# Record of Revision

<table>
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<th>Revision No.</th>
<th>Date</th>
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<tr>
<td>0</td>
<td>May, 2021</td>
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</tbody>
</table>

Standards Committee Approval:

Mark Belcik, Principal Engineer  
Wastewater Engineering

Departmental Approval:

Ryan Welsh, Deputy Director  
Wastewater Engineering
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1 Overview

An effective estimate can be used to establish a realistic budget and provide accurate information for cost monitoring and progress measurement throughout a project’s execution. The Project Costing Manual (PCM) is intended to document the approach used by the Metropolitan Sewer District of Greater Cincinnati (MSD) to estimate overall project costs. The purpose of this document is to establish standard definitions and processes necessary to estimate various components of a project’s cost. Standardization is intended to produce not only more accurate estimates, but also greater confidence in those estimates. While professional judgment is critical, the standards established in this document should be used as the basis for all estimates created by MSD staff and consultants.

1.1 Project Cost Definitions

In order to understand the relationship between various project cost estimating documents, it is necessary to clearly define each stage of the cost provided so that it is understood what is included in each. The definitions shown in Figure 1 are as follows:

- **Base Construction Cost** is the actual costs for labor, material, equipment and other costs to create the asset.

- **An Opinion of Probable Construction Cost (OPCC)** is the Base Construction Cost plus the contractor markups and other incidentals that are included in the contractor’s bid estimate for the project to be completed. This is also sometimes referred to as Total Construction Cost.

- **Project Cost** is the OPCC plus the addition of the indirect costs necessary to complete the construction and startup of an asset. These indirect costs include Planning and Design, certain construction services performed by a Design consultant, Right of Way (ROW) costs, and other Miscellaneous costs.

- **Life Cycle Cost** is the Project Cost plus the operation and maintenance costs over the life of the asset. This is used to compare alternatives over the life of the assets. Life Cycle Costs are usually reported in terms of their present value.

![Figure 1: Illustration of Project Cost Buildup](image-url)
For clarity, this Manual focuses on project estimates. Estimates represent the best approximation of what a project should cost. These estimates can then be taken to the Board of County Commissioners (BoCC). Through a legislative process, the BoCC can use estimates to establish budgets that determine how much MSD can spend. In other words budgets are intended to be binding while estimates are not. When possible, users should be careful to distinguish between estimates and budgets.

1.2 Financial Analysis Team

Because it is necessary to incorporate “lessons learned” from the previous year performance analysis and update values within this manual based on economic fluctuations, a team will be assembled by the Standards Committee, to update the PCM annually. The update will be completed during the first quarter of the year by the Financial Analysis Team and will be led by a chair appointed by the Standards committee. This team may be comprised of the division heads (and/or personnel directed by the division heads to attend) of the following MSD Divisions and Sections.

- Office of the Director
- Wastewater Engineering Division
- Wastewater Treatment Division
- Wastewater Collections Division
- Quality Assurance/Quality Control Section
- Development Services Branch Section
- Accounting Section
- Project Controls Section
2 Opinion of Probable Construction Cost

The base construction cost only includes the actual costs for labor, material, equipment and other cost to create the asset. The total construction cost builds on this base by adding various markups. This is often referred to as an Opinion of Probable Construction Cost (OPCC) since this is the cost MSD would pay a construction contractor to construct the asset.

In general, estimating methodologies fall into two broad categories, conceptual and deterministic. As the level of project definition increases, estimating methodology tends to progress from conceptual (stochastic or factored) methods to deterministic methods.

With conceptual estimating methods, the independent variables used in the estimating algorithm are generally something other than a direct measure of the units of the item being measured. They usually involve simple or complex modeling (or factoring) based on conferred or statistical relationships between costs and other, typically design-related, parameters. Often the cost estimating relationships used in conceptual estimating methods are somewhat subject to conjecture.

Conceptual estimating methods are as follows:

- **Capacity Factor Method**: A capacity factored estimate is one in which the cost of a new facility is derived from the cost of a similar facility with known (but usually different) capacity. This method relies on the non-linear relationship between capacity and cost.

- **Ratio or Factor Methods**: Ratio or factored estimating methods are used in situations where the total cost of an item or facility can be reliably estimated from the cost of a primary component. For example, these methods are commonly used when estimating the cost of specialized process equipment that makes up the significant portion of the construction cost.

- **Parametric Method**: A parametric model is a mathematical representation of cost relationships that provides a logical and predictable correlation between the physical or functional characteristics of a project and its resultant cost. A parametric estimate is developed using cost estimating relationships and other estimating functions that provide logical and repeatable relationships between independent variables, such as design parameters or physical characteristics; and the dependent variable, cost.

For deterministic estimating methods, the independent variables used in the estimating algorithm are more or less direct measures of the item being estimated, such as straightforward counts or measures of items multiplied by known unit costs. Deterministic estimating methods rely on a high degree of precision and a determination of quantities, pricing, and a complete scope definition.
2.1 Estimate Classification

Estimate classification is commonly used to categorize estimates to indicate the overall maturity and quality. Most organizations will use some form of classification system to identify and categorize the various types of project estimates that they may prepare during the life cycle of a project. The classification described in this guide is based on the framework developed by the Association for the Advancement of Cost Engineering International (AACE). Their “Cost Estimate Classification System (Recommended Practice No. 18R-97)” provides generic guidelines for the general principles of estimate classification that may be applied across a wide variety of industries. These guidelines have been adapted to fit the specific needs of MSD.

Table 1-1 shows the MSD Estimate Classification System. Like the AACE framework, MSD uses a five-level classification system to describe estimates developed for different project stages. Class 5 cost estimates refer to conceptual estimates when a project is first conceived and very little project information has been determined. As projects are further defined the Class number decreases. An estimate may be classified as Class 1 when the project has reached 100% Design and is ready for bidding.

As the project moves through the five classes, the number of unknowns in a project diminishes. This is shown in Table 1-1 by the decreasing values for Design Contingency. At Class 5, few design parameters are known, so a high design contingency is recommended. By Class 1, the design should be finalized, so no design contingency is needed. Design contingency is covered in greater detail in Section 2.3.6 of this guide. At the same time the risk of overruns and under-runs is reduced. The Expected Accuracy Range column shows that a Class 1 estimate has a much narrower band of expected results than a Class 5 estimate. The two columns for contingency and accuracy are related, but mean distinctly different things. AACE Recommended Practice 40R-08(Contingency Estimating –General Principles) explains that an estimate’s accuracy is dependent on the correct amount of contingency being included. Even after an appropriate contingency is applied, the accuracy range for a Class 5 estimate may still be -50% to +100%.
Organization of Estimates

The organization of estimates into discrete work items is essential to the perception and subsequent analysis of estimates. There are three basic estimate classification systems that may be used for MSD estimates.

2. Work Breakdown Structure (WBS)
3. Uniformat I and Uniformat II.

Using estimate database software, a single estimate can be coded against one or all three of these classification systems to analyze and compare costs. Estimates for MSD will be organized by using the WBS with the CSI classification system encoded for each estimate line item. A schedule of values can also be generated from the WBS.

### 2.2.1 Construction Specification Institute (CSI)

All MSD estimate details will be organized using the CSI Masterformat 2004 Codes. Using CSI codes to organize an estimate facilitates a direct comparison to the project specifications and drawings. The CSI system has three main strengths:

