unit price for these items. The RFP stated," Prices you propose for bid items in Appendix D will be compared to prices for the same bid items in the [final bid]. They are expected to be the same unless the team has identified a clear justification for change." Table 5 below shows the winning proposer's prices for these key bid items, the state average prices (one year prior to the proposal) and the final unit price agreed upon at bid opening.

TABLE 5 – Bid Items Included in Contractor's Price Submittal Section of RFP

Description	Est. Quantity (Provided in RFP)	Unit	Winning Proposal Unit Price	2008 State Ave. Price	Awarded Bid Unit Price
Structural Concrete	500	cu yd	$562.00	$415.54	$485.30
Precast Deck Panels	21000	sq ft	$46.00	$48.55	Not Used in Design
Bridge Demo	1	Lump	$152,500.00	$148,520.41	$121,100.00

The prices from the winning proposal were compared to state averages. This preliminary comparison of the cost proposal suggested that the contractor would be providing prices slightly above the state average prices. The one item that was significantly higher than the state average price was structural concrete which was 35% higher than the state average at the time of selection. However, at bid opening the unit price charged was less than that provided during the proposal stage. This lowering of the unit price was due to the continued reduction of unit costs statewide for structural concrete. The final bid price of structural concrete was 24% higher than the state average at the time of award ($391.65 per cu-yd).

While the comparison to state averages showed the winning proposal offered high prices, a comparison of the proposal prices to the final awarded prices shows the cost of these particular bid items was reduced through the CMGC process. The contractor's final bid for Bridge Demo was $31,400 less than their proposal price, and their final unit price for Structural Concrete was $76.70 less than the unit price they included in their proposal. Precast Deck Panels were not included in the final design.

Cost Model

The team maintained a real-time estimate of the project cost throughout the design process by continuously gathering pricing information from the contractor. This information took different forms during different stages of the design. Table 6 shows what information was used to develop the cost model at each stage in the design.

TABLE 6 – Cost Models at Each Design Stage

Design Stage	Cost Model	Basis for Pricing Information
Proposal	Price Proposal	Preliminary List of Bid Items Uncertainties Assumed Quantities
Early Design *(30%-60%)*	Cost Estimate	Expanded List of Bid Items Estimated Quantities VE Alternatives Identified Risks Risk Mitigation Strategies
Late Design *(90%)*	Blind Bid Opening	Complete List of Bid Items Certain Quantities Anticipated Production Rates and Indirect Costs
Final Bid Package	Formal Bid	Guaranteed Contract Amount

When issuing the RFP for the Summit Park project, the Department asked proposers to submit a Technical Proposal, as well as a Price Proposal. The RFP specified key construction activities, and materials that proposers were required to bid on. In addition to bid prices, proposers were also asked to specify possible innovations, risks, and risk mitigations that would affect their prices. The winning contractor's Price Proposal then served as the earliest cost model.

Based on the Price Proposal of the winning proposer, the design team set about to verify assumptions, eliminate uncertainties, and produce Value Engineering (VE) alternatives. The team investigated specific risk items to ensure that the proper amount of funding was held in contingency. Risks that could not be mitigated, or eliminated were incorporated directly into updated cost estimates. Likewise, the contractor provided revised cost estimates as viable VE alternatives were included in the design. In addition to the direct measures that the team took to control costs, some uncertainty naturally abated as design progressed and bid item quantities became better defined.

Once the design was nearly complete the running cost estimate was replaced with a preliminary bid. The preliminary bid was referred to as the "Blind" bid because the team held an early bid opening in which the contractor's prices were compared to an Independent Cost Estimate (ICE). Both the ICE and the contractor based their bid prices on quantities established in the Engineer's Estimate (EE) and included production rates and current market conditions. The actual ICE prices were not revealed during this comparison; instead the contractor was simply shown whether or not each bid item price was within 10% of the ICE, or more than 10% above the ICE.

This "Blind" bid comparison served to verify that the cost model had not deviated from early price expectations, and to ensure that the project was on pace to meet its pricing goal. Any bid items that showed a significant discrepancy between the contractor and the independent estimate were discussed before proceeding to the final bid. As a result of these discussions, any remaining uncertainties were addressed before releasing the final bid package. For further information concerning the price influence from the Blind Bid opening process please see the “Analysis of Performance” section below.

The Final Bid was the ultimate means of determining if the project had met its pricing goal. For detailed information concerning each cost model refer to the Risk, Innovation, and Performance Measures sections of this report.

Design and Constructability

To assess the contribution that the contractor made to the design process the Department conducted a project debriefing meeting with the design team. A synopsis of this meeting can be found in Appendix A. The explicit scope of construction stated in the RFP was to remove and replace the bridge decks, provide repairs to other deteriorating components of the bridge, and provide traffic control through the project limits. The challenge during design was to determine construction methods that would meet those goals with minimum complexity. The team considered many construction scenarios, ranging from a partial-depth deck replacement, to a complete bridge replacement. The contractor was instrumental in determining the construction scenario that provided an optimal balance of construction cost and traffic delays.

The contractor proposed building entirely new structures and sliding them into place. The bridge slide option offered a greatly reduced impact to traffic over replacing the deck with full-depth, or partial-depth panels. Reduced MOT costs could then be used to furnish additional built elements, such as new approach slabs. Replacing the entire structures would also eliminate complications potentially arising from the need to replace deficient bridge components as they are discovered. Additional benefits of the full bridge replacement included the added durability of the new single-span structure over the existing multi-span structures, and the overall widening of structures. Future plans for I-80 include the addition of a climbing lane. Replacing only the decks would have required the bridge to be retrofitted when the climbing lane is installed.

Because the contractor had performed similar bridge moves in the past they were able to review designs in progress and specify additional details that were needed in order to build the project efficiently. This was especially true concerning rideability issues. Based on their previous experience, the contractor was able to suggest a number of design improvements that will enhance ride quality, such as:

- Extending the transition to the approach slabs; and,
- Conducting enhanced surveys; and,
- Use steel girders which deflect more predictably than concrete girders; and,
- Casting the deck monolithically with the approach slabs; and
- Adjusting the MOT window to allow time for activities like rotomilling.

The contractor's experience also helped determine the best type of bridge installation. The basic options included either a single slide, or multiple slides. Although the contractor's original proposal suggested multiple slides, they worked with the Department to facilitate a single slide option by identifying an MOT plan that would maintain traffic on I-80 during the bridge installation. The single-slide option allowed for a superior design by eliminating the need for a longitudinal joint and by enabling many of the rideability enhancements mentioned above.

Overall, the team worked together to develop a unique approach to building the new Summit Park bridge. This approach involved many of the project enhancements mentioned above, as well as many other innovations, and risk-control measures. The following section gives a detailed account of the cost, and time savings produced by a number of innovations, and risk mitigations.

Innovation Used

To take full advantage of the contractor's expertise the team held a value engineering workshop during the project kickoff, and continued to track proposed innovations throughout the design process. An innovation matrix recorded proposed innovations, estimated savings, and important technical details. Because of this formal Value Engineering procedure and tracking process the team was able to estimate a total project savings of $1,296,000 due to innovations. In addition, the team estimated that the project saved an entire year in construction time. The following section describes a number of key innovations that contributed to the overall savings estimate.

TABLE 7 – Innovation Savings

Innovation	Technical Details	Savings	
		Cost	Time
Early Steel Procurement	Obtained Structural Steel at a Lower Rate	$66,000	1 Year
Improved Ride Quality	Enhanced Surveys Steel Girders with More Predictable Deflections Precast Stem Wall to Eliminate Excessive Approach Slab Settlement	$80,000	
Single Slide Installation	Monolithic Casting Eliminated Longitudinal Joint	$35,000	14 Days
Use of Micro Piles	Replace more Expensive H-Piles	$115,000	2 Days
Widened Structure	Accommodates Future Climbing Lane	$1,000,000	
	Total	**$1,296,000**	**> 1 Year**

CMGC enabled the team to prepare a contract for the early procurement of long lead-time items, like structural steel. This ensured that the materials would be on hand by the time the construction package was complete. Having the materials on hand made it possible to begin construction as soon as the contractor received their Notice to Proceed (NTP). Under traditional project delivery methods the contractor would not be able to order the structural steel until they received NTP. The team estimated that arranging to have the materials available by the NTP date saved the project an entire construction season, which means they will be able to deliver the project an full year sooner than they could have under another delivery method.

