

Estimating the Capital Cost of ♦ Wastewater System

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Abstract

This study is focused on developing a general cost model to estimate the capital cost of a new Wastewater System. The capital cost includes material and installation costs for pipeline, manholes, pump stations and treatment plant installation. The cost of manholes and pipelines is dependent not only on the size of the conveyance system, but also the depth at which it is laid out. Multiple regression analysis is performed and correlation is developed between various factors while developing the model, which can best estimate the capital cost of a Wastewater system.

1. Introduction

A sanitary sewer system is one of the most expensive assets of a city; hence, a good estimate of the capital cost of the system is necessary based on the needs of the community. In developing the cost model it is important to identify the variables. The data available in the literature and the data provided by the City of Victoria are used to verify the relationship developed in this study. Default cost data is provided in the model but the user can input relevant data specific to the location.

2. Objective

The objective of this study is to develop a model to estimate capital cost of a city ♦s Wastewater System:

1. To identify the major components of a sewer system and important parameters that influences the capital cost.
2. To develop mathematical models involving the important parameters identified.
3. To identify various miscellaneous costs involved in construction of a sewer system.

3. Model development

A model is developed by breaking down the cost of construction into three components. 1) Material cost, 2) Installation cost, 3) Miscellaneous cost (involves administrative and other expenses).

$$\text{Total cost of construction } (T_C) = C_{PM\diamond} + C_{L\diamond} + C_{MH\diamond\diamond} + C_{TP} + C_{PS} + OC + M$$

$C_{PM\diamond}$ = Total cost of pipe material.

$C_{L\diamond}$ = Total cost of pipeline Installation.

$C_{MH\diamond}$ = Cost of Manhole Material and Installation.

$C_{TP\diamond}$ = Cost of Waste Water Treatment Plant (WWTP) based on capacity in million gallons per day ♦♦

♦♦♦♦♦♦♦♦♦♦ (MGD) (Includes material and installation cost).

♦ $C_{PS\diamond}$ = Cost of pump stations based on capacity in MGD (Includes material and installation costs).

OC = Other Costs (Includes major cost components like trench system design, mobilization of manpower and machinery, repair existing roads, Traffic control, etc.).

M = Miscellaneous (Includes minor cost components like site preparation, taxes, etc.).

1) Pipe material cost: $C_{PM\diamond} = \sum_{i=1}^n w_i D L_i^*$, where D is the diameter of the pipe and w is the cost parameter which varies with pipe diameter and location.

2) Pipe Installation Cost (Installation less then 20 feet of depth: $H < 20$ ft): $C_{Li\diamond} = a_1\diamond + b_1 D_i + g_1 H_j$, D is the diameter of the pipe and H is the depth at which the pipe is installed. a_1 , b_1 and g_1 are cost parameters that vary from place to place.

$$\text{Total Pipe Installation Cost} = \sum_{i=1}^n \diamond C_{Li} (D_i, H_j) L_i^*$$

♦Pipe Installation Cost (Installation more then 20 feet of depth: $H > 20$ ft): Based on the available data following relationship

was observed $C_{Lj} = a_2 + b_2 D_i + g_2 H_j + d_2 D_i H_j$,

$$\text{Total Pipe Installation Cost} = \sum_{i=1}^n C_{Li}(D_i, H_j) L_i^*$$

3) Manhole cost: Based on data available the cost for each manhole can be best represented as

$$C_{MHk} = a_3 + b_3 D_k + g_3 H_k$$

$$\text{Total Manhole Cost} = \sum_{k=1}^p C_{MHk} N_k^*$$

4) Cost of Wastewater Treatment plant (C_{TP}) and Cost of Pump station (C_{PS}) will be determined based on their capacity in MGD.

$C_{TP} = a_4 + b_4 C_1$, where C_1^* is the Capacity in MGD.

$C_{PS} = a_5 + b_5 C_2$, where C_2^* is the Capacity in MGD.

The values of a_i , b_i and g_i is determined by using multiple regression analysis on actual sets of data.

L_i^* , N_k^* , C_1^* and C_2^* are available from CIGMAT/UH Life Cycle Cost Model.

4. Conclusion

This is only the preliminary effort to quantify the costs related to each major component of Wastewater system. Further literature search is underway to develop more comprehensive cost relationships.

5. Acknowledgements

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6. References

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If you have any questions, please contact [Dr. C.Vipulanandan](#)

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