Book

1

Guidelines and Standards

General Design Guidelines

City of San Diego Water Department
Capital Improvements Program

Issue No.

Water CIP Guidelines and Standards

BOOK 1

GENERAL DESIGN GUIDELINES

Revision Table

Chapter	Initial Issue	Revised Dates				
1	December 1998					
2	December 1998					
3	December 1998					
4	December 1998					
5	December 1998					
6	December 1998	November 2003				
7	December 1998					
8	December 1998					
9	December 1998	January 2004				
10	December 1998					
11	December 1998					
12	December 1998					
13	December 1998					
14	December 1998					
15	December 1998					
16	December 1998					
17	December 1998					
18	December 1998					
19	December 1998					
20	December 1998					
21	December 1998					

PREFACE

This Guidelines and Standards Book contains information to assist planners and engineers with the design and construction of water facilities. The City's intent is to ensure uniformity of design concepts, formats, methodologies, procedures, construction materials, types of equipment and quality of work products. These standards have been produced and adopted to encourage exceptional quality while using current technology for all Water Department facilities.

These Guidelines and Standards are not a substitute for good engineering. Sound judgement must be exercised in all applications to create quality and cost efficient facilities.

Water Department management encourages the creation of relationships between project stakeholders that promotes engineering excellence and timely completion of projects. City staff and consultants are encouraged to take the time at the beginning of all projects to identify common goals, common interests, lines of communication, and a commitment to cooperative problem solving.

LARRY GARDNER
Water Department Director

BOOK LISTING

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Book 1

General Design Guidelines

Chapter 1
Introduction

City of San Diego Water Department
Capital Improvements Program

Chapter 1
INTRODUCTION

1.1 Background and Purpose

The City of San Diego serves over 1.2 million people populating over 200 square miles of developed land. In addition to its 3 existing water treatment plants, San Diego currently maintains and operates over 2,800 miles of water transmission and distribution lines, 45 water pumping stations, over 90 pressure zones, and over 200 million gallons of potable water storage capacity in 33 standpipes, elevated tanks, and concrete and steel reservoirs.

Lacking significant local water resources, San Diego County must import over 85 percent of its water from other areas, specifically northern California and the Colorado River. The San Diego County Water Authority, composed of various San Diego County Water agencies, receives its water from the Metropolitan Water District of Southern California and conveys it to San Diego County.

In addition to supplying over 250,000 metered service connections within its own incorporated boundaries, the City of San Diego conveys and sells potable water to the city of Del Mar, the Santa Fe and San Dieguito Irrigation Districts, and the California American Water Company, which, in turn, serves the cities of Coronado and Imperial Beach and portions of south San Diego.

As with existing water infrastructure in many American cities, some of San Diego's water system components–pipelines, pumping stations, storage facilities, and treatment plants–have deteriorated and need corrective action. Moreover, Federal Safe Drinking Water Act and state of California health regulations mandate certain standards of water quality in treatment and delivery systems. To ensure continued system reliability and delivery of safe drinking water to its citizens, certain repairs, upgrades and expansions are needed.

To finance and implement the needed repairs or improvements, the City Water Department initiated a Water Capital Improvements Program (CIP). The Water CIP is a nine-year program (Fiscal Years 1998-2006) to repair and replace aging and deteriorated water infrastructure components, upgrade the water treatment plants to meet Safe Drinking Water Act requirements, and expand treatment capacity to meet the needs of current and future residential, commercial and industrial customers.

These Water Department Capital Improvements Program Guidelines and Standards, or Water CIP Guidelines, apply to all the above facilities. These Guidelines are to be used by all DESIGN CONSULTANTS and Construction Management Firms selected by the CIP Program Management Division of the Water Department to perform design, construction management or provide startup services.

The primary purpose of these Water CIP Guidelines is to ensure uniformity of design concepts, formats, methodologies, procedures, construction materials, types of equipment, and quality of work products to be produced under the Water CIP. With several hundred types of materials, equipment, systems and subsystems available to a program of this magnitude, these Guidelines will also simplify the logistics associated with the storage of spare parts required for startup, maintenance, and repairs. In addition, operator training will be better coordinated and standardized.

Recognizing the need to maintain creativity, innovation, and ingenuity, DESIGN CONSULTANTS are expected to adapt these Water CIP Guidelines for design and construction management of the facilities for which they are responsible. This responsibility is in no way diluted or absolved by these Guidelines.

These Water CIP Guidelines provide a framework for the design of a wide variety of project complexity included in the CIP and may not be applicable to "less complex" projects. For less complex projects, the administrative and procedural sections of the Guidelines should be varied to meet the needs of the project. For example, the Guidelines may require weekly meetings during design to discuss technical questions. This is appropriate for a complex pumping station or storage reservoir and should be followed. For such projects, fewer meetings may be appropriate for the design of a short section of pipeline. Variations or departures from these Guidelines are determined on a project-by-project basis during scope negotiations between the DESIGN CONSULTANT and the CIP Program Manager, based on the experience of the CIP staff and the requirements of each project.

1.2 Scope and Coverage

The Water CIP Guidelines have been organized and issued as six books as follows:

- Book 1, **General Design Guidelines,** provides direction on design issues, administrative procedures and facility implementation that are common to all CIP projects.

- Book 2, **Facility Design Guidelines,** provides guidelines for estimating of water demands and service criteria, pipeline transmission and distribution design, pressure control facility design, storage facility design, and pumping station design. Book 2 also includes typical facility layouts or general arrangements.

- Book 3, **Standard and Guide Details,** presents guide details for use in developing construction documents and discusses the use of other available standard City Details.

- Book 4, **Standard and Guide Specifications,** provides a guide technical construction specification for use by designers in developing construction documents.

- Book 5, **CADD Standards,** documents CADD requirements, outlines file transfer protocols, provides standard drawing formats and provides drafting standards.

- Book 6, **Construction Management Guidelines,** provides an outline of construction management procedures.

Each book is contained in a separate binder with a detailed Table of Contents. The users of these Guidelines should study the Table of Contents of each book to obtain a broad understanding of the subjects covered.

1.3 CIP Program Terms

A list and description of terms, abbreviations, and acronyms used throughout the Water CIP Guidelines is included in Attachment 1-1 at the end of this chapter.

1.4 Interface Between Work of Design Consultants

The City is expected to select several DESIGN CONSULTANTS for the design of water facilities. The DESIGN CONSULTANTS selected for the design of such facilities must coordinate work closely to ensure that necessary operational links are accommodated in their respective designs. However, the CIP Program Manager maintains overall responsibility for such design coordination, and ensures that design and construction schedules for such facilities are coordinated so that linked facilities become operational at the same time.

However, unmitigable factors may arise which prevent successful simultaneous completion of linked facilities. DESIGN CONSULTANTS must provide flexibility in their design(s) so that the construction work associated with the operational links between projects can be added or deleted, depending on the timing of construction.

1.5 Permits

Most CIP projects, depending on their characteristics and location, require planning, temporary access, and/or encroachment and environmental permits from regulatory and private agencies prior to construction. Key permitting agencies include the U.S. Army Corps of Engineers; the California Department of Water Resources; the California Department of Transportation (Caltrans); the Regional Water Quality Control Board; the California and San Diego County Departments of Health Services; the California Department of Fish and Game; the California Coastal Commission; the California Department of Safety of Dams; the Atchison, Topeka, and Santa Fe Railroad; and the Metropolitan Transit Development Board. In addition, compliance with the plan check and permitting processes of the Development Services and Public Works Departments of the City of San Diego is required.

DESIGN CONSULTANTS identify all required permits early in the design process and, if provided for contractually, assist the CIP Project Manager and the CIP Permit Coordinator in the preparation and timely submittal of permit application packages, including any necessary analytical studies which the DESIGN CONSULTANT is contracted to prepare. The DESIGN CONSULTANT assists the CIP Project Manager in complying with any follow-up requests for additional information or clarification of permit submittals.

1.6 Inconsistencies Between Guidelines

If the DESIGN CONSULTANT finds inconsistencies between different guidelines, or if inconsistencies should develop during design (necessitated by site-specific and/or project-specified considerations and constraints), it immediately notifies the CIP Program Manager in writing of its findings, recommendations and reasons for such recommendations. DESIGN CONSULTANTS are ultimately responsible for their designs and resolve all conflicts, inconsistencies, errors, and omissions in any conflicting or inconsistent guidelines and standards to ensure that the designs completed by the DESIGN CONSULTANT meet the highest professional standards.

1.7 Order of Precedence

DESIGN CONSULTANTS are provided with both the Water CIP Guidelines and the copies of all pertinent predesign reports for their projects upon request. Inconsistencies and conflicts may exist between these two documents.

Should such inconsistences and conflicts be discovered, the DESIGN CONSULTANT must immediately notify the CIP Program Manager in writing. In general, predesign reports take precedence over the Guidelines by virtue of the fact that these documents are site- and project-specific, while the Water CIP Guidelines may be more generic in nature. If in specific instances the DESIGN CONSULTANT feels that adherence to the Water CIP Guidelines, rather than the predesign reports, would provide a better facility or product, the DESIGN CONSULTANT recommends such adherence per paragraph 1.8 of this chapter.

1.8 Procedure to Deviate from Guidelines or Predesign Reports

The DESIGN CONSULTANT may desire, from time to time, to deviate from the Water CIP Guidelines and/or the predesign reports. This situation could be prompted by a design concept or a feature that the DESIGN CONSULTANT believes is better or more cost-effective than the one provided in the Guidelines and/or the predesign reports, or by the development of new equipment or systems since the completion of predesign. In such cases, the DESIGN CONSULTANT immediately brings this matter to the attention of the CIP Project Manager.

The DESIGN CONSULTANT requests deviation(s) from the Water CIP Guidelines and/or the predesign reports using the format presented in Figure 1-1. The deviations are discussed with the CIP Project Manager within one week of when the DESIGN CONSULTANT recognizes the need for such a deviation and confirmed in writing no later than two weeks thereafter. Each request must be accompanied by full documentation and justification for the deviation(s).

Project-specific deviations proposed by the DESIGN CONSULTANT are directed to the CIP Program Manager. If the deviation request is not accepted, the CIP Program Manager notifies the DESIGN CONSULTANT in writing. However, if the deviation request is accepted as presented, or in some modified form, the CIP Program Manager executes the form shown in Figure 1-1 listing any conditions applicable with its acceptance. No deviation(s) are permitted without written authorization from the CIP Program Manager.

1.9 Application of Guidelines to Small Projects

For relatively small projects, certain aspects of these Guidelines (e.g., procedural, quality assurance, and/or cost estimating and scheduling, etc.) may not fully apply. When such a project is identified, the assigned CIP Project Manager makes recommendations on project scope (technical, procedural, etc.) and schedule to the CIP Program Manager. The CIP Program Manager then decides the exact scope of the project, including QA/QC and other procedures required, which becomes the basis of a Request for Proposal to prospective DESIGN CONSULTANTS or the basis for in-house implementation, as the case may be.

1.10 Maintenance and Distribution of Water CIP Guidelines

For procedures involving the maintenance and distribution of these Guidelines, see paragraph 21.9 of Chapter 21. These procedures include the following:

- Control of annual revisions
- Revision distribution
- Controlled distribution
- Maintenance of CIP Guidelines inventory

Figure 1-1
Deviation from Program Guidelines and Standards
or Predesign Reports

1. Request No.: _____ 2. Date: _____

3. Project Title: _____ 4. CIP No.: _____

5. Consultant: _____

6. Affected Documents:
(Please provide full description of the Guideline and/or the Predesign element from which deviation or change is requested. Include affected specification section and/or subsection, equipment number, drawing number, etc., to enable the Program Manager to fully and easily understand the element from which deviation is proposed.)

7. Proposed Change:
(Please provide a detailed description of proposed change. Attach sketches, specifications or other applicable material which fully describes the scope of your proposal.)

8. Reason for Request:
(Please provide complete documentation and justification for this request. Include cost-effectiveness analysis if applicable, and any other supporting data and analysis which will facilitate evaluation.)

9. Date by Which Approval is Requested (please explain why):

10. Impact of Proposal On:
    a. Design Schedule & Cost
    (Please explain as necessary)

    b. Construction Schedule & Cost
    (Please explain as necessary)

11. Remarks:
(Please include any other information and/or concerns not covered above.)

SUBMITTED: APPROVED:

_____ _____
(Project Manager CIP Program Manager

_____ _____
(Name of Consultant) Date

Attachment 1-1
CIP Program Terms, Abbreviations, and Acronyms

BODR	Basis of Design Report, described in paragraph 6.6 of Chapter 6 of Book 1, Design Development.
CIP Program Manager	Program Manager for the City of San Diego Water Department Capital Improvements Program Division.
CIP Project Manager	The Engineer who has designated management responsibility for a project to be implemented as part of the Water CIP.
CIP Permit Coordinator	An individual designated by the City to be in overall charge of obtaining regulatory permits and approvals for the construction of CIP projects.
CIP Projects	Water projects specifically identified in the City's Capital Improvement Program (CIP) for design and/or construction, and administered by the CIP Program Management Division of the Water Department
CIP Senior Planner	An individual employed by the CIP Program Management Division of the Water Department in overall responsible charge of planning and predesign studies for CIP Projects.
City	City of San Diego Water Department or Owner.
City of San Diego	Water Department or Owner.
Corrosion Control Engineer	An individual or private entity retained by the DESIGN CONSULTANT to provide specialized expertise in corrosion control.
Construction Contractor	An individual, partnership, corporation, joint-venture, or other legal entity with whom the Owner has signed an agreement to construct the project based on the Contract Documents.
Construction Engineer	An individual either retained by the Construction Manager, or employed by the City, designated to monitor and inspect the day-to-day onsite construction activities.
Construction Manager	Individual partnership, corporation, joint-venture, or other legal entity appointed by Owner during the construction phase of the project.

Attachment 1-1
CIP Program Terms, Abbreviations, and Acronyms
(Continued)

Contract Document(s)	The Notice Inviting Bids, Instruction to Bidders, Bid Forms (including the Bid, Bid Schedule(s), Information Required of Bidder, Bid Bond, and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplementary General Conditions, Technical Specification, Drawings, and all addenda, change orders and payment requirements executed pursuant to the provisions of the Contract Documents.
DESIGN CONSULTANT	Private or public individual, partnership, corporation, joint-venture, or other legal entity appointed by Owner during the design phase of the project.
DESIGN CONSULTANT's Project Manager	The person designated by the DESIGN CONSULTANT to direct the project by continuous and timely communication with the CIP Project Manager and the DESIGN CONSULTANT's project team.
Geotechnical Engineer	An individual or private entity retained by the DESIGN CONSULTANT to provide specialized geotechnical expertise.
Predesign Report	A report prepared by the City describing the project prior to engagement of the DESIGN CONSULTANT.
Water CIP Guidelines or Guidelines	These guidelines and standards (6 Books) as described in Chapter 1 of Book 1, Introduction.
Water Department	City of San Diego Water Department

Book 1

General Design Guidelines

Chapter 2
Administration

City of San Diego Water Department
Capital Improvements Program

Chapter 2
ADMINISTRATION

2.1 Purpose

The Water CIP Guidelines provide general administrative and technical guidelines to be followed by DESIGN CONSULTANTS selected by the City of San Diego Water Department to prepare detailed construction drawings and specifications for the facilities necessary to implement the Water CIP. The design of these facilities is based on the Water CIP Guidelines and criteria presented in the Predesign Report. The Water CIP Guidelines also describe the relationships between the DESIGN CONSULTANT and the CIP Program Manager and other Water CIP staff.

2.2 Background

The City's Water Department intends to contract directly with the DESIGN CONSULTANT for the preparation of Contract Documents. The agreement for design services incorporates a detailed scope of work and specific administrative requirements. The Water CIP Guidelines supplement the detailed scope of work.

The CIP Program Manager designates a project-specific CIP Project Manager to administer and act as the main point of contact on the project. The CIP Project Manager administers the DESIGN CONSULTANT's contract with the City's Water Department to ensure compliance with the contract and Water CIP Guidelines. The DESIGN CONSULTANT submits invoices for work accomplished to the CIP Project Manager, who reviews each invoice for contract compliance, assesses progress and recommends payment.

2.3 Project Administration

In addition to the provisions of the Agreement between the City's Water Department and the DESIGN CONSULTANT, the CIP Project Manager uses the Water CIP Guidelines, of which this chapter is a part, for guidance in administering each project. These Water CIP Guidelines provide a basis for uniformity of format, methodology, procedures, and quality of work products. DESIGN CONSULTANTS and their staffs and subconsultants must familiarize themselves, in detail, with these Guidelines.

2.4 Schedules and Progress Monitoring

2.4.1 Project Schedule

The purpose of the project schedule is to assist the DESIGN CONSULTANT in organizing its sequence of activities, identifying potential bottlenecks and making work assignments. The schedule also assists all project team members to communicate about work requirements and the progress of the work, and assists the CIP Project Manager in monitoring work progress and in reviewing the DESIGN CONSULTANT's invoices.

The scope of work provides requirements for scheduling the DESIGN CONSULTANT's design effort, and for the number, timing and contents of submittals. The required schedule must include all project activities and subactivities, interrelationships, milestones, and intermediate

and final project deliverables. The schedule must incorporate sufficient detail to permit straightforward, accurate monitoring of progress. Schedule standards and procedures are provided in Chapter 3, Project Controls.

The DESIGN CONSULTANT updates and re-evaluates the project schedule monthly, using actual resources (defined in the scope of work) expended. Potential delays caused by circumstances beyond the DESIGN CONSULTANT's control, or which could result from the failure of others to provide timely inputs to the design effort, is identified in the schedule. The work remaining must be compared with remaining resources to determine if the project can be completed on time and within budget. If resources must be reallocated, or if the schedule must be revised, the DESIGN CONSULTANT brings this to the immediate attention of the CIP Project Manager.

2.5 Project Deliverables

Chapter 6, Design Development, provides requirements for the number, timing and content of design deliverables. The CIP Project Manager reviews project work products and forwards written comments to the DESIGN CONSULTANT. The DESIGN CONSULTANT must address written comments resulting from the reviews in writing in a timely manner. The CIP Project Manager's review of work products does not, however, relieve the DESIGN CONSULTANT of full responsibility for its work in accordance with its contractual agreement with the City's Water Department.

The CIP Project Manager schedules formal design review meetings to discuss and resolve comments on the submittals. The DESIGN CONSULTANT prepares and distributes minutes of these meetings within 10 calendar days of each session. As a minimum, these minutes include a summary of items discussed, decisions reached and items needing further development or action.

If the DESIGN CONSULTANT disagrees with the CIP Project Manager's comments or instructions, the CIP Project Manager refers the subject to the CIP Program Manager for resolution.

2.6 Invoice Procedures

DESIGN CONSULTANT's invoices to the City's Water Department for work performed under the contract must be prepared and submitted in accordance with the contract.

2.7 Records Management

The DESIGN CONSULTANT must develop a document control system that ensures that documents and deliverables generated by the design team can be easily and cost-effectively retrieved.

2.8 Equal Opportunity and MBE/WBE Policies

The City has a broad-based, comprehensive equal opportunity program designed to ensure equal employment opportunity for all. The Water CIP is committed to meeting or exceeding the City of San Diego's goals for employing minorities and women, and for subcontracting to minority business enterprises (MBE), women business enterprises (WBE), disadvantaged business enterprises (DBE) and disabled veteran business enterprises (DVBE). Every effort is made to fully inform the minority community of employment opportunities, and to inform the MBE/WBE/DBE/DVBE community of contract opportunities.

The overall objective of the Equal Opportunity Contracting Program (EOCP) is to ensure that DESIGN CONSULTANTS doing business with the City's Water Department or receiving funds from the City do not discriminate against any employee or applicant for employment because of race, color, religion, sex, handicap, age, or national origin, and that equal employment opportunity is provided to all applicants and employees without regard to race, religion, sex, handicap, age, or national origin. The goal of the Equal Opportunity Contracting Program is to ensure that all DESIGN CONSULTANTS or subconsultants achieve parity in the representation of women, and minorities, in their workforce with the availability of women, and minorities, in the San Diego County labor market.

2.9 Contract Activity Report

The DESIGN CONSULTANTS doing business with the City's Water Department are required by contract to report quarterly contracting activity in a format specified by the City. These reports are submitted to the Equal Opportunity Contracting Program, via the CIP Project Manager, no later than 30 days after the close of each quarter. Reporting forms are available from the CIP Project Manager.

The basis for reporting contracting activity includes all expenditures except for:

- Payment to employees, including payroll and reimbursements
- Expenditures for employee benefits
- Refunds
- Legal settlements
- Rents and leases for property
- Payments for utilities and telephone service
- Interagency payments and payments to governmental entities
- Memberships (e.g., professional organizations)
- Payments to nonprofit organizations

These are the only approved exclusions; all other payments must be included in the reporting base. Reporting periods correspond with the City's Water Department's fiscal year beginning July 1 and ending June 30.

The DESIGN CONSULTANTS must make an effort to achieve established contracting goals for the contract. When reporting contract activities, only those firms certified MBE, WBE, DBE, or DVBE by either the City of San Diego (SD), the San Diego Joint Agency Contracting Opportunity Task Force (JA), or state of California Department of Transportation (CT), may be credited toward MBE/WBE/DBE/DVBE participation.

Book 1

General Design Guidelines

Chapter 3
Project Controls

City of San Diego Water Department
Capital Improvements Program

Chapter 3
CONTROL OF DESIGN COSTS AND SCHEDULES

3.1 Introduction

This chapter establishes the minimum requirements for the control of cost and schedule for work performed by DESIGN CONSULTANTS contracted by and for the CIP Program Management Division of the City of San Diego Water Department. Additional requirements or exceptions to these Guidelines are addressed in the scope of work of each design contract.

Each DESIGN CONSULTANT schedules, monitors, controls, and reports the work under contract in conformance with these Guidelines and the scope of work. While each DESIGN CONSULTANT may use its own system of control, these Guidelines specify the basic elements that the Water CIP requires each DESIGN CONSULTANT to manage and report on.

3.2 Schedule Control

The DESIGN CONSULTANT submits a detailed project design schedule to the CIP Project Manager not later than 30 calendar days after receipt of the Notice to Proceed (NTP). The schedule includes all design activities, project deliverables, and required project reviews. Design activities are the tasks required to create each deliverable, described in Chapter 6 of Book 1, Design Development, broken down by professional discipline. These detailed design schedules must contain sufficient detail to ensure that the work can be monitored and managed efficiently, and that the project can be completed on time and within contract price. This schedule is referred to as the Initial Schedule.

The DESIGN CONSULTANT submits a Status Schedule to the CIP Project Manager on the 15th day of every month after submittal of the Initial Schedule. The Status Schedule shows the percent completed and the forecasted remaining time to complete for each design activity. In the cover letter for this submittal, the DESIGN CONSULTANT explains any changes to start and/or end dates in the Initial Schedule. The CIP Project Manager approves proposed schedule changes in writing before implementation. The effective date of the Status Schedule is the last day of the previous month.

3.3 Schedule Standards

The DESIGN CONSULTANT submits all schedules in bar chart format and ensures that they contain the design activity number, the activity description (brief description of the work), the start and finish dates, the duration of the activity in calendar days, the budgeted cost, the forecasted remaining time to completion, and a percent complete. The overall project percent complete is calculated as follows: each activity earns a value equal to its budget multiplied by the percent complete; the summation of all earned values divided by the total budget equals the total percent complete. If the City specifies a Work Breakdown Structure (WBS) in the contracted scope of work, the DESIGN CONSULTANT prepares the schedule in accordance with the WBS.

All pages of an earned value and schedule report must be clearly identified with the project CIP or "sub" CIP numbers, if applicable, as well as the project name, the effective date of the schedule, and the name of the DESIGN CONSULTANT. If the report is more than one page long, all pages are numbered and referenced to the total number of pages (1 of 10, 2 of 10, etc.). All activities are plotted so that beginning and end dates can be visually determined by comparison with a calendar scale.

3.4 Electronic Data Files

The DESIGN CONSULTANT submits an electronic form of the schedule data on one or more 3.5-inch high density disk(s) formatted to the Windows program management system in current use by the City. The file must contain all the data defined in the first paragraph of section 3.3. The file can be in a Primavera version 2.0 or a delimited text file format.

The disk(s) must have a permanent exterior label indicating the CIP number or sub-CIP number, if applicable, and the name, the submittal date, the DESIGN CONSULTANT name, and the file names and extensions contained in the disk.

3.5 Data Consistency Responsibility

The DESIGN CONSULTANT is responsible for consistency between the electronic and printed report data submitted with each status schedule. If the electronic file information differs in any way from the printed schedule reports, the CIP Project Manager will disapprove the entire schedule submission and returns it for resubmittal. The DESIGN CONSULTANT must then provide the CIP Project Manager with a completely revised and consistent schedule submittal within 48 hours of notification of disapproval.

3.6 Preliminary Construction Schedule

The DESIGN CONSULTANT submits a preliminary construction schedule in hardcopy and electronic format, as outlined above, consistent with the requirements of this chapter. This schedule assists all parties to:

- Establish a probable sequence of construction activities and probable construction methods.
- Estimate the duration of each construction activity and the overall time to complete the project.
- Identify the long lead items possibly to be prepurchased and determine the necessity of packaging of the project into multiple construction packages.
- Establish scheduling requirements for connections to existing facilities or other projects being constructed.
- Set schedule constraints for external factors such as imposed milestones, beneficial occupancy, etc.
- Provide a starting point for evaluating the Construction Contractor's initial schedule submittal.

The preliminary construction schedule does not appear in the Construction Contract Documents, nor does it direct any Construction Contractor's approach or means and methods of construction. However, the Contract Documents include an estimated overall construction duration that establishes certain construction milestones and/or constraints.

The DESIGN CONSULTANT develops and submits the first Construction Schedule with the 75% design complete submittal and updates it in final form with the 90% design complete submittal.

3.7 Preliminary Construction Schedule Standards

The Preliminary Construction Schedule is based on:

- Quantities when takeoffs are available and experience in areas where quantities are not available.
- Predecessor and successor activities and logic ties, with a narrative explaining the basis of the logic used.
- Non-resource loadings.
- Activities corresponding to the CSI Standard Code of Accounts.
- Activities not exceeding $200,000 in value (exclusive of material or equipment) and no longer than eight weeks in duration.

Book 1

General Design Guidelines

Chapter 4
Cost Estimating

City of San Diego Water Department
Capital Improvements Program

Chapter 4
COST ESTIMATING

4.1 Introduction

The DESIGN CONSULTANT 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 DESIGN CONSULTANT applies the best estimating practices of the engineering and construction industries in preparing these cost estimates.

Cost estimates prepared under contract with the Water Department are strictly confidential and distribution is prohibited beyond that specified in the DESIGN CONSULTANT's contracted scope of work.

Construction cost estimates prepared by the DESIGN CONSULTANT take into account the current climate of the construction industry in the City of San Diego to avoid overly conservative estimates.

4.2 Definition and Types of Cost Estimates

The American Association of Cost Engineers' definition of Cost Estimates Types/Classes is to be used to derive construction cost estimates. The DESIGN CONSULTANT 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 an 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, construction equipment, construction supervision, material costs and equipment installation costs. All reasonable costs a Construction Contractor can expect to incur are also included.

The DESIGN CONSULTANT provides the following types of construction cost estimates to the CIP Project Manager during design at the design complete levels:

- 30% Design Complete: Type C
- 75% Design Complete: Type B
- 90% Design Complete: Type A
- 100% Design Complete: Type A

Refer to the following paragraphs and Table 4-1 for the definitions of estimate types.

Table 4-1
Cost Estimate Types

Type of Estimate	Class of Estimate	Design Level	Expected Accuracy	Contingency	Task Performance
30% Submittal Estimate (Budget level cost estimate)	"C"	30%	+30% to -15%	20%	– Design Consultant – Reviewed by CIP
75% Submittal Estimate (Management directed and corrected scope of work)	"B"	75%	+20% to -10%	15%	– Design Consultant – Reviewed by CIP
90% and 100% Submittal Estimate (Definitive Estimate)	"A"	90% and 100%	+10% to -10%	10%	– Design Consultant – Reviewed by CIP

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 Predesign Report. This Class "C" cost estimate has an expected accuracy of +30% to -15% of 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 75% 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 reports and the completed Predesign Report. This Class "B" cost estimate has an expected accuracy of +20% to -10% of 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.

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 4-4 for examples of cost items):

- 30% design complete estimates: 15% allowance
- 75% design complete estimates: 10% allowance
- 90% design complete estimates: 5% allowance
- 100% design complete estimates: no allowance

For each cost estimate prepared, the DESIGN CONSULTANT 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 DESIGN CONSULTANT participates in cost estimate review meetings with the CIP Project Manager to reconcile cost estimates and discuss each party's respective cost estimate.

4.3 Basis of Cost Estimate

The DESIGN CONSULTANT 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 4-3, Sample Basis of Estimate.)

The DESIGN CONSULTANT 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 DESIGN CONSULTANT may use industry cost databases or estimates on unit costs developed specifically for the project. The DESIGN CONSULTANT 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 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 DESIGN CONSULTANT 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 Water Department system shutdowns, connections, and water service highlining are excluded from

the construction cost estimates submitted by the DESIGN CONSULTANT unless otherwise directed by the CIP Program Manager. Installation costs for these items incurred by the Construction Contractor are included in the cost estimate.

4.4 Format Requirements 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 4-1 through 4-3, 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 DESIGN CONSULTANT breaks down the cost estimate by CSI section and division, and provides backup worksheets. Attachment 4-1 is a sample breakdown sheet prepared for another project. The CSI divisions are as follows:

Division 1	-	General Requirements
Division 2	-	Sitework
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 4-2 for a sample summary sheet.

4.5 Cost Estimate Reports

The DESIGN CONSULTANT prepares cost estimate reports summarizing the total cost, quantities of materials, labor manhours and unit costs for materials and labor. This information is supported by detail that breaks down the cost components by:

- Manhours
- Labor
- Material
- Equipment
- Supplies
- Subcontracts
- Total Cost

Other costs for these items are allocated as a percentage of other total cost 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 4-2 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
- Worksheets Report Sorted by CSI Section Number
- Worksheet Report Sorted by Work Task

As part of each cost estimate report, the DESIGN CONSULTANT 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 XYZ Inc. dated _____.

- Air Compressor Quotation from XYZ Inc. 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.

4.6 Use of Computerized Cost Estimating System Software and Submission of Electronic Data

The DESIGN CONSULTANT 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.

Attachment 4-1
Sample Cost Estimating Sheet By CSI Division

CITY OF SAN DIEGO
WATER DEPARTMENT
ALVARADO WATER TREATMENT PLANT EXPANTION
DRAFT 90% (REV) FOR FINAL COST ESTIMATE
WORKSHEET

MECHANICAL

SECTION	DESCRIPTION	MEANS CODE	QTY	UNITS	UNIT COSTS					SUBS COST	TOTAL LABOR HOURS	TOTAL MAT COST	TOTAL LABOR COST	TOTAL EQUIP COST	TOTAL COST
					HOURS PER UNIT	MAT COST	LABOR COST	EQUIP COST	TOTAL INSTLLD COST						
15054	CONCRETE PIPE, 54" OVERFLOW, DWG C-25														
	SEE 15051 SCHEDULE														
	54" PCCP, AVE DEPTH = 17.5 ' D, STA 50+04 TO 55+02	NA	498	LF	1.75	150.49	52.5	5.4	208.39		871.5	$74,944	$26,145	$2,689	$103,778
	54" PCCP 22.5 DEG ELBOWS	NA	2	EA	24	3110	720	108	3938		48	$6,220	$1,440	$216	$7,876
	TRENCH EXC. 26' W X 17.5' D X 498' LG / 27 = 8392 CY	022-254-1300	8392	CY	0.05	0	1.5	1.66	3.16		419.6	$0	$12,588	$13,931	$26,519
	TRENCH BEDDING, 8.5' W X 8' D X 498' LG / 27 = 125	026-012-0100	125	CY	0.016	15.4	4.8	1.18	21.38		20	$1,925	$600	$148	$2,673
	TRENCH BACKFILL, 8392 - (125 + 283) = 7974 X 1.27	026-254-3040	10126	CY	0.06	0	1.8	1.18	2.98		607.56	$0	$18,227	$11,949	$30,175
	COMPACT TRENCH FILL	022-226-7500	10126	CY	0.029	0	0.87	0.22	1.09		283.654	$0	$8,810	$2,228	$11,037
															$0
15064	18" & 24" PVC, SDR, STORM DRAIN, DWG C-25														$0
	SEE 15051 SCHEDULE, INCLUDE 4"														$0
	18" & 24" SDR35, SDR42, 8' D X 100' LG	NA	100	LF	0.25	22.6	7.5	2.1	32.2		25	$2,260	$750	$210	$3,220
	4'D, PVC, 5' D X 67'	NA	67	LF	0.12	2.83	3.6	0.4	6.83		8.04	$190	$241	$27	$458
	TRENCH EXC. 13' W X 19' D X 100' LG / 27 =	022-254-1300	433	CY	0.05	0	1.5	1.66	3.16		21.65	$0	$650	$719	$1,366
	TRENCH EXC. 6' W X 5' D X 67' LG / 27 +	022-254-1300	99	CY	0.05	0	1.5	1.66	3.16		4.95	$0	$149	$164	$313
	TRENCH BEDDING, 4' W X 8' D X 100' LG / 27 = 12 CY	026-012-0100	12	CY	0.16	15.4	4.8	1.18	21.38		1.92	$185	$58	$14	$257
	TRENCH BEDDING, 2.5' W X 8' D X 67' LG / 27 = 5 CY	026-012-0100	5	CY	0.16	15.4	4.8	1.18	21.38		0.8	$77	$24	$6	$107
	TRENCH BACKFILL	026-254-3040	621	CY	0.06	0	1.8	1.18	2.98		37.26	$0	$1,118	$733	$1,851
	COMPACT TRENCH FILL	022-226-7500	621	CY	0.029	0	0.87	0.22	1.09		18.009	$0	$540	$137	$677
	CATCH BASINS, 8' D	027-152-1130	2	EA	15	455	450	101	1006		30	$910	$900	$202	$2,012
															$0
15061	48" RW LAKE MURRAY SUCTION, CML&C STEEL, DWG														$0
	C-25, SEE 15051 SCHEDULE														$0
	48" CML&C STEEL ELBOWS	NA	2	EA	20	2176	600	96	2872		40	$4,352	$1,200	$192	$5,744
	48" DRESSER COUPLINGS WITH HARNESS RODS	NA	2	EA	15	1152	450	48	1650		30	$2,304	$900	$96	$3,300
	48" CML&C STEEL PIPE, 8' D, STA 1+00 TO 1+48.82	NA	49	LF	1.5	108.84	45	4.8	158.64		73.5	$5,333	$2,205	$235	$7,773
	TRENCH EXC. 16' D X 8' W X 49' LG / 27 = 232 CY	022-254-1300	232	CY	0.05	0	1.5	1.66	3.16		11.6	$0	$348	$385	$733
	TRENCH BEDDING, 8' W X 8' D X 49' LG / 27 = 11.6 CY	026-012-0100	12	CY	0.16	15.4	4.8	1.18	21.38		1.92	$185	$58	$14	$257
	COMPACT TRENCH FILL, INCLUDES B.F., 026-254-3040 +	022-226-7500	278	CY	0.089	0	1.4	0.22	1.62		24.742	$0	$389	$61	$450
															$0
15061	48" RW LAKE MURRAY DISCHARGE,, CML&C STEEL, DWG														$0
	C-25, SEE 15051 SCHEDULE														$0
	48' CML&C STEEL PIPE, 17.5' D STA 0+98 TO 2+16.41	NA	119	LF	1.5	108.84	45	4.8	158.64		178.5	$12,952	$5,355	$571	$18,878
	48' CML&C STEEL ELBOWS	NA	2	EA	20	2176	600	96	2872		40	$4,352	$1,200	$152	$5,744
	48' CML&C STEEL TEE	NA	1	EA	26	3265	780	96	4141		26	$3,265	$780	$96	$4,141
	48' BLIND FLG., OR BULKHEAD	NA	1	EA	12	960	360	24	1344		12	$960	$360	$24	$1,344
	48 ' DRESSER COUPLINGS WITH HARNESS RODS	NA	2	EA	15	1152	450	48	1650		30	$2,304	$900	$96	$3,300
	TRENCH EXC. 25.5' W X 17.5' D X 119' LG / 27 = 1967 CY	022-254-1300	1967	CY	0.05	0	1.5	1.66	3.16		98.35	$0	$2,951	$3,265	$6,216
	TRENCH BEDDING, 8' W X 8' D X 119' LG / 27 = 28 CY	026-012-0100	28	CY	0.16	15.4	4.8	1.18	21.38		4.48	$431	$134	$33	$599
	COMPACT TRENCH FILL, INCLUDES B.F., 026-254-3040 +	022-226-7500	2360	CY	0.089	0	1.4	0.22	1.62		210.04	$0	$3,304	$519	$3,823
															$0
15064	48" X 24" BLOWOFF FOR LAKE MURRAY, SUCTION														$0
	DWG C-25, SEE 15051 SCHEDULE, AWWA C905														$0

Division 15 15-1 Mechanical

Attachment 4-2
Sample Summary Sheet by CSI Division

EST DATE:	June 15, 1998							1		
JOB NO.:	CIP		CITY OF SAN DIEGO					M.T.O		
PROGRAM:			WATER DEPARTMENT					PRICED:		
DESCR:			CLASS "A" CONSTRUCTION ESTIMATE					CHECKED:		
CSI NO.	DESCRIPTION	MATERIAL COST	PERM EQUIP	CONSTR EQUIP	SUBS COST	LABOR M/H	LABOR COST	TOTAL COST		
	CSI DIVISION SUMMARY									
	GENERAL CONDITIONS	6,074		25,020	545,500	20,104	702,406	1,279,000		
DIV. 1	GENERAL REQUIREMENTS	279,497		224,520	601,725	6,074	296,758	1,402,500		
DIV. 2	SITEWORK	1,818,857		1,142,066		36,879	1,428,733	4,389,656		
DIV. 3	CONCRETE	383,422		31,252		14,478	593,007	1,007,681		
DIV. 4	MASONRY	12,188				726	26,768	38,956		
DIV. 5	METALS	363,992		24,280		3,415	140,085	528,357		
DIV. 6	WOOD AND PLASTICS									
DIV. 7	THERMAL/MOISTURE PROTECTION	9,419		544		368	13,567	23,530		
DIV. 8	DOOR AND WINDOWS	6,818		84		89	3,758	10,660		
DIV. 9	FINISHES	48,960		4,359		2,472	84,268	137,587		
DIV. 10	SPECIALTIES	1,620				13	538	2,158		
DIV. 11	EQUIPMENT									
DIV. 12	FURNISHINGS									
DIV. 13	SPECIAL CONSTRUCTION -OPTION 3				1,278,900			1,278,900		
DIV. 14	CONVEYING SYSTEMS									
DIV. 15	MECHANICAL - SUBCONTRACT				6,195,000			6,195,000		
DIV. 15	MECHANICAL (By Prime Contractor)	965,883	795,292	88,447		15,146	654,319	2,503,941		
DIV. 16	ELECTRICAL				1,748,100			1,748,100		
PERCENT	FIELD INDIRECT COST AND DIRECT COST	3,896,730	795,292	1,540,572	10,369,225	99,764	3,944,207	20,546,026		
8.25%	SALES TAX	387,092						387,092		
	SUBTOTAL	4,283,822	795,292	1,540,572	10,369,225		3,944,207	20,933,118		
3.90%	PRIME CONTRACTORS HOME OFFICE	1,670,069	31,016	60,082			153,824	411,991		
	SUBTOTAL	4,450,891	826,308	1,600,654	10,369,225		4,098,031	21,345,109		
See Page	PRIME CONTRACTORS PROFIT	222,545	41,315	80,033			409,803	753,696		
	SUBTOTAL	4,673,436	867,623	1,680,687	10,369,225		4,507,834	22,098,805		
2.50%	CONTINGENCY		19,882				112,696	112,696		
	SUBTOTAL	4,673,436	867,623	1,680,687	10,369,225		4,620,530	22,211,500		
	ESCALATION									
	GRAND TOTAL	4,673,436	867,623	1,680,687	10,369,225	99,764	4,620,530	22,211,500		

Attachment 4-3
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 City Engineer's Estimate, evaluating bid proposals and to serve 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 in the design submittal or on data sheets, and construction equipment. The purchase price of the Microfiltration Equipment is supplied by Memcor/U.S. Filter, and the purchase price of the Reverse Osmosis equipment including installation is supplied by American Services, Inc. Construction labor manhours 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 and General Requirements 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 expense 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 their estimate with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforseen conditions, or any other unplanned costs.

That the Contractor will provide for the General Conditions and Requirements of this contract, perform all mechanical work, install all instrumentation in-line devices, perform all sitework, concreting and steelworks 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 #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 Microfiltration Equipment and Reverse Osmosis Equipment within an 18-month period, and fully commissioned within 22 months. The final 4 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 which 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 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 GC do the installation, only the labor and material are included in the GC's overhead and profit calculations.

2. Reverse Osmosis: The R.O. vendor will be a subcontractor to the GC 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 Microfiltration and Reverse Osmosis suppliers and the associated costs is already included in their estimate. Only instrumentation outside the MF and R.O. 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 or which require 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 4-4
Example of Allowances for Known But Undefined Work

Permits	$46,000
Recommended Spare Parts – The spare parts requirement will be determined by maintenance personnel following approval of equipment O&M submittals	$80,000
Startup Assistance – Contractor support during minimum 4-month startup and commissioning period. Includes contractor-supplied personnel and equipment as required to support plant operations.	$250,000
Allowance for City Inspection – 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
Engineers Office Supplies and Equipment – 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
Operations and Maintenance Training – 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
Additional Potholing – 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 at the direction of the Engineer.	$40,000
Survey Services – 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
Geotechnical Services – This is an allowance to be spent at the Engineer's discretion and recommendation.	$45,000
Differing Site Conditions – This is an allowance to be spent at the Engineer's approval upon discovering of any differing site conditions.	$150,000
Fixed Lump Sum Amounts	
Technical Manuals – Submittal of technical manuals under General Requirements Article [ ]. In addition to the Liquidated Damages under this section, a substantial line item amount serves 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 4-5
Schedule of Work and Prices

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

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 item 17, 18, and 19.

