Technical Memorandum

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Project:	Collection System Rehabilitation Project Basin 6 and 7
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Subject:	Alternative Delivery Design and Construction Methods

Introduction

The City of Sandy, Oregon (City) is planning to rehabilitate a significant portion of its wastewater collection system to control excessive rainfall-derived infiltration and inflow (RDII) that is overwhelming the downstream pipe and treatment systems' capacities. The City needs to accelerate the RDII Reduction Program implementation in order to reduce the peak wet weather flows to the treatment plant that are contributing to Oregon Department of Environment (DEQ) National Pollutant Discharge Elimination System (NPDES) permit compliance issues. Typically, municipal construction projects can take over a year, and often longer, to design and plan before any improvements are made in the field. The City desires to start construction during the late summer of 2022, significantly shortening the design effort. This memorandum reviews alternative delivery methods that could provide accelerated project delivery and recommends a customized approach for the City to meet its ambitious timeline.

Summary of Recommendations

Four delivery methods were reviewed for the City to design and construct pipe rehabilitation. The options included design-bid-build (DBB), design-build (DB), progressive design build (PDB) and construction management/general contractor (CM/GC).

A modified CM/GC method is recommended for the City to implement the RDII reduction in Basins 6 and 7. The approach can utilize the existing contract with Leeway Engineering Solutions to provide streamlined design services. Design will be done using existing GIS data to create simplified plan sheets. Surveys, geotechnical investigations, and utility locates will be limited to locations where excavation will be necessary to replace poor condition pipes. To meet the timeline, the CM/GC contractor would need

to be retained to provide input into the 30% design by late spring, starting with pre-construction services of inspection and selection of rehabilitation methods. This early work will be followed by the CM/GC contractor working with the designer to develop one early work package for acquiring materials and one final guaranteed maximum price work package for project construction.

The benefits of this method include an accelerated schedule compared to the DBB method and reduced effort on the part of City staff in contracting and contract management and greater cost certainty compared to the DB and PDB methods. Using the streamlined design approach will provide cost and time savings compared to all other methods.

Alternative Delivery Evaluation Method

The project delivery methods are evaluated based on criteria specific to the challenges and opportunities the City faces and the goals of the RDII Reduction Program. Each method has associated risks, such as the City's familiarity with procedures, staff availability, and cost, which are also considered in the evaluation and recommendation.

Project Challenges

In the broader context of the economy and business environment, there are several factors impacting the project and subsequent alternative contracting processes.

Global Pandemic - The greater context of project implementation is the SARS-CoV-2/COVID-19 global pandemic and it's associated with changes in everyday business activities throughout the country. The effort to slow the spread of infection instantly transformed business operations and shrunk the local, state, national and global economies. Changes continue every week, as Oregon updates recommendations on what workplaces should open and what health and safety measures citizens and workers should practice. These constant changes make it difficult to predict and plan for what will happen in the next few months.

For a construction project, these conditions present uncertainties in timing, availability of contractors, and future revenues of public agencies. Ultimately, the challenges associated with the pandemic are compounding the challenges of meeting the project schedule, making the simplification of the project delivery more essential to project success.

Time is the most critical factor in implementing this project, for the following reasons:

- The City at risk of violating their DEQ NPDES Permit if the project is not delivered on time, before the start of the rainy season.
- Delaying by a month or two potentially causes a much longer delay in project completion due to the seasonal construction cycle. A few months delay would likely extend the project into the next year and possibly into the next summer construction season.
- Lead times for equipment have been impacted by the global pandemic, increasing the risk of delays in delivery

Costs are a concern for the City as it balances the costs of RDII reduction with other improvements to the wastewater system and faces a dire economic forecast.

- Any pathway to reduce costs helps reduce the future increases in user rates and saves the community money. This is a small community facing a big financial lift to get its wastewater system in compliance with regulations.
- Supply chain issues and inflation have made material costs escalate significantly and provide unknowns on lead times to acquire materials and difficulty predicting construction costs as material costs are rapidly changing.

City Opportunities

While there are certainly several challenges facing the City, there are also opportunities to streamline the project delivery and minimize the impact of those challenges.

