

# WATER AGENCIES' DESIGN GUIDE

## Design Guidelines for Water and Sewer Facilities

### SECTION 3.4 COST ESTIMATES

#### 3.4.1 PURPOSE

The purpose of this section is to provide a procedure for development of cost estimates to be used to obtain project funding, budgeting, and engineers cost estimates.

#### 3.4.2 GUIDELINE

The ENGINEER OF WORK is to apply this Guideline during the preparation of project cost estimates to achieve uniformity in the development of the estimates and to facilitate review by various project participants. The ENGINEER OF WORK applies the best estimating practices of the engineering and construction industries in preparing these cost estimates.

Cost estimates prepared under contract with the Agency are strictly confidential and distribution is prohibited beyond that specified in the ENGINEER OF WORK's contracted scope of work.

Construction cost estimates prepared by the ENGINEER OF WORK take into account the current climate of the construction industry in the San Diego region and the construction materials associated with the project, to avoid overly conservative or optimistic estimates.

#### 3.4.3 STANDARD TERMS AND DEFINITIONS

The American Association of Cost Engineers' definition of Cost Estimates Types/Classes is to be used to derive construction cost estimates. The ENGINEER OF WORK provides construction cost estimates with each design submittal as defined below. Each cost estimate is titled to correspond with the design completion stage and the type of estimate. The cost estimate includes assessment of the difficulties inherent in the construction work and documents the determination of productivity, production and pricing for preparing the cost estimates. This includes such factors as labor conditions, bidding climate, construction equipment, construction supervision, material costs and equipment installation costs. All reasonable costs a Construction Contractor can expect to incur are also included.

The ENGINEER OF WORK provides the following types of construction cost estimates to the Project Manager during design at the design complete levels:

- 30% Design Complete: Type C
- 60% Design Complete: Type B
- 90% Design Complete: Type A
- 100% Design Complete: Type A

Refer to the following paragraphs and Table 3.4-1 for the definitions of estimate types.

**Table 3.4-1  
Cost Estimate Types**

Type of Estimate	Class of Estimate	Design Level	Expected Accuracy	Maximum Contingency	Task Performance
30% Submittal Estimate (budget level cost estimate)	"C"	30%	+30% to -15%	20%	<ul style="list-style-type: none"> <li>• ENGINEER OF WORK</li> <li>• Reviewed by Agency</li> </ul>
60% Submittal Estimate (management directed and corrected scope of work)	"B"	60%	+20% to -10%	15%	<ul style="list-style-type: none"> <li>• ENGINEER OF WORK</li> <li>• Reviewed by Agency</li> </ul>
90% and 100% Submittal Estimate (definitive estimate)	"A"	90% and 100%	+10% to -10%	10% / 5%	<ul style="list-style-type: none"> <li>• ENGINEER OF WORK</li> <li>• Reviewed by Agency</li> </ul>

**NOTE:** Class of Estimate A, B, and C is in accordance with American Association of Cost Engineers (AACE).

A. Class "C" Cost Estimate

A Class "C" cost estimate is developed at or near the completion of preliminary design and is referred to as the Budget Level cost estimate. It is the first construction budget developed from project specific design criteria. This estimate is submitted with the 30% design. The framework of this estimate is based on quantities and unit price models developed from the design criteria, site layout, soils reports and the completed Pre-design Report. This Class "C" cost estimate has an expected accuracy of +30% to -15% of the actual cost of construction (cost estimate is 30% higher to 15% lower than the actual cost of construction).

B. Class "B" Cost Estimate

A Class "B" cost estimate is an extension of the Class "C" cost estimate. It is the interim budget cost estimate developed to conform to the latest project-specific design criteria. This estimate is submitted with the 60% design. The framework of this estimate is based on quantities and unit price models, further refined or revised assumptions from the design criteria, site layout, soils report and the completed Pre-design Report. This Class "B" cost estimate has an expected accuracy of +20% to -10% of the actual cost of construction (cost estimate is 20% higher to 10% lower than the actual cost of construction).

C. Class "A" Cost Estimate

A Class "A" cost estimate is referred to as the definitive estimate or the final Engineer's Estimate. This estimate is usually independent of the earlier budget level estimates and serves as a final check on the expected construction cost of the project. This level of cost estimate is submitted with the 90% and the 100% design. The estimate is intended to serve as the final project cost plan and as a comparison to the interim budget level cost estimate and for the Analysis of Construction Bids.