Book 1

General Design Guidelines

Chapter 5
QA/QC Program Guidelines

City of San Diego Water Department
Capital Improvements Program

Chapter 5
QA/QC PROGRAM GUIDELINES

5.1 Introduction

5.1.1 General

The concept of quality has evolved from conformance with specifications to meeting consumer requirements. DESIGN CONSULTANT quality control has advanced from checking deliverables to multiple reviews and evaluations, concurrent with the Water Department reviews described in Chapter 6, Design Development. All design services must result in a facility that meets the City's needs.

This guideline presents the Quality Assurance/Quality Control (QA/QC) philosophies and procedures to be followed by the DESIGN CONSULTANT during design of Water CIP facilities for the Water Department. Adherence is necessary for design activities to support the objectives and purposes of the Water CIP.

5.1.2 Quality Objectives

Four quality goals apply to design work on the Water CIP:

1. Designed facilities must meet the scope and objectives in the Predesign Report. The predesign work typically describes each facility in moderate detail (layout, functions, major equipment items, etc.) and provides performance goals and a budgetary cost estimate, thereby establishing a baseline for each facility. After designed facility described in the construction Contract Documents matches the scope baseline except as modified by changes approved during design. Adherence to the scope baseline is judged by comparing the drawings and the specification to the contents of the Predesign Report.

2. Designed facilities must conform to the design guidelines presented in Book 2 and the design parameters and overall criteria set forth in the project-specific predesign report. Similarly, adherence to the design parameters and overall criteria, is judged by comparing the designed facility to the predesign report.

3. Design services must be performed in accordance with design contracts. Required procedures and activities, schedules for deliverables, and budgets must be followed to meet this goal.

4. Construction Contract Documents must be prepared to the standards of best engineering practice for clarity, uniformity, and completeness. Multiple reviews are conducted to ensure that these goals are met.

5.1.3 Purpose of QA/QC Program Guidelines

The purpose of these QA/QC Guidelines is to communicate the goals, responsibilities and procedures to each DESIGN CONSULTANT so that emphasis on quality can be planned into the project, starting with proposal submittal. The program guidelines, including the QA/QC program guidelines, are either contained in or referenced in the request for proposal, enabling the DESIGN CONSULTANT to understand the requirements before fee estimates and negotiations.

5.2 QA/QC Program

5.2.1 Responsibilities

All members of the DESIGN CONSULTANT project team must understand their responsibility for quality design.

A. Design Consultant

Each DESIGN CONSULTANT is solely responsible to the Water Department for the quality of service provided and the construction Contract Documents prepared. The CIP Project Manager monitors the DESIGN CONSULTANT's efforts and provides certain reviews from an independent perspective as described in Chapter 6, Design Development. Each DESIGN CONSULTANT should implement QA/QC procedures at least as extensive and effective as the procedures discussed in this chapter. The DESIGN CONSULTANT budgets for and provides assistance described in the Water Department's QA/QC reviews in Chapter 6, Design Development.

B. Design Consultant Project Manager

As its primary representative, the DESIGN CONSULTANT's Project Manager prepares and implements an action plan for quality control activities. After receiving the Notice to Proceed (NTP), the DESIGN CONSULTANT's Project Manager organizes, plans, and budgets for the design and QA/QC activities relating to the project.

The DESIGN CONSULTANT's Project Manager prepares a QA/QC project plan for all project QA/QC activities and adds supplements that document what actually occurs during plan implementation. Further information on the QA/QC project plan is presented later in these Guidelines.

QA/QC project plan reviews are conducted regardless of changes to the design schedule. When the design schedule changes, the DESIGN CONSULTANT's Project Manager reschedules the reviews and communicates the changes to the CIP Project Manager in writing.

When QA/QC review comments are presented by DESIGN CONSULTANT design teams, the DESIGN CONSULTANT's Project Manager ensures that appropriate design resources consider the comments and respond by noting the actions to be taken. Copies of the responses are submitted to the CIP Project Manager to indicate that the QC review is complete and that reviewers concur with the response.

If the DESIGN CONSULTANT's Project Manager detects impending deviations from the scope, schedule or budget of the design services contract, it takes appropriate action to correct such deviations or to obtain written approval from the CIP Project Manager if deviations cannot be avoided.

C. Design Consultant Staff Members

Each person assigned by the DESIGN CONSULTANT to a specific task must be sensitive to the need for quality in that task. They document work thoroughly so it can be checked, including assumptions with appropriate references, calculations, and input parameters to computerized programs. All documentation is arranged in a logical fashion for easy review.

D. Design Consultant Preparer

The preparer researches a problem, determines the analysis to be performed, lists assumptions, selects formulas or programs of solution, does data entry, performing mathematics manually or by computer, and records the entire process on calculation sheets, drawings and specifications.

E. Design Consultant Checker

The checker checks the accuracy of data transfer to calculation sheets, computer programs, drawings or specifications and ensures the accuracy of mathematical solutions presented. The objective of this exercise is to document that data has been accurately transferred and that the preparer's mathematical calculations are correct. **The checker and preparer may not be the same person.**

F. Design Consultant Reviewer

The reviewer verifies the appropriateness of the preparer's decisions about the choice of analysis performed, the appropriateness of references, assumptions, adherence to codes, selection of formulas or programs of solution and reasonableness of the results. **The reviewer and preparer may not be the same person, but the checker can be the reviewer.**

G. Design Consultant Approver

The approver verifies that all calculations, drawings and specifications have been checked and reviewed, that the results are reasonable, and that the concepts documented in the calculations are compatible and applicable with the overall project concepts. The approver also certifies the final individual construction contract drawing(s) by signing and sealing.

5.2.2 QA/QC Project Plan

The purposes of the QA/QC project plan are to:

- Develop a specific comprehensive approach to project QA/QC activities.
- Document the actual QA/QC effort and related activities.

The following suggestions may help in developing the QA/QC project plan.

- List every document or work product element to be checked, reviewed and approved, such as drawings, specification sections, calculations by discipline, report sections, study tasks, document files, etc.

- List the criteria to be checked, reviewed and approved for each document or work product element. Use the DESIGN CONSULTANT's standard checklists where appropriate or feasible.

- Develop a matrix of who is to do the checks, reviews and approvals, and include a schedule of when these tasks are to be done.

- Establish a method for documenting checks, reviews or approvals, and who maintains the records.

- Establish procedures for implementing QC comments and assign someone to verify that they have been implemented.

- Include a Review and Comment Form so the designer can respond to review comments.

A description of each review to be conducted by the Water Department is included in Chapter 6, Design Development.

The DESIGN CONSULTANT submits the QA/QC project plan to the CIP Project Manager at least 10 days before the DESIGN CONSULTANT's staff conducts Basis of Design Report (BODR) reviews.

5.3 Implementation

All design work must be thoroughly checked, reviewed and approved by experienced, knowledgeable personnel who are not involved in the original design work. The DESIGN CONSULTANT is completely responsible for quality reviews of its design work.

5.3.1 Types of QA/QC Reviews

A. Calculations

The DESIGN CONSULTANT ensures that participants preparing, checking, reviewing and approving calculations sign and date the preprinted calculation sheets. All original calculation sheets are indexed in file folders maintained in a single location where all original calculations for the entire project can be found. When camera-ready Contract Documents are submitted to the Water Department, a legible copy of all calculations, organized in file folders, is also submitted to the CIP Project Manager.

Calculations are organized in file folders for easy retrieval of specific calculations. A calculation index is maintained to allow easy access to the information. The index includes the items listed in paragraph 21.2.1 in Chapter 21, Records Management and Document Control.

Every calculation, including computer generated output, should be checked within one week after the calculation is prepared and every design assumption should be reviewed and

approved for reasonableness and correctness before being presented to the City. Checked, reviewed and approved calculations are identified and placed in the file folders for all original calculations. Erroneous calculations are marked "VOID" and the reason for doing so noted, and placed in the file folders with the corrected calculations. Voided and corrected calculations are cross-referenced.

Revised, superseded, or voided calculations are clearly identified, dated and initialed.

During construction, any revisions to the calculations are clearly identified with revision numbers placed in the file folders. Revised calculations are checked, signed and cross- referenced to the original calculations.

The DESIGN CONSULTANT's Project Manager monitors the design team to ensure that the file folders of calculations are maintained as required. The CIP Project Manager monitors and spot checks the file folders to ensure that they are properly maintained as part of Quality Assurance.

Calculation sheets include the information in paragraph 21.3.1.C in Chapter 21, Records Management and Document Control.

B. Design Consultant's Basis of Design Report Review

The contents of a Basis of Design Report (BODR) are defined in detail in Chapter 6, Design Development. The BODR is key to establishing design criteria and guidelines for the project being designed. The review includes an examination and evaluation of all calculations, analysis of alternatives, mass balances, P&IDs, materials of construction and layouts. The review is organized by the DESIGN CONSULTANT's Project Manager and assigned discipline reviewers, the constructability reviewer, and the operability reviewer. Review comments are normally made on a draft copy of the BODR, with a written memorandum for resolution of actions to be taken on all comments.

C. Design Consultant's Intradisciplinary Progress Reviews

These reviews include all completed calculations, drawings and specifications at a prescribed percentage of design phase completion. The percent complete, such as 30, 75, and 90%, is defined in the contract scope of work and in the QA/QC project plan. The level of detail expected for each discipline at each completion level is defined in Chapter 6, Design Development. The review is organized by the DESIGN CONSULTANT's Project Manager and is conducted by the assigned DESIGN CONSULTANT discipline reviewers, constructability reviewer, and operability reviewers. Comments are responded to, agreed upon and recorded on the DESIGN CONSULTANT's Review and Comment Form.

D. Design Consultant's Interdisciplinary Review

Design problems may arise from inconsistencies between disciplines. One or more engineers perform detailed interdisciplinary reviews to ensure consistency between disciplines and between drawings and the specification. These problems can be identified by examining the specification page by page, verifying consistency with drawings in information or procedures, and ensuring that all project elements are specified and/or detailed. Attachments 5-1 through 5-7 are typical checklists for an interdisciplinary review, and are included here for use by the DESIGN CONSULTANT.

E. Design Consultant's Peer Review

Peer reviews are generally conducted at a central location by independent discipline representatives who freely evaluate, without constraints, elements of Contract Documents for appropriateness. Peer review findings are reduced to significant written comments for further project team consideration. Peer reviews are not a substitute for the reviews and checks described above and are intended only for the review of project concepts, approaches, layouts, and appropriateness of equipment and materials.

Peer reviews are done at the BODR and at the 75 and 90% design stages by persons from each major design discipline involved in the project. Good practice involves key engineers representing the different design disciplines to convene for a day or two with no interruptions to resolve comments resulting from the review(s). The DESIGN CONSULTANT's Project Manager and Project Engineer also attend this meeting to resolve or arbitrate conflicts or points of contention.

F. Design Consultant's Final Review

The final review is conducted after all 90% review comments have been incorporated and before printing begins. The final review also confirms that all previous review comments have been incorporated.

5.3.2 Review and Comment Form

Each reviewer's comments are placed on the DESIGN CONSULTANT's Review and Comment Form, which contains the following information:

- Name of Project
- Contract Number
- Type of Review
- Document Being Reviewed
- Identification of Page, Paragraph or Drawing
- Review Comment
- Designer Response
- Agreed Upon Resolution
- Signature and Date of Reviewer
- Signature and Date of Design (Responder)
- Signature and Date of DESIGN CONSULTANT's Project Manager

Each reviewer's comments must be constructive and professional in tone. The DESIGN

CONSULTANT staff completes the Response to Comments and Comment Resolution area of the form and properly files the forms to document that all comments have been appropriately addressed.

5.4 Summary of QA/QC Reviews

Table 5-1 summarizes the review packages to be assembled by the DESIGN CONSULTANT. This table also summarizes the review techniques to be used by the DESIGN CONSULTANT and the Water CIP on each submitted package.

Table 5-1
Summary of QA/QC Review

Submittal Package	Review Technique by the DESIGN CONSULTANT	Review Technique by the Water CIP/Owner/Water Department
Basis of Design Report (BODR)	Peer Review(1); Intradisciplinary Progress Review	Intradisciplinary Progress Review
30% Design Complete	Intradisciplinary Progress Review	Value Engineering Review(2); Operations and Maintenance Review(2); Intradisciplinary Progress Review
75% Design Complete	Intradisciplinary Progress Review; Interdisciplinary Review; Peer Review	Operations and Maintenance Review; Intradisciplinary Progress Review
90% Design Complete	Intradisciplinary Progress Review; Interdisciplinary Review; Peer Review	Biddability/Constructability Review(2); Operations and Maintenance Review; Intradisciplinary Progress Review
100% Design Complete	Final Review	Final Review

NOTE: (1) Peer reviews are required for "larger" projects and are so indicated in the contracted scope of services for any project.

(2) See Chapter 6, Design Development, for discussions of Value Engineering Review, Operations and Maintenance Review, and Biddability/Constructability Review.

Attachment 5-1
Architectural Interdisciplinary Checklist

Project Title _____

Client _____ Job No. _____

		Completed	Not Applicable
A.	GRAPHICS		
1.	Check for North arrows on plan views of all drawings and verify orientation	☐	☐
2.	Verify all matchline drawing references	☐	☐
3.	Verify that drawing titles and numbers match index	☐	☐
4.	Verify all section and detail references and orientation	☐	☐
5.	Verify all abbreviations used are on abbreviation list	☐	☐
6.	Verify all references in notes to see other drawings and correct	☐	☐
7.	Verify all architectural symbols used are on and/or agree with legend	☐	☐
8.	Verify directions indicated on all elevations match	☐	☐
9.	Verify all door swings are correct	☐	☐
10.	Verify that room names and numbers on plans match schedules	☐	☐
B.	SPECIFICATIONS		
1.	Verify flashing material names, gage, and construction match specification descriptions	☐	☐
2.	Verify sealant and caulking material names match specification descriptions	☐	☐
3.	Verify all materials listed in finish schedules are specified	☐	☐

		Completed	Not Applicable
C.	CIVIL		
1.	Using overlays or interdisciplinary layer plots, verify architectural structure locations match civil site layout	☐	☐
D.	STRUCTURAL		
1.	Using overlays or interdisciplinary plots verify columns, walls, and dimensions match structural plans	☐	☐
2.	Verify architectural wall sections match structural	☐	☐
3.	Verify building expansion joints match structural	☐	☐
4.	Verify size and location of doors and windows match structural	☐	☐
E.	ELECTRICAL		
1.	Using overlays or interdisciplinary plots, verify reflected ceiling plan matches lighting fixture plan	☐	☐

Drawings Reviewed _____ through _____

Reviewed by: _____ Date _____

Attachment 5-2
Process, Mechanical Interdisciplinary Checklist

Project Title _____

Client _____ Job No. _____

		Completed	Not Applicable
A.	GRAPHICS		
1.	Check for North arrows on plan views of all drawings and verify orientation	☐	☐
2.	Verify all matchline drawing references	☐	☐
3.	Verify drawing titles and numbers match index	☐	☐
4.	Verify all section and detail references and orientation	☐	☐
5.	Verify all abbreviations used are on abbreviation list	☐	☐
6.	Verify all references in notes to see other drawings are correct	☐	☐
7.	Verify all mechanical symbols used are on legend or adequately noted	☐	☐
A.	SPECIFICATIONS		
1.	Verify same names and/or equipment numbers for each piece of equipment shown on drawings match specifications	☐	☐
2.	Verify same-type pipe joints shown as those specified for each service	☐	☐
3.	Verify any pipe material callouts match specifications	☐	☐
4.	Verify all gates (sluice, slide, etc.) shown or scheduled match specifications	☐	☐
5.	Verify all valve types shown match specifications for each service	☐	☐
6.	Verify all equipment sizes designated on drawings match those in specification	☐	☐

		Completed	Not Applicable
3.	ELECTRICAL		
	1. Verify all 3-phase motors specified are shown on one-line diagrams and that names and/or numbers match	☐	☐
	2. Using overlays or interdisciplinary layer plots, verify each electric powered piece of equipment is located in same location as on mechanical drawings and that names and/or equipment numbers match	☐	☐
	3. Using overlays or interdisciplinary layer plots verify conduit and cable trays do not interfere with process piping	☐	☐
4.	STRUCTURAL		
	1. Using overlays or interdisciplinary layer plots and comparing dimensions, verify equipment layout similar with structural	☐	☐
	2. Verify similar elevations used for all slabs and walls	☐	☐
	3. Verify wall pipe types, location, size, and elevations are similar	☐	☐
	4. Verify same sizes and locations for all slab openings	☐	☐
	5. Verify adequate structural hoist supports provided for equipment removal	☐	☐
5.	BUILDING SYSTEMS MECHANICAL		
	1. Using overlays or interdisciplinary layer plots, verify duct work does not conflict with process piping	☐	☐
	2. Verify adequate floor drains are provided for all wet equipment	☐	☐
6.	INSTRUMENTATION		
	1. Verify same equipment names and/or numbers used on mechanical drawings and P&IDs	☐	☐
	2. Verify same drawings and/or numbers used on mechanical and instrumentation drawings	☐	☐

Drawings Reviewed _____ through _____

Reviewed by: _____ Date _____

Attachment 5-3
Instrumentation Interdisciplinary Checklist

Project Title _____
Client _____ Job No. _____

		Completed	Not Applicable
1.	GRAPHICS		
	1. Verify all process line-continuation arrow numbers	☐	☐
	2. Verify drawing titles and numbers match index	☐	☐
	3. Verify all abbreviations are on abbreviation list	☐	☐
	4. Verify all symbols and line descriptions used are in legend and/or are adequately noted	☐	☐
	5. Verify all equipment names and major flow patterns match those on process flow diagram	☐	☐
	6. Verify sufficient space is provided to access the instrument panels	☐	☐
2.	STRUCTURAL		
	1. Verify structural supports are provided for instruments and panels	☐	☐
3.	ELECTRICAL		
	1. Verify electrical power provided for all instruments as required	☐	☐
	2. Where applicable, verify insulation and heat tracing have been indicated on P&IDs, when appropriate	☐	☐

DrawingsReviewed _____ through _____

Reviewed by: _____ Date _____

Attachment 5-4
Civil Interdisciplinary Checklist

Project Title _____
Client _____ JobNo. _____

		Completed	Not Applicable
1.	GRAPHICS		
	1. Check for North arrows on plan views of all drawings and verify orientation	☐	☐
	2. Verify all matchline drawing references	☐	☐
	3. Verify drawing titles and numbers match index	☐	☐
	4. Verify all section and detail references and orientation	☐	☐
	5. Verify all abbreviations used are on abbreviation list	☐	☐
	6. Verify all references in notes to see other drawings are correct	☐	☐
	7. Verify all sitework symbols used are on and/or agree with legend	☐	☐
	8. Verify all facilities and structure locations are defined on site plan	☐	☐
	9. Verify all yard piping and electrical utilities are shown on profiles at crossings to avoid conflict	☐	☐
	10. Verify lengths stated in profiles match stationing	☐	☐
	11. Verify air relief is provided at high points on pressure main profiles	☐	☐
2.	SPECIFICATIONS		
	1. Verify all references to granular material match specification names and descriptions	☐	☐
	2. Verify fence specifications material description matches details and site layout	☐	☐
	3. Verify names given on pavement details match specifications names and descriptions	☐	☐

	Completed	Not Applicable
4. Verify names and details given for drainage structure components and piping match specifications	☐	☐
5. Verify all items in Civil Specifications indicated “as shown” or “as detailed” are actually on drawings	☐	☐
6. Verify all references to concrete indicate a grade or strength included in concrete specifications	☐	☐
3. PROCESS MECHANICAL		
1. Verify all piping entering structures matches mechanical drawings for size location and elevation	☐	☐

Drawings Reviewed _____ through _____
Reviewed by: _____ Date _____

Attachment 5-5
Building Systems Mechanical Interdisciplinary Checklist

Project Title _____
Client _____ Job No. _____

		Completed	Not Applicable
1.	GRAPHICS		
1.	Check for North arrows on plan views of all drawings and verify orientation	☐	☐
2.	Verify all matchline drawing references	☐	☐
3.	Verify drawing titles and number match index	☐	☐
4.	Verify all section and detail references and orientation	☐	☐
5.	Verify all abbreviations used are on abbreviation list	☐	☐
6.	Verify all references in notes to see other drawings are correct	☐	☐
7.	Verify shutoff valves provided for all equipment	☐	☐
8.	Verify adequate maintenance space for removing filters, etc. from all equipment	☐	☐
2.	SPECIFICATIONS		
1.	Verify same names and equipment numbers for each piece of equipment shown on drawings	☐	☐
2.	Verify same-type pipe joints shown as those specified	☐	☐
3.	Verify any pipe material callouts match specifications	☐	☐
4.	Verify all valve types shown match specifications	☐	☐
5.	Verify all equipment sizes designated on drawings match those in specifications	☐	☐

	Completed	Not Applicable
3. CIVIL		
1. Verify all new utilities and drains are connected to either new or existing site utilities	☐	☐
4. ARCHITECTURAL		
1. Using overlays or interdisciplinary plots, verify all plumbing fixtures match architectural locations	☐	☐
2. Using overlays or interdisciplinary layer plots, verify roof drain locations and roof slopes match architectural roof plan	☐	☐
3. Using overlays or interdisciplinary layer plots, verify air conditioners, heaters, and exhaust fans match architectural roof plan	☐	☐
4. Verify wall chases are provided on architectural to conceal vertical pipeline	☐	☐
5. STRUCTURAL		
1. Verify adequate ceiling height at worst-case ductwork intersections with largest beams	☐	☐
2. Verify structural supports are included for all HVAC equipment	☐	☐
3. Using overlays or interdisciplinary layer plots, verify opening for roof penetrations are indicated on structural roof plans	☐	☐
6. ELECTRICAL		
1. Using overlays or interdisciplinary layer plots, verify all equipment is provided with power	☐	☐
2. Verify that equipment names and/or numbers match those on one-line diagrams for all 3-phase motors	☐	☐

Drawings Reviewed _____ through _____

Reviewed by: _____ Date _____

Attachment 5-6
Building Systems Electrical Interdisciplinary Checklist

Project Title _____

Client _____ Job No. _____

		Completed	Not Applicable
1.	GRAPHICS		
1.	Check for North arrows on plan views of all drawings and verify orientation	☐	☐
2.	Verify all matchline drawing references	☐	☐
3.	Verify drawing titles and number match index	☐	☐
4.	Verify all section and detail references and orientation	☐	☐
5.	Verify all abbreviations used are on abbreviation list	☐	☐
6.	Verify all references in notes to see other drawings are correct	☐	☐
7.	Verify electrical symbols used are on legend and/or are adequately noted	☐	☐
8.	Verify electrical schematics are provided for all 3-phase equipment	☐	☐
2.	SPECIFICATIONS		
1.	Verify horsepower ratings, phases, and voltages on one-line diagrams match mechanical equipment specifications	☐	☐
2.	Verify all references to granular material names in trench specifications match electrical details	☐	☐
3.	Verify all references to concrete indicate a grade or strength included in concrete specifications	☐	☐
3.	CIVIL		
1.	Using overlays or interdisciplinary layer plots, verify site electrical utilities do not interfere with yard piping	☐	☐

	Completed	Not Applicable
2. Using overlays or interdisciplinary layer plots, verify site electrical poles or structures do not conflict with pavement or parking	☐	☐
3. Verify trench excavation details are adequate for buried electrical items	☐	☐
4. STRUCTURAL		
1. Using overlays or interdisciplinary plots, verify lighting fixtures do not conflict with structural plans	☐	☐
2. Verify structural supports are provided for electrical equipment	☐	☐
5. BUILDING SYSTEMS MECHANICAL		
1. Using overlays or interdisciplinary layer, plots verify lighting fixtures do not conflict with HVAC equipment and ductwork	☐	☐
6. INSTRUMENTATION		
1. Verify names and/or numbers match those on P&IDs	☐	☐

Drawings Reviewed _____ through _____
Reviewed by: _____ Date _____

Attachment 5-7
Structural Interdisciplinary Checklist

Project Title _____

Client _____ Job No. _____

		Completed	Not Applicable
1.	GRAPHICS		
1.	Check for North arrows on plan views of all drawings and verify orientation	☐	☐
2.	Verify all matchline drawing references	☐	☐
3.	Verify drawing titles and number match index	☐	☐
4.	Verify all section and detail references and orientation	☐	☐
5.	Verify all abbreviations used are on abbreviation list	☐	☐
6.	Verify all references in notes to see other drawings are correct	☐	☐
7.	Verify structural symbols used are on legend and/or that they are adequately noted	☐	☐
8.	Verify schedule provided for all columns and footings match details	☐	☐
9.	Verify schedules for concrete beams match details	☐	☐
10.	Verify all weld symbols are correct	☐	☐
2.	SPECIFICATIONS		
1.	Verify structural notes on drawings are identical to specifications description (preferable not to have structural notes on drawings)	☐	☐
3.	ARCHITECTURAL		
1.	Using overlays or interdisciplinary plots, verify depressed or raised concrete slabs match architectural plan	☐	☐
2.	Verify all slab elevations match structural plans	☐	☐

	Completed	Not Applicable
3. Verify there is not cross bracing across door or window openings	☐	☐

4. PROCESS MECHANICAL

1. Using overlays or interdisciplinary plots, verify equipment pad locations match equipment locations	☐	☐

5. BUILDING MECHANICAL

1. Using overlays or interdisciplinary plots, verify equipment pad locations match equipment locations	☐	☐

Drawings Reviewed _____ through _____

Reviewed by: _____ Date _____

Book 1

General Design Guidelines

Chapter 6
Design Development

City of San Diego Water Department
Capital Improvements Program

Chapter 6
DESIGN DEVELOPMENT

6.1 Design Phase

The project DESIGN CONSULTANT's areas of design responsibility and responsibility for providing assistance to the City during design are as follows:

- Prepare Design Construction Documents
- Obtain Approval of Plan Checks
- Prepare Basis of Design Report (BODR)
- Prepare Owner Procurement Documents
- Prepare O&M Manuals
- Prepare Construction Cost Estimating
- Complete QA/QC Reviews
- Assist in Value Engineering Review
- Assist in Program Scheduling
- Prepare Permit Applications
- Provide Planning/Environmental Assistance
- Assist in Land Acquisition, Permits, and Rights-of-Way
- Assist in Public Information Program
- Implement Equal Opportunity Compliance Program
- Request Deviations
- Manage Claims Avoidance

The responsibilities of the DESIGN CONSULTANT during the Bid Phase, Construction Phase and the Startup and Closeout Phases are described in Chapters 18, 19, and 20 of Book 1.

6.2 Purpose

These Water CIP Guidelines establish the DESIGN CONSULTANT's deliverable milestones, define the contents of each deliverable package and describe the reviews to be conducted by the Water Department during preparation of construction drawings and the specification for the facilities necessary to implement the Water Department CIP.

6.2.1 Submittal Packages

A list of submittal packages for each project appears in Table 5-1 in Chapter 5, QA/QC Program.

6.2.2 Reviews Conducted

Reviews required of the DESIGN CONSULTANT's staff and those normally conducted by the Water Department are shown in Table 5-1 in Chapter 5, QA/QC Program. The table also shows the timing of each review.

6.2.3 Descriptions of Deliverables

DESIGN CONSULTANT deliverable packages are described in paragraphs 6.6 through 6.10 of this chapter.

6.3 Initial Project Scope

Design of facilities, as part of the Water Department CIP, are based on the contract scope of services described in the contract agreement between the City and the DESIGN CONSULTANT, the project described in the predesign report and in these Guidelines.

6.4 Deviations From Initial Scope

Occasions may arise when the DESIGN CONSULTANT desires to deviate from the project scope of services described in paragraph 6.3 above. Procedures for the DESIGN CONSULTANT to request such deviations are described in paragraph 1.6 of Chapter 1, Introduction.

6.5 Submittal Guidelines

The DESIGN CONSULTANT submits progress submittals or milestone deliverables for the City to the CIP Project Manager in accordance with the terms of the contract agreement between the DESIGN CONSULTANT and the City, or with the Guidelines in Chapter 2, Administration.

These deliverable packages are submitted in accordance with the project schedule included in the agreement between the DESIGN CONSULTANT and the City.

6.6 Basis of Design Report

When included in the DESIGN CONSULTANT's contract scope of services, the Basis of Design Report (BODR) is to be developed at the outset of the design phase. Some less complex pipeline or pressure control station projects may not require a BODR. The BODR is normally preceded by a Predesign Report, which includes:

- An assessment of existing conditions
- A determination of future requirements
- The identification of major alternatives (including facility sites, alignments, configurations, processes, materials and construction methods)

The BODR provides a concise, definitive description of the alternatives evaluated and the facilities recommended for detailed design. It typically includes a presentation of design criteria, summary descriptions of major systems, preliminary drawings, and supporting information. It also provides an expanded description of the recommended design, including critical processes, materials of construction, key design features, volumes or flow rate pressure needs or constraints, and facility arrangements at or along the project site.

The BODR serves the following specific purposes:

- *Technical Guide for Conducting Final Design*. The BODR provides the basic outline of plans for each design discipline (process, civil, general mechanical systems, structural, electrical, instrumentation and control, and architectural). Because it presents preliminary information on all aspects of the design, it serves as a technical guide for completing the final design.

- *Document for Review*. The draft BODR provides a document for formal in-house review by the DESIGN CONSULTANT and the Water Department. Its preparation requires coordination with the Water Department to select alternatives, resolve technical issues, define the process, define requirements for ancillary facilities, establish space and support requirements, define requirements for future operation and maintenance, and define architectural concepts, among other steps. Changes resulting from these reviews are incorporated into the final BODR which, upon approval by the Water Department, becomes the basis for preparing the detailed design documents. The final BODR is used as a baseline for defining scope changes.

- *Convenient Reference Guide for the Water Department and DESIGN CONSULTANT*. In addition to its use by the project design team, the BODR is distributed to Water CIP management, design staff, and operations and maintenance staff as a convenient guide for review, coordination, and reference.

- *Definition of Scope for Subconsultants*. Because it defines overall work requirements, the BODR can be used as a tool to establish the scope of work for DESIGN CONSULTANT subconsultants participating in the final design.

- *Tool for Interdisciplinary Communication*. The BODR establishes a baseline document for discussion between disciplines. Summarizing essential project-related information in one document, the BODR optimizes communication between disciplines.

Figure 6-1 presents a typical BODR outline of a pumping station or storage facility project. For a pipeline or pressure control facility project, the outline would normally include only Sections 1 through 4, as Figure 6-1 shows.

Figure 6-1
Typical BODR Outline

Section	Title
1.	Introduction
	Introduction
	Scope of work
2.	Evaluation of Alternatives
	Description of Alternatives Evaluated
	Comparison of Alternatives
	Summary and Recommendations
3.	Description of Process Design Criteria
	Process Design Criteria
	System Descriptions
	Hydraulic Design
4.	Geotechnical Investigations and Design Criteria
	Design Codes and Standards
	Seismic Protection
	Slope Stability (if applicable)
5.	Site Development and Civil Design Criteria
	Design Codes and Standards
	Building Arrangements
	Roads, Parking and Paving
	Process and Yard Piping
	Drainage and Erosion Control
6.	Structural Design Criteria
	Design Codes and Standards
	Design Loads
	Reinforced Concrete and Foundation Design
	Structural Steel Design
7.	Architectural Design Criteria
	Building Codes and Standards
	Building Architecture Concept
	Noise Control

Figure 6-1
Typical BODR Outline
continued

Section	Title
8.	General Mechanical Systems Design Criteria Design Codes and Standards Mechanical Process Equipment and Piping HVAC Corrosion Protection Plumbing Codes Fire Protection
9.	Electrical Design Criteria Design Codes and Standards Power Distribution Lighting Communications Standby Power Requirements
10.	Instrumentation, Control and Monitoring System Design Criteria Design Philosophy Hardware Requirements Computer Interfaces Telemetry/Radio Software Control Strategies
Appendix A	Preliminary Construction Contract Drawing List
Appendix B	Preliminary Drawings Process Flow Diagram Site Plan(s) Hydraulic Profile
Appendix C	Calculations
Appendix D	Topographic Survey

6.7 30% Design Submittal Package

6.7.1 Pumping Station or Storage Facility Projects (30%)

1. Comments from BODR review incorporated.

2. All reviewed calculations completed to date.

3. Complete list of construction contract drawings.

4. Table of contents for specifications.

5. Process control strategies complete.

6. Geotechnical report.

7. Cost estimate at 30% completion level.

8. Civil Drawings:
   - Existing utilities plotted; existing facility horizontal controls, and elevations confirmed with current survey.
   - All major system structures located.
   - Preliminary drawings include site layout, yard piping, and major grading elements.

9. Architectural Drawings:
   - Preliminary architectural design completed and ready for approval. Show floor plans, exterior elevations, and roof plans of buildings.

10. Landscape Architectural Drawings:

    - Preliminary landscape architectural design completed and ready for approval. Show hardscape, planting areas, grading and berming. Plant palette described.

11. Structural Drawings:
    - Layout for structural design established.
    - The main structural system and detailed design approach for each structural component established.
    - Layout plan drawings started.

12. Mechanical Drawings:
    - General arrangement layout of major equipment completed.
    - All major equipment, pipe sizes, work clearances, equipment spacing, and access shown.
    - System flow diagrams complete.

13. Electrical Drawings:
    - Preliminary single-line diagrams of major distribution systems and of motor control centers prepared.

- Preliminary site layouts showing locations of switchgear and main motor control centers prepared.
- Partial equipment control schematic diagrams started.

14. Instrumentation P&IDs depicting:
    - General control philosophy.
    - Type of instrumentation and control philosophy.
    - All primary and secondary control devices (elements, transmitters).
    - All instrumentation (primary, secondary, panel and computers) shown but not tagged.
    - Area designation drawing and equipment numbering system finalized.

6.7.2 Transmission Pipeline, Distribution Pipelines, and Pressure Control Station Projects (30%)

1. Comments from BODR review incorporated when applicable.

2. Hydraulic calculations complete and reviewed.

3. List of special conditions prepared.

4. Geotechnical report (if alignment is finalized).

5. Cost estimate at 30% completion level.

6. Drawings:
    - Complete cover sheet listing all construction contract drawings.
    - Plan view on all plan and profile drawings with existing utilities, existing structure, existing roadways shown. Profile indicating existing ground surface elevations directly above the pipeline alignment, and size of existing utilities (showing size and elevations, if known) crossing the pipeline alignment.

6.8 Description of 75% Design Submittal Package

6.8.1 Pumping Station or Storage Facility Project (75%)

1. Comments from all 30% design submittal reviews incorporated.

2. All calculations completed, reviewed, and bound.

3. Complete list of construction contract drawings.

4. Complete guide specifications set including drafts of DESIGN CONSULTANT development sections.

5. Process control strategies complete.

6. Geotechnical report.

7. Cost estimate at 75% completion level.

8. Preliminary construction schedules per paragraph 3.6 in Chapter 3 of Book 1.

9. Civil Drawings:
   - Grading plans and demolition plans essentially complete.
   - Plan and profile sheets essentially complete.

10. Landscape Architectural Drawings:
   - Plant material legend complete. Irrigation plan partially complete: meter, mainline, backflow devices shown and all equipment has been selected.

11. Architectural Drawings:
   - Floor, roof and reflected ceiling plans essentially complete.
   - Elevations and sections essentially complete.
   - Door, window and finish schedule partially complete.

12. Structural Drawings:
   - Foundation plans essentially complete.
   - Other plans and sections and details partially complete.

13. Mechanical Drawings:
   - General arrangement drawings essentially complete.
   - Sections and details partially complete.
   - Schedules partially complete.

14. Electrical Drawings
   - Power block diagrams, single-line diagrams and motor control diagrams essentially complete.
   - Power and control layouts partially complete.
   - Panel, duct-bank, pull box, and cable/conduit schedules partially complete.
   - Electrical equipment elevations partially completed.
   - Lighting plans partially completed.
   - Grounding plans partially completed.
   - Electrical details partially completed.

15. Instrumentation
   - P&IDs complete and tag numbers shown.
   - Process control strategies essentially complete and tag numbers included.
   - Panel layout drawings and details partially complete.

6.8.2 Transmission Pipeline, Distribution Pipeline, and Pressure Control Station Projects (75%)

1. Comments from all 30% design submittal reviews incorporated.

2. All calculations completed, reviewed and bound.

3. Initial draft of special conditions.

4. Geotechnical report.

5. Cost estimate at 75% completion level.

6. Preliminary construction schedules per paragraph 3.6 in Chapter 3 of Book 1.

7. Drawings:
   - Cover sheet and legends complete.
   - Plan and profile drawings essentially complete.
   - Section and details partially complete.
   - Traffic plans partially complete.

8. Complete guide specifications set including drafts of DESIGN CONSULTANT development sections.

6.9 Description of 90% Design Submittal Package

1. Comments from all 75% design submittal reviews incorporated.

2. All calculations completed, reviewed and bound.

3. Geotechnical report updates.

4. Electrical system report for pumping stations.

5. Cost estimate at 90% completion level.

6. All drawings in all disciplines complete.

7. Final construction schedule per paragraph 3.6 in Chapter 3 of Book 1.

8. All specification sections essentially complete. No square brackets or Notes to Specifiers remain.

6.10 Description of Final Submittal

The final submittal consists of camera ready copy of all drawings and specification sections necessary for a complete construction bid package. All DESIGN CONSULTANT's in-house review comments and all Water Department review comments are addressed and all disagreements and open issues are resolved prior to submittal of these documents to the CIP Project Manager.

6.11 Water CIP Reviews

6.11.1 Intradisciplinary Progress Reviews (BODR, 30%, 75%, and 90%)

The Water CIP conducts Intradisciplinary Progress Reviews of each project on the BODR, 30, 75, and 90 percent level of design completion packages. This review is a scrutiny of calculations, drawings, specifications and other data performed by a team of experienced reviewers in each discipline included at project implementation. They evaluate the products and prepare written comments. The DESIGN CONSULTANT's Project Manager submits documents for review. The DESIGN CONSULTANT responds to all comments, suggestions and recommendations on the CIP Review and Comment spreadsheet, and incorporates the approved recommendations into the design prior to the next submittal.

6.11.2 Operation and Maintenance Reviews (30%, 75%, and 90%)

A. Responsibilities

The Operation and Maintenance (O&M) Reviews are conducted by City personnel responsible for operation and maintenance of the completed facility.

City Operation and Maintenance staff conduct the O&M Review on each project at the 30, 75, and 90 percent design complete stages. The DESIGN CONSULTANT responds to all comments, suggestions and recommendations on the Review and Comment Form and incorporates the approved recommendations into the design prior to the next submittal.

B. Review Issues

Items to be considered during an O&M Review include:

- Can a maintenance person access equipment which may require attention? Is there laydown room for equipment components and tools? Is there room for removal of equipment?
- Has standby equipment been provided for use when critical equipment must be removed? Are isolation valves provided?
- Has consideration been given to sole source procurement for units of equipment which are already in use at the site to minimize inventory of spare parts?
- Does the process control strategy meet the needs of the operational staff?
- Does the O&M staff have favorable experience with the equipment specified?
- Does the facility have any unsafe areas? If unsafe areas cannot be eliminated, are they clearly indicated?
- Does the location of equipment and circuit breakers or motor control centers provide for safe repairs?

6.11.3 Bidability/Constructability Review (90%)

A. Objectives

The Bidability/Constructability Review is a scrutiny of the drawings and specifications from the Construction Contractor's perspective.

The review is intended to examine the Contract Documents for clarity and completeness and to verify that the facility shown on the drawings and specification is buildable and free from problems that may increase costs unnecessarily. Features that are unnecessarily complex or difficult to build, or specifications that require unneeded exotic materials or custom fabrication techniques, are examples of unnecessarily high cost features. Ambiguous or ill-defined requirements that could lead to requests for clarifications and change orders are detected and corrected in this review. Reviewers scrutinize the General Conditions, General Requirements, General Provisions, Technical Specifications and drawings to verify the presence of provisions for the Construction Contractor to properly plan, control, and conduct the work and to verify that unnecessarily complex, difficult or expensive features are not a part of the design.

B. Responsibilities

The CIP Project Manager conducts the Bidability/Constructability Review at the 90% level of design completion. City staff participate in the review.

The DESIGN CONSULTANT's Project Manager responds to the suggestions and comments from the Bidability/Constructability Review. The CIP Construction Manager passes all the review suggestions and comments, the responses from the DESIGN CONSULTANT's Project Manager, and his/her own comments and recommendations on to the CIP Project Manager. The CIP Project Manager reviews the CIP Construction Manager's comments and recommendations, and approves or rejects each. The CIP Project Manager forwards approved items to the DESIGN CONSULTANT. The DESIGN CONSULTANT then incorporates the approved recommendations into the design.

C. Review Issues

Items to be considered during a Bidability/Constructability Review include:

- On projects with contracts that overlap in time or in use of the same site, check that each contractor's responsibilities, constraints and work boundaries are clearly specified and that the Contract Documents clearly reflect the presence of the work of other contractors.

- Check that delivery, storage and installation responsibilities for Owner-purchased equipment and materials are clearly spelled out.

- Check to see that reasonable space is provided for each Construction Contractor's operations. Temporary rights-of-way must be shown. Space allocations must be explicit in the Contract Documents.

- Compare the drawings and the specification: Can all requirements of the specification be reasonably accomplished?

- Verify that the salient features upon which substitutes and "or equals" will be judged are clear.

- Special provisions in the specification must include allowable durations of equipment outage when the Construction Contractor must tie into existing operating equipment. All sequencing requirements must be clear.

- Verify that major construction components are buildable with usual construction methods unless a compelling reason exists to specify otherwise.

- Verify that the specification and drawings are clear about temporary operating facilities or special conditions, limitations or restrictions imposed by the site.

- Review the configuration of building components for unnecessary construction difficulties.

- Consider whether the allowed construction duration is reasonable.

- Identify any conflicts, ambiguities or omissions that may result in change orders.

6.11.4 Value Engineering Review (30%)

A Value Engineering (VE) Review may be conducted by a third party VE team under the direction of the City. Value engineering systematically analyzes a facility during design to ensure that its function can be achieved at the lowest overall cost without sacrificing quality. VE Reviews, if conducted, are at the 30% level of design. If required, the DESIGN CONSULTANT's Project Manager prepares project and information and provides technical support for the VE team, within design budget constraints, and makes a presentation to the VE team at the orientation session early in the VE process.

