3B

HALTON REGION
Integrated Master Plan

APPENDIX 3B

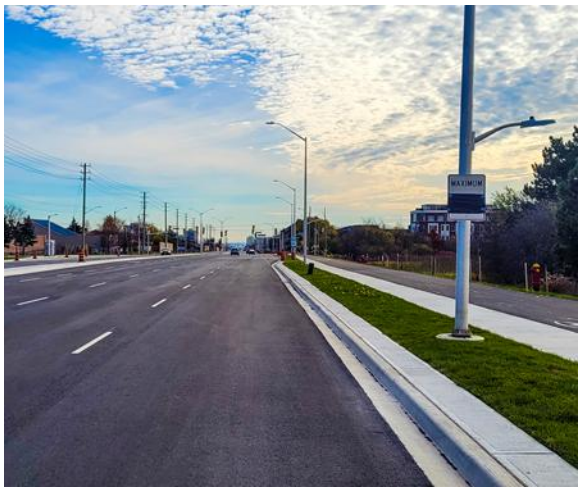
Cost Estimation Framework Tech Memo

Halton Region

Integrated Master Plan

Water, Wastewater and Transportation

Costing Framework
Technical Memo



Prepared by: GEI Consultants Canada Ltd.
Contact person: Chris Hamel – Senior Vice President
E: CHamel@geiconsultants.com
Royal Centre, 3300 highway no. 7
Suite 402, Vaughan, Ontario, L4K 4M3
Phone: 416 703 0667

Halton REGION

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1.0 Introduction

Halton Region has undertaken an Integrated Master Plan (IMP) to develop the next region-wide Water, Wastewater and Multi-Modal Transportation Master Plans. The outcome of this work is a long-term integrated servicing strategy for Regional infrastructure to accommodate future growth to 2051. This IMP provides the strategies and tools required to meet future water, wastewater, and transportation infrastructure needs beyond 2031.

The IMP ensures that water and wastewater infrastructure and services are effectively planned and implemented to maintain appropriate levels of service for residents and businesses as the Region continues to grow. In parallel, the development of a robust multimodal transportation network supports Halton Region's long-term vision by accommodating increasing travel demand and enhancing connectivity. Together, these infrastructure strategies have been developed to align with Local growth priorities and remain flexible to adapt to evolving needs through Halton's Enhanced Growth Monitoring process.

A key component of this Master Plan is the development of a consistent and transparent costing framework. The IMP costing framework builds upon the methodology used in the Region's 2022 Development Charges (DC) Update, while incorporating refinements, for example updated unit rates.

This Technical Memorandum provides an overview of the costing framework for water and wastewater infrastructure projects. A separate memorandum will address the costing framework for transportation infrastructure projects.

1.1 Master Plan Level Cost Estimates

Cost estimates evolve over the course of a project as the level of definition increases. At the IMP stage, estimates are generally considered Class 4 or Class 5 under the Association for the Advancement of Cost Engineering (AACE) classification system, with the majority of estimates prepared at the Class 4 level. These estimates provide order-of-magnitude costs that are suitable for long-range planning but carry a wider accuracy range given the limited project definition available at the planning stage.

As projects advance through the MCEA study process, preliminary design, and detailed design, the level of project definition increases and the accuracy of cost estimates improve. When more advanced estimates are available, such as those prepared during detailed design or from other completed representative projects, these values are used in the IMP in place of planning-level estimates, as they provide greater reliability.

This relationship between project definition and estimate accuracy is illustrated in **Figure 1**.

