METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

Estimating Guidelines

January, 2009

Contents

Section 3 – CSI Masterformat 2004

Appendices

Section 1
Introduction

1.1 Overview

The purpose of this document is to establish standard estimating guidelines to increase the accuracy of Metropolitan Sewer District (MSD) estimates. An accurately developed and properly reviewed estimate will result in a more precisely forecasted budget for a project. As potential projects are considered, there are decisions that affect whether a specific project should continue to be developed. Each decision point during the project life cycle typically requires a cost estimate of increasing accuracy. Estimating is thus an iterative process that is applied in each phase of the project's design life cycle as the project scope is defined, modified, and refined. Estimate input continues during the construction phase as changes and claims require cost verification before acceptance.

The capital cost of a proposed project is one of the key determinants in evaluating the financial viability and business case of that project. Estimating serves as a tool supporting both scheduling and cost control of projects. An effective estimate establishes a realistic budget and provides accurate information for cost monitoring and progress measurement during project execution.

Contracted Designers will use the procedures and tools in this document to produce standardized estimates and to evaluate estimate reports for consistency and completeness.

1.2 Organization of this Document

Section 1 – Introduction/Overview

Section 2 – Work Breakdown Structure

Section 3 – CSI Master Format 2004

1.3 Estimating Flow

Figure 1-1 shows the process flow of the project cost forecast life cycle, and Figure 1-2 presents the design estimating process flow.

Figure 1-1 Project Cost Forecast Life Cycle

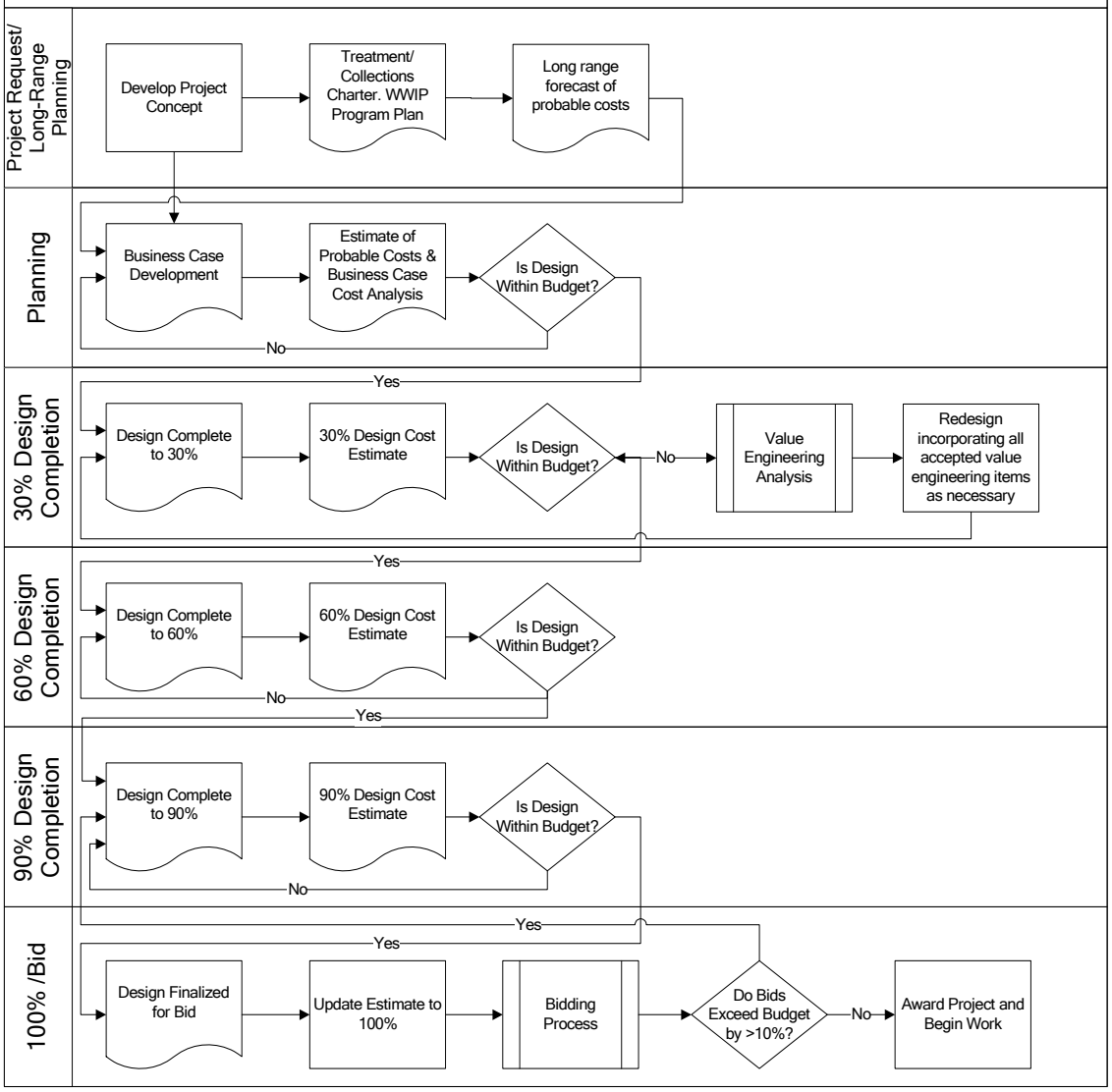
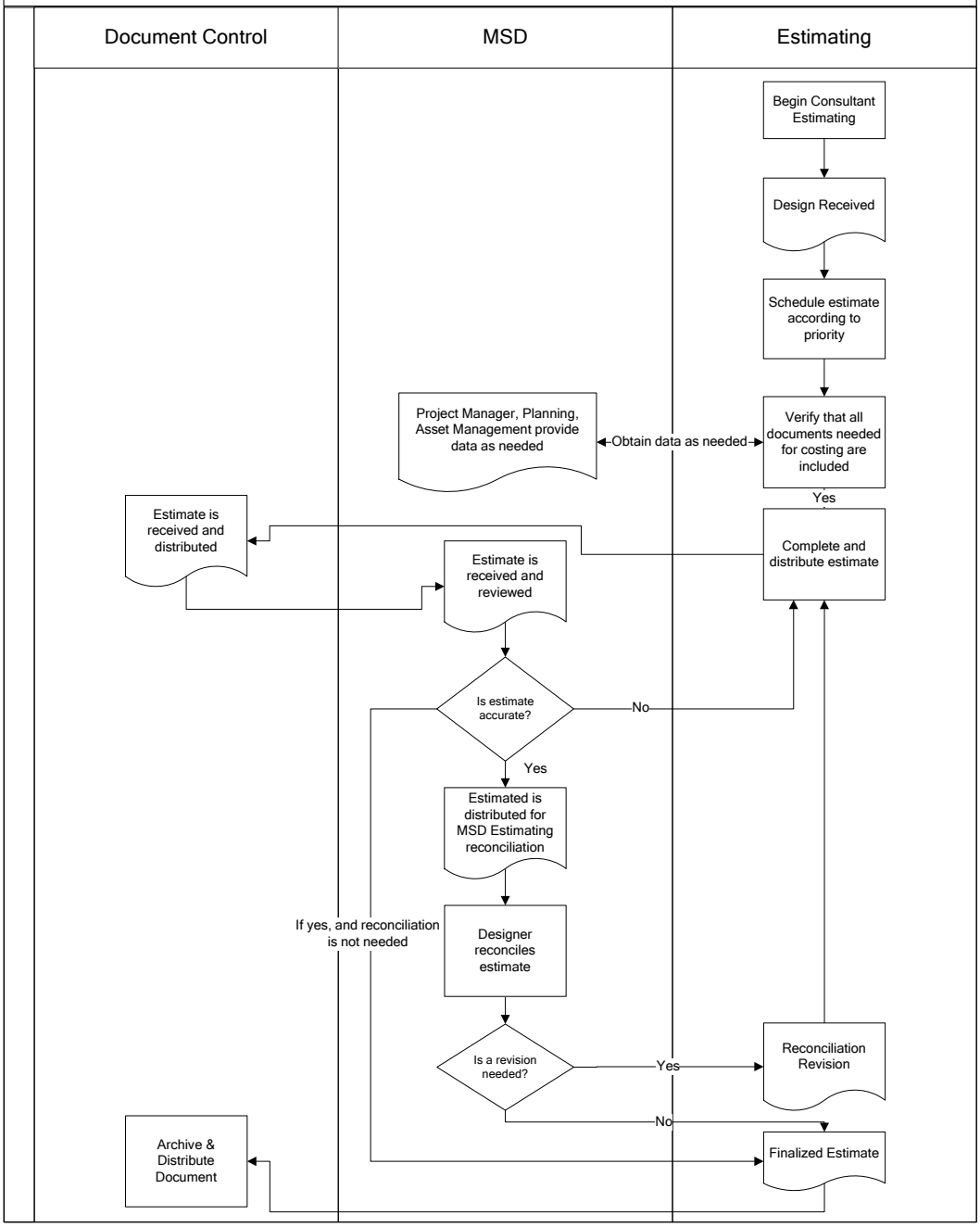