On the last day of the workshop, the recommendation phase begins with the VE team making an oral presentation of its findings to the DESIGN CONSULTANT's Project Manager and the CIP Project Manager. This presentation includes a discussion of each recommendation and potential cost savings.

A copy of all handwritten information generated by the team during the workshop is given to the DESIGN CONSULTANT's Project Manager and the CIP Project Manager so that they can begin an immediate review of the recommendations at the conclusion of the workshop. The DESIGN CONSULTANT thoroughly reviews the VE recommendations and prepares written responses to each proposal. The CIP Program Manager reviews the VE recommendations and the responses for impact on the program intent. The City accepts or rejects each proposal recommendation. Every recommendation rejection is supported by strong, valid reasons including, where feasible, life-cycle cost comparisons.

The DESIGN CONSULTANT implements accepted value engineering recommendations and accepted design suggestions as soon as possible.

6.12 Design Review Comments

The Water CIP's design submittal review process involving the DESIGN CONSULTANT consists of the following steps:

1. The DESIGN CONSULTANT makes an oral presentation describing the project design effort (e.g., 30, 75, and 90% design levels) to Water CIP project review personnel.

2. The CIP Project Manager collects and compiles the review comments from all reviewers and transmits the compiled review comments to the DESIGN CONSULTANT.

3. The DESIGN CONSULTANT prepares and submits a written draft response containing a proposal for the disposition of each review comment. The CIP Project Manager reviews this draft response and takes one of the following actions:

   - Accepts the DESIGN CONSULTANT's response as stated.

   - Resolves minor conflicts with the DESIGN CONSULTANT's response by telephone, fax, e-mail, or other similar means.

   - Arranges a meeting with the DESIGN CONSULTANT to resolve major conflicts with the DESIGN CONSULTANT's response.

4. The DESIGN CONSULTANT then prepares and submits a final written response to indicate the agreed-upon disposition of each review comment.

5. The DESIGN CONSULTANT meets with the CIP Project Manager for a final review of the responses to review comments. The CIP Project Manager issues a signed confirmation of the agreed-upon project design development and authorization to proceed to the next level of design.

6. The DESIGN CONSULTANT incorporates all review comments into the design documents as indicated in the final written response, and proceeds to the next level of design.

Book 1

General Design Guidelines

Chapter 7
Telemetry/Control

City of San Diego Water Department
Capital Improvements Program

Chapter 7
TELEMETRY/CONTROL

7.1 Intent of the Telemetry/Controls Design Guidelines

These Water CIP Guidelines provide the DESIGN CONSULTANT with an overview of the existing telemetry/control system and with design concepts, formats, methodologies, procedures and quality to be applied in the design of Water CIP projects. Refer to Book 2 for specific telemetry/control design criteria guidelines related to pumping stations, water storage facilities and pressure control stations.

7.2 Descriptions of Existing Telemetry System and Planned Future Upgrades

7.2.1 Existing System

The supervisory control and data acquisition (SCADA) system installed at the Alvarado Water Treatment Facility (AWTF) consists of a PC-based Wonderware Intouch software that interfaces with a Siemens 560 PLC for control and monitoring. The programmable logic controller (PLC) interfaces with tone telemetry which communicates with various remote sites via Pacific Bell leased telephone circuits throughout the city and areas of San Diego County. This system will continue to operate until a planned new SCADA system is completed and operational, by about the end of summer 1999.

7.2.2 Planned Future Upgrades

The new SCADA system being developed for the AWTF will greatly enhance the control and monitoring capabilities at the water treatment plant and improve communication with remote sites. The microwave system currently ends at the Chollas Operations Station will be linked to the AWT central control system by Pacific Bell ADN leased telephone circuits as shown in Figure 7-1. Figure 7-2 shows the block diagram of the remote SCADA system currently being planned for installation.

7.3 Requirements for New SCADA RTU

As the City expands its services through implementation of Water CIP projects, additional SCADA remote terminal unit (RTU) will be interfaced with the existing telemetry system in three different ways:

7.3.1 Case 1 – Backbone Spurs

The RTU will be connected to one of the five microwave backbone repeaters via 900 MHz Microwave Data System (MDS)/Multiple Address System (MAS) radios.

Figure 7-1
Planned SCADA Upgrades

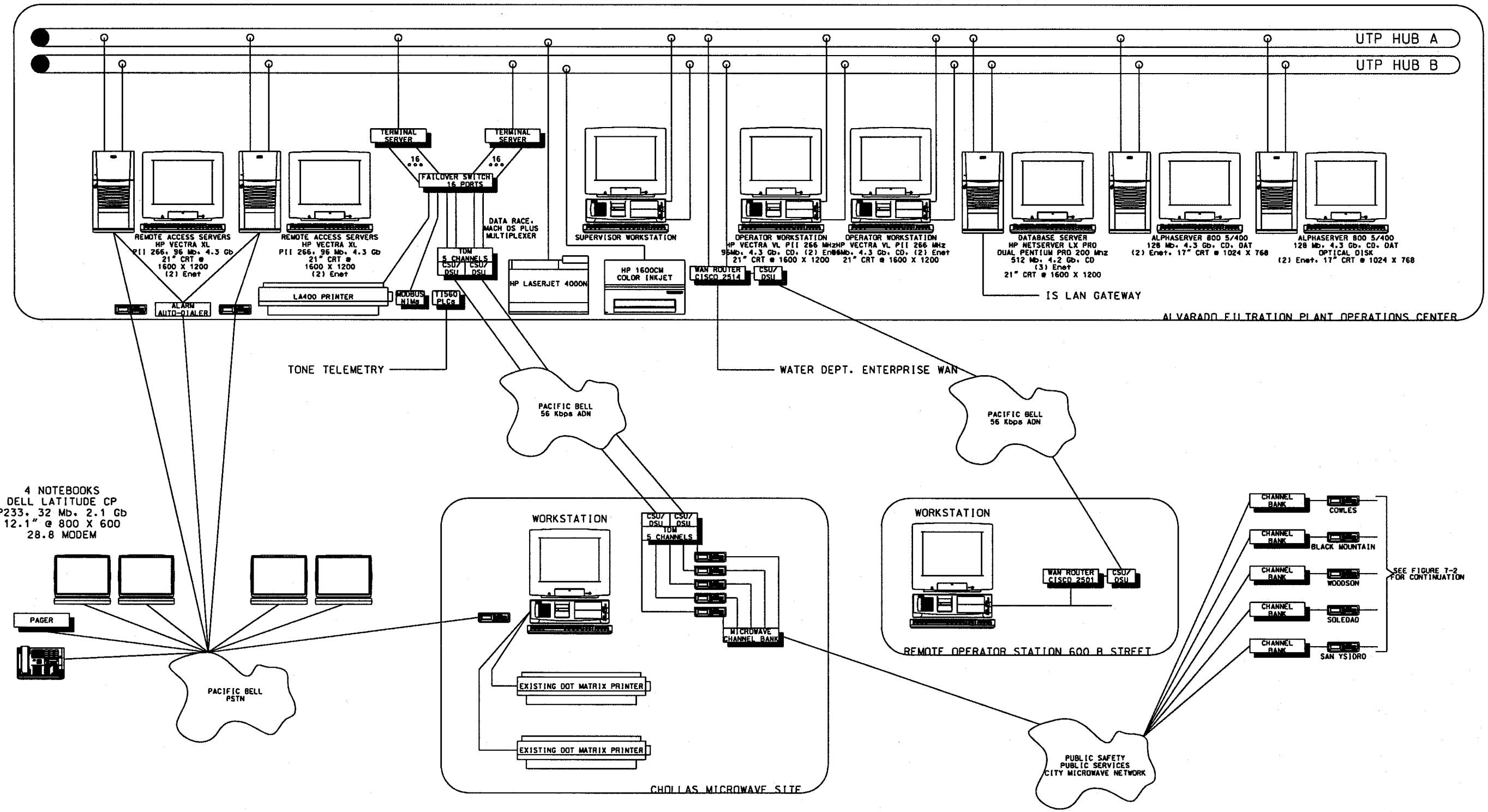
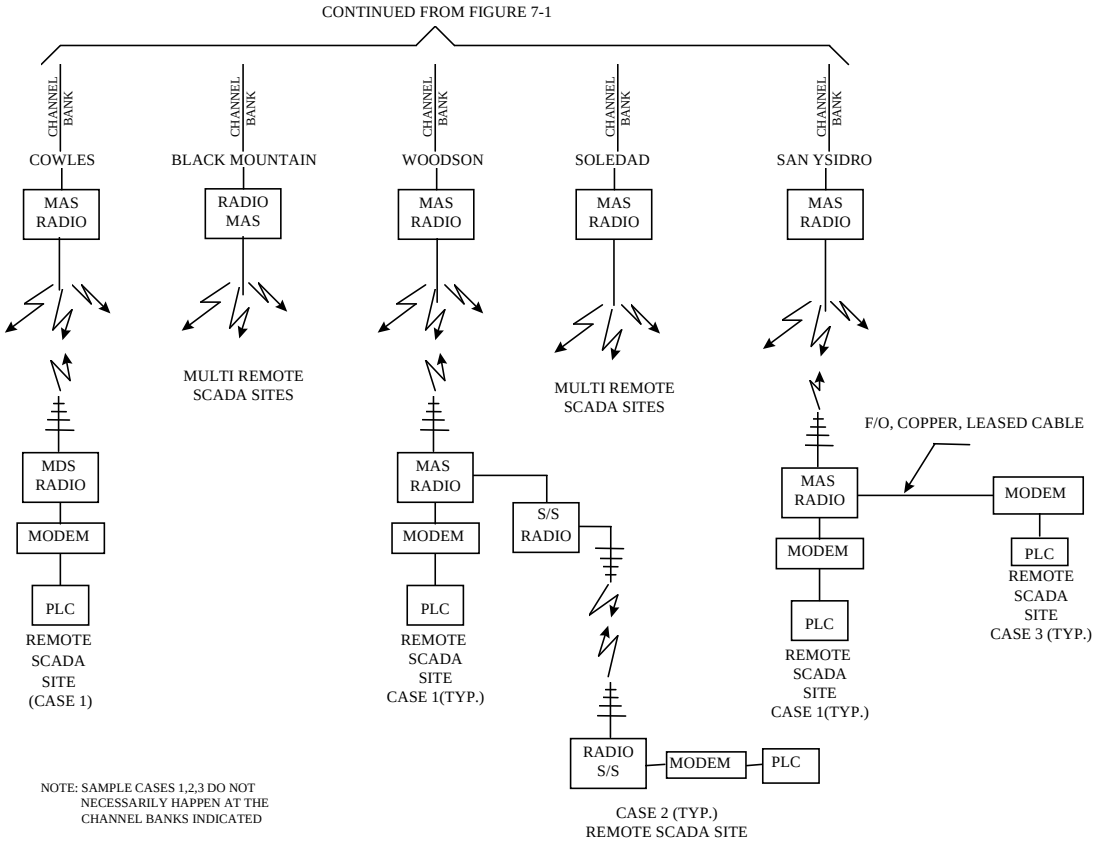


Figure 7-2
Planned Remote Telemetry Upgrades



7.3.2 Case 2 – Spur Repeaters

Where the new SCADA RTU location does not have a direct microwave path to one of the five backbone repeaters, a 900-MHz microwave spread spectrum radio will be used to transmit to a remote SCADA location having a path to a backbone repeater.

7.3.3 Case 3 – Blocked SCADA Remote

Where a remote SCADA location does not have direct microwave path to one of the five backbone repeaters or a path to any other remote SCADA location, a land line (leased line, fiber optic or copper cable) will be used to connect to an adjacent remote SCADA location or backbone repeater, or directly to the Chollas Operations Station, whichever is the most economical and feasible solution.

7.4 General Requirements for SCADA RTU Control Panels

7.4.1 RTU Control Panels

The RTU control panels contain the intelligence to monitor and control of operations at remote facilities and the telemetry necessary to communicate with the AWTF central control system. The extent of the telemetry/radio system required is specified in the Predesign Report for the specific remote facility and ranges from simple pressure reducing station monitoring to complex PLC controlled pump operation. The DESIGN CONSULTANT's work requires close coordination with the City's Telemetry, Power, and Control Group.

7.4.2 Complex Control Logic at Remote Sites

Remote facilities requiring complex control logic a PLC have it provided in the control panel. The PLC is a Modicon TSX Quantum with redundant power supplies. The existing PLC programming software is Taylor ProWork NxT running on a Windows-based PC. For remote communication with the central control center, the PLC is provided with a built-in RS-232 serial port interfacing with the microwave radio transceiver, leased line modem or fiber optic modem as applicable for the remote site. Modbus is the standard protocol for communication with all the remotes.

7.4.3 Process Monitoring at Remote Sites

In remote facilities where simple process monitoring is required, e.g., pressure control stations, the PLC is Modicon Micro PLC model 110CPU61203. The Micro PLC Modbus or equal serial communication port must be connected to the radio transceiver, leased line modem or fiber optic modem as required.

7.4.4 Additional Serial Communication Ports

Additional serial communication ports may be required at a remote site PLC to interface with instruments or equipment furnished with serial MODBUS, MODBUS+, or similar protocols, e.g., turbidometers valve electric actuators, access monitoring terminals, etc. When the PLC communication port capability is exceeded, a bridge/multiplexer is to interface between these instruments and the PLC.

7.4.5 Remote RTU PLCs Programming

The Construction Contractor programs the remote RTU PLC. The control logic programmed in the PLC should agree with the control philosophy stated in the Predesign Report and should be coordinated with the City Water Department Telemetry, Power and Control Group. The remote RTU is polled by the central control system. The Construction Contractor programs the transmitted data in a block of contiguous data registers to facilitate data polling and contain direct inputs (discrete and analog) and calculated states and values. The central control software shall have the capability of downloading conversion constants so that local display can show actual units of a measurement (psi, gpm, etc.)

7.4.6 Communications Methods

Microwave communication is the preferred means between a SCADA RTU and the central control system. Where microwaves are blocked by buildings or by natural terrain, dedicated leased lines are used. The telephone modem specified by the DESIGN CONSULTANT to interface the PLC with the telephone system must be compatible with the existing and/or planned system. The PLC must also support and initiate dial-up phone communications based on logic in the PLC (e.g., an alarm condition occurs).

7.4.7 Man-Machine Interface

The RTU control panel has an Operator Interface (OI) with keypad providing color graphics and operator process control, thus minimizing the number of discrete switches and components required on the front panel. The OI displays process graphics especially configured for the remote location and an alarm window showing the most recent alarms and an alarm summary page.

7.4.8 Uninterruptable Power Supply

The RTU control panel also has a 120 Vac uninterruptable power supply (UPS) with battery backup, sized to power the control system for a minimum of 1 hour after a power failure, and 24/12 Vdc redundant power supplies to power the field transmitters and transceiver. The PLC memory size, the power supply, the number of input/output (I/O) points and wiring terminals must have a minimum of 20 percent active spare capacity. An additional 30 percent space capacity for growth must be provided in the PLC chassis and for field terminals and wiring in the control panel.

7.4.9 Site Access System

The SCADA RTU interfaces with the site access monitoring system designed to monitor and log operator entrance and exit to and from the remote site and prevent unauthorized entrance. A programmable card swipe terminal with keypad is installed at the site entrance and connected to the PLC via a MODBUS serial port or similar. This identifies the person that has entered the facility for the SCADA system to log at the Central Control System. The site access terminal is stand-alone and sends data to the central control center upon request. Intrusion switches installed at the remote site access are hardwired to the PLC.

7.5 Design Documents Requirements

7.5.1 Process and Instrumentation Diagrams

Process and instrumentation diagrams (P&IDs) indicate each instrument, monitoring and control device and communication device for the remote station, including components of the subsystems of the remote station. P&IDs follow the instrumentation and control (I&C) standards listed in paragraph 7.5.3 and industry standard practices that promote consistency, clarity and informative illustrations. Several chapters in Book 2 show samples of P&IDs.

7.5.2 P&ID Support Documents

Support documents provide a constructable and biddable completed design and include the following:

1. PLC and RTU input and output point summary lists
2. Instrument summary list
3. Control loop descriptions
4. Instrumentation installation detail drawings
5. Panel layout detail drawings
6. SCADA system communication block diagram
7. Communication interface detail drawings

7.5.3 Instrumentation and Controls Standards

Numerous standards apply to I&C work. The DESIGN CONSULTANT must be familiar with and follow these major standards and recommended practices in designing the I&C system.

Reference	Title
API RP550	Manual on Installation of Refinery Instruments and Control Systems
IEEE 100	Dictionary of Electrical and Electronic Terms
IEEE 472	Guide to Surge Withstand Capability (SWC) Tests
ISA S5.1	Instrumentation Symbols and Identification
ISA S5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
ISA S5.4	Instrument Loop Diagrams
IS RP7.3	Quality Standard for Instrument Air
ISA RP12.6	Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations
ISA S18.1	Annunciator Sequences and Specifications
ISA S20	Specification Forms for Process Measurement and control Instruments, Primary Element and Control Valves
ISA S51.1	Process Instrumentation Terminology
NEMA 250	Enclosures for Industrial Controls and Systems
NEMA ICS	Industrial Control
NFPA 70	National Electrical Code (NEC)
NFPA 72	National Fire Alarm Code

7.5.4 Contract Documents

The DESIGN CONSULTANT provides drawings and specifications, including support documents, in hardcopy and electronic format. Calculation records are provided on 8½ x 11-inch hardcopy.

7.5.5 Input and Output Summary Lists

The DESIGN CONSULTANT compiles a list of all input/output (I/O) points required for the I&C system. The tabulation lists separately each point required to meet immediate and future process needs. I/O are in the same logical order of the P&ID drawings referenced. Spare points are not annotated. These data is provided in hardcopy and electronic format. The I/O list indicates tag/loop number, process description, P&ID drawing reference, I/O type (analog, discrete, digital link), associated number, and a remarks column to present clarifications as needed (e.g., if a pulse input is required, future point requirement). Each instrument and I/O summary is organized by RTU/PLC and includes the following information:

1. Tag number of I/O point
2. Description of I/O point
3. P&ID drawing number on which the I/O point is indicated
4. Associated specification section
5. I/O type (analog, discrete, digital link, etc.)
6. Associated control panel number, RTU or PLC
7. Applicable installation detail
8. Applicable remarks or comments not covered elsewhere
9. Total number of digital input, digital output, analog input and analog output points associated with each RTU and PLC

7.5.6 Instrument Summary

The DESIGN CONSULTANT compiles a list of all required instruments. Instrument summaries list each instrument tag and loop number, specification number, associated instrument panel name/number, I/O list (including tag and loop number, process description and P&ID drawing reference), installation detail number, instrument range, calibrated span, instrument setpoints, trip points, NEMA rating, material requirements, and all other data needed to precisely define the instrument requirements. These data are presented on 8½ x 11-inch hardcopy and electronic format suitable for inclusion on the specification.

7.5.7 Control Logic Descriptions

The DESIGN CONSULTANT prepares a control strategy for each instrument loop that controls equipment. The DESIGN CONSULTANT also prepares overall process control strategies which interlock numerous individual control strategies to provide an efficient operator interface. Control and process strategies list all applicable inputs and outputs, generally describe what the strategy does, and explicitly describes how each element in the control loop functions. Each strategy describes monitoring, alarm, and control functions for both local and remote control. Each strategy describes in detail the sequence of operations required to start or stop a device under normal and abnormal conditions and quantifies all process trip points, set points and timers. Strategies are annotated using the instrument and equipment tag numbers shown on the P&IDs, and reference the relevant P&ID . Each strategy describes what should happen

under abnormal conditions such as an I&C system failure, transmitter failure, abnormal process values, and loss of communication between RTUs or between PLCs. Shutdown sequence descriptions cover normal, equipment malfunction and emergency shutdown modes.

7.5.8 Functional Block Diagrams

The control logic descriptions are supplemented with a functional block diagram prepared by the DESIGN CONSULTANT. The diagram shows function blocks connected in sequential order reflecting the sequence of events in the process. The function block contains the logic step that must be performed before the next logic step can start. The connecting line arrowheads show the direction of the logic step.

7.5.9 Software Logic Program

The DESIGN CONSULTANT requires the Construction Contractor to program the PLC (see paragraphs 7.4.2 and 7.4.5). The software logic program is in ladder format with annotations on each rung describing the logic step performed. The PLC program is submitted in hardcopy and electronic format.

7.5.10 Field Instrumentation

All field instruments are of the latest proven industrial quality design and manufacturing. Each instrument must have a history of successful use in its specified application. If the failure of any single field instrument could jeopardize the continuous operation of the process, redundant instruments must be designed for a fault-tolerant configuration. If a field instrument is available in an intelligent version, the DESIGN CONSULTANT determines the intelligent device to be used. Analog signals are 4 to 20 mAdc or 1 to 5 Vdc inside panels.

7.5.11 Instrument Specifications

The DESIGN CONSULTANT compiles instrument specifications for each type of field and panel-mounted instrument to be provided. These data are presented in 81/2 x 11-inch hardcopy and electronic format suitable for inclusion in the specification. See Book 4, Division 13.

7.5.12 Data Sheets

The DESIGN CONSULTANT requires the Construction Contractor to prepare and submit data sheets conforming to ISA S20 for the specific equipment used.

7.5.13 Loop Diagrams

The DESIGN CONSULTANT requires the Construction Contractor and its instrument suppliers to prepare and submit loop diagrams conforming to ISA 5.4. The Construction Contractor shall provide loop diagrams conforming to the expanded format of ISA 5.4 for all loops. The loop diagrams incorporate all instruments and loops for the I&C system.

7.5.14 Electrical Layout Drawings

Electrical layout drawings show each field instrument with electrical connections and all instrument panels. Particular care is taken to ensure that adequate space is reserved for instrument panels. The DESIGN CONSULTANT shows electrical signal cables and raceways on the electrical layout drawings. Licensed electricians install all electrical signal cables and raceways.

7.5.15 Panel/Layout Detail Drawings

Layout detail drawings for control panels are prepared by the Construction Contractor. Each face-mounted device shows a reference number coordinated with the instrument and input/output summary. Front-view drawings show maximum cabinet dimensions, but show minimal detail dimensions because the specific equipment dimensions and clearances are not generally known during design. The drawings show nameplate and annunciator schedules.

7.5.16 Control Panels

Control panels are installed in enclosures that are environmentally suitable for the area. Control panels that require NEMA 3 or 4 rating are provided with window kits as specified on the contract drawings to preserve panel integrity and allow operator viewing. Lens covers for indicating lights on all control panels are colored as the DESIGN CONSULTANT determines.

7.5.17 Criteria

Specifications developed by the DESIGN CONSULTANT promote commonality of hardware, the use of proven and established hardware and software products, and the use of current technology to support upward compatibility with hardware and software products.

Industrial grade instrumentation and control devices are specified. Design emphasizes safety, process control, reliability, maintainability and economics.

Field-situated instrumentation devices are electronic. Individual equipment monitoring is performed by monitoring status contacts. Out-of-range or abnormal conditions are annunciated by visual alarms.

Controllers, instruments, and control panels are designed to accommodate all known immediate loads. The DESIGN CONSULTANT allocates all required space and resources needed for the installation of immediate and future equipment on control panels. Components are sized for both current and future control requirements. All instrument ranges use English system units for the measured variable of the process. In addition to meeting present needs, all control panels have a spare active capacity (e.g., I/O cards, memory, panel size, terminations, power supplies) of 20 percent. An additional 30 percent space capacity for growth must be provided in the PLC chassis, and for field terminals and wiring in the control panel. All control panels designed to accommodate future expansion have blank plates to cover cutouts.

7.5.18 Level of Automation

The DESIGN CONSULTANT confirms the level of automation of each process loop. All process equipment, including valve actuators, is operable from manual controls. Manual control stations are designed and located to enable the safe and judicious operation of process equipment if the I&C system becomes unavailable.

Book 1

General Design Guidelines

Chapter 8
Operation and Maintenance Manuals

City of San Diego Water Department
Capital Improvements Program

Chapter 8
OPERATION AND MAINTENANCE MANUALS

8.1 Introduction

This Guideline ensures that a consistent level of detail and content is provided in Operation and Maintenance (O&M) manuals developed under the CIP. The DESIGN CONSULTANT develops O&M manuals during the project construction phase and are based on detailed information provided by the Construction Contractor in accordance with the provisions of the Contract Documents.

8.2 Construction Contractor's O&M-Related Submittals

8.2.1 Specification Requirements

The DESIGN CONSULTANT ensures that the Contract Documents include provisions for the Construction Contractor to furnish adequate O&M information. Information is provided in each section of the Technical Specification in a form that can be understood by the City technical staff. The Construction Contractor presents O&M information in the following eight-part format:

1. *Equipment Summary.* The Construction Contractor completes an Equipment Record Form (see Figure 8-1) for each item of mechanical, electrical and instrumentation equipment installed at the facility.

2. *Mechanical Operational Procedures.* The Construction Contractor describes mechanical operational procedures for all installed equipment, as appropriate, including installation instructions, adjustment, startup, operation, load changes, calibration, shutdown, troubleshooting, disassembly, reassembly, realignment and testing.

3. *Preventive Maintenance Procedures and Schedules.* The Construction Contractor provides preventive maintenance procedures and schedules for all installed equipment, including periodic inspection, lubrication and calibration. Such procedures and schedules detail maintenance that can be performed on installed equipment, including its removal and replacement, and repairs that can be performed with the equipment in place.

4. *Parts List.* The Construction Contractor provides a complete parts list for all installed equipment, including a list of recommended spare parts for two years of continuous operation, a generic description and identification number for each part, addresses and telephone numbers of vendors from whom parts can be purchased, and cross-sectional or assembly-type drawings. Any instructions, parts lists or other items packed with or attached to the equipment when delivered are also provided.

5. *Wiring Diagrams.* The Construction Contractor provides complete internal and connection wiring diagrams for each installed component, if applicable.

6. *Machine Shop Fabrication Drawings.* The Construction Contractor provides approved machine shop fabrication drawings, complete with dimensions, for all installed component.

7. *Safety.* The Construction Contractor provides safety instructions and precautions to be taken when working on all installed equipment items.

8. *Documentation.* The Construction Contractor provides all warranties, affidavits and certifications required for all installed equipment items.

8.2.2 Submittal Formats

The DESIGN CONSULTANT ensures that the Technical Specification requires the Construction Contractor to provide O&M-related information in both hardcopy and electronic format. Hardcopies of O&M-related submittals must be prepared on 20-lb, 8-1/2 by 11-inch paper, bound in three-ring binders. All material is in black and white, suitable for xerographic reproduction. Drawings and diagrams are presented using standard paper sizes (8-1/2 by 11 inches or 11 by 17 inches). Where impractical to reduce drawings to these sizes, larger drawings are folded separately and placed in envelopes in the binders. Each envelope should bear suitable identification on the outside. Material is assembled and bound in the order specified, and each binder contains a table of contents and suitable index tabs.

The DESIGN CONSULTANT ensures that all electronic media for O&M-related submittals are also provided on compact disks (CDs). The Construction Contractor prepares all written documentation using word processing software in current use by the City. CAD drawings are developed using Intergraph's PC Microstation software. Information not presented in the City's current word processing software or Microstation format must be scanned. The CDs are organized by specification section, in accordance with the eight parts described in subsection 8.2.1.

The DESIGN CONSULTANT ensures that the Technical Specification provides a reasonable schedule for the submittal and approval of the Construction Contractor's O&M-related submittals. This schedule is established to (1) give the DESIGN CONSULTANT time to prepare the final O&M manuals in advance of the equipment being placed in operation, and (2) allow time to train City technical staff with the aid of the final O&M manuals. The schedule developed for the submittal of O&M-related documents depends on the complexity of each project and its duration.

Figure 8-1
Equipment Record Form

Project Name		Page _____ of _____
Equipment Description	Date Installed	Date Started
Equipment Location Tag No.	Cost	Estimated life
	Shop Drawing Transmittal No.	Specification Section
Equip. Manufacturer	Old Equip. No.	
Manufacturer Address		Phone
Local Vendor		Phone
Vendor Address		Phone

Break-In Maintenance Requirements (initial oil change, etc.)	D	W	M	Q	S	A	Hrs

Preventive Maintenance Requirements	D	W	M	Q	S	A	Hrs

Recommended Spare Parts		
Part No.	Part Name	Quantity

Electrical Name Plate Data			
Equip.			
Make			
Serial No.		ID No.	
Model No.		Frame No.	
HP	Volts	Amps	Hz
Phase	RPM	SF	Duty
Code	Insul Class	Temp Rise	Type
Name	Camo	Design	Type
Misc		Breaker Location	

Mechanical Name Plate Data			
Equip			
Make			
Serial No.		ID No.	
Model No.		Frame No.	
HP	RPM	CAP	Size
TDH	Imp Size	Design	CFM
PSI	Assy No.	Case No.	Shaft Size
Misc			

Form No. _____

Figure 8-1
Equipment Record Form *(continued)*

Lubrication Summary						
Description			Tag No.		Page _______ of _____________	
Lubrication Point						
	Manufacturer		Product	AGMAS	SAE	ISO
TYPE	1					
	2					
	3					
	4					
	5					
Lubrication Point						
	Manufacturer		Product	AGMAS	SAE	ISO
TYPE	1					
	2					
	3					
	4					
	5					
Lubrication Point						
	Manufacturer		Product	AGMAS	SAE	ISO
TYPE	1					
	2					
	3					
	4					
	5					
Safety Hazards						
Special instructions or warnings associated with this equipment:						

8.2.3 Design Consultant's Review of Contractor-Furnished O&M Information

The DESIGN CONSULTANT reviews O&M-related materials submitted by the Construction Contractor in accordance with the provisions of its contracted scope of work and the provisions of the Contract Documents.

8.3 O&M Manual Preparation and Organization

8.3.1 Preparation of the O&M Manual

The DESIGN CONSULTANT prepares the O&M Manual after acceptance of O&M-related submittals from the Construction Contractor. The O&M Manual is rationally organized for easy comprehension by Facility Operators. The final O&M Manual is provided to the CIP Project Manager both as hardcopy and on CDs.

8.3.2 Organization of the O&M Manual

The O&M Manual is organized in three parts:

1. Operational Information
2. Standard Operating Procedures
3. Maintenance Manual

8.4 Part 1 – Operational Information

Part 1, Operational Information, has sections corresponding to the principal elements of the project. The basic outline of each section of Part 1 is as follows:

Introduction and Overview
Components, Operation, and Controls

- Description of System Components
- Description of System Operations
- Description of System Controls
- Description of Auxiliary and Support Systems
- Equipment Design Information

Safety Procedures and Precautions

- Description of Safety Items, Warnings and Suggestions
- Lockout/Tagout Policy and Procedures
- Precautions When Working Around the Equipment or System
- Possible Safety Hazards (e.g., confined spaces, chemicals, tripping hazards)

Plans, elevations, cross-sections, and schematic figures supplement the descriptive text. The locations of equipment items, motor control centers and control panels is identified on these drawings. To aid in understanding, detailed technical information is, in general, provided in tabular format.

Attachment 8-1 gives a sample outline for Part 1 of the O&M Manual for a pumping system (pump station, pipeline and reservoir) project. The DESIGN CONSULTANT can modify and adapt this general outline as needed, subject to approval by the CIP Project Manager.

8.5 Part 2 – Standard Operating Procedures

Part 2, Standard Operating Procedures, provides detailed directions for the operation of equipment or groups of similar items. There is no need to develop separate operating procedures for identical equipment items. Information is organized in tabular format as described in paragraphs 8.5.1 through 8.5.6 and shown in Attachments 8-2 through 8-7, which are samples of the expected level of detail.

8.5.1 Troubleshooting Procedures

The troubleshooting guide provides a list of corrective actions to be taken by the Operator when a specific item of equipment or a system malfunctions (see Attachment 8-2).

8.5.2 Pre-Startup Procedures

The troubleshooting guide identifies orderly, step-by step procedures for normal work before individual pieces of equipment or a system are started (see Attachment 8-3).

8.5.3 Startup Procedures

The troubleshooting guide lists orderly, step-by step procedures for manual and automatic startup. For automatic startup, the procedures describe the actual physical steps which occur automatically so that the Operator can verify that the automatic procedure is progressing properly (see Attachment 8-4).

8.5.4 Routine Operations Procedures

The troubleshooting guide describes the routine duties of the Operator, including routine checking of recorded data (see Attachment 8-5).

8.5.5 Shutdown Procedures

The troubleshooting guide gives orderly, step-by step procedures for stopping individual items of equipment. The guide describes the ramifications of a shutdown, along with special precautions to be taken before starting a shutdown. The procedures differentiate, as applicable, between short-time shutdowns (minutes to hours) and extended shutdowns (days to months). The procedures discuss the effects of the shutdown on other equipment. The procedures also define lockout/tagout procedures (see Attachment 8-6).

8.5.6 Abnormal Condition Procedures

The troubleshooting guide describes orderly, step-by step procedures for responses to abnormal conditions, including emergency shutdowns, equipment and power failures, control system failures, and annunciated alarm conditions. It also describes remedial measures required to address each condition. If equipment or system shutdowns are part of the remedial measures, the Shutdown Procedures text should not be repeated, but the Operator should be referred to that subheading (see Attachment 8-7).

8.6 Part 3 – Maintenance Manual

The DESIGN CONSULTANT assembles the Maintenance Manual using detailed technical information provided in submittals from the Construction Contractor.

The Maintenance Manual gives the Operator additional detailed information about assembly, installation, alignment, adjustment, troubleshooting, preventive maintenance, corrective maintenance, lubrication schedules, parts lists, predicted lives of parts subject to wear and limiting conditions. The Maintenance Manual also includes, if applicable, outline, cross-section, and assembly drawings; engineering data; wiring diagrams; test data; and performance curves.

The Maintenance Manual is organized by sections following the CSI Specification numbers in the Contract Documents. Each section is separated by a labeled and tabbed divider. The table of contents should be followed by a tabulation that cross-references equipment number, equipment name, facility area, and associated specification number.

Each Maintenance Manual includes the completed Equipment Record Form shown in Figure 8-1.

Attachment 8-1
Sample Outline of Part 1, Operational Information
for Pump Stations and Pipelines

SECTION 1 PUMP STATION AND PIPELINE OVERVIEW
- Introduction
  - Purpose of this Document
  - Overview of the Pump Station and Pipeline
- Organization of this Volume

SECTION 2 RESERVOIR, PUMP ROOM AND MOTOR/CONTROL ROOM
- Introduction
- Components, Operations and Controls
  - Reservoir
  - Isolation Valves
  - Control Valves
  - Flow, Level and Pressure Control Equipment
  - Water Pumping System
  - Variable Frequency Drives
- Safety Procedures and Precautions

SECTION 3 AUXILIARY AND SUPPORT SYSTEMS
- Introduction
- Components, Operation and Controls
  - Flow Metering System
  - Compressed Air System
  - Ventilation System
  - Hoists, Monorails and Cranes
  - Sump Pumps
  - Electric Power Supply and Distribution System
  - Standby Power System
  - Site Security Systems
- Safety Procedures and Precautions

SECTION 4 PIPELINE AND SURGE CONTROL SYSTEM
- Introduction
- Components, Operation and Controls
  - Pipeline
  - Surge Control System
  - Combination Air Valves
  - Blow-Off Assemblies
  - Pressure Relief Valves
  - Cathodic Protection System
  - Interconnections
- Safety Procedures and Precautions

Attachment 8-2
Sample Troubleshooting Procedures
Davit Cranes

Observations	Probable Causes	Solutions
• Davit crane motor won't run.	1. Circuit breaker tripped	a. Reset circuit breaker
	2. Electrical connections damaged or loose	b. Inspect, repair and tighten as necessary
	3. Motor burnt out	c. Replace motor
• Davit crane motor runs but drum doesn't turn.	1. Broken drum spring pin	a. Replace spring pin
	2. Loose, stripped or broken gears	b. Inspect gears and repair as necessary
• Davit crane motor tries to turn but can't.	1. Poor voltage supply	a. Check voltage and rewire as necessary
	2. Unit overheated	b. Allow to cool
	3. Load too heavy	c. Lighten load
	4. Brake band too tight	d. Loosen brake and readjust
	5. Gears broken or locked	e. Inspect and replace as necessary
	6. Bearings broken or locked	f. Inspect and replace as necessary
• Oil leakage	1. Worn bearings	a. Inspect and replace as necessary
	2. Damaged oil seals	b. Inspect and replace as necessary
	3. Gasket damaged or leaking	c. Replace gasket or tighten set screwsOperational Reservoir

Attachment 8-3
Sample Pre-Startup Procedures
Pumping System

Location	Task	Steps
Operational Reservoir	1. Add water to the reservoir to elevation 20 ft MSL	a. Fill the reservoir to elevation 20 ft MSL.
Pump Room	1. Prime pump P-101	a. Open the vent on the highest point of the casing of pump P-101. b. Open suction valve HV-101A. c. Allow the liquid to flow from the vent hole until all air bubbles are vented, and then close the vent.
	2. Prime pump P-102	a. Open the vent on the highest point of the casing of pump P-102. b. Open suction valve HV-102A. c. Allow the liquid to flow from the vent hole until all air bubbles are vented, and then close the vent.
Motor/Control Room and Pump Room	1. Prepare each pump motor for the initial start	a. Ensure that the motor and control device connections agree with the wiring diagrams. b. Ensure that the voltage, phase, and frequency of the line circuit (power supply) agree with the motor nameplate. c. Check the insulation resistance as indicated in Part 3. d. Check the foundation, base and coupling bolts to ensure they are tight. e. Refer to the manufacturer's recommendations in Part 3 regarding use of the motor following storage. f. Check oil-lubricated bearings to be certain that bearing housings have been filled to the maximum level with the correct lubricant. g. Check the direction or rotation of the motor as described in Part 3. h. Ensure that all protective devices are connected and operating properly, and that all outlet accessories and access covers have been returned to their original intended positions. i. Ensure that all loosened or removed parts are reassembled and tightened to their original specifications. Ensure that all tools, chains, equipment, etc., are clear of the unit before energizing the motor. Ensure that all protective guards are in place over rotating parts. j. Ensure that the universal joints on the drive shaft are properly lubricated.

Attachment 8-3 (continued)
Sample Pre-Startup Procedures
Pumping System

Location	Task	Steps
Surge Control Tank and Pump Room		a. Ensure that the surge control system is functional and that the pump check valves have been properly installed and have received the prescribed initial adjustment in accordance with the manufacturer's recommendations.
Motor/Control Room	1. Start the seal water flow to the pump to be started	a. Open the seal water service isolation valve for the pump to be started.
Pump Room	1. For the pump to be started, ensure that the pump discharge isolation valve is closed	a. Close the pump discharge isolation valve for the pump to be started.
Reservoir	1. Introduce water to the reservoir	a. Refer to Section 1 for the operation of gates in the reservoir. The level should be monitored during the entire initial startup operation to ensure it is maintained within the normal operating range. The level may be monitored remotely at LIT-10 in Bubbler Control Panel CP-10.
Motor/Control Room	1.Start the motor of the first 150-hp pump	a. Ensure that the *HAND-OFF-AUTO* switch for the pump to be started is in the *OFF* position. b. Close the pump circuit breaker. c. If the pump motor leads have been disconnected while the pump was out of service, bump the motor and check for proper rotation by quickly switching the *HAND-OFF-AUTO* switch to *HAND* then back to *OFF*. If the pump rotation is incorrect, remove the pump from service, proceed with the startup of the remaining pumps, and correct the problem with the faulty pump. d. If the pump rotation direction is correct and the reservoir level is above the normal "pumps off" level, set the *HAND-OFF-AUTO* selector switch to *HAND*. The reservoir level should not be pumped lower than the normal -10 ft MSL to avoid potential pump cavitation damage. The reservoir level may be monitored remotely at LIT-10 in Bubbler Control Panel CP-10. e. Open the pump discharge valve slowly to prevent water hammer.

Attachment 8-3 (continued)
Sample Pre-Startup Procedures
Pumping System

Location	Task	Steps
		f. Monitor the bearing temperature, pump noise level, discharge pressure, flow rate, and reservoir level to ensure proper operation. If abnormal operation is observed, stop the pump, remove the pump from service as described in the shutdown procedure below, and investigate the problem. While investigating the problem and monitoring the liquid level in the reservoir, initiate the procedure for pre-startup of the next pump.
		g. Upon stopping of the pump, adjust the rate of closure of the discharge check valve in accordance with the manufacturer's recommendations presented in Part 3.
		h. If the initial pump operation is successful, set the pump *HAND-OFF-AUTO* selector switch to the *OFF* position.
	2. Start the motor of the second 150-hp pump	a. Apply the procedure described above for the first 150-hp pump to the second 150-hp pump.
	3. Identify the mode of control of the pumps (automatic or manual)	a. For the selected mode of system control, initiate the respective startup procedure.

Attachment 8-4
Sample Startup Procedures
Pumping System

Location	Task	Steps
Motor/Control Room	1. Select the mode of operation for the pumps	a. If the operation of the pumps is automatically controlled, set the *HAND-OFF-AUTO* selector switches (HS-101A and HS-102A) at the motor control centers to the *AUTO* position. b. If the operation of the pumps is manually controlled, set the *HAND-OFF-AUTO* selector switches (HS-101A and HS-102A) at the motor control centers to the desired position (*HAND* or *OFF*). Monitor the reservoir level and operate the pumps to maintain the reservoir level within the range of 10 ft MSL to 20 ft MSL.

Attachment 8-5
Sample Routine Operation Procedures
Pumping System

Location	Task	Steps
Pump Room and Motor/Control Room	1. Monitor the operation of the pumping system twice per shift	a. Check the pump for unusual noise, vibration, overheating, or lubricant leakage. b. Check the pump drive condition and alignment, and check for electrical control malfunctions. c. Check the operation of the pump seal water system to ensure that the solenoid valve opens when the respective motor starter is energized and the valve closes when the motor starter is de-energized. d. Take caution when working near equipment that may automatically start at any time. Shut off equipment before attempting to service the equipment. Always replace safety shields immediately upon completion of the task. Observe all safety rules. e. Maintain systematic records for the pumping system including inspection results, repairs, cleaning, and lubrication.

Attachment 8-6
Sample Shutdown Procedures
Pumping System

Location	Task	Steps
Motor/Control Room	1. Shut down the pump driver	a. Set the *HAND-OFF-AUTO* switch for the pump to the *OFF* position. b. Throw (open) and lock out the power to the driver at the circuit breaker for the motor at the motor control center. Tag the breaker.
Pump Room	1. Isolate the pump suction and discharge lines	a. If the pump or motor is removed for repair, close the pump suction and discharge isolation valves.
Motor/Control Room	1. Isolate the seal water supply system	a. Close the seal water service isolation valve for the pump.