<table>
<thead>
<tr>
<th>Class</th>
<th>MSD Phase</th>
<th>Project Definition</th>
<th>Recommended Design Contingency</th>
<th>Background Information Used</th>
<th>End Use</th>
<th>Expected Accuracy Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Project Request/Long-Range Planning</td>
<td>1-5%</td>
<td>40%</td>
<td>Few or no design parameters; estimate based on past history data</td>
<td>○ Preliminary Project ○ Screening ○ Capital Budget ○ Strategic Analysis</td>
<td>L: -20% to -50% H: +30% to +100%</td>
</tr>
<tr>
<td>4</td>
<td>Planning</td>
<td>6-15%</td>
<td>20%</td>
<td>Based on project narrative and recommendations</td>
<td>○ Project Funding ○ Reality Check ○ Alternate Schemes ○ Preliminary Project ○ Feasibility Study</td>
<td>L: -15% to -30% H: +20% to +50%</td>
</tr>
<tr>
<td>3</td>
<td>30% Design</td>
<td>15-40%</td>
<td>15%</td>
<td>Rudimentary design and estimator experience with known parameters needed to develop the estimate</td>
<td>○ Fair Price Check ○ Change Alert Check ○ Alternate Schemes</td>
<td>L: -10% to -20% H: +10% to +30%</td>
</tr>
<tr>
<td>3</td>
<td>60% Design</td>
<td>20-60%</td>
<td>10%</td>
<td>Design development documents. Estimator experience needed for cost gap.</td>
<td>○ Project Funding ○ Fair Price Check ○ Change Alert Check ○ Alternate Schemes</td>
<td>L: -10% to -20% H: +10% to +30%</td>
</tr>
<tr>
<td>2</td>
<td>90% Design</td>
<td>60-90%</td>
<td>5%</td>
<td>Detailed estimating data from plans and specifications</td>
<td>○ Project Funding ○ Control Estimate ○ Change Alert</td>
<td>L: -5% to -15% H: +5% to +20%</td>
</tr>
<tr>
<td>1</td>
<td>100% Design Bid</td>
<td>90-100%</td>
<td>0%</td>
<td>Detailed documentation ready for bid submittal</td>
<td>○ Change Alert Estimate ○ Firm Bid Estimate</td>
<td>L: -3% to -10% H: +3% to +15%</td>
</tr>
</tbody>
</table>
1. The CSI Divisions are widely known and used in the construction industry so it becomes easy for an owner, architect, engineer, contractor, subcontractor or supplier to communicate a specific construction concern or change by referencing the six-digit CSI code number.

2. The CSI Subheadings provide an organized coding structure where new products or upgrades of existing products can easily be incorporated into project specifications by referencing a new six-digit CSI number.

3. Contractors find CSI useful because the building materials and products are organized in the order that they are procured and installed during construction on a project.

2.2.2 Work Breakdown Structure (WBS)

All MSD Estimate Summaries will be organized using a predetermined WBS. The WBS provides a systematic organization for all the costs in the estimate and is typically unique to a particular type of project. For example, a treatment plant may have a WBS structured around the plant process units, while a tunnel may be organized by each defined reach. A consistently applied WBS from the beginning of a project will facilitate a comparison of costs for each estimate submittal. Under each WBS heading, individual estimate line items will be coded using the CSI Masterformat 2004. The same estimate can then be presented in estimate reports that are either sorted in the WBS or the CSI classification system. An example of MSD’s WBS for conveyance projects is included in Appendix A.

2.2.3 Schedule of Values

Estimates should be established as a control baseline as early as possible in the design process. Project budgets are derived from estimates prepared using all of the design and cost information available at the time. Although estimates will be refined as the projects are upgraded from conceptual to deterministic, all parties must be cognizant of the current estimates for their activities and for the execution of their work. Once the design process commences, project estimates will have necessarily stipulated the work breakdown structure that can be converted into an approved schedule of values. A schedule of values structure should be coordinated with the Designers early in the design phase to ensure that all work output is included and defined with its own budget and schedule. This will simplify later evaluation of the effect of change and can be used as a future planning reference and risk analysis basis. The historical project information can then be used as raw data for trend analysis, indexing, and estimating unit data.
2.3 Components of Estimate Report

All MSD estimates, regardless of their type, method of creation or report format have fundamental parts that are essential to their completeness and accuracy. An estimate report must always include the following:

1. Document List
2. Assumptions
3. Parametric Measurements
4. Body of the Estimate
   a) Estimate line item structure
   b) Quantities
   c) Unit of measure
   d) Pricing
      i. Material cost
      ii. Labor cost
      iii. Equipment cost
      iv. Subcontractor cost
      v. Other construction costs
5. Estimate Markup Items
   a) Contractor on site General Conditions, Bonds and Insurance
   b) Contractor overhead
   c) Contractor profit
   d) Contingency
   e) Escalation

2.3.1 Document List

The document list establishes the basis of the estimate. It will include a complete project description and reference all currently available drawings, sketches, reports, studies, equipment schedules, and outline specifications. The date on the drawings and documents will also be noted.

2.3.2 Assumptions

Assumptions include information regarding labor rates, labor productivity, hours of work, unique site restrictions, building materials used, and construction methods. Assumptions will be
documented to understand costs that were estimated when there was insufficient or minimal project scope information.

2.3.3 Parametric Measurements

The estimate total and subtotal for each heading will be expressed in these commonly designated units for each estimate creation, evaluation of costs, and historical databases. If a parametric unit applies to the scope of the project, it can be shown in the Body of the Estimate. An example would be the “Million Gallons per Day” (MGD) for a Pump Station.

2.3.4 Body of the Estimate

Estimate reports for MSD will include the following items:

a. Estimating Line Item Structure: Each line item will be coded to a WBS and CSI code with a description of the type of material involved or the scope of the item that is being priced.

b. Quantities: If the scope of an entire construction item or task is difficult to take off, it will be designated as a “lump sum.” Quantities can also be expressed as a designated number of total individual labor hours to complete a task.

c. Unit of Measure: Each estimate line item will have a quantity of work expressed in its appropriate unit of measure.

d. Pricing: This is the application of unit costs to the quantities for each unit of measure to be acquired or installed. Unit costs are determined by calculating variables in the following five categories:

i) Material: The material unit price will be derived from vendor quotes, source books such as those produced by RS Means, and historical cost data. Sources should be identified within the Assumptions section of the Estimate Report.

ii) Labor: Labor unit price will be based on probable labor production rates and crew sizes. Labor cost = (quantity/labor production rate) x labor rate where the labor production rate is the number of units of work produced by a person in a specified period of time, usually hours or days. This rate varies between trades, projects, climatic conditions, job supervision, complexity of the installation process, and other factors.

iii) Equipment: The Contractor’s major construction equipment costs include the rental, transportation, handling on the job, operation and maintenance costs. The equipment costs will be allocated to each appropriate line item, but may be shown as an individual line item if a major piece of equipment is used for many different work tasks during the project.
iv) Subcontractor Costs: The subcontractor’s quote will be reviewed for items that are included and excluded from their quotation and the length of time the subcontractor will honor the price.

v) Other Construction Costs (Allowances): This includes miscellaneous cost items that are not included in the unit costs. They may include costs associated with the following factors: weather, crew transportation, soil conditions, hazardous material removal, utility relocations, wetland replacements, road/highway/special crossings, traffic control, ground water, labor strikes, material and/or subcontractor availability, general material economic conditions, complexity of the project, and construction phasing. These costs should be clearly explained within the Estimate Report.

2.3.5 Estimate Markup Items

Estimate markups are costs that are expressed as a lump sum, deterministic units or calculated as a percentage of the subtotal of the estimated construction costs. These markups represent costs that may be incurred by a contractor outside of the direct actions required to build the asset.

1. Contractor’s On-Site General Conditions: The contractor’s general conditions take into account the cost of items that cannot be associated with a specific element of work, but must be furnished to complete a project. The general conditions include cost items such as supervision, temporary facilities, office trailers, toilets, utilities, permits, photographs, small tools, etc. This amount may be based on the monthly cost of the project and the project duration acquired from the schedule. Alternatively, they can also be calculated as a percentage of the base construction cost. Often there are common general condition items that have a higher than usual cost due to the uniqueness of the project. There is also a danger of having items that are assumed to be included in the contractor’s construction costs but are not because of their ambiguity. Some of these unforeseen conditions may include: traffic control and barricades, construction crew parking, right of way costs, testing, staff time to attend and conduct meetings, restoration of property, OSHA requirements, new design or building code standards, work hour restrictions, pollution controls, and bonding of subcontractors. Assumptions used to calculate the General Conditions should be identified in the Estimate Report.

2. Contractor’s Overhead: This is the contractor’s cost of doing business. This is typically calculated as a percentage of the Base Construction Cost. Table 2-1 outlines the overhead percentage range to be used at each estimate class. Estimators should generally use the High Range value associated with each estimate class. Deviations from this should include a rationale within the Estimate Report.
3. Contractor’s Profit: This includes the cost amount as compensation for risk and efforts to undertake and complete the project. This percentage will be based directly on economic conditions for local construction industry, the individual contractor’s overhead costs, and their perception of the risk of losing money on the project. This is typically calculated as a percentage of the Base Construction Cost. Table 2-2 outlines the profit percentage range to be used at each estimate class. Estimators should generally use the High Range value associated with each estimate class. Deviations from this should include a rationale within the Estimate Report.