Figure 1-2 Design Estimating Flow Diagram



1.4 Estimating Methodologies

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.

1.4.1 Conceptual Estimating

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 total project cost.

- **The 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.

1.4.2 Deterministic Estimating

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 require a high degree of precision and a determination of quantities, pricing, and a complete scope definition.

1.5 Estimate Classification

Estimate classification is commonly used to categorize project cost estimate types to indicate the overall maturity and quality from the various types of estimates that may be prepared; and 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 lifecycle of a project.

The Association for the Advancement of Cost Engineering (AACE) international developed the "recommended practice for cost estimate classification" (AACE 17R-97) to provide generic guidelines for the general principles of estimate classification that

may be applied across a wide variety of industries. The estimate classification provides:

- A common understanding of the concepts involved in classifying project cost estimates
- The major characteristics, fully defined and correlated, used in classifying cost estimates so that different organizations may clearly determine how the particular practices compare to the AACE guidelines
- The degree of project definition used as the primary characteristic in categorizing estimate classes

Table 1-1 shows the MSD estimate correlation to the AACE Estimate Classification System.

Table 1-1 Estimate Classes

Class	Phase/ Type of Estimate	MSD/PMC	Project Definition	Expected Project Contingency	Background information used	End use
5	Pre-planning – Order of Magnitude	Project Request/ Long-Range Planning	1-5%	20-60%	Few or no design parameters: estimate based on past history data	Preliminary Project Screening Capital Budget Strategic Analysis
4	Planning – Applied Parametric Estimate	Planning	6-15%	15-50%	Based on project narrative and recommendations	Project Funding Reality Check Alternate Schemes Preliminary Project Feasibility Study
3	Schematic/ Deterministic	30% Design	15-40%	10-50%	Rudimentary design and estimator experience with known parameters needed to develop the estimate	Fair Price Check Change Alert Check Alternate Schemes
3	Deterministic Design Development	60% Design	20-60%	7-40%	Design development documents. Estimator experience needed for cost gap.	Project Funding Fair Price Check Change Alert Check Alternate Schemes
2	Deterministic Estimate	90% Design	60-90%	5-20%	Detailed estimating data from plans and specifications	Project Funding Control Estimate Change Alert
1	Construction Document/ Bid Development	100% Bid Design	90-100%	5-20%	Detailed documentation ready for bid submittal	Change Alert Estimate Firm Bid Estimate

As estimate accuracy increases through the five class continuum, where Class 5 is the least accurate and Class 1 the most accurate, risk of overruns and under-runs decreases. These classes were developed by the AACE to standardize the classification of estimate types industry-wide.