This estimate is usually the most costly to produce and the most sensitive to actual bidding climate and site conditions. Substantial effort should go into defining the scope or basis for the estimate. A clear definition in all these elements should be realized prior to the commencement of this definitive estimate. This Class "A" cost estimate has an expected accuracy of +10% to -10% of the actual cost of construction (cost estimate is 10% higher to 10% lower than the actual cost of construction).

The following allowances are recommended in preparing cost estimates. Allowances are for known cost items that cannot be quantified because of lack of detail (see Attachment 1 for examples of cost items):

- 30% design complete estimates: 25% allowance
- 60% design complete estimates: 15% allowance
- 90% design complete estimates: 10% allowance
- 100% design complete estimates: no allowance

For each cost estimate prepared, the ENGINEER OF WORK identifies any deviation from the previous cost estimate and explains the differences between the estimates. The variance in cost (over or under) from the previous estimate is identified at the cost item level and is later included in the summary level cost estimate. Detail and summary reports reflect the variances with notations for each item and include any changes in design scope with the cost increase for each change identified. The ENGINEER OF WORK participates in cost estimate review meetings with the Agency's Project Manager to reconcile cost estimates and discuss each party's respective cost estimate.

#### **3.4.4 BASIS OF COST ESTIMATE**

The ENGINEER OF WORK documents the basis of the construction cost estimate. This documentation includes lists of drawings and specifications, quantities, equipment lists, Qualifications, assumptions, inclusions, exclusions, a brief narrative of the cost estimate variances for the current design completion and the construction approach used in developing the cost estimate. (see Attachment 1, Sample Basis of Estimate)

The ENGINEER OF WORK provides a quantity takeoff with each applicable cost estimate and defines the unit cost (pricing) data used to calculate/extend each line item. The quantity takeoff is adjusted between cost estimates. For pricing, the ENGINEER OF WORK may use industry cost databases or estimates on unit costs developed specifically for the project. The ENGINEER OF WORK clearly defines the cost sources on which the pricing is based, including indirect costs and direct costs for labor, material, equipment, subcontractors and suppliers. Escalation and sales tax are shown as separate line items. The amount of escalation used is determined by taking the *Engineering News Record* (ENR) construction cost index (CCI) for San Diego at the time the cost estimate is prepared and escalating it to the estimated midpoint of construction. The escalation rate to the midpoint of construction shall be 5%, or the inflation rate as determined by the ENGINEER OF WORK and approved by the Project Manager. The ENR CCI used is identified on all cost estimates. Cost allowances and cost contingencies are shown separately with definitions of the items included in these allowances and contingencies.

The ENGINEER OF WORK identifies all major material and equipment costs, backing up each estimate with supporting written price quotations. These quotations are in written form issued by manufacturers and/or suppliers. Minor equipment costs may be documented by written telephone quotations. All backup information is neatly bound and sorted based on CSI section or category of work. An index is provided identifying the support material.

All the Owner-furnished equipment or materials and all labor costs associated with Agency system shutdowns, connections, and water service high-lining are excluded from the construction cost estimates submitted by the ENGINEER OF WORK unless otherwise directed by the Agency's Program Manager. Installation costs for these items incurred by the Construction Contractor are included in the cost estimate.

#### **3.4.5 FORMAT REQUIREMENT AND COMPONENTS OF THE ESTIMATE**

The format of the cost estimate allows for detailed and summary presentation of project costs. The cost breakdown facilitates review, comment and reconciliation of cost estimates with other participants. As a minimum, information and content is similar to the examples included in Attachments 1, 4, and 5, Sample Cost Estimate Reports. The cost estimating system used must have summarization, sorting and selecting capabilities for items such as category of work, materials, CSI section, and CSI division.

The ENGINEER OF WORK breaks down the cost estimate by CSI section and division, and provides backup worksheets. Attachment 4 is a sample breakdown sheet prepared for another project. The CSI divisions are as follows:

Division 1	-	General Requirements
Division 2	-	Site work
Division 3	-	Concrete
Division 4	-	Masonry
Division 5	-	Metals
Division 6	-	Carpentry
Division 7	-	Thermal and Moisture Protection
Division 8	-	Doors and Windows
Division 9	-	Finishes
Division 10	-	Specialties
Division 11	-	Equipment
Division 12	-	Furnishings
Division 13	-	Special Construction (includes instrumentation)
Division 14	-	Conveying Systems
Division 15	-	Mechanical
Division 16	-	Electrical

Refer to Attachment 5 for a sample summary sheet.