Attachment 8-7
Sample Abnormal Condition Response Procedures
Pumping System

Location	Task	Steps
Pump Room and Motor/Control Room	1. Determine whether an alarm has been initiated	a. Check the main control panel for alarms that stop the pumps (high-high vibration, high-high motor winding temperature, high pump discharge pressure, low-low seal water pressure, and low-low seal water level in the seal water air gap tank). Determine whether operation may be resumed or if repairs are necessary. b. If the pump has failed, set the lead/lag selector switch at the main control panel to select the other identical pump as the lead pump.
	1. Determine whether the pump is rotating but not transferring liquid	a. Check for closed valves. b. Check for air lock.
	1. If unable to correct the problem, shut down the pump	a. Follow established shutdown procedures for the failed pump. b. At the MCC, turn the *HAND-OFF-AUTO* switch for the failed pump to *OFF*. c. At the MCC, shut down, tag and lock out power to the pump. d. Close the seal water service isolation valve for the failed pump. e. Close the pump suction and discharge isolation valves. f. If the pump must be removed, see Part 3 for procedures for disconnecting the pump and for subsequent servicing.

Book 1

General Design Guidelines

Chapter 9
Corrosion Control

City of San Diego Water Department
Capital Improvements Program

Chapter 9
CORROSION CONTROL

9.1 Introduction

Many water facilities contain metallic components which, when placed in contact with soil and/or water without protection from its surrounding environment tend to corrode, deteriorate and fail prematurely. This chapter addresses one of the mitigation measures required for corrosion protection for such facilities; that is, cathodic protection.

The principle of cathodic protection is to make the entire surface of the structure cathodic, thus directing corrosion elsewhere (to anodes). Cathodic protection is accomplished by superimposing an electrical current from an expendable material (anode) through an electrolyte (soil, water, wastewater) in a manner that ensures that the current enters all parts of the metallic surface (e.g., pipe, tank, etc.) and the entire surface becomes a cathode.

If required by a project and required in the contracted scope of the work, the DESIGN CONSULTANT retains a NACE-certified cathodic protection specialist to design corrosion mitigating systems. In addition, it may be necessary to coordinate corrosion control systems with adjacent projects in various stages of design and/or construction. The DESIGN CONSULTANT should contact the CIP Program Manager for additional information concerning the status and details of adjacent projects.

9.1.1 Evaluation of Cathodic Protection Needs

The need for cathodic protection is determined through field and laboratory tests and other investigations to assess the corrosion potential of the environment toward proposed facility materials. Field and Laboratory investigations are conducted for all proposed facility sites or alignments. The DESIGN CONSULTANT also retains the services of a corrosion engineer to evaluate soil and water corrosivity at the site and along pipeline alignments through field and laboratory tests. The corrosion engineer provides preliminary data on corrosion control methods, including protective coatings, materials of construction and cathodic protection.

A. Field and Laboratory Investigation

Field investigations by the qualified geotechnical engineer include onsite measurements of soil resistivity and the collection of soil and water samples for laboratory analysis. Testing procedures are performed in accordance with the predesign surveys described in Attachment 9-1.

Soil/Water Tests. Tests are made to characterize the corrosivity of electrolytes (existing soils and water) in which the structures are to be located. The required testing is described in the following paragraphs.

Field Resistivity Survey. Soil resistivity depends primarily on the chemical and moisture content of the soil. The higher the level of chemical constituents, the lower the soil resistivity. Moisture generally decreases soil resistivity until the maximum solubility of the chemicals is achieved. Beyond this point, an increase in moisture generally increases resistivity as the chemicals become more diluted. As Table 9-1 shows, the corrosion of metals in soil and water normally increases as electrical resistivity decreases.

Table 9-1
Resistivity Values vs. Corrosivity

Soil Resistivity, ohm-cm	Degree of Corrosivity
0-1,000	Very Corrosive
1,000-3,000	Corrosive
3,000-5,000	Fairly Corrosive
5,000-12,000	Mildly Corrosive
Above 12,000	Negligible

Measurements of the electrical resistivity of existing soils are made using the Wenner 4-pin method in accordance with ASTM G57 or other ASTM approved methods. Tests are made at intervals not exceeding 1,000 feet along the pipeline alignment or on a 300-foot-square grid at any facility site. Resistivity is measured in ohm-cm from 1 foot (ground level) to depths of 5, 10, 15, 20, and 30 feet. Tests are made at greater depths at locations where structure depth is greater than 30 feet.

Laboratory Analysis. Soil and water samples are collected in the field for laboratory analysis to determine their corrosive properties. Tests are conducted for the following parameters:

- Electrical resistivity using the soil box method defined in ASTM G57 for samples with moisture contents “as-received” and saturated with deionized water
- Water-soluble chloride
- Water-soluble sulfate
- pH

Any samples with a pH of less than 6.5 is tested to determine total acidity in addition to the other required tests. Additional tests may also be warranted depending on the results of the field resistivity survey.

Coordination with Geotechnical Studies. Planning, collection, and investigation of soil samples is coordinated by both the corrosion and geotechnical engineers for efficiency in retrieving samples. Soil samples collected by augers, split-spoon samples or other methods are acceptable. However, samples should not be taken from holes where drilling mud is used, as drilling mud may contain salts that could affect the test results. All data listed in Attachment 9-1 should be included in the Geotechnical Report.

Stray Current Evaluation. The evaluation of stray current requires the use of a specialty expert in this area. The DESIGN CONSULTANT provides the expertise necessary to meet these requirements through the use of a cathodic protection specialist.

Field investigations include interviews with knowledgeable sources and measurements to determine the potential for stray current from dc sources. Possible sources of dc include cathodic protection systems in operation on other utilities or agencies, electric transit systems, if any, and industrial sources such as metal processors and welding machines.

Evaluations also consider the possible effects of cathodic protection systems for pipelines under consideration on other buried utilities in the vicinity.

Coordination with Other Utilities. Other utilities or companies with underground metallic piping or tank systems that lie in or near the pipeline alignment must be contacted to determine the extent of potential interference.

Earth Potential Gradient Tests. In conjunction with personnel interviews to determine probable locations of dc sources, field measurements of earth potential gradient are made to detect the presence of current in the earth at locations along the pipeline alignment. Tests are made by measuring the potential between two identical portable reference electrodes placed a suitable distance apart in contact with the soil. Where appropriate, the cathodic protection or other electrical system is interrupted to observe the change in earth potential gradient associated with the system.

Induced Voltage. The potential for induced voltage from high voltage electrical power transmission lines is evaluated if a facility site or alignment is situated near power lines. Field measurements of the electromagnetic field may not be sufficient to assess the potential for induced voltage. A specialist in ac-induced voltage mitigation must evaluate the need for induced voltage suppression and design the facility accordingly unless the contracted scope of work specifically excludes this requirement. In any case, the DESIGN CONSULTANT ensures that induced voltage mitigating devices, if required, do not interfere with already installed or to be installed cathodic protection systems.

9.1.2 Interpretation of Results

The cathodic protection specialist interprets and evaluates results of field and laboratory investigations and interviews to determine the needs for cathodic protection. The evaluation includes consideration of the information in Book 2 about protective coatings and linings and materials of construction.

The results of this evaluation are included in a Corrosion Control Field Report. This report includes preliminary studies of corrosion potential and related subjects covered in this chapter.

9.1.3 Standards and References

The practices and recommendations of accepted references are used during the course of the work. The following references should be considered primary sources of information:

A. NACE International

Methods for performing field and laboratory testing, data collection, and evaluation of results should follow the recommended practices of NACE International. NACE International is located in Houston, Texas. Particular attention should be given to the following standard practices and test methods:

- RP0169-96, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
- RP0177-95, Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems.

- RP0187-96, Design Considerations for Corrosion Control of Reinforcing Steel in Concrete.
- RP0196-96, Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks.
- RP0285-95, Corrosion Control of Underground Storage Tank Systems by Cathodic Protection.
- RP0286-97, The Electrical Isolation of Cathodically Protected Pipelines.
- RP0388-95, Impressed Current Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks.
- TM0497-97, Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems.

B. American Water Works Association Standards and Publications

Information on pipe materials, coatings and corrosion control practices used in the water industry can be obtained from AWWA in Denver, Colorado.

C. Manufacturers' Associations

Trade associations may provide supplemental sources of information about details and common practices for specific materials of construction. Caution should be used in strictly following their recommendations because the recommendations may be structured to benefit a particular product in competing with alternative products.

9.1.4 Corrosion Control Report —Conclusions and Recommendations

In general, cathodic protection in conjunction with highly effective dielectric coatings should be provided for buried or submerged metallic structures if any of the following conditions exist:

- Soil resistivity is 12,000 ohm-cm or less (measured in the field only) or 5,000 ohm-cm or less (measured in a laboratory in saturated condition), or when a wide range of soil resistivities exists regardless of their absolute values.
- Soil with high chloride or sulfate concentrations.
- Waters with high chloride concentrations, high TDS, or high dissolved oxygen concentration (cathodic protection is not effective in waters with high velocity).
- Areas subject to stray electrical currents.
- Support facility steel or ductile iron piping and steel storage tanks.

The evaluation reaches one of two possible conclusions.

The first possible conclusion is that, at the time the study is conducted, cathodic protection is necessary. This approach results in the design, installation and commissioning of cathodic protection systems concurrent with construction of the facility. The cathodic protection system is designed for a minimum service life of 20 to 30 years, after which it requires replacement or upgrading for continued service. Cathodic protection systems are normally the impressed current type, unless the current requirements are low and the current density requirement can be reduced by providing a highly effective dielectric coating on the facility. When current requirements are 1 to 2 amps or less, the use of cast or ribbon galvanic anodes (magnesium or zinc) should be considered.

A major consideration for the cathodic protection alternative is that stray current from the cathodic protection system must be controlled to prevent damage to other facilities. The cost savings resulting from leak prevention on the protected facility could be surpassed by the costs of damage to other facilities.

The second possible conclusion of the evaluation is that cathodic protection is not required at the time of construction. All facilities are then provided with the test stations. Electrical continuity system is necessary for future needs of a CP system. Corrosion monitoring results are used to determine when, or if, cathodic protection is required. The major consideration with this conclusion is the requirement for a correct future assessment of the need for cathodic protection.

Therefore, the competent evaluation of the need for cathodic protection can be difficult. Unless test data shows actual corrosive failure by a facility, consultants and vendors will offer a wide range of opinions on whether cathodic protection is required. Future cathodic protection installations will most likely be the impressed current type because galvanic anode installations for existing large facilities are usually prohibitive as adequate amounts of current is limited.

The conclusions and recommendations of the cathodic protection specialist's and corrosion engineer's evaluation for corrosion control on the project are submitted as the Corrosion Control Report.

9.1.5 Corrosion Control Design

The design of cathodic protection systems for projects, including test stations and electrical continuity systems, must be in accordance with this paragraph.

A. Coordination With Structure Design

Coordination is required to ensure that the cathodic protection system is fully compatible with the design of the structure to be protected. The materials and protective coating considerations for a particular structure require coordination between the corrosion engineer and the "specifiers" of the materials of construction and coatings. It is also necessary to identify locations and configurations of appurtenant facilities such as valve vaults, service connections, instrumentation, and connections to other structures.

The locations of cathodic protection equipment, devices, outlets, and appurtenances is shown at approximate locations on the drawings. Exact locations are determined by the Construction Contractor subject to approval by the Construction Manager.

The Construction Manager verifies all data and final locations of work done under other sections of the Construction Contract specification required for placing the electrical work.

The cathodic protection engineer coordinates with the DESIGN CONSULTANT's electrical discipline staff to make sure that electrical grounding methods do not accelerate corrosion of pipes, tanks and other structures and equipment in the area by draining protective current from the intended structures to be protected.

Pipe and Equipment Materials. Some pipelines may be constructed from metallic materials other than steel such as ductile iron, copper or galvanized iron. All candidate pipe materials are considered for cathodic protection needs.

Underground steel tanks, water immersed sluice gates, valves, steel parts of other structures, and equipment exposed to corrosive environments may also receive cathodic protection or may require protection from the adverse effects of impressed current cathodic protection applied to other structures.

Optimization of Coating and Cathodic Protection. Cathodic protection systems are designed to provide adequate current to polarize the structures to be protected to levels generally accepted for complete protection.

A key consideration for designing cathodic protection systems is minimizing the cathodic protection current requirement. This is necessary to minimize the total current output from the cathodic protection facilities and reduce the consumption of anodes and the cost of power supply. The larger the current output, the greater the chance of stray current interference. Such interference increases the resultant costs for mitigation.

The current requirement for cathodic protection is a function of several variables, including the facility surface area to be protected and soil conditions. The larger the facility, the greater the surface area and the larger the required current. The major determinant in current requirement for a given facility size is its effective coverage of the protective coating on the facility. A coating with a high degree of coverage of the pipe surface requires less current because less of the its bare surface is in contact with the soil.

To achieve the most cost-effective corrosion protection system, the combined facility coating and cathodic protection must be optimized. The coating must protect most of the facility surface and be complemented by an appropriate cathodic protection system to protect the uncoated areas of the pipe surface. The coating is selected for greatest effective coverage

without excessive cost. The cathodic protection system is selected to deliver sufficient current to the uncoated areas without causing stray current interference on other facilities.

Stray Current Control. Stray current from a cathodic protection system must be controlled to prevent damage to other facilities. The cost savings resulting from corrosion prevention on the protected facility could be surpassed by the cost of damage to other facilities. The cathodic protection design should provide a means for testing for and mitigating stray currents produced by the systems.

Grounding Needs. The cathodic protection system is coordinated and consistent with electrical grounding facilities to mitigate induced voltage from high voltage power transmission lines.

Facilities with cathodic protection systems are insulated from electric utility grounding systems to prevent excessive current requirement and waste of energy. This means that facilities such as pumps, electrically operated equipment, instruments and controls and similar connections should be electrically insulated from the protected facility.

Interfaces Between Contracts. Facilities and other structures are designed and constructed so that the finished system is compatible with existing structures and facilities, and that corrosion protection is not compromised for both new and existing structures. Where insulating joints are required, the connecting Construction Contractor provides and installs the insulating joint assembly.

B. Cathodic Protection System Type

The type of cathodic protection system selected by the cathodic protection specialist must provide an acceptable service life of 20 to 30 years or more. Factors to be considered during selection are:

1. Galvanic or Sacrificial Anodes. Galvanic anodes use the natural potential difference (voltage) between two different metal alloys to generate direct electrical current (dc). These anodes consist of magnesium or zinc castings or ribbons directly connected to the pipe. Because magnesium and zinc are anodic to steel, ductile and cast iron, stainless steel, lead and copper, the resulting galvanic cell consists of the galvanic anodes and the structure being protected.

   Zinc anodes should be used in low resistivity environments (less than approximately 500 ohm-cm) or in brackish or saline water and soil conditions. In these low resistivity conditions, zinc anodes have a longer operating life than magnesium anodes because of lower current output. In soil conditions where galvanic anodes are required, magnesium anodes should be used.

   The number of anodes depends on the electrolyte conditions and the current requirement. Anodes are sized to provide a minimum service life of 15 to 20 years. Galvanic anode systems are best suited to applications where current requirements are low (less than 2 amps), where structures are well-coated, and in areas of low electrolyte

resistivity. Galvanic anode systems are frequently used where the following items are important:

- No external power supply is available or allowed (classified areas).
- Low maintenance effort needed.
- Minimal interference with other structures is mandatory.
- Low installation cost is mandatory (needs economical comparison).
- Minimal easement or right-of-way needed.

Considerations that discourage the use of galvanic anode systems are:

- Limited driving potential and current.
- High resistivity of electrolyte.
- High cost of retrofit or upgrade
- Adjustment of output is required.

Where conditions are unfavorable for galvanic anode or sacrificial anode protection, impressed current systems should be considered.

2. *Impressed Current.* Impressed current cathodic protection systems use an external source of dc power. The power is used to make the structure cathodic relative to some other metal in the ground or water.

Rectifiers should be used to convert alternating current (ac) to direct current. The dc current goes from the positive dc terminal of the rectifier to the groundbed (anodes) where it is discharged into the electrolyte. This current is collected on the structure to be protected. The electrical circuit is completed as the dc current returns via the protected structure to the dc negative terminal of the rectifier. Typical impressed current anodes are made of graphite, high-silicon cast iron, mixed-metal oxide coated titanium and platinized titanium or niobium.

Impressed current systems are best suited to applications where current requirements are high, and in areas of high electrolyte resistivity.

Impressed current systems are frequently used where:

- Large current is required.
- High-resistivity soil or water conditions exist.
- Current must be adjustable.
- Contamination of the product is prohibited.

The following considerations may discourage the use of impressed current systems:

- Slightly higher initial installation cost.
- Skilled maintenance effort.
- Continuous cost for ac power.
- Interference with other structures.
- Congested areas

Where conditions are unfavorable for impressed current protection systems, galvanic or sacrificial anode protection, or a combination of the two methods should be used.

3. *Selection of Protection System.* The type of cathodic protection system, design configuration, and component specifications should be selected to deliver the required current with due consideration of the control of stray currents.

The replaceable parts of cathodic protection systems are designed to provide a service life of 20 to 30 years. This includes items such as rectifiers, anodes and wiring. A longer design life is not recommended and is not economical because the durability of construction materials for continuous use becomes marginal and the risk of equipment failure increases substantially.

The actual service life of a cathodic protection system may be greater or less than the design life, depending on the following:

- The average current output.
- Soil or water conditions.
- Actual anode consumption efficiency.
- The rate of material deterioration.
- The addition of facilities

The design should incorporate sufficient safety and redundancy factors to achieve the design life under a reasonable range of conditions.

Features necessary for the operation of the cathodic protection system must be designed to last for the life of the structure or facility.

C. Consistency Among Contracts

Cathodic protection systems are designed for consistency among adjacent projects. All system components and configurations are as required by these standards and guidelines. In the absence of pertinent standards, the specifications and details of a previously designed facility for previous projects are used as a reference for consistency.

D. Design Criteria for Cathodic Protection

Pumping station, storage facility, pipeline, and pressure control station project design criteria are as described in Book 2 of these Guidelines.

E. Construction Phase Considerations

Successful installation and operation of cathodic protection systems requires special attention to certain details. Examples are provided in the following paragraphs.

Inspection during construction of test stations and cathodic protection systems is important for certain parts of the work. Cathodic protection systems are relatively fragile, so there is considerable potential for mechanical damage. Also, the systems rely on low voltage and current, any unplanned resistance in wires and wire connections could reduce system effectiveness.

Some important items to be addressed by the Construction Manager during detailed inspection are:

- Thermite weld wire connections to structures must be sound and properly insulated from contact with the electrolyte.
- Splices are not allowed in impressed current anode wires or headers. However, if a splice must be made, it should be in an aboveground splice box. Splices between galvanic anode lead wires and anode header wires must be thoroughly insulated from contact with the electrolyte.
- Anodes must be properly positioned and installed without stressing the lead wire. Wires must be correctly color coded and marked as to function and the structure to which they are connected. This is especially important for rectifier output leads and pipeline crossings.
- The power supply to the rectifier must be the correct voltage and phase.
- Electrical continuity of the structure must be tested to ensure that electrical continuity exists. All insulators must be tested to ensure they are functioning. The loss of an insulator can cause loss of protection for part or all of the structure.

F. Operation and Maintenance Considerations

The items included in paragraph 9.1.5.E which are accessible from the ground must be checked periodically during the life of the structures.

The DESIGN CONSULTANT designs facilities for corrosion monitoring and cathodic protection for periodic access and measurement. Test boxes, rectifiers and other facilities are placed in accessible locations and away from hazards such as traffic and areas prone to flooding. Signage is provided for corrosion protection facilities if streets and walks are not fully developed.

City staff must use technical specialists to conduct the appropriate measurements, maintain records, recommend modifications to the system, and determine replacement requirements.

Attachment 9-1
Standard Corrosion Testing Procedures

Predesign Surveys

Soil Resistivity Testing (Field)
Soil resistivity testing is typically conducted by the Wenner 4-Pin Method. This test procedure requires the use of an ac resistance meter, such as a Soil Resistance Meter, Model 400, manufactured by Nilsson Electrical Laboratory, Inc. The Wenner method requires that 4 electrodes, or pins, be driven into the ground along a straight line, equidistant from each other, as shown in Figure 9-1-1. An alternating current from the meter flows through the outside probes, C1 and C2. Due to the resistance of the soil, a voltage drop is created across the inner pins, P1 and P2. This voltage gradient is proportional to the average resistance of the soil mass to a depth equal to the pin spacing. The resistivity of the soil is then computed from the meter reading according to the following equation

$$o = 2(\pi) AR$$

Where:

o	=	soil resistivity (ohm-cm)
A	=	distance between pins (cm)
R	=	soil resistance (ohms)
π	=	3.14159

Resistance measurements should be made at 1000-foot intervals, as a minimum, along the proposed alignment or on 300-foot-square grid at any facility site. As mentioned, the resistivities are determined as an average value to a depth equal to the pin spacing. Since it is desirable to obtain information about the soil conditions at the depth of the structure, pin spacings should be selected to contain the strata in which the structure is to be located. Samples should also be taken above the structure to account for changes due to moist conditions or leaching of material or chemicals from upper soil strata.

Soil Resistivity Testing (Laboratory)
Soil samples should be extracted from specific locations and depths. The samples should be packaged appropriately and tested as soon as practical upon removal to reduce the effect of changes in in-situ moisture content. Representative samples should be placed in a soil box, as shown in Figure 9-1-2. The sample resistivity is determined from the resistance meter reading and the geometry or constant for the soil box. The testing should be repeated after successive increases in moisture content with the deionized water. The sample should be retested after each addition of water, until a minimum value has been reached. This value should then be recorded as the “minimum” saturated resistivity.

Chemical Analyses
Soil samples should be forwarded to a qualified laboratory, certified by the state of California, for testing of pH, and chloride, sulfate and bicarbonate ion concentrations. Once again, the samples should be analyzed as soon as possible upon arrival, so as not to cause significant variation in the “as-found” condition of the sample. Chemical testing is performed in accordance with recognized standard procedures and reported in ppm or mg/kg.

Half Cell Potential Surveys

Half cell potential surveys should be incorporated in a predesign survey where a structure is existing. Ideally, the testing is performed at test station locations. Where test stations have not yet been installed, electrical connection must be made to the structure at appurtenances. The voltmeter to be used in the testing must have an input impedance of at least 10 meg-ohms. The testing must also be performed with a calibrated copper/copper sulfate reference electrode which is known to be functioning properly.

If an analog voltmeter is used, the positive test lead is connected to the copper copper/sulfate reference electrode and the negative test lead is connected to the structure. If a digital voltmeter is used, the positive test lead is connected to the structure and the negative test lead is connected to the reference electrode. The reference electrode is placed as close to the structure as possible, as shown in Figure 9-1-3. The use of water at the half cell location may be advisable to reduce contact resistance between the cell and the soil. The potential is recorded in millivolts and a notation is made indicating the test station number and any other relevant information such as pipeline station number.

Where half cell potential measurements are to be performed on a structure under galvanic cathodic protection, the potential of the structure should be recorded with the anode both connected and disconnected from the structure. The open circuit potential of the anode must also be recorded. Where the cathodic protection system is an impressed current type, the potential of the structure is recorded prior to and during temporary interruption of current to the anodes, or "instant off" using a current interrupter.

Current Requirement Testing

Current requirement testing is generally performed to determine how much current is needed to protect a structure, regardless of the type of system planned for design. Testing requires the use of a portable dc power supply, voltmeter with shunt or an ammeter, reference electrode, test leads, temporary anodes and means for making electrical connection to the structure. The temporary anodes may be an existing structure (for example, a chain link fence) or an anode system installed for the purpose of testing. The power supply may be a portable rectifier or power supply or a battery. The positive lead from the power supply should be connected to the temporary anodes and the negative lead to the structure, as shown in Figure 9-1-4. Half cell potential measurements should be made at multiple locations prior to energization of the structure. These locations should be selected to facilitate testing both close to and far away from the temporary anode location so that attenuation characteristics, as defined in "Corrosion Control Testing" can be estimated, in addition to the levels of polarization achieved during testing. The potentials should be recorded both with the dc power "on" and "off." The voltage and current outputs should all be recorded for each test setup. Multiple measurements may be required to calculate incremental increases in polarization for the purpose of design of the cathodic protection system.

Electrical Continuity Testing

Testing for Pipelines

Electrical continuity testing for joint bonded pipe is performed prior to the backfilling of the pipe, if possible. Testing requires the use of a power supply, volt and ammeter or multimeter, test leads and means of making electrical connection to the pipe. The positive and negative terminals of the power supply should be connected to the pipeline at a known distance along the pipeline to be tested. The length of pipe and number of joints must be

recorded, as well as the voltage and current output of the power supply. The voltage drop should be measured along the section of pipe being tested and the voltage recorded. This testing may be done along a length of pipe or across individual pipe joints, as required and shown in Figure 9-1-5. From the power supply outputs and the voltage drops measured, the resistance of the pipeline and joints can be calculated. This value should be compared to the theoretical resistance of the pipe and joint bonds. These are calculated from the pipe material, size, wall thickness, wire gauge and length of bond. Test readings of not more than 120% of the theoretical resistance value indicate the pipe is continuous.

Isolation Testing
Insulating flange kits and dielectric unions are tested using a Gastronics Model 601 Insulation Checker, or with other proven test methods. The meter is placed across the flange or other insulating device being tested. Electrical isolation is sufficient when the meter reading is 100%. .

Post Installation Testing

Post installation testing is performed as required in the plans and specifications for the project and as directed by the Construction Manager. Testing requires the performance of the standard test methods presented in this attachment. The minimum requirements are as listed in the test method or as required by the Construction Manager and shown on the drawings and specifications.

Figure 9-1-1

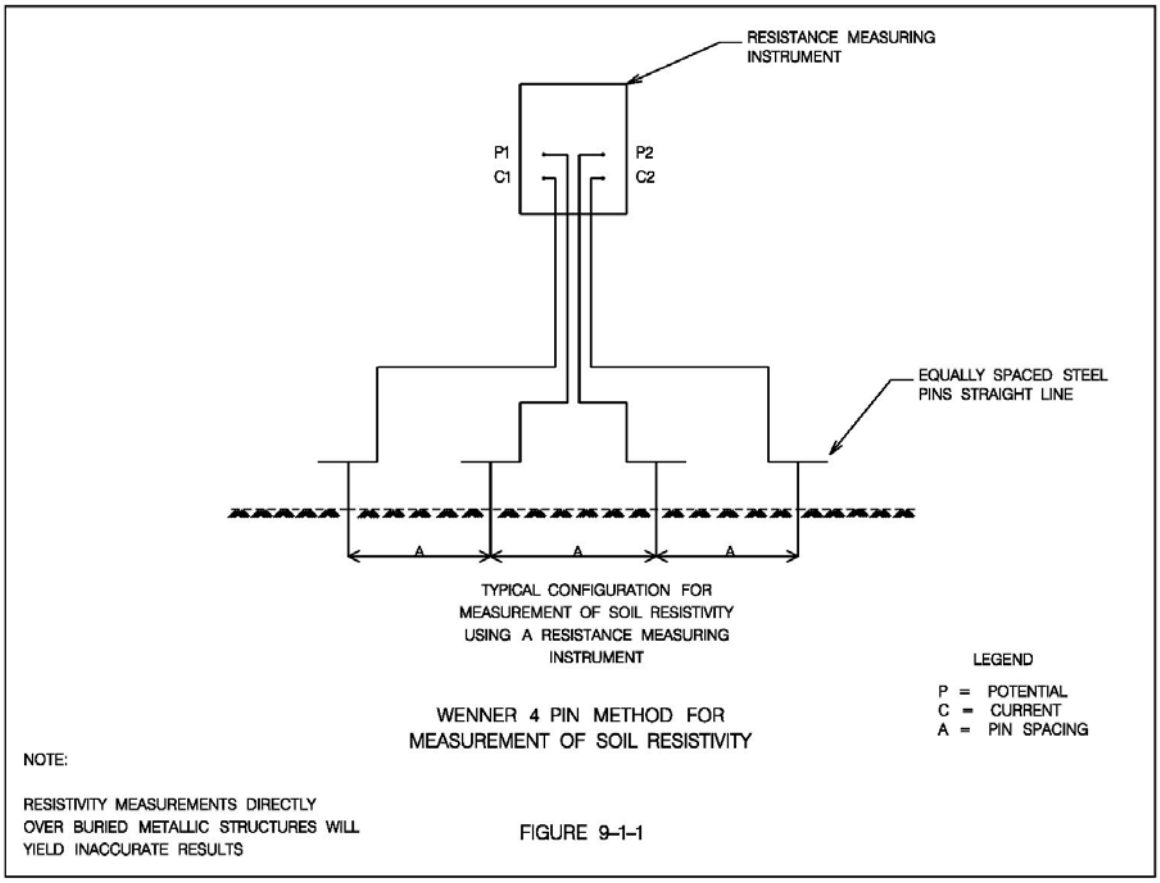
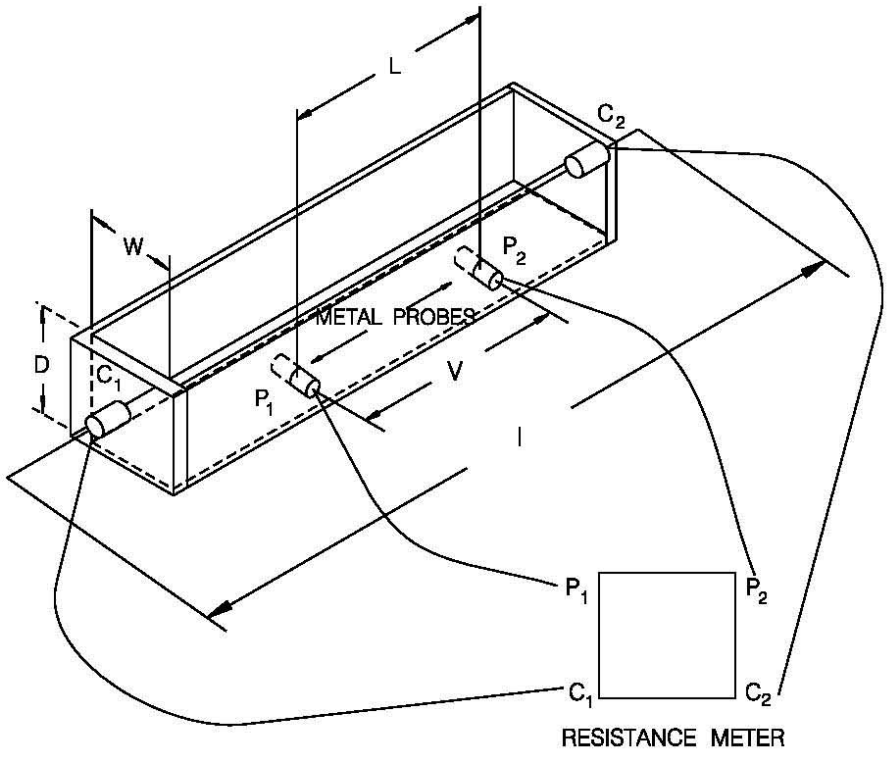

RESISTANCE MEASURING INSTRUMENT
P1
C1
P2
C2
EQUALLY SPACED STEEL PINS STRAIGHT LINE
A
A
A
TYPICAL CONFIGURATION FOR MEASUREMENT OF SOIL RESISTIVITY USING A RESISTANCE MEASURING INSTRUMENT
LEGEND
P = POTENTIAL
C = CURRENT
A = PIN SPACING
WENNER 4 PIN METHOD FOR MEASUREMENT OF SOIL RESISTIVITY
NOTE:
RESISTIVITY MEASUREMENTS DIRECTLY OVER BURIED METALLIC STRUCTURES WILL YIELD INACCURATE RESULTS
FIGURE 9-1-1

Figure 9-1-2



SOIL BOX METHOD

FIGURE 9–1–2

Figure 9-1-3

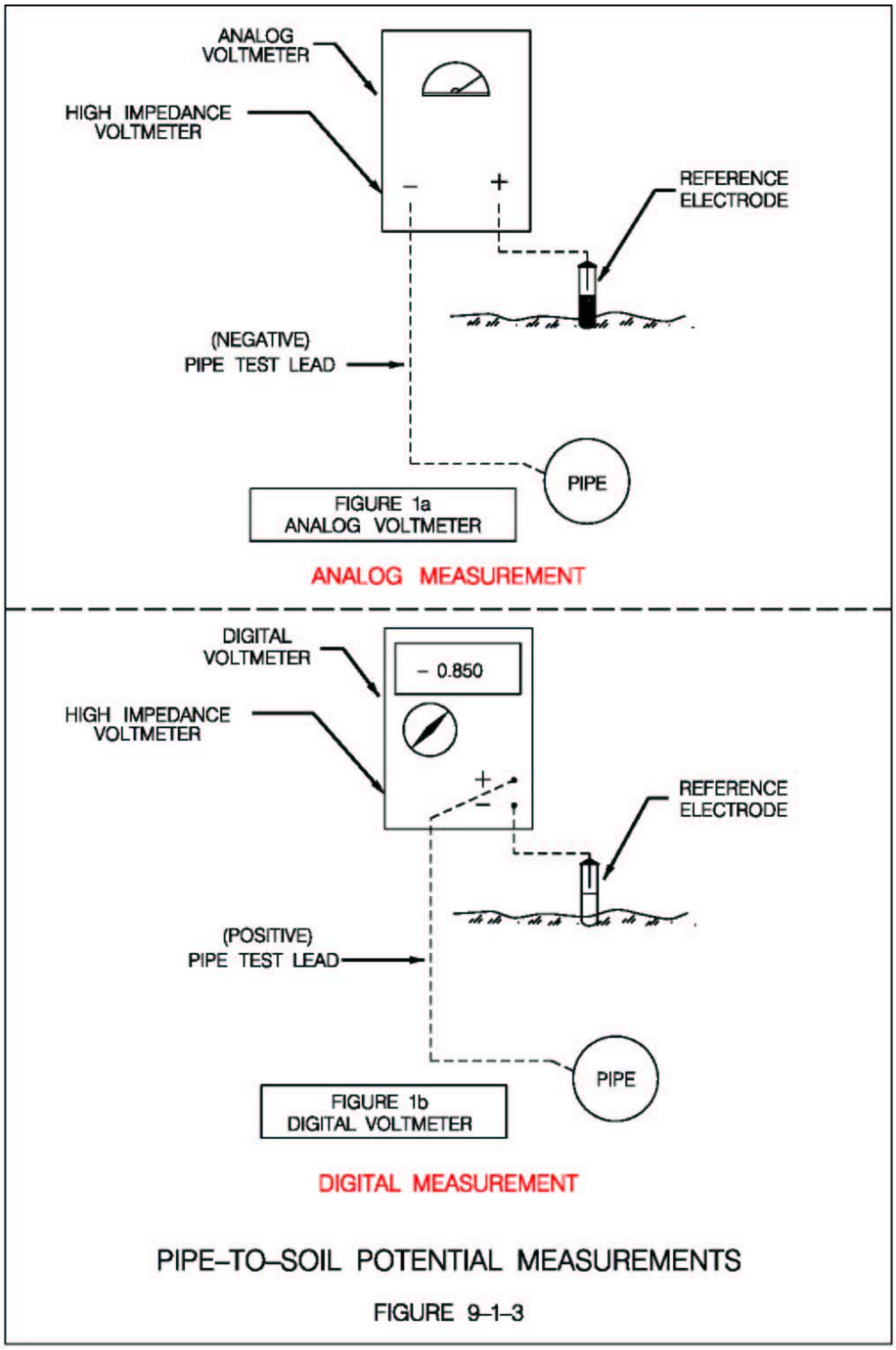

ANALOG VOLTMETER
HIGH IMPEDANCE VOLTMETER
REFERENCE ELECTRODE
(NEGATIVE) PIPE TEST LEAD
PIPE
FIGURE 1a ANALOG VOLTMETER
ANALOG MEASUREMENT
DIGITAL VOLTMETER
– 0.850
HIGH IMPEDANCE VOLTMETER
REFERENCE ELECTRODE
(POSITIVE) PIPE TEST LEAD
PIPE
FIGURE 1b DIGITAL VOLTMETER
DIGITAL MEASUREMENT
PIPE–TO–SOIL POTENTIAL MEASUREMENTS
FIGURE 9–1–3

Figure 9-1-4

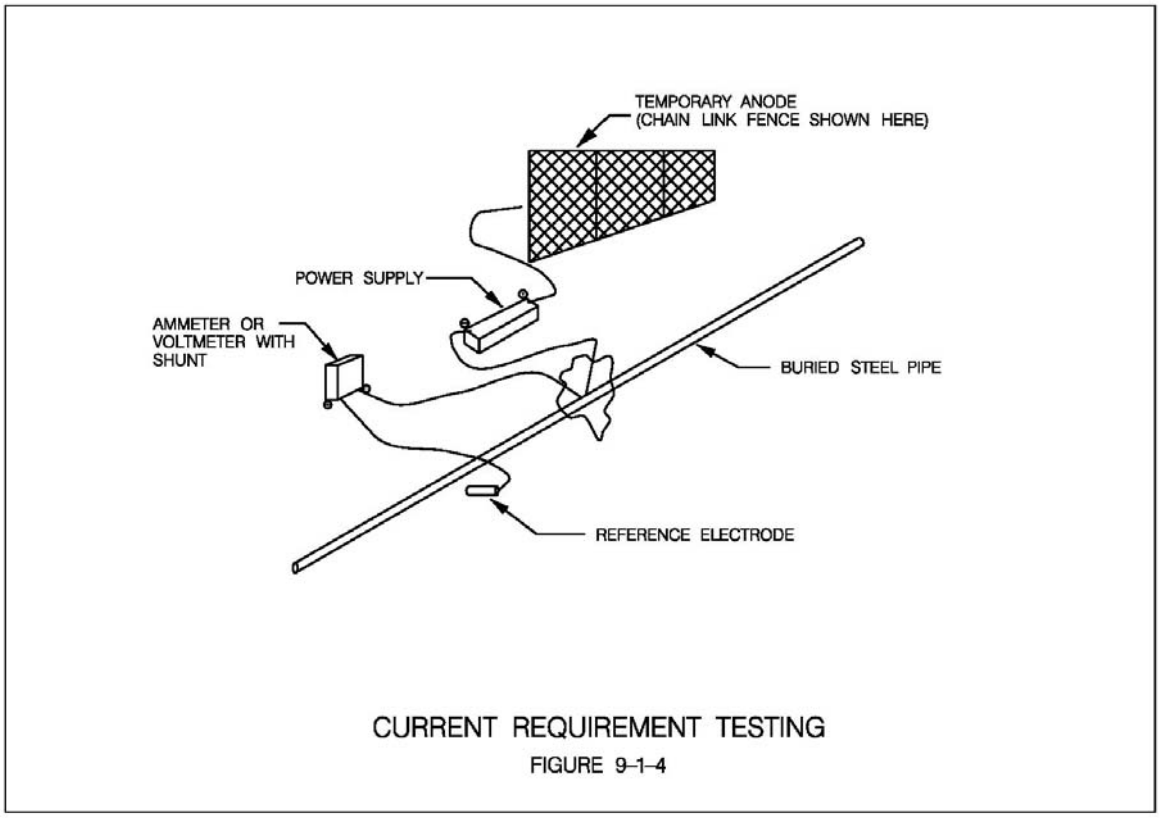
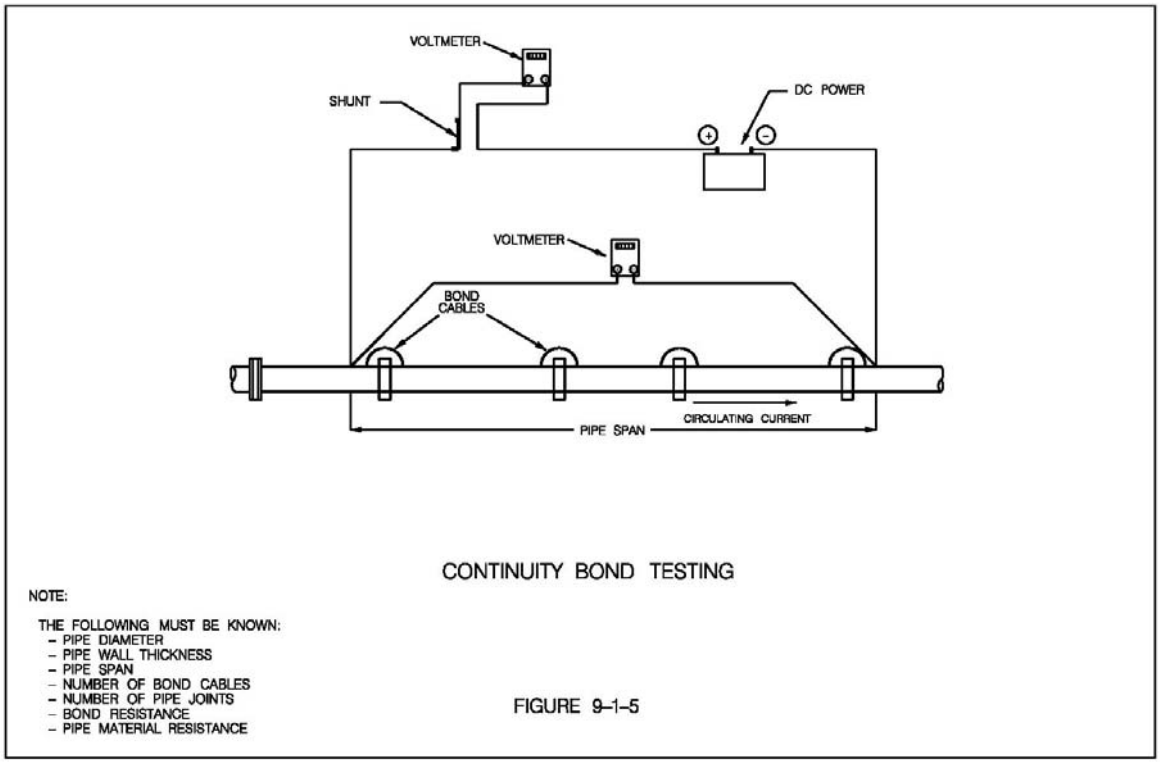

TEMPORARY ANODE
(CHAIN LINK FENCE SHOWN HERE)
POWER SUPPLY
AMMETER OR
VOLTMETER WITH
SHUNT
BURIED STEEL PIPE
REFERENCE ELECTRODE
CURRENT REQUIREMENT TESTING
FIGURE 9-1-4

Figure 9-1-5


VOLTMETER
SHUNT
DC POWER
VOLTMETER
BOND CABLES
CIRCULATING CURRENT
PIPE SPAN
CONTINUITY BOND TESTING
NOTE:
THE FOLLOWING MUST BE KNOWN:
- PIPE DIAMETER
- PIPE WALL THICKNESS
- PIPE SPAN
- NUMBER OF BOND CABLES
- NUMBER OF PIPE JOINTS
- BOND RESISTANCE
- PIPE MATERIAL RESISTANCE
FIGURE 9-1-5

Book 1

General Design Guidelines

Chapter 10
Permitting, Environmental Compliance, and Public Coordination Guidelines

City of San Diego Water Department
Capital Improvements Program

Chapter 10
PERMITTING, ENVIRONMENTAL COMPLIANCE, AND PUBLIC COORDINATION GUIDELINES

10.1 Introduction

This chapter provides guidelines for obtaining permits and complying with regulatory agency laws, regulations and other procedures for Water CIP projects. It also describes the DESIGN CONSULTANT's role in assisting the Public Information Section of the Water CIP Program Management Division.