In addition to the time savings, the team also saved the project $66,000 by procuring structural steel for significantly less than the going price at the time that the construction contract was awarded. The $66,000 figure is based on the difference in the unit price of steel at the time that the early procurement package was released ($1.94/lb) and the price at the NTP date for the construction package ($2.04/lb).

Another cost-saving innovation involved the use of micro piles instead of h-piles. The micro piles were made of a less costly material, and the contractor estimated that their use saved the project $115,000. Also, because installing the micro piles required less excavation, the contractor estimated that they saved two working days.

Because the contractor had participated in previous bridge moves they were able to provide insights into the most efficient way to install the structure. To accommodate the single-slide the contractor helped develop an alternate MOT plan that still kept I-80 traffic open while replacing the associated structures. This approach eliminated some of the costs associated with conducting bridge moves. Also, the ability to cast the structures monolithically eliminated the need to install the each structure in two halves. The contractor estimated that this simplified installation saved the project $35,000, and 14 Days.

In addition to the immediate savings mentioned above, the project also generated savings that will be realized on later construction that is planned along I-80. In the future the roadway will be widened to accommodate a climbing lane. The initial plans for the Summit Park Bridge Deck Replacement did not include widening the structure. At the project kickoff the team recognized that the structure would need to be widened in the future, and began exploring the possibility of including this work in the current project. Addressing this issue early on ensured that no time was wasted making revisions to previous designs.

While the team estimates that this expanded scope increased the project budget by a total of $1 Million, the cost of widening the bridge after construction would have been roughly $1 Million in each direction (for a total cost to the project of $2 Million). This estimate is based on the I-15 bridge deck repairs project in which 4 bridges were widened for a total added cost of $4 Million. Therefore, the team estimates an overall savings of $1 Million in today's dollars, and perhaps more depending on market conditions when the climbing lane is actually installed.

These savings produced by innovations represent only part of the overall project savings made possible through the CMGC process. The project also experienced significant savings through the unique risk management methodology that UDOT has begun implementing for CMGC projects.

Risk

The team employed a risk assessment process that relied on input from the designer, owner, and contractor to identify individual risks, assess their probable cost, assess their likelihood of occurring, develop successful mitigations, and maintain the appropriate level of contingency funding. To track this process the team used a risk register. Through the risk mitigation process the project saved an estimated $580,000, and reserved $378,000 in contingency funds. The table below shows key risks that were successfully mitigated on the Summit Park Bridge Project.

TABLE 8 – Mitigated Risk Savings and Total Risk Results

Probability	Risk	Cost	Mitigation Savings	Accepted Risk	Contingency
35%	Material Availability	$ 200,000	$ 200,000	$ 0	$ 0
15%	Mechanical Failures during Demo	$ 200,000	$ 175,000	$ 25,000	$ 3,750
15%	Bridge Fit, Ride Quality	$ 200,000	$ 125,000	$ 75,000	$ 11,250
50%	Aspen Drive Closures and Road Damage	$ 50,000	$ 40,000	$ 10,000	$ 5,000
20%	Unknown Utilities	$ 50,000	$ 40,000	$ 10,000	$ 2,000
	Subtotal	$ 700,000	$ 580,000	$ 120,000	$ 22,000
All Risks Addressed by the Team Including Those that were not Mitigated					
	Grand Total	$ 1,750,000	$ 580,000	$ 1,170,000	$ 378,000

The total contingency was calculated using the following formula:

(COST - MITIGATION SAVINGS) X PROBAILITY = CONTINGENCY

In the above formula "PROBABILITY" represents the percent chance of a particular risk occurring. "COST" represents the dollar amount that the team estimated each risk would add to the overall project cost. "MITIGATION SAVINGS" refers to the difference between the estimated cost of each risk, and the estimated cost of the risk after mitigation methods were taken. The total contingency of $378,000 represents 5.7% of the total construction cost.

Typically, the amount held in contingency on a project is at the discretion of the Project Manager (PM). Because contingency funding is typically established subjectively there is no data to compare the 5.7% contingency held on the Summit Park project to statewide averages, but it is understood that as PM's become more entrenched they become more risk-averse, and sequester more funds for contingency. What CMGC offers in response to this tendency is a systematic method of establishing the reasonable contingency amounts.

The estimated cost of each risk was established by reaching a consensus among the team members. The contractor submitted an original estimate for each risk that the team identified. The team then reviewed the contractor's estimates in order to appropriately gauge the magnitude of each risk. Due to this rigorous and collaborative approach to addressing project uncertainty the team feels that their $580,000 Mitigation Savings estimate is accurate.

To produce the mitigation savings claimed above the team took a unique approach to every uncertainty that they faced. With uncertainties such as the availability of materials, the solution was simply a matter of procuring long lead-time items in advance of construction. Similarly, keeping backup equipment on hand offset almost the entire cost of a potential delay due to mechanical failures during demolition. These simple mitigations accounted for $375,000 in savings, but other uncertainties required a more complex approach to mitigation.

One of the most complex challenges with any bridge move is to achieve a satisfactory fit with the existing roadway and substructure elements. The complexity is amplified when there is a limited timeframe to address these issues. The contractor had direct experience with the challenges of addressing fit issues within a very limited timeframe on the I-80 East Canyon and Lamb's Canyon bridge moves. On that Design Build (DB) project the MOT requirements were firmly set before bidding, and the contractor could not include provisions to address fit issues during installation. As a result, the finished product had a less than ideal fit with the roadway. These two projects highlight the fundamental difference between how CMGC, and DB apply innovative technologies. CMGC grants more opportunity to partner and find the best application for a new technology, whereas DB places high stakes on the success or failure of new technology, and challenges the contractor to make it work.

With the goal of providing a better ride on the Summit Park Bridge, the team reevaluated the MOT requirements, and the liquidated damages for traffic closures. To allow for the single slide, the team permitted a full closure of the Summit Park Bridge. The team also modified the incentives/disincentives to allow for ample time to tie the new structure in with the roadway. This was all accomplished without closing I-80. The final plan involved re-routing traffic via the on and off ramps on two separate nights. The first night was designated for the actual placement of the bridge, and the second night was designated for additional fitting work, and dressing of the abutments.

While the actual innovations that led to an improved ride were more a matter of quality and constructability, this approach to MOT allowed the team to meet a higher quality standard without exposing the project to inflated costs due to service interruptions. Because liquidated damages tend to creep into the bid price, the team estimates that mitigating the risk of traffic interruptions upon the Summit Park Bridge produced a direct savings of $125,000.

Another risk on this project was the possible location of unknown utilities. Based on the information available at the onset of design, the team estimated that the project would have to hold $50,000 in reserve to cover costs if any utilities were encountered during construction. To mitigate this issue the team contracted with a third party to conduct a pothole investigation process within the area impacted by the project. The investigation uncovered UDOT's own Active Traffic Management System (ATMS) as well as other utilities. The potholing services cost about $10,000, which accounts for the $40,000 mitigation savings reported by the project team.

By avoiding the cost of potentially having to close Aspen Drive for an extended period, the team produced further savings through risk mitigation. In order to pre-construct the new Summit Park structure, it had to be constructed adjacent to the current bridge. Constructing it at an offsite location would have involved the use of SPMTs, and been far more costly. One issue that complicated the bridge slide option was the profile of Aspen Drive, which passes beneath the Summit Park Bridge. Constructing the new bridge at its final elevation would not have allowed sufficient clearance to keep Aspen Drive open. The team estimated that the cost of closing Aspen Drive would be $50,000. The team mitigated this risk by planning to construct the bridge at a higher elevation, and then lower it into position during the installation. Once this strategy was developed the team reassessed the risk and determined that there was only a small outstanding risk of delays and damages on Aspen Drive. The final estimate for this risk was reduced to $10,000, which accounts for the $40,000 mitigation savings reported in the table above.

Other Applicability Criteria

In addition to the innovations and risk mitigations that produced direct cost and schedule savings, this project also took advantage of opportunities to address many of the other Applicability Criteria listed in the MOU.

Project Schedule

As mentioned in the innovation section above, releasing an early procurement package for structural steel allowed the project to begin construction an entire year sooner than would have been possible under another delivery method. There were also other alterations to the means and methods that further streamlined construction, such as the 2 weeks saved by conducting a single slide, and the two days saved by using micro piles.

CMGC has long shown the ability to develop a highly efficient construction timeline, but it does tend to extend the design timeline, albeit to a lesser degree. In the case of this project the design schedule did slip somewhat as a result of additions to the scope, as well as fluctuations in the direction provided by upper management for both the Department and the contractor. Although these delays pressed the construction schedule, they were ultimately offset as the team made up time during the selection process, and they pale in comparison to the time-savings delivered through early procurement.