- The City already has completed the contracting process to get a design engineer on board.
- Use of mainline trenchless pipe rehabilitation minimizes the need for excavation. This minimizes the need for geotechnical investigation and detailed survey and reduces risks associated with open trench pipeline construction. Excavation will be required to rehabilitate some pipelines and laterals if their condition warrants full replacement. However, this will not be the standard approach and should apply to a limited number of locations.
- With the focus on trenchless, the design drawing requirements can be simplified, even eliminating the linework and profiles traditionally done in CAD. Plan view design drawings can be rendered with available GIS files, including utility locations, streets, curbs, tax lots, buildings and other relevant location-based information. This will save time and costs for preparing designs, allowing construction to start sooner.
- The City just completed a similar project on two other basins utilizing the CM/GC process with the same consultant. The learning curve for this project will be minimal due to the experience on the previous project.

Evaluation Criteria

The City is looking for a streamlined approach to project delivery that will eliminate unnecessary processes and allow tasks to move forward concurrently to efficiently implement the project. The advantages and disadvantages, as they relate to these goals and the City's resources, are considered for each project delivery method. The best delivery method best meets the following criteria, in order of importance:

1) Accelerated timeline of project delivery
2) Straightforward/simplified contracting
3) Cost efficiency
4) Reduced uncertainty overall, including risk of project not being delivered on time and of satisfactory quality

The methods are evaluated against each criterion on a scale from poor to best meeting each criterion. These are not ranking scores, so the same values can be used for more than one method in a given criterion. The overall method that best meets the criteria is the top-ranked method. This is not a strict scoring-only selection process, so additional advantages and disadvantages are incorporated into the reasoning for recommendation.

Alternative Delivery Method Evaluation

Overview of Delivery Methods

Design-Bid-Build (DBB)

DBB is the traditional project delivery approach. Because it is so commonly practiced, DBB is the most familiar approach for the majority of engineers. In DBB, the owner contracts with the design engineer separately from the construction contractor. These two contracts are sequential, meaning that the construction contract is bid after the completion of the design documents. This method requires the highest level of engagement of City staff and consultants, longest time from scoping of project to completion of construction.

Design-Build (DB)

The DB method is generally the fastest method to get a project from inception through startup. DB consists of a single contract for both design and construction. Because the method requires a single Contractor-Engineer team, less involvement is required from City but that also represents a loss of City control over the project. Clear project scope and outcomes defined at the outset of the contracting process are important in place of ongoing owner involvement.

Progressive Design-Build (PDB)

The Progressive Design-Build is another fast method that will allow the City to begin constructing its project early. PDB contracts with a Contractor-Engineer team, with some level of engagement and control by City while benefiting from Contractor input and resources. PDB also requires clearly defined project scope and outcomes.

Construction Manager/General Contractor (CM/GC)

CM/GC is a method that engages the construction contractor early. This approach allows some preparatory field work to be conducted during the design phase of the project and the construction contractor gives more input throughout the process. This early construction involvement saves time during the construction. CM/GC offers an accelerated schedule while keeping some engagement and control by the City.

The distinguishing characteristics of the four standard delivery methods are summarized in **Table 1**.

Table 1. Summary of Project Delivery Methods

	Contracting Structure

	DBB	DB	PDB	CM/GC
Construction Scope of Work / Design Responsibility	City	Contractor	Contractor	Joint
CCTV Responsibility	City	Contractor	Contractor	Joint (can be put on Contractor)
Lateral Investigation	City	Contractor	Contractor	Joint (can be put on Contractor)
City Staff/Consultant Level of Involvement	Highest	Lowest	Moderate	Moderate
Permits and Easements	City	Joint	City	Joint
Potential for high construction costs	Normal	Highest	Higher	Normal (greater cost certainty)
Availability of firms/bidders	Best	Low	Low	Good
Quality of construction	High	Medium	Medium	High
Public safety	Normal	High	High	High

Conceptual Delivery of RDII Reduction by Method

Design-Bid-Build (DBB)

The DBB approach requires two sequential procurement processes, one for design contract that is generally awarded on the basis of qualifications, and another for the construction that is awarded based on the lowest bid. **Figure 1** illustrates the responsibilities of the City and the contractors during the DBB process. As **Figure 1** shows, any investigation work (e.g., CCTV, manhole inspections, etc.) done prior to construction would be the responsibility of the City or the City's Designer. In DBB, there is limited interaction between the design and construction contractors, thereby putting the burden of management, support, and coordination, as well as responsibility for the design on the City. Because of the multiple roles filled by the City and the multiple procurement processes, this method requires the most involvement from the City, and the City takes on more risk. The time from scoping to construction is the longest for this method due to the separate and sequential procurement processes for the design and construction of projects. The primary benefit of this method is that it is commonly practiced and the most familiar approach for the majority of engineers. Given the available time to go through the process, this is often the go-to approach because it is well understood by owner-organizations that have systems set up to implement projects with this method.