### Table 2-2 Contractor’s Profit Calculation Guide

<table>
<thead>
<tr>
<th>Class</th>
<th>Phase</th>
<th>Low Range</th>
<th>Mid Range</th>
<th>High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Long-Range Planning</td>
<td>5%</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>4</td>
<td>Planning</td>
<td>5%</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>30-60% Design</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>90% Design</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>1</td>
<td>100% Design</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
</tr>
</tbody>
</table>

4. Bonds and Insurance: Contractors are required to submit a performance bond to guarantee satisfactory completion of a project. MSD typically requires this amount to be 1% of the contract amount. Contractors are also required to carry certain Liability and Vehicle Insurances. Many factors affect each area of insurance, including project complexity and contractor’s history. MSD will use an average of 1% to estimate Insurance costs.

5. Escalation: This is used to accommodate price increases or decreases during the life of an asset or the life of a project contract. Escalation is included in financial analysis to evaluate anticipated cost changes in material and/or labor. Note that this is distinct from inflation
which is described in Section 4.2.2. Escalation may be applied to a variety of costs over the life of a project, if the rate of increase or decrease in those projected costs are expected to be significantly different than the general rate of inflation in the community. OPCCs should be escalated to the mid-point of construction.

Escalation values can be retrieved from a table on MSD’s capital project resource library (http://msdgc.org/doing_business/capital_project_resource_library/index.html). This table is updated quarterly by MSD staff to reflect changes in the local and national economies. Development of this table is described in Appendix B of this document.

2.3.6 Contingency

This represents the uncertainty inherent in every estimate. This uncertainty includes not knowing precise quantities, exact methods, site conditions, etc. Estimators are aware that these uncertainties exist and can estimate their probable cost based on professional judgment. The estimated cost of these uncertainties is called contingency. MSD’s approach to contingency has been based on the framework developed by the Association for the Advancement of Cost Estimating International (AACE). The AACE RP No. 40R-08(Contingency Estimating-General Principles) provides generic principles for the practice of estimating contingency. In general, the AACE provides four methods of estimating contingency: expert judgment, predetermined guidelines, simulation analysis, and parametric analysis. MSD has adopted the predetermined guideline option with some flexibility to allow for expert judgment.

For MSD estimates, three types of contingency may be included in project estimates. A fourth contingency may be used in certain circumstances but is included in an overall program budget rather than individual project budgets.

1. Design Contingency: As the design progresses through the project design life cycle, a percentage will be added to the estimate to account for uncertainties inherent in the estimating process. This percentage is anticipated by the estimator as the relative stability of the design documents, project scope, and assumptions upon which the estimate is based are assessed. Items typically covered by design contingency are:

   • Design that may not be complete enough to determine final quantities at the time of estimate preparation
   • Some items that may defy precise quantification as far as what all is required to be estimated
   • Some items to be quantified that are generally computed by factors for other conceptual methods

The design contingency percentage should decrease as the design life cycle progresses. The design contingency should be applied to the base construction cost plus contractor markups, but before escalation. Table 2-3 outlines the design contingency range to be used at each design stage. Estimators should generally use the High Range value associated with
each estimate class. Deviations from this should include a rationale within the Estimate Report.

<table>
<thead>
<tr>
<th>Class</th>
<th>Phase</th>
<th>Low Range</th>
<th>Mid Range</th>
<th>High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Long-Range Planning</td>
<td>15%</td>
<td>30%</td>
<td>40%</td>
</tr>
<tr>
<td>4</td>
<td>Planning</td>
<td>7%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>3</td>
<td>30% Design</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>60% Design</td>
<td>3%</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>90% Design</td>
<td>0%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>1</td>
<td>100% Design</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

2. Bidding Contingency: Bidding contingency is a factor added to the estimate to account for the potential overrun of the estimate due to the following:
   - Omissions in the design process
   - Design that may not be complete enough to determine final quantities at the time of estimate preparation
   - Labor productivity variability

The bidding contingency amount shall be 10% of the base construction cost plus all markups and the design contingency. This value was selected to reduce the potential of rebidding, which becomes necessary when the lowest received bid is more than 10% in excess of the estimated cost (OPCC) in accordance with the State of Ohio Laws and Rules. Note that while it is called Bidding Contingency, it should be applied at all stages of planning and design.

3. Market Conditions Contingency: This contingency is a factor that may be added to the estimate to account for uncertainties which may adversely impact the bidding market. Examples of these conditions include:
   - Reduced bidding competition from Contractors
   - Labor Availability from tradesmen
   - Sudden changes in material pricing (e.g. tariffs)
   - Other unforeseen conditions (e.g. COVID-19)

The need for inclusion of this contingency in projects shall be evaluated by the Consultant on a project by project basis. This guide makes no recommendation for the value or the
method for determining the value. Any value that is included in an estimate should be accompanied by an explanation in the estimate report.

4. Program Contingency: Project budgets in the CIP do not include a contingency line item. MSD uses programmatic contingency to fund construction and design change orders for all projects in the capital program. Costs are allocated to specific capital projects as they are expended.
3 Project Cost

The Project Cost is the OPCC plus the addition of the indirect costs necessary to complete the construction and startup of an asset. These indirect costs include Planning and Design Services, Right of Way (ROW), certain Construction services performed by a Design consultant, and other Miscellaneous costs. A summary of these costs is included in Appendix C. An example estimate that shows all of these indirect costs is included in Appendix F.

3.1 Planning and Study Phase Services

For planning and scheduling purposes, the costs for planning and study phase services are included. Planning can be defined as making decisions now with the objective of influencing the future of the successful execution of a capital improvement project. This future-oriented decision process involves:

- Setting objectives
- Gathering information
- Evaluating alternatives through the triple bottom line evaluation
- Recommending alternatives through a Business Case Evaluation
- Key determinants that establishes the designs philosophy
- Communicating the plan

The Planning estimate includes but is not limited to:

- Professional services to complete the Planning phase

Planning estimates shall be based on a percentage of the OPCC, determined by the following formula.

$$ Planning Factor = 17.016 \times [OPCC]^{-0.371} $$

This formula was derived by comprising and normalizing MSD historical data and plotting a logarithmic curve for potential planning expenditures. All projects up to a total cost of construction of $10,000,000 shall use the planning algorithm. For projects above $10,000,000 in construction cost, professional judgment should be utilized to assess the final estimated amount for Planning as it is applied to the validity of the overall projected estimate.

Escalation (to the beginning date of design) on the cost of planning is then added to the planning cost.
3.2 Design and Other Engineering Services

Included for all purposes of estimating the Design Phase of a project is to plan out the system necessary to implement a solution to meet the potential projects requirements established during the Planning Phase. The design phase involves:

- Ensure consistent quality of the solution for implementation
- Assumptions regarding means and methods of construction activities to implement the project
- Develop contract documents
- Communicating the plan to construct the project

The Design Estimate includes professional services to complete the Design Phase.

Design estimates shall be based on a percentage of the OPCC:

\[
Design \ Factor = 5.418 \times [OPCC]^{-0.267}
\]

This formula was derived by comprising and normalizing MSD historical data and plotting a logarithmic curve for potential design expenditures. Design estimates for projects over $20,000,000 should be developed on a case by case basis. If no detailed estimate can be developed, an assumption of 6% can be used for OPCCs greater than or equal to $20,000,000. This formula is calculated by comprising and normalizing MSD historical data and plotting a logarithmic curve for potential design expenditures.

3.3 Pre-Construction Services

Pre-construction services are those services necessary to administer the project through the beginning date of construction. The Pre-Construction Services estimate is for MSD labor that includes but is not limited to the following:

- Project Management
- QA / QC
- Internal design
- Estimating
- Planning Modeling
- Right of Way (MSD Labor)
- Document Control
- Administrative staff
- Supervisory staff
- Supplemental staff
An alternate approach that was adopted for the 2020 CIP and moving forward was to create a project account in the annual CIP book for MSD capitalized labor. At the conclusion of each fiscal year, MSD Accountants will proportionately allocate the capitalized labor cost to all projects active during the year. This approach negates the need to include Pre-Construction Services as an indirect cost as part of a project’s cost.