10.2 Permit Coordination

10.2.1 Permits and General Responsibilities

Table 10-1 lists state and local permits that may be required for individual projects. The DESIGN CONSULTANT assists the CIP Project Manager to identify and obtain all necessary permits and approvals in a manner consistent with the program master schedule. The CIP Project Manager maintains the original permits files, while the DESIGN CONSULTANT retains copies.

The DESIGN CONSULTANT obtains permits required for performing design work and absorbs any costs associated with such permits. Examples of permitted work include excavations for surveying and geotechnical operations within the public rights-of-way of a jurisdictional agency.

The DESIGN CONSULTANT ensures that permits and approvals required during construction are described in the Contract Documents. The Construction Contractor obtains such permits.

10.2.2 Procedures

The typical procedure for obtaining permits and approvals, shown in Figure 10-1, is described in the following paragraphs.

In cooperation with the CIP Permit Coordinator, the DESIGN CONSULTANT identifies the permits and approvals required for the project and the information needed to fulfill the agencies' requirements, and prepares a schedule that includes critical path activities for obtaining approvals in a sequenced and timely manner. The DESIGN CONSULTANT checks with the CIP Permit Coordinator for any updated information available.

Early in the design process, the DESIGN CONSULTANT meets with the responsible agency and the CIP Project Manager to determine any special requirements. The DESIGN CONSULTANT provides completed application or notification packages to the CIP Project Manager for review and processing. The DESIGN CONSULTANT also provides all necessary technical assistance and background studies to complete the documents and applications required by the agencies (for example, biological or cultural resource studies). The DESIGN

CONSULTANT assists the CIP Project Manager with follow-up permitting agency coordination, including responses to clarification questions. All regulatory agency discussions and correspondence are through the CIP Project Manager.

10.3 Environmental Compliance

Individual environmental compliance activities typically take place during the design stage of Water CIP projects. All City discretionary projects must be reviewed by the Development Services Department for compliance with the California Environmental Quality Act (CEQA). Depending on project characteristics, Development Services may require separate approval for certain projects under the City's Resource Protection and Sensitive Coastal Resources Ordinances. The DESIGN CONSULTANT must be aware of these separate activities as well as potential design requirements for site monitoring, noise control, visual aesthetics and contaminated site avoidance.

10.3.1 California Environmental Quality Act Review

A. Early Consultation

CEQA encourages early consultation between the lead agency (City) and responsible (permitting) agencies to effectively address fundamental environmental issues head on early in the process and to avoid unnecessary delays due to additional environmental analysis and/or project redesign. According to the CEQA Guidelines, project sponsors must incorporate environmental considerations into project conceptualization, design and planning at the earliest time feasible. The lead agency is encouraged to hold meetings with permitting agencies to expedite the consultation.

At the request of the CIP Project Manager, the DESIGN CONSULTANT provides information and attends meetings to support the CEQA compliance process, including early consultation. The DESIGN CONSULTANT should be available at all times to discuss the project description, alternative facility locations or designs if appropriate, and the appropriateness and feasibility of potential measures to avoid or minimize environmental impacts. For large and/or complex projects, this consultation may entail frequent, ongoing discussion between the CIP Project Manager, the DESIGN CONSULTANT and the CEQA consultant.

B. Mitigation Measures

Under CEQA, any potentially significant effects associated with a project must be reviewed for impact avoidance or mitigation. Mitigation measures developed through the environmental impact report or mitigated negative declaration processes are typically incorporated into a Mitigation Monitoring or Reporting Program (MMRP) and adopted by the City Council as conditions of project approval. The MMRP is prepared to ensure that the mitigation measures and project revisions identified in the environmental document are implemented.

The DESIGN CONSULTANT ensures that mitigation measures affecting project construction and/or design are incorporated into the construction contract documents. Mitigation measures should be incorporated verbatim from the MMRP to the specifications, unless the CIP Project Manager and the CIP Senior Planner approve modified wording. The DESIGN CONSULTANT

coordinates with the CIP Project Manager about consultation with the environmental consultant or the feasibility of recommended mitigation measures.

10.3.2 Special Monitoring and Reporting

An environmental consultant may be retained for some Water CIP projects to monitor specific on- or offsite resources. Monitoring is usually required when impacts cannot be conclusively determined until construction commences. This activity is commonly associated with a site-specific environmental study. Impacts to biological, archaeological and paleontological resources are typically assessed as part of the monitoring process.

A. Biological Resources

Monitoring biological resources may be required when design field work is planned in or near an area containing sensitive plants or animals. Field work during the design process, including corrosion, geotechnical and hazardous waste studies may require the use of a drill rig, backhoe and trucks which generate loud noises and can damage natural habitat. CEQA compliance is not required for these field investigations; however, compliance with Section 7 or 10(a) of the Endangered Species Act is required if a federally-listed threatened or endangered species could be affected by the activity. When any of these activities is proposed on ungraded and undeveloped land, the DESIGN CONSULTANT consults with the CIP Project Manager to determine any biological constraints. The CIP Project Manager coordinates with the CIP Permit Coordinator, CIP Senior Planner and Development Services Department to ensure that required environmental compliance is achieved before field work is conducted.

Unless specified otherwise, Biological Monitors for design field work are retained by the City and coordinated through the CIP Project Manager and CIP Permit Coordinator. The DESIGN CONSULTANT must give at least two weeks' notice to facilitate the timely coordination of monitoring services. Additionally, when performing activities regulated under a permit from a federal agency, the DESIGN CONSULTANT typically gives 72 hours' notice to the permitting agency before work begins.

Monitors have the authority to temporarily stop work if a situation arises where a threatened or endangered species could be harmed. The CIP Project Manager, CIP Permit Coordinator, and DESIGN CONSULTANT are required to resolve such situations before work can be allowed to resume. Biological Monitors submit biweekly reports to the CIP Project Manager detailing monitoring activities and any incidents of noncompliance.

Biological resource monitoring may also be required when construction is planned in or near an area containing sensitive plants or animals. The City may retain a biologist to monitor area conditions and ensure that construction is conducted in compliance with the stipulations set forth in the CEQA document and any Biological Opinion prepared through U.S. Fish and Wildlife Service consultation. The DESIGN CONSULTANT ensures that monitoring stipulations contained in the CEQA document and/or Biological Opinion are incorporated into the Contract Documents.

B. Archaeological Resources

Archaeological resources monitoring may be required when design field work is proposed in previously undisturbed open spaces. Potholing or excavating above an underground utility can be assumed not to impact archaeological resources. However, activities

away from existing utility lines, for instance, or opening access across undisturbed land may damage a resource. Compliance with Section 106 of the National Historic Preservation Act is required if an activity could affect an archaeological or historical resource, which includes resources eligible for the National Register of Historic Places. Consequently, if design field work is proposed on undisturbed land, the DESIGN CONSULTANT confers with the CIP Project Manager to determine any potential archaeological issues. The CIP Project Manager then coordinates with the CIP Permit Coordinator, CIP Senior Planner and Development Services to ensure that required environmental compliance is achieved before field work is conducted.

The Development Services Department may require that an Archaeological Monitor, retained by the DESIGN CONSULTANT, be present onsite during design field work or construction. When construction monitoring is required, the DESIGN CONSULTANT notes the archaeological monitoring requirements on the construction plans and describes them in the Contract Documents. The DESIGN CONSULTANT also ensures that procedures for temporary work stoppage in areas where archaeological resources are discovered during grading or excavation are included in the Contract Documents. If an archaeological resource is uncovered during field work or construction, monitors have the authority to temporarily stop or redirect ground disturbing activities away from the find and call a representative from the Development Services Department to the site. The potential significance of the resource is determined by the archaeologist in consultation with Development Services staff. Development Services must concur with the evaluation procedures before grading or excavation is allowed to resume. At this time, the agency representative may implement additional stipulations before allowing work to continue in the affected area. The Archaeological Monitor prepares a monitoring results report for submittal to Development Services after termination of the cultural resources program.

C. Paleontological Resources

In some areas, permit stipulations may require that a Paleontological Monitor, retained by the DESIGN CONSULTANT, be present onsite during excavation in previously undisturbed formations that may contain fossilized materials. If construction monitoring is required, the DESIGN CONSULTANT notes the paleontological monitoring requirements on the construction plans and describes them in the Contract Documents.

The DESIGN CONSULTANT also ensures that procedures for temporary work stoppage in areas where paleontological resources are discovered during excavation are included in the Contract Documents. If well-preserved fossils are uncovered during construction, monitors have the authority to temporarily stop or redirect ground disturbing activities away from the find and call a Development Services representative to the site. Development Services must concur with the salvaging methods before excavation is allowed to resume. The Paleontological Monitor prepares a monitoring results report for submittal to Development Services after termination of the cultural resources program.

10.3.3 Noise Control

Noise due to CIP Program management design, construction and operation can adversely affect human health, sensitive wildlife and the enjoyment of recreational opportunities. The potential effects of project-related noise, and measures to reduce any significant impacts, are typically discussed in the CEQA document. The DESIGN CONSULTANT incorporates site-specific noise control and mitigation measures into the Contract Documents.

The DESIGN CONSULTANT should be cognizant of: (1) standards and abatement measures when conducting design field activities; (2) applicable noise control measures to be applied by the Construction Contractor, some of which are included in the CIP Guide Specifications; and (3) applicable operational noise standards. Noise and vibration standards and measures to minimize noise impacts are described below.

A. Impact Criteria

According to the City of San Diego Municipal Code, Section 59.5.0405, Noise Abatement and Control,"it is unlawful for any person, including the City of San Diego, to conduct any construction activity so as to cause, at or beyond the property lines of any property zoned residential, an average sound level greater than 75 decibels during the 12-hour period from 7:00 a.m. to 7:00 p.m. The City imposes no limits on construction noise in land use areas other than those zoned residential. For nighttime construction (7 p.m. to 7 a.m.), a special permit must be obtained from the Noise Abatement and Control Administrator."

Section 59.5.0401 of the Municipal Code sets maximum daytime (7 a.m. to 7 p.m.) one-hour average sound levels at 50 dB for R-1 zoned property, 55 dB for R-2, 60 dB for all other residential, 65 dB for commercial, and 75 dB for areas zoned for manufacturing, industrial, agricultural and extractive uses. Public utility distribution or transmission facilities situated on or near a property line are also subject to these operational noise level limits. For these facilities, the measurement limits apply beyond six feet from the easement boundary upon which the equipment is situated.

B. Noise Criteria for Blasting

The construction of facilities may require explosives in some areas to excavate rock. Blasting can produce an impulsive sound called an airblast. Airblast can be undesirable and can propagate over large distances, particularly if favorable weather conditions(e.g., with temperature inversions).

At higher levels of airblast overpressure, three possible adverse effects are (1) damage to structures; (2) human health risk; and (3) human annoyance. The most likely impact from airblast is human annoyance. A "moderate" risk of human annoyance resulting in complaints could occur when the peak overpressure is between 110 and 125 dB. The risk becomes "high" when the peak overpressure is between 125 and 140 dB. The recommended annoyance criterion for airblast noise is 110 dB at an occupied property line. Levels of 110 dB or below are considered a low risk of human complaint. The recommendation of these criteria is based on infrequent blasting during daytime hours only (i.e., fewer than 5 blasts per day between 7 a.m. and 5 p.m.).

C. Noise Control Measures

The following noise control measures should be considered (and may be required) to avoid noise disturbance if design field work or construction activity is located near noise-sensitive land uses:

- Normally scheduled construction activities are limited to daytime hours, 7 a.m. to 7 p.m., Monday through Saturday. As stated in paragraph 10.3.3.A, a permit is required for major night work. There may be a public hearing associated with this permit.

- A minimum requirement for field and construction equipment might be that equipment must be equipped with manufacturers' standard noise control devices (i.e., mufflers, acoustical lagging and/or engine enclosures) which normally comply with recommended noise limits, if operated conservatively. Conservative operation of equipment means the operator takes special care not to throttle the engine excessively and keep the engine rpm as low as possible. In addition, the operator should not leave equipment running or idling needlessly.

- To the extent feasible, noisier equipment should be used no closer than 100 feet from the property line of any noise-sensitive land use for any length of time, and should avoid coming closer than 200 feet if multiple pieces of equipment are operating simultaneously. If such cases are unavoidable, the equipment operator should take special care not to throttle the engine excessively or leave the equipment running needlessly.

- The distance between noisy field- and construction-related activities and noise-sensitive land uses should be maximized.

- Heavy truck access and egress routes should be carefully selected to avoid noise-sensitive land uses to the extent feasible.

- Concrete trucks should perform mixing and other activities that require engine revving a minimum of 600 feet from noise-sensitive land uses. Engine rpm should be kept as low as possible at closer distances.

- If dewatering pumps and generators must operate during nighttime hours (7 p.m. to 7 a.m.), they should be treated with acoustical noise control measures (e.g., mufflers, shrouding and/or enclosures).

- The use of temporary noise barriers may be required to protect against excessive noise levels if construction activities (including contractor staging areas) occur near noise-sensitive land uses. Noise barriers can be made of plywood, heavy vinyl curtain material, earth berms or stockpiles of construction material. The objective of barriers is to block the line-of-sight between the noise creating source(s) and receiver locations. Typically, barriers provide 5 to 10 dBA of noise reduction.

The following impact reduction measures are recommended to minimize noise impacts related to blasting:

- Blasting noise should be monitored where there is concern for human health or property. Efforts should be made to restrict the peak overpressures to 110 dB at any occupied property line and 130 dB at all building structures.

- Blast noise monitoring should be conducted to ensure that the peak overpressure of 110 dB for human annoyance and 130 dB for building damage is not exceeded. In addition, when within 1,000 feet of residential structures or areas designated for human use, blasting should occur only between 7 a.m. and 5 p.m., and the total number of blasts should not exceed five per day to minimize complaints from the community.

- Blast holes should be adequately stemmed to help reduce airblasts.

The DESIGN CONSULTANT incorporates any or all of these elements into the project design where applicable, or implements them as mitigation measures during construction.

10.3.4 Visual Aesthetics

A. Visual Impacts and Mitigation

The potential visual effects of a project, and measures to reduce their significance, are typically discussed in the CEQA document. The DESIGN CONSULTANT must incorporate site-specific measures to minimize a project's visual impacts into the Contract Documents. To the extent feasible, the DESIGN CONSULTANT designs and locates aboveground structures to minimize potential visual effects and the permanent blockage of views from surrounding public and private perspectives.

A project's visual impacts vary depending on the nature of the project and the natural or aesthetic importance of the existing landscape. In general, aesthetic impacts can be minimized through the following measures:

- Ensuring that architectural details incorporate materials that blend with the existing environment and structures.
- Incorporating surface painting or concrete varnishing and/or coloring to tint and match the colors of surrounding environments or structures.
- Incorporating cut-and-fill techniques that include rough and feathering cuts to minimize visual impacts.
- Using earthen berms, when appropriate, to reduce visual impact on viewsheds and adjacent communities.
- Incorporating landscape elements such as large boulders and vegetative planting to minimize visual impact.
- Limiting the use of artificial outdoor lighting to basic safety and security requirements and directing light toward objects requiring illumination.

The DESIGN CONSULTANT incorporates these elements into the project design where practicable. Otherwise, they may be used as CEQA mitigation measures and incorporated by the DESIGN CONSULTANT into the Contract Documents.

B. Public Art

The City's Public Arts Commission encourages but does not mandate the incorporation of artistic concepts into the design of City projects. As a result, for some Water CIP projects, the City may include a public art component. For any Water CIP projects involving public art, the Artist becomes part of the DESIGN CONSULTANT team. The Public Arts Commission can provide the DESIGN CONSULTANT with a list of qualified artists. At the request of the CIP Project Manager, the Artist gives presentations to City staff and at public meetings.

C. Site Landscaping

The City is committed to providing aesthetically pleasing facilities with appropriate landscaping. A natural landscape theme is conducive to minimizing visual impacts caused by the construction of new facilities. Landscaping that requires minimal maintenance tends to last longer and have a better overall appearance. Plant selection and irrigation design is of utmost importance in creating a low-maintenance project. In keeping with these considerations, the DESIGN CONSULTANT should specify low-maintenance, native plant materials when practicable.

The DESIGN CONSULTANT coordinates with City staff through the environmental and architectural review processes to determine the locations and specific plant types to be used. Detailed procedures for soil preparation, planting and maintenance appear in the City's standard specifications.

Resource agencies frequently require the preparation of a Revegetation Plan as part of their permitting process for projects affecting wetlands or other sensitive habitats. These plans are usually prepared by a landscape architectural or biological firm under contract to the City. Revegetation Plans include details of fencing, soil preparation, plant palette selection, planting, irrigation, maintenance and monitoring. The DESIGN CONSULTANT attaches the Revegetation Plan to the Contract Documents if it is prepared for a specific Water CIP project.

10.3.5 Water Quality

All CIP projects are designed in compliance with the following: (1) water quality objectives established by the California Regional Water Quality Control Board (RWQCB), San Diego Region; (2) federal and state antidegradation policies; and (3) the federal Clean Water Action Plan. The DESIGN CONSULTANT must be aware of clean water policy and beneficial use objectives for the watershed within which work is conducted. The DESIGN CONSULTANT can obtain a copy of the policy and criteria from the CIP Permit Coordinator.

The Clean Water Act regulates non-point and point-source pollution from construction activities. Projects involving a disturbed construction area of five acres or greater must comply with the General Construction Stormwater Permit of the RWQCB. (The EPA is currently recommending that the regulations be amended to stipulate a one-acre minimum instead of a five-acre minimum disturbed area.) The CIP Project Manager must first submit a Notice of Intent (NOI) to the State Water Resources Control Board, informing it that a project is about to begin construction. To comply with the general permit, a report called the Storm Water Pollution Prevention Plan (SWPPP) must be prepared and implemented before construction begins. The SWPPP identifies potential sources of pollution on the project site, and recommends best management practices (BMPs) to prevent, control or reduce stormwater from being polluted by construction activities, to eliminate non-stormwater discharges from the site, and to monitor discharges for the construction duration. In most instances, the SWPPP is prepared by the Construction Contractor and approved by the Construction Manager. The DESIGN CONSULTANT incorporates stormwater control BMPs into the specifications and design drawings.

10.3.6 Site Contamination

To the extent possible, project designs minimize the need to acquire or traverse areas where the presence of hazardous waste is suspected or has been verified. To accomplish this, the DESIGN CONSULTANT may be asked to investigate existing site conditions by researching available reports, searching regional databases and reviewing unauthorized discharge records available for public inspection at the County Department of Health Services, Hazardous Materials Management Division.

10.4 Construction Moratoriums

10.4.1 Annual Holiday Construction Moratorium

This construction moratorium applies to the downtown area and to all other streets adjacent to major retail areas of the City. The purpose of this moratorium is to minimize construction traffic impacts on retail merchants.

The limits of the “downtown” area are Cedar Street on the north, Twelfth Avenue on the east, Harbor Drive on the south and North Harbor Drive on the west. Major retail areas include the streets around Fashion Valley Center, Mission Valley Center, University Towne Center, downtown La Jolla, and other major retail shopping areas.

Construction activities which affect on-street parking, vehicle travel lanes or pedestrian sidewalk areas must be scheduled either before or after the holiday season. The holiday season starts on Thanksgiving Day and extends through New Year’s Day.

10.4.2 Annual Beach Area Moratorium

The annual beach area construction moratorium is intended to minimize construction impacts on beach area residences and businesses. The restriction affects travel and parking lanes as well as pedestrian walkways on streets adjacent to beach areas where merchants could be adversely affected by construction activities. The beach area construction moratorium includes Memorial Day, Fourth of July, and Labor Day weekends. Thus, construction activities may not be scheduled on the days immediately before or after these holiday periods.

10.5 Public Coordination

The Water Department is committed to working cooperatively with the public during the planning, design and construction of infrastructure improvement projects. The Public Information Section of the CIP Program Management Division assists CIP Project Managers to develop communication programs and materials to provide a process for two–way communication with impacted communities.

Along with other communication tools, a 24-hour public information line must be available for community members to discuss project components or register complaints. All calls to the public information line are tracked and addressed by the Public Information Section, with assistance from the CIP Project Manager, Construction Manager or DESIGN CONSULTANT, as appropriate.

The DESIGN CONSULTANT participates in project presentations to community groups in conjunction with the project team. The DESIGN CONSULTANT also assists with the production of visuals and other materials such as renderings or material samples, as needed, to help explain projects to the community during the design process. When feasible, the DESIGN CONSULTANT works with the City to incorporate feedback from the community into the design process. Community input should be incorporated as early in the project design process as possible.

The Public Information Section assists with public outreach as it relates to the environmental review process, as needed. Ad placement and public notices, as well as the coordination of public meetings is arranged with the CIP Senior Planner. The DESIGN CONSULTANT may be required to participate in environmental public outreach meetings to assist in explaining the project and answering questions.

Figure 10-1
Typical Procedure for Permits and Approvals

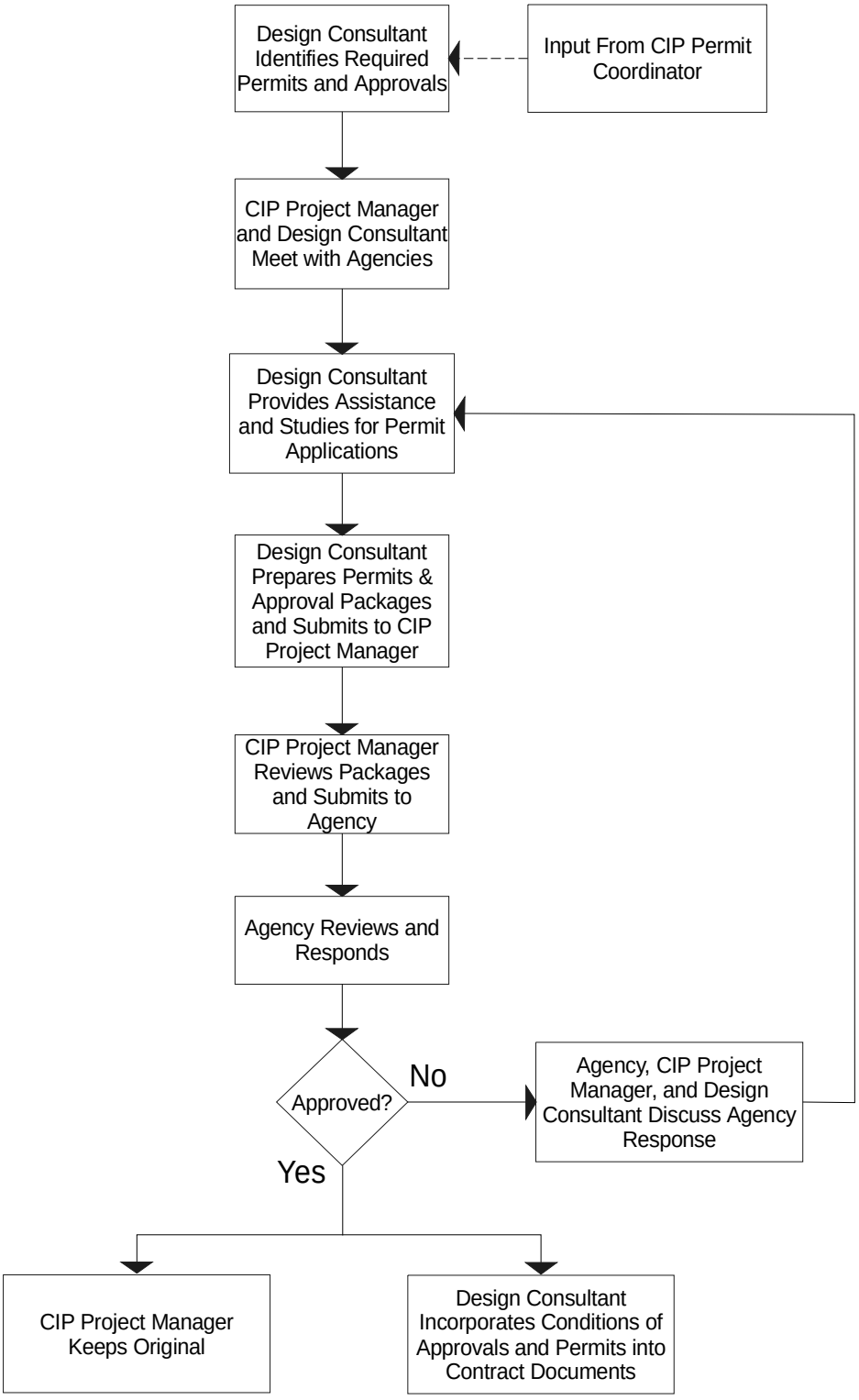


Table 10-1
Permits Matrix

Issuing Agency and Staff Contact	Permit/ Approval Type	Description	Scheduling/Permittee		
			Prior to Construction Bidding/ Design Team	Prior to Construction Activity/ Contractor	Begin System Operation/ CIP Staff
Air Pollution Control District 9150 Chesapeake Dr. San Diego, CA 92123 (619)694-3313	Registration for back-up generator	Applies to back-up diesel generator sets			X
	Authority to Construct (ATC)	Required for new or modified equipment that may emit air pollutants	X		
	Permit to Operate	Second stage of ATC			X
CA Coastal Commission 3111 Camino del Rio North, Suite 200 San Diego, CA 92108 (619) 521-8036	Coastal Development Permit	Required for projects in coastal zone; permit authority rests with City if there is a certified Local Coastal Plan which applies to the subject area	X		
CA Dept. of Fish and Game P.O. Box 6657 Laguna Niguel, CA 92607 (714) 363-7538	Streambed Alteration Agreement	Approval required for work within the banks of a streambed, including wetlands and lakes	X		
	CA Endangered Species Act Compliance	Applies to projects that could potentially “take” a state-listed species	X		
CA Dept. of Transportation, District 11 4080 Taylor Street San Diego, CA 92110 (619) 688-6158	Encroachment Permit	Caltrans issues permits for any design or construction activity that encroaches into a state highway right-of-way	X		
CA Dept. of Water Resources Division of Safety of Dams P.O. Box 942836 Sacramento, CA 94236 (916) 322-6206	Approval of Plans and Specifications	Dam safety plan check review required for construction of new dams, some reservoir tanks, and construction of new facilities within the vicinity of existing dams	X		X
CA Dept. of Health Services 1350 Front Street Room 2050 San Diego, CA 92101 (619) 525-4159	Domestic Water Supply Permit	Responsible for compliance order enforcement, including project review for achievement of water quality goals			X
CA Dept. of Industrial Relations 7807 Convoy Court Ste. 140 San Diego, CA 92111 (619) 637-7325	Construction Permit for Excavation Unit	OSHA permit required for excavation greater than 5 feet and/or structures higher than 36 feet		X	

Table 10-1
Permits Matrix
(Continued)

Issuing Agency and Staff Contact	Permit/ Approval Type	Description	Scheduling/Permittee		
			Prior to Construction Bidding/ Design Team	Prior to Construction Activity/ Contractor	Begin System Operation/ CIP Staff
CA Dept. of Industrial Relations 6150 Van Nuys Boulevard, #310 Van Nuys, CA 91404 (818) 901-5420	Construction Permit for Mining and Tunneling Unit	Cal-OSHA issues underground classifications for tunnels and other underground projects 30-inch diameter or larger	X	X	
CA State Lands Commission 100 Howe Ave., 100 South Sacramento, CA 95825 (916) 574-1861	Land Use Lease	Lease required to build a facility on state-owned sovereign land	X		
City of San Diego Development Services Dept. 1222 First Ave., MS 502 San Diego, CA 92101 (619) 236-7202	Traffic Control Plan Review	Plan check process for traffic control	X	X	
City of San Diego Development Services Dept. 1222 First Ave., MS 501 San Diego, CA 92101 (619) 233-6176	Resource Protection Ordinance Permit	Required for projects which are located in areas with: sensitive habitat, including wetlands; steep slopes; flood plains; and/or significant prehistoric or historic resources	X		
	Sensitive Coastal Resources Permit	Required for projects that are located in the coastal zone and are within an area with certified Local Coastal Plan	X		
City of San Diego Development Services Dept. 1222 First Ave., MS 401 San Diego, CA 92101 (619) 236-6397	Plan Check/Building Permit	Applies to any project which has a structure covered by the Uniform Building Code	X	X	
City of San Diego Fire Dept. 1222 First Ave., MS 401 San Diego, CA 92101 (619) 236-6447	Tank Permit	Permit required for any outdoor storage facility containing hazardous materials; including repiping and tank removal	X	X	

Table 10-1
Permits Matrix
(Continued)

Issuing Agency and Staff Contact	Permit/ Approval Type	Description	Scheduling/Permittee		
			Prior to Construction Bidding/ Design Team	Prior to Construction Activity/ Contractor	Begin System Operation/ CIP Staff
City of San Diego Development Services Dept 1222 First Ave., MS 401 San Diego, CA 92101 (619) 236-6545	MSCP Third Party Beneficiary Status	Third-party beneficiary designation is required for any project which could potentially result in a "take" of species listed in the City's Subarea Plan	X		
Metropolitan Wastewater Dept. Industrial Waste Program 9192 Topaz Way, MS901 San Diego, CA 92123 (619) 654-4104	Industrial User Discharge Permit	To allow temporary dewatering to the sanitary sewer of excavations associated with construction activity		X	
County of San Diego Hazardous Materials Management Division P.O. Box 85261 San Diego, CA 92138 (619) 338-2372	CalARP Compliance/ RMP Preparation	Applies to facility owner/operator of a stationary source with a process in excess of a threshold quantity of acutely hazardous materials			X
County of San Diego Hazardous Materials Management Division P.O. Box 85261 San Diego, CA 92138 (619) 338-2232	Business Plan Update CIP	Plan required to protect the health and safety of the community and emergency response personnel			X
County of San Diego Hazardous Materials Management Division P.O. Box 85261 San Diego, CA 92138 (619) 338-2207	Well Permit	Required for some exploratory borings, including test holes, as specified in the County regulations	X		
Regional Water Quality Control Board 9771 Clairemont Mesa Blvd., Suite A San Diego, CA 92124 (619) 627-3941	General Construction Storm water Permit	Applies to construction activities involving excavation or grading totaling 5 acres or greater	X	X	

Table 10-1
Permits Matrix
(Continued)

Issuing Agency and Staff Contact	Permit/ Approval Type	Description	Scheduling/Permittee		
			Prior to Construction Bidding/ Design Team	Prior to Construction Activity/ Contractor	Begin System Operation/ CIP Staff
Regional Water Quality Control Board 9771 Clairemont Mesa Blvd, Ste. B San Diego, CA 92124 (619) 467-2952	General NPDES permit for Dewatering	A permit is required for any discharge of ground water effluent to a stream, river or ocean	X	X	
U.S. Army Corps of Engineers 10845 Rancho Bernardo Road, #210 San Diego, CA 92127 (619) 674-5385	Section 10 Permit	Applies to projects that would cause the obstruction or alteration of navigable waters	X		
	Section 404 Permit	Applies to projects that would cause the discharge of dredged or fill material into waters of the United States	X		
U.S. Fish and Wildlife Service Coastal Resources 2730 Loker Avenue West Carlsbad, CA 92008 (619) 431-9440	Section 7/10A Consultation	Coordination with the USFWS is required for any project which could potentially result in a threat to an endangered species or critical habitat	X		
U.S. Forest Service Cleveland National Forest 10845 Rancho Bernardo Road Rancho Bernardo, CA 92127-2107 (619) 673-6180	Use Permit	Required for any development activity involving access over or through USFS lands	X		

Book 1

General Design Guidelines

Chapter 11
Easements, Encroachments and Land Acquisition

City of San Diego Water Department
Capital Improvements Program

Chapter 11
EASEMENTS, ENCROACHMENTS AND LAND ACQUISITION

11.1 Introduction

This chapter summarizes easement, encroachment, and land acquisition processes for CIP projects and the expected involvement of the DESIGN CONSULTANT in assisting the Real Estate Assets Department.

11.2 Definitions

11.2.1 Easements

An easement is a partial interest in real property that permits its holder to do specific things, such as construct, operate and maintain a pipeline. Ownership of the property underlying the easement remains with the party from whom it was acquired.

Facilities that cannot be placed in the public right-of-way are located in permanent exclusive easements. Such easements are granted in perpetuity, may conditionally restrict future use within the easement, and prevent the current and any future owner from granting other use of the easements without written permission of the Water Department.

Temporary construction easements are sometimes required to accommodate construction activity that typically requires additional space to provide access, to store materials, and to provide working room. Since temporary construction easements have a limited term and expire on a fixed date, the planned construction period (including contingencies) is included.

11.2.2 Encroachment Permit

An encroachment permit (either temporary or permanent) conveys permission to temporarily work or to place permanent improvements within another party's right-of-way or easement(s). For example, a private citizen wishing to install improvements within a public right-of-way is required to obtain an encroachment permit from the City of San Diego.

11.2.3 Right-of-Use

The right-of-use is the federal government's equivalent to a permanent exclusive easement. In practice, the federal government grants a long-term rights-of-use with provisions for renewal and periodic adjustment of fair market value.

11.3 Real Estate Assets Department

All land acquisition efforts in the City of San Diego are managed by the Real Estate Assets Department. The department is composed of multiple sections two of which have the following roles in implementing the CIP:

1. One section gathers and analyzes appraisal data, prepares appraisals for sites and rights-of-way, provides preliminary land and right-of-way cost estimates, provides alternative alignment cost estimates, prepares valuation studies and assists the City Attorney in real property valuation proceedings.

2. Another section acquires all property rights required for public projects and provides for necessary relocations before the start of construction.

11.4 Acquisition Process

11.4.1 Determination of Need

Minimum land requirements for permanent easements, temporary construction easements, rights-of-way and other special conditions are presented in Book 2 for pipelines, pressure control stations, storage facilities and pumping stations. Based on those minimum requirements, the DESIGN CONSULTANT evaluates and recommends land acquisition and easement requirements for each CIP project. The recommendation is subject to review and approval by the CIP Project Manager and the Real Estate Assets Department.

For projects that require the acquisition of rights-of-way and easements, involve federal and/or state property, or are wholly or partially within other municipalities, the DESIGN CONSULTANT contacts the Real Estate Assets Department at the 30% design stage, or earlier, to identify the special requirements that may apply to the acquisition process. The DESIGN CONSULTANT may contact the Real Estate Assets Department directly during the early design phase, but keeps the CIP Project Manager informed of its activities.

11.4.2 Encroachment Permits

The DESIGN CONSULTANT alerts the CIP Project Manager of design alternatives that traverse third-party or utility easements. Once alerted, the CIP Project Manager coordinates with the Real Estate Assets Department to determine the need for encroachment permits and takes steps to acquire those permits. The DESIGN CONSULTANT supports the CIP Project Manager as required in acquiring encroachment permits.

11.4.3 Public Acquisition Process

The public acquisition process is mandated by federal and state eminent domain law. Council Policy 700-32, Acquisition of Real Property Interests, sets out the mandated acquisition process for both property acquisition and easement acquisition. The typical process for property or easement acquisition takes one year from start to completion in a series of 90-day segments:

- 90 days for the appraisal

- 90 days for offers and negotiation
- 90 days for the escrow period and/or hearing of necessity, litigation and immediate possession
- 90 days for relocation of owners, tenants or personal property (not required if the property is unimproved)

The CIP Project Manager initiates the public acquisition process. The DESIGN CONSULTANT prepares the following documents, which accompany the application to the Real Estate Assets Department:

- *Signed, sealed right-of-way drawings.* Requirements for right-of-way drawings are presented in Attachment 11-1 for acquisition and Attachment 11-2 for condemnation. The DESIGN CONSULTANT meets with Acquisition Services Division staff as necessary during the design phase to review right-of-way drawings.
- *Construction drawings.* The DESIGN CONSULTANT meets with the Real Estate Assets Department as necessary during the design phase to review engineering plans. As the design progresses, the DESIGN CONSULTANT and the Real Estate Assets Department coordinate to refine the alignment or facility site as necessary and to define permanent and temporary construction easements.
- *Preliminary title reports.* The DESIGN CONSULTANT arranges for the preparation of preliminary title reports. These reports are prepared by a title company selected by the DESIGN CONSULTANT from a list of approved companies developed by the Real Estate Assets Department.

Once the land and easement acquisition process is completed, the Real Estate Assets Department certifies that the project can proceed and that Bid Documents can be issued.

11.4.4 Acquisition Support

The DESIGN CONSULTANT supports the CIP Project Manager and the Real Estate Assets Department during the acquisition process. Neither the DESIGN CONSULTANT nor the CIP Project Manager has direct contact with the property owners at any time unless specifically requested by the Real Estate Assets Department . All contact with property owners is by the Real Estate Assets Department .

If property owners request specific information about the project and its potential impact on their property, the Real Estate Assets Department may ask the DESIGN CONSULTANT to provide illustrations or other materials. The DESIGN CONSULTANT works with the Real Estate Assets Department staff to resolve issues associated with impacts of the project on existing improvements.

11.4.5 Construction Phase

During the construction phase, the Real Estate Assets Department remains the property owners' sole contact with the City. Should situations arise where additional information is needed (for example, if additional easements are necessary, if existing improvements must be removed, or if access to a property is adversely affected), the DESIGN CONSULTANT may be asked to provide design modifications or surveys to support this effort.

11.4.6 Project Completion

At the completion of construction, the Real Estate Assets Department initiates steps to terminate any outstanding temporary construction easements and finalize other matters of real property.

Attachment 11-1
Requirements for B Sheet or D Sheet Drawings for Acquisition

All B Sheet or D Sheet size drawings to be used for land and easement acquisition purposes are prepared by the DESIGN CONSULTANT and include the following items:

1. Index map for multiple map projects.

2. Multiple maps numbered in consecutive order.

3. Appropriate title block.

4. North arrow and scale.

5. The total ownership parcel whether the acquisition is an easement or partial or total fee take.

6. Distinct property lines shown and identified if more than one property owner is involved.

7. Bearings and distances on property lines.

8. Bearings and distances for the portion to be acquired.

9. Radial bearings for all nontangent curves.

10. Area of total ownerships in square feet on lot/block or smaller parcels or in acres and square feet on larger parcels.

11. Area of the portion to be acquired in square feet and acres.

12. Tie points identified on the drawing.

13. Point of beginning or commencement identified, including basis of bearings, and described.

14. Detailed blow-ups of areas too small to be easily discerned.

15. Brief legal description of properties affected by acquisition (i.e., Lots 1 & 2, Block 54, Paradise Hills Unit #3, Map 2101), or Metes and Bounds description if sited on unsubdivided land.

16. Widths of any public rights-of-way shown on the drawing.

17. Cross hatching or other illustrative means to show existing easements which affect the acquisition process. Record information and the area of the existing easement that affect the acquisition area must be shown. Show area of overlapping easements.

18. Area of any overlapping of easements to be acquired (in square feet).

19. Clear definition of each type of easement if more than one type is to be acquired (i.e., street easement, pipeline easement, working area, etc.)

20. Assessor's Parcel numbers for property affected by the acquisition.

21. Property owner's name.

22. Street boundaries to be dedicated with appropriate bearings and distances so that a legal description can be shown for each street.

23. Any additional information required by the Water Department.

24. Signatures of appropriate City staff.

25. Legal descriptions, preferably prepared by a Licensed Land Surveyor or a Registered Civil Engineer authorized to practice land surveying.

Attachment 11-2
Requirements for "Exhibit B" Drawings for Condemnation

In addition to drawings prepared for acquisition purposes, if condemnation is necessary, the DESIGN CONSULTANT prepares an "Exhibit B" drawing for each property ownership which includes the following information:

1. Total ownership outlined even if a broken line must be used.

2. Portion to be acquired including any temporary work areas shown in relation to total ownership boundaries and designated by cross hatching or some other distinct method.

3. Bearings and distances for the total ownership.

4. Bearings and distances for the portion to be acquired with a clear Point of Beginning and Basis of Bearings delineated (i.e., lot corner, intersection of street centerline, etc.)

5. Area of total ownership in square feet on lots/blocks and in acres on larger parcels, or both.

6. Area of portion to be acquired, in square feet and acres. Be clear regarding overlapping easements, if any.

7. The wording "Exhibit B" boldly set out on the drawing.

8. Reference drawings or maps, if any, identified.

9. If the total ownership is more than one parcel (i.e., Lots 1 & 2, etc.), the area for the portion to be acquired set out for each parcel.

10. North arrow and scale.

11. Vicinity map on drawing (does not need to be to scale)

12. Brief legal description(s) of the total ownership (i.e., Map 2101), or Metes and Bounds description if sited in unsubdivided land.

