ALAMEDA COUNTY TRANSPORTATION COMMISSION

Cost Estimating Guide

June 2015

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EXECUTIVE SUMMARY

This Cost Estimating Guide (Guide) is provided by the Alameda County Transportation Commission (Alameda CTC) for sponsors preparing project or program cost estimates for consideration in the Countywide Transportation Plan (CTP) and/or other funding plans managed by the Alameda CTC.

Intended use of this Guide

This Guide is intended for people qualified to prepare cost estimates (cost estimators). The cost estimators should be able to provide a good basis for the estimates and to document (and explain) any specific elements of the cost estimate. This Guide may also be used as a primer for stakeholders and other interested parties, to introduce them to the principles and elements of cost estimating for projects and programs. This Guide is not intended to provide instruction to an individual inexperienced in estimating costs.

Purpose of this Guide

Accurate cost estimating is critical to the success of any project or program. **This Guide establishes a uniform approach for preparing cost estimates based on proven standard practice so that more accurate and reliable estimates can be prepared to help Alameda CTC more effectively and efficiently manage available funding.** This Guide seeks to provide a standard approach that captures any potential costs due to the risks of unknowns or uncertainty and to provide more robust and accurate estimates.

The Guide also establishes a standardized format to preparing estimates for both projects and programs, thereby providing the opportunity for fair comparisons between projects and programs competing for inclusion in the CTP. It lays out assumptions to use for a variety of the standard cost elements of a project, and helps remind sponsors of the elements that should be considered in order to accurately estimate the costs of any project or program. The intention is to provide tools to make those estimates as accurate as possible.

Overview of this Guide

This Guide sets out a consistent framework for estimating capital project and program costs at the conceptual and detailed levels. Typical project phases, estimate types, and standard general contingencies are discussed. In addition, the Guide provides a Risk-Based Allowances Approach to help project sponsors evaluate risks that may not be fully developed or quantified. The end result of the approach is a cost estimate that includes allowances for risks that may not have been identified had a more traditional approach been applied.

Section 5.0 provides risk assessment references to a variety of sources and links to respective websites. This Guide also provides a streamlined approach that helps identify risks at a conceptual level. Sponsors are encouraged to conduct a field review to their proposed project site in order to identify possible risks using the Preliminary Risk Assessment Questionnaire (Appendix A). Once identified, the risks are assigned an allowance (percentage) based upon their probability of occurrence. Each risk allowance is multiplied by the appropriate cost estimate line items and eventually added to the total cost.

Cost Estimating for Programs

This Guide also presents guidelines for estimating the costs of programs by presenting the basic elements that comprise typical program costs. Since program types and details may differ broadly, sponsors are encouraged to submit questions to the Alameda CTC. It is most important that programs submitted for inclusion in the CTP be well thought out and well documented.

Quick Reference Guide for Common Project/Program Sponsor Needs

If you are interested in:	**See section (hyperlinked):**
Conceptual Capital Cost Estimate	3.4 Conceptual Cost Estimates
Detailed Capital Cost Estimate	3.5 Detailed Cost Estimates
Program Cost Estimate	4.1 Program Cost Categories
Cost references including unit costs and (Caltrans)	5.1 RESOURCES

Acknowledgements

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COST ESTIMATING GUIDE

1.0 INTRODUCTION

This Cost Estimating Guide (Guide) sets out a consistent framework for estimating capital project and program costs at the conceptual and detailed levels. Project and program sponsors are encouraged to use this Guide when preparing cost estimates for Alameda County Transportation Commission (Alameda CTC) funded projects and programs and to be considered for inclusion in the Alameda Countywide Transportation Plan (CTP).

The US Government Accountability Office (GAO) defines a cost estimate as, "the summation of individual cost elements, using established methods and valid data, to estimate the future costs of a program, based on what is known today." An estimate is an interpretation of the project in terms of cost. As every project is unique, it takes a great deal of professional judgment based on the best available information for an estimate to provide a reasonable probable cost of a project. To do a good job, the estimator must have a complete understanding of the project, the market conditions, the relevant cost data and their adjustment to suit the unique features of the project at hand.

The preparation of an estimate is a dynamic process with some static features. The dynamic part includes the market conditions, the adjustment of previous data, knowledge and experience to fit the project at issue, the uniqueness of the working conditions, and time difference of each project. The static part includes the quantities as interpreted from drawings, specifications and other sources, the use of standard format, and the accuracy of calculations.

Sound financial programming requires consistent and reasonable cost estimates. Accurate cost estimates allow project and program sponsors to establish reliable funding plans for their projects and programs and enable the Alameda CTC to program sufficient funding to support sponsors' projects and programs.

1.1 Intended Use of this Guide

This Guide is intended for use by project and program sponsors. Specifically, it is intended for use by people qualified to prepare cost estimates (cost estimators) for a proposed project or program. In the case of a capital project, it is assumed that the estimate is being prepared by a professional cost estimator or a qualified individual, probably an engineer or other person qualified by training or experience. In the case of a cost estimate for a program, the estimate should be prepared by qualified estimator in collaboration with a planner, manager, or someone intimately familiar with the scope of the program being proposed. Regardless of the nature of the proposed project or program, the preparer of the estimate should be able to document and explain the specific elements included in the cost.

This Guide may also be used as a primer for stakeholders and other interested parties, to introduce them to the principles and elements of cost estimating for projects and programs. This Guide is not intended to provide instruction to an individual inexperienced in estimating costs.

1.2 Qualities of a Good Cost Estimate

A good estimate is well documented, comprehensive, accurate and credible for its intended use. It should truly reflect the scope of work, fully capture all project requirements, accurately predict the probable construction cost and serve as a useful tool for effective cost management and cost control. Regardless of whether the estimate is conceptual or detailed, good estimates address the following issues:

- **Scope:**
  What is included?
  What is excluded?
  Does the scope of the estimate match the scope of defining documents?
  Is all impacted or implied work captured?
  Any variations must be identified and any deviations explained

- **Quantities:**
  Are the quantities reasonable?
  Is the methodology for calculating the quantities clear and easy to follow?
  Has the math been checked?
  Do the totals come forward to the summaries?

- **Pricing:**
  Are the unit prices reasonable?
  Are the explanations reasonable?
  Does the pricing cover the type and quality of materials contemplated?
  Are incidentals like sales tax and freight covered?
  Have unusual working conditions been factored into the pricing?

- **Major items:**
  The major items of work should be investigated with care. A faulty assumption on a major work item will have a large effect on project cost.

- **Support and Other Soft Costs:**
  Is work by others considered?
  Are environmental studies considered?
  Are preliminary engineering and final design included?
  Are construction staking and construction management covered?
  Are other soft costs included? Examples include project management, program management planning, design and engineering, public outreach.
  If estimate excludes any of project related costs, it should be so noted in the basis of the estimate.

- **Presentation:**
  Is the estimate presentation clear?
  Is it easy to follow?
  Is the basis of the estimate documented in a concise fashion so that it will be readily understood by an unfamiliar party?

2.0 ESTIMATING METHODOLOGY

2.1 Estimate Format

Cost estimates will vary in format and content depending on type of project and agency as well as the level of available information and the type of estimate needed. The Alameda CTC assumes that the sponsor's experience in cost estimating is such that they may have previous cost estimates to work from and should be able to identify resources to create an effective cost estimate. (Some recommended cost estimating resources are provided in Section 5.0.)

For transportation projects, especially federally funded projects, the most commonly used format is FTA's Standard Cost Categories for Capital Projects (SCC). It consists of 10 main categories which are further divided into subcategories. Other commonly used formats in the estimating field are Uniformat II Elemental Classification for Building Specifications, Cost Estimating and Cost Analysis by National Institute of Standards and Technology (NIST) and the MasterFormat by the Construction Specifications Institute (CSI). Caltrans and many public agencies also have their own standard estimating formats.