3.4 Right of Way

Factors that should be included in estimating Right of Way (ROW) will be based on type of acquisition needed for the project. The bulk of MSD’s projects only require permanent and temporary easements. Occasionally, full fee acquisitions are needed which adds an additional layer of professional real estate services, known as Relocation. It is MSD’s policy to follow federal, state and local guidelines in acquiring the property needed for MSD projects to ensure compliance. MSD’s ROW Section has real estate professionals on staff trained in the following acquisition disciplines: Negotiators, Appraisers, Relocation Agents and a Real Estate Manager who sets the Fair Market Value (FMV). The FMV is the compensation offered to property owners. They also have experienced Engineering Technicians who review plans and easement plats for accuracy and ensure they match construction drawings as well as offer suggestions throughout the design process to avoid problems with owners and minimize the project’s impact to private property. Additional outside professional services needed for Right of Way include, independent fee appraisers, relocation agents and title companies. It is highly recommended that the ROW Section be included early in the process and stay involved throughout design and construction to avoid problems with owners and potential public relation issues.

For legislation purposes, right of way costs must be provided by the ROW Section. They should also be used for other purposes such as research of existing easements, property ownership, etc.

- A Right of Way estimate request shall be submitted to the ROW group for analysis and inclusion in the future legislation of the project. Lead time submittal allowance is two weeks for turn around.

- The ROW estimate will include:
  - All easement or fee take acquisition costs that are needed to complete the project
  - Appraisal costs
  - Title reports
  - Compensation due owners known as FMV
  - Relocation costs if applicable
  - Property management costs/real estate tax bills/utilities
  - Recording costs/mailing costs
- Eminent domain costs (expert witness costs/court filing costs/settlement costs)
- All easement and acquisition costs that are needed to complete the project

For the alternative analysis or planning and scheduling phases only, an acceptable variance from the ROW Section is allowed following these guidelines:
- A project that will require acquisition costs can be estimated based on the Project Engineer’s knowledge of the property involved along the alignment or at the proposed site. It is suggested that the Project Engineer refer to the Hamilton County Auditors web site (www.hamiltonco.org/Auditor.htm) for values of properties that will need to be purchased.

If specific location information is not available and assumptions are made regarding the cost of land acquisition, the real estate cost curves shown in Figures 2, 3, and 4 are used in order to provide consistency in alternative cost comparisons. For conveyance projects, which typically involve easements along a route, the real estate costs are developed by the equation shown in Figure 2, developed by MSD based on historical data. For storage and treatment-related projects, which require the purchase of a certain amount of land, costs are estimated using the equations shown in Figures 3 and 4 that translates the volume or flow rate, respectively, of the proposed facility to a footprint and then applies a real estate unit cost of $130,680 per acre or approximately $3 per square foot. Note that these curves are based on 2006$, so estimates that use these curves will need to be escalated appropriately.

Escalation (to the beginning date of construction) on the cost of ROW is then added to the ROW cost.
Figure 3 - Storage Facility Real Estate Cost Curve

\[ y = 130,680(-0.0009x^2 + 0.2893x + 0.7233) \]

Figure 4 - Treatment Facility Real Estate Cost Curve

\[ y = 130,680(1.85E-6x^3 - 0.0003x^2 + 0.0262x + 0.7685) \]
3.5 **Construction Services**

The Construction Services is the estimate for project management, field engineering, inspection and any other engineering services conducted by a design consultant during the construction phase. These costs will include services for the following:

- Design support personnel
- Construction phase customer service
- Third Party Testing Consultant services during the construction phase

The Construction Services calculations will be determined as follows:

- Identify the roles and responsibilities of Designers/Vendors to be handled under a Work Order.
  - Construction Administration
    - Submittal Reviews, Request for Information, Meeting Administration, As-Built Drawings, etc.
  - SCADA
  - Commissioning (excludes SCADA)
  - Testing
  - Submittal Reviews (technical reviewers)

- A specific calculation methodology will not be required. However, the project manager will need to be able to defend how the Construction Services estimate was established.

Calculations for consideration are as follows:

- Negotiated Contract Amount
- Singular Flat Percentage ("X"%)
  - Construction Services= {"X"%}{O.P.C.C}
- Construction Administration ("X"%), SCADA ("Z"%), Project Duration ("C"-Cost per Week):
  - Construction Services = {"X"% (Admin)}{O.P.C.C.} + (Z%(SCADA){(O.P.C.C.}+{“C”/week}{Project Duration}
  - Construction Services for Sewer Lateral Assessment Projects is to be set at $5000 in accordance with a directive from the County Monitor Team dated June 6, 2017

If no detailed data exists, the following multipliers shall be used for estimating purposes for the Construction Services. Historical data is a best practice used by most utilities to predict costs for services. MSD historical data suggests the use of the ranges presented in Table 3-1. These values are consistent with the updated policy that MSD labor will not be included in a project’s
cost. Estimators should generally use the average value presented. Deviations from this should include a rationale within the Estimate Report.

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Average Construction Services (% of Construction Cost)</th>
<th>95% Confidence Interval of Construction Services (% of Construction Cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyance Project</td>
<td>5.9</td>
<td>4.7 to 7.1</td>
</tr>
<tr>
<td>Pump Station Upgrade/Elimination</td>
<td>9.7</td>
<td>2.4 to 17.0</td>
</tr>
<tr>
<td>Facility Projects</td>
<td>18.7</td>
<td>15.1 to 22.3</td>
</tr>
</tbody>
</table>

Escalation (to the end date of construction) on the cost of construction services is then added to the construction services estimate.

### 3.6 Capitalized Interest

Capitalized Interest is the interest added to the cost of a long-term asset. This item may sometimes be referred to as Interest or Financing. It will only be relevant for projects that are pursuing low-interest loans through Ohio’s Water Pollution Control Loan Fund (WPCLF). It involves the interest on debt used to finance the asset’s construction, which is applied to the individual projects only during the construction phase. The estimate for capitalized interest is calculated using the following formula:

\[
\text{Interest Budget} = \frac{\text{OPCC} \times \text{rate} \times \frac{\text{Construction duration (in weeks)}}{52}}{2}
\]

For estimates at the planning stage, the estimators use the rate of 0.05. When the project is ready for legislation, Project Management will use the current bond rate as prescribed by the MSD Finance team. If a project is being pursued for a low interest loan (WPCLF), the current WPCLF rate should be used for legislation.

### 3.7 Miscellaneous Costs

The Miscellaneous Costs (sometimes called Miscellaneous Expense) estimate includes items that represent expenditures necessary to complete a project, but cannot be categorized into discernible scheduled phases.

The Miscellaneous Costs estimate includes but is not limited to:
• Street opening permits and inspections: Calculated at $4 per square yard plus a $50 permit application fee.

• Environmental inspections and/or Inspection of Erosion Control Structures: To be evaluated only when the riparian area (approximately within 100 linear feet of a stream) threshold has been reached or exceeded. Environmental Inspections calculation is $11.40 per linear foot of construction.

• Geotechnical Report: Calculated to include 1 soil boring per 500 linear feet of project with a minimum cost of $4000 per project.

• Utility Relocation: Contact the utility estimate and assumptions on the relocations required for the individual project.

• Public Relations: Please see the following table for inclusion of Public Relation funds. If MSD personnel perform public relations tasks, this cost will not be reflected in project estimate.

<table>
<thead>
<tr>
<th>Project Criteria</th>
<th>Public Relation Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project value is less than $2,000,000 and/or the public impact that is</td>
<td>$25,000</td>
</tr>
<tr>
<td>anticipated for constructing the project is minimal.</td>
<td></td>
</tr>
<tr>
<td>Project value is between $2,000,000 and $10,000,000 and/or the effort to</td>
<td>$25,000 - $50,000</td>
</tr>
<tr>
<td>communicate and address public concern is anticipated to be typical.</td>
<td></td>
</tr>
<tr>
<td>Project Value is greater than $10,000,000 and/or the effort to communicate and</td>
<td>$50,000-$100,000: Should not exceed $100,000 without prior approval from the</td>
</tr>
<tr>
<td>address public concern is anticipated to be extensive</td>
<td>project stakeholders</td>
</tr>
</tbody>
</table>

• Permit to Install (PTI): A permit to install is needed for any installation or modification of wastewater treatment, conveyance or disposal system, except as exempted by rule. The cost of the permit is determined by the formula below. The total cost is not to exceed $15,100 per application.

\[
PTI \ Cost (\$) = (OPCC \times 0.0065) + 200
\]

• Rail Road Permits: Rail Road permits will be evaluated on an “as needed” basis specific to the needs of the project’s anticipated design. If Rail Road Permits are needed, please contact: MSD Right of Way Manager.