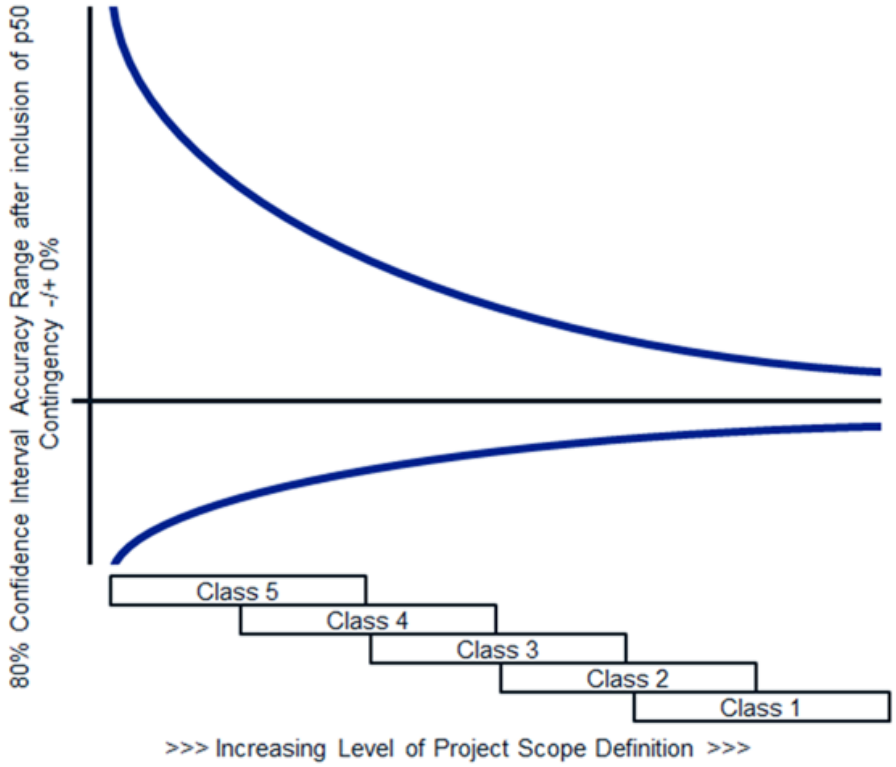

Figure 1 – Cost Estimate Accuracy vs Level of Project Definition

Source: AACE® International Professional Guidance Document No. 01. GUIDE TO COST ESTIMATE CLASSIFICATION SYSTEMS

1.2 Cost Estimates Classification

To provide consistency and clarity, the IMP cost estimating classifications generally follows the AACE (Association for the Advancement of Cost Engineering) International cost estimate classification system. This framework defines the level of accuracy that can be expected at different stages of project development, based on the maturity of project definition, the intended purpose of the estimate, and the methods used to prepare it.

Table 1 summarizes the five estimate classes based on the AACE International Cost Estimate Classification System, including their typical purpose, methodology, and expected accuracy ranges.

Table 1 – Cost Estimates Classification

Class	Project Definition (% of design complete)	Typical Use	Methods Used	Expected Accuracy Range
Class 5 – Order of Magnitude	0%–2%	Early screening, long-range planning, feasibility studies	Parametric models, capacity factors, analogy to past projects	-20% to -50% / +30% to +100%
Class 4 – Conceptual	1%–15%	Feasibility studies, concept evaluation, preliminary business planning	Parametric models, some unit costs, factored estimates	-15% to -30% / +20% to +50%
Class 3 – Budget	10%–40%	Budget authorization, initial cost control	More detailed unit costs, partial quantity take-offs, vendor budget quotes	-10% to -20% / +10% to +30%
Class 2 – Control	30%–75%	Project control during design, detailed budgeting	Detailed unit costs, quantity take-offs, vendor/fabricator quotes	-5% to -15% / +5% to +20%
Class 1 – Definitive	65%–100%	Tendering, contract award, final control estimate	Detailed unit pricing, contractor bids, fully developed quantities	-3% to -10% / +3% to +15%

2.0 Water and Wastewater Cost Estimation Framework Overview

The following sections describe the costing framework developed for water and wastewater projects in the IMP. The framework reflects both project-specific characteristics and the components that contribute to total project cost. It accounts for factors such as project complexity, area conditions, and project type, which influence construction environment, effort, and risk, and ensures that unit costs are applied consistently while recognizing the variability inherent in project delivery.

The framework also defines the cost estimate components, covering preliminary planning, environmental assessments, detailed design, property, and construction, that together form the total project cost. In addition, updated unit rates reflecting recent market conditions and available tender data have been incorporated to better represent current construction trends.

2.1 Project Details

Project details provide the context for how individual cost estimates are developed within the IMP framework. Factors such as project complexity, the area in which a project is located, and the type of project influence both the base construction costs and the additional factors that must be applied. Recognizing these details helps ensure consistency across estimates while allowing the framework to reflect the practical differences between projects.

2.1.1 Project Complexity

Project complexity is an important factor in determining appropriate cost estimates. Complexity reflects the overall level of effort required to plan, design and construct a project, and accounts for additional potential construction risks and challenges that may be encountered throughout the project implementation.

In the IMP, as in past frameworks, complexity has been categorized as low, medium, or high, with each level applied consistently across projects of similar scope. A low-complexity project may involve straightforward, short linear works with minimal external constraints and generally a lower risk of cost increases. Medium-complexity projects typically involve moderate design or construction challenges, such as longer linear infrastructure with multiple service connections or site coordination. High-complexity projects include potentially significant design and construction challenges, such as large pumping stations, deep trunk sewers, or projects requiring extensive staging and coordination with other infrastructure. The high complexity projects are seen to have more potential unknowns that may result in design and/or construction cost increases.

Assigning complexity categories allows estimates to incorporate an appropriate range of engineering, contingency, and implementation factors, while maintaining consistency in costing across the capital program.