1.7 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.

1. Construction Specification Institution (CSI) Masterformat 2004

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 will also be generated from the WBS.

1.7.1 Construction Specification Institute (CSI)

All MSD estimate details will be organized using the CSI Masterformat 2004 Codes. See Section 6 for Masterformat 2004 scope, clarification, and structure.

Using CSI codes to organize an estimate facilitates a direct comparison to the project specifications and drawings. The CSI system has three main strengths:

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.

1.7.2 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. Section 3 includes scope, clarification, and structure of the MSD Work Breakdown Structure.

1.7.4 Schedule of Values

A budget must be established as a control baseline as early as possible in the design process. The budgets are derived from estimates prepared using all of the design and cost information available at the time. Although budgets will be refined as the estimates are upgraded from conceptual to factored to definitive, all parties must be cognizant of the current budgets 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 MSD proprietary trend analysis, indexing, and estimating unit data.

1.8 Estimating Software Overview

Because reconciliation between the contracted designer's estimate and an estimate of probable costs developed by the MSD is necessary, the ability to prepare, calculate, analyze, and present estimated project costs consistently is crucial for a timely development of the costing phase. A database application is required to generate reports at different summary levels and by various formats required by these guidelines. Accordingly, a specific software application is not specified; however, the following minimum required features must be included in any estimating software that is used for MSD project:

- Encourage the use of MSD's database of costs, or create a database of costs as needed, that can be updated and used on each individual project
- Sort each estimate by CSI and project specific WBS Codes
- List notes, assumptions, or cost sources of each estimate line item
- Produce an audit trail for entered quantities

- Have the flexibility to customize estimate reports
- Electronically compare the current estimated costs to previous estimates.

1.9 Components of the 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
6. **Triple bottom line business case analysis (if needed)**

Each of these components is described in the following sections.

1.9.1 Document List

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

1.9.2 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.

1.9.3 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 will be shown on the **Estimate Report Summary (See Appendix B).** An example would be the "Million Gallons Per Day" (MGD) for a Pump Station.

1.9.4 Body of the Estimate

Estimate reports for MSD will include the following items:

1. **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.

2. **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.

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

4. **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:

    a) **Material:** The material unit price will be derived from vendor quotes or historical cost data.

    b) **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. The most current Davis-Bacon prevailing labor rates will apply.

    c) **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.

d) **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.

e) **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.

1.9.5 Estimate Markup Items

Estimate markups are indirect and direct costs that are expressed as a lump sum, deterministic units or calculated as a percentage of the subtotal of the estimated construction costs. Indirect costs are costs that are required to complete a project. Direct costs are costs that are used to run the contractor's business.

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, local Business & Occupation (B & O) Taxes, bonds, and insurance. The Estimating Group will base general condition costs on the monthly cost of the project and the project duration acquired from the schedule; however, they can also be calculated as a percentage of the total project 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.

2. **Contractor's Overhead:** This is the cost of doing business. The Estimating Group will calculate this percentage by gauging the amount of annual construction work of the contractor performing the work, on the particular project size and complexity, as well as the knowledge of what historically has been used on similar project of this type and apply the corresponding value in Table 1-2. Table 1-2 outlines the overhead percentage range to be used at each estimate class.

Table 1-2 Overhead Calculation Guide

Class	Phase/ Type of Estimate	Low Range	Mid Range	High Range
5	Pre-planning – Order of Magnitude	7%	10%	12%
4	Planning – Applied Parametric Estimate	7%	10%	12%
3	Schematic/ Planning – Conceptual Level Design	5%	8%	10%
2	Design Development – Deterministic Estimate	5%	8%	10%
1	Construction Document/ Bid Development	5%	8%	10%

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. Table 1-3 outlines the profit percentage range to be used at each estimate class.

Table 1-3 Contractor's Profit Calculation Guide

Class	Phase/ Type of Estimate	Low Range	Mid Range	High Range
5	Pre-planning – Order of Magnitude	5%	8%	10%
4	Planning – Applied Parametric Estimate	5%	8%	10%
3	Schematic/ Planning – Conceptual Level Design	3%	5%	10%
2	Design Development – Deterministic Estimate	3%	5%	10%

Table 1-3 Contractor's Profit Calculation Guide

Class	Phase/ Type of Estimate	Low Range	Mid Range	High Range
1	Construction Document/ Bid Development	3%	5%	10%

4. **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 percentage calculates off of the raw capital cost in the estimate. Table 1-4 outlines the design contingency range to be used at each estimate class.

Table 1-4 Design Contingency Allowance Guide

Type of Estimate	Low Range	Mid Range	High Range
Long Term Planning Class 5	7%	10%	20%
Planning Class 4	7%	10%	20%
30% Design Class 3	5%	10%	15%
60% Design Class 3	3%	7%	10%
90% Design Class 2	0%	3%	5%
95% Design Class 1	0%	0%	0%

5. **Construction Contingency:** Construction contingency is a factor added to the estimate to account for the estimators anticipated overrun of the estimate due to the following:

   - Errors and 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
   - Labor availability, skills, and productivity that may vary from the fact originally assumed
   - Estimator assumed change orders that may be inherent within the project design.

   The construction contingency amount relies upon the technical ability of the estimator or the estimating team, and is used in the estimate to deal with the uncertainties inherent in the project design process. The responsible estimator will assess all of the documents used to assemble the estimate to verify completeness and accuracy. From this assessment, the estimator formulates the project contingency amount for the estimate. The project contingency amount is applied using a percentage variable that calculates off of the initial construction raw costs, plus markups and escalation.