The following sections should be included with every estimate, each is explained in more detail below:

a) Basis of Estimate

b) Estimate Summary

c) Estimate Details

Basis of Estimate should cover the following:

- Documents used for this estimate
- Brief description of the scope of the project
- Estimating assumptions
- Bidding assumptions
- Estimating exclusions
- Factors affecting the estimate
- Abbreviation used

Estimate Summary should list the direct cost items by work sections (or CSI divisions), followed by the markups. The markup items include:

- Design & Estimating Contingencies
- General Contractor's general conditions and general requirements
- Bonds and insurance premiums
- General contractor's home office overhead and profit
- Cost escalation projected to the mid-point of construction.

Estimate Details of Direct Costs should include:

- Description of Work
- Quantity
- Unit (of measurement)
- Unit Cost
- Estimated Amount

2.2 Scope of the Estimate

A good estimate should accurately reflect the scope of the project based on best available information and the estimator's experience and judgment. The item descriptions should correspond to the level of information available.

2.3 Quantity Takeoffs

Quantity takeoffs is the process of quantifying the project. Quantity takeoffs should be performed in a consistent method with appropriate units of measurement. Quantity takeoffs used in cost estimate categories should be based on available conceptual or detailed engineering. Quantity takeoffs may be calculated on any standard takeoff sheet or Sponsors may wish to use their own spreadsheet. Assumptions should be clearly described in the back-up documentation.

2.4 Pricing

This guide contains guidance for standard units of measure for typical project bid items in Appendix B. It does not, however, provide specific unit prices for specific items, because there is great variation (potentially over 100%) in the unit price for most items, depending on the quantity required, geographic location of the project, and economic conditions. Given the fluctuation of construction prices over time, it is important that a cost estimate always be prepared with the most current and accurate cost data available at the time. While no specific unit costs are given here, it is expected that project sponsors use good professional judgment in selecting the prices and that they are prepared to defend those decisions.

Unit pricing should be carefully considered. Prices may vary greatly for the same material in different geographical areas or quantity, and may also shift with economic markets. Compare your unit prices to those within the corridor or region. There are several sources of cost data that can be used to determine appropriate unit prices (described in Section 5.0).

The basis for the pricing of all items included in the cost estimate should be well documented and as accurate as possible. Providing thorough descriptions and references are encouraged to help facilitate the understanding of the cost estimate. Estimators may be asked to support the derivation of a unit price or a lump sum item.

2.5 Escalation

"Cost Escalation" is an allowance to cover the change of cost over a period of time, from day of estimate to mid-point of construction, based on an estimated annual rate of escalation (inflation) compounded annually. As with most things, costs associated with projects and programs tend to increase over time. If an estimate is being prepared for a project or program that will be constructed or implemented at least a year into the future, it is important to include an appropriate escalation factor. This escalation rate should be based on reasonable assumptions regarding market conditions, economic outlook, geographical location, and historic data. The Alameda CTC may make a specific recommendation for an escalation rate to use at a specific time or for a specific application. If no particular escalation rate is established by the Alameda CTC, then the preparer of the estimate should be able to defend the rate used.

2.6 Risk Assessment

An estimate consists of both known items and unknown items. Known items include all construction items which can be identified in design documents (e.g. the amount of wall to be strengthened), or due to existing site conditions (e.g. the amount of wall to be retrofit or type of impacted items need to be relocated). All known items will be adequately captured in the cost estimate to lessen the chance of scope creep, which leads to a

more reliable prediction of probable construction cost. These items will be quantified and priced based on experience, vendor/supplier price quotes as appropriate, historical data, experience and consideration of project specific factors. Exercising professional standard care, all known items will be under the control of the project team.

Unknown factors include: cost trends and escalation, bidding market, material and labor cost movement. These factors cause risks and uncertainties for the project. They cannot be controlled by the project team, but they must be recognized and addressed early in the project so that reasonable allowances are included in the project budget.

The estimator must work closely with the project team to identify the risk factors, provide reasonable cost allowances and contingencies to cover these risks at the start of the project. Throughout the design phase, at each design submittal milestone, the project team shall review and revise these allowances and contingencies to match with changed project requirements, material price trends, prevailing wages, bidding conditions, and projected cost escalation.

Risks have the potential to impact project scope, cost, schedule, and quality. Identifying and understanding the risks associated with a proposed project provides a more accurate and thorough cost estimate, which is especially useful to the Alameda CTC when evaluating conceptual cost estimates.

Alameda CTC recommends that project sponsors include a cost estimate category titled Risk-Based Allowances, which consists of identified risk line-items. Each risk line-item has an appropriate percentage allowance, calculated using the Guide's proposed risk assessment methodology, described in Section 3.7. A worksheet called the Preliminary Risk Assessment Questionnaire is in this Guide (Appendix A). It should be used to develop the project-specific risk allowances that will be carried over to the project cost estimate.

3.0 CAPITAL PROJECT COST ESTIMATES

3.1 Types of Cost Estimates

This Guide provides a description of two methods to be used in preparation of cost estimates for Alameda CTC projects – Conceptual and Detailed Cost Estimates. Figures 1 and 2 show how project phases align with these two types of estimates.

Conceptual Cost Estimates: A conceptual estimate is prepared at the beginning of the project, prior to any design or engineering, based on only limited information. It is also known as a top-down, order of magnitude, feasibility, or preliminary estimate. The project may be less than 20% defined, so a good list of assumptions is of paramount importance. It is also important to include allowances to capture project risks that may not be fully developed or quantified.

Detailed Cost Estimates: A detailed cost estimate is prepared by a "bottom-up" approach. It is achieved by using an itemized scope of work based on design or engineering, accurate quantities from available documents, or information and unit prices with good backup analysis or basis. A detailed cost estimate is generally required at certain design milestones, most commonly at 35%, 65%, 95%, and 100% design completion levels.

3.2 Capital Project Phases

There are typically six basic phases of project development from concept through construction. For each phase leading up to completion of the final design, there may be one or more estimate types associated with it. Figure 1 below illustrates this relationship along a project timeline – phases are shown above the line, milestones at which estimates are prepared are shown below the line. Conceptual estimates are most appropriate for the early milestones and detailed estimates for the later milestones as shown in Figure 2.

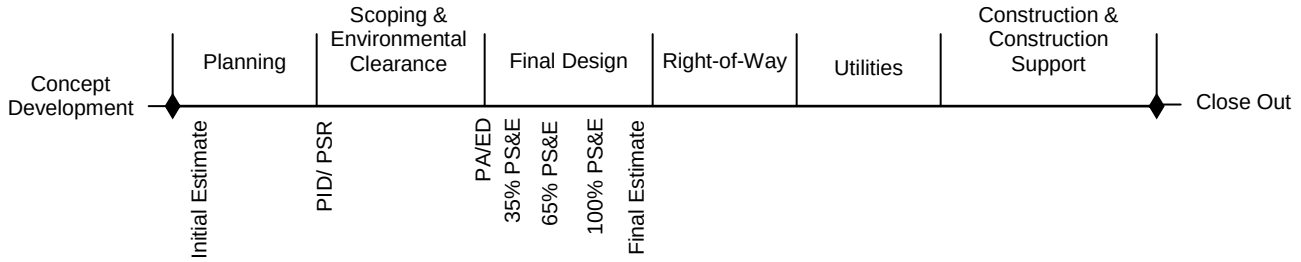

Figure 1 - Typical capital project timeline, showing phases and estimates

- Concept Development
  This is not specifically a funded phase, but is the initiation of the project timeline. The need for a project may be identified as the result of a corridor study, major investment study, feasibility study, or by some other means (e.g. the need may have been identified during the development of another project).

- Planning
  This phase covers the project from its identification through preparation of a programming document. In the case of a Caltrans project, this is referred to as a Project Initiation Document (PID) and usually takes the form of a Project Study Report (PSR). An initial estimate is prepared in order to begin programming funds for the project.

- Scoping & Environmental Clearance
  During this phase of the project the scope of work is fleshed out, alternatives are considered, and engineering is commenced and usually taken to the level of 10-15% design. Depending on the type of project, it receives California Environmental Quality Act (CEQA) and/or the National Environmental Policy Act (NEPA) clearance and usually some type of formal approval to move into the final design phase. In the case of a Caltrans project, this project approval document is called a Project Approval/Environmental Document (PA/ED). The estimates prepared at this phase should be more accurate than initial estimates because is the project is well defined with more knowledge of impacts and mitigations. An updated conceptual estimate is prepared to capture any additional scope modification and requirements.