13. Identify existing easements from the Preliminary Title Report as they affect the portion to be acquired.

14. Detailed blow-ups for areas too small to be properly discerned.

15. Width of any public rights-of-way shown on the drawing.

16. Appropriate title block.

17. Assessor Parcel number.

18. Separate drawing for each ownership parcel if more than one ownership is involved.

19. All other information required on the City's "B" and "D" Sheet Drawings.

20. Signatures of appropriate City staff from the Water Department.

Book 1

General Design Guidelines

Chapter 12
Utility Coordination

City of San Diego Water Department
Capital Improvements Program

Chapter 12
UTILITY COORDINATION

12.1 Introduction

This chapter provides guidelines for coordinating with various public utilities and agencies on design work performed as part of the Water CIP. The DESIGN CONSULTANT investigates, researches, coordinates, and provides other services necessary to ensure that the design minimizes unforeseen conflicts with utilities during construction. In all cases, the DESIGN CONSULTANT locates proposed facilities to minimize disruptions to or modifications of existing utilities. Utilities are located in public rights-of-way to minimize inconvenience to the public and ensure that safe conditions are maintained.

Typical utilities which may be encountered in the implementation of the Water CIP include:

- Potable water pipelines
- Reclaimed water pipelines
- Sewers and force mains
- Storm drains
- Traffic control signal loops
- Oil and gas pipelines
- Telecommunication cables
- Television cables
- Electric power lines
- Street lights
- Railroads and light rail transit
- Roads and highways
- Telephone lines
- Cathodic protection devices

The utility coordination process described in this chapter is shown in Figure 12-1.

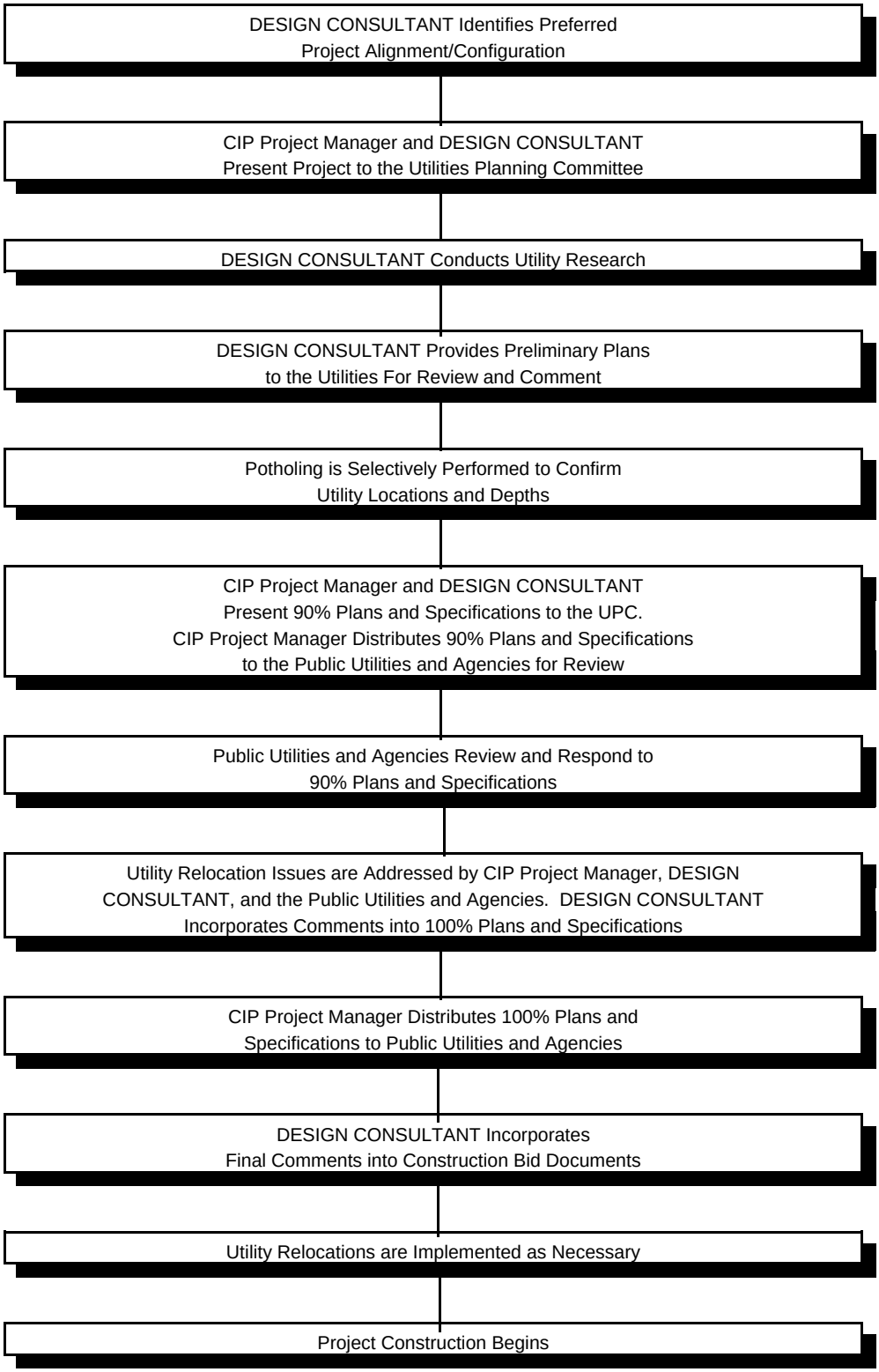
12.2 Utility Coordination Requirements for the Design Consultant

12.2.1 Utilities Coordination Committee and the Utilities Planning Committee

The Water Department participates in the Utilities Coordination Committee (UCC) and its standing subcommittees. All utilities franchised by the City and operating within the public right-of-way are members of the UCC. The UCC meets regularly to review and make recommendations to all utilities and the City on matters of utility installations and operations within public rights-of-way. One of the standing subcommittees of the UCC, the Utility Planning Committee (UPC), coordinates all street and utility construction projects.

The DESIGN CONSULTANT assists the CIP Project Manager and provides documents as needed to coordinate with the UPC. During the project planning phase, after the preferred alignment of the project is identified, but no later than the completion of the 30% complete design package, the DESIGN CONSULTANT assists the CIP Project Manager in a formal presentation of the project to the UPC. A similar presentation is made to the UPC with the 90% complete design package.

Figure 12-1
Utility Coordination Process



12.2.2 Utility Research

During design, the DESIGN CONSULTANT investigates existing utilities in the project area and conducts field verification to confirm that utility structures are accurately represented on the drawings. In its investigations, the DESIGN CONSULTANT contacts the public utilities or responsible agencies and obtains the most current maps and descriptions of their facilities. The CIP Project Manager gives the DESIGN CONSULTANT the title and phone number of the contact at each utility. The current (May 1998) list of contacts of public utilities and agencies (excluding divisions of the City of San Diego and other agencies located outside the City limits) is presented in Table 12-1.

The DESIGN CONSULTANT collects as-built information for City-owned improvements, including roads, water pipelines, sewers, storm drains, parks, public buildings and other improvements through the Map Check and Records Section of the Development Services Department.

To facilitate reviews by public utilities and agencies, the DESIGN CONSULTANT develops preliminary plans that show the project limits, centerline, rights-of-way and other pertinent information (i.e., poles, aboveground structures, etc.). Such plans are typically developed by the DESIGN CONSULTANT for the 30% complete design package. Public utilities are asked to mark out all their facilities within the project boundaries, and to respond in writing within 15 days. If no reply is received within that period, the DESIGN CONSULTANT contacts the utility representative. Information received on pertinent existing utilities is included in the 30% complete design package. If conflicts with existing utilities become apparent, the DESIGN CONSULTANT immediately brings the conflicts to the attention of the CIP Project Manager and the utility representative for resolution.

The DESIGN CONSULTANT keeps the CIP Project Manager informed of information obtained from public utilities and agencies. The DESIGN CONSULTANT maintains a file for each public utility and agency, which includes records of all correspondence, submittals and discussions about the project. The DESIGN CONSULTANT conducts QA/QC procedures throughout the design process to ensure that utility coordination requirements are fulfilled.

12.2.3 Potholing

In some cases, potholing is necessary during the design phase to confirm the locations, depths and dimensions of buried utilities. The DESIGN CONSULTANT directs this potholing in accordance with the provisions of its consulting services agreement with the City. All potholing in the public right-of-way is performed in accordance with the requirements of the City Traffic Engineer.

At a minimum, potholing is performed at locations where the proposed facility crosses major existing utilities. In some cases, the identification of potential conflicts may make it necessary to pothole at tie-in points and at additional crossing points, including house connections and service laterals, as well as other sites where the proposed facility is close to an existing utility.

Table 12-1
Utility and Agency Contacts
(Excludes City Divisions and other Agencies Located Outside the City Limits)

Name/Contact	Address	Telephone Nos.
American Telephone and Telegraph Company Underground Cable Department	17096 Thornmint Court Rancho Bernardo, CA 92127	tel. (619) 673-3901 fax (619) 673-4507
Caltrans Director of Engineering	3024 Juan Street San Diego, CA 92186-5406	tel. (619) 688-6721 fax (619) 688-2587
Cox Communications Project Planning Supervisor	5159 Federal Blvd. San Diego, CA 92105	tel. (619) 266-5598 fax (619) 266-5205
ICG Telecommunications Outside Plant Manager Outside Plant Engineer	5375 Mira Sorrento Place, Suite 500 San Diego, CA 92121	tel. (619) 713-1751 tel. (619) 713-1749 fax (619) 713-1703
Kinder Morgan Energy Partners (formerly San Diego Pacific Pipeline) Area Manager	9950 San Diego Mission Road San Diego, CA 92108	tel. (619) 283-6511 fax (619) 285-5706
MCI Investigations Team Leader	2250 Lakeside Blvd. Richardson, TX 75082	tel. (972) 498-5474 fax (972) 498-6044
MFS/World Comm Operations Manager Field Installation Manager	10065 Barnes Canyon Road, Suite A San Diego, CA 92121	tel. (619) 625-6250 tel. (619) 503-4521 fax (619) 625-6260
MTDB Trolley Right-of-Way Manager Right-of-Way Agent	1255 Imperial Avenue San Diego, CA 92101	tel. (619) 557-4566 tel. (619) 557-4549 fax (619) 234-1047
North County Transit Right-of-Way	810 Mission Avenue Oceanside, CA 92054	tel. (760) 966-6504 fax (760) 754-9403
Pacific Bell Governmental Liaison Maps & Requests for As-Builts	4220 Arizona Street, Room 100 San Diego, CA 92104	tel. (619) 574-3777 fax (619) 296-0127
San Diego County Water Authority Director of Right-of-Way	3211 Fifth Avenue San Diego, CA 92103	tel. (619) 682-4190 fax (619) 692-9356
San Diego Gas & Electric Company Real Estate Operations	101 Ash EB-5B San Diego, CA 92101	tel. (619) 696-2490 fax (619) 696-2595

Name/Contact	Address	Telephone Nos.
Southwestern Cable TV/Time Warner Director of Construction	8949 Ware Court San Diego, CA 92121	tel. (619) 635-8366 fax (619) 635-8775
Sprint Outside Plant Engineer	1750 West Penhall Anaheim, CA 92801	tel. (714) 520-9698 fax (619) 533-6998
Teleport Communications Group/AT&T Operations Supervisor	5355 Mira Sorrento Place, Suite 700 San Diego, CA 92121	tel. (619) 812-0125 fax (619) 812-0084
Underground Service Alert Administrative Assistant President	3030 Saturn Street, Suite 200 Brea, CA 91821	tel. (800) 422-4133 tel. (714) 528- 0322

12.2.4 Utility Coordination for the 90% Design Complete Package

The CIP Project Manager submits the 90% design complete drawings and specifications to public utilities and agencies for review and comment. The CIP Project Manager may elect to submit drawings and specifications at an earlier stage of completion if a public utility or agency so requests. In such event, the DESIGN CONSULTANT makes the drawings and specification available to the CIP Project Manager. In addition, the CIP Project Manager informs public utilities and agencies of project status, possible delays, advertising date, construction schedule and any other information necessary to establish tentative work schedules for any necessary utility relocations.

Each utility representative is requested to respond in writing to the CIP Project Manager within 30 calendar days of receipt of the 90% design complete drawings and specification. The CIP Project Manager transmits these responses in turn to the DESIGN CONSULTANT. As appropriate, the DESIGN CONSULTANT responds to the comments through the CIP Project Manager and modifies the construction Contract Documents accordingly.

12.2.5 Utility Relocation

The DESIGN CONSULTANT meets with public utilities and agencies as necessary during the design process to gain an understanding of the requirements, concepts, concerns and approaches of each utility company or agency. Early contacts with public utilities and agencies are strongly recommended. The DESIGN CONSULTANT documents all discussions with utilities and agencies, and forwards copies to the CIP Project Manager upon request.

In the case of conflict with an existing utility that could necessitate its relocation, the CIP Project Manager investigates the utility franchise conditions and Public Utility Commission rules governing prior rights and who bears the expense of relocation. Based on these findings, the DESIGN CONSULTANT coordinates with the CIP Project Manager to select the facility alignment. In all cases, the DESIGN CONSULTANT locates proposed facilities to minimize disruptions and modifications of existing utilities.

If a public utility or agency is determined to be responsible for the relocation of its facility, the CIP Project Manager requests, within 60 calendar days of receipt of the 90% design complete drawings and specifications, that the public utility or agency develop plans for its relocation. The CIP Project Manager monitors the progress of the public utility or agency in the design of its relocation, noting and adjusting for any scheduling changes or difficulties in the relocation project. Relocation projects by public utilities or agencies are often discretionary actions, such as obtaining railroad permits or acquiring additional right-of-way, etc., and may also induce unwanted delays. The CIP Project Manager should be proactive where utility relocations are concerned, and negotiate scheduling requirements for utility relocations with the respective utilities or agencies where required.

While the CIP Project Manager negotiates schedules for utility relocations with the respective utilities, the DESIGN CONSULTANT communicates with the public utility or agency representative during the design phase of the relocation to resolve potential conflicts.

Attachment 12-1 is a document titled "Agency's Public Work Improvement Projects Project Flow with Utility/Franchise Operations." It is an agreement between public utilities regarding the review of improvement plans, and is included for information only.

12.2.6 Utility Coordination for the 100% Design Complete Package

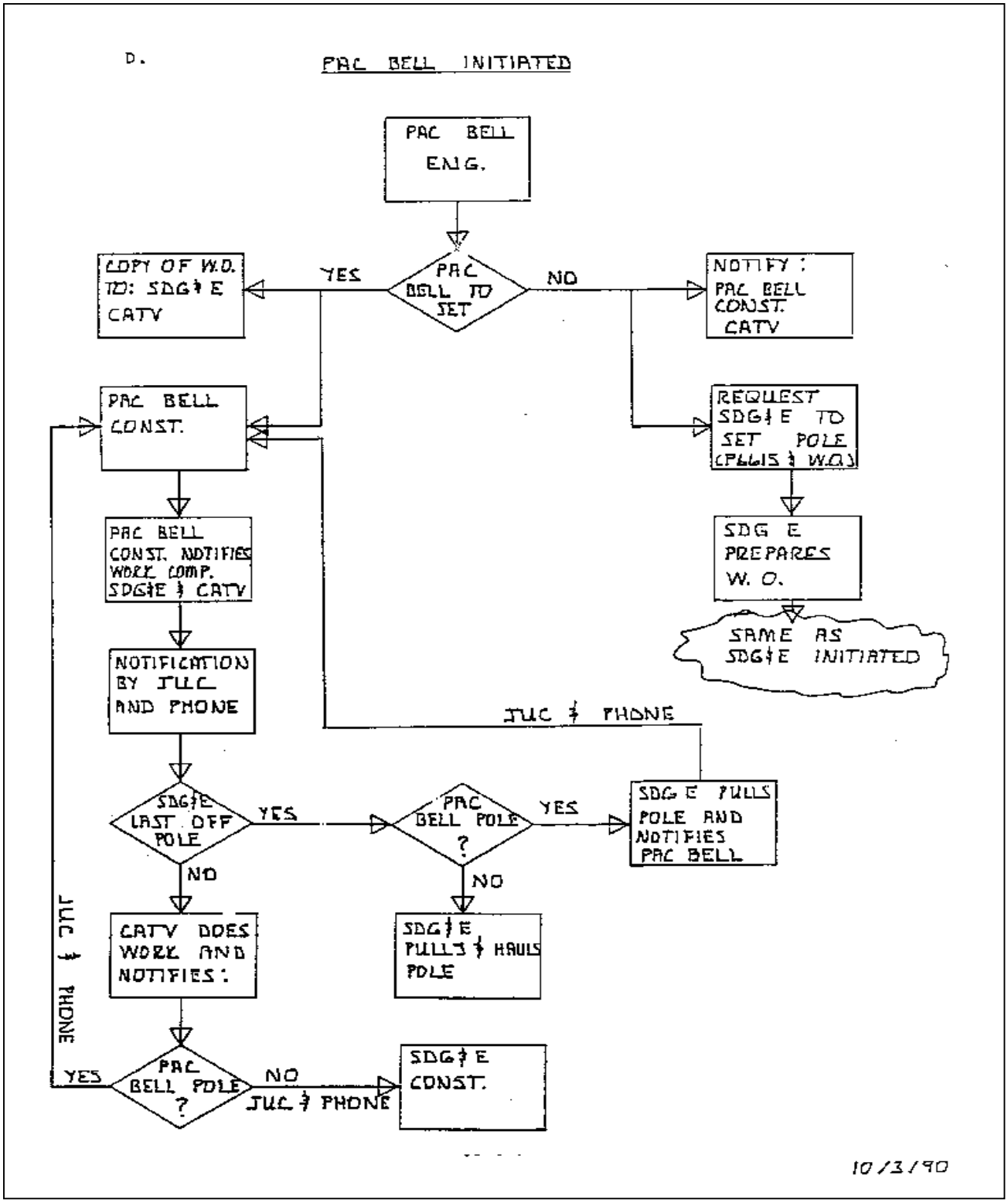
The CIP Project Manager forwards the 100% design complete drawings and specification to public utilities and agencies and outlines in writing any changes since releasing the 90% design complete drawings (i.e., engineering design, bid date, construction schedule or any foreseeable delays in the project due to public hearings, etc.). Each public utility and agency is asked to respond in writing within 10 calendar days of receipt of the 100% design complete drawings and specification, confirming the schedule of relocation construction. Significant changes between the 90% and 100% complete drawings and specification that require reengineering by the utility precipitate the development of a new timetable.

Unless otherwise previously negotiated, public utilities and agencies are requested to implement the relocations within a period of 60 calendar days, or before the work of the City's Construction Contractor begins.

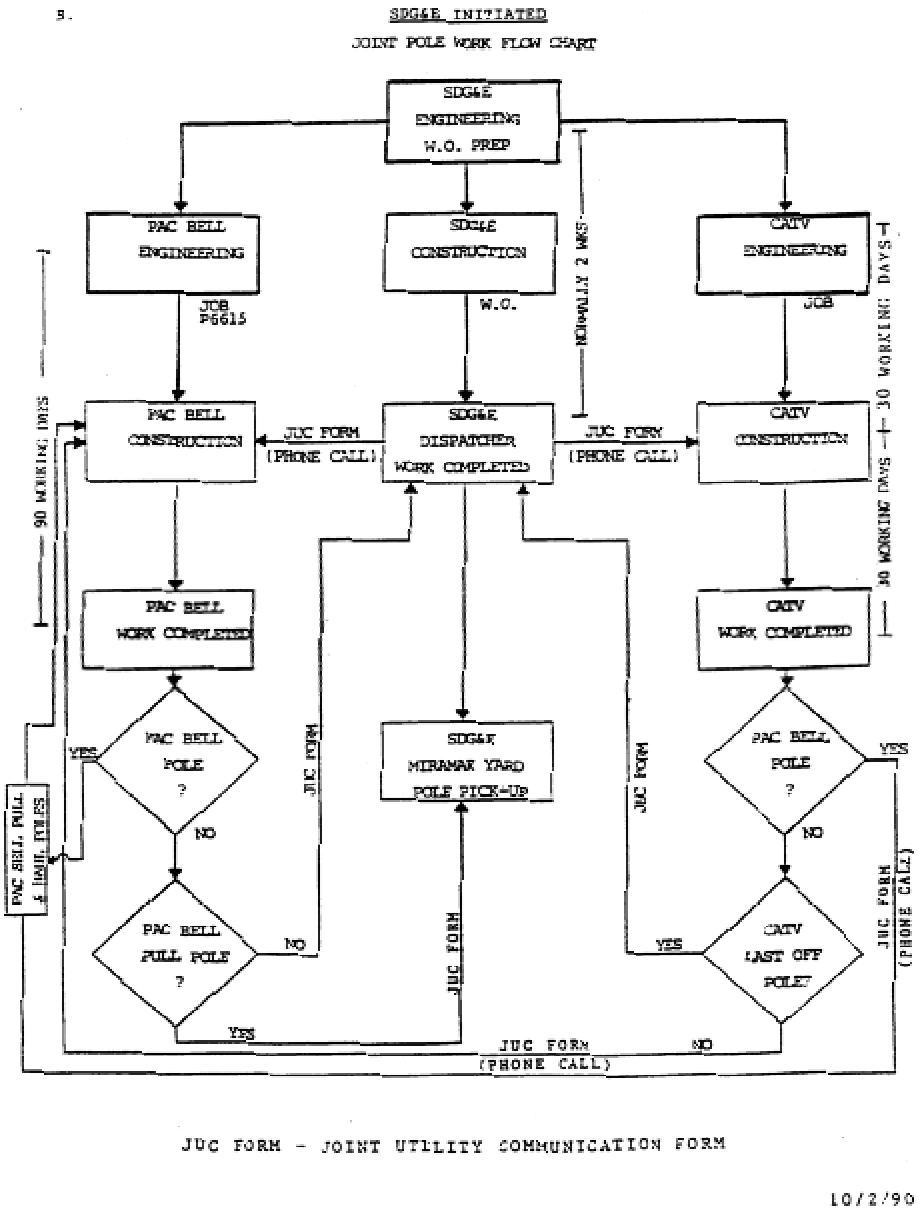
12.3 Other Utility Coordination Requirements

For Water CIP projects designed by public or private entities such as the Water and Wastewater Facilities Division of the City of San Diego's Engineering and Capital Projects Department, or by a private developer, utility coordination is the responsibility of that entity. Each CIP Project Manager in charge of such CIP project ensures that utility coordination is in accordance with Chapter 12 of these Guidelines.

Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations

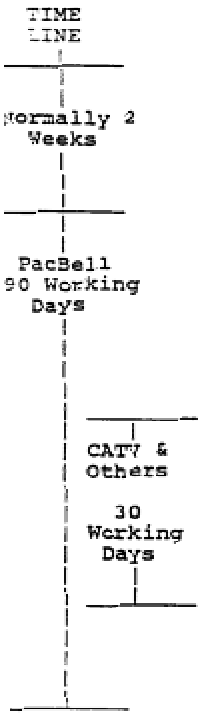


Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued



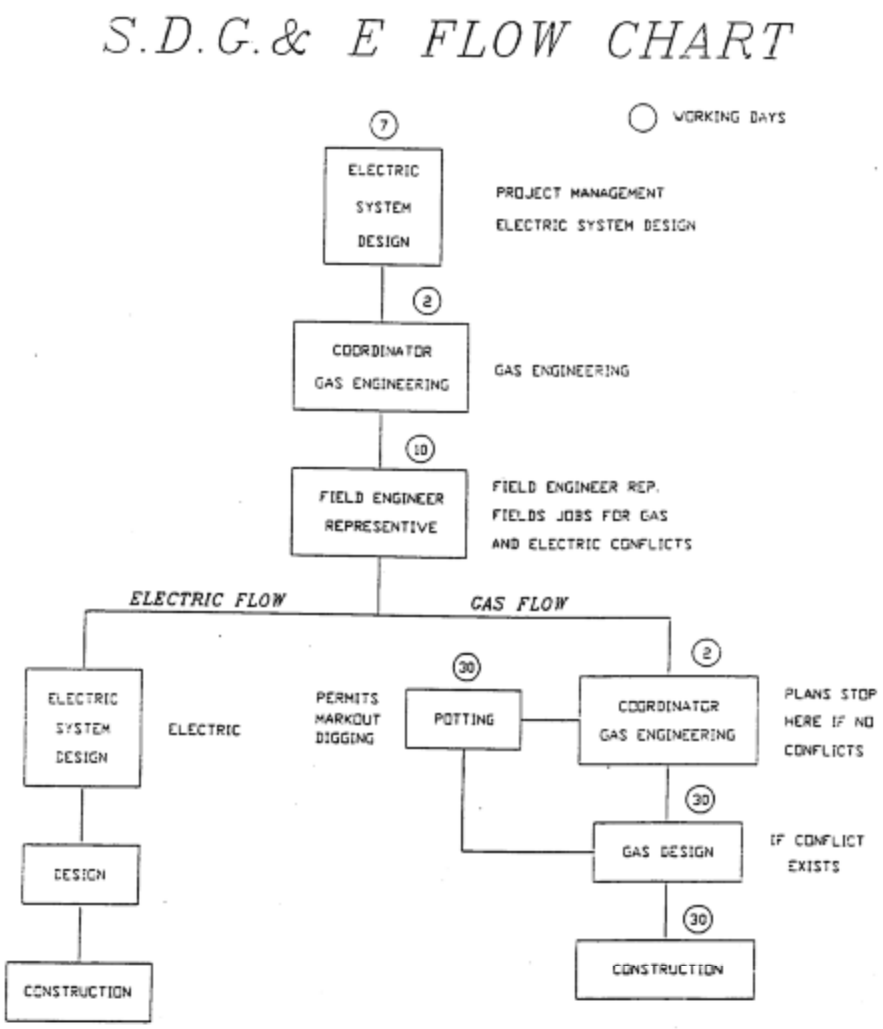
Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued

JOINT POLE WORK FLOW
SDG&E INITIATED



1. SDG&E Engineering prepare work order and plans, and issue to construction.
2. SDG&E sends a set of plans and work orders to Pacific Bell, Cable T.V., and other parties attached.
3. Pacific Bell, Cable T.V. and other parties attached, prepare work order and plans.
4. Pacific Bell, Cable T.V. and other parties attached issue job to their construction department. The job is placed on hold awaiting a phone call and Joint Utility Communication Form from SDG&E dispatcher informing all parties that SDG&E work is completed. Joint meet will be arranged by the construction forces as needed.
5. SDG&E dispatcher calls Pacific Bell, Cable T.V. and other parties attached, and mails the Joint Utility Communication form informing all parties SDG&E work is completed and attachments may be made.
6. Cable T.V. and other parties attached, remove/transfer attachments from old pole, call Pacific Bell, and mail the Joint Utility Communication Form informing Pacific Bell work is completed and removals/transfers may be made.
7. Pacific Bell makes removal/transfer attachments, pulls old pole, and mails the Joint Utility Communication Form to SDG&E confirming the work has been completed.
8. If pole is owned by SDG&E and can not safely be left behind, Pacific Bell will haul pole to Pacific Bell yard and notify SDG&E Miramar.

Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued



Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued

AGENCY'S PUBLIC WORK IMPROVEMENT PROJECTS
PROJECT FLOW WITH UTILITY/FRANCHISE OPERATIONS

1. Agency mails utility information request to utility/franchise operator.

2. Utility/franchise operator research for conflicts.

3. Utility/franchise operator returns utility information request with the following information:

   A. ( ) No facilities – No conflicts.
   B. ( ) We have facilities – No apparent conflicts, enclose one set of underground utility/franchise plans.
   C. ( ) We have facilities with apparent conflicts, enclose one set of underground utility/franchise plans.

4. Agency incorporates utility/franchise operator information in preliminary improvement plans and mail to utility/franchise operators.

5. Utility/franchise operators review preliminary improvement plans and prepares preliminary relocation plans.

   a. Negotiate change in agency improvement plans when possible to clear conflicts.
   b. Prepare preliminary relocation plans to clear conflicts.
   c. Preliminary relocation plans are put on hold awaiting agency final improvement plans.

6. Agency mails final improvement plans to utility/franchise operators.

7. Utility/franchise operator finalize their plans to relocate facilities. Bill of material (BOM) is prepared. Bid out relocation of facilities.

8. Utility/franchise operator budget relocation, prepare work orders, and acquire management approvals.

9. Utility/franchise operator issue the relocation plans and work orders to construction.

10. Utility/franchise operator construction schedules relocation to clear conflicts with agency improvement projects.

Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued

PACIFIC BELL
Conversion/Relocation Procedures

1. Receipt and return of utility check (UG only) 2-3 weeks

2. Receipt of preliminary plans from City

3. Pacific Bell field check and await SDG&E preliminary design (if applicable)

4. Start preliminary design process, i.e.:

    a. Layout (8-12 weeks)
    b. Right-of-way (easements)
    c. Planning ($ funding) 30-45 days
    d. Etc.

5. Start preliminary cable design

6. Receipt of final plans from City

7. Receipt of final SDG&E design

8. Design final job and submit for approval (30-60 days)

9. Release job to Construction after receipt of all right-of-way, easements, money, etc.

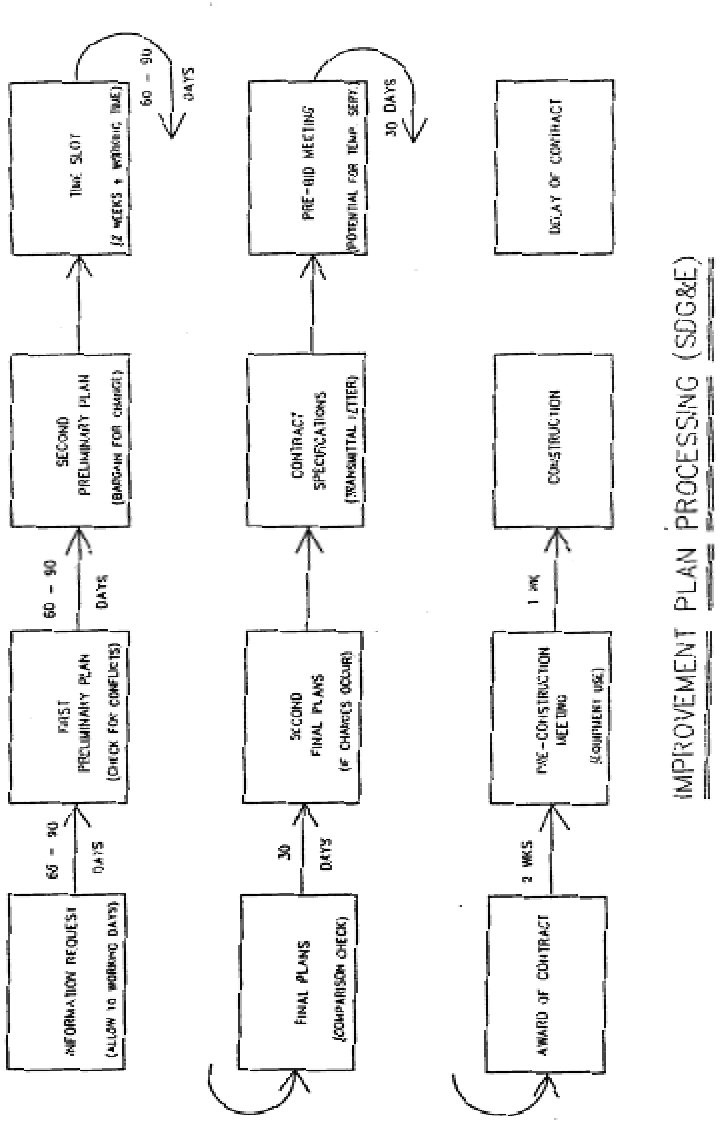
10. Bid process begins (30-60 days)

11. Schedule Construction groups

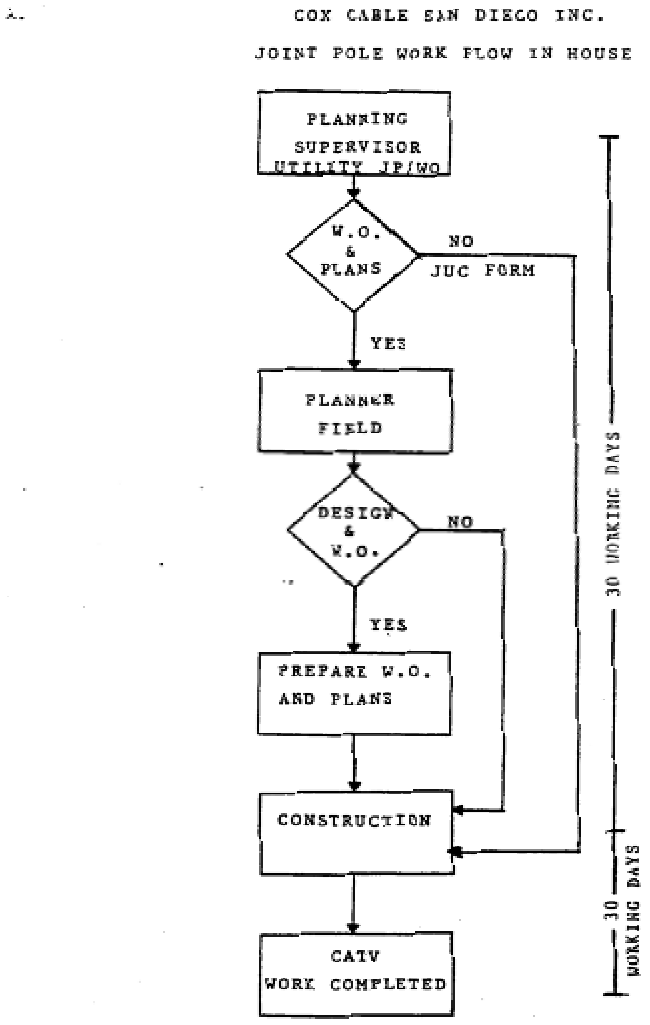
    a. Contract (30-60 days)
    b. Placing (15-30 days)
    c. Splicing (30-120 days)
    d. Line rearrangements (30 days)
    e. Wrecking (7-45 days)

    NOTES: Construction begins **after** completion of other utilities' work.

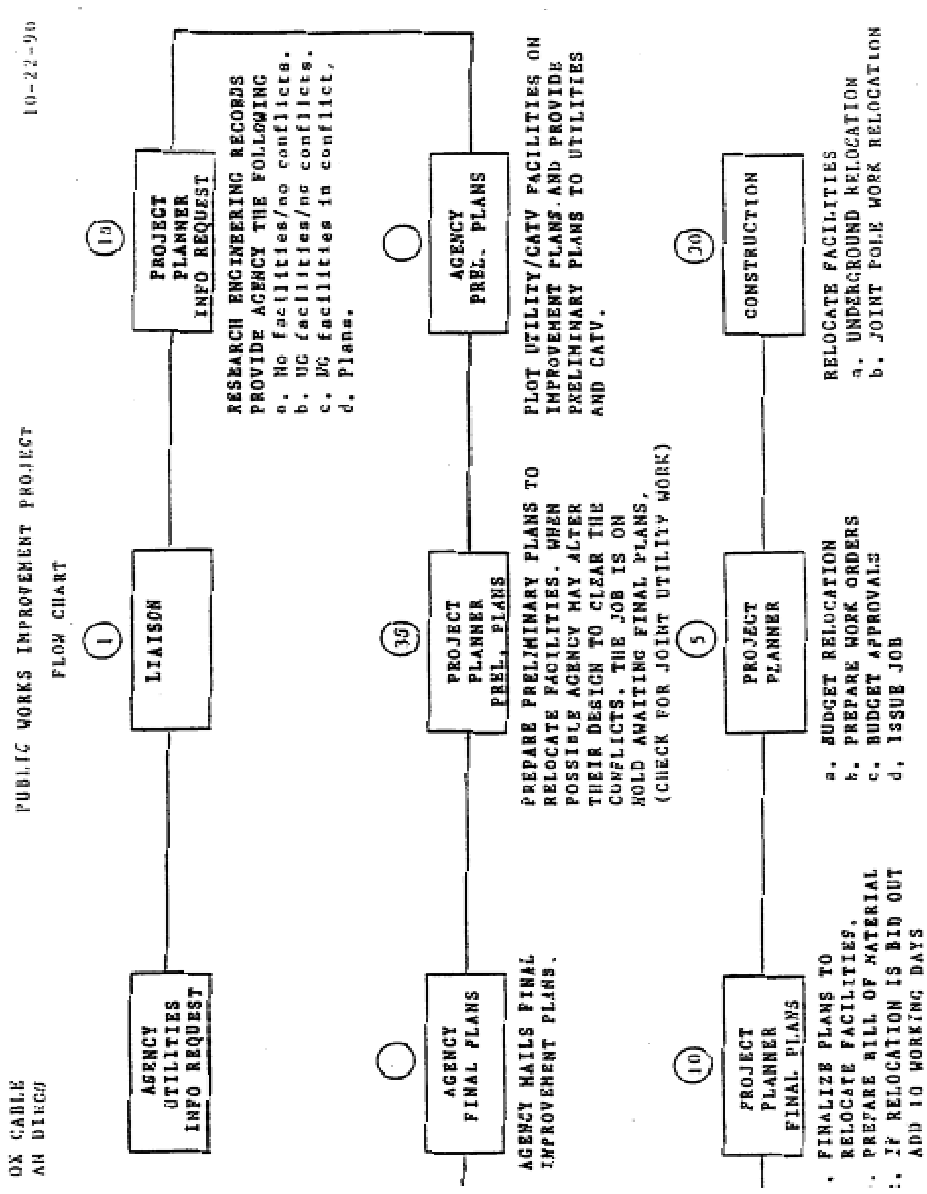
Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued



Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
Continued



Attachment 12-1
Agency's Public Work Improvement Projects
Project Flow with Utility/Franchise Operations
continued



Book 1

General Design Guidelines

Chapter 13
Survey and Mapping

City of San Diego Water Department
Capital Improvements Program

Chapter 13
SURVEY AND MAPPING

13.1 Introduction

This chapter describes guidelines for surveying and aerial mapping to be performed for the Water CIP.

13.2 Surveying During Design

13.2.1 Standards of Work

The Surveyor provides field surveying as required to obtain sufficient information to perform the design. All surveying for design purposes and to determine rights-of-way and land acquisition is in conformance with the state of California Professional Land Surveyors Act and all applicable state and local regulations.

All surveying work is done under the supervision of a licensed land surveyor or a registered civil engineer qualified to practice land surveying in the state of California.

Measurements are made to a precision compatible with a particular problem consistent with the accuracy desired. Measurements are recorded and shown on the final presentation to the number of significant figures representative of the precision of the work.

13.2.2 Horizontal and Vertical Control Surveys

A. Horizontal Alignment Control

Horizontal alignment control is established on the California State Plane Coordinate System, NAD 83, Zone 6, by ties to monuments with values published by the National Geodetic Survey (N.G.S.), San Diego County, City of San Diego, or Caltrans, or established by global positioning systems (GPS), minimum standards per Federal Geodetic Control Committee for Second Order Class II. Horizontal alignment control is established to a minimum accuracy of 1:20,000 (Caltrans modified 2nd order, 2nd class).

The monuments set for horizontal alignment control must be stamped with the license number of the land surveyor in charge. Monuments are spaced at a maximum interval of 1,000 feet with a clear line of sight between them. The Surveyor must establish systematic numbering system for the monuments.

All horizontal control data, including found and set monuments and Basis of Bearings ties, is shown and described on the survey drawings for design. All measurements are to be in decimal feet.

The Surveyor provides a complete listing of control points used, including the following items:

- A person or an agency that established the points
- Order of accuracy
- Description

- Coordinates
- Elevation and datum, if known
- If new control, how it was established, field notes and calculations

B. Vertical Alignment Control

Vertical control is based on the City of San Diego Mean Sea Level (MSL) Datum of 1929 as established by the U.S. Coast and Geodetic Survey. Benchmarks published by the City of San Diego reference this datum.

Control surveys greater than 1 mile in length are tied to benchmarks established within 3,000 feet of the alignment. At least two benchmarks must be used.

Additional benchmarks are tied in at a maximum interval of 5 miles along the alignment. Benchmarks within 1 mile of the alignment must be used.

All vertical control data, including found and set monuments and benchmarks, are shown and described on survey drawings for design. All measurements are to be in decimal feet.

The Surveyor provides a complete listing of benchmarks used, including the following items:

- A person or agency that established the benchmark
- Order of accuracy
- Description
- Coordinates, if known
- Elevation and datum
- If new benchmark, how it was established, field notes and calculations

C. Perpetuation of Monumentation

Sufficient monumentation must be located to determine street centerlines and right-of-way and boundary lines in the project area. All street centerline monuments and right-of-way and boundary monuments at street intersections in the project area must be located and referenced to permanent project control during the field survey for design. Street centerline monuments and right-of-way and boundary monuments are shown and described, with coordinates, on the survey drawings for design.

The control lines and points to which the survey is referenced are marked with physical monuments providing a degree of permanency consistent with the terrain, physical features and purpose of the survey. Sufficient information for all lines and points is shown to allow the efficient retracement of the work. Monuments are shown and described, with coordinate data and elevations, on the survey drawings for design.

The Water CIP Construction Manager ensures that monuments destroyed during construction are properly replaced. Any street centerline monuments and right-of-way and boundary monuments destroyed during construction are replaced in kind by the construction surveyor, who files a Corner Record filed with the County of San Diego in accordance with state and local law.

13.2.3 Field Surveying for Aerial Photomapping

A. Premarking for Aerial Photomapping

All control points, both project alignment control and supplemental photo control, are marked prior to aerial photography. Project control points outside the photo coverage need not be premarked. Markings are centered on the survey point and may not deviate from the center of the point by more than 0.02 foot horizontally. The pattern markings must conform to those used by Caltrans for similar mapping. The Surveyor obtains permission to premark and to dispose of the premark in a satisfactory manner. Photo identification of control points is not allowed without the CIP Project Manager's permission.

The Surveyor provides a complete listing of aerial panels used, including description, coordinates and elevation.

The Surveyor paints a 2-inch-wide outline on the outside edges of all well monuments, valves and manholes, curb inlets and inlet grates found in streets (do not paint on sidewalks). The Surveyor paints 3-inch x 12-inch marks from physical street centerlines toward water meter boxes. White paint is to be used, except on light surfaces, in which case, black paint is acceptable.

B. Data to Supplement Aerial Photomapping

The CIP Project Manager provides a checklist of items to be located and/or delineated on the survey drawings (see Attachment 13-1, Checklist for Surveying and Mapping). This checklist may include property boundaries, street right-of-ways, record utilities, existing structures and improvements, traffic markings and other site-specific features. Some items may be delineated by aerial survey only (see paragraph 13.4, Aerial Photogrammetry); others must be located by supplemental field surveys. These items are noted on the checklist. Elevations are established to an accuracy of 0.01 foot. When supplemental field surveys are made, the field data collected is added by the Surveyor to the aerial survey drawing.