6. **Escalation:** This is a provision for an increase in the cost of equipment, material, and labor above the costs specified in the contract, due to continuing price changes over time.

1.9.6 Business Case Cost Analysis

Engineering economics is the primary tool for stakeholders to formulate project decisions and applied comparative economic analysis. There are a variety of economic analysis techniques available to help the estimator make accurate choices when comparing alternatives. The general principle is that there are competing alternatives and the goal is to choose the alternative that fits best within the MSD business model. The tools used to analyze returns from the various alternatives are:

- Present worth (used for comparing alternatives)
- Lifecycle cost analysis
- Annual cash flow analysis
- Rate of return analysis
- Cost-Benefit ratio analysis.

1.10 Estimate Numbering System

Estimates will follow the MSD Capital Improvement Program Project Numbering Procedure (MSD CIP Number) to adhere to the "common thread" numbering schema put in place by the PMC Document Control Group. This will be the initial framework of the estimate numbering system with an "estimating extension grouping" so that the estimate type, number of estimates, and revisions can be easily obtained. The following is an example of an estimate number:

$$\{10170000\} - \{P30\} - \{001\} - \{R1\}$$

MSD CIP Numbering System	Estimate Classification Code	Sequential Estimate Number	Revision Number

1.10.1 Estimate Classification Code

The estimate classification code is the designation that will immediately follow the MSD CIP Number. This designation is to be used to quickly categorize and compare the type of cost forecast that is needed in relation to the design documents completion phase. The classification codes are as follows:

- LRP – Project request/Long-range planning estimate
- PLN - Planning level estimate

- P30 – 30% design stage completion estimate
- P60 – 60% design stage completion estimate
- P90 – 90% design stage completion estimate
- P100 – 100% design stage completion estimate / bid design estimate
- COR – Change order estimate.

1.12 Estimate Distribution

Because document control coordination is essential to the efficient control of a project, a finalized estimate at any classification level will need to adhere to a strict distribution matrix developed by the Project Manager. This distribution matrix should include the project manager, scheduling, cost and budget control, contract QA/QC, design QA/QC, PMC senior level management, WWE senior level management, and change order control management when necessary. Distribution may also include contracted designers or in-house WWE design personnel.

1.13 Quality Control/Estimate Review Process

Because an estimate is critically important to the project's success, it makes sense that the estimate should undergo a rigorous quality control process. The estimate should be evaluated not only for its quality and accuracy, but also to ensure that it contains all the required information and is presented in a way that is understandable to all project team members. The Estimating Group will adhere to a structured (if not formal) estimate review process. The following sequence of steps will discuss a formal review process for internally prepared estimates.

1.13.1 Estimating Department Review/Guidelines

The first estimate review will be conducted by the estimating team that prepared the project estimate. This is essentially a screening review to ensure that the math is correct (extension of pricing are correct, summaries backup properly, etc.), that the estimate is documented correctly (comprehensive basis of estimate document is prepared), and that it adheres to MSD estimating guidelines. This review will be held by the lead estimator with the members of his estimating team. On very large projects or those of significant importance, this review will be held by the estimating department manager.

A careful review will be done to verify that the cost estimate follows standard estimating guidelines for the department. This would include a review to verify that standard estimating procedures were followed regarding estimate format, cost coding, presentation, and documentation. This would include items such as the following:

- Verify that the proper estimating methods, techniques, and procedures were used for the stage of the project completeness. In other words, different estimating

techniques will be used depending on the type and completeness of the engineering documents available to create the estimate.

- Confirm that the estimate summary and details are organized and presented in the proper format (i.e., following the project WBS code of accounts); and that the format is consistent with the intended purpose of the estimate (i.e., an estimate serving as a basis for cost control contains sufficient detail).

- Ensure that all estimate backup information is organized properly. All values on the summary page of the estimate should be traced to the estimate detail pages, and all information on the estimate detail pages should be traced to the estimate backup or source documents.

- Verify that all allowances and factors are appropriate for the type of estimate being prepared, and that they are consistent with comparable projects and estimates.

This level of estimate review helps to ensure that all estimates prepared by the Estimating Group are using established guidelines and are presented in a consistent manner from project to project.

1.13.3 Project Management Review

The objective of the Project Management Review is to gain the entire project team support of the estimate, and especially that of the project manager. This is also the first point where the estimate should be able to pass overall validation tests, in addition to quality review.

Although primarily the responsibility of the engineering team, the scope related costs should also be reviewed by the rest of the project team to gain consensus. In particular, the following areas should be discussed:

- Verify that the latest project schedule agrees with the estimate (particularly as it relates to escalation).

- Examine the project administration and other home office related costs for reasonableness.

- Conduct a final constructability review to ensure that the methods of installation and construction assumed in the estimate are reasonable and cost effective.

- Review the construction indirect costs (i.e., field staff, temporary facilities, temporary services, construction equipment and services, construction tools and consumables, etc.) to make sure they are reasonable.

- Ensure that all required startup and commissioning materials are included.

Finally, the project manager will coordinate a reconciliation of the current estimate to the MSD estimate of probable costs. This is an important, but often overlooked aspect

of the overall estimate review process. Comparing the current estimate with the MSD estimate can increase its credibility, clearly defining project scope and construction methods. The reconciliation will be presented at a high level without excessive detail, but the backup should be available in case it is required during the review.

The project manager may also be interested in a reconciliation of the current estimate to the preceding estimate (or estimates).