- Final Design
  This phase entails the preparation of Plans, Specifications, and Estimates (PS&E)—the final versions of which will become the bid and construction documents. The detailed cost estimates prepared for various submittals during this phase should become increasingly accurate as the design is further detailed. Accordingly, cost contingencies intended to account for unknowns are reduced as the design is refined.

- Right-of-Way
  Initially, the cost of right-of-way necessary for the project should be approximated using unit prices for comparable land values. Once the proposed acquisition/parcel is specifically defined, special expertise is required to develop a more accurate cost. The appropriate detail should be included in the description for this type of work, which may include cost for new easements, temporary construction easements, relocation costs, land acquisition services, hazardous material remediation, and other possible contingencies.

- Utilities
  This phase covers any work related to design, accommodation, protection and/or relocation of utilities, if necessary. Ideally, it should take place before construction begins. The estimate should be updated to reflect any major utilities changes.

- Construction & Construction Support
  This phase includes the construction of the project according to the final plans and specifications. It includes labor and materials supplied by the contractor, as well as any materials supplied by the owner or others. This phase also covers design support during construction (e.g. responding to contractor requests for information, reviewing shop submittals, etc.), as well as construction management. Estimates are needed to support change orders.

- Close Out
  This is not a specifically funded phase, but it concludes the project timeline. Close out of a project involves settlement of administrative and project control items and ends with the transfer of the project from the contractor to the owner.

The seven types of estimates correspond to the two methods of estimate preparation described previously, Conceptual and Detailed as shown below.

Type of Cost Estimate	Description	Appropriate Project Milestone
Conceptual Cost Estimates	Prepared during the early planning development phases when detailed information about the project or program is unknown.	Initial Estimate PID/PSR Estimate PA/ED Estimate
Detailed Cost Estimates	Prepared for a program or during the design phases of project development when more detailed engineering is being/has been performed.	35% PS&E Estimate 65% PS&E Estimate 100% PS&E Estimate Final Engineer's Estimate

Figure 2 – Project Milestones and Appropriate Type of Cost Estimate

3.4 Conceptual Cost Estimates

Types of Conceptual Estimates

- Initial Estimate
  An initial estimate, based upon the project concept, is usually the first cost estimate prepared for a new project and typically includes large contingencies. Initial estimates are also known as rough order of magnitude (ROM) estimates or planning level estimate. This may be estimated parametrically based on historical cost data of comparable projects (e.g. $/linear foot of road or $/square foot of building). It is important that t sponsors use the Preliminary Risk Assessment Questionnaire (Appendix A) included in this Guide to assess potential risks so that appropriate amount of allowances are included in the estimate.

- PID/PSR or equivalent Estimate
  An updated conceptual estimate should be prepared when preliminary engineering or technical documents are available. This conceptual estimate will form part of a Project Initiation Document/Project Study Report (PID/PSR) which is generally be required for all projects on the State Highway System. It is important that this estimate accurately reflect the scope and the schedule per PID/PSR.
  Note: Caltrans has a defined Project Study Report Cost Estimate format. This Guide is consistent with that format, although it has been expanded to include Risk-Based Allowances, soft costs, and escalation.

- PA/ED or equivalent Estimate
  The conceptual estimate should be updated and expanded at the PA/ED phase with reference to engineering studies prepared in support of the environmental document and project approval document such as a Caltrans Project Report (PR).
  Note: Caltrans has a defined Project Report Cost Estimate format. As stated above, this Guide is consistent with that format.

Conceptual Estimating Methodology

A systemic, consistent, and comprehensive approach and methodology should be followed in order to generate accurate and reliable cost estimates. This includes the following actions:

a) Understand the project or program.

b) Scope the project or program to accurately capture all required work scope, direct, indirect, associated, or impacted work as defined in scoping documents such as PID, PSR, PA, ED. Scope items should be itemized and arranged by similar category.

c) Quantify the project scope based on available information. For conceptual estimates available information may include some or all the following: PID, PSR, PA, ED, discussions with stakeholders and planners, narratives, plans, specs, sketches, as-builts, existing site conditions, and other relevant documents. An appropriate unit of measure should be used for each line item. Examples of units of measure for some standard items used in capital project costs estimates are presented in Appendix B as a guideline. Sponsors are encouraged to use these units of measure or use a more appropriate unit of measure as appropriate for the project.

d) Price the estimate using various cost databases and cost sources, combined with the estimator's experience and judgment of current and projected market conditions, and the understanding of the specific project requirements, risks and constraints. For conceptual estimates, unit prices are typically composite and include labor, equipment, material, sales tax and installing contractor's markup.

e) QA/QC Check - Perform quality assurance check includes both a bottom up and a top down review to ensure that the estimate properly and completely reflects the project scope as well as the current and projected market conditions.

f) Prepare basis of cost estimate. This should include the following:

1. Documents/sources used to establish the estimate scope
2. Brief description of project scope
3. Estimating assumptions (e.g. construction start and finish date, project delivery method, sources of pricing, description of risk items and allowances)
4. Estimating inclusions
5. Estimating exclusions
6. Abbreviations used

g) Present the estimate – At a minimum the estimate should include the following sections: Basis of Estimate; Estimate Summary; Estimate Details. See Section 2.1 for more details

3.5 Detailed Cost Estimates

Types of Detailed Estimates

- 35% PS&E Estimate
  This estimate is based upon documents prepared for the 35% design submittal and should include all major elements of the project.

- 65% PS&E Estimate
  This estimate is based upon documents prepared for the 65% design submittal and should include greater detail for the major project elements, as well as most minor elements. Many specific project risks should be understood at this time and may be reflected in the selection of line items and/or unit costs.

- 100% PS&E Estimate
  This estimate is based upon documents prepared for the 100% design submittal. Costs evaluated for this submittal address the final design of the project, completed specifications, and a detailed implementation schedule. The estimate should also consider any special terms or conditions in the contract. Almost all of the project risks should be developed at this time. Nonetheless, it may still be appropriate to include Risk-Based Allowances to address likely risks that are not otherwise reflected in the cost estimate.

- Final Engineer's Estimate
  This estimate is based on the advertised contract bid documents and any subsequent addenda, including any review comments, which may have been incorporated into the project since preparation of the 100% PS&E Estimate. The Final Engineer's Estimate may be the same as the 100% PS&E Estimate if no changes occurred nor addenda issued. Specific project risks not captured in the 100% PS&E Estimate should be realized at this time and may be reflected in the selection of unit costs. It may still be appropriate to include Risk-Based Allowances to address likely risks that are not otherwise reflected in the cost estimate.

Detailed Estimating Methodology

A systemic, consistent, and comprehensive approach and methodology should be followed in order to generate accurate and reliable cost estimates. This includes the following actions:

a) Understand the project or program.

b) Scope the project or program to accurately capture all required work scope, direct, indirect, associated, or impacted work.

c) Quantify the project scope from plans, specs, sketches, as-built, existing site conditions, and other relevant documents.

d) Price the estimate using various cost databases and cost sources, combined with the estimator's experience and judgment of current and projected market conditions, and the understanding of the specific project requirements, risks and constraints.

e) QA/QC Check - Perform quality assurance check includes both a bottom up and a top down review to ensure that the estimate properly and completely reflects the project scope as well as the current and projected market conditions.

f) Present the estimate - At a minimum the estimate should include three sections: basis of estimate, estimate summary, and estimate details. (See Section 2.1 for more details.)

3.6 Below the Line Costs

Items excluded from the total capital cost are termed "Below the Line Costs". These costs may be separate from the prime contract subtotal, but are still included in the total cost for the project. There are several types of "Below the Line Costs", defined as follows:

- Engineering and Management
  Included in this category are pre-design, design engineering, construction staking, and construction management services. Pre-design services include engineering and environmental studies necessary to obtain environmental clearance.