#### **3.4.6 COST ESTIMATE REPORTS**

The ENGINEER OF WORK prepares cost estimate reports summarizing the total cost, quantities of materials, labor man-hours and unit costs. This information is supported by detail that breaks down the cost components by:

- Man-hours
- Labor
- Material Equipment
- Supplies
- Subcontracts
- Total Cost

Other costs for these items are allocated as a percentage of other total components. These costs appear as separate line items in the cost estimate summary as follows:

- Federal/State Unemployment Insurance
- Social Security Tax
- Field Supervision
- Main Office Expense
- Tools/Minor Equipment Expense
- Contingency
- Taxes
- Profit
- Escalations
- Economic Adjustment

The data shown on the sample estimate in Attachment 5 is the minimum information required for cost estimate submissions. The display format used must be similar to that shown in the sample sheet.

The following reports are developed and submitted with each cost estimate as appropriate:

- Summary Cost Estimate Report Sorted by Work Task
- Summary Cost Estimate Report Sorted by CSI Division Number
- Detail Cost Estimate Report Sorted by CSI Section Number
- Worksheet Report Sorted by CSI Section Number
- Worksheet Report Sorted by Work Task

As part of each cost estimate report, the ENGINEER OF WORK provides documentation of the sources, methods, and procedures used in developing the cost estimates. Examples of possible source documentation are:

- R.S. Means cost database index for concrete, site work and mechanical, etc., for unit labor costs.
- Pipe quotation from \_\_\_\_\_ dated \_\_\_\_\_.
- Air compressor quotation from \_\_\_\_\_ dated \_\_\_\_\_, with estimated installation (labor) and operator training cost requirements.
- In-house historical unit cost rates from completed projects. These projects are: (list projects).
- American Association of Cost Engineers Guide to Cost Estimating (AACE).
- Attached details, sections, and sketches used to perform typical quantity takeoffs for \_\_\_\_\_.
- Construction equipment costs obtained from the "Contractor's Equipment Cost Guide" published by Dataquest.

#### **3.4.7 USE OF COMPUTERIZED COST ESTIMATING SYSTEM SOFTWARE AND SUBMISSION OF ELECTRONIC DATA**

The ENGINEER OF WORK must use a computerized cost estimating software to generate cost estimates. The system must clearly identify the various cost categories, types, codes, standard calculations and defaults. The name and version of the software must be identified in the submittal.

#### **3.4.8 REFERENCES**

- A. Attachments 3.4.1 and 3.4.2 shall be used when preparing an engineer's estimate of work to be done for a project. Attachment 3.4.1 provides an example of the detail that should be used for each bid item including labor, materials and equipment for each specification section including the appropriate format. Attachment 3.4.2 gives a higher summary level of the Construction Specification Institute (CSI) format.

## **ATTACHMENT 1**

### **Sample Basis of Estimate**

#### **Type of Estimate**

This is a Class "A" estimate prepared using the quantity takeoffs and supplier quotations based on 90% design drawings and specifications. When obtainable, subcontractor quotations have been used.

Class "A" estimates are used for budgeting construction funds, preparing the Engineer's Estimate, evaluating bid proposals and serving as a basis of comparison during change order and claim evaluation.

#### **Estimating Methodology**

This construction cost estimate includes all direct labor costs, bulk purchased materials, process equipment shown on the design submittal or on data sheets, and construction equipment. The purchase price of the Microfiltration (MF) Equipment is supplied by Memcor/U.S. Filter, and the purchase price of the Reverse Osmosis (RO) equipment including installation is supplied by American Services, Inc. Construction labor man-hours are calculated from production rates contained in published MCA, NECA, R.S. Means and Richardson Engineering Services. Material costs including Contractor furnished equipment are provided from vendor quotation or catalog prices.

#### **Direct Cost Development**

A detailed estimate of the General Conditions (GC) and General Requirements (GR) was performed. The estimated cost for GRs and GCs are divided into groups, a time related group (i.e., field personnel), and non-time related group (i.e., bonds and insurance). All labor burdens such as Health & Welfare, Vacation, Union Benefits, Payroll Taxes, and Workers Compensation insurance are included in the labor rates used throughout the estimate. Trade discounts available to contractors have been taken and applied where applicable.