• WPCLF (Water Pollution Control Loan Fund) loan origination fees are percentages that are paid to OWDA (Ohio Water Development Authority) for an award of a WPCLF loan. If project costs excluding Capitalized Interest during the life cycle of a project exceeds $3,500,000 the project will be assumed to be nominated for a WPCLF loan. The flat rate
for the Administrative fee to OWDA is 0.35%, with a minimum charge of $400. This should be verified annually at the www.epa.state.oh.us website by reviewing the latest version of the Loan Application Instructions.

- 401/404 Creeks and Outfalls Certification: Certifications will be evaluated on an “as needed” basis specific to the needs of the project’s anticipated design. If a Certification is needed, costs will be provided by the project manager or basin manager.

When full detail of miscellaneous costs are not available, the miscellaneous cost multiplier may be obtained from the cost curve shown in Figure 5. A fixed percentage of 0.5 applies to construction phase miscellaneous costs and the balance applies to pre-construction miscellaneous costs. Note that as the OPCC approaches $47,500,000 the result of the equation falls below the fixed 0.5% multiplier for construction phase. At that point, a minimum multiplier of 0.5% is applied solely to the construction phase miscellaneous costs and there are no pre-construction miscellaneous costs. Note that this curve is based on 2006$, so estimates that use this curve will need to be escalated.

Regardless of the method used, the assumptions used to develop the Miscellaneous Costs estimate should be explained in the estimate report.

Escalation (to the end date of construction) on the miscellaneous costs is then added to the miscellaneous cost estimate.

Figure 5 - Miscellaneous Cost Multiplier Curve
3.8 Program Management

Program Management includes a number of legislated allowances that are used for the totality of MSD’s capital program rather than individual projects. These allowances currently include:

- **Program Management and Support Services:** The Program Management Team (PMT) consists of outside professional consultant staff working in an integrated manner with internal MSD personnel. The PMT is providing support for the development and delivery of the entire CIP, inclusive of all WWIP and Asset Management projects.

- **MSD Labor:** This allowance was initiated to allow MSD staff to discontinue direct charges to projects and instead charge to an allowance that would then be allocated back to projects based on a formula. The cost of MSD labor has been removed from project specific budgets to avoid double counting.

- **Hamilton County Utility Oversight and Coordination:** To provide oversight of the capital program, the County has established a Monitor Team. As directed by the Board of County Commissioners, the Monitor Team may address MSD related regulatory and legal matters, public outreach, and other assigned tasks. The Monitor team consists of County staff, consultants and attorneys.

This indirect cost activity is only used in certain cases when it is deemed necessary to capitalize the costs of overhead for individual projects. The exact amount each project receives from the different allowances is based on a weighted average spend formula performed by MSD Accounting. In general, this indirect cost will be recorded as zero for the individual projects until the allocation is completed.
4 Life Cycle Cost

Life Cycle Cost is the Project Cost plus the operation and maintenance costs over the life of the asset. This is used to compare alternatives over the life of the assets. Financial analysis of unique capital investments challenges the analyst to combine diverse elements into a cohesive structure for evaluating purposes. Where traditional economic evaluation techniques have limitations with respect to addressing specific issues relevant to capital investment decisions, there is a potential for consolidating their individual strengths into a composite system that satisfies the evaluation requirements for MSD. MSD will use economic analysis models to evaluate the time value of money based on the cost of capital.

4.1 Life cycle cost analysis

Life cycle cost analysis (LCCA) is a method of project evaluation in which all costs arising from owning, operating, maintaining, and ultimately disposing of the asset are considered. Life cycle cost analysis is particularly suitable for evaluating asset design alternatives to ensure a required level of performance, engineering standards, system reliability, and even aesthetic considerations while taking into account that the alternatives differ in initial investment costs and useful life. Life cycle cost analysis can be applied to any capital investment decision in which higher initial costs are traded for reduced future cost or obligations. Life cycle cost analysis also provides a significantly better assessment of long-term cost-effectiveness of an asset than alternative economic methods that focus only on first costs with short-term operating related costs.

Life cycle cost analysis is a powerful tool of economic analysis. As such, it requires more information than analyses based on first cost or short-term considerations. It also requires understanding on the part of the analyst of concepts such as discounted cash flow, constant versus current dollars, and price escalation rates.

The MSD life cycle cost is the basic building block of the present value cost analysis method. The life cycle cost analysis method, as applied here, is used to compute the life cycle cost of the asset or a combination of interdependent systems over a given period of study (usually related to the useful life for capital assets) with all costs and revenues expressed in constant dollars (no inflation). While revenues do not often come into play in MSD life cycle cost analyses, if there are additional revenues to MSD associated with any alternative, they should be incorporated into the analysis.

Estimators will assess all costs related to the initial capital investment based on estimating methodology as outlined earlier in this document. Based on the initial estimate of probable costs, the estimators will evaluate and assess all operation, repair, and maintenance costs including non-annual costs or cyclic costs, annual costs, and any startup costs as related to the initial capital investment. These cost assessments will begin in the year of the initial capital investment and over the useful life of the proposed project.

Each capital investment is unique, it is necessary to assign a useful life to major MSD capital assets. In most cases, generally accepted accounting principles require that capital assets be
Depreciation is the systematic and rational allocation of the historical cost of the capital assets over their estimated useful lives. The estimated useful life assigned to a capital asset will directly affect the life cycle cost analysis. Once established, estimated useful life for major categories of capital assets should be periodically compared to MSD’s actual experience and appropriate adjustments should be made to reflect this experience. It will be the responsibility of the financial analysis team to compare MSD actual experience with the asset’s useful life. The MSD Useful Life of Capital Assets are provided in the table in Appendix D.

If alternatives are being compared with differing useful lives, the study period will typically be based on the alternative with the longer useful life. Many alternatives will be comprised of assets with differing useful lives. The life of the alternative may thus reflect some assets with short useful lives and others with longer lives. The life of the alternative may thus reflect a weighted average, based on cost or investment, of the useful lives of those components, or reflect the life of the predominant assets being purchased or constructed. Professional judgement may be exercised in determining the useful lives of the alternatives with components with varying useful lives, and in selection of the analysis study period.

Assets with useful lives remaining at the end of the study or analysis period shall be depreciated utilizing straight line depreciation as outlined in section 4.1.1 to derive a residual value at the end of the analysis period. This is based on the useful life for capital assets in the appendices (See Appendix D). It should be noted that the useful life for capital assets listed in Appendix D represents the average useful life for these assets and is meant to be used for the purpose of life cycle analysis and the present value cost analysis. These average useful life values do not necessarily represent the current status of the asset within its life cycle, which may vary from the average value depending on the individual asset conditions and applications. All life cycle cost assessments may be escalated as necessary to account for predicted market variability.

### 4.1.1 Depreciation

Depreciation is a form of capital recovery applicable to a property with a lifespan of more than one year, in which an appropriate portion of the asset’s value is periodically decreased. The rationale underlying the depreciation concept is that physical assets lose value over time due to such factors as deterioration, wear, technological advancements, or obsolescence.

MSD will use the straight-line depreciation method which takes an equal amount of depreciation every year over the estimated useful life of the asset. The straight line method takes the original cost less the salvage value divided by the number of years of life of the asset as follows:
Depreciation Straight Line Method: \( D = \frac{(C-S)}{N} \)

Where:

- \( D \) = Depreciation charge
- \( C \) = Asset original cost
- \( S \) = Salvage value
- \( N \) = Asset useful life

While depreciation is not included in the present value calculations, residual values for assets shall be included in the LCCA evaluations unless exclusion of the residual value is approved by submitting a deviation based on best professional judgment.

4.2 Present value cost analysis

Building on the life cycle costs analysis, the present value cost analysis is adjusted to reflect the time value of money. This adjustment is accomplished by utilizing the MSD discount rate. In calculating the present value cost analysis, all future costs are discounted to their present value equivalent (as of the base date) using the MSD minimum acceptable rate of return. The present value of an asset has little meaning by itself; however, it is most useful when compared to the present value of all the alternatives which can perform the same function, in order to determine which alternative is most cost effective for this purpose. These alternatives are called “mutually exclusive” because typically only one of the alternatives evaluated can be selected for implementation.