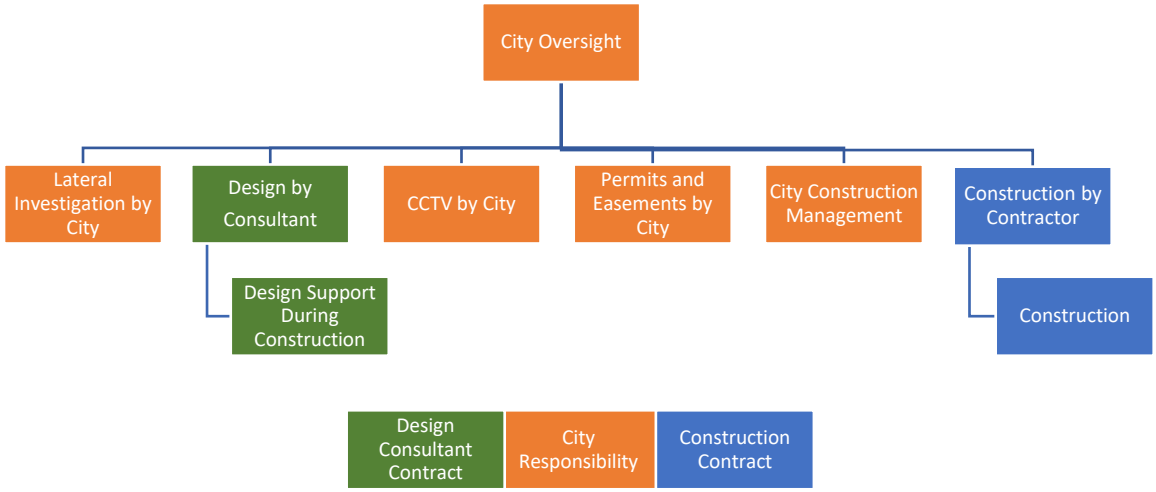

Figure 1. Design-Bid-Build Organization and Responsibility Chart

Design-Build (DB)

DB consists of a single contract team to complete both design and construction. The contract would include preconstruction investigations that could be completed during the design process, as illustrated in **Figure 2**. This contract is negotiated as a fixed price agreement. The method requires a single team with greater scope of services, so less involvement and control are needed from City. To ensure that a satisfactory project is delivered, clear project scope and outcomes defined at the outset of the contracting process are important in place of ongoing owner involvement. The incentive for constructors with the DB method is to build the project as cheaply and quickly as possible to meet the definitions of the project scope and outcomes. While this results in quick turnaround from solicitation to startup, the fixed price for the whole project can lead to higher construction costs without a higher quality product. Another potential disadvantage to this method is that the requirement of a team with capabilities to design and construct will limit the available firms that will compete for the work.