Benefits to the Public

While nearly all project enhancements benefit the public in some way, the team was able to work with the contractor to produce a few specific modifications to the project that would make the facility useful to a wider range of stakeholders. One example is the pedestrian/wildlife crossing.

An additional benefit of CMGC that is not as tangible as the ones already mentioned is what the designer referred to as "the revitalization of the bridge-building industry," and the residual benefits from public investment in new technologies. On the Summit Park Bridge project UDOT designed the super-structure in-house; a leading design firm designed elements of the permanent and temporary substructure; the contractor provided reviews and recommendations on all aspects of the design. This resulted in a true partnership between vastly different members of the transportation community in order to deliver the best possible application of an unproven technology. The team views this partnership as a success and the contractor believes that the plan set for the Summit Park Bridge is the best of any bridge slide conducted anywhere to date.

Because the Department did not outsource the design the public can expect residual benefits from its investment in the innovative techniques applied on this project. Expertise gained from this project will become a matter of public record rather than the proprietary information of those involved in the design, thereby ensuring that the public will not have to pay a premium to achieve equal quality, and efficiency on future bridge-slide projects. In fact during the design close out interviews the team mentioned that many of the innovations resulting in better bridge fits implemented on Summit Park were being transferred to other UDOT projects being delivered via Design Build and Design Bid Build methods.

Learning Opportunities

The Department learned a great deal about the technical aspects of a bridge slide project, but the CMGC process also offered insights into the Departments established practices, such as the importance of having a clearly defined scope before moving too far forward with the design. On this project some of the roadway design lagged because the project was originally scoped as just a structure project. The widening, and additional roadway work were added to the scope after design was underway, which made it difficult to coordinate the preparation of the design package.

In addition, the Department recognized the need to better address the DBE goal on CMGC projects. On this project the Department attempted to compensate for DBE shortfalls on previous projects be setting a DBE goal that was much higher than usual for this type of project. Because the contractor was selected on the basis of their ability to self-perform much of the work it was exceedingly challenging to meet the DBE goal prescribed to them. Although the goal was ultimately met, future CMGC projects would have an easier time meeting the DBE goal if the Department revealed that goal before awarding the contract, and also if the Department took specific project details into account when setting the DBE goal.

Another insight into the management of CMGC projects had to do with securing ROW clearances. As efforts were made to compress the design schedule there was an increased risk that all of the necessary ROW would not be cleared in time. In general, ROW requires 6 months, and a set of plans that are complete enough to base contractually binding documents. Because CMGC often focuses on conducting construction while design is ongoing, ROW acquisitions can greatly hinder the process. Ultimately, the design schedule for CMGC projects can only be compressed as far as ROW will allow.

Procurement of CMGC Services

Project Milestones

TABLE 9 – Project Milestones

Stage	Date
Environmental Document	09/02/2010
CMGC RFP Advertised	06/11/2009
Contractor Selected	05/05/2010
Contractor Design Services NTP	06/03/2010
Blind Bid Opening Date	01/20/2011
Bid Opening	03/01/2011
Construction NTP	03/14/2011

Analysis of Performance

Proposed Construction Schedule

In the contractor's proposal they showed a CMGC award date of June 21, 2010, with bid opening in mid-January. They planned on finishing the girder design, and bidding the early procurement in late November 2010. They expected NTP on the construction package in early February 2011, and project completion in mid-August 2011. Comparing this proposed schedule to the project milestones shows that the design was on schedule in the beginning, and fell behind as the project proceeded. However, some lost time was recovered by compressing the construction schedule.

The actual date of the early procurement NTP was in mid-November, slightly ahead of the contractor's proposed date in late November 2010. During design of the second construction package the project fell behind schedule. The contractor had proposed an NTP date for this package in early February 2011; however, the actual NTP date was in mid-March. This equates to a six-week delay. The contractor expects to make up much of this time during construction, as the final project completion date is expected to be in early September 2011, only 2-3 weeks later than the originally proposed completion date in mid-August 2011.

The team identified some specific issues that caused the design to fall behind schedule. The issues that had the greatest impact on the schedule were scope expansions, and ROW. The scope expansion to widen the bridge effected some of the roadway design, and the designers working on roadway were somewhat delayed in working out those issues because they were reluctant to consume time during design meetings, or to directly solicit design reviews from the contractor. This was because roadway made up a very small portion of the project and the roadway designers did not want to consume a disproportionate amount of resources. Because of the changing scope ROW also had difficulty obtaining all clearances within the original design schedule.

Cost Comparison

The proposed bid presented by the contractor was compared with the Engineer's Estimate (EE) prepared by the Designer and an Independent Cost Estimate in accordance with UDOT's standard procedure. The engineer estimate was used as the baseline for comparison. Results are shown in Table 10 below:

TABLE 10 – Cost Comparison of Accepted Bid

Project Number	Engineer's Estimate (EE)	Independent Cost Estimate (ICE)	Final Bid	% Difference of EE	% Difference of ICE
F-I80-4(140)141	$1,257,200.00	$1,198,213.72	$1,216,400.00	-3.25%	1.52%
F-I80-4(118)141	$5,173,709.48	$5,696,456.00	$5,459,703.08	5.53%	-4.16%
Totals	**$6,430,909.48**	**$6,894,669.72**	**$6,676,103.08**	3.81%	-3.17%

The table above shows that the bid for the first construction package was less than the EE by 3.25%, but higher than the ICE by 1.52%. It also shows that the bid for the second construction package was 5.53% above the EE, and 4.16% below the ICE. Because the first construction package only involved early procurement for structural steel it would appear that the engineers estimate was not based on the most up-to-date steel prices, whereas the ICE and the Final Bid were developed direct quotes that reflected current market conditions. That is why, on the first construction package, the ICE and Final Bid were closer to one another than to the EE. All pricing was within the 10% limit that UDOT has set for project award.

On the second bid package and on the entire project, the Final bid was above the EE, but below the ICE. This shows that the ICE served as an effective substitute for market forces by driving the contractor's price down. UDOT's CMGC process included the Blind Bid Opening (BBO) described earlier in this report. As a result of the BBO the contractor reduced many of their unit prices in order to bring them closer to the ICE. Table 11 on the next page shows the top five greatest unit price adjustments between the BBO and the Final Bid.

TABLE 11 – Top 5 Price Adjustments between BBO and Final Bid

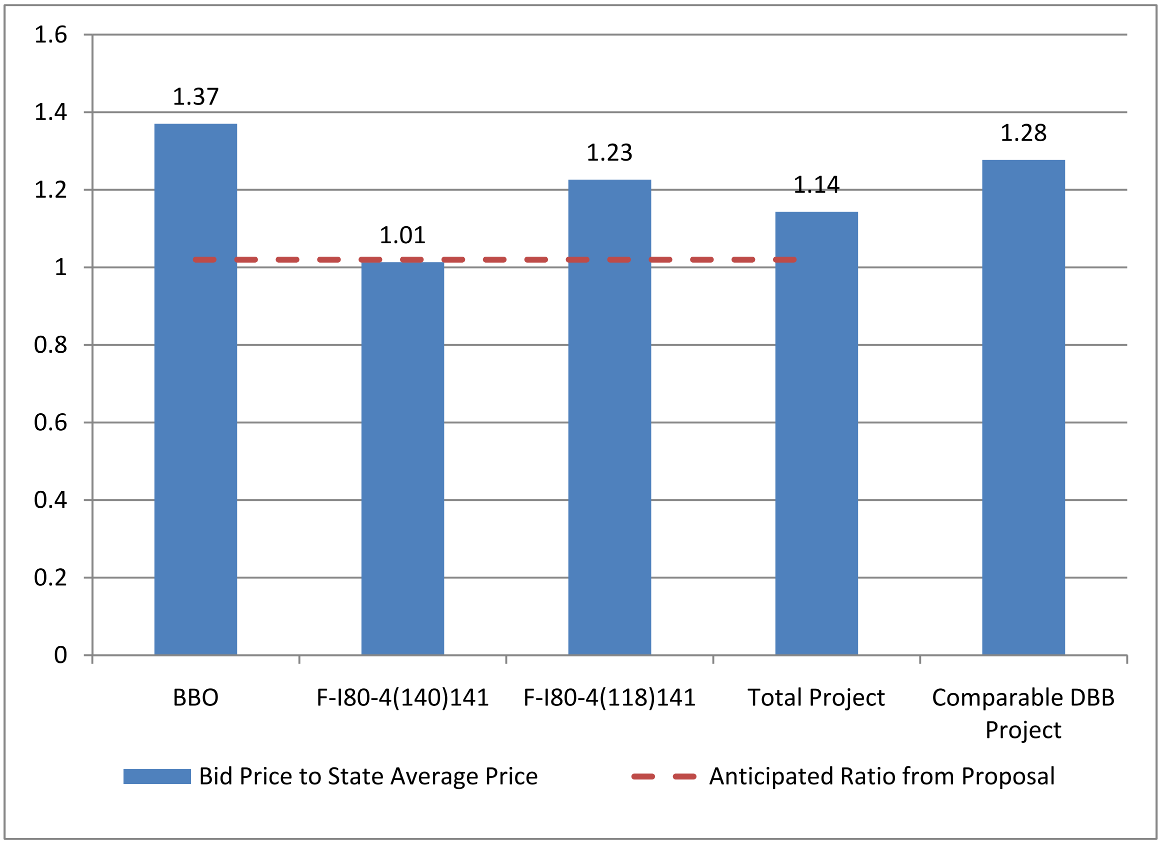
Item	Unit	Final Bid Qty	Unit $ BBO	Unit $ Final	Savings
1 Open Grading Surface Course	Ton	2964	85.00	39.30	135,454.80
2 Rotomilling - 1 1/2 Inch	sq yd	57117	2.00	0.68	75,394.44
3 Remove Concrete Slope Protection	sq yd	2593	25.00	9.07	41,306.49
4 Cast-in-Place Concrete Slope Barrier	lin ft	1465	95.00	72.30	33,255.50
5 Flowable Fill	cu yd	1625	150.60	131.00	31,850
				Total Savings	**317,261.23**