Table 2 provides general definitions of project complexity: High, Medium, and Low.

Table 2 – Project Complexity Descriptions

Project Complexity	Complexity Description

High Complexity	• Large in scale, scope and ultimately, cost.
	• Uncommon project not frequently constructed.
	• Complex project details that, in general, have high uncertainty and may potentially change in later stages of the project (EA, scoping study, design, construction).
	• Multiple options and project details for design & construction (alignment, dimensions, facility layout, construction methodology) that are not yet confirmed.
	• Other anticipated project details that can contribute to consideration as a High Complexity project:
	  ○ Existing utility and linear infrastructure conflicts that may not be located at the Master Planning Stage
	  ○ Unknown subsurface conditions – Soil, rock, groundwater
	  ○ Significant restoration
	  ○ Environmental features that may require additional approvals and/or mitigation during construction
	  ○ Potentially long construction duration
	  ○ Linear – Deep sewer/watermain/forcemain
	  ○ Linear – Large Diameter
	  ○ Facility – Deep Wet Well
	  ○ Facility – Large Capacity (Reservoir, Elevated Tank, Pumping Station)
	
	The nature of the project details in a high complexity project (e.g., many unknowns, utility conflicts, large diameter, high base construction costs, etc.) necessitate the inclusion of further additional costs to account for the risk of construction cost increases.

Medium Complexity	• Relatively moderate in scale, scope and ultimately, cost. • Most project details generally fall in between High and Low complexity. • Medium complexity projects may have some elements that fit the High Complexity category, while some elements falling within Low complexity category. (e.g., short section of small diameter watermain constructed within built up area with several utility conflicts, small-medium WWPS in a redevelopment area).

Low Complexity	• Smaller in scale, scope and ultimately, cost.
	• Common project frequently constructed.
	• Straightforward project details that, in general have low uncertainty and are not likely to change in later stages of the project (EA, scoping study, design, construction).
	• Most options and project details for design & construction (alignment, dimensions, facility layout, construction methodology) that are generally confirmed at this stage.
	• Other anticipated project details that can contribute to consideration as a Low Complexity project
	  ○ Few existing utility and linear infrastructure conflicts – generally associated with greenfield/rural construction
	  ○ Subsurface conditions are known or assumed with high level of certainty
	  ○ Minimal restoration required
	  ○ Little to no environmental features within project construction area
	  ○ Short anticipated construction duration
	  ○ Linear – Shallow sewer/watermain/forcemain
	  ○ Linear – Small diameter
	  ○ Facility – Shallow Wet Well
	  ○ Facility – Small Capacity (Reservoir, Elevated Tank, Pumping Station)
	
	The nature of project details in a low complexity project (e.g., few unknowns, few utility conflicts, small diameter, low base construction cost, etc.) does not necessitate significant additional costs.

2.1.2 Area Condition

Area condition is another factor that influences the total cost of a project. The construction environment, whether rural, suburban, or urban, affects the level of effort required to deliver infrastructure and is reflected through an uplift factor applied to the base construction cost.

- Rural – Greenfield construction
- Suburban – Developed built up environment
- Urban – Heavily developed built up environment

These factors account for the increased complexity of construction in more developed environments, such as traffic management, utility coordination, restoration requirements, and site constraints. Applying area condition factors results in estimates that are more reflective of construction in different construction environments across the Region.

2.1.3 Type of Projects

The costing framework distinguishes between different types of projects, as the nature of the work directly affects the way costs are estimated. For the purposes of the IMP, projects are categorized into three main project types: linear, vertical, and other. Differentiating between these project types is important because unit rates are developed and applied specifically for each category, resulting in cost estimates that reflect the unique characteristics of the work.

- **Linear Projects**
  Linear infrastructure represents the majority of water and wastewater works and includes:
  - Sanitary Sewers (shallow and deep)
  - Watermains
  - Forcemains
- **Vertical Projects**
  Vertical infrastructure consists of facilities required to support system capacity, treatment, and storage, including:
  - Water Pumping Stations
  - Sanitary Pumping Stations
  - Reservoirs
  - Elevated Tanks
  - Wastewater Treatment Plants
  - Water Treatment Plants

- **Other Projects**
  Certain projects fall outside of conventional linear or vertical classifications but are still integral to system performance. These include:
    - Studies (e.g., master plans and MCEAs)
    - Pressure Reducing Valves (PRVs)
    - Real-Time Control (RTC) installations
    - Other specialized works not captured in the above categories

This classification ensures that the costing framework applies the most appropriate methodology to each project type, with unit rates tailored to the specific planning, design requirements and construction methods involved.