1.15 MSD Procedure for Construction Estimates Prepared by Design Consultant

Design estimates should be produced by an estimating professional who is not influenced by design, budgets, political interests, or other conflicts of interest. This approach will result in an unbiased assessment of costs to complete the project. The estimating personnel are either selected by the PM (pending estimating department review) or are part of the design consultant team that is awarded the project. In either case, the Project Manager should review and approve the proposed estimating personnel based on the following minimum qualifications:

1. The use of appropriate estimating software with the minimum required features (see Section 1.8)

2. Ability to produce estimate reports formatted according to MSD requirements for the specific project

3. Ability to produce estimate cost comparisons to record cost changes and provide a history of the project's cost and scope changes

4. The use of MSD's cost database, as well as historical cost databases which are updated and adjusted for local viability for the particular project type

5. Estimating staff or resources who are familiar with the project type

6. Understanding and ability to produce business case analysis for the project on an as needed basis.

7. Agreement that all project information and estimated costs be kept confidential. (This is particularly critical when "what-if scenarios" or project options are being considered and estimated.)

It is best to use the same estimating team members throughout a project's design to consistently document all assumptions, scope, and cost changes. Consistent documentation of the estimates will help MSD staff quickly understand the estimates and identify factors that impact the estimated costs.

1.15.1 Consultant Prepared Estimate Review

When reviewing estimates prepared by design consultants, the Estimating Group will keep in mind the basic fundamentals described herein. Complicating the matter;

however, is the problem that often only a short amount of time is allowed for a complete estimate review. Thus the review of an estimate prepared by the design consultant will be accomplished by critical assessment of the estimate and its documentation, and a series of questions to assist in evaluating the level of diligence used in preparing estimate. The following section focuses on guidelines that the Estimating Group will use to efficiently review estimates prepared by design consultants.

1.15.1.1 Basis of Estimate

The Estimating Group will assess the following for the basis of estimate:

- The estimate is well-organized and complete.
- The estimate provides the required information regarding the design basis, planning basis, cost basis, and risk basis of the estimate.
- The design basis clearly documents the scope of the project, and all engineering documents have been used in developing the estimate.
- Scope assumptions have been identified.
- Planning basis (schedule, resource planning, construction plan, etc.) is reasonable, in line with expectations, and consistently applied throughout the estimate.
- Risk basis has been clearly identified and defined, and is reasonable for the level of information available to prepare the estimate.

1.15.1.2 Estimating Personnel

The Estimating Group will examine the credentials of the consultant's personnel that prepared the estimate, and assess their level of estimating experience. The Estimating Group will also assess whether the estimating personnel used internal procedures and guidelines to complete the estimate, and if the estimate was checked and reviewed before publication and release.

1.15.1.3 Estimate Methodology

The Estimating Group will assess the following:

- The estimating methods, techniques, and procedures used in preparing the estimate
- If the appropriate level of information is available for the project type
- The different estimating methods used for different parts of the estimate
- If the level of detail in the estimate is sufficient for the purpose of the estimate
- The parts of the project that are difficult to estimate, and why

- If sufficient time was available to prepare the estimate
- The adjustments made to the estimate for location, complexity, etc., and their reasonableness
- If the estimate is prepared according to the organizational breakdown outlined in this document in Section 2 and/or Section 3

1.15.1.4 Estimate Documentation

The Estimating Group will assess the following for documentation:

- If the estimate is documented clearly and is complete as outlined in Section 1.9.
- If the estimate summary and detail page is well organized and presented at an appropriate level of detail
- If the cost appearing on the summary is traceable to the estimate detail and other estimate back up documentation

1.15.1.5 Estimate Validation

The Estimating Group will report on the following during the review process:

- Metrics showing key estimating metrics and benchmark ratios for the estimate and similar past projects
- Comparisons with a quick-check estimate (using conceptual estimating techniques)

Section 2
Work Breakdown Structure (WBS)

1.1 Overview

A definition of the work to be accomplished is the logical starting point for implementing an organized system approach to cost estimating. The use of a Work Breakdown Structure (WBS) is the approach that is used to coordinate all communications of cost data.

Project Management Consultant (PMC) Estimators/MSD Estimators, MSD Planning, MSD Designers, MSD Project Managers, MSD Construction Managers, and Contracted Designers will use this document to assemble and/or evaluate estimate reports for effective costing of corresponding work results, consistency and completeness. PMC and MSD program and department managers will use these guidelines to understand and direct the estimating process.

1.2 Organization of this Document

Section 1 – Introduction/Overview

Section 2 – Work Breakdown Structure

Section 3 – CSI Master Format 2004

1.3 Work Breakdown Structure (WBS)

The WBS is the logical subdivision of products, equipment, services and all other tasks that make up the estimate. The WBS is also the framework for all cost estimating, and should be the basis for all subsequent actual cost collection (i.e. Schedule of values.)

A WBS serves cost estimating for three primary reasons

1. To provide consistency between estimates thereby facilitating estimate comparison.

2. To provide a summarization structure which guarantees vertical traceability from detailed accounts to summary accounts, thereby defining the interrelationships between various account levels.

3. To provide a basis for establishing standard estimate formats/templates.

If the implemented WBS structure does not support estimate development and actual cost collection, then it will never be possible to confirm that all the estimated costs are accurate and transferable to subsequent estimates in the project forecast life cycle.

Examples of Work Breakdown Structures (WBS) are as follows:

1. CSI Masterformat: 50 divisions that standardize information in construction project manuals.

2. Uniformat: organizes preliminary construction information based on its systems and assemblies, and is used for preliminary project descriptions, performance specifying and cost estimation. Generally used for architectural construction work results.

3. Omniclass: consists of 15 tables, each representing a different facet of construction information.

4. Greenformat: offers efficient searching and objective product data for green commercial construction.

5. Proprietary Framework Dictionary: Agency specific breakdown structure, representing a different facet of construction work results. Developed by the MSDGC Project Manager.