- Construction Contingency
  This is a financial reserve to cover construction and engineering change orders. Typically, 10% of the total project cost is a reasonable amount to allow for this item. Construction Contingency applies *only* to the Final Engineer's Estimate and should not be confused with the Design Development Contingency, which is carried through all the estimate phases. This percentage may be overridden or adjusted if it is deemed appropriate.

- Work by Others
  Certain items of work may be excluded from the work of the construction contract. For instance, relocation of a railroad track or a gas line may be accomplished by force account (i.e. change order or payment of all costs associated with work ordered to be done without prior agreement) by the railroad or the local utility, or the owner may procure an item and provide it to the contractor for installation. Detailed information should be provided in the description regarding this type of work.

- Risk-Based Allowances
  Design development contingencies are established to cover costs associated with truly unforeseeable unknown costs that may arise during project development. Risk-Based Allowances are intended to cover a different sort of unknown cost referred to as "known unknowns". These are costs that are not yet fully understood or quantifiable, but of which there is some likelihood of occurring. To account for these, project sponsors should complete a preliminary field review and give some focused consideration to a list of typical project risk areas that have often been the cause of inaccurate estimates on transportation projects. By completing the Preliminary Risk Assessment Questionnaire (Appendix A), a sponsor will develop project specific Risk-Based Allowances that should result in a more accurate estimate than those developed only with standard rule-of-thumb contingencies. Section 3.7 further describes this approach.

- Design Development Contingency
  Design Development Contingency is an allowance to cover the "unknown unknowns" inherent in design project development and imprecision in estimating. The Contingency Guidelines in Table 1 show the contingency that is recommended to be used during each phase of project development as a percentage of estimated construction cost. The contingency decreases as more detailed engineering is performed. This table should be used to determine the appropriate contingency percentage, unless there is justification for deviation from these guidelines.

The Alameda CTC requires the use of informed Risk-Based Allowances to capture some costs associated with "known unknowns;" therefore, this Guide recommends using an initial design development contingency of 20%, as opposed to the more common 25%, to capture the costs associated with "unknown unknowns." Please note that the recommendations shown in Table 1 allow the project sponsor to select a lower or higher contingency at some of the early phases of project development. The rule of thumb is to assume the higher percentage for contingency unless there is specific justification for using the lower percentage. A small project that is not well-defined from the outset may be justified in using 15% contingency at the PR phase rather than 10%, for example.

Table 1 - Contingency Guidelines

Type	Estimate Description	Probable Contingency as to Percentage of Construction Cost
1	Initial *or* PSR	●
2	PSR *or* PR	●
3	PR *or* 35% Submittal	●
4	35% Submittal *or* 65% Submittal	●
5	100% Submittal *or* Engineer's Estimate	●
		20% 15% 10% 5%

3.7 Development of Capital Project Risks

The level of development for capital project cost estimates depends on whether the estimate is conceptual or detailed. Detailed capital project cost estimates will have more accurate costs and lower contingencies due to the fact that more is known about the project. For this reason, detailed cost estimates may be easier for the sponsor to assess for risk. Conceptual cost estimates will have less information to work with and will need some preliminary assessment and research in order to determine appropriate levels of risk.

- Risk-Based Allowance Approach
  Regardless of whether the cost estimate is detailed or conceptual, it is imperative that sponsors include Risk-Based Allowances to account for "known unknown" risks. There are several risk-management documents available through a variety of transportation authorities (e.g. Caltrans, FHWA, see Section 5.0 for their respective websites) that help sponsors identify, quantify, analyze, and manage risks. Although the guidance provided in these documents produces a well-defined and thorough risk assessment, it is in the best interest of the Alameda CTC to have sponsors apply a streamlined approach to assess risks in their cost estimates, as discussed below.

  The Risk-Based Allowance Approach is:

  Step 1: Conduct a project field review.

  Step 2: Identify risks using the table in the Preliminary Risk Assessment Questionnaire.

  Step 3: Assign low, medium, or high probability to each identified risk.

  Step 4: Determine the Risk-Based Allowances.

  Step 5: Apply and add Risk-Based Allowances to your estimate.

- Field Review Requirements and Guidelines
  The Risk-Based Allowance Approach starts with a field review of the project site by the project sponsor. A project site visit should be performed for the estimator to observe the existing site conditions, specific

site constraints, accessibility, site layout, traffic conditions and other elements which may have cost impacts so that they are captured appropriately in the cost estimate.

It is during the field review that the sponsor identifies risks by answering questions in Preliminary Risk Assessment Questionnaire (Appendix A). A risk is identified if any question is answered in the affirmative, i.e. “Y”. Then, a level of probability (low, medium or high) is assigned to each identified risk. Finally, using the identified risks and probabilities, the sponsor can determine the appropriate allowances to apply to their cost estimate. The final outcome of the approach is a separate section within the cost estimate titled “Risk-Based Allowances”, which includes each of the identified risks as line items.

4.0 PROGRAM COST ESTIMATES

4.1 Program Cost Categories

Below is a list of the various elements that may comprise a program cost estimate at a particular milestone. Not all elements would necessarily be included in every program estimate.

- Administrative
  Includes document coordination, office management, and various support for sponsor and consultant staff. This element of cost may be limited to a maximum allowable amount by the Alameda CTC.

- Operations
  Includes costs for the actual operation of the program including the following categories:

  - Labor
  - Maintenance
  - Other Operating Costs (e.g. fuel)
  - Equipment

- Materials
  This may include costs of various materials necessary for successful implementation of the program. Sales tax and handling/freight cost should be included with material cost.

- Sponsor and Consultant Staff
  Includes sponsor and consultant staff costs incurred while working on the program, other than administrative.

- Production
  Includes document reproduction costs (e.g. mass copying, binding, distribution).

- Evaluation
  Includes costs incurred by staff for evaluation of the program.

- Rental/Lease
  Includes costs related to the rental or lease or real estate (e.g. office space) for implementation of the program.

- Outreach
  Includes costs related to raising public awareness of the program, such as conducting polls, distributing informative documents, and holding public meetings.

4.2 Development of Program Costs

Sponsors of programs should be able to demonstrate that their cost estimates are well thought out and well documented. Sponsors requesting funds for new programs need to thoroughly validate the basis of their program cost estimate. In the case of existing programs, the sponsor should be able to provide historical data from similar programs as back-up for their cost estimate. In addition, the program cost estimate should be developed to a level which corresponds to the available level of program information.

5.0 CONCLUSION AND RESOURCES

In a challenging economic climate, accurate cost estimates for publicly funded transportation project and programs are more important than ever. Good estimates are essential for good planning, cost management, and effective funding of a robust multimodal transportation network. The Alameda CTC also benefits during its calls for projects by having sponsors use similar methodology and assumptions in preparing cost estimates. This Guide is intended to provide a standard approach to cost estimating for transportation projects and programs seeking inclusion in the CTP.

5.1 RESOURCES

The following resources are provided for the convenience of project and program sponsors and were current at the time of this writing. The Alameda CTC is not responsible for any changes to others' websites that might render the information below obsolete or incorrect.