4.2.1 MSD Discount Rate

The discount rate is a financial metric used to determine the present value of future payments or expenditures. A project’s viability is often a function of the discount rate chosen for the present value cost analysis. Thus, this important component cannot be chosen arbitrarily. Since the project life cycle cost is based on future cash flows, it is important to have a realistic discount rate.

The selected discount rate should reflect that rate of return that the MSD would be indifferent about investing in a project. That is, if the investment would provide a rate of return greater than this amount the MSD would invest in it, and if it was less, then it would not. The desired rate of return needs to reflect current market rates and may require a higher level of return if there are higher levels of risk associated with the project. Most MSD projects do not provide a rate of return, per se, but any savings must be evaluated compared to the status quo or other alternatives given a selected discount rate. As such, most projects will use the discount rate selected by the financial division manager, however the discount rate can be adjusted using professional judgment for projects with greater levels of risk. Any deviation from the discount rate selected by the financial division manager must be approved by submitting a deviation based on best professional judgment (Section 5).

Discount rates may be real or nominal. Real discount rates apply to present value analyses where the costs and revenues are expressed in constant dollars (no inflation), while nominal
discount rates apply to analyses where the costs and revenues are expressed in inflated dollars over the life of the project.

Historically, MSD has used the interest rate it is paying on recent bond issues as the basis for setting its discount rate. It must be understood that this interest rate is subsidized by virtue of the interest income received by the investors on the MSD’s bonds not being subject to income tax. The Federal government borrowing does not receive a similar subsidy, and thus its borrowing cost may better reflect current market interest rates. Using the Federal government borrowing rate for analysis should only be considered once the source of the funding for a project is fully determined and shows that the Federal rate is more applicable.

The discount rate to bring future cost to their present value will be based on the current Bond Rate listed below. In order to use the rate for calculations, a Real Interest Rate is needed and the current Bond Rate is a Nominal Interest Rate and includes inflation. To remove inflation and adjust the rate, use the inflation rate calculated in the next section.

The current real discount rate to be used in conducting cost effectiveness analyses is as follows:

Current Nominal Discount Rate (MSD Bond Rate) = 5% (Apr 2021)
Inflation Rate from Section 4 = 2.0% (Apr 2021)
Calculation for Real Discount Rate = \(((1.05/1.02)-1)\)*100 = 2.9%

2.9% - Updated April, 2021

It will be the responsibility of the financial division manager to monitor and update the discount rate used by MSD. This update will be finalized in the first quarter of each year.

4.2.2 Inflation Rate

Inflation is defined for MSD as a rise in the general price level of goods and services produced in the economy. It should be noted that this is not the only definition of inflation, but it is the most appropriate for MSD purposes. The definition involves rising prices for current output. Rising prices for bonds, equity claims (stocks), and existing durable goods. Also, the price increases must occur across many lines of goods and services.

The terms inflation and escalation, for this text, are not considered to be synonymous. The following will be assumed by MSD:

- Inflation incorporates the overall economy growth/recession impact to the economic evaluations and is measured by incorporating both national and local economic inflation forecasts. Inflation is applied to the growth of all costs over time that is not related to the initial capital investment.
- Escalation is then defined as those price level changes predicted to occur for specific types or groups of goods and/or services and is measured by the rate of rise of some product-price index in percent per year (i.e. construction cost index or labor cost index).
Note: if a good or service is being escalated over a given time period, it should not be inflated during that same time period, and vice versa.

This inflation rate is the same as the cost growth rate used by MSD's rate consultant as part of the annual revenue requirement study, which is used to set customer rates.

This update will be evaluated and finalized by the financial analysis team in the first quarter of each year.

The inflation rate is calculated from Office of Management and Budget Federal Real Discount Rate for projects of similar life as published every December (Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs). The appropriate discount rate will vary depending on the expected useful life of the project. For projects with a useful life of over 30 years, the 30 year bond interest rate will be used. For the life cycle cost analysis, costs and revenues will be expressed in constant dollars (not inflated), thus the real discount rate will be used. The current rates that are used to inflate all future cash flows are as follow from OMB Circular A-94:

- OMB Nominal Interest Rate for 30 year – 1.7% (Dec 2020)
- OMB Real Interest Rate for 30 year – -0.3% (Dec 2020)

Calculation for Inflation Rate = \( \frac{(1.017/0.9977)-1}{100} = 2.0\% \)

**2.0\% Inflation Rate – Updated April, 2021**

For life cycle cost analyses, costs will be expressed in current dollars and will not be inflated.
5 Professional Judgment

As a project’s scope becomes more defined throughout Planning and Design, there may be instances when it is appropriate to deviate from the guidelines described in this manual. Deviation should only occur when the estimator utilizes best professional judgment and concludes that some individual guidelines do not match the project’s expected costs. When it is justifiable that a deviation from the PCM is needed, it is necessary that documentation and approval processes are followed. The Deviation of Indirect Costs Based on Professional Judgment (DPJ) form can be found in Appendix E and must be submitted for review and approval. The basis of deviation must include:

- a. Information regarding the basis of the proposed deviation(s).
- b. Clear documentation of the proposed deviation(s).
- c. Identification and the proposed plan for management of all associated financial risks due to the proposed deviation. If the anticipated financial risks due to a deviation of indirect costs is anticipated to be minimal and/or nonexistent, the submitting agent must document on the DPJ form the associated reasoning for a nonexistent risk category.

The DPJ form must be submitted and proper approval must be obtained before the proposed deviation can be submitted in the final financial analysis report. A copy of the form with justifications must be attached to the estimate report.
6 Estimate Review Process

Estimates are a critical component in successful projects. It therefor is reasonable that the estimate should undergo a quality control process. The estimate should be evaluated not only for its quality and accuracy, but also to ensure that it contains all of the required information. When reviewing economic analyses prepared by design consultants the Quality Assurance Quality Control Section (QAQC) within Wastewater Engineering will keep in mind the basic fundamentals described herein. The estimate review will be accomplished by critical assessment of the estimate and its associated documentation, and a series of questions to assist in evaluating the diligence used in preparing the estimate. Estimators will support the Engineering Division in evaluating all initial project costs and all LCCA costs. The following section focuses on guidelines that QAQC will use to efficiently review estimates prepared by design consultants.

6.1 Basis of Evaluation

QAQC will assess the following for the basis of the estimate.

- The economic analysis is organized and complete.
- Scope assumptions have been clearly identified.
- Economic impact assumptions have been clearly identified.
- The planning basis (schedule, resource planning, etc.) is reasonable, in line with expectations, and consistently applied throughout.

6.2 Methodology

QAQC will assess the following to ensure that methodology for analysis is sound:

- The methods, techniques, and procedures used in preparing the estimate are sound.
- The appropriate level of information available for the project type is available and being used.
- The financial analysis methods used for the economic analysis are appropriate.
- If the level of detail in the analysis is sufficient for the purpose of the analysis.
- If sufficient time was available for preparation of the analysis.

6.3 Documentation

QAQC will assess the following:

- If the estimate report is documented clearly and is complete as outlined herein.
- If the estimate report is well-organized and presented at an appropriate level of detail.
## Appendix A Example of MSD Work