1.4 Developing the Work Breakdown Structure (WBS)

It is important to be cognizant of the necessary useful level that will facilitate effective communication of costs between all project stake holders. An effective WBS should include the following characteristics:

1. Is project-oriented

2. Includes ALL work, material, equipment and services, and each element logically aggregates those below it.

3. Supports vertical traceability for all estimates in the project forecast life cycle

4. Supports transferability for all estimates in the project forecast lifecycle

5. Supports historical cost collection for future cost estimating purposes.

The MSDGC Project Manager coordinating with the Estimating Manager will develop the Estimate Summary WBS and coordinate all communications of the breakdown structure to all project stakeholders and cost analysis personnel. All other cost estimating breakdown structure levels will strictly adhere to the CSI Masterformat 2004.

An example of MSDGC Proprietary Framework Dictionary for conveyance estimates is as follows:

ODOT Specification

1	201	Clearing and Grubbing	
2	202	Fill, Seal & Abandon Existing Sewers (12" and Larger)	CY

3	202	Seal and Abandon Existing Sewers	
4	202	Manholes Removed	EA.
5	202	Manholes Abandoned	EA.
6	202	Inlets Removed	EA.
7	202	Inlets Abandoned	EA.
8	202	Remove and Salvage Existing WWTP	
9	202	Remove and Salvage Existing Lift Station	
10	210	Special Excavation	CY
11	211	Special Fill Material (Bank Run Gravel)	TON
12	211	Special Fill Material (No. 3 Gravel Bedding)	TON
13	602	Concrete Masonry Cl. "C"	CY
14	602	Concrete Masonry Cl. "C" (Encasement, Cradles, Key Blocks)	CY
15	602	Brick Masonry	CY
16	603	6" Conduit, Type "I"	LF
17	603	6" Conduit, Type "I" With Compression Joints - Stacks	LF
18	603	X" Conduit, Type "X"	LF
19	603	X" Conduit, Type "X"	LF
20	603	X" Conduit, Type "X"	LF
21	603	X" Conduit, Type "X"	LF
22	603	X" Conduit, Type "X"	LF
23	603	X" Conduit, Type "X"	LF
24	603	X" Conduit, Type "X" (Tunnel)	LF
25	603	X" Conduit I.D., HDPE (Pipe Burst)	LF
26	603	X" Conduit I.D., HDPE (Directional Drill)	LF
27	603	X" Conduit, With Compression Joints - (Jack and Bore)	LF
28	603	6" T-Branches on X" Conduit, Including Bends	EA.
29	603	Standard Two Way Cleanout	EA.
30	603	Sewer Service Reactivation (Only used with Pipe Burst)	EA.

31	603	Video Taping of Installed Sewers	
32	604	Remodel Bottom of Existing Manhole	EA.
33	604	Standard Type "S" Manhole	EA.
34	604	Standard Type "S" Drop Manhole	EA.
35	604	Modified Type "S" Manhole	EA.
36	604	Modified Type "S" Drop Manhole	EA.
37	604	Type "T" Manhole	EA.
38	604	Modified Type "T" Manhole	EA.
39	604	Lamp Hole (Including Casting)	EA.
40	623	Construction Layout (use only as needed)	
41	623	Construction Layout - Supplement (use only as needed)	HR.
42	SPEC	Environmental Compliance (Mitigative Measures & Erosion Control Plan)	
43	SPEC	Environmental Compliance (Creek Crossing Restoration)	LF
44	SPEC	Environmental Compliance (Silt Fence)	L.F.
45	SPEC	Stormwater Pollution Prevention Plan - SWPPP, NOI, & NOT	
46	SPEC	Performance Bond	

Section 3
CSI Masterformat 2004

1.1 Overview

The purpose of this document is to establish common formats and standards that will be used to guide estimates through the project cost forecast life cycle. The Construction Specifications Institute (CSI) Masterformat is a master list of numbers and subject titles for organizing information about construction work results, requirements, products, and activities into a standard sequence. Each construction project uses many different delivery methods, products and installation techniques; the Masterformat contributes to the successful completion of these projects by standardizing communication among the project stakeholders. During the project cost forecast life cycle the Masterformat facilitates standard retrieval and comparison schemes.

Project Management Consultant (PMC) Estimators/MSD Estimators, MSD Planning, MSD Designers, MSD Project Managers, MSD Construction Managers, and Contracted Designers will use this document to assemble and/or evaluate estimate reports for effective costing of corresponding work results, consistency and completeness. PMC and MSD program and department managers will use these guidelines to understand and direct the estimating process.

1.2 Organization of this Document

Section 1 – Introduction/Overview

Section 2 – Work Breakdown Structure

Section 3 – CSI Master Format 2004.

1.3 Masterformat

MasterFormat is the most widely used standard for organizing specifications and other written information for commercial and institutional building projects in the U.S. and Canada. It provides a master list of divisions, and section numbers and titles within each division, to organize information about construction requirements and associated labor, equipment and material activities. Materformat helps the project team deliver projects to owners according to their requirements, timelines, and budgets. MasterFormat is a product of the Construction Specifications Institute (CSI) and Construction Specifications Canada. In November 2004 MasterFormat expanded from 16 Divisions (Masterformat 1995) to 50 Divisions (Masterformat 2004), reflecting innovations in the construction industry. All estimates submitted to MSD for review and/or reconciliation will follow the Masterformat 2004 organization guidelines for the details within an estimate. It is possible that, at the MSD project manager's discretion, the Masterformat 2004 will be used to coordinate summary level construction work results within a submitted estimate.

1.4 Masterformat 2004

Each Masterformat number and title defines a "section" arranged in "levels" depending on their breadth of coverage. The broadest collection of related construction products and activities are level one titles, otherwise known as divisions. Each division is made up of level two, level three and occasionally level four numbers and titles, each of which delineate a gradually more detailed area of work results.