2.2 Cost Estimates Components

The water and wastewater costing framework is organized into a series of components that together form the Total Project Cost. These components capture the full range of project activities from early planning through construction, ensuring that estimates reflect both direct construction costs and the supporting factors required to implement projects.

The key cost estimate components for water and wastewater projects include:

- **Preliminary Planning** – Costs for feasibility or early planning studies that help define project needs and scope.
- **Environmental Assessment (EA)** – Costs associated with Schedule B and Schedule C Class EA studies, carried as fixed lump sums.
- **Detailed Design** – Costs for design studies and investigations, external consultant engineering, in-house design fees, and related activities required to advance a project to construction.
- **Property** – Costs for land acquisition
- **Construction** – Costs for base construction (derived from unit rates), construction environment factors (rural, suburban, urban), additional construction factors (e.g., mobilization, traffic, bonding), in-house construction fees, and construction contingency.
- **Total Project Cost** – The combined estimate, which may also incorporate available estimates from other studies or detailed design where they provide a higher level of accuracy.

This framework ensures a consistent and transparent approach to cost estimation across all water and wastewater projects, while providing the flexibility to use more detailed project-specific information where available.

The detailed breakdown of water and wastewater cost estimate components applied in the IMP is summarized in **Table 3**.

Table 3 – Water and Wastewater Cost Estimate Components

Component	Approach
1. Preliminary Planning	
A - Feasibility Study	Lump sum - $250,000
2. Environmental Assessment	
B - Environmental Assessment	Schedule B - $1,000,000 Schedule C - $1,500,000
3. Detailed Design	
C - Design Studies and Investigations	0.5% - 2% x (L) for geotechnical, hydrogeological, etc.
D - External Consultant Engineering	10% - 15% x (L) based on project complexity
E - In-House Design Fees	5.0% - 7.5% x (L) based on project complexity
F - Total Detailed Design	**C + D + E**
4. Property	
G - Property/Land Acquisition	Based on unit rate per land use categories
5. Construction	
H - Base Construction Cost	Linear Unit Rate x Length Vertical Unit Rate x Capacity Other
I - Construction Uplift	Rural: 0% x (H) Suburban: 20% x (H) Urban: 30% x (H)
J - Additional Construction Cost	10% – 20% x (H + I) based on project complexity.
K - Construction Contingency	10% x (H + I + J)
L - Sub-Total Construction Base Cost	**(H + I + J + K)**
M - In-House Construction Cost	5.0% - 7.5% x (L) based on project complexity
N - Total Construction Cost	**L + M**
O - Non-Refundable HST	Applied to all components except for in-house fees
6. Total Project Cost	**A + B + F + G + N + O**

2.3 Unit Rates Update

Unit rates are a fundamental input to project cost estimates, as they represent the cost of constructing a unit length or capacity of infrastructure. To ensure that the IMP provides reliable cost estimates, all unit rates were reviewed and updated as part of this study. The update reflects recent trends in construction costs, including inflation and labour market conditions, resulting in estimates that are in alignment with current market conditions.

The update covered all major types of water and wastewater infrastructure. For linear projects, this included watermains and sanitary sewers at both shallow (<5m) and deep (5-7m) depths, as well as tunnelling. For vertical projects, unit rates were updated for water pumping stations, wastewater pumping stations, reservoirs, and elevated tanks. For treatment facilities, where recent tender data is limited and project configurations vary widely, high-level order-of-magnitude estimates were developed based on subject matter expert input and comparable industry benchmarks. Each type of infrastructure was assessed using the most appropriate data sources and methods available, recognizing that the level of information varied across project types.

Recent tender information formed the primary basis for the unit rate updates, with supplementary approaches such as cost curves and engineering expertise applied where tender data was limited. All tender values were normalized to 2025 dollars for consistency across project categories.

The outcome of this update is a set of unit rates that are specific to each type of infrastructure and reflective of current construction environments. These rates improve the accuracy and comparability of project cost estimates and provide a sound basis for long-range financial planning. The updated unit rates form the foundation for calculating base construction costs within the IMP costing framework.

3.0 Conclusions and Recommendations

Overall, the costing framework developed for the Integrated Master Plan provides a clear and consistent basis for estimating water and wastewater infrastructure costs at the master planning level. The framework reflects the appropriate level of project definition available at this stage and applies a structured approach that considers project complexity, construction environment, project type, and updated unit rates.

By establishing a consistent methodology across the capital program, the framework supports informed decision-making, long-range financial planning, and prioritization of infrastructure investments to support growth to 2051. As projects advance through subsequent planning, environmental assessment, and design stages, the framework is intended to be refined using more detailed, project-specific information, ensuring that cost estimates continue to evolve alongside project definition.