Cost Estimating Resources

- Caltrans Cost Estimating Resources
  Caltrans provides a number of resources for preparing cost estimates at various stages of project development. For an overview of cost estimating resources, access the Caltrans Cost Estimating webpage, which contains a "…collection of policy, tools, guidance, training, best practices and lessons learned… …to assist in the development of cost estimates that are complete and accurate, reflecting the true scope of work to be performed and reflecting current market trends," at: http://www.dot.ca.gov/hq/oppd/costest/costest.htm

- Caltrans Project Development Procedures Manual
  This manual provides the basis for Caltrans policies and procedures for State highway projects. The section specific to development of cost estimates is Chapter 20: Project Development Cost Estimates: http://www.dot.ca.gov/hq/oppd/pdpm/chap_pdf/chapt20.pdf
  The full manual is available here: http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm

- Caltrans Contract Cost Database
  The Caltrans Contract Cost Database is a summary of cost (by item) for highway construction projects. Prices shown in this summary are the mathematically weighted average of the low bidders' prices and are affected by geographical location, time, and quantity, as well as the item's significance. This Contract Cost Data is published annually by the Department of Transportation, Office of Office Engineer, available at: http://www.dot.ca.gov/hq/esc/oe/awards

- National Cooperative Highway Research Program (NCHRP)
  The *"Final Report for NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction"* is a Guidebook developed by research through the NCHRP that provides strategies, methods, and tools to achieve more accurate and consistent cost estimates. A pdf copy of the report may be accessed online at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w98.pdf

- Federal Transit Administration Standard Cost Categories (SCC) for Capital Projects
  http://www.fta.dot.gov/13070_2580.html

- RS Means Construction Publishers and Consultants
  RS Means publishes several resources for construction cost data. These may be purchased by contacting RS Means, 63 Smiths Lane, Kingston, MA 02364-0800. Phone: (781) 422-5000. RS Means publications may also be found at: http://www.rsmeans.com/

- Uniformat II Elemental Classification for Building Specifications, Cost Estimating and Cost Analysis by National Institute of Standards and Technology (NIST)
  http://fire.nist.gov/bfrlpubs/build99/art080.html

- MasterFormat by the Construction Specifications Institute (CSI) - 2014
  http://www.csinet.org/

Risk Assessment and Allocation

- Caltrans Project Risk Management Process
  The Caltrans Project Risk Management Process webpage contains numerous links to Risk Management resources, including the Caltrans *Project Risk Management Handbook*:
  http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

- Federal Highway Administration (FHWA), Office of International Programs
  The FHWA provides a webpage for risk assessment and allocation related to highway construction management. A complete guide for assessing risk titled, *"Guide to Risk Assessment and Allocation for Highway Construction Management"* can also be found there:
  http://international.fhwa.dot.gov/riskassess/index.cfm

APPENDIX A: PRELIMINARY RISK ASSESSMENT QUESTIONNAIRE

PRELIMINARY RISK ASSESSMENT QUESTIONNAIRE

Sponsors are encouraged to conduct a field review of the project site to complete the Preliminary Risk Assessment Questionnaire included in this appendix. Any items which have potential cost implication should be identified or itemized in the estimate.

To use the questionnaire, first answer the questions in each risk category and mark “Yes” or “No” in the adjacent column. Keep in mind the Field Review Requirements and Guidelines to help assess your project site in addition to anything else that may not be included in the table. Then, for each risk category marked with one or more “Yes”, consider its probability of occurrence (low, medium, or high) and carry down the appropriate allowance into the “Assessed Risk Allowance” row below the risk category. If something is considered over 80% likely to occur, it should be assumed that it will definitely occur and be accounted for in the project estimate with a specific line item, rather than with a percentage from the Preliminary Risk Assessment. Next, apply the risk allowance to the appropriate section(s) of the cost estimate.

Field Review Requirements and Guidelines:

Participants in the field review should at least include the project manager, project engineer, and lead environmental planner and cost estimator. Other qualified staff such as a construction manager or operations and maintenance personnel may benefit the quality and thoroughness of the effort.

Plan to spend at least a half day in the field, depending on the size and complexity of the project and site. It may be necessary to obtain the right to enter certain properties, and it is of value to walk as much of the project site as possible. On the other hand, in the interest of trying not to cause undue concern or anxiety on the part of property owners, discretion must be used in determining which properties will be visited for a specific field review.

Assign one member of the review team to gather and record the field notes. Take photographs, preferably with the point of view of each photograph referenced on a map. This can become an invaluable tool in project development. Observe and document all elements of the project site and conditions.

Below are some specific suggestions for the field review intended to help answer questions in the Preliminary Risk Assessment Questionnaire, but do not limit your observations only to these items. It is impossible to know too much about a site, and it can be surprising how much detail can be gleaned simply through careful observation and documentation.

1) UTILITIES: Pay close attention to any visible signs of underground utilities such as underground vaults, manholes, junction boxes, valve farms, switch boxes, pump stations, high risk markings, hydrants or depressions. Check for overhead utilities and utilities on structures. If feasible, you may wish to have the utilities within the project area identified and marked by Underground Service Alert (USA).

2) GEOTECHNICAL and/or SEISMIC: Observe any signs of earth movement or slides in the area such as heaving of concrete, consistent or unusual fracture patterns across multiple structures, offsets of walls or other structures, eroded areas, unusual moisture patterns, or other physical signs of potentially unstable soils or slopes. Take note of uneven settlement patterns or other problems with pavement within the site.

3) ENVIRONMENTAL: Take note of any drainage areas (engineered or natural) or other potential wetlands within the site. Observe whether there is any open space in proximity to the project site. If so, it may well host protected plant or animal species. If there are mature trees within the project area – even if they will not be disturbed by the project – provisions to avoid them or maintain a required

distance from them during construction may be necessary. During the field review be sure to note the presence of any bird or animal species encountered. In order to gain a thorough understanding of potential environmental constraints, costs, and mitigations on a site, if possible bring an experienced environmental planner on the field review.

4) SITE ACCESS AND TRAFFIC CONTROL: Take note of the traffic and access conditions in the area of the project. Consider how trucks, workers and equipment will access the project site to deliver materials and to construct the project. Observe whether there are any available areas for staging or material storage within or near the project site. If the project involves widening or reconstructing an existing facility, consider how the project might be staged and how existing access and traffic will be maintained. If the project is in a multi-modal corridor, consider how modes other than automobiles (e.g. bike/pedestrian, transit, rail) will be served and impacted.

5) HAZARDOUS MATERIALS: Prior to the field review, have a qualified individual perform a records search of the state hazardous materials database prior to preparing the project cost estimate. The Caltrans Hazardous Waste Management website at: http://www.dot.ca.gov/hq/env/haz/index.htm, is a good resource that provides guidance and tools for assessing and managing properties that may contain hazardous waste. In addition, sponsors should check if the project site is listed on the Caltrans "Cortese List" at: http://www.dot.ca.gov/hq/env/haz/hw_contaminated_properties.htm. Presence on the "Cortese List" has bearing on local permitting as well as compliance with CEQA. While a field review may provide additional information, it is not the best way to assess possible hazardous materials concerns that may affect a project's cost. Nonetheless, observe and document the presence of any gas stations, railroad tracks, material storage areas, automotive shops, or other industrial uses. Include and document any existing structures that are painted, especially if they are old enough to have had lead paint used on them.

6) CONTROVERSY and/or ENVIRONMENTAL JUSTICE: As with Hazardous Materials, a field review is not the primary method to assess risks related to controversy and/or environmental justice. However, if there are any indicators that the project is or could become controversial or will require an environmental justice assessment, take the opportunity to familiarize yourself with any points of interest within the project site. Take note of the neighborhood or surroundings of the project site. Consider any information you may have regarding public activism in the area and any community involvement in the project to date. All projects tend to have a minimum level of public outreach associated with them, especially during the scoping and environmental clearance phase of development. It should be expected, however, that certain projects will have the need for extensive or intensive outreach that should be estimated early on.

7) OTHER ISSUES: Anything that makes a project particularly unique can potentially affect the project budget or schedule. During the field review, take note of any unique features or conditions. Think about how they might have an impact on the project's development process and whether there is anything that could translate into a consideration in the cost estimate or schedule.

Preliminary Risk Assessment Questionnaire

Project Sponsor: _____

Name of Project: _____

Project Location and Brief Description:

_____

_____

_____

Date of Field Review: _____

Estimate Type (check one): ☐ Initial ☐ PID/PSR ☐ PA/ED

☐35% PS&E ☐65% PS&E ☐100% PS&E ☐Final Engineer Estímate

Directions:
Answer the questions in each risk category and mark "Yes" or "No" in the adjacent column. For each risk category marked with one or more "Yes", consider its probability of occurrence (low, medium, or high) and carry down the appropriate allowance into the "Assessed Risk Allowance" row below the risk category.
*** If something is considered over 80% likely to occur, it should be assumed that it will definitely occur and be accounted for in the project estimate with a specific line item, rather than with a percentage from the Preliminary Risk Assessment.**
Note: References to applicable cost estimate sections (i.e. Section I. Roadway, Section II. Structures, and Section III. Utilities & Right-of-Way) are analogous to the groupings in the Caltrans Standard Cost Estimate format.