The following is the expected MSD Masterformat 2004 numbers and titles that indicate the construction activities that all MSD projects will necessitate. Further organizational guidelines are possible to commensurate with the design. To see a complete edition of Masterformat 2004 numbers and titles please refer to http://www.csinet.org/s_csi/docs/9400/9361.pdf.

01 DIVISION 01 – GENERAL REQUIREMENTS

01 00 00 General Requirements
01 20 00 Price And Payment Procedures
01 30 00 Administrative Requirements
01 40 00 Quality Requirements
01 50 00 Temporary Facilities And Controls
01 60 00 Product Requirements
01 70 00 Execution And Closeout Requirements
01 80 00 Performance Requirements
01 90 00 Life Cycle Activities

02 DIVISION 02 – EXISTING CONDITIONS

02 00 00 **Existing Conditions**
02 20 00 **Assessment**
02 21 00 Surveys
02 22 00 Existing Conditions Assessment
02 24 00 Environmental Assessment
02 25 00 Existing Material Assessment
02 26 00 Hazardous Material Assessment
02 30 00 Sub-surface Investigation
02 40 00 Demolition & Structure Moving
02 50 00 Site Remediation
02 51 00 Physical Decontamination
02 55 00 Remediation Soils Stabilization
02 56 00 Site Containment
02 57 00 Sink Hole Remediation
02 60 00 Contamination & Site Material Removal
02 70 00 Water Remediation
02 80 00 Facility Remediation

03 DIVISION 03- CONCRETE

03 10 00 Concrete Forming & Accessories
03 20 00 Concrete Reinforcing
03 30 00 Cast-In-Place Concrete
03 31 00 Structural
03 33 00 Architectural

03 34 00 Low Density
03 37 00 Specialty Placed

03 40 00 Precast Concrete

03 41 00 Precast Structural
03 45 00 Precast Architectural
03 48 00 pre cast concrete specialties

03 50 00 Cast Decks And Underlayment
03 60 00 Grouting
03 80 00 Concrete Cutting And Boring

04 DIVISION 04 – MASONRY

04 20 00 Unit Masonry
04 40 00 Stone Assemblies
04 60 00 Corrosion-Resistant Masonry
04 70 00 Manufactured Masonry

05 DIVISION 05 – METALS

05 10 00 Structural Metal Framing
05 20 00 Metal Joists
05 30 00 Metal Decking
05 40 00 Cold-Formed Metal Framing
05 50 00 Metal Fabrications
05 70 00 Decorative Metal

06 DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00 Rough Carpentry
06 20 00 Finish Carpentry
06 40 00 Architectural Woodwork
06 50 00 Structural Plastics
06 60 00 Plastic Fabrications
06 70 00 Structural Composites
06 80 00 Composite Fabrications

07 DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 10 00 Dampproofing And Waterproofing
07 20 00 Thermal Protection
07 30 00 Steep Slope Roofing
07 33 00 Natural Roof Coverings
07 40 00 Roofing And Siding Panels
07 50 00 Membrane Roofing
07 70 00 Roof And Wall Specialties And Accessories
07 80 00 Fire And Smoke Protection
07 90 00 Joint Protection

08 DIVISION 08 – OPENINGS

08 10 00 Doors And Frames
08 30 00 Specialty Doors And Frames
08 40 00 Entrances, Storefronts, And Curtain Walls
08 50 00 Windows
08 60 00 Roof Windows And Skylights
08 90 00 Louvers And Vents

09 DIVISION 09 – FINISHES

09 20 00 Plaster And Gypsum Board
09 30 00 Tiling
09 50 00 Ceilings (Non-gypsum)
09 60 00 Flooring (Non-Tile)
09 70 00 Wall Finishes
09 80 00 Acoustic Treatment
09 90 00 Painting And Coating

10 DIVISION 10 – SPECIALTIES

10 10 00 Information Specialties
10 20 00 Interior Specialties
10 40 00 Safety Specialties
10 50 00 Storage Specialties
10 70 00 Exterior Specialties
10 80 00 Other Specialties

11 DIVISION 11 – EQUIPMENT

11 10 00 Vehicle And Pedestrian Equipment
11 20 00 Commercial Equipment
11 50 00 Educational And Scientific Equipment
11 80 00 Collection And Disposal Equipment

12 DIVISION 12 – FURNISHINGS

12 00 00 Furnishings
12 20 00 Window Treatments
12 30 00 Casework
12 40 00 Furnishings And Accessories
12 50 00 Furniture
12 90 00 Other Furnishings

13 DIVISION 13 – SPECIAL CONSTRUCTION

13 00 00 Special Construction
13 30 00 Special Structures

14 DIVISION 14 – CONVEYING EQUIPMENT

14 20 00 Elevators
14 40 00 Lifts
14 90 00 Other Conveying Equipment

21 DIVISION 21 – FIRE SUPPRESSION

21 00 00 Fire Suppression

22 DIVISION 22 – PLUMBING

22 00 00 Plumbing

22 10 00 Plumbing Piping And Pumps
22 30 00 Plumbing Equipment
22 40 00 Plumbing Fixtures
22 50 00 Pool And Fountain Plumbing Systems
22 60 00 Gas And Vacuum Systems For Laboratory And Healthcare Facilities

23 DIVISION 23 – HEATING, VENTILATING,

AND AIR-CONDITIONING (HVAC)

23 00 00 Heating, Ventilating & Air Conditioning

23 00 00 Heating, Ventilating & Air Conditioning
23 10 00 Facility Fuel Systems
23 20 00 Hvac Piping And Pumps
23 30 00 Hvac Air Distribution
23 40 00 Hvac Air Cleaning Devices
23 50 00 Central Heating Equipment
23 60 00 Central Cooling Equipment
23 70 00 Central Hvac Equipment