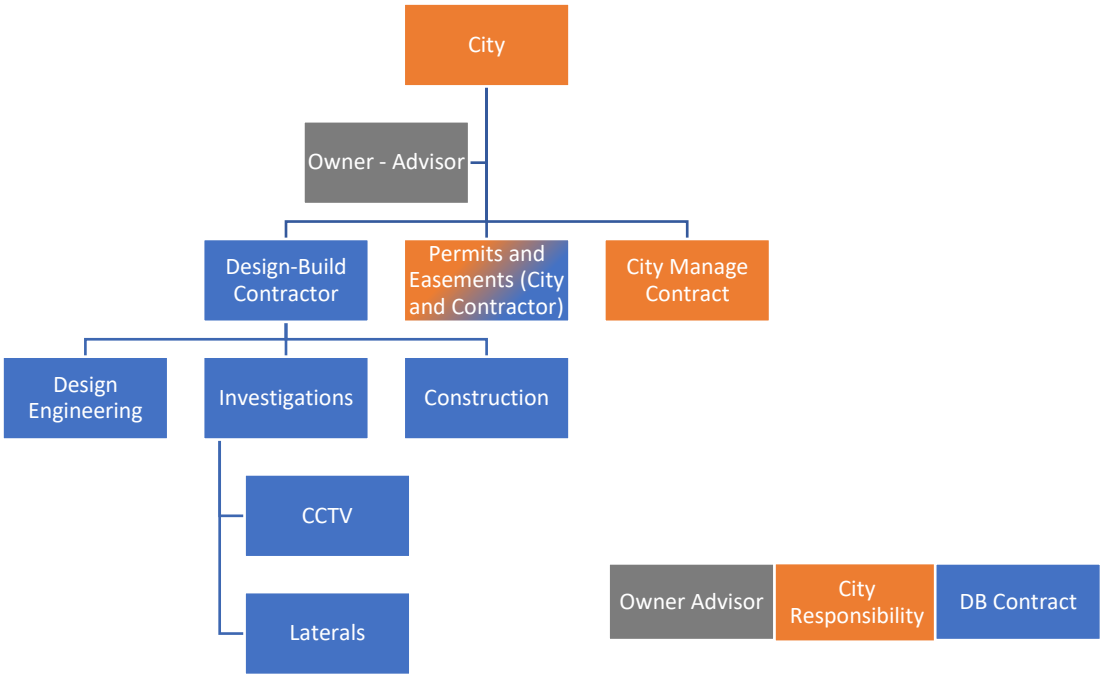

Figure 2. Design Build Organization and Responsibility Chart

Progressive Design-Build (PDB)

The PDB method is similar to the DB method in that the City would go through a single procurement process with a design-construction firm, as illustrated in **Figure 3**. The main difference between PDB and DB is that in PDB, the cost of construction is determined during design and is contingent upon a price agreement between the PDB contractor and the owner. Construction can take place over in multiple cycles authorized by an amendment for each cycle. The City would be more involved with permits and easements, as well as reviews throughout the design process. This method requires a qualified Contractor-Engineer team and a moderate level of engagement and control by the City. The benefit of this method is that it would allow the City to begin constructing its project early, while in theory giving the City more opportunity to control costs compared to the DB method. However, in practical terms, the risk of high construction costs could increase because the City has little leverage in cost negotiations when failed negotiation would amount to failing to deliver the project on the regulatory schedule. Like with the DB method, a clearly defined project scope and outcomes will be critical to delivering a satisfactory project with PDB.