C. Field Verification

To ensure the accuracy and completeness of aerial mapping, the photogrammetrist provides field verification of check prints before they are submitted to the DESIGN CONSULTANT. This requires onsite verification by the Surveyor or aerial mapping consultant to ensure that marked-out utilities or other pertinent surface features that might have been missed or not originally compiled are shown on the check prints. These additional features, if any, are located and plotted within 2 feet of their actual location. This additional information is incorporated into the design file and plotted on the final copy of the check print.

13.2.4 Deliverables

The Surveyor records all pertinent information, measurements, observations and data collection in the field during the survey in appropriate field note form or by other data-recording techniques in a manner intelligible to another surveyor.

The Surveyor provides copies of survey field notes and digital files to the CIP Project Manager and furnishes the survey results in an appropriate form (i.e., CADD drawings, plat maps, cross-sections, diagrams, tabulations, etc.). All items requested in Attachment 13-1 are included. The Surveyor provides other sketches and drawings as required, including City standard formats for B and D drawings, Records of Survey Maps, or Corner Records.

The Surveyor adheres to specified CAD/GIS data file formats (see CIP Guidelines and Standards, Book 5, CADD Standards).

13.3 Aerial Photogrammetry

13.3.1 Standards of Work

The Photogrammetrist adheres to the current edition of San Diego County's Standard Conditions and Specifications for Aerial Surveying and Topographic Mapping unless otherwise specified herein.

All field surveying for horizontal and vertical control, premarking and locating data supplemental to aerial photomapping is performed under the Survey Guidelines established in paragraphs 13.2.2 and 13.2.3.

All mapping adheres to specified CADD data file formats (see CIP Guidelines and Standards, Book 5, CADD Standards).

13.3.2 Items Provided for Photogrammetrist

The following items are provided to the photogrammetrist:

- Map sheets with project locations clearly delineated.
- Specification of photo and mapping scales and contour intervals required.
- Horizontal and vertical control data, in accordance with the specifications in paragraph 13.2.2.
- Checklist for Surveying and Mapping (Attachment 13-1). Checklist of items to be located and/or delineated on the survey drawings.
- CIP Guidelines and Standards, Book 5, CADD Standards.
- Any additional requirements unique to the project.

13.3.3 Requirements of the Photogrammetrist

A. Photography

The photogrammetrist marks a flight plan, including model layout, direction of flight, and location of premarks to be shown on the layout map provided.

All flying for mapping purposes and photographs is done between the hours of 10:00 a.m. and 2:00 p.m. to minimize shadows. The time of flying must be recorded on each negative at the time of exposure.

Flying is done in accordance with San Diego County's Standard Conditions and Specifications for Aerial Surveying and Topographic Mapping, with the following exceptions:

1. The camera must have forward motion compensation and be equipped with electronic exposure system (built-in light meter).

2. The camera must have a 6-inch nominal focal length and use 9-inch x 9-inch film format for taking vertical exposures. Film yielding a 9-inch by 18-inch image may not be used.

On all strip mapping or on other mapping as shown or deemed necessary an additional exposure must be taken at each end of the requested mapping area.

The following information must appear on all negatives used for mapping or photographs:

1. Date
2. Photo scale
3. Project name
4. Negative number
5. Flight line
6. Exposure number

Two sets of 9-inch x 9-inch color prints with glossy finish and all negatives must be provided.

Two color photographs of the area shown on the map sheet must be provided. Photographs must be at 1" = 100' scale and be approximately 40-inches x 40-inches in size. Enlargements are printed on double weight semi-matte paper.

All color contact prints and photo enlargements are submitted to the CIP Project Manager immediately after flying and processing.

B. Mapping

If an analytical solution for mapping is used, analytical measurements are made on analytical stereoplotters or comparators having the precision necessary to achieve nationally accepted x, y, and z accuracies. This work is performed in accordance with Section 72 of the San Diego County standard specifications, except that the last line of 72.307 is changed to read: "In no case shall the targeted points of basic control be farther apart than three (3) stereoscopic models."

All underground utilities and surface features, i.e., sewer manholes, gate valves, etc., are premarked with paint and color coded per utility. All photography is in color using the appropriate City of San Diego color/symbology tables.

Mapping includes all checked items on the City's Checklist for Surveying and Mapping (Attachment 13-1) as well as various street spot elevations, grid coordinates and contour index elevations.

All mapping and digital mapping must conform to CIP Guidelines and Standards, Book 5, CADD Standards.

C. Digital Mapping

Survey control for the Water CIP is established using the global positioning system (GPS) and digital mapping is based on the California Coordinate System, Zone 6, NAD83 Coordinate Base. Intergraph design files must have a Global Origin of x=+6165251.6353, y=+1772251.6353 and z=-214748.3648 to allow for the NAD83 coordinate values.

Intergraph Design File working units are 1, 10, 1000 - i.e., Feet (Master Units), 10ths of a foot (sub-units), and 1000ths of a foot (positional units). Use an apostrophe (') symbol for foot annotations, and (th) for tenths annotations in working units tutorial. (Note: These parameters are provided in N83seed.dgn).

The appropriate City of San Diego cell library, level scheme and seed file parameters are used to place elements in the design file, with strict adherence to Working Units and seed file Global Origin. Base map level schemes are provided in these CIP Guidelines and Standards, Book 5, CADD Standards. A diskette containing the most current version of these seed files and cell libraries is provided to the aerial photogrammetrist upon request.

All graphic elements in the project design file adhere to appropriate MicroStation element definitions to allow for error-free translation of design files from 3D to 2D. If the design file has incorrect element definitions which produce errors in either the 3D to 2D file translations, or produce errors when used with other Intergraph software, the aerial contractor must correct any errors or deficiencies in the design file related to incorrect graphic element definitions.

To prevent project delays, each design file must be reviewed using an appropriate file checking software (e.g., MicroStation EDG or Axion File Fixer). This step helps to identify and correct any element definition and/or design file format errors before the files are sent to the City.

Digitized graphic data files of the topographic mapping are 3D DGN format for Intergraph Systems software, furnished on DOS 32 inch HD, CD-ROM, standard Zip drive, or other agreed upon media. Limit individual DGN files to 7.7 MB. If Zip diskettes are provided due to design file size, the type of Zip or compression utility used is to be clearly noted on the diskette. The DOS version must be 3.30 or higher. Diskettes are furnished to the City with each check print and with the final submittal. The final deliverable is also provided in DWG format, version 12 or higher.

A separate Breakline/Spot elevation (DTM) file is provided containing all planimetric and topographic features necessary to create an accurate digital terrain model (DTM) of the aerial mapping area also in Intergraph 3D DGN format. The contours shown are generated from this DTM data.

This DGN file has unique level and symbology structures per the DTM file level (refer to CIP Guidelines and Standards, Book 5, CADD Standards).

Attachment 13-1
Checklist for Surveying and Mapping

Project Name:_____ Date: _____ W.O. _____

The following items must be shown on all survey drawings/documents.

1. Surveyor's name, address, telephone number, registration number and date of expiration, and signature and seal.

2. Date of field work and surveyor's file names.

3. Location description of project referenced to title description (council district #) and geographic location Lambert Coordinate (L.C.) Index.

4. Statement describing the survey technique used to accomplish the work (e.g., "This map was prepared by photogrammetric methods," "Topography by total station and data collector," etc.).

5. Identification of the horizontal and vertical datums to which the work is referenced and specific descriptions of the monuments used to establish the reference.

6. North arrow and scale.

7. Pertinent dimensions and directions with sufficient notations to identify their source.

8. All pertinent monuments found or set, with notations indicating which were found and which were set, with identification of character. Found monuments are accompanied by a reference to their origin. If no documented reference is available, so state.

9. Sufficient information for all control lines or points to which the survey is referenced is shown to allow the efficient and exact retracement of the work.

10. Any compiled data of an information type is noted to the source and authority of the data and to what degree the information was verified (e.g., "Sewer information shown hereon was obtained from the as-built plans on file with the office of the City Engineer; manhole locations and invert elevations were field verified.")

11. Identify data intentionally excluded from the survey, such as easements and setbacks.

12. The following statement:

    This survey was made by me or under my direction on date of survey.

    *Signature*_____

    Print name L.S. No. Date

13. If the presentation consists of more than a single document, all material furnished is adequately indexed and cross-referenced.

Attachment 13-1
Checklist for Surveying and Mapping
continued

Project Name:_____ Date: _____ W.O. _____

The items checked below must be located/delineated on the survey drawings. Aerial mapping may be used. Also see attached marked up project drawings.

_____ **Mapping Specifications**
Drawing Scale: 1" = ____ feet
Contour Interval: _____ feet
Supplemental Spot Elevations (specify): _____
Orientation of North: _____
NAD83 Coordinates Yes_____ Other _____

_____ **Existing Structures and Improvements**
Describe and show on the attached project drawing the limits of the area in which existing structures and improvements are located. Specify if record locations of items may be used or if actual locations must be determined.

_____
_____
_____
_____

_____ **Buildings** (specify "building fronts only" or "all corners")(If plotted from aerial survey, provide precise location from field measurements)

_____ **Pavement Items**
_____ Edge of Paving
_____ Curb Lines
_____ Curb Islands
_____ Sidewalks
_____ Driveways

_____ **Utility Items**
_____ Drainage Grates and Inlets, Manholes, Cleanouts
_____ Water Gate Valves, Manholes, Meters, Fire Hydrants
_____ Irrigation Control Valves, Sprinkler Heads
_____ Sewer Manholes, Cleanouts
_____ Gas Valves, Meters
_____ Cable TV, SDG&E, Telephone Risers, Vaults, Poles, Overhead Wires
_____ Street Light Standards

_____ **Traffic Control Items**
_____ Traffic Signals
_____ Traffic Actuators
_____ Traffic Signal Control Boxes
_____ Stop Signs, Speed Limit Signs, Street Signs

Attachment 13-1
Checklist for Surveying and Mapping
continued

Project Name:_____ Date: _____ W.O. _____

_____ **Traffic Markings**
Describe and show on the attached project drawing which traffic markings are to be located (e.g., centerline striping, direction arrows, turn lanes, cross walks, bike lanes, etc.):
_____
_____
_____
_____

_____ **Miscellaneous Features**
_____ Fences/Gates
_____ Trees
_____ Walls
_____ Other (describe and show on attached project drawing)
_____
_____
_____
_____

_____ **Other Site-Specific Features** (i.e., accident site features, erosion, etc.)
Describe and show on attached project drawing which features are to be located:
_____
_____
_____
_____

The items checked below must be field-measured and delineated on the survey drawings. Also see attached marked up project drawings.

_____ Precise location of buildings (vs. building/roof lines from aerial mapping)

_____ Elevations of hard surfaces to be matched, met or overlaid (e.g., concrete slabs, cross gutters, street centerlines, top of curb, flowlines of gutters, and finished floor)

_____ Elevations of manhole rims

_____ Invert elevations, size, and direction of flow of sewers and storm drains

_____ Location, invert elevations and size of culverts

_____ Identification numbers of power and telephone poles and location of guy anchors

_____ Centerline location, diameter and species of trees with diameters greater than 4 inches

_____ Location, size, shape and elevation of any other topographic features not shown on the aerial photomapping

Attachment 13-1
Checklist for Surveying and Mapping
continued

Project Name:_____ Date: _____ W.O. _____

_____ Other items to be field measured:
_____
_____
_____
_____

The items checked below must be shown on the survey drawings. Also see attached marked up project drawings.

_____ **Street Right-of-Way, Property Lines, Easements**
Describe and show on the attached project drawing which street right-of-way lines, property lines, and/or parcel boundaries are located and the limits of the property and right-of-way to be located. Provide Title Reports. Specify if record widths of right-of-way may be used or if actual property lines must be determined.
_____
_____
_____
_____

_____ **Utilities Research and Plotting**
Obtain record drawings and plot main utilities and/or services and laterals as checked below (see attached project drawing for locations):

Utility	Main	Service/Lateral
Sewer		
Water		
Gas		
Electric		
CATV		
Other		

_____ **Potholing to Locate Utilities**
(see attached project drawing for locations):

Utility	Main	Service/Lateral
Sewer		
Water		
Gas		
Electric		
CATV		
Other		

Requested by: _____

Book 1

General Design Guidelines

Chapter 14
Geotechnical

City of San Diego Water Department
Capital Improvements Program

Chapter 14
GEOTECHNICAL

14.1 Introduction

The purpose of these guidelines is to give the DESIGN CONSULTANT the basic information required for geotechnical reports, testing services and hazardous materials reports for pipelines, pump stations and storage facilities.

The type of report required for each project depends on the site location and project scope. For example, the report required for a grading permit is determined by consulting the City of San Diego's Seismic Safety Study report and the accompanying maps of geotechnical land use, geologic hazards and fault locations, while the report required for building permits is specified in Section 91.2905(H) of the San Diego Municipal Code. In addition, as applicable, the geotechnical report must adhere to requirements outlined in the Coastal Zone Implementing Ordinance, City of San Diego Municipal Code, Section 101.0480, and the Hillside Review Overlay Zone Resource Protection Ordinance, City of San Diego Municipal Code, Section 101.0454.

Before submitting reports to the CIP Project Manager, the DESIGN CONSULTANT ensures that all topics covered by these guidelines have been addressed and that applicable recommendations in the reports are included in the Construction Contract Documents. If an item is not in the report, it is assumed that the investigating geotechnical engineer did not recognize a problem in this area. All geotechnical reports submitted to the CIP Project Manager are signed by a geotechnical engineer registered in the state of California, giving his/her professional registration number.

Preliminary (predesign level) geotechnical and hazardous materials site assessment reports are prepared and made available by the CIP Project Manager to the DESIGN CONSULTANT prior to detailed design.

These geotechnical guidelines were developed with reference to the following documents and information:

- City of San Diego, Technical Guidelines for Geotechnical Reports.
- City of San Diego, Metropolitan Wastewater Department, Clean Water Program Guidelines.
- Uniform Building Code.
- City of San Diego Subdivision Ordinance
- City of San Diego Municipal Code
- Currently accepted good engineering practice.

14.2 Types of Reports

Reports come in four types: Geotechnical, As-Built (As-Graded), Seismic, and Hazardous Materials. Geotechnical and As-Built reports are required on all projects. The Seismic report is required in areas dictated by local or state regulations (for state of California regulations, refer to Preliminary Review Map of Proposed Special Studies Zones pursuant to the Alquist Priolo Special Studies Zone Act, May 1, 1991). The Hazardous Materials Report is required if recommended in the predesign report or when specifically required by the City. Brief descriptions of the four types of reports follow:

Type I *Geotechnical Report* – This report includes detailed geotechnical information and an in-depth study of regional and onsite geology. The report is based on a review of available reference material, visual reconnaissance and detailed geologic mapping and subsurface exploration. This report contains the signatures and registration seals of both a Certified Engineering Geologist (CEG) and a Geotechnical Engineer (GE) or Registered Civil Engineer (RCE).

Type II *As-Built (As-Graded) Report* – This report reflects any special problems encountered and/or any changes made during the construction phase, and includes the final design recommendations for the project, based on actual finished grade conditions. It includes a summary of in-place and laboratory compaction test results. An As-Built Report is required for all projects for which a Geotechnical Report is required. This report contains the signature and registration seal of a person with the same level of registration and/or certification as the author of the Geotechnical Report.

Type III *Seismic Report* – This report is required where state regulations require special seismic investigations because of the proximity of the property to a potentially active or active fault. The report includes all investigations and analysis required in a Geotechnical Report, plus any special state requirements. This report contains the signature and registration seal of both a CEG and a GE or RCE.

Type IV *Hazardous Materials Report* – This report presents the findings and recommendations of the second phase of hazardous materials investigation. The work includes subsurface investigation as indicated. The extent of investigations is as recommended in the project Predesign Report and as described in these guidelines. This report contains the signatures and registration seals of a CEG or Registered Geologist, and a GE or RCE.

14.3 Type I – Geotechnical Reports

Geotechnical Reports are organized in four sections: general information, field investigation, engineering/material characteristics and testing, and foundation design criteria. The Seismic Safety Element for the City of San Diego and/or Sections 91.2905, 101.0480 and 101.0454 of the San Diego Municipal Code are referred to, as applicable, in preparing Geotechnical Reports.

14.3.1 General Information

The following information is provided in Geotechnical Reports for all types of projects:

1. Signatures and professional registration numbers of the project GEG and the GE or RCE.

2. Job/project address.

3. Location description and/or location index map with north reference, bar scale, etc.

4. Source of base map with date, including from what information the map was made (e.g., aerial, land survey, etc.) and when it was last updated.

5. Description of site conditions (topography, relief, vegetation, man-made features, drainage and watershed).

6. Proposed grading (general scope, amount, special equipment and/or methods if applicable, and appropriate shrinkage factor to use).

7. Description of project and planned construction (type of structure and use, type of construction and foundation/floor system, number of stories, estimated structural loads).

8. Description of geologic setting, geologic structure and site specific geologic conditions particularly as they relate to the proposed project.

9. References to previous geologic and geotechnical reports (or published papers) and aerial photo of site area.

10. Discussion of topographic features and relationship to site geology (outcrop distribution, slope height and angle and/or ratio, dip slopes, cliffs, fault contacts, erosion patterns, etc.).

11. Description of site conditions, including distress to existing improvements in area (expansive, settlement/subsidence, mass movement, or creep areas), if any.

12. Discussion of proposed grading and special grading equipment or methods needed for cemented, saturated, or other unusual materials or situations.

13. Proposed grading methods in areas of abundant cobbles, including discussion of source and percentage required of fine matrix material for reuse as suitable fill and backfill material.

14. Proposed rock disposal methods (for clasts and residuals larger than 12 inches). Location of rock disposal areas included on geotechnical map, if disposal area is on site.

15. Discussion of presence and extent of existing fill soils (include associated documentation), if available.

16. Evaluation of excavation characteristics of onsite materials, including a rippability study, if needed.

17. Discussion of earthwork and grading, including general recommendations for site preparation, areas requiring remedial grading and/or special treatment (e.g., removal of unsuitable material, slope stabilization, compaction of soil on slopes, oversize rock placement, dewatering and other conditions).

18. General discussion of soil conditions for selected pipeline route, plant site, or reservoir site, including summary of existing available geotechnical data, evaluation of expansive potential of the onsite soils, and suitability of the existing material for use as fill and backfill.

19. Stability evaluation of site; slopes, tract boundary areas, etc.

20. General discussion of groundwater conditions including groundwater levels, groundwater quality, potential for natural or artificial seepage effects in the future, and anticipated seasonal changes.

21. Discussion of dewatering requirements.

22. Discussion of suspected soil and/or groundwater contamination.

23. Evaluation of scouring potential at river crossings; evaluation of erosion potential in adjacent waterways.

24. Discussion of flooding, surface water runoff, drainage and erosion and mitigation measures, if applicable.

25. E' (modulus of soil reaction, lb/sq in) values for backfill of various excavated soils and of various depths of cover.

26. Presence and influence of other major pipelines.

27. Discussion of site conditions with respect to tunneling, including:

    - Ground conditions
    - Excavation characteristics
    - Small tunnel criteria; jack-and-bore characteristics
    - Ground behavior
    - Rock mass discontinuities
    - Groundwater
    - Shaft/portal configuration
    - Construction staging areas
    - Tunnel excavation
    - Initial support requirements
    - Final tunnel lining

- Muck disposal
- Instrumentation
- Other considerations (noise, groundwater discharge, air quality, traffic, etc.)

28. Discussion of potential geologic hazards including evaluation of potential impacts of onsite geologic constraints such as faulting, ancient landslides, or other adverse geologic conditions. Include an assessment of the type and degree of hazard and recommendations for measures to mitigate or reduce hazards.

29. Seismic evaluation, including information on local and regional seismicity, proximity to known or suspected faults, estimated levels of strong shaking during project design life, and potential for seismic-induced ground failure (liquefaction, seismic settlement, lateral spreading, ground rupture, lurching, and other seismic effects). Include calculation/estimation of the Upper Bound Earthquake (Maximum Credible Earthquake) for earthquake faults occurring within a 100-km radius of the site. Provide:

    - The potential ground acceleration having a 10 percent probability of exceedance in 50 years.

    - The potential ground acceleration having a 10 percent probability of exceedance in 100 years or the maximum level of motion which may ever be expected at the project site within the known geological framework (i.e., the ground acceleration associated with the Upper Bound Earthquake).

    - Seismically induced lateral earth pressures; seismic response spectra for 0.5 percent, 2 percent, 5 percent and 10 percent damping.

    Address methods to mitigate potential seismic effects.

30. Allowable lateral soil bearing pressures at a depth of approximately 4 feet below ground surface for design of restraint systems for buried pipe (thrust blocks, etc.).

31. Statements as to adequacy of site for the proposed development, including an evaluation of potential geologic hazards/adverse geologic conditions identified at the site, an assessment of the degree of hazard, and recommendations for measures to mitigate or reduce hazards.

14.3.2 Field Investigation

The geotechnical field investigation is planned to provide information for geotechnical analysis and design and, as appropriate, for the evaluation of potential soil/groundwater contamination. The scope of the field investigation may include the following activities, with the results presented in the Geotechnical Report.

1. Geologic reconnaissance and geologic mapping along the pipeline route or at the pump station, reservoir, and/or plant site. Reconnaissance includes a review of available topographic and geologic information, aerial photographs, and available data of and near the project site.

2. Subsurface exploration and soil/rock sampling. The geotechnical engineer recommends the type, number, and depths of subsurface explorations and the number and type of soil/rock samples with approval from the DESIGN CONSULTANT. The geotechnical engineer determines intervals between test borings for pipeline alignments with approval from the DESIGN CONSULTANT. The spacing of test borings along a pipeline alignment varies depending on site conditions and proposed design. These borings typically extend approximately 7 feet below preliminary pipe invert elevations; however, deeper explorations are performed if necessary. Field screening procedures may be used for preliminary evaluation of possible contamination.

3. Groundwater monitoring using wells or other appropriate methods for groundwater sampling. Document well design, development and sampling protocol, and sampling interval/duration.

4. Soil corrosivity survey including field resistivity survey using the Wenner method or other resistivity probe methods.

5. Observation of possible contamination. If during subsurface investigations, field personnel suspect soil or groundwater contamination, document the possibility on the boring logs or other field notes.

6. Other field exploration (as necessary or appropriate) such as trenching, large diameter test borings, cone penetration tests, and/or geophysical surveys.

The following items, addressed during the field investigation, are discussed in the Geotechnical Report.

1. Scope (date work done, investigative methods, sampling methods, logs of exploratory excavations, actual or assumed elevations of excavations for reference of material and samples to finished grade or footing elevations).

2. Physical properties of soils, alluvial deposits, colluvial deposits, and other earth materials encountered.

3. Geomorphic features that suggest the presence of landslides, mud/debris flows, faults, near surface groundwater, effluent seepage, and/or other possible adverse conditions.

4. Groundwater conditions, such as location of present water level(s), perched conditions, etc.

5. Known differences of opinion with recently available geologic reports or published data or maps of the site.

6. Earth materials (bedrock and surficial units).

- Unit classification, general lithologic type, and geologic age.
- Unit description and characteristics (in sequence of relative age) including:
  - Composition texture, fabric, lithification, moisture, etc.
  - Pertinent engineering geologic attributes (clayey, weak, loose); degree of cementation; alignments, fissility; planar boundaries; permeable or water-bearing zones; susceptibility to mass wasting, erosion, piping, or compressibility.
  - Distribution, dimensions, or occurrences (supplemental to data furnished on illustrations).
  - Suitability as construction and foundation material.
  - Effects and extent of weathering (existing and relationship to project design and future site stability, material strength, etc.).

7. Geologic structure
   - General geologic structure.
   - Distribution of structural features including position, attitude, pattern and frequency of:
     - Fissures, joints, shears, faults, and other features of discontinuity.
     - Bedding, folds, and other planar features.
   - Character of structural features including continuity, width of zones and activity, dominant vs. subordinate, planar nature, plunge, depth, degree of cementation or infilling, gouge.
   - Structural-sections or cross-sections (one or more appropriately positioned and referenced on map; especially through critical areas, building pads, slopes, and slides) of suitable size and engineering scale, with labeled units, features and structures, and a legend. These sections should correlate surface and subsurface data showing representative dip components, projections, and stratigraphic/structural relationships; the locations of borings and test sites utilized should be accurately located on the cross sections.
   - Inferred soil profiles along the entire pipeline alignments (these are used for design purposes and by the Contractor for bidding purposes).

8. Stability Features and Conditions

- Adequate mapping, sections, and descriptions showing position, dimensions, and type of existing downslope movement features including soil/rock creep, flows, falls, slumps, and slides, if any.

- Activity, cause, or contributing factors of downslope movement features.

- Recent erosion, deposition, or flooding features.

- Subsidence/settlement, piping, solution, or other void features or conditions.

- Groundwater and surface drainage characteristics or features.

  – Surface expression (past and present); permeability/porosity of near-surface materials.

  – Actual or potential aquifers or conduits, perched situations, barriers, or other contributors to percolation and groundwater movement and fluctuation of groundwater levels at the site.

  – Potential for groundwater migration and its effect on the project.

9. Slope stability analysis (dependent on slope height and ratios, strength of earth materials, internal structure, susceptibility to weathering, actual or potential groundwater, surficial covering, proximity to site improvements or structures); perform appropriate laboratory testing in conjunction with the stability analysis, as deemed necessary by the geotechnical subconsultant (special considerations is given to slopes steeper than 2:1 [horizontal: vertical] and/or in excess of 30 vertical feet in height).

   - Gross stability of natural or man-made slopes with graphics, supporting data, and applicable parameters. Proposed slopes have a minimum static factor of safety of 1.5, and minimum seismic factor of safety of 1.25. Where factors of safety fail to meet those required, mitigating measures (i.e., buttress, etc.) are necessary. Provide stability analysis for mitigating measures. Use an appropriate seismic coefficient in the seismic analysis.

   - Surficial stability of slopes with graphics, supporting data, and applicable parameters. Factor of safety must exceed 1.5. Otherwise appropriate mitigating measures (e.g., buttresses, debris walls, etc.) are required.

10. Surface and subsurface indications of faulting.

11. Retaining walls: design criteria on proposed walls (surcharged or greater than 3 feet in height above the base).

    - Slope surcharge and geologic surcharge factors and parameters.

- Drainage and backfill requirements including suitable drains.
- Allowable bearing values, lateral bearing resistance and coefficient of friction based on testing or UBC (Chapter 29), current edition.
- Lateral earth pressure diagrams for braced and free walls, active and passive pressures and seismic forces on walls.
- Surcharge pressure distribution due to uniform load, live load and point loads through the soil and engineered fill.
- Footing setback from face of slopes, in accordance with Section 2907.D of UBC (Chapter 29), current edition.
- Temporary stability during construction.

12. Plan and coordinate the collection of soil samples with the corrosion control engineer. See paragraph 9.1.1.A of these Guidelines for required corrosion-related information included in the Geotechnical Report.

The following figures are included in the Geotechnical Report:

1. Plan with legend showing site limits, terrain features, man-made features, boring/test pit locations, proposed improvements (including slopes with ratios, soil or formational contacts, daylight lines, paving areas, retaining walls, subdrains, over-excavation, cleanout, and uncompacted fill areas).

2. Logs and location of all borings drilled and test pits excavated (results of laboratory test data location of all samples taken, surface and subsurface conditions and materials).

3. Geologic map showing (as appropriate) site geology, approximate location of proposed keyways, proposed buttresses, proposed or existing subdrains, seeps or springs, etc. The map scale is chosen so that geologic and geotechnical designations are legible. The map contains an adequate legend. The map highlights representative geologic data of sufficient amount and location for the evaluation of general rock or soil unit distribution, geologic structure, downslope movement features (including soil/rock creep), groundwater conditions, subsidence/settlement features or potential, and other pertinent site characteristics. In preparing maps, use the engineering geology map symbols referred to as the Genesis-Lithology-Qualifier System to indicate the age and formation as well as rock type or other distinguishing characteristics.

4. Geologic cross-sections, as appropriate, through pump stations and storage facilities.

14.3.3 Engineering/Material Characteristics and Testing

All Geotechnical Reports contain sufficient laboratory and/or in-situ testing data (if appropriate) to characterize subsurface material and substantiate analyses and calculations from which

conclusions and recommendations are derived. The report includes descriptions of the sample preparation and testing procedures if the tests are not in accordance with the American Society for Testing and Materials (ASTM) standard procedures, International Society of Rock Mechanics (ISRM) procedures, local code requirements, and procedures acceptable to the geotechnical engineering profession. Materials are classified in accordance with the Unified Soil Classification System (USCS).

Note the appropriate designation numbers for ASTM and ISRM procedures or local code requirements. In general, types, numbers and procedures of laboratory testing should represent the site conditions before, during and after site development from a geotechnical engineering perspective. Testing procedures and time of preparation, such as length of saturation time, are in accordance with testing procedures for the type of earthen materials (soil and/or rock) identified by the GE and/or CEG. The Geotechnical Report contains the type or condition of samples, applicable engineering graphics, results of all tests, and locations of all test samples.

Laboratory analysis may include any of the following tests:

1. Material competency and strength.

    - Field densities and moisture content, as well as relative compaction where pertinent.

    - Shear strength parameters of foundation material and those considered in stability analysis (drained or undrained conditions, effective stress or total stress analysis); identify in-situ or remolded samples.

    - Consolidation or settlement potential.

    - Expansion potential by UBC Standard No. 18-2, Expansion Index Test, or other generally accepted method. Provide anticipated at-grade expansion potential for each lot. The test method is described in the report. The criteria as described in the following section, Foundation Design Criteria are based in part on the anticipated expansion potentials and revised as necessary upon completion of grading.

2. Expansion Index (UBC Standard 18-2).

3. Maximum dry density/optimum moisture parameters as determined by ASTM D1557-91, Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18-in (457 mm) Drop.

4. Penetration tests (standard penetration or other method of known correlation to material density).

5. Hardness.

6. Slake-Durability tests.

7. Gradational size analyses.

8. Specific gravity.

9. Atterberg limit analyses and parameters.

10. Appropriate chemical testing including testing of corrosive characteristics of water and soil in contact with pipelines, concrete and utility lines.

14.3.4 Geotechnical Design Criteria

A discussion on the following items, as appropriate, is included in the Geotechnical Reports for the project.

A. Pump Stations and Storage Facilities

1. Footing depth, width, design and placement, and the criteria on which they are based.

2. Criteria for foundation material preparation.

3. Allowable soil bearing capacity at different depths at locations.

4. Requirements of bedding materials and foundation support.

5. Lateral pressures (active, passive, or at-rest conditions) and coefficient of friction.

6. Resistance to lateral sliding.

7. Expected settlement: total, differential, and rate of settlement.

8. Bridging and grade beam recommendations.

9. Prestressed (post-tensioned) flotation slab recommendations, if this system is proposed.

10. Exterior flatwork recommendations.

11. Moisture barriers and/or selective grading (aggregate or sand base or other subbase).

12. Soil moisture measures.

13. Mitigation of cut/fill or other differential transitions beneath improvements.

14. Backfill specifications and recommendations for compaction of utility trenches under structures, pavements, and slopes (minimum recommended percent relative compaction) vs. landscape and other areas.

15. Provisions for final observation and necessary testing during and upon completion of grading.

16. Other pertinent geotechnical information for the development of the site, such as methods of soil treatment for expansive soil.

17. Unsuitable material removal (canyon cleanout, over excavation, etc.).

18. Keyways and benching for existing or proposed slopes.

19. Recommendations for the compaction of soil within the zone of the slope face.

20. Slope stability: susceptibility to mass-wasting (creep to rapid failure potential).

    - Favorable or unfavorable interrelationships of fractures (joints, shears, faults or zones) to planar structures (bedding, contacts, folds, plunges, weathered zones, etc.) and to each other, forming potential failure planes, veneers, masses, or blocks.

    - Favorable or unfavorable interrelationships of geologic structures, conditions, and potential failure planes to natural and/or man-made topography forming actual or potential adverse dips and contracts, adverse fractures (jointing, shearing, faulting), adverse fold limbs or synclinal axes, adverse earth masses or blocks.

    - Favorable or unfavorable interrelationships of height of existing or proposed slopes to present and future strength of earth materials (weathering effects; rate, depth, etc.).

    - Slope stability effects onto or from developed, natural or, if known, proposed slopes of adjacent properties.

21. Opinion and recommendations regarding surficial and gross stabilities of natural and manufactured slopes.

22. Depths observed to competent material and testing methods used to determine material competency.

23. Recommendation for CEG, RCE, or GE to observe excavation of cleanouts and keyways.

24. Suitability of site for geotechnical conditions and proposed development.

25. Corrective or selective grading.

26. Recommendations for subgrade specifications.

27. Soil cement or lime stabilization measures.

28. Rock placement or disposal.

29. Blasting.

30. Irrigation and drainage controls, dewatering, surface and subsurface drains and subdrains.

31. Protection of existing structures during grading.

32. Recommendations for foundation and wall excavation.

33. Shoring requirements.

34. Potential effects extending into the site from adjacent areas, or from the site into adjacent areas, and recommendations for stability, erosion, sedimentation, groundwater, etc.

35. Stabilization measures.

    - Fill blankets for pads or stabilization blankets for slopes.

    - Stabilization fills: recommendations, subdrains, stability analysis and supporting test data and parameters.

36. Fill-over-cut slope recommendations.

37. Subsidence, hydrocompaction and piping potential.

38. Consolidation analysis including estimate of total and differential settlements expected due to site grading and structural loading.

39. Deep foundations, including pile type, size and penetration depth, method of support (friction or end bearing pile) in soil or rock or both, pile capacity and design load in compression and uplift, axial and lateral load deflection evolution, installation recommendations (method, equipment, drivability analysis, the need of pre-drilling or jetting, etc.) and requirements for an indicator pile program and/or pile load test.

40. Recommendations for dealing with contaminated soil and/or groundwater.

41. Pipe bedding requirement and characteristics for pipeline.

42. Corrosivity potential and corrosion protection requirements.

43. Paving section for roads for various traffic conditions.

B. Pipelines and Pressure Control Stations

1. Protection of existing structures during grading.

2. Recommendations for dealing with contaminated soil and/or groundwater.

3. Recommendations for trench excavation.

4. Shoring requirements.

5. Pipe bedding requirement and characteristics for pipeline.

6. Recommendations for E' (modulus of soil reaction) based on pipe depth and backfill type and depth.

7. Soil conditions related to tunneling and pipe jacking, if applicable.

8. Scour potential, if applicable.

9. Paving section for roads for various traffic conditions.

10. Include geotechnical design criteria for pressure control stations associated with pipelines in Geotechnical Reports in accordance with paragraph 14.3.4.A above.

11. Buoyancy potential (for pressure control stations) due to the existing or potential presence of a high water table.

12. Suitability of native materials as backfill.

14.4 Type II -- As-Built (As-Graded) Reports

An As-Built (As-Graded) Report is provided in addition to the Geotechnical Report. Grading operations undertaken according to the approved grading plan are subject to geotechnical observation and testing by a qualified geotechnical engineer (a GE or an RCE and, if geologic conditions dictate, a CEG). The geotechnical engineer reports whether, in his/her professional opinion, the grading operations were performed in compliance with the geotechnical requirements of the grading plans and specifications.

After grading operations are completed, compaction test data and any new recommendations are included in the As-Built Report. If the site grading is done by area or structure, an As-Built Report is provided for each area or structure as the grading is completed.

The following sections describe in more detail the information to be included in the As-Built Report. Items may be deleted from the report if no wok of that type occurred in the actual grading operations.

14.4.1 General Information

The following items are provided in As-Built Reports:

1. Signature(s) and professional registration number(s) of persons of the same level of registration or certification as the parties signing the Geotechnical Report.

2. Job address, lot and tract number.

3. Plan file number.

14.4.2 Placement of Fill

The following items are provided in As-Built Reports:

1. Purpose for which fill was placed.
2. Method of preparation of natural grade to receive fill.
3. Placement of fill (depth of layers, watering, etc.).
4. Equipment used for compaction.
5. Method of compacting and testing the outer slope area.

14.4.3 Compaction Testing

The following items are provided in As-Built Reports:

1. Test procedures used (field and laboratory), including rock corrections, if applicable.

2. Plot plan showing the location of all density tests; the plan should be sized to be easily read.

3. Summary of test results.

    - Test identification number
    - Date test performed
    - Maximum dry density test
    - Optimum moisture
    - Field dry density
    - Field moisture
    - Relative compaction
    - Approximate elevation of test
    - Approximate finish grade elevation at test site

14.4.4 Utility Trench Compaction Testing

The following items are provided in As-Built Reports:

1. Location of test.
2. Depth of test.
3. Method of backfill and compaction equipment.
4. Summary of test results described under Compaction Testing.

14.4.5 Other Testing

The following items are provided in As-Built Reports:

1. Summary of expansion test results (identify areas with swelling potential). Expansivity tests, as described in the UBC Standard No. 18-2 and which are representative of at least the top 3 feet of the finished soil profile throughout the project, are required by the City of San Diego for all projects involving grading covered by Land Development Permit or Subdivision Improvement Agreement. The results of these tests, in the form of a list of areas and representative expansivity indices for the soil of all areas, along with the results of the soil compaction tests, must be included in the as-built soil report for the project.

2. Summary of chemical test results, as required.

3. Summary of corrosion testing results, as required.

14.4.6 As-Graded Conditions

The following items are provided in As-Built (As-Graded) Reports:

1. Plot plan showing limits of the compacted fill area (approximate pad elevation, depth of fill, areas of overexcavation, keys and subdrains). If slope failures occurred during construction, the limits of these failed areas are shown on the plan.

2. Method of treatment of "daylight" or cut/fill transition zones (extent of overexcavation outside of footing).

3. Type of soil encountered and used during grading (fill, native, imported borrow).

4. Groundwater conditions identified and details on subdrains or other methods used to mitigate adverse effects.

5. Geologic conditions encountered, including geologic contacts, structural attitudes, marker beds, faults, and bedding plane shears. Geologic data should be included in areas mapped as fill and in buttress excavations.

6. Comments on changes made during grading and their effect on the recommendations in the geotechnical report.

7. Exploratory borings and trenches performed during grading are shown on the as-graded maps, and logs of these excavations are included in the report.

8. Locations of instrumentation at the site, including settlement monuments, extensometers, piezometers, etc., are plotted on the as-graded maps; results of instrument readings are included in the report.

9. Elevations at the bottom of cleanouts, keyways, or other excavations; these areas are shown on the geologic map.

14.4.7 Recommendations and Opinions

The following items are provided in As-Built Reports if different from the Geotechnical Report:

1. Footing recommendations and bearing value on compacted fill or formational material.

2. Footing and floor slab recommendations based on the results of expansion and soluble sulfate tests (construction details of footing if applicable). Foundation and floor slab design details appropriate for use on soils having an expansive index greater than 20, per UBC Standard No. 18-2, are submitted to the Building Inspection Department as part of the building plans. In lieu of the expansivity index of 20, expansive soils may also be identified by the use of a greater than 2% swell factor, which is determined by the test method prescribed in Chapter 6, Division 7, Title 8 of the San Diego County Code. If the expansion index is greater than 20, or the swell test is greater than 2%, special design considerations as required by UBC 2904 (b) are submitted.

3. Opinion of the suitability of natural soil to support the fill or structure.

4. Opinion of the adequacy of the site for the intended use, as affected by soil engineering and/or geologic factors.

5. Opinion of the gross and surficial stability of slopes; cross-sections prepared during grading for stability calculations are included, as well as a description of the calculation method, summary of calculation results, and conclusions.

6. A statement about whether the soil engineering and geologic aspects of the grading comply with the applicable conditions of the Grading Permit and the geotechnical engineer's and engineering geologist's recommendations.

If in the course of fulfilling their responsibilities, the DESIGN CONSULTANT and geotechnical engineer find that the grading work is not being done in conformance with approved grading plans, they must report discrepancies immediately in writing to the Construction Contractor and the CIP Construction Manager. The geotechnical engineer’s recommendations for corrective measures, along with a report of findings, are submitted to the CIP Construction Manager as construction change drawings. All changes from the original approved grading plan are reflected in the As-Built Report and on the As-Built Grading Plan.

14.5 Type III – Seismic Reports

Seismic Reports (Fault Hazard Reports) are required, as outlined in the Seismic Safety Element for the City of San Diego, in areas where the onsite seismicity is of concern due to proximity to a potentially active or active fault. The following guidelines for Seismic Reports are based on the criteria established by the California Department of Conservation, Division of Mines and Geology, UBC Chapter 23, and City of San Diego Municipal Building Code on liquefaction. The following suggested format and scope are flexible and should be tailored to the site-specific seismic and geologic conditions and intended land use.

14.5.1 General Information

The following are provided in Seismic Reports:

1. Signature and professional registration number of the project CEG and the project RCE, GE or RCE.

2. Job address and location map.

3. Description of the existing general site conditions; description of proposed development or changes in land use, as applicable.

4. A review of existing maps and technical literature to evaluate the seismic or earthquake history of the region; to establish the relationship of the site to known faults and epicenters; and to determine groundwater levels, barriers and anomalies which may indicate the presence of faults. The report should include a discussion of the near-site major earthquakes during historic times, with epicenter locations and magnitudes. The report should also include the location of any major or regional fault traces affecting the site being investigated, and a discussion of the tectonic mechanics and other relationships of significance to the proposed construction.

5. Potential for liquefaction and associated recommendations.

6. A bibliography of the reference material utilized in the study.

7. Geologic map of regional and/or local faults.

8. Map(s) of earthquake epicenters.

9. Fault strain and/or creep map.

14.5.2 Field Investigation

The following is provided as part of Seismic Reports:

1. Location and chronology of local faults and the amount and type of displacement estimated from historic records and stratigraphic relationships. Features normally related to fault activity, including fault scarps, triangular facets, alignment of springs, offset bedding, disrupted drainage systems, closed depressions, fault valleys, offset ridges, faceted spurs, dissected alluvial fans, alignment of landslides, and vegetation patterns should be shown on the geologic map and discussed in the report.

2. Locations of other earthquake-induced features as the result of lurching, settlement, liquefaction, etc. Evidence of these features should be included with the following:

    - A map showing location of features relative to the proposed construction.

- A description of the features including length, width and depth of the disturbed zone.