Although these 5 bid items suggest a total price reduction of $317,261.23, the overall savings due to the Blind Bid Opening are less. The contractor recovered some of the reduced cost on these and other items by increasing the unit prices of bid items that were within 10% of the ICE at the time of the BBO. However, the contractor reduced the overall price of their bid by $117,000 between the BBO and the Final Bid.

While the comparison to the ICE suggests that the Final Bid price was favorable to current market conditions, UDOT also compared the bid price to state average prices for one year prior to the bid opening date as a standard analysis for all CMGC projects (see basis of analysis in Appendix B). This procedure is done to identify what the project would have cost if the quantity of the bid items were assessed using the state average price rather than the agreed upon unit price of the accepted bid. This comparison shows that the early procurement phase of the project was very close to state average pricing. However, the subsequent phase of work was approximately 20% higher than the state average pricing at bid opening (See Figure 2). The overall project was approximately 14% higher than the state average pricing model. Knowing that the state average pricing model does not take into consideration location and complexity of the project, the team based its confidence with the bid comparisons of the Engineer's Estimate and the Independent Cost Estimate and moved forward with awarding the project.

For further pricing verification, the state average pricing model was applied to a similar Design Bid Build project: I-80; Eastbound Structure #F-801 at Atkinson Canyon. This project is a single bridge replacement that is being built concurrently with the Summit Park Bridge project. The Atkinson bridge replacement is located approximately 9 miles further east on I-80. Figure 2 shows the comparison of the pricing ratios based on the state average pricing model. The pricing for each phase of the Summit Park Bridge was lower than the Atkinson Bridge project which was bid through a competitive bidding process. Based on this comparison, there is a savings on unit prices between the CMGC process and the Design Bid Build process. This savings may be due to the reduction of risk and penalties associated with the respective projects.

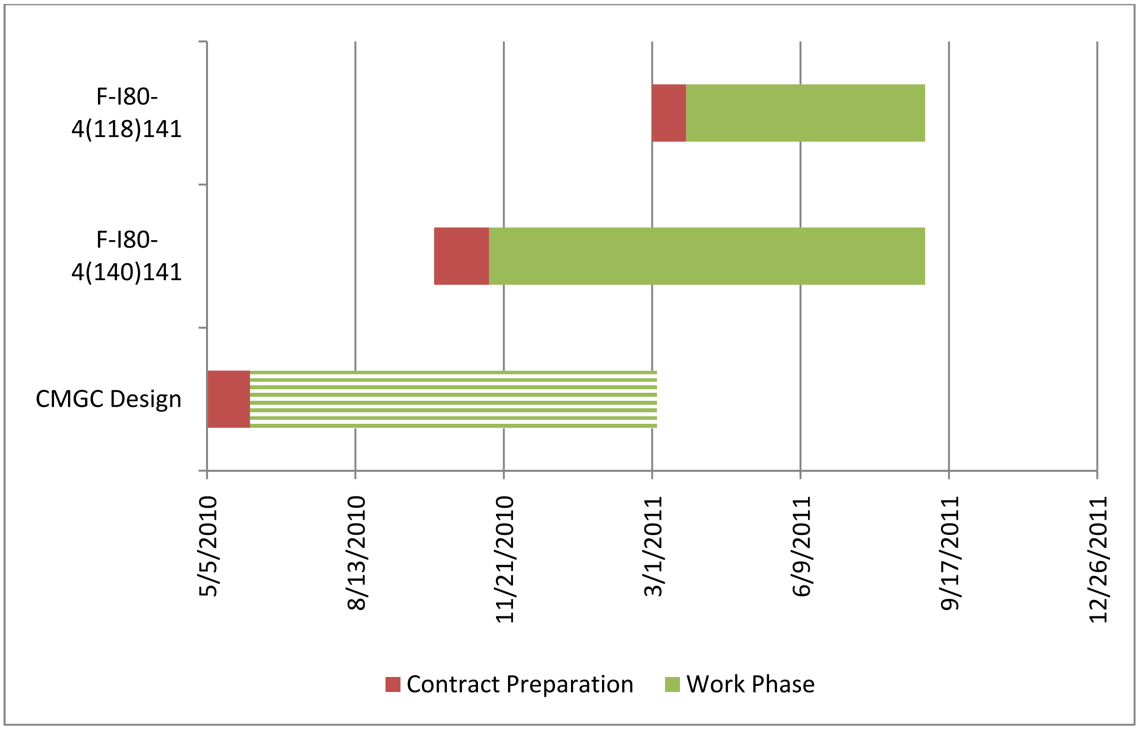
Figure 2 – Cost Comparison of Accepted Bid



Delivery Process and Timeline

Figure 3 illustrates the timeline of the CMGC process up to the anticipated substantial completion of construction. Contract preparation time is the duration used by UDOT to prepare the contractual requirements for the specific phase of work. This duration is typically from the approval of the proposer and the date of their respective NTP. Please note that the days shown herein are total days.

Figure 3 – Construction Timeline



Lessons Learned

Data collection for this report included personnel interviews of representatives from the project team including Reuel Alder, Ritchie Taylor, Dennis Wise, David Deng, Tony Lau, Kevin Howlett, Todd Wadsworth, Mike Romero, Patrick Cowley, Tom Hales, Kevin Griffin. Notes from the design team meeting and personal interviews are contained in Appendix A. Key lessons learned by the team are summarized below.

UDOT benefitted a great deal from conducting in-house design of this CMGC project. The lessons learned applied to both the application of new technology, and the process of conducting a CMGC design. As a result of doing hands-on design work rather than merely conducting oversight the Department has gained new perspective on the decision-making process that goes into preparing design packages, and defining construction phases as it pertains to bridge mobilization. In addition, the Department is already seeing residual benefits from the technology applied on this project. They have taken lessons learned from this project and applied them to the VE process on Atkinson Canyon bridge on I-80, which is a Design Bid Build project.

After going through the CMGC process the Department has also identified opportunities to operate more effectively. The following list highlights improvements to the design process that were recommended by the project team.

- It would have been helpful to have more design-oriented meetings. The meetings were geared more towards discussions of the process, which were not useful in providing clear direction to the design team.
- Normally, CMGC projects involve discreet breakout sessions for the different design disciplines. This did not occur on this project because the project was so small, and consisted almost entirely of the structure. In hindsight, this was problematic.
- The roadway designers would have benefitted from more discussions with the contractor.
- Schedule driven design does not allow enough time for coordination between the true cost and the cost model which means that ICE has difficulty defending their numbers.
- There is usually a crunch at bid time because CMGC projects end up being schedule driven during design. In many cases final plans are barely complete in time to produce an adequate estimate, and a sound bid.
- CMGC is a risk-reduction process, rather than an accelerated design process.
- The additional design time tends to help expedite construction by overcoming likely construction obstacles during design.
- The proper time for a design team to consider the DBE goal is after PS&E. However, once the DBE goal is established the scope cannot change.
- Sometimes Civil Rights may not be familiar enough with the specifics when establishing the DBE goal. It is helpful to notify Civil Rights about specialty work that cannot be provided by a DBE.