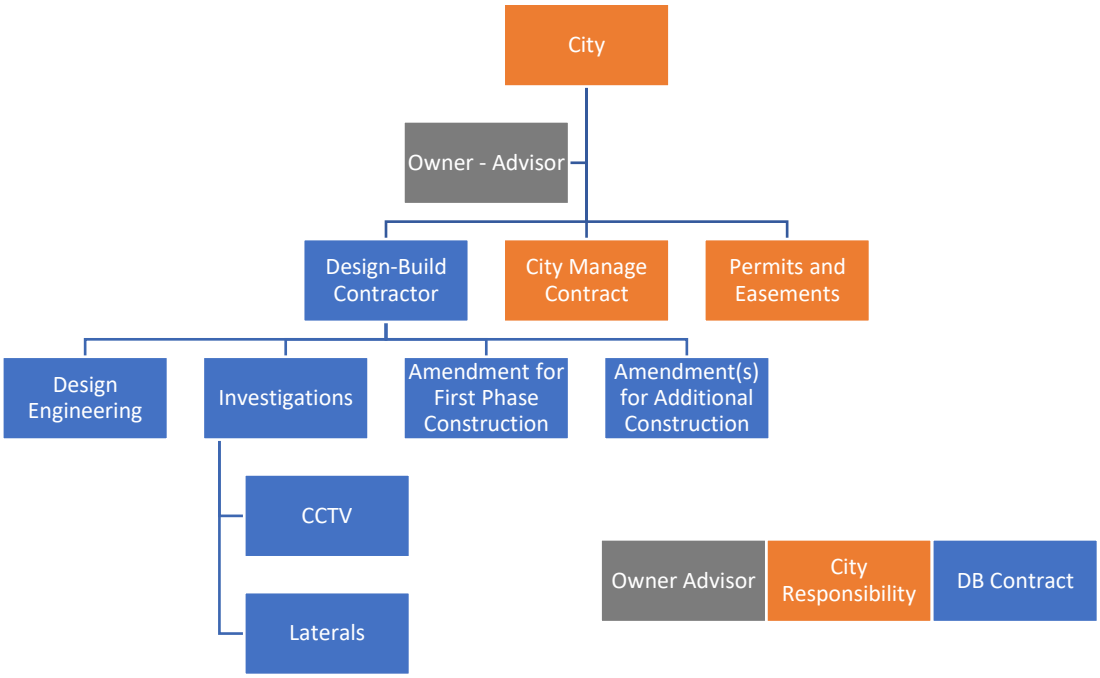

Figure 3. Progressive Design-Build Organization and Responsibility Chart

Construction Manager/General Contractor (CM/GC)

CM/GC is a method that involves retaining the construction contractor early, but through a separate contract from the design consultant. The CM/GC firm is selection is usually based on qualifications, with the construction cost being agreed on by negotiation during design, either as guaranteed maximum or fixed price. The roles and responsibilities of CM/GC are illustrated in **Figure 4**. GM/GC is similar to DBB in some ways, but differs in the potential for improved delivery speed, reduced construction risk on the City, and more cost certainty. The construction contractor functions as both the construction manager and the general contractor. With this early and expanded role, the construction contractor can provide input and support during design, reducing the level of City staff involvement required. Design-phase construction support can include conducting preparatory field investigations and input from the construction contractor on the design. This early construction involvement would save time in transitioning from design to construction, streamlines construction, and increase cost certainties by reducing surprises and changes during construction. It is also a benefit to the City to negotiate construction costs when the project scope is more clearly defined. Although the City has less leverage in the cost negotiations with the construction contractor in this method compared to DBB, there could still be an opportunity to procure another contractor for project construction in case the City and original contractor could not come to an agreement. CM/GC offers an accelerated schedule while keeping some engagement and control by the City and offering greater cost certainty (fewer change orders or claims, often resulting in final project costs that are equivalent to DBB).

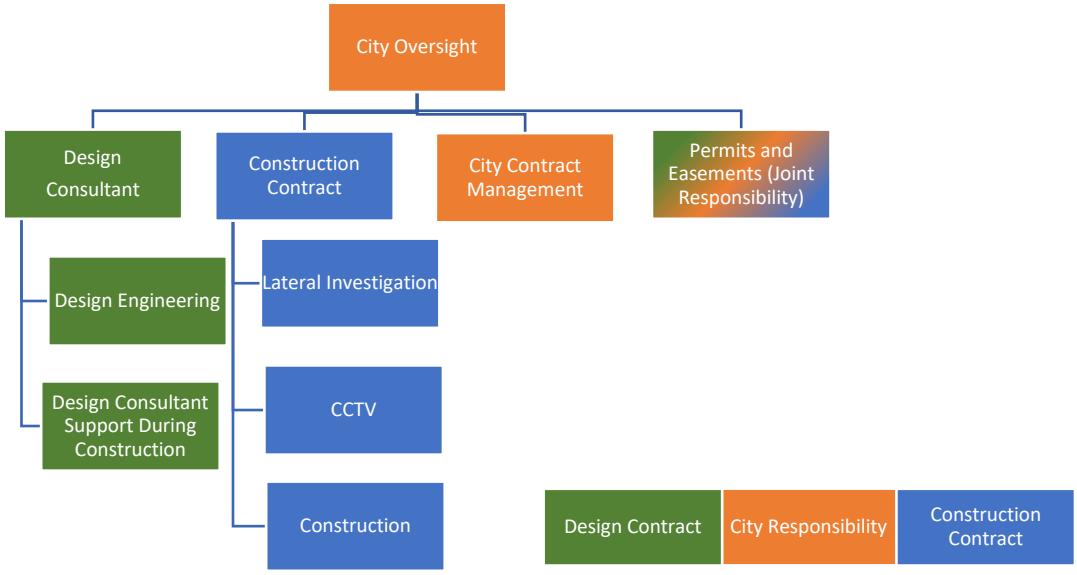

Figure 4. Construction Manager/General Contractor Organization and Responsibility Chart