#### **Indirect Cost Development**

Sales Tax on materials and permanent equipment was applied to all related costs at a rate of 8.25%. A percentage allowance for home office expenses was applied to all categories of cost at a rate of 3.9%. This rate is typical for a construction contractor with an annual volume of over \$10,000,000 and is based on MEANS HEAVY CONSTRUCTION COST DATA – 1998.

#### **Bidding Assumptions**

That the California Contractor's license classification required on this project is "A".

That the Contractor will develop his/her estimate with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions, or any other unplanned costs.

That the Contractor will provide for the General Conditions and Requirements of this contract and perform all mechanical work, install all instrumentation in-line devices, perform all site work, concreting and steel works with its own forces (except for that required to be performed by the Reverse Osmosis specialist).

That the Contractor will subcontract all the Vibroflotation, electrical, instrumentation, HVAC, insulation, protective coatings, and architectural finishes. That the Contractor will subcontract the preparation of all Process Operation and Maintenance Training material in accordance with guidelines to be supplied by the Engineer, and associated costs paid from the allowance under Bid Item No. 6. Equipment Vendor training, using industry standard O&M material is included in the purchase price of major equipment items.

As the economy recovers, there will be upward pressure on prices during the construction period. With a projected NTP of March 1999, the completion of this construction project is expected to occur by August 2000. For the purposes of estimating cost escalation, the mid-point of construction is

assumed to be January 2000. A 3% escalation factor has been added to the total costs for labor and materials in this estimate.

### **Construction Schedule**

A schedule analysis performed during the constructability review indicated that the project can be mechanically completed for the startup of MF Equipment and RO Equipment within an 18-month period, and fully commissioned within 22 months. The final four months of the construction program will involve startup assistance as the plant begins operation. Project completion time is 545 calendar days.

### **Contingency**

This estimate was based on 90% plans and specifications. During the preparation of this estimate, a constructability review of the drawings was conducted and is the basis for the estimating team's recommendation for a 2.5% contingency factor. This factor has been applied to all direct costs as an allowance for quantities not shown on the drawings and for the finalization of the Specifications and General Requirements.

### **Specialty Trades**

For the purposes of this estimate, it is assumed that this project will be constructed by a General Civil/Mechanical Contractor (General Contractor) and that the electrical and instrumentation portions of the work will be considered specialty trade work to be subcontracted. Bid Items 17 and 18, Electrical and Instrumentation, represent approximately 12% of the total estimated contract cost.

### **Specialty Equipment**

1. Microfiltration: Since the City will be purchasing the microfiltration equipment directly and having General Contractor do the installation, only the labor and material are included in the General Contractor's overhead and profit calculations.
2. Reverse Osmosis: The R.O. vendor will be a subcontractor to the General Contractor to do the assembly and installation of the R.O. Only a 5% fixed fee is added to the R.O. estimates.
3. Instrumentation: A large portion of the instrumentation is provided by the MF and RO suppliers and the associated costs are already included in their estimate. Only instrumentation outside the MF and RO is provided by the subcontractor.

### **Recommended Mandatory Subcontract Minimum (MSM)**

The following categories of work represent the major items, which are customarily not performed by a general contractor of which requires a special license.

- Demolition
- Soil Stabilization by Vibrocompaction
- Miscellaneous Metalwork
- Light Metal Framing
- Thermal & Moisture Protection
- Doors and Windows
- Finishes
- Specialties
- HVAC

It is recommended that the Mandatory Subcontract Minimum be established at 20%, excluding specialty items and specialty equipment. A stricter requirement would place restraints on the successful bidder to the extent that it may interfere with the successful planning and execution of the work. It is also recommended that the Prime Contractor execute a minimum of 50% of the work with his own forces.