While this project involved several measures that were in place to control overall cost, and verify the contractor's prices, the team recognized a number of opportunities to improve the quality of data gathered by the ICE. Specific recommendations made by the project team include:

- Subcontractors are not disposed to spend the same amount of time developing a quality estimate for an ICE as they would for a contractor. Usually much of the ICE's time was diverted to educating subcontractors on what CMGC is.
- The PM needs to be responsible for making it clear about how attainable a scheduling goal is.
- The ICE was able to get ballpark estimates before the bid opening when going out and talking to all the suppliers, and subs, but when working on the actual bid for the BBO he could not get revised estimates from any of them, except for a few
- The contractor was in favor of still having the ICE go through the effort to gather quotes.

- This project revealed that the ICE and contractor will sometimes develop bids that assume different elements are subcontracted, and different elements are self-performed. This can lead to significant discrepancies. Yet, it is best not to dictate to the ICE which items they should sub, and which items they will self-perform.

Conclusion

The Summit Park Bridge project took advantage of the CMGC process to significantly reduce user costs. If the bridge, or even just the deck were cast-in-place the service interruption could have lasted for months, but by sliding the bridge into place the interruption was reduced to less than a week. In addition to the reduced traffic interruption, CMGC also enabled the project to get construction under way sooner than any other delivery method could have allowed. This is because the team was able to release a contract for the early procurement of structural steel. Having the steel on hand at the date of the construction NTP ensured that construction could begin immediately, which saved an entire construction season.

To address the technical complexity of this bridge slide the design team took advantage of Ralph L. Wadsworth's previous experience with bridge moves. The contractor's expertise helped the team generate innovations, and risk mitigations that saved the project an estimated $1,876,000. In addition to the savings, the contractor's input also led the team to take several measures to ensure a good fit between the new bridge and the roadway. As a result of this diligence, the team expects the Summit Park bridge project to deliver a level of quality and rideability that surpasses all previous bridge move projects to date.

Many of the benefits enjoyed on this project will be applied to future projects because the Department conducted much of the work in-house. As a result of the Department's involvement in the design, some of the lessons from the Summit Park project are already being applied to the Atkinson Canyon bridge project. In addition to becoming more fluent in bridge moving techniques, the CMGC process also allowed the Department to recognize the impact that many of its policies and procedures have on the construction industry. This insight has given the Department the option to adjust some of its methods, such as establishing the DBE goal, and verifying bid prices on CMGC projects.

APPENDIX – A – Team Interview Notes

Reuel Alder - UDOT
Dallas Wall - WCEC
Ritchie Taylor - UDOT
Dennis Wise - PBS & J
David Deng - UDOT
Tony Lau - UDOT
Kevin Howlett - RLW
Todd Wadsworth - RLW
Mike Romero - UDOT
Patrick Cowley - UDOT R2
Tom Hales - UDOT Structures
Kevin Griffin - UDOT

Background

This was the first CMGC structure project, and second project overall that UDOT designed in-house.

1. **Phasing**

   A. How did phasing help the project proceed?

      i. This project only included two phases. One was for early procurement, and one was for the rest of construction.
      ii. The early procurement phase was critical in getting construction underway, and probably saved a construction season.
      iii. Early procurement also allowed the team to take advantage of low steel prices. By the time the second design package was complete steel prices had increased 20-30% of the amount steel was purchased for under early procurement.

   B. What was the logic behind phasing the project?

      iv. It was simply to ensure long lead items would be in hand by the time the construction package was released.

C. Did phasing the project save overall delivery time of the project? How much?

v. The actual difference between the two design packages was 3-4 months. So early procurement saved at least that much time, and probably more because if both packages were released at the same time there would have been an additional delay while waiting for the steel fabricator to complete their work.

vi. Also, because a delay in excess of 4 months would have meant that construction would not have been able to commence for an additional year.

D. Knowing what you know now, how would you have changed the phasing?

vii.

2. **Design**

A. Was the contractor brought on too soon in the process? How was he beneficial during the early stages of design?

viii. The contractor appreciated being involved in the design process because it educated UDOT on how to address construction sequencing in a way that meets the overall goals of the project.

ix. UDOT benefitted from doing the hands-on design work, rather than only conducting oversight. They learned a great deal about the decision-making process that goes into preparing design packages, and defining construction phases.

x. Discussions about constructability were a large benefit, and UDOT learned ways that they could improve their designs by providing the design details that will be most relevant to the construction process.

xi. They contractor felt that they were productively engaged, and found value in being involved before design was heavily underway. They were able to offer input on establishing the project goals, and brainstorming means of accomplishing those goals.

xii. Ultimately, the roadway tie-in was going to be simple, but it got more complicated as it got moved further back, and wider. The contractor was open and available to help alleviate the complexity of designer for the larger scope, but the UDOT Roadway designers were not familiar enough with the CMGC process to take full advantage.

xiii. It would have been helpful to have more design-oriented meetings. Of the meetings were geared more towards discussions of the process, which were not useful in providing clear direction to the design team.

xiv. Normally, CMGC projects do involve discreet breakout sessions for the different design disciplines. This did not occur on this project because the project was so small, and consisted almost entirely of the structure. With this in mind the team consciously made the decision not to hold task force meetings related to the different disciplines. In hindsight, this was problematic. In the future it would be useful to always designate some time specifically for addressing design issues pertaining to each discipline.

xv. Not paying attention to lesser aspects of the design earlier on led to something of a crisis at the end. However, some of this "crisis" was generated by a separate project suddenly causing a problem with the roadway design.

xvi. Ultimately, in spite of the challenges, we were able to design a better project than was originally expected.

xvii. On curb and gutter it was good to have a contractor present because we were able to mitigate a risk by making adjustments to the design up front.

xviii. We have been able to take lessons learned from this project and apply them to the VE process on Atkinson Canyon Bridge, which is a D-B-B project. This allows us to "double-dip" on the advantages that CMGC gave us on this project.

xix. The contractor also helped us obtain funding for the expanded scope on this project because the team was able to approach senior leadership with a precise estimate of the cost increase.

B. What would you have done to improve the contractor's participation?

xx. The roadway designers would have benefitted from more discussions with the contractor. This was especially true of the sleeper slab design. The designers found it difficult to form assumptions about how the sleeper slab would be constructed, and thus were unsure of how to detail the design. Ultimately, UDOT Roadway designers did not take proper advantage of the opportunity to meet with the contractor more during design. Because of this missed opportunity UDOT did not present their roadway design to the contractor until late in the process, and at that point the contractor informed them that their design was too narrow.

xxi. Contrary to most other projects, roadway was not a large part of the design. This is why the roadway designers were hesitant to consume time, and attempted to glean what information they could from general meetings.

C. What measures of budget control were used by the team?

xxii. The contractor developed a cost model early in the design phase, and updated it throughout the process. This was key in allowing the team to promptly generate an accurate estimate once they became aware of the scope expansion.

xxiii. The Department was initially concerned about the high PE costs that are generally associated with CMGC projects. Much of these high costs were related to consultant services costs absorbed during the selection process. It was difficult to get comfortable with those costs at the outset, because PM's are used to expecting considerable budget creep during design. However, the cost model was a helpful resource that allowed the PM to remain confident in the likely cost of the project. It also allowed him to see how the PE costs were being offset.

xxiv. Cost modeling also allowed the team to obtain a real-time cost estimate for proposed innovations. Thus they did not have to speculate on the value of an idea when making a decision about whether or not to include it in the design.

xxv. Sometimes it can be difficult on CMGC projects to maintain an iterative cost model that is up to date nearing the end of design. Because this was a smaller project this was not a problem. There were never any humungous surprises, aside from a DBE issue that arose toward the end. It would have been better to be aware of the associated $100,000 cost earlier.

xxvi. The DBE goal of 8% on this project was unexpectedly high.

xxvii.

xxviii. Normally on DBB we do not normally have the DBE goal established until we send the project off to Civil Rights just before the bid. In this case we were aware of the DBE goal before bidding, and were able to consider ways of meeting that goal during design, albeit it was later in the design process. This led to very productive conversations. The Department gained some insight into seeing what the contractors go through when determining how to meet the DBE goal.

xxix. The proper time for a design team to consider the DBE goal is when...Maybe after PS&E...The sooner the better. One thing to be careful of, however, is that once the DBE goal is established the scope cannot change. This is because changing the scope means changing the commitment.