- Estimation of amount of disturbance relative to bedrock and surficial materials.

3. Distribution, depth, thickness, and nature of the various unconsolidated earth materials, including groundwater, which may affect the seismic response and damage potential at the site.

4. Surface investigation, including geologic mapping, preparation of geologic cross-sections illustrating fault displacement and/or rupture, and study of aerial photographs. Geologic maps and cross-sections along with a discussion of the local fault patterns and mechanics relative to the existing and proposed ground surface. The minimum scale of the geologic map is 1:24,000.

5. Subsurface investigation, including:

   - Trenching across any known or suspected fault zones to evaluate fault location and recency of movement, width of disturbance, physical condition of fault zone materials, type of displacement, and fault geometry. The trench logs are included in the report.

   - Advancement of exploratory borings to evaluate depth of unconsolidated materials and groundwater levels, as well as fault plane geometry. Samples of soil and bedrock obtained from the borings for laboratory testing and soil engineering studies. The boring logs are included in the report.

   - Performance of geophysical surveys which may indicate types of materials and their physical properties, groundwater conditions, and fault displacements. The geophysical survey data are included in the report.

14.5.3 Conclusions and Recommendations

The Seismic Report concludes with the following:

1. Estimated age, type of surface displacement, and amount of reasonable anticipated future displacements of any faults within or immediately adjacent to the site.

2. Definition of any areas of high seismic risk.

3. Estimated magnitude and distance to the epicenter of all relevant earthquakes.

4. Potential for lurching and shallow ground rupture.

5. Liquefaction potential of sediments and soils.

6. Estimated dynamic settlement of soils.

7. Potential for earthquake induced landsliding.

8. Potential for earthquake induced flooding, tsunamis, and seiches.

9. Recommended building restrictions, set-back distances, special foundations, or remedial earthwork use limitations within any designated high risk area.

14.6 Type IV – Hazardous Materials Report

The DESIGN CONSULTANT investigates the possibility of finding hazardous materials along pipeline alignments and at each plant, pump station, reservoir or other project site. The investigation reviews surface features, underground storage tanks, and other items that could contribute to the hazardous materials potential.

Hazardous materials site investigations, or site assessments, are typically broken up into two phases. Phase I consists of research and reconnaissance. Phase II is performed when there is a strong likelihood of contamination present, based on the Phase I research and recommendations. The Phase II investigation consists of a subsurface investigation and is designed to identify site contamination. Where contamination is present, the vertical and horizontal extent is determined as it affects the site.

In most cases, the predesign level of investigation done by the City covers the research and reconnaissance (Phase I) for the site or facility. The DESIGN CONSULTANT performs the subsurface investigation (Phase II) during the project detailed design phase if recommended in the initial site assessment. The subsurface investigation identifies site conditions and defines the extent of contamination at the site.

The subsurface investigation may consist of surface sampling, soil-gas surveys, soil borings, monitoring well installation, or other techniques recommended in the initial site assessment (Phase I). The DESIGN CONSULTANT prepares a work plan and submits it to the CIP Project Manager for review. A site safety plan is prepared in all cases. All safety precautions and training stipulated in 29 CFR 1910:120 should be followed. If contamination is found, the DESIGN CONSULTANT notifies regulatory agencies.

The DESIGN CONSULTANT prepares a report describing the investigation performed, including the locations of subsurface work and a discussion of work techniques used. Consult the County of San Diego *Site Assessment and Mitigation Manual* for a detailed description of what to include in a site assessment report where contamination is identified. The report identifies the extent and limits of hazardous materials found and presents recommendations for any remediation work required.

If the Phase I assessment is not part of the predesign work, the investigation should include the following:

- Research and review of pertinent geologic, hydrogeologic and topographic literature about the facility sites and surrounding areas which may be available from California Department of Water Resources, California Division of Mines and Geology, County of San Diego Public Works Department, U.S. Geological Survey quadrangle maps and other literature pertinent to the site.

- Research and review of historical aerial photographs along the pipeline corridors as well as areas within one-half mile of facility sites; photographs available at the San Diego Public Works Department and at other public or private photobanks should be reviewed.

- Review of in-house files as they pertain to the site.

- Review of site maps provided by City staff.

- Visual reconnaissance of pipeline corridor and properties within 500 feet of the corridor, and of areas within one-half mile of the facility sites to observe facilities for indications for potential to have used, stored, or disposed of hazardous substances.

- Interview of onsite or adjacent tenants.

- For site information, contact the San Diego County Department of Environmental Health Services and the San Diego Fire Department Underground Tank Unit.

- Review of the current list from the following agencies: U.S. Environmental Protection Agency (EPA), state of California Department of Health Services (CDHS), state of California Regional Water Quality Control Board (CRWQCB), San Diego Department of Environmental Health Services, Hazardous Materials Management Division (HMMD), and California Integrated Waste Management Board (CIWMB). List known hazardous substance sites within 500 feet of the pipeline alignment or within one-half mile of the facility sites. At a minimum, lists reviewed should include the following:

  – U.S. EPA Comprehensive Environmental Response Cleanup and Liability Act Information System (CERCLIS) List

  – U.S. EPA National Priority List (Superfund Site)

  – CDHS, Abandoned Site Program Information System (ASPIS)

  – CDHS, Expenditure Plan for the Hazardous Substance Cleanup Bond Act

  – CDHS, Toxic Substances Control Division, Potential Hazardous Waste Properties in California

  – CIWMD, Active Landfills

  – CIWMD, Inactive Landfills

  – CRWQCB, San Diego Region, Leaking Underground Tank Facilities List

  – California Office of Planning and Research Hazardous Waste and Substance Sites List (Governor's List)

– HMMD, Selected Hazardous Materials Records List (SHMRL)

In addition to these sources, Sanborn Fire Insurance Maps and historical business directories may be used to characterize past activities along the pipeline alignment or near facility sites.

A summary report of the research performed, the findings and professional opinions of the potential for environmental contamination along the corridors and facility sites are included in Hazardous Material Reports. These reports also include a discussion of existing and potential contamination sources. Specific recommendations for further investigation if warranted, are included.

15.3 Design Procedure

A. Conceptual Plan

The DESIGN CONSULTANT prepares a concept review package that is submitted with the 30% design complete package. It is prepared in 8-1/2 x 11-inch format and includes:

1. Map showing location of work.
2. Names of streets affected by construction.
3. Daily traffic volumes of affected streets.
4. Posted speed limits.
5. Written description of traffic control approach, e.g., closure of number 2 lane of A Street from First to Second.
6. Typical cross-sections identifying the construction work areas, trench width and depth, travel lanes and pedestrian paths (see Figure 15-1 for an example).
7. Aerial photo of the project area, if available.
8. Other information helpful to fully understand the work area requirements, including a description of the construction, expected rate of progress of project, duration and special equipment requirements.

B. Concept Review

Each CIP project is assigned to an Engineer in the T&DDD who reviews the conceptual plan package and visits the project site. The T&DDD Engineer contacts the DESIGN CONSULTANT to set up a concept review meeting. At this meeting, the T&DDD's concerns are discussed and an agreement reached on a traffic control approach. The DESIGN CONSULTANT prepares meeting minutes to document this agreement and provides copies to the CIP Project Manager and T&DDD Engineer within 2 weeks of the concept review meeting.

C. Traffic Control Plan Drawings

Plans are prepared on D-sized sheet (24 inches x 36 inches), clearly showing the traffic controls and phasing agreed to at the concept review meeting.

The first plan sheet includes:

1. Standard Notes per Figure 2 of Attachment 15-1.
2. Construction Notes applicable to the project.

3. Traffic Control Plan Index showing sheets and phasing.

4. Legend showing all signs (shape, wording, size) barricades, flashing arrow boards, etc. This may be shown on a separate sheet if there is insufficient room on the first sheet.

Subsequent sheets show, at a suitable scale, all traffic controls by construction phase. They each include:

1. Existing and temporary signs, striping, and markings.
2. All adjacent streets, alleys, driveways, sidewalks, and bike lanes.
3. Location and length of tapers and transitions.

D. Specification

The specification includes references to Chapter 5 of the Caltrans Traffic Manual and the City of San Diego's Standard Drawings. It also provides necessary material, measurement and payment provisions for traffic control, temporary signing and striping, barriers, permanent signing, striping, signal loop replacement and notification to adjacent residents and businesses (a sample specification is included in Attachment 15-2).

For streets with traffic volumes less than 10,000 ADT, the Construction Contractor is required to submit shop drawings showing the proposed traffic controls. The specification identifies this requirement and any special features to be included.

E. Traffic Control Plan Submittal and Review

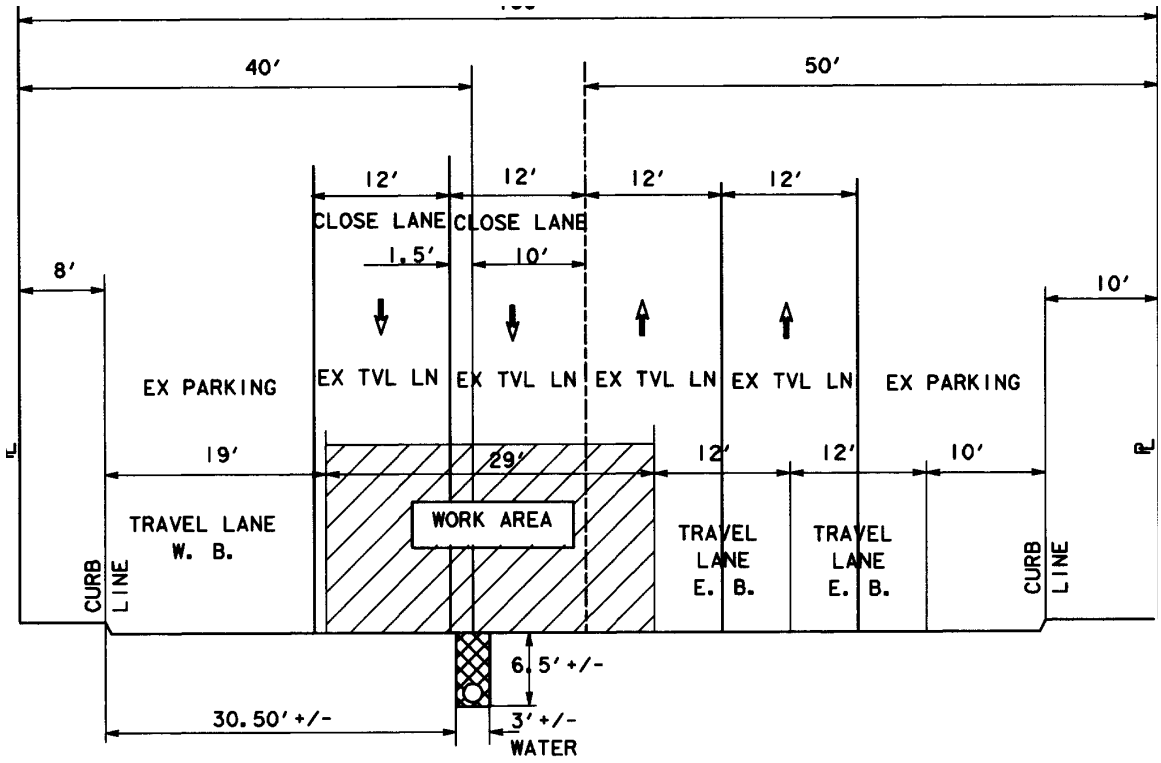
The traffic control plans, specification and estimate are included with the 75% design complete submittal. The CIP Project Manager transmits the submittal package to the T&DDD after it is completed and checked by the DESIGN CONSULTANT. The package includes:

1. Traffic Control Plans
2. Specification
3. Cost and Quantity Estimate
4. Concept Review Meeting Minutes
5. Cross-sections showing work areas, trench width and depth
6. 75% Improvement Plans (marked reference)

The T&DDD Engineer reviews and approves the submittal and returns it to the CIP Project Manager.

Subsequent submittals include the previous plan check comments.

Figure 15-1
Typical Cross-Section
(major streets)



TYPICAL CROSS SECTION
(MAJOR STREETS)
SCALE: NONE

NOTE: A TYPICAL CROSS SECTION SHOULD INCLUDE THE FOLLOWING:

* CURB TO CURB DISTANCE
* EXISTING STRIPING (LANE WIDTHS, PARKING WIDTH, CENTER LINE, MEDIAN, BICYCLE LANE (S))
* TRENCH WIDTH AND DEPTH
* SIZE OF WORK AREA
* PROPOSED LANE WIDTHS ADJACENT TO WORK AREA.

Attachment 15-1
Traffic Control Notes

1. Traffic control requirements conform to standard specifications, special provisions and drawings. The working hours set forth in the special provisions are shown on these plans. The Construction Contractor maintains the full width of all traveled lanes on existing roadways during non-working hours and when construction operations are not actively in progress, except when specifically noted in these plans.

2. All work is performed during daylight hours. All trenches are backfilled or trench plated at the end of each workday. An asphalt ramp shall be placed around each trench plate to prevent the plate from being dislodged. Upon completion of trench backfill, the surface of the roadway is brought to a smooth, even condition, free of humps and depressions, and temporary striping provided. After backfill has been completed, the Construction Contractor repairs any damage to the roadway, including damage caused by his/her operations or construction traffic. All existing striping, pavement markings, signing and loop detection altered or damaged during construction is restored to its original condition by Construction Contractor by completion of the underground work.

3. The Construction Contractor performing work on a City street supplies, installs and maintains traffic control devices shown herein, as well as any such additional traffic control devices required to ensure the safe movement of traffic, pedestrians and bicyclists through or around the work area and to provide maximum protection and safety to construction workers.

4. All signs, delineators, barricades, etc., conform to the latest Caltrans Traffic Manual, Traffic Control Through Construction Zones.

5. The Construction Contractor notifies all affected agencies at least 5 working days in advance of any street or alley closure or before implementing any construction detour.

Fire Department, Dispatch	573-1300
Police Department, Dispatch	531-2000
Waste Management Department	492-5060
Street Division/Electrical	525-8650
San Diego Transit	238-0100 ext. 424
Underground Service Alert	1-800-422-4133
All other affected agencies as necessary	

6. If construction is to be performed in stages, all work is completed in each stage before work begins on the next stage.

7. The Construction Contractor posts Tow Away/No Parking signs and bagging parking meters (if required). Signs must be posted 24 hours in advance of the approved prohibition and indicate specific days, dates and times of restrictions.

8. Equipment, material or debris may not be stored or remain in the public right-of-way without prior approval by the City Traffic Engineer.

9. This traffic control plan is not valid until work dates are approved. The Construction Contractor calls the Engineering Traffic Control Section, 619-533-4443, to obtain a

permit a minimum of 2 working days prior to starting work. Prior notification of 5 working days is required when work affects a traffic signal.

Attachment 15-2
Sample Specification

Traffic Striping, Pavement Markings and Pavement Markers

The Construction Contractor performs all striping and installation of pavement markers and signs. Pavement markers and striping must conform to Section 84 and Section 85 of the latest Caltrans' Standard Specifications, and the Caltrans Traffic Control Manual.

The Construction Contractor controls alignment and layout, subject to approval by the Construction Manager.

Section 84-03.02, Materials, of the Standard Specifications, is amended to read:

Paint for traffic stripes shall conform to the following State Specifications:

Item	Specification
Rapid Dry Water-Borne Paint, White and Yellow	8010-42L-30 or 8010-61g-10
Glass Beads	5010-51J-22 (Type 1D)

Copies of State Specifications for traffic paint and glass beads may be obtained from the Transportation Laboratory, P. O. Box 19128, Sacramento, CA 95819, (916) 739-2400.

Paint thinning is will not allowed.

The Construction Contractor installs reflectorized pavement markers on all lane lines and centerline striping.

Construction Contractor performs all sandblasting of conflicting striping and replaces all striping removed during construction.

The Construction Contractor installs all signs. Signs must conform to the requirements of the California Department of Transportation Traffic Manual. All sign posts are anchored in two feet of concrete 18-24 inches from the curb face. Bottoms of signs must be 7 feet above ground level.

Notifications

The Construction Contractor informs all affected residents and businesses of the work. The Construction Contractor distributes printed notices that include dates and hours of work to all affected residents and businesses at least 5 working days before starting work. Affected parties include all properties within one block of the construction zone, including the detour route. The notification is submitted to the Construction Manager for review and approval at least 2 working days before distribution.

Trenches Through Signalized Intersections

Damaged signal equipment is repaired and/or replaced per Caltrans Standard Specifications.

Detector Loops are as Follows:

Bike Lane Detector Loops	=	Type O
Limit Line Detector Loops	=	Type D
Intermediate and Advanced Detector Loops	=	Type B
All other Detector Loops	=	Type A

The Construction Manager is contacted at least 5 workdays before any disruption of normal traffic signal operations.

All detector loops, including conduits and signal poles, are replaced and made operational within 3 working days of initial removal or disruption.

All temporary signal pole locations shown on the drawings are approximate. Actual locations are determined by the City in the field. The Construction Contractor obtains approval of detector loop locations from the Construction Manager before the loops are installed.

Book 1

General Design Guidelines

Chapter 15
Traffic Control

City of San Diego Water Department
Capital Improvements Program

Chapter 15
TRAFFIC CONTROL

This chapter presents traffic control guidelines to be used for projects in the Water CIP. The City of San Diego's Transportation and Drainage Design Division (T&DDD) reviews all traffic control plans. For work outside the jurisdiction of the City of San Diego, the DESIGN CONSULTANT determines and meets all requirements of the appropriate agency.

15.1 Requirements for the Contract Documents

As part of the construction drawings, the DESIGN CONSULTANT prepares traffic control plans for all work on or near streets carrying average daily traffic volumes of 10,000 or more vehicles. Where incursions into those high-volume streets are minor, the T&DDD may waive the requirement for the DESIGN CONSULTANT to prepare traffic control plans and allow them to be prepared by the Construction Contractor.

Traffic control plans show the traffic control required for each construction phase. They reflect actual conditions for each mid-block and intersection location, including the location of all driveways, walkways, travel lanes and bicycle lanes.

The plan for each construction phase covers enough area to show the location of all signs, markers, barricades, flashing arrow boards and other devices for traffic control of that phase. Construction hours acceptable to the T&DDD are indicated on each plan sheet and referenced in the relevant portion of the specification to clearly establish order of precedence.

Where traffic volumes are less than 10,000 vehicles per day, the specification requires the Construction Contractor to prepare traffic control plans. These plans are submitted to the CIP Construction Manager as shop drawings.

A separate bid item should be included in the Contract Documents for traffic control to allow the Construction Contractor to be compensated fairly for traffic control as construction progresses. It also gives the Construction Manager the flexibility to withhold payment for traffic control if it is not implemented adequately.

15.2 Design Requirements

Traffic Control Plans are prepared by or under the supervision of a Registered Professional Engineer in the state of California experienced in traffic control.

Traffic Control Plans are designed in accordance with:

1. Caltrans Traffic Manual, Chapter 5

2. City of San Diego Standard Drawings

3. City of San Diego Department Instruction DI-3900-305, Traffic Control Through Construction Zones

4. City of San Diego Department Instruction DI3980-001, Temporary Street Closures

15.3 Design Procedure

A. Conceptual Plan

The DESIGN CONSULTANT prepares a concept review package that is submitted with the 30% design complete package. It is prepared in 8-1/2 x 11-inch format and includes:

1. Map showing location of work.
2. Names of streets affected by construction.
3. Daily traffic volumes of affected streets.
4. Posted speed limits.
5. Written description of traffic control approach, e.g., closure of number 2 lane of A Street from First to Second.
6. Typical cross-sections identifying the construction work areas, trench width and depth, travel lanes and pedestrian paths (see Figure 15-1 for an example).
7. Aerial photo of the project area, if available.
8. Other information helpful to fully understand the work area requirements, including a description of the construction, expected rate of progress of project, duration and special equipment requirements.

B. Concept Review

Each CIP project is assigned to an Engineer in the T&DDD who reviews the conceptual plan package and visits the project site. The T&DDD Engineer contacts the DESIGN CONSULTANT to set up a concept review meeting. At this meeting, the T&DDD's concerns are discussed and an agreement reached on a traffic control approach. The DESIGN CONSULTANT prepares meeting minutes to document this agreement and provides copies to the CIP Project Manager and T&DDD Engineer within 2 weeks of the concept review meeting.

C. Traffic Control Plan Drawings

Plans are prepared on D-sized sheet (24 inches x 36 inches), clearly showing the traffic controls and phasing agreed to at the concept review meeting.

The first plan sheet includes:

1. Standard Notes per Figure 2 of Attachment 15-1.
2. Construction Notes applicable to the project.

3. Traffic Control Plan Index showing sheets and phasing.

4. Legend showing all signs (shape, wording, size) barricades, flashing arrow boards, etc. This may be shown on a separate sheet if there is insufficient room on the first sheet.

Subsequent sheets show, at a suitable scale, all traffic controls by construction phase. They each include:

1. Existing and temporary signs, striping, and markings.
2. All adjacent streets, alleys, driveways, sidewalks, and bike lanes.
3. Location and length of tapers and transitions.

D. Specification

The specification includes references to Chapter 5 of the Caltrans Traffic Manual and the City of San Diego's Standard Drawings. It also provides necessary material, measurement and payment provisions for traffic control, temporary signing and striping, barriers, permanent signing, striping, signal loop replacement and notification to adjacent residents and businesses (a sample specification is included in Attachment 15-2).

For streets with traffic volumes less than 10,000 ADT, the Construction Contractor is required to submit shop drawings showing the proposed traffic controls. The specification identifies this requirement and any special features to be included.

E. Traffic Control Plan Submittal and Review

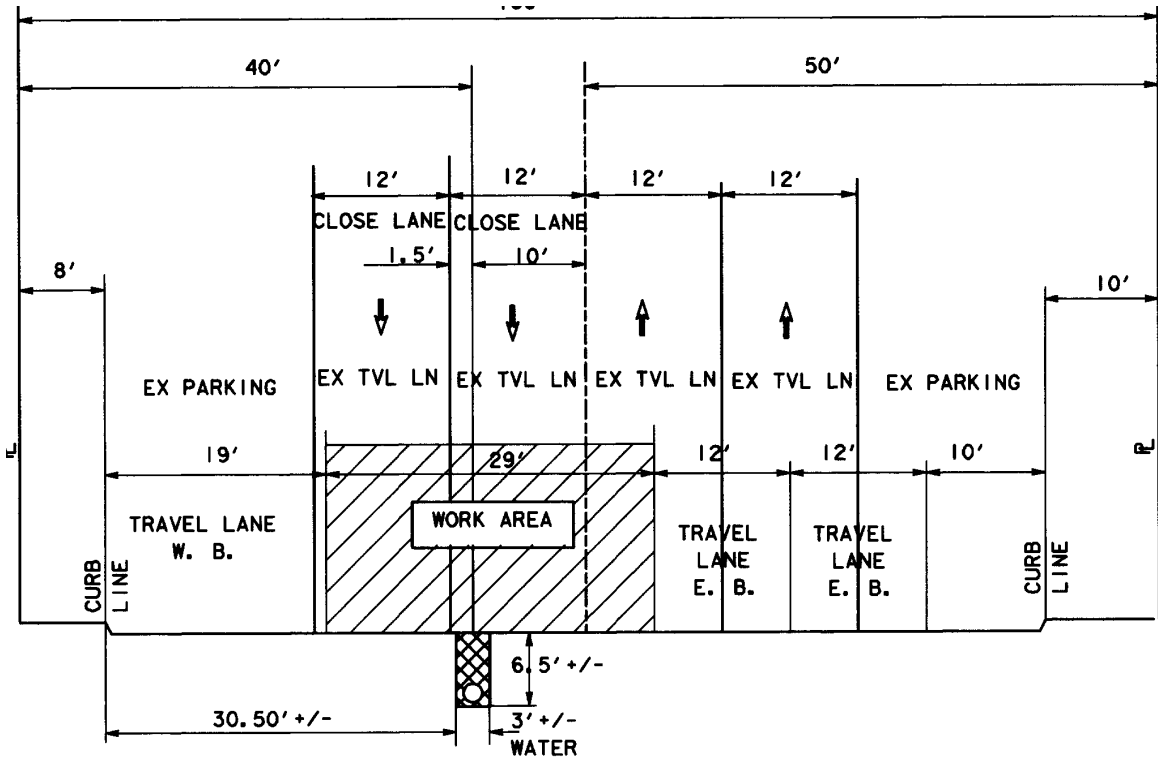
The traffic control plans, specification and estimate are included with the 75% design complete submittal. The CIP Project Manager transmits the submittal package to the T&DDD after it is completed and checked by the DESIGN CONSULTANT. The package includes:

1. Traffic Control Plans
2. Specification
3. Cost and Quantity Estimate
4. Concept Review Meeting Minutes
5. Cross-sections showing work areas, trench width and depth
6. 75% Improvement Plans (marked reference)

The T&DDD Engineer reviews and approves the submittal and returns it to the CIP Project Manager.

Subsequent submittals include the previous plan check comments.

Figure 15-1
Typical Cross-Section
(major streets)



TYPICAL CROSS SECTION
(MAJOR STREETS)
SCALE: NONE

NOTE: A TYPICAL CROSS SECTION SHOULD INCLUDE THE FOLLOWING:

* CURB TO CURB DISTANCE
* EXISTING STRIPING (LANE WIDTHS, PARKING WIDTH, CENTER LINE, MEDIAN, BICYCLE LANE (S))
* TRENCH WIDTH AND DEPTH
* SIZE OF WORK AREA
* PROPOSED LANE WIDTHS ADJACENT TO WORK AREA.

Attachment 15-1
Traffic Control Notes

1. Traffic control requirements conform to standard specifications, special provisions and drawings. The working hours set forth in the special provisions are shown on these plans. The Construction Contractor maintains the full width of all traveled lanes on existing roadways during non-working hours and when construction operations are not actively in progress, except when specifically noted in these plans.

2. All work is performed during daylight hours. All trenches are backfilled or trench plated at the end of each workday. An asphalt ramp shall be placed around each trench plate to prevent the plate from being dislodged. Upon completion of trench backfill, the surface of the roadway is brought to a smooth, even condition, free of humps and depressions, and temporary striping provided. After backfill has been completed, the Construction Contractor repairs any damage to the roadway, including damage caused by his/her operations or construction traffic. All existing striping, pavement markings, signing and loop detection altered or damaged during construction is restored to its original condition by Construction Contractor by completion of the underground work.

3. The Construction Contractor performing work on a City street supplies, installs and maintains traffic control devices shown herein, as well as any such additional traffic control devices required to ensure the safe movement of traffic, pedestrians and bicyclists through or around the work area and to provide maximum protection and safety to construction workers.

4. All signs, delineators, barricades, etc., conform to the latest Caltrans Traffic Manual, Traffic Control Through Construction Zones.

5. The Construction Contractor notifies all affected agencies at least 5 working days in advance of any street or alley closure or before implementing any construction detour.

Fire Department, Dispatch	573-1300
Police Department, Dispatch	531-2000
Waste Management Department	492-5060
Street Division/Electrical	525-8650
San Diego Transit	238-0100 ext. 424
Underground Service Alert	1-800-422-4133
All other affected agencies as necessary	

6. If construction is to be performed in stages, all work is completed in each stage before work begins on the next stage.

7. The Construction Contractor posts Tow Away/No Parking signs and bagging parking meters (if required). Signs must be posted 24 hours in advance of the approved prohibition and indicate specific days, dates and times of restrictions.

8. Equipment, material or debris may not be stored or remain in the public right-of-way without prior approval by the City Traffic Engineer.

9. This traffic control plan is not valid until work dates are approved. The Construction Contractor calls the Engineering Traffic Control Section, 619-533-4443, to obtain a

permit a minimum of 2 working days prior to starting work. Prior notification of 5 working days is required when work affects a traffic signal.

Attachment 15-2
Sample Specification

Traffic Striping, Pavement Markings and Pavement Markers

The Construction Contractor performs all striping and installation of pavement markers and signs. Pavement markers and striping must conform to Section 84 and Section 85 of the latest Caltrans= Standard Specifications, and the Caltrans Traffic Control Manual.

The Construction Contractor controls alignment and layout, subject to approval by the Construction Manager.

Section 84-03.02, Materials, of the Standard Specifications, is amended to read:

Paint for traffic stripes shall conform to the following State Specifications:

Item	Specification
Rapid Dry Water-Borne Paint, White and Yellow	8010-42L-30 or 8010-61g-10
Glass Beads	5010-51J-22 (Type 1D)

Copies of State Specifications for traffic paint and glass beads may be obtained from the Transportation Laboratory, P. O. Box 19128, Sacramento, CA 95819, (916) 739-2400.

Paint thinning is not allowed.

The Construction Contractor installs reflectorized pavement markers on all lane lines and centerline striping.

Construction Contractor performs all sandblasting of conflicting striping and replaces all striping removed during construction.

The Construction Contractor installs all signs. Signs must conform to the requirements of the California Department of Transportation Traffic Manual. All sign posts are anchored in two feet of concrete 18-24 inches from the curb face. Bottoms of signs must be 7 feet above ground level.

Notifications

The Construction Contractor informs all affected residents and businesses of the work. The Construction Contractor distributes printed notices that include dates and hours of work to all affected residents and businesses at least 5 working days before starting work. Affected parties include all properties within one block of the construction zone, including the detour route. The notification is submitted to the Construction Manager for review and approval at least 2 working days before distribution.

Trenches Through Signalized Intersections

Damaged signal equipment is repaired and/or replaced per Caltrans Standard Specifications.

Detector Loops are as Follows:

Bike Lane Detector Loops	=	Type O
Limit Line Detector Loops	=	Type D
Intermediate and Advanced Detector Loops	=	Type B
All other Detector Loops	=	Type A

The Construction Manager is contacted at least 5 workdays before any disruption of normal traffic signal operations.

All detector loops, including conduits and signal poles, are replaced and made operational within 3 working days of initial removal or disruption.

All temporary signal pole locations shown on the drawings are approximate. Actual locations are determined by the City in the field. The Construction Contractor obtains approval of detector loop locations from the Construction Manager before the loops are installed.

Book 1

General Design Guidelines

Chapter 16
Owner-Procured Equipment

City of San Diego Water Department
Capital Improvements Program

Chapter 16
OWNER-PROCURED EQUIPMENT

16.1 Introduction

Direct purchases of equipment and materials is not program-wide for the Water CIP. Individual projects may arise, however, which benefit from direct procurement of equipment and materials. This chapter defines the procedures to be followed by the DESIGN CONSULTANT in instances of direct procurement of equipment and materials under the Water CIP.

16.2 Issues Regarding Direct Procurement

The benefits of direct procurement of equipment and materials include:

- *Meeting Schedule Requirements.* On some projects, it may only be possible to meet a schedule by pre-purchasing equipment and materials. These projects may require special equipment or materials with long lead times for manufacturing and delivery, materials in short supply, or materials that are otherwise difficult to procure.

- *Standardization.* Pre-purchase contracts may be implemented to ensure that standardized equipment is provided in Water CIP facilities, thereby reducing operator training requirements and inventories of spare parts.

- *Cost Savings.* Cost savings may be realized through large volume purchases of equipment and materials directly through the City Purchasing Division, a procedure that eliminates handling charges otherwise assessed by Construction Contractors.

The benefits of direct procurement may be offset by complications or additional costs arising through:

- *Delayed Delivery.* The Construction Contractor may be delayed by the late delivery of equipment or materials under the procurement contract.

- *Storage of Equipment and Materials.* Significant costs may be associated with the storage of equipment and materials, including the costs of insurance during storage, maintenance during storage, and transportation from the storage site to the jobsite.

- *Poorly-Defined Responsibilities.* The responsibilities of the supplier and the Construction Contractor must be explicitly defined with respect to installation procedures, observation of the installation, testing of the installation, identification of installation deficiencies, certification of the installation, furnishing startup advice, recommendations regarding operations and maintenance procedures, and training of City staff.

- *Inadequate Construction Coordination.* Interfaces that require coordination between the Supplier and Construction Contractor must be defined, including

piping, wiring, equipment anchorage, floor openings, instrumentation and plumbing.

- *Warranty Issues.* The supplier must provide a warranty with the warranty period defined. If the equipment does not perform as intended, the warranty may be compromised through improper installation by the Construction Contractor. Splitting responsibility between the supplier and the Construction Contractor may also lead to ambiguities on a warranty.

16.3 Responsibilities of the Design Consultant on Projects Involving Direct Procurement of Equipment or Materials

The DESIGN CONSULTANT defines the need for direct procurement of equipment and materials on a Water CIP project in its Basis of Design Report. If the DESIGN CONSULTANT believes significant benefits would be achieved through direct procurement, it identifies and enumerates these benefits for review and evaluation by CIP Project Manager.

If the pre-purchase of equipment or materials is approved by the CIP Project Manager, the DESIGN CONSULTANT provides any or all of the following:

- *Preparation of the Technical Specification.* The DESIGN CONSULTANT prepares one Technical Specification for the procurement of equipment or materials from the Supplier, and a separate Technical Specification for installation of that equipment or material by the Construction Contractor. The Technical Specification sections define the technical interfaces between the Construction Contractor and the supplier, the respective technical responsibilities of the Construction Contractor and the supplier, and performance parameters for the equipment. The Technical Specification sections are fully compatible with the front end of the project Contract Documents, and the Engineer of Record, as the DESIGN CONSULTANT, assumes full responsibility for the Technical Specification. The Technical Specification is prepared by adapting the Water CIP Guide Specification to satisfy project requirements. Chapter 17 of these Guidelines describes in detail the Water CIP Guide Specification and the DESIGN CONSULTANT's responsibilities.

- *Coordination with the CIP Project Manager.* The DESIGN CONSULTANT coordinates with the CIP Project Manager in preparing Divisions 0 and 1 of the Bid Documents on all procurement contracts. The front end of the Bid Document for the procurement of equipment or materials is adapted from the Guide Specification. Chapter 17 of these Guidelines describes in detail the CIP Guide Specifications and the DESIGN CONSULTANT's responsibilities.

- *Preparation of a Justification for Sole Source Procurement.* On some projects, it may be necessary to acquire a piece of equipment from a single manufacturer. This equipment may be needed to ensure compatibility with existing systems or for other equally important reasons. In such cases, the DESIGN CONSULTANT prepares a memorandum justifying sole source procurement. The CIP Project Manager forwards this memorandum to the City Purchasing Division along with other required documentation.

- *Assistance in Bid Evaluation.* The City Purchasing Division usually requires that the Water Department assist in the evaluation of bids. In some cases, the low bid may involve materials or equipment that do not conform to the specified brands and model numbers. In such cases, the CIP Project Manager may request that the DESIGN CONSULTANT assist in the bid evaluation.

Policies and procedures for the procurement of equipment and materials by the City of San Diego are defined in the San Diego Municipal Code Section 22.0504 and Administrative Regulation 35.10. Requirements for procurement depend on the value of the equipment or materials to be procured. The following table summarizes the key requirements and the time required by the City Purchasing Division to implement a procurement contract (including bidding, evaluation and award).

Procurement Contract Value	Advertisement Required?	City Council Approval Required?	Approximate Period Required for Contract Implementation by City Purchasing Division
Under $5,000	No	No	3 days
$5,000 to $10,000	No	No	1 week
$10,000 to $50,000	No	No	2 weeks
$50,000 to $1,000,000	Yes	No	4 to 6 weeks
Over $1,000,000	Yes	Yes	10 to 12 weeks

The City Purchasing Division and Auditors prefer that payments on pre-purchase contracts be made for individual items. However, lump sum payments have been made on occasion. Although City policy precludes payment for goods or services not yet received, partial payments can be made if it is clearly understood that, upon such payment, the item of equipment or material becomes the property of the City, even if the item has not been delivered.

Book 1

General Design Guidelines

Chapter 17
Specifications

City of San Diego Water Department
Capital Improvements Program

Chapter 17
SPECIFICATIONS

17.1 Introduction

This chapter presents an overview on the use of the guide specifications in Book 4. It also describes the documents to be prepared, the format for contract documents, and other specification preparation procedures. Each contract specification prepared by the DESIGN CONSULTANT for the City is based primarily on these guide specifications.

The goals for use of the Water CIP Guide specifications are:

- Clear, concise, legally and technically sufficient language.
- Similar approach on similar subjects.
- Uniform appearance and organization between different sections of a contract and between different contracts conforming to the Water CIP format.
- Thorough, but not excessive, detail.
- Promotion of competition between bidders and suppliers of products and materials.
- Satisfaction of engineering and operating staff preferences for equipment and materials incorporated into Contract Documents.

17.2 Type of Specification

Projects to be constructed shall use the most current approved edition of the SSPWC together with adopted city and regional supplements and CIP Special Provisions to define requirements normally covered in the Conditions of Contract [CSI Division 00] and General Requirements [CSI Division 01]. A copy of the Special Provisions will be included for the DESIGN CONSULTANT to mark-up with suggested project specific modification. The DESIGN CONSULTANT prepares technical Specification sections normally included in CSI Divisions 01 through 16 using the CSI three-part format.

17.3 Design Consultant Responsibilities

As the Engineer of Record, the DESIGN CONSULTANT assumes full responsibility for project-specific use of these specifications. As a result, when preparing contract specifications, the DESIGN CONSULTANT cannot assume that the guide specification automatically meets all project requirements. For this reason, the DESIGN CONSULTANT must conduct its specification writing and quality control activities so that appropriate adaptations and refinements can be made to the project specification as necessary.

The DESIGN CONSULTANT highlights the changes from the guide specifications by strikeouts and/or shading. The CIP Project Manager reviews the requested changes and deviations for adherence to existing City guidelines, regulations and policies.

17.4 Specification Appearance

A. General

Contract documents prepared for Water CIP projects are processed by the Contracts Services Division of the Engineering and Capital Projects Department. The Table of Contents is prepared by the Contracts Services Division and includes the CIP Special Provisions – General ahead of the CSI Special Provisions – Technical.

The three-part CSI format (Part 1 - General; Part 2 - Products; Part 3 - Execution) is used to prepare the contract specification for works which are not covered by SSPWC. Technical specification sections are numbered for Division 01 through Division 16 according to the 16-division CSI numbering system. The guide specifications were prepared using this format and numbering system.

17.5 Software and Editing Features

The guide specifications included in Book 4 of these Guidelines are available from the CIP Program Manager on paper and on 3-1/2-inch HD floppy diskettes. Allow approximately one week for delivery after receipt of request.

A. Software

All the guide specification sections in Division 01 through Division 16 were prepared using the version of WordPerfect currently in use by the City on IBM-compatible equipment.

B. Document Formatting

1. Margins:
   — Top/bottom margins: 1 inch (6 lines)
   — Left margin: 1 ½ inches (15 spaces)
   — Right margin: 1 inch (12 spaces)

2. Font: Arial 11 point

3. Tabs: Set at 5 space intervals from left margin

4. Justification: Fully justified

5. Paragraph Numbering/Outline:
   Paragraph numbering is incorporated through the use of the style feature in WordPerfect (paragraph outline styles are included in the disk media provided by the CIP Program Manager). Do not use the automatic outline feature of the software.

6. Headers/Footers:
Neither the company name nor the logo of the DESIGN CONSULTANT should appear anywhere on the specification. Footers should include project title, page number, and section reference.

C. Notes to Specifier

To increase the flexibility of the guide specifications, some material is included which may not be appropriate for all projects or from which the specifier must select one alternative. "Notes to Specifier" (NTS) present specification editing information in the following format:

$# _____

NTS:

_____ #$

"Notes to Specifier" may not be included in the contract specification. Each NTS should be edited out after the specifier addresses the instruction in it.

D. Square Brackets

To facilitate use of the guide specifications, the City has anticipated typical values DESIGN CONSULTANTS might use in project-specific applications, placing them inside square brackets ([ ]) to signify that the DESIGN CONSULTANT must address their appropriateness. In some instances, blank square brackets are provided showing where the DESIGN CONSULTANT must fill in a number or a phrase. In other instances, two or more square brackets have been provided, one of which contains a typical value or phrase; these are handled in the same manner as the single bracket with an anticipated value.

E. Footers

Each page of each specification section contains a footer with certain information as required by the Records Management and Document Control Guidelines in Chapter 21 of Book 1. Square brackets on the footer of each guide specification indicate the number and name of the project to be entered on the 100% complete specification. Intermediate drafts of specifications include the word processing date. Square brackets are edited out before the specifications are finalized.

17.6 Influence of SSPWC on Contract Documents

Standard Specifications for Public Works Construction (SSPWC) was developed jointly by the Southern California Chapter of American Public Works Association (APWA) and the Southern California Districts of the Associated General Contractors (AGC) of California. Known as the GREENBOOK, the SSPWC is republished in its entirety every three years.

Copies of this publication, including the regional and City of San Diego Supplement Amendments, can be purchased from the Publications Counter, City Operations Building, 1222 1st Avenue, Third Floor, San Diego, California 92101. For information, call (619) 236-7075.

The SSPWC primarily covers the most frequent types of projects in public works construction, such as sewers, pipelines, roads, gutters and storm sewers in public rights-of-way. It does not adequately address the broader needs and practices of pumping stations and water storage reservoirs projects being built under the Water CIP. Since SSPWC adequately covers certain facilities, it is incorporated by reference, where applicable, in the development of the guide specifications in Book 4 of these Guidelines. Although used to develop several specification sections covered in these two volumes, two sections are particularly noteworthy:

- 03280 - Expansion and Contraction Joints
- 03310 - Cast-In-Place Sitework Concrete

These two specification sections apply for the roads and gutters work at the pumping stations, as noted in these sections. Because of the unique requirements of water-retaining structures, separate sections are included in the guide specification to cover the same category of work:

- 03290 - Joints in Concrete Structures
- 03300 - Cast-In-Place Structural Concrete

In all specification sections, including those listed above, where SSPWC is referenced, it means the latest adopted edition including the latest adopted regional and City of San Diego Supplement Amendments.

17.7 Hierarchy of Technical Sections

Certain technical requirements sometimes apply to several pieces of equipment covered in more than one technical specification section. For example, couplings, bearings, shafts and drives apply to almost all mechanical equipment covered in several specification sections. Instead of being repetitive in specifying the requirements of such common elements in all related specification sections, these common requirements are consolidated into a few grandparent/parent sections. This concept is best illustrated in the following technical specification sections:

1. Section 11000 - Equipment, General

2. Section 11175 - Pumps, General

3. Section 11200 - Horizontal Split Case Pumps

4. Section