### Breakdown Structure

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>201</td>
<td>Clearing and Grubbing</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>202</td>
<td>Fill, Seal &amp; Abandon Existing Sewers (12&quot; and Larger)</td>
<td>CY</td>
</tr>
<tr>
<td>3</td>
<td>202</td>
<td>Seal and Abandon Existing Sewers</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>202</td>
<td>Manholes Removed</td>
<td>EA.</td>
</tr>
<tr>
<td>5</td>
<td>202</td>
<td>Manholes Abandoned</td>
<td>EA.</td>
</tr>
<tr>
<td>6</td>
<td>202</td>
<td>Inlets Removed</td>
<td>EA.</td>
</tr>
<tr>
<td>7</td>
<td>202</td>
<td>Inlets Abandoned</td>
<td>EA.</td>
</tr>
<tr>
<td>8</td>
<td>202</td>
<td>Remove and Salvage Existing WWTP</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>202</td>
<td>Remove and Salvage Existing Lift Station</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>210</td>
<td>Special Excavation</td>
<td>CY</td>
</tr>
<tr>
<td>11</td>
<td>211</td>
<td>Special Fill Material (Bank Run Gravel)</td>
<td>TON</td>
</tr>
<tr>
<td>12</td>
<td>211</td>
<td>Special Fill Material (No. 3 Gravel Bedding)</td>
<td>TON</td>
</tr>
<tr>
<td>13</td>
<td>602</td>
<td>Concrete Masonry Cl. &quot;C&quot;</td>
<td>CY</td>
</tr>
<tr>
<td>14</td>
<td>602</td>
<td>Concrete Masonry Cl. &quot;C&quot; (Encasement, Cradles, Key Blocks)</td>
<td>CY</td>
</tr>
<tr>
<td>15</td>
<td>602</td>
<td>Brick Masonry</td>
<td>CY</td>
</tr>
<tr>
<td>16</td>
<td>603</td>
<td>6&quot; Conduit, Type &quot;I&quot;</td>
<td>LF</td>
</tr>
<tr>
<td>17</td>
<td>603</td>
<td>6&quot; Conduit, Type &quot;I&quot; With Compression Joints - Stacks</td>
<td>LF</td>
</tr>
<tr>
<td>18</td>
<td>603</td>
<td>X&quot; Conduit, Type &quot;X&quot;</td>
<td>LF</td>
</tr>
<tr>
<td>19</td>
<td>603</td>
<td>X&quot; Conduit, Type &quot;X&quot;</td>
<td>LF</td>
</tr>
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<td>603</td>
<td>X&quot; Conduit, Type &quot;X&quot;</td>
<td>LF</td>
</tr>
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<td>603</td>
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<td>LF</td>
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<tr>
<td>23</td>
<td>603</td>
<td>X&quot; Conduit, Type &quot;X&quot;</td>
<td>LF</td>
</tr>
<tr>
<td>24</td>
<td>603</td>
<td>X&quot; Conduit, Type &quot;X&quot; (Tunnel)</td>
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<td></td>
<td></td>
<td>Description</td>
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</tr>
<tr>
<td>---</td>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>25</td>
<td>603</td>
<td>X” Conduit I.D., HDPE (Pipe Burst)</td>
<td>LF</td>
</tr>
<tr>
<td>26</td>
<td>603</td>
<td>X” Conduit I.D., HDPE (Directional Drill)</td>
<td>LF</td>
</tr>
<tr>
<td>27</td>
<td>603</td>
<td>X” Conduit, With Compression Joints - (Jack and Bore)</td>
<td>LF</td>
</tr>
<tr>
<td>28</td>
<td>603</td>
<td>6” T-Branches on X” Conduit, Including Bends</td>
<td>EA</td>
</tr>
<tr>
<td>29</td>
<td>603</td>
<td>Standard Two Way Cleanout</td>
<td>EA</td>
</tr>
<tr>
<td>30</td>
<td>603</td>
<td>Sewer Service Reactivation (Only used with Pipe Burst)</td>
<td>EA</td>
</tr>
<tr>
<td>31</td>
<td>603</td>
<td>Video Taping of Installed Sewers</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>604</td>
<td>Remodel Bottom of Existing Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>33</td>
<td>604</td>
<td>Standard Type “S” Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>34</td>
<td>604</td>
<td>Standard Type “S” Drop Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>35</td>
<td>604</td>
<td>Modified Type “S” Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>36</td>
<td>604</td>
<td>Modified Type “S” Drop Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>37</td>
<td>604</td>
<td>Type “T” Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>38</td>
<td>604</td>
<td>Modified Type “T” Manhole</td>
<td>EA</td>
</tr>
<tr>
<td>39</td>
<td>604</td>
<td>Lamp Hole (Including Casting)</td>
<td>EA</td>
</tr>
<tr>
<td>40</td>
<td>623</td>
<td>Construction Layout (use only as needed)</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>623</td>
<td>Construction Layout - Supplement (use only as needed)</td>
<td>HR</td>
</tr>
<tr>
<td>42</td>
<td>SPEC</td>
<td>Environmental Compliance (Mitigative Measures &amp; Erosion Control Plan)</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>SPEC</td>
<td>Environmental Compliance (Creek Crossing Restoration)</td>
<td>LF</td>
</tr>
<tr>
<td>44</td>
<td>SPEC</td>
<td>Environmental Compliance (Silt Fence)</td>
<td>L.F.</td>
</tr>
<tr>
<td>45</td>
<td>SPEC</td>
<td>Stormwater Pollution Prevention Plan - SWPPP, NOI, &amp; NOT</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>SPEC</td>
<td>Performance Bond</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B Development of Escalation Values

A cost index is a dimensionless number used to adjust the cost of an item from one time period to another. Typically, an index documents the historic changes in cost as well as providing a mechanism for extrapolating this historic information to predict future cost changes. Although there are many existing general and more focused cost indices that are readily available, the basis of each index must be understood with regard to its specific project development characteristics before the user can assess which is most applicable to its work and location. Seldom does an index offer a perfect relationship but the index with the least individual application deficiencies is often accepted as a trade-off to its convenience.

Considering the size and complexity of the Capital Improvement Program (CIP) and the intent of MSD to closely track all relevant cost-related issues over time, MSD reasoned that in the same time it takes to determine the application issues that a published cost index data would and wouldn’t satisfy, the majority of the work has already been completed toward the preparation of a “customized” composite cost index. Research on this customizing concept reinforces that the follow-up effort needed to ensure continuing applicability of the published index will probably approach the magnitude of the effort to maintain an MSD-specific index. Moreover, this same research indicates that during a period of high rates of escalation, a customized index is more responsive to changing conditions.

The use of a customized MSD/Cincinnati Waste Water Cost Index (MI) is consistent with MSD’s business model goal of remaining a leader in its industry. The value of this customized approach includes the following:

- Functional in providing a context for estimating data
- Capable of guiding special studies aimed at future cost reduction
- Transparent when documenting project costs
- Illustrates reasons for construction price fluctuations over time
- Provides accurate escalation factors for project commodity price projections
- Provides known capital expenditure factors for use in de-escalating dollars expended to compare with original and/or current approved baseline budgets.
- Flexible in the frequency of the publication and update, especially during rapid economic change.

The index concept pursued by MSD was to build on the many applicable published indices and develop a composite that takes the most applicable characteristics of each of those indices as they relate to MSD and its local influences. This approach has been adopted while MSD’s estimating database grows more robust and comprehensive.
Certain elements of various indices related differently to MSD’s work. These differences result in the varying weight given to each index. The development process for the MI identified that, after weighting indices within the National and Local areas, it was necessary to further weight the national portion at 30% and the local portion at 70% to better correspond the MI to price changes being realized in the local area.

The following table identifies the six (6) published indices that are used to calculate the MI.

<table>
<thead>
<tr>
<th>INDEX</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.S Means (National)</td>
<td>30.0%</td>
</tr>
<tr>
<td>U.S. Bureau of Reclamation Construction Cost Trends</td>
<td>25.0%</td>
</tr>
<tr>
<td>Engineering News Record Building Cost Index (National)</td>
<td>20.0%</td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers Civil Works Construction Cost Index</td>
<td>25.0%</td>
</tr>
<tr>
<td>National Portion</td>
<td>30%</td>
</tr>
<tr>
<td>R.S. Means (Cincinnati)</td>
<td>70.0%</td>
</tr>
<tr>
<td>Engineering News Record Construction Cost Index (Cincinnati)</td>
<td>30.0%</td>
</tr>
<tr>
<td>Local Portion</td>
<td>70.0%</td>
</tr>
</tbody>
</table>

Once the MI has been calculated for the current quarter, it is compared to the previous quarter’s value. The growth trend between the two is then projected ahead one more quarter. Knowing that economic trends may not last longer than a quarter, an average growth rate of 2.2% per year is added for all succeeding quarters. This average value is based on the average growth trend from the inception of the custom index in 2006.

It may sometimes be necessary to report project costs in terms of what the project would have cost in 2006, the year of MSD’s initial consent decree. This can be accomplished by de-escalating the value. This de-escalation is based on how much the index has grown relative to its value in 2006.

Escalation and De-Escalation Multipliers and Inverse Multipliers - Updated tables can be found at the following links:

http://msdgc.org/doing_business/capital_project_resource_library/index.html

Select the links for Escalation table or for the de-escalation table.