xxx. It is possible to create in PDBS a generic code that is X% for DBE, and on CMGC the contractor would have the flexibility to assign where they are going to fill those percentages out up front, instead of making commitments without necessarily knowing what the quantities and exact costs will be.

xxxi. On DBB UDOT allows the bidder to define which elements will be performed by the DBE. For example, the bidder may specify that striping is going to be performed by the DBE.

xxxii. It would be nice to know how the DBE commitment is determined. Civil Rights should not exist in a bubble, and should be capable of providing information about the commitment sooner, so that the PM is not in the dark about an important aspect of the budget.

xxxiii. Maybe outsourcing PI is a good way to consistently meet the DBE goals.

xxxiv. It would be nice if Civil Rights could provide items to the contractor that they believe specific DBE firms would be capable of providing.

xxxv. Sometimes Civil Rights may not be familiar enough with the spec when establishing the DBE goal. For example, on this project the specification called for a non-destructive removal of striping on mainline. There is not a DBE capable of doing that, yet Civil Rights may notice that the project involves striping, and base the DBE goal on the fact that there are DBE firms that provide striping.

xxxvi. A lot of contractors will bid a whole package based on "all-or-none" subcontractor quotes. So, the fact that some elements could be provided by DBE's is sometimes inapplicable because removing a particular element that could be done by a DBE from subcontractor's package nullifies the entire bid.

xxxvii. Subcontractors are not disposed to spend the same amount of time developing a quality estimate for an ICE as they would for a contractor. Usually much of the ICE's time was diverted to educating subcontractors on what CMGC is.

xxxviii. It is helpful to notify Civil Rights about specialty work that cannot be provided by a DBE.

xxxix. Contractors tend to consider, and address DBE goals at the last minute. Some of this could be improved by making the DBE goal known earlier, so that the team can manage some of that during design.

xl. The contractor wonders if Civil Rights is not getting full credit for the work that DBE's are getting. This has an impact on later projects, when Civil Rights must compensate for shortfalls on the DBE goals in previous projects. For example, when bidding, contractors will commit enough to meet the DBE goal, and tend not to commit beyond that even if the contractor has DBE's that they have selected, and intend to use. The reason for that is because it leaves the contractor no flexibility to decide later to change the DBE's scope slightly. Yet it is possible that at the end of the day the contractor will have used several more DBE's than they mentioned in their commitment. That is getting tracked, but there is no incentive for the contractor to put all of their expected DBE commitments into their bid if those commitments are in excess of the DBE goal. System should be set up to give the contractors all of the benefits without penalizing them for falling short of any commitments beyond the DBE goal. Overall the Department is running 2% ahead on their DBE commitments.

xli. DB projects are a perfect example. Usually, because bids on DB projects are not based on 100% quantities the contractor will under commit on quantities, simply because of what a hassle it is if they go under.

xlii. Thus the practice for addressing DBE items is to bid them in such a way that ensures they exceed their DBE goals.

xliii. RLW was selected because of their ability to self-perform work, so having a high DBE goal was counterproductive to the goals set in the selection process.

D. How was the design schedule impacted by the CMGC process?

xliv. The design schedule ended up being rather tight. Perhaps not in terms of the design itself, but funding for the scope expansion (widening) was not officially provided until the day of the Transportation Commission meeting. This again came down to the fact that the additional roadway costs were not anticipated when the Department initially pledged to fund the scope expansion.

xlv. The PM needs to be responsible for making it clear about how attainable a scheduling goal is.

xlvi. The schedule was hung up a few weeks because there was a rumor that there would be a climbing lane going into the canyon that would affect the design. Ultimately the team was able to make up for this delay during the advertising period.

3. **Contract Bidding**

A. How was the bidding process perceived by the team?

xlvii. The ICE, EE, and Bid were all in fairly close agreement.

xlviii. The ICE was able to get ballpark estimates before the bid opening when going out and talking to all the suppliers, and subs, but when working on the actual bid for the BBO he could not get revised estimates from any of them, except for a few. If he were able to get a revised price on just one key item, such as paving and milling, there may not have been much discrepancy in pricing at all.

xlix. Rudy has wondered why we have been having the ICE go out and get separate quotes. Can't we just use the quotes that the contractor provides, and use the ICE to estimate work that the contractor will self-perform?

l. The ICE has been involved in other projects where it is done this way, and he only provides quotes on the work that the contractor will self-perform work.

li. Then the ICE wouldn't have to try to obtain the competitive bid. When you only look at the self-performed work for this project the contractor and ICE were really not that far apart at all.

lii. The contractor is in favor of still having the ICE go through the effort to gather quotes. The ICE did not mind reviewing all of the items, including putting a bid on how to meet the DBE goal. In this case the ICE had figured out a way to meet the goal without using a DBE rebar provider, whereas the contractor did use one for rebar.

liii. There are pros and cons to having the ICE bid on subcontracted work. On some projects subcontracted work makes up a large portion of the work, and in those cases it is nice to have an independent estimate of that work.

liv. This project revealed that the ICE and contractor will sometimes develop bids that assume different elements are subcontracted, and different elements are self-performed. This can lead to significant discrepancies. Yet, it is best not to dictate to the ICE which items they should sub, and which items they will self-perform.

B. What were the problems identified by the team with pricing?

lv. Bid prices were higher than the cost model suggested, but this was probably because the design was fast-paced, and the cost model was not kept up to date with the design.

C. How were these problems resolved?

lvi. The fact that schedule driven design does not allow enough time for coordination between the true cost, and the cost model means that the ICE cannot defend his numbers. Therefore, the cost model should carry contingency for the unknowns the team has identified.

D. How were the blind bid openings a benefit to the project?

lvii. There was one BBO on this project, which was appropriate to the size of the project.
lviii. The BBO does serve a good purpose to bring everybody up to speed on the scope of bid items. It also allowed the Department to price the value of accelerating the construction schedule.
lix. On this project the plans were very close to complete at the BBO, which meant that there was not a great deal of change on most item prices between the BBO and the final bid? This made the final bid easier.
lx. Putting the word out about the CMGC project to subcontractors would be helpful. Possibly this could be done using project explorer.
lxi. There is usually a crunch at bid time because CMGC projects end up being schedule driven during design, even though they should not be. In many cases final plans are barely complete in time to produce an adequate estimate, and a sound bid. This may able be an advantage, shrinking the bidding time, but it requires a committed contractor.
lxii.

4. **Risk**

A. How did the Risk process reduce necessary contingency funds? How much?

lxiii. The contractor spent a great deal of time internally discussing risk.
lxiv. Many elements of the structure design and construction methods alleviated a lot of cost risks.

B. How was the design changed due to the risk analysis?

lxv. The type of slides was evaluated. Double slide versus single slide.
lxvi. Allowing them to go down those ramps for the full closure reduced risk, provided savings, and improved the quality of the whole bridge structure by far.
lxvii. The team was able to ensure, through design, that they would avoid impacting utilities, thus reducing the risk on that utility from $50K to $2K.
lxviii. In this case the Department designed all the temporary bridge supports, which was a good way of designing out risk that would have been costly if, as usual, it was been left up to the contractor.
lxix. Some of the lessons learned from this project about structure design are being applied to the Atkinson project.

lxx. By loosening up the window for traffic closure that the contractor has to work within, and not giving him an incentive to rush the project we are allowing them time to go back in a improve the ride by performing rotomilling and things like that.

lxxi. By reducing liquidated damages we reduced cost on this move, reducing the overall price to move the bridge.

lxxii. The incentives and disincentives were "right-sized," as was the schedule. The contractor provided insight into where the Department could set the delivery date so that there would be no risk bid into meeting that deadline.

lxxiii. The focus on this project was to enhance the ride on the finished roadway. We expect the quality of this project to be the best bridge move of any done so far.

C. How did the contractor's view of risk enhance the team's decisions?

lxxiv. By reducing liquidated damages on the move the costs of the move were reduced. We discussed what was valued, what changed later on.

lxxv. We right-sized incentives/disincentives, schedule because we could see the cost of decisions.

lxxvi. Assigned risks to contractor where appropriate.

lxxvii. Contractor maintained the risk matrix.

D. Was funding set aside to address issues that were better handled during construction (planned change orders)?

lxxviii. No. To avoid planned change orders the team moved unknowns into the next phase, and addressed them then.