Modified CM/GC

A customized CM/GC approach would leverage the City's opportunities discussed above, resulting in the most streamlined project delivery. The design effort would be reduced by minimizing geotechnical investigations and surveys and simplifying the design process. The design consultant role could then be filled by the City's existing consulting engineer who has already been procured to support collection system improvements, thereby reducing procurement time and effort. A CM/GC construction contract would be required, to support the project during design and carry out the construction. The City would hopefully be able to take advantage of the competitive construction market increasing the availability and competition of CM/GC contractors. This approach would reduce the procurement effort to similar levels needed for DB or PDB, while getting the benefits of early construction contractor involvement, reduced demand on staff, and faster overall delivery.

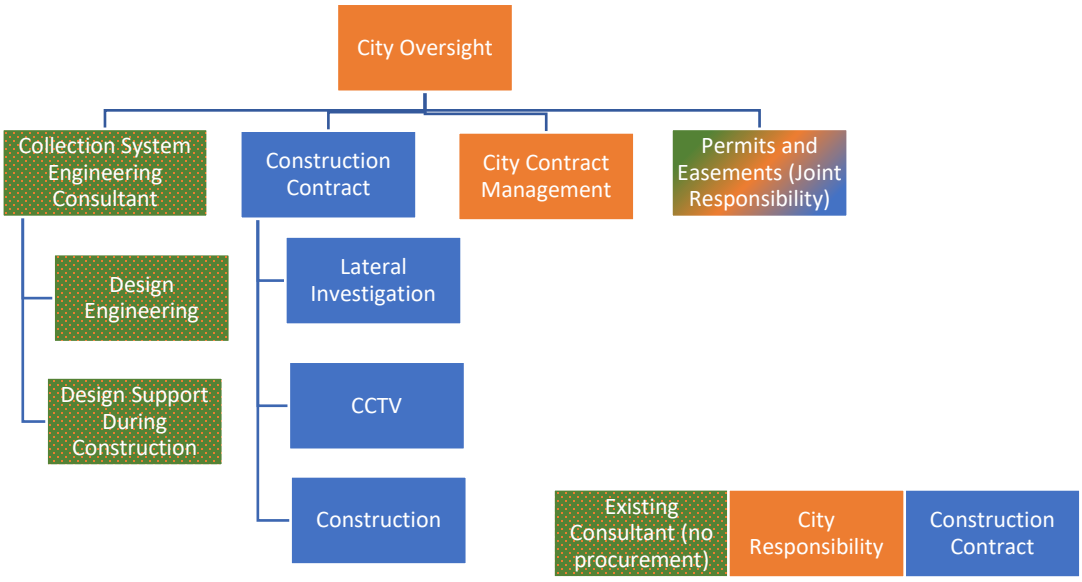

Figure 5. Modified CMGC Method Organization and Responsibility Chart

Comparison of Delivery Methods

The advantages and disadvantages of each method are described in this section. The criteria evaluation for all methods is shown in **Table 2**. Comparison of advantages and disadvantages by method is tabulated in a matrix in Table 4.

The DBB method is the slowest method, but most predictable. Another disadvantage to DBB is the increased demand on staff to manage multiple procurements, contracts, and to be responsible for handing off the design work to the construction contractor. Given time for the process, the benefit can be high-cost certainty and high availability of firms to compete for the project.

While DB would be the fastest way to deliver the project and requires the least staff involvement, the cost uncertainty and the need for clear and defined scope at the outset of the project outweighs its speed advantages. The City needs a method that can allow investigations to proceed during design, feeding back to methods selection, other design decisions, and construction costs negotiations.

The PDB method strikes a balance between staff involvement, accelerating the delivery timeline and providing some cost certainty. The disadvantage is in that the scope definition is still important early on to achieve the best cost certainty and construction price negotiations during design may not lead to better costs.

CM/GC offers another balanced method, with early procurement of the construction contractor to support pre-construction fieldwork leading to a moderately accelerated timeline. The staff involvement

and contracting responsibilities are higher compared to DB and DBB, but the tradeoff is increased cost certainty and lower risk of failing to deliver a satisfactory project.