**Attachment 2**  
**Example of Allowances for Known But Undefined Work**

<b>Permits</b>	\$46,000
<b>Recommended Spare Parts</b> – The spare parts requirement will be determined by maintenance personnel following approval of equipment O&M submittals	\$80,000
<b>Startup Assistance</b> – Contractor support during minimum 4-month startup and commissioning period. Includes contractor-supplied personnel and equipment as required to support plant operations.	\$250,000
<b>Allowance for City Inspection</b> – Allowance for travel costs incurred by the Engineer or Inspector for shop inspections outside the San Diego area. Included costs for Engineer and/or Inspector to conduct prefabrication conferences and periodic shop inspections. This cost is over the above the cost of third party inspection included by the Contractor in the bid.	\$100,000
<b>Engineers Office Supplies and Equipment</b> – Allowance for the purchase of site Office equipment and the payment of telephone/fax bills etc., required by the Engineer and Inspector during the course of the project. The quantity and specifications of equipment will be determined by the project management team.	\$35,000
<b>Operations and Maintenance Training</b> – Allowance for the preparation of O&M training material by a specialty training subcontractor who will be approved by Engineer and the Terminal Island Treatment Plant. Actual training requirement will be determined by the plant once specific equipment has been identified.	\$150,000
<b>Additional Potholing</b> – Due to the nature of this project, it is anticipated that additional underground investigations will become necessary to locate utilities etc. prior to commencement with the construction work. Article [ ] of the General Requirements provides for the Contractor to conduct additional investigation or potholing third party survey services.	\$40,000
<b>Survey Services</b> – In the event the City is not able to provide survey services as required by [ ], this is an allowance to be spent at the Engineer's discretion to procure third party survey services.	\$50,000
<b>Geotechnical Services</b> – This is an allowance to be spent at the Engineer's discretion and recommendation	\$45,000
<b>Differing Site Conditions</b> – This is an allowance to be spent at the Engineer's approval upon discovering of any differing site conditions.	\$150,000
<b>Fixed Lump Sum Amounts</b>	
<b>Technical Manuals</b> – Submittal of technical manuals under General Requirements Article [ ]. In addition to the Liquidated Damages under this section, a substantial line item amount services as an incentive for the Contractor to submit technical material early to permit the development of the training material by the Engineer. Allowance was prorated across the estimated Mechanical, Electrical, and Instrumentation Bid Items.	\$65,000

**Attachment 3  
Schedule of Work and Prices**

<b>Item No.</b>	<b>Description</b>	<b>Unit</b>	<b>Item Total</b>
1	<b>Permits</b> (Article [ ] of General Conditions)	LS**	\$46,000
2	<b>Recommended Spare Parts</b> (Article [ ] of General Requirements)	LS**	\$80,000
3	<b>Startup Assistance</b> (Article [ ] of General Requirements)	LS**	\$250,000
4	<b>Allowance for City Inspection</b> (Article [ ] of General Requirements)	LS**	\$100,000
5	<b>Engineer's Office Supplies &amp; Equipment</b> (Article [ ] of General Requirements)	LS**	\$35,000
6	<b>Operation and Maintenance Training</b> (Article [ ] of General Requirements)	LS**	\$150,000
7	<b>Additional Potholing</b> (Article [ ] of General Requirements)	LS**	\$40,000
8	<b>Technical Manuals</b> (Article [ ] of General Requirements)	LS**	\$65,000
9	<b>Differing Site Conditions</b> (Article [ ] of General Requirements)	LS**	\$150,000
10	<b>Geotechnical Services</b> (Article [ ] of General Requirements)	LS**	\$45,000
11	<b>Survey Services</b> (Article [ ] of General Requirements)	LS**	\$50,000
12	<b>Mobilization</b> (Article [ ] of General Requirements)	LS*	\$
13	<b>Demolition</b>	LS	\$
14	<b>Site work</b>	LS	\$
15	<b>Vibroflotation</b>	LS	\$
16	<b>Structural &amp; Architectural</b>	LS	\$
17	<b>Mechanical, Plumbing &amp; Process Piping</b>	LS	\$
18	<b>Electrical</b>	LS	\$
19	<b>Instrumentation</b>	LS	\$
20	<b>Reverse Osmosis (American Services, Inc.)</b>	LS	\$
<b>TOTAL AMOUNT OF BID:</b>			<b>\$</b>

**Notes to Construction Division**

\*\*The amounts shown for these items are "must bid amounts" by all bidders. Do not leave these boxes blank for the bidders to fill in. The amounts shown for these items should be printed into the schedule of work and prices form.

Note: Microfiltration Equipment is in a separate purchase order by the City, but the installation, associated piping, electrical and instrumentation should be included in Items 17, 18, and 19.