5. **Innovation**

A. Were innovations reactions to difficulties or were they value engineering changes?

lxxix. The team applied VE changes to some minor MOT details in order to reduce delays. (CMGC really is a VE process).

lxxx. There were also some risk-oriented innovations, such as the improved, and more complete plans for the bridge slide. In this case the Department was able to rely on expertise from past projects in order to provide a level of detail that the Department would ordinarily not do--instead opting to defer that risk to the contractor. Of course, deferring that risk comes with added costs.

6. **Deliverables**

A. What kind of deliverables was required of the contractor during the design process?

lxxxi. Constructability review
lxxxii. Conceptualized roadway, lighting, and structures

7. **Lessons Learned**

A. What worked well (what helped the project)?

lxxxiii. CMGC is a risk-reduction process, rather than an accelerated design process.
lxxxiv. The additional design time tends to help expedite construction by overcoming likely construction obstacles during design.
lxxxv. Severable packages were useful for lowering the contingency and giving the team confidence for delivery. The also helped provide the flexibility to start work before design is complete, and save in early procurement.
lxxxvi. While severable packages do cost more money initially, their cost is offset by the fact that the team can confidently include a lower contingency on them.
lxxxvii. The plans that the team developed for a bridge slide were of surpassing quality. Much better than Nevada, and California.

B. What did not work well (what hindered the project)?

lxxxviii. It is a mistake to consider CMGC a rapid delivery process.
lxxxix. Projects that need to get underway quickly are not good to be CMGC delivered, unless you can take the time you need in design.

xc. Outside forces were trying to influence the project based on goals that were beyond, and irrespective of the project goals. To correct this problem it would have been good to have top-level management on all sides attend the kick-off meeting to provide input, and ultimate buy-off on the project goals.

xci. The designer and contractor were not familiar enough with one another to understand their core values, and goals, hence it seemed as though the contractor expected the designer to sacrifice quality in order to reduce cost.

xcii. On this project ROW did not have enough time to get all of the clearances in place. This caused delays to the project. ROW needs 6 months, and a set of plans that are complete enough to base contractually binding documents upon. Because CMGC often focuses on conducting construction while design is ongoing this is incredibly difficult for ROW. For this reason, ROW ended up driving the project schedule to a large degree.

xciii. The fact that the owner changed their expectations and goals during the design process was a hindrance.

xciv. The design team should have been better at following up with each discipline to ensure that they had sufficient direction to proceed with the design.

xcv. The 5-6 hour general design meetings were too long. Instead there should be shorter meetings, focused on each discipline area.

xcvi. It would have been nice after the design was better developed it would have been good to have the contractor spend more time reviewing designs instead of participating in process meetings.

xcvii. While structures had the support of the contractor when learning a new process, the roadway designers felt like they were flying blind. Since structures was the design lead on this project it would have been nice for them to provide roadway with a list of deliverables in order to guide their design process somewhat.

xcviii. It was odd that as the design came to an end many good ideas were presented, but it was too late to incorporate them.

xcix. It is beneficial to talk to the contractor about specifics rather than generalities.

C. What was the largest benefit to the public?

c. CMGC has revitalized the whole bridge building industry. This is real partnering not only in construction, but also in the entire delivery of the project.

8. **Final Comments and Perceptions**

ci. The CMGC process is key for the success of complex projects.

APPENDIX – B – State Average Pricing Analysis

Project No: F-I80-4(140)141 Project Name: I-80; SUMMIT PARK BRIDGE Desc of Construction: I-80; SUMMIT PARK BRIDGE, EARLY PROCUREMENT Estimate Completion date on or before 09/01/2011 County: SUMMIT (43)					RALPH L WADSWORTH CONSTRUCTION CO LLC 166 East 14000 South Suite 200 Draper,UT 84020		State Average price from 09-05-2009 to 09-04-2010	
seq_num	item_num	item_desc	qty	unit	unit price	Amount	unit price	Amount
1	05120002P	Structural Steel(Est. Lump Qty: 628600)	628600	lb	1.94	1,216,400.00	1.91	1200626
						1,216,400.00		1,200,626.00
		Paid 2.04 at subsequent bidding of actual construction			SSR	1.01		
		Estimated savings:	$65,944.00					

Project No: F-I80-4(118)141 Project Name: I-80; SUMMIT PARK BRIDGE Desc of Construction: BRIDGE REPLACEMENT, F-298, EB & WB Estimate Completion date on or before 09/01/2011 County: SUMMIT (43)					RALPH L WADSWORTH CONSTRUCTION CO LLC 166 East 14000 South Suite 200 Draper, UT 84020		State Average Pricing 02-01-2010 to 01-31-2011	
	item_num	item_desc	qty	unit	Unit Price	Amount	Unit Price	Amount
1	00830001U	Equal Opportunity Training	1200	Hour	10	12,000.00		$0.00
2	12850010	Mobilization	1	Lump	420,200.00	420,200.00		$0.00
3	01315001*	Public Information Services	1	Lump	10,240.00	10,240.00		$0.00
4	15540005	Traffic Control	1	Lump	188,400.00	188,400.00		$0.00
5	01557000*	Maintenance of Traffic	1	Lump	83,110.00	83,110.00		$0.00
6	15720020	Dust Control and Watering	45	1000 gal	57.5	2,587.50	$7.80	$351.00
7	20560005	Borrow (Plan Quantity)	72	cu yd	11.5	828	$11.67	$840.24
8	20560020	Granular Borrow	973	Ton	13.8	13,427.40	$8.16	$7,939.68
9	20750010	Geotextiles - Separation	435	sq yd	4.6	2,001.00	$1.18	$513.30
10	02216000*	Pothole Utility	6	Each	1,150.00	6,900.00		$0.00
11	22210075	Remove Guardrail	77	ft	3.29	253.33	$1.84	$141.68
12	22210110	Remove Concrete Sidewalk	163	sq yd	7.55	1,230.65	$5.99	$976.37
13	22210125	Remove Concrete Curb and Gutter	936	ft	4.68	4,380.48	$4.17	$3,903.12
14	22210127	Remove Concrete Slope Protection	2593	sq yd	9.07	23,518.51	$9.07	$23,518.51
15	22210165	Remove Asphalt Pavement	427	sq yd	11.1	4,739.70	$2.23	$952.21
16	22210170	Remove Precast Concrete Barrier	1302	ft	5.29	6,887.58	$4.32	$5,624.64

17	23160020	Roadway Excavation (Plan Quantity)	612	cu yd	20.7	12,668.40	$5.81	$3,555.72
18	27210010	Untreated Base Course	547	Ton	18.4	10,064.80	$13.91	$7,608.77
19	27410060	HMA - 3/4 inch	409	Ton	94.65	38,711.85	$55.13	$22,548.17
20	02744000*	HMA - 1/2 inch (Thin Overlay)	192	Ton	90.5	17,376.00		$0.00
21	27480040	Emulsified Asphalt CSS-1	38	Ton	443	16,834.00	$551.00	$20,938.00
22	27610023	Longitudinal Rumble Strip - Asphalt	2114	ft	5.03	10,633.42	$0.10	$211.40
23	02765005*	Pavement Marking Paint	29	gal	78.85	2,286.65	$21.52	$624.08
24	27680005	4 inch Pavement Marking Tape - White	11695	ft	2.29	26,781.55	$2.12	$24,793.40
25	27680015	4 inch Pavement Marking Tape - Yellow	15574	ft	2.29	35,664.46	$2.14	$33,328.36
26	27680105	Pavement Message (Preformed Thermoplastic)	4	Each	151.8	607.2	$130.36	$521.44
27	27680115	Pavement Message (Preformed Thermoplastic Stop Line, Crosswalks - 12 inch)	71	ft	12.65	898.15	$6.01	$426.71
28	27710035	Concrete Curb and Gutter Type M1	938	ft	18.75	17,587.50	$15.77	$14,792.26
29	27710059	Pedestrian Access Ramp	2	Each	1,229.00	2,458.00	$1,044.17	$2,088.34
30	27760015	Concrete Sidewalk	343	sq yd	46.55	15,966.65	$25.11	$8,612.73
31	27860010	Open Graded Surface Course	2964	Ton	39.3	116,485.20	$56.59	$167,732.76
32	02786005P	Asphalt Binder PG 58-34	178	Ton	849.7	151,246.60		$0.00
33	28430010	Crash Cushion Type B	5	Each	14,130.00	70,650.00	$13,677.89	$68,389.45
34	28440030	Cast-in-Place Concrete Constant Slope Barrier	1465	ft	72.3	105,919.50	$50.95	$74,641.75