No.	Risk Category	Yes or No	Probability of Occurrence & Allowance [%]*		
			Low (1-12%)	Med (13-32%)	High (33-80%)
1	**UTILITIES:** 1) Is it possible that there are utilities that are present and unaccounted for within the project footprint? 2) Are you missing utility maps from any utility company that may have facilities in the area? 3) Are there utilities within the project site that have not been located by USA? 4) Are there any high-risk utilities (e.g. gas lines, oil lines, high voltage transmission lines) within the project footprint? 5) Are there overhead powerlines that might need to be relocated? 6) Are there fiber optic lines within the footprint, and if so, is there any chance the project will conflict with them? 7) If the project is within Caltrans' right-of-way, are there longitudinal utilities that you may be required to relocate as part of the project? 8) Do any of the utilities have prior rights status? 9) Are there utilities on any of the structures?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Utilities: (Apply to Section I. Roadway Category 2 and Section III. Utilities & Right-of-Way)				

No.	Risk Category	Yes or No	Probability of Occurrence & Allowance [%]*		
			Low (1-12%)	Med (13-32%)	High (33-80%)
2	**GEOTECHNICAL and/or SEISMIC:** 1) Are there known faults within, or in close proximity to, the project site? 2) Is there a documented history of earth movement in the area? 3) Are there any visible fractures or offsets of existing facilities near or within the project site? 4) Are there current signs of unstable soils or slopes within or close to the project site? 5) If there is existing pavement within the project footprint, does it show signs of uneven settlement or other problems that could be attributable to underground conditions? 6) Is there a high water table within the project vicinity? 7) Are there signs of drainage issues or flooding? 8) Are there any existing soil borings or technical data available from previous projects that you have not reviewed?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Geotechnical and/or Seismic issues: (Apply to Section I. Roadway Categories 1-4 and Section II. Structures)				
3	**ENVIRONMENTAL:** 1) Is the site likely to affect any known sensitive resources? 2) Is the site within or near any special jurisdictions that will require more coordination than average or issuance of a special permit? 3) Are there any regulatory agencies that the project will have to coordinate with that you have not contacted? 4) Is the site within proximity to open space? 5) Are there mature trees or other mature landscape elements within the footprint or in close proximity to it? 6) Are there known species of concern (plant or animal) in the general area of the project site? 7) Are there sensitive noise receptors in the vicinity that could trigger the need for sound walls? 8) Is there a possibility that there could be an archaeological site within the project footprint? 9) Is there a possibility that there could be a paleontological site within the project footprint? 10) Are there any bridges over water? 11) Are there wetlands in or near your site?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Environmental issues: (Apply to Section I. Roadway Categories 4 and 6, Section III. Utilities & Right-of-Way, Section IV. Conceptual Engineering Studies, and Section V. Environmental Studies)				

No.	Risk Category	Yes or No	Probability of Occurrence & Allowance [%]*		
			Low (1-12%)	Med (13-32%)	High (33-80%)
4	**SITE ACCESS and TRAFFIC CONTROL:** 1) Is access to the site constrained (i.e. is it accessible only from freeway ramps or other controlled facilities)? 2) Will construction of a project at this location require lane closures or significant re-routing of traffic? 3) Will there be potential impacts to other modes of transportation such as bike/pedestrian, bus, light rail, or rail? 4) Is the project within a particularly congested or constrained corridor that will result in limited work hours/days? 5) Do you expect there to be significant limitation on allowable days/times for lane closures? 6) Is the project in a corridor that provides the primary access to/from a destination or facility? 7) Will workers be in close proximity to traffic (i.e. will there need to be special considerations for worker safety)? 8) Will the project require night and/or weekend work (could be due to location, congestion, or other)? 9) Are there overhead utilities that could affect access, especially for equipment, to the site?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Site Access and Traffic Control: (Apply to Section I. Roadway Categories 1, 5, 7, and 9, and Section II. Structures)				
5	**HAZARDOUS MATERIALS:** 1) Is the project site listed on the Caltrans “Cortese List”? 2) Are there records of any hazardous materials present within the project footprint? 3) Are there any gas stations, automotive repair, or other industrial uses that might be associated with hazardous materials within or in close proximity to the project? 4) Is the site on or near an active or past railroad right of way? 5) Are there buildings or other structures on the site that will be disturbed and might contain asbestos or other hazardous materials or lead based paints? 6) Will the project disturb ground that is likely to contain aerially deposited lead? 7) Is there an old landfill in the area or within your site?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Hazardous Material: (Apply to Section I. Roadway Categories 1 -4 and Section III. Utilities & Right-of-Way)				

No.	Risk Category	Yes or No	Probability of Occurrence & Allowance [%]*		
			Low (1-12%)	Med (13-32%)	High (33-80%)
6	**CONTROVERSY and/or ENVIRONMENTAL JUSTICE:** 1) Is the project already or likely to become controversial? 2) Is there organized opposition to the project? 3) Has the project been the subject (directly or indirectly) of any lawsuits? 4) Has the project been featured in any press coverage? 5) Will the project be constructed in a neighborhood that will require Environmental Justice evaluation and assessment? 6) Will demolition of an existing structure or facility be required in order to construct the project? 7) Are there nearby residential neighborhoods?	Y/N Y/N Y/N Y/N Y/N Y/N Y/N	x%	x%	x%
	Assessed Risk Allowance based on understanding of risks associated with Controversy and/or Environmental Justice: (Apply to the Section IV. Engineering Studies, Section V. Environmental Studies, and Section VI. Design Engineering)				
7	**OTHER ISSUES:** Are there any unique features of the project or its location that might have an affect the cost or the schedule of the project? If so, describe below, and indicate the likelihood that the issue will affect the project. Use your judgment to determine which elements of the project cost estimate will be affected, and make a reasonable determination about the percent increase on those elements could be incurred if it were to occur. (If applicable, describe other issues in the space below.)	Y/N	X%	X%	X%
	Assessed Risk Allowance based on understanding of risks associated with other issues not listed above: (Determine as appropriate and apply to relevant Section/s)				

Participants in Field Review:	**Title or Project Role:**
1)	1)
2)	2)
3)	3)
4)	4)

APPENDIX B: COST ESTIMATING REFERENCE: BASIS OF QUANTITY AND UNIT COST MEASURE

COST ESTIMATING REFERENCE
BASIS OF QUANTITY AND UNIT COST MEASURE

This estimating reference includes some standard items used in capital project cost estimates, but is not meant to be exhaustive. The units of measure provided are most effective for conceptual level estimates. Sponsors are encouraged to use a more appropriate unit of measure, if available. This reference is used with permission from the Contra Costa Transportation Authority.

ADVANCE WORK

- Temporary Work (Primarily for maintaining traffic)
  Temporary work, detours, etc., includes all labor materials and incidental costs for the installation and removal of all items necessary to maintain reasonable flow of traffic and safety during construction of the proposed work. The scope includes, but is not limited to, such items as temporary pavement, signs, signals, barriers, striping, traffic control, traffic management plan, etc.

  Unit of Measure: LS (lump sum)
  Guideline Unit Cost: 10% of Total Construction Cost

  For freeways, interchanges, or major arterial projects that will require significant detours or construction staging, additional costs may need to be included in the estimate.

- Maintenance of Utilities
  Maintenance of utilities includes all labor, materials and incidental costs for temporary relocations, supports, protection, and restoration of electrical or mechanical utilities located in the work areas as required to maintain service with minimal or no interruption. This does not include utility relocation, which is discussed under land and right-of-way costs.

  Unit of Measure: LS (lump sum)
  Guideline Unit Cost: 3% of Total Construction Cost

  Particular attention should be given to these items. Costs could be significantly larger than the percents shown, especially if project requires significant rehabilitation and involves traffic management, detours and construction staging.

- Mobilization
  Mobilization provides reimbursement of cost to the contractor prior to “move in”.