2.2% Escalation Rate annual projection – Updated April, 2021
Appendix C Project Cost Assumptions and Definitions

The purpose of this page is to provide readers with very broad and high-level assumptions pertaining to the MSD annual CIP legislation. For all in-depth assumptions the reader should refer to the MSD Project Costing Manual.

Escalation, Inflation and Labor Inflation

Per MSD’s Project Costing Manual:

- Escalation = 2.2%
- Inflation = 2.0%
- Labor inflation = 3.0%

Planning / Study

The cost for planning or study during any stage of the planning phase by consultant contract.

Design

The cost for detailed design during the design phase either by consultant contract. Beginning in 2020, MSD labor will not be included in this line item.

Pre-Construction Services

The cost for MSD labor from planning to the beginning date of construction. Beginning in 2020, these costs were no longer assigned to individual project budgets.

Right of Way

The cost of professional services for appraisal and title opinions, appropriation costs, court costs, and compensation paid to property owners for easements. Beginning in 2020, MSD labor will not be included in this line item.

Construction

The bid cost to construct the project as estimated by the engineer including startup and commissioning if required for the project. This amount is equal to the OPCC.

Construction Services

The cost for construction services during the construction phase by consultant contract. This can be calculated using formulas contained in the MSD Project Costing Manual.

Interest / Financing (Capitalized Interest)

This is the cost to finance the project. This is calculated using a formula in MSD’s Project Costing Manual.
**Miscellaneous Expense (Miscellaneous Costs)**

The cost of all permit fees paid directly by MSD, including building permits, street opening permits, environmental inspections, geotechnical reporting, public relations, PTI applications, WPCLF loan fees, railroad permits, 401/404 permits, and other miscellaneous costs determined by MSD planning and/or project management staff. The basis for this number is found in the MSD’s Project Costing Manual.

**Rounding of Estimates**

All estimates are rounded to the nearest hundred dollars.

**Program Management**

This cost includes a number of legislated allowances that are used for the totality of MSD’s capital program rather than individual projects.
## Appendix D Useful Life of Capital Assets

<table>
<thead>
<tr>
<th>CATEGORIES</th>
<th>USEFUL LIFE (YEARS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Category</strong></td>
<td></td>
</tr>
<tr>
<td>Building Structures</td>
<td>50</td>
</tr>
<tr>
<td>Pump Station Structures</td>
<td>40</td>
</tr>
<tr>
<td>Paving</td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>30</td>
</tr>
<tr>
<td>Asphalt</td>
<td>20</td>
</tr>
<tr>
<td>Gravel</td>
<td>10</td>
</tr>
<tr>
<td><strong>Conveyance Category</strong></td>
<td></td>
</tr>
<tr>
<td>Force Mains</td>
<td>40</td>
</tr>
<tr>
<td>Gravity Sewers/Tunnels</td>
<td>100</td>
</tr>
<tr>
<td>Pipe Liners</td>
<td>50</td>
</tr>
<tr>
<td><strong>Equipment Category</strong></td>
<td></td>
</tr>
<tr>
<td>Auxiliary Equipment</td>
<td>15</td>
</tr>
<tr>
<td>Computer Equipment</td>
<td>5</td>
</tr>
<tr>
<td>Process Equipment</td>
<td>25</td>
</tr>
<tr>
<td>Pumping Equipment</td>
<td>10</td>
</tr>
<tr>
<td>Electrical Equipment</td>
<td>20</td>
</tr>
<tr>
<td>HVAC Equipment</td>
<td>20</td>
</tr>
<tr>
<td>Instrumentation/Sensor Equipment</td>
<td>10</td>
</tr>
</tbody>
</table>

The useful life listed here represents the average useful life for these assets and is meant to be used for the purpose of life cycle analysis and the present value cost analysis. These average useful life values do not necessarily represent the current status of the asset within its life cycle, which may vary from the average value depending on the individual asset conditions and applications.
Appendix E Deviation Based on Professional Judgment

Please select a soft cost from the list below that you would like to change and enter a description of the requested changes.

SELECT A SOFT COST

Enter a description of the requested soft cost changes in the provided boxes.

SELECT A SOFT COST

SELECT A SOFT COST

Approval:

Project Manager/Planner: ________________________________

Note: If the above signatory is the Project Delivery Project Manager then the Project Delivery Superintendent or the designee appointed must accompany this document. If the above signatory is the Project and Business Development Project Manager then the Project and Business Development Superintendent or the designee appointed must accompany this document.

Estimating Manager: ________________________________

Engineering Supervisor: ________________________________

Financial Manager: ________________________________

DPJ Version 1.0 Effective 3/9/2011
# Appendix F Example of Project Cost Buildup

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
<th>Rate</th>
<th>Amount</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Construction Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td>1,990,106</td>
</tr>
<tr>
<td>General Conditions</td>
<td></td>
<td>0.150</td>
<td>298,516</td>
<td></td>
</tr>
<tr>
<td>Profit &amp; Overhead</td>
<td></td>
<td>0.220</td>
<td>503,497</td>
<td></td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>2,792,119</td>
</tr>
<tr>
<td>Design Contingency</td>
<td></td>
<td>0.200</td>
<td>558,424</td>
<td></td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>3,350,543</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td>0.010</td>
<td>33,505</td>
<td></td>
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<tr>
<td>Bonding</td>
<td></td>
<td>0.010</td>
<td>33,505</td>
<td></td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>3,417,553</td>
</tr>
<tr>
<td>Escalation (Mid-Construction)</td>
<td>Oct-24</td>
<td>0.146</td>
<td>700,599</td>
<td></td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>4,118,152</td>
</tr>
<tr>
<td>Bidding Contingency</td>
<td></td>
<td>0.100</td>
<td>411,815</td>
<td></td>
</tr>
<tr>
<td><strong>Total Construction - OPCC</strong></td>
<td></td>
<td></td>
<td></td>
<td>4,530,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Date</th>
<th>Rate</th>
<th>Amount</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROW</td>
<td></td>
<td>0</td>
<td>0</td>
<td>Indirect Cost estimates should be rounded to the nearest $100</td>
</tr>
<tr>
<td>ROW Escalation</td>
<td>Apr-24</td>
<td>0.127</td>
<td>261,540</td>
<td>284,700</td>
</tr>
<tr>
<td>Total ROW</td>
<td></td>
<td></td>
<td></td>
<td>261,540</td>
</tr>
<tr>
<td>Planning</td>
<td></td>
<td>0.091</td>
<td>23,202</td>
<td>284,700</td>
</tr>
<tr>
<td>Planning Escalation (Start Design)</td>
<td>Apr-23</td>
<td>0.089</td>
<td>23,202</td>
<td>284,700</td>
</tr>
<tr>
<td>Total Planning</td>
<td></td>
<td></td>
<td></td>
<td>284,700</td>
</tr>
<tr>
<td>Design</td>
<td>factor=5.418*OPCC^-0.267</td>
<td>0.061</td>
<td>400,965</td>
<td>462,000</td>
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<tr>
<td>Design Escalation (Start Construction)</td>
<td>Apr-24</td>
<td>0.127</td>
<td>51,992</td>
<td>462,000</td>
</tr>
<tr>
<td>Total Design</td>
<td></td>
<td></td>
<td></td>
<td>462,000</td>
</tr>
<tr>
<td>Pre-Construction Services</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Construction Services</td>
<td>Value varies based on type of project.</td>
<td>0.187</td>
<td>847,110</td>
<td>971,100</td>
</tr>
<tr>
<td>Construction Services Escalation (End Construction)</td>
<td>Oct-24</td>
<td>0.146</td>
<td>123,992</td>
<td>1,105,092</td>
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<tr>
<td>Total Construction Services</td>
<td></td>
<td></td>
<td></td>
<td>971,100</td>
</tr>
<tr>
<td>Miscellaneous Costs</td>
<td>See PCM 3.7 for breakdown of Miscellaneous costs.</td>
<td>0.146</td>
<td>99,100</td>
<td>113,600</td>
</tr>
<tr>
<td>Miscellaneous Escalation (End Construction)</td>
<td>Oct-24</td>
<td>0.146</td>
<td>14,505</td>
<td>113,600</td>
</tr>
<tr>
<td>Total Miscellaneous Costs</td>
<td></td>
<td></td>
<td></td>
<td>113,600</td>
</tr>
<tr>
<td><strong>Total Project Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td>6,361,400</td>
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