35	28440040	Cast-in-Place Concrete Constant Slope Barrier Approach End (A) 12 feet	5	Each	2,407.00	12,035.00	$1,892.86	$9,464.30
36	02891001*	Sign, Type A-1	65	sq ft	35.55	2,310.75	$36.74	$2,388.10
37	02891002*	Sign Type A-2	189	sq ft	60.85	11,500.65	$44.98	$8,501.22
38	02891003*	Sign Type A-2, 48 inch X 48 inch	11	Each	404.2	4,446.20	$230.61	$2,536.71
39	02891004*	Remove Sign Less Than 20 Square Feet	8	Each	211.2	1,689.60	$69.57	$556.56
40	02891005*	Remove Sign Greater Than or Equal to 20 Square Feet	3	Each	550.4	1,651.20	$266.66	$799.98
41	02891006*	Sign Post Base (B6A) for Standard Pipe Posts	7	Each	766.2	5,363.40	$643.68	$4,505.76
42	02891007*	Sign Post Base (B6B) For S & W Section Steel Posts	6	Each	904.8	5,428.80	$693.20	$4,159.20
43	02891008*	Post S6 X 12.5	4	Each	706.5	2,826.00	$912.75	$3,651.00
44	02891009*	Post S8 X 18.4	2	Each	1,313.00	2,626.00	$1,058.48	$2,116.96
45	02891010*	Post 5 Inch Standard Pipe	7	Each	869.3	6,085.10	$611.36	$4,279.52
46	02961025P	Rotomilling - 1 1/2 Inch	57117	sq yd	0.68	38,839.56	$0.34	$19,419.78
47	29630010	Profile Rotomilling	623	sq yd	3.12	1,943.76	$1.72	$1,071.56
48	18920010	Reconstruct Catch Basin	6	Each	1,380.00	8,280.00	$4,746.25	$28,477.50
49	18920020	Reconstruct Cleanout Box	2	Each	1,380.00	2,760.00	$1,005.94	$2,011.88
50	22210030	Remove Catch Basin	3	Each	553.9	1,661.70	$461.44	$1,384.32
51	22210095	Remove Pipe Culvert	93	ft	16.6	1,543.80	$14.54	$1,352.22
52	02224001*	Abandon Pipe in Place	2	Each	1,329.00	2,658.00		$0.00
53	23730010	Loose Riprap	10	cu yd	74.75	747.5	$37.37	$373.70

54	26101386	18 Inch Irrigation/Storm Drain, Class C, smooth	77	ft	59.8	4,604.60	$48.56	$3,739.12
55	26101616	18 Inch - Reinforced Concrete Pipe, Irrigation/Storm Drain, Class C	99	ft	66.7	6,603.30	$31.54	$3,122.46
56	26130030	Culvert End Section 18 inch	2	Each	460	920	$460.28	$920.56
57	26330030	4 Foot Standard Manhole - CB 11	2	Each	2,300.00	4,600.00	$2,922.22	$5,844.44
58	26330120	Concrete Drainage Structure 3 ft to 5 ft Deep - CB 9	3	Each	3,450.00	10,350.00	$2,183.72	$6,551.16
59	26330130	Concrete Drainage Structure 5 ft to 7 ft Deep - CB 9	1	Each	3,910.00	3,910.00	$2,116.15	$2,116.15
60	15720020	Dust Control and Watering	243	1000 gal	51.75	12,575.25	$7.80	$1,895.40
61	20560020	Granular Borrow	3249	Ton	13.8	44,836.20	$8.16	$26,511.84
62	20750010	Geotextiles - Separation	5379	sq yd	3.45	18,557.55	$1.18	$6,347.22
63	27210010	Untreated Base Course	1411	Ton	20.7	29,207.70	$13.91	$19,627.01
64	27410060	HMA - 3/4 inch	1280	Ton	85.05	108,864.00	$55.13	$70,566.40
65	27480040	Emulsified Asphalt CSS-1	7	Ton	443	3,101.00	$551.00	$3,857.00
66	27860010	Open Graded Surface Course	426	Ton	37.1	15,804.60	$56.59	$24,107.34
67	27860050	Asphalt Binder PG 64-28	26	Ton	810.7	21,078.20	$128.62	$3,344.12
68	20560025	Granular Backfill Borrow (Plan Quantity)	1180	cu yd	75.85	89,503.00	$17.27	$20,378.60
69	22210015	Remove Bridge	1	Lump	121,100.00	121,100.00		$0.00
70	02229000*	Temporary Retaining Walls	1	Lump	80,900.00	80,900.00		$0.00
71	02466000*	Micropile	4758	ft	47.75	227,194.50		$0.00
72	32110010	Reinforcing Steel - Coated (Plan Quantity)	390310	lb	1.1	429,341.00	$0.96	$374,697.60

73	03310001P	Normal Weight Structural Concrete(Est. Lump Qty: 1075 cu yd)	1075	cu yd	485.30	521,700.00	$391.65	$421,023.75
74	03314000*	Light Weight Structural Concrete(Est. Lump Qty: 1304 cu yd)	1304	cu yd	628.99	820,200.00		$0.00
75	03371000*	Move Prefabricated Bridge	1	Lump	624,900.00	624,900.00		$0.00
76	03381000*	Cargill SafeLane HDX Overlay	26925	sq ft	10.3	277,327.50		$0.00
77	35750010	Flowable Fill	1625	cu yd	131	212,875.00	$124.80	$202,800.00
78	51200020	Structural Steel	546	lb	2.04	1,113.84	$2.00	$1,092.00
79	165260010	Electrical Work Bridges	1	Lump	23,210.00	23,210.00		$0.00
80	01571002*	Check Dam (6" Bag - Stone Filled)	7	Each	153.2	1,072.40		$0.00
81	15710030	Silt Fence	1450	ft	2.24	3,248.00	$2.33	$3,378.50
82	01571007*	Drop-Inlet Barrier (6" Bag - Stone Filled)	124	ft	44.75	5,549.00		$0.00
83	20750040	Geotextiles - Weed Barrier	3945	sq yd	2.17	8,560.65	$2.06	$8,126.70
84	23760010	Erosion Control Blanket	800	sq yd	1.77	1,416.00	$1.46	$1,168.00
85	29110015	Wood Fiber Mulch	113	1000sqft	54.75	6,186.75	$71.79	$8,112.27
86	29120010	Contractor Furnished Topsoil	12555	sq yd	3.54	44,444.70	$3.08	$38,669.40
87	02913001*	Rock Mulch (Type I)	2827	sq yd	9.12	25,782.24		$0.00
88	02913002*	Rock Mulch (Type II)	1118	sq yd	18.25	20,403.50		$0.00
89	02922004P	Broadcast Seed (Type I)	108	1000sqft	43.8	4,730.40	$55.30	$5,972.40
90	02922005P	Broadcast Seed (Type II)	5	1000sqft	109.5	547.5	$55.30	$276.50
91	02932003P	Plant - No. 1 Container	16	Each	147.9	2,366.40	$8.22	$131.52

92	02932005P	Plant - No. 5 Container	17	Each	251.9	4,282.30	$29.90	$508.30
93	02932011P	Plant - 6 ft	11	Each	560.6	6,166.60	$162.43	$1,786.73
94	02948001*	Landscape Boulders	60	Each	136.9	8,214.00		$0.00
95	03310003P	Structural Aesthetics (Above Base Line)	1	Lump	10,280.00	10,280.00		$0.00
96	16525004D	Highway Lighting System	1	Lump	18,120.00	18,120.00		$0.00
97	135530025	One 3-Inch Conduit	601	ft	13.25	7,963.25	$9.90	$5,949.90
98	135540010	Polymer Concrete Junction Box	2	Each	1,375.00	2,750.00	$690.28	$1,380.56
99	13561000P	Buried Electrical Cable for ATMS Power	465	ft	6.41	2,980.65		$0.00
100	13594002*	Remove Type 1Double junction Box	8	Each	87.65	701.2		$0.00
101	13594003*	Pre-Terminated Drop Cable Unit	2	Each	1,369.00	2,738.00		$0.00
102	13594005*	6 Strand SMFO Cable	3592	ft	1	3,592.00	$0.87	$3,125.04
103	13594013*	Fusion Splice	4	Each	44.3	177.2	$49.28	$197.12
104	13594014*	Type A Splice Enclosure	4	Each	1,278.00	5,112.00	$805.06	$3,220.24
						5,459,703.08		
						$2,296,899.49		$1,873,169.71
		Number of Items with State Average				78		
		Percent of items in analysis				75.0%		
		Percent of Cost in Analysis				42.1%		
		Silver Standard Ratio				1.23		
		Percent of Mob				7.7%		
		Percent of Traffic Control				3.5%		