  Unit of Measure: LS (lump sum)
  Guideline Unit Cost: 10% of Total Construction Cost

- Clearing and Grubbing
  Clearing and grubbing includes all labor, materials and incidental costs for clearing from the entire area of the construction right-of-way all vegetation, shrubs, trees including the removal of stumps and disposal of the cleared items.

  Unit of Measure: LS (lump sum)

Guideline Unit Cost: 2.5% of Total Construction Cost

- Demolition
  Demolition includes all labor, materials and incidental costs for the removal of all items within the right-of-way that interfere with the construction of the proposed work. Exceptions are those items which are to remain functional during construction and which will be an integral part of the finished project. Demolition includes the cost of hauling and disposing of all demolished items. Removal and disposal of hazardous materials should be included under miscellaneous costs.

  Demolition of Typical Items (Excluding Bridges, Major Structures, & Buildings):

  Unit of Measure: LS (lump sum)
  Guideline Unit Cost: 2% of Total Construction Cost

  Demolition of Bridges, Major Structures, & Buildings:

  Unit of Measure: LS (lump sum)

  Removal of buildings and miscellaneous structures can involve significant costs and should be estimated separately.

EARTHWORK

Earthwork includes all labor, materials and incidental costs for all earthwork operations including haulage, testing and disposing of excess excavation, backfill compaction, and grading. Excavation for drainage ditches will be included under "Drainage".

Earthwork (Roadway Excavation) costs can vary significantly between larger and smaller projects. Often for smaller projects, the significant portion of the roadway excavation is associated with grading for the roadway pavement section. This is more labor intensive and therefore more costly than for larger projects with a larger volume of mass earthwork. It is important to use a unit price that is consistent with the size of the project.

- Roadway Excavation
  Roadway excavation includes but is not limited to, excavation, embankments using excavated materials, compaction for embankments, haulage, and disposal of over-excavation.

  Unit of Measure: CY (cubic yard) of excavated material (in place volume)

  The unit price per cubic yard is typically based on a cut and fill operation in soft soil. If conditions suggest that rock excavation will be required, an appropriate allowance should be included.

- Imported Borrow
  Imported borrow includes, but is not limited to, imported material, its placement and compaction, including haulage.

  Unit of Measure: CY (cubic yard) of imported borrow in place

  Typically, the unit price per cubic yard is based on the availability of suitable borrow material within 10 miles. Similar to Roadway Excavation, unit prices for Imported Borrow can vary significantly between smaller and larger volume projects and should be selected to be consistent with the specific project.

- Erosion Control
  Erosion Control includes all slope and unpaved areas that will not be landscaped. It consists of, but is not limited to, placing soil retention netting, hydro-seeding and mulching or, where required. Other methods of erosion control, such as rip-rap, concrete or asphaltic cover need to be estimated separately.

  Unit of Measure: AC (acre) of applicable area

DRAINAGE

Drainage includes all labor, material and incidental costs for providing adequate drainage of the roadway, and all connections to existing storm sewers, modifications to existing catch basins and manholes as required.

- Drainage Ditches
  Drainage ditches include excavation and lining, or seeding as required.

  Unit of Measure: LF (linear feet) of ditch

  Drainage ditches vary in size, and therefore, cost per linear foot. A large ditch might be concrete lined with an average cross section of 3 feet bottom width, 9 feet top width, and 3 feet depth; while a small ditch might be a concrete lined V-ditch with a 1:1 slope and a top width of 4 feet. It is important that the unit price selected is appropriate for the size of ditch that will be required. Roadside ditches would typically only be appropriate in rural or semi-rural settings, as urban projects would normally have curb & gutter.

- Reinforced Concrete Pipe (RCP)
  Reinforced concrete pipe includes furnishing of pipe material, hauling, excavation, and placing the RCP, endwalls, all connections and modifications to existing storm drain systems, as required.

  Unit of Measure: LF (linear feet) of RCP

- Drainage Structures (Manholes, Catch Basins)
  Drainage Structures include excavation, furnishing and installing manholes and catch basins (inlets) with covers and grates.

  Unit of measure: EA (each)

  Unit prices vary for manholes and catch basins (inlets), and for smaller and larger projects.

- Box Culverts (RCB)
  Box culverts include excavation, furnishing and placing the culvert, and end structures. Because box culverts vary greatly in size, it is important to use a unit cost that is appropriate for the specific project.

  Unit of Measure: SF (square feet) of box culvert

PAVEMENT

Pavement includes all labor, materials and incidental costs for compaction, fine grading, and placing sub-base, base, wearing and finish course. Striping and pavement markings, including all delineator buttons and reflectors, will be estimated separately.

Typically city street and arterial projects (non-freeway/expressway) will include curbs & gutters, sidewalks, and sometimes raised medians. Estimate line items are included for these items.

Roadway Pavement Sections and corresponding costs vary significantly between Freeway/Expressways and local streets and arterials. Costs also vary between smaller and larger projects. It is important to select unit costs that consider these variations.

- Asphalt Concrete Pavement (AC)
  Asphalt Concrete pavement should include the area of main road, shoulders, and ramps. Typical road sections might be as follows:

  Local Streets and Arterials:

Asphalt Concrete (Type A)	0.5 ft
Class 3 Aggregate Base	0.75 ft
Class 4 Aggregate Sub-base	1.0 ft

  Freeway:

Asphalt Concrete (Type A)	0.67 ft
Class 3 Aggregate Base	0.83 ft
Class 4 Aggregate Sub-base	1.33 ft

  Unit of Measure: SF (square feet) of asphalt concrete pavement

  The Asphalt Concrete pavement unit price should also include the necessary surface coating(s) such as prime coat and tack coat.

- Portland Cement Concrete Pavement (PCC)
  Portland Cement Concrete pavement should include the total area of PCC pavement based on a typical structural section. The structural section below is typical for a Long Life (40-year Design Life) pavement, as the majority of freeways will require it. Normal (20-year Design Life) pavement would be approximately 20% less in unit cost.

Portland Cement Concrete	1.00 ft
Lean Concrete Base (LCB)	0.50 ft
Class 4 Aggregate Sub-base	0.75 ft

  Unit of Measure: SF (square feet) of PCC pavement

- Pavement Striping & Markings
  Pavement striping includes striping with reflective paint, all delineator buttons and reflectors required.

  For Conceptual Pavement Striping & Markings Costs:

  Unit of Measure: LS (lump sum)
  Guideline Unit Cost: 1 % of Total of Roadway Pavement (including shoulder)

  For a more detailed Pavement Striping Cost:

  Unit of Measure: LF (linear feet) of striping

  For a more detailed Pavement Markings Cost:

  Pavement markings will include all markings such as direction arrows, lettering, etc. with reflective paint and all delineator buttons and reflectors required.

Unit of Measure: SF (square feet) of marked area

- Sidewalk and Curb & Gutter
  Sidewalk, Curb, and Curb & Gutter are assumed to be constructed of PCC.

  Curb :

  Unit of Measure: LF (linear feet) of curb

  Curb & Gutter:

  Unit of Measure: LF (linear feet) of curb & gutter

  Sidewalk:

  Unit of Measure: SF (square feet) of sidewalk

STRUCTURES

Structures include all labor, materials and incidental cost for structural earthwork, foundations, and superstructures.

- Bridges
  Bridges include structural excavation and backfill, piles, abutments, foundations, piers, girders and beams, the bridge deck, and cast in place curbs.

  Unit of Measure: SF (square feet) of bridge deck

  It is useful to consider bridges as either being “relatively straight forward and uncomplicated” or “more complex”, with the unit price reflecting this assessment. Unique or extremely complex bridges should e examined more closely and unit prices adjusted accordingly.

- Retaining Walls
  Retaining walls include structural earthwork, piling, footing and stem wall.

  Unit of Measure: LF (linear feet) of retaining wall

  Costs for retaining walls will vary greatly, depending on height. If the project will have multiple or very long walls, you should use different unit costs for sections with significantly different heights. The guide suggests unit prices for Retaining Walls in increments of 5 feet and 10 feet, up to a wall height of 30 feet.

  Special consideration should be given as to whether the retaining walls are Caltrans standard design or specially designed.