25 DIVISION 25 – Integrated Automation

25 00 00 Integrated Automation

25 10 00 Integrated Automation Network Equipment

25 30 00 Integrated Automation Instrumentation and Terminal Devices

25 31 00 integrated automation instrumentation and terminal devices for facility equipment
25 32 00 integrated automation instrumentation and terminal devices for conveying equipment
25 33 00 integrated automation instrumentation and terminal devices for fire suppression systems
25 34 00 integrated automation instrumentation and terminal devices for plumbing
25 35 00 integrated automation instrumentation and terminal devices for HVAC
25 36 00 integrated automation instrumentation and terminal devices for electrical systems
25 37 00 integrated automation instrumentation and terminal devices for Communications Systems
25 38 00 integrated automation instrumentation and terminal devices for electronic safety and security systems

25 50 00 Integrated automation facility controls

25 51 00 integrated automation control of facility equipment
255200 integrated automation control of conveying equipment
255300 integrated automation control of fire suppression systems
255400 integrated automation control of plumbing
255500 integrated automation control of HVAC
255600 integrated automation control of electrical systems
255700 integrated automation control of communications systems
255800 integrated automation control of electronic safety and security systems

25 90 00 Integrated Automation Control Sequences

259100 integrated automation control sequences for facility equipment
259200 integrated automation control sequences for conveying equipment
259300 integrated automation control sequences for fire suppression systems
259400 integrated automation control sequences for plumbing
259500 integrated automation control sequences for HVAC
259600 integrated automation control sequences for electrical systems

259700 integrated automation control sequences for communications systems

26 DIVISION 26 – ELECTRICAL

26 00 00 Electrical
26 08 00 Commissioning of Electrical Systems
26 09 00 Instrumentation and Control for Electrical Systems
26 10 00 Medium -Voltage Electrical Distribution
26 20 00 Low -Voltage Electrical Distribution
26 30 00 Facility Electrical Power Generating And Storing Equipment
263200 Package Generator Assemblies
263300 Battery Equipment
263600 Transfer Switches
26 40 00 Electrical And Cathodic Protection
26 50 00 Lighting

27 DIVISION 27 – COMMUNICATIONS

27 00 00 Communications
27 10 00 Structured Cabling
271100 communications equipment room fittings
271300 communications backbone cabling
271500 communications horizontal cabling
271600 communications connecting cords, devices and adapters
27 20 00 Data Communications
27 30 00 Voice Communications
27 40 00 Audio-Video Communications

28 DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 00 00 Electronic Safety And Security
28 10 00 Electronic Access Control And Intrusion Detection
28 20 00 Electronic Surveillance
28 30 00 Electronic Detection And Alarm
28 40 00 Electronic Monitoring And Control

31 DIVISION 31 – EARTHWORK

31 00 00 Earthwork
31 10 00 Site Clearing
31 20 00 Earth Moving
312100 off gassing mitigation
312200 grading
312300 excavation and fill
312400 embankments
312500 erosion and sedimentation controls
31 30 00 Earthwork Methods
313100 soil treatment
313200 soil stabilization
313300 rock stabilization
313400 soil reinforcement
313500 slope protection
313600 Gabions
313700 rip rap
31 40 00 Shoring And Underpinning

31 50 00 Excavation Support And Protection
31 60 00 Special Foundations And Load-Bearing Elements
31 70 00 Tunneling And Mining
317100 tunnel excavation
317200 tunnel support systems
317300 tunnel grouting
317400 tunnel construction
317500 shaft construction

32 DIVISION 32 – EXTERIOR IMPROVEMENTS

32 00 00 Exterior Improvements
32 10 00 Bases, Ballasts, And Paving
32 30 00 Site Improvements
32 70 00 Wetlands
32 80 00 Irrigation
32 90 00 Planting

33 DIVISION 33 – UTILITIES

33 00 00 Utilities
33 10 00 Water Utilities
331100 water utility distribution piping
331200 water utility distribution equipment
331300 disinfecting of water utility distribution
331600 water utility storage tanks
33 20 00 Wells
33 30 00 Sanitary Sewerage Utilities
333100 sanitary utility sewerage piping
333200 wastewater utility pumping stations
333300 low-pressure utility sewerage
333400 sanitary utility sewerage force main
333600 utility septic tanks
333900 sanitary utility sewerage structures
33 40 00 Storm Drainage Utilities
334100 storm utility drainage piping
334200 culverts
334400 storm utility water drains
334500 storm utility drainage pumps
334600 subdrainage
334700 ponds and reservoirs
334900 of storm drainage structures
33 50 00 Fuel Distribution Utilities
33 70 00 Electrical Utilities
33 80 00 Communications Utilities

40 DIVISION 40 – PROCESS INTEGRATION

40 00 00 Process integration
40 10 00 Gas and vapor process piping
40 20 00 liquids process piping
40 30 00 solid and mixed materials piping and shoots
40 40 00 process piping and equipment protection
40 80 00 commissioning of process systems
40 90 00 instrumentation and control for process systems

DIVISION 40 – MATERIAL PROCESSING AND HANDLING EQUIPMENT

41

41 00 00 Material Processing and Handling Equipment
41 10 00 bulk material processing equipment
41 20 00 piece material handling equipment
41 30 00 manufacturing equipment
41 40 00 container processing and packaging
41 50 00 material storage
41 60 00 mobile plant equipment

DIVISION 43 – Process, Gas and Liquid Handling, Purification and Storage Equipment

43

43 00 00 Process, Gas and Liquid Handling, Purification and Storage Equipment

44 DIVISION 44 – Pollution Control Equipment

44 00 00 Pollution Control Equipment
44 10 00 air pollution control
44 40 00 water treatment equipment
444100 packaged water treatment
444200 general water treatment equipment
444300 water filtration equipment
444400 water treatment chemical systems equipment
444500 water treatment biological systems equipment
444600 sludge treatment and handling equipment for water treatment systems
44 50 00 solid waste control