The modified CM/GC leverages the City's opportunities to further accelerate the delivery timeline and reduce costs of the standard CM/GC method. This approach minimizes the demands on City staff, reduces the contracting complexity, and saves cost on design. By bringing a CM/GC contractor on early, pre-construction work can begin at 30 percent design and significantly reduce the delay between completion of design and notice to proceed with construction.

Table 2. Project Delivery Methods Against Evaluation Criteria

	Project Delivery Method				
Criteria	**DBB**	**DB**	**PDB**	**CM/GC**	**Modified CM/GC**
Accelerated Timeline	Slowest	Fastest	Faster	Medium	Fastest
Simplified Contracting	Most Complex	Simplest	Simpler	More Complex	Simplest
Cost Efficiency	Good	Low	Moderate	Good	Best
Uncertainty and delivery risk	Lowest	High – need clear scope at outset	Moderate – scope definition still important	Low	Low
Evaluation Key	Poor	Fair	Moderate or Neutral	Good	Best

Recommended Project Delivery Method

The recommended project delivery method for the City's RDII Reduction Program is a modified CM/GC. CM/GC is also a good choice with many advantages over the other methods for this project. By taking advantage of some of the opportunities unique to this project, the City can further streamline the project and compress the timeline. The specific steps listed in **Table 3** are recommended.

Table 3. Recommended Implementation Steps

Step	Benefit to City
Simplify design approach (with readily available GIS, no pipe profiles or CAD, minimal geotech and survey)	• Cost savings in design work • Quicker project completion

Step	Benefit to City
Use the consulting engineer on-hand for design	• Reduces procurement • Time savings in that consultant already on board and ready to begin work • Simplified Design
Bring the CM/GC contractor on board at 30%. Early Work Package will include preconstruction inspection and selecting rehab methods	• Relieves city staff from additional involvement in things like investigations and CCTV • Speeds up construction process as investigations are done during design
The designer and CM/GC contractor work together to develop final design package, contract drawings and requirements	• Contractor working with design engineer means more confidence in plans and constructability, right construction methods

References

Hanifin Bonner, Linda, ed. 2016. Water and Wastewater Design-Build Handbook. Fourth Edition. Water Design-Build Council.

Table 4. Advantages and Disadvantages for Each Delivery Method

DBB		DB		PDB		CM/GC		Modified CMGC	
Advantage	**Disadvantage**	**Advantage**	**Disadvantage**	**Advantage**	**Disadvantage**	**Advantage**	**Disadvantage**	**Advantage**	**Disadvantage**
City familiarity makes it the simplest procurement	Two separate procurements	Single procurement means less burden on City staff in contracting process and management.	May require special permissions to implement	Single procurement means less burden on City staff in contracting process and management.	May require special permissions to implement		Two separate procurements, but still may need special permissions to implement	One procurement if using existing available consulting engineer for design	
	Time from scoping to delivery longest	Single procurement saves time. This is the fastest method.		Fast method. Construction starts sooner and overall project timeline accelerated.		Accelerated schedule		Quicker compared to CMGC	
	More responsibility by City, including plans, specs, supporting investigations and contract management	Least involvement required from City. City not responsible for designs.	City loses some control that may be desirable Clear project scope and outcomes need to be defined at the outside of project to ensure satisfactory delivery	Early contractor engagement City more engaged than in DB	Clear project scope and outcomes need to be defined at the outside of project to ensure satisfactory delivery	Early contractor engagement Construction scope can be clarified later in project when conditions better understood.		Early contractor engagement Construction scope can be clarified later in project when conditions better understood.	
Familiarity of engineering professionals– reliable and predictable process			Less competitive - Greater scope and more breadth of team capability means fewer firms qualified		Less competitive - Greater scope and more breadth of team capability means fewer firms qualified	More competitive than other collaborative methods (DB and PDB)		More competitive than other collaborative methods (DB and PDB)	
Lower cost risk/higher cost predictability			Fixed price has potential for high cost	Can be lower cost than DB method because construction cost is negotiated during design	Still more risk than DBB and CM/GC	Lower cost risk than DB and PDB,	Less cost certainty than DBB	Lower cost risk than DB and PDB. Cost savings can be realized by modifying delivery approach slightly.	Less cost certainty than DBB