  Alternately, if retaining wall is a major cost item, estimator should separate it as follows:
  Earthwork (CY),
  Piling (LF) and
  Wall (SF)

- Sound Walls
  Sound Walls include structural earthwork, piling, concrete base, and reinforced masonry wall, pre-cast or cast in place concrete wall.

  Unit of Measure: LF (linear feet) of sound wall

  A unit price should be selected that reflects the height of wall that is likely to be used. For conceptual purposes, a typical sound wall could be assumed to be a 16 feet high, 8 inch thick concrete masonry wall, on a 1 foot-8 inch high concrete base, with 16" drilled piers, at 16 feet center to center.

  Alternately, if sound wall is a major cost item, estimator should separate it as follows:
  Earthwork (CY),
  Piling (LF) and
  Wall (SF)

MISCELLANEOUS ITEMS

Miscellaneous items include all labor, materials, and incidental costs for supply and installation.

- Fencing
  Fencing includes all posts, rails, chain link fabric, and hardware as required.

  Unit of Measure: LF (linear feet) of fence

  Unit prices will vary, depending on fence height, whether there is barbed wire on the top, and the size of the project.

- Railings and Barriers
  Railings and barriers include metal beam guardrails and cast in place or pre-cast concrete barriers. All posts, brackets and hardware are included.

  Unit of Measure: LF (linear feet) of railing or barrier

- Traffic Signals
  Traffic signals include, but are not limited to, signals, supports, controllers, and power supply.

  Unit of Measure: EA (each) of intersections

  Costs for Traffic Signals will differ depending on whether for a Partially Modified Existing System, a New, or a Totally Reconstructed Traffic Signal System, and the size of the intersection.

- Roadway Lighting
  Roadway lighting includes fixtures, posts, cabling and power supply, panels and controls

  Unit of Measure: EA (each) individual street light/electrolier

  The specific street light/electrolier spacing requirements for the individual jurisdiction that will operate the roadway should be utilized to estimate the approximate total number of lights/electroliers required.

- Signing
  Signing includes directional and traffic control signs such as Speed Limit, Do Not Enter, Merge, Yield, etc.

  Unit of Measure: for off ramps: RMP (ramp) individual ramp
  for on ramps: RMP (ramp) individual ramp
  for additional highway signs: MI (mile) of roadway
  for truss signs: EA (each)
  for roadside signs: EA (each)

  Signing for on-ramps should be based on 8 signs on wood posts associated with the ramps and freeway merge.

  Signing for off-ramps should be based on 2 truss signs and 10 signs on wood posts associated with the ramps and located both on and off the freeway.

  A good rule of thumb for additional highway signs is to assume 1 additional truss sign and 10 additional signs on wood posts per 5 miles of roadway.

  A typical truss sign is a 48 feet cantilever sign with foundations and lighting.

  Typical roadside signs either have a single wood post or two wood posts.

- Landscaping
  Landscaping includes all seeding, planting of shrubs and trees, fertilizing and mulching, except for hydro-seeding as included under erosion control and irrigation. No provision is made for hardscaping in this unit price.

  Unit of Measure: SF (square feet) of landscaped area

  A typical assumption for freeway/expressway locations is based on 1 shrub or tree per 100 SF, wood chip mulch over the entire area, irrigation, and a maintenance period is one year.

  For city street and arterials, roadside or median locations, the average level of treatment is significantly denser than typical freeway landscaping. It may also include some hardscape treatments within the total landscaped area.

- Construction Storm Water BMP's
  Increased legislation concerning handling construction storm water has resulted in the addition of significant construction costs to projects. The guideline costs for this storm water handling provides for the use of construction related Best Management Practices (BMP's) and development of project specific Storm Water Pollution Prevention Plans (SWPPP).

  Unit of Measure: LS (lump sum)
  Guideline Cost: 3.0% of paved surfaces including bike paths, ramps, etc.

- Ramp Metering System
  Typically all on-ramps to freeways will require the installation of a Ramp Metering System.

  Unit of Measure: EA (each) lane of an on-ramp lane installation.

WORK BY OTHERS

Work by others shall include all labor, materials and incidental items furnished by companies or agencies other than the construction contractor. Typical items included here are utility construction or relocations provided by a Utility company, force account work by a railroad company, and materials furnished by others (i.e. owner). For State Highways, Caltrans furnishes various items such as signal controllers, Resident Engineer's Office, COZEEP (additional CHP patrols and enforcement in construction zones), monument disks, padlocks, route shields for funding signs, and sign panels.

Unit of Measure: LS (lump sum)

ENGINEERING AND MANAGEMENT

The costs for engineering and management have been broken down into the following categories:

- **Engineering Studies**
  Engineering studies includes all costs associated with conceptual engineering activities. This may include alternative configuration studies, site investigations, information gathering, and other engineering studies and reports as needed, except as included with Environmental Studies.

  Guideline Cost: 3% of Total Construction Cost

  The stated 3% general allowance should be reviewed for appropriateness for each individual project, as project complexity and size can have dramatic effect on this cost.

- **Environmental Studies**
  Environmental studies shall include all costs of studies and reports as required to obtain an environmental permit. All consulting fees, regulatory requirements and cost shall be included.

  Guideline Cost: 3% of Total Construction Cost

  The stated 3% general allowance should be reviewed for appropriateness for each individual project, especially for smaller projects. Certain types of environmental studies have a minimum cost, regardless of the construction value of the project, so their potential cost impact can easily be under estimated for smaller projects.

- **Design Engineering**
  Design Engineering shall include all engineering costs from preliminary engineering to final construction drawings, including right-of-way engineering. All consulting fees, fieldwork necessary for design, and coordination costs with regulatory agencies and authorities shall be included. The extent of approval requirements associated with Caltrans makes it appropriate to have a varying allowance for Design Engineering depending on the degree of Caltrans involvement.

Caltrans Involvement	Design Engineering Allowance
Category 1: Having No Direct Involvement	12% of Total Construction Cost
Category 2: Requiring an Encroachment Permit	13% of Total Construction Cost
Category 3: Having Direct Involvement and Approval	14% of Total Construction Cost

- **Design Services During Construction**
  Construction Engineering includes all design services during construction (i.e. review of shop drawings and contractor submittals, responding to Requests for Clarifications, and the preparation of construction Record Drawings).

Guideline Cost: 2% of Total Construction Cost

- **Construction Staking**
  Construction Staking includes all staking costs for the location of the proposed structure.

  Guideline Cost: 2.5% of Total Construction Cost

- **Construction Management**
  Construction Management includes all supervision, inspection, administrative support and materials testing necessary to ensure the work is being constructed to the appropriate standards.

  Guideline Cost: 13% of Total Construction Cost

UTILITIES & RIGHT-OF-WAY

Utilities and right-of-way shall include all costs associated with purchase of land, easements and right-of-way such as purchase price, cost of relocating current businesses or residences, right-of-way engineering, and acquisition services. All units of measure are lump sum. Backup documentation is required for all costs identified in this category.

Unit of Measure: LS (lump sum)

- **Land Costs**
  Land costs are to include the purchase price of land, easements and right-of-way. These costs are particularly sensitive and fluctuate with time and the economy. For these reasons, land costs should be prepared by an experienced right-of-way estimator.

- **Relocation Costs**
  Relocation costs shall include all costs associated with the relocation of a current tenant and may include locating a suitable replacement property, interest payments during a construction of the replacement property as well as all costs associated with relocating all movable property to the replacement property.

- **Acquisition Services**
  Acquisition services include the costs of all services necessary to bring the purchase of land, easements and Right-of-Way to a satisfactory conclusion. This includes legal services, title searches, appraisal preparation, negotiations with current owners, financial and real estate consultants, etc.

- **Right-of-Way Engineering**
  Right-of-way engineering includes developing plans for land requirements, reapportionment of assessment districts, surveying, documenting the land and easement limits. For Caltrans facilities, services include preparation of right-of-way appraisal maps and record of surveys.

- **Utility Relocation Costs**
  Include all utility relocation costs, excluding any costs for maintenance of utilities, which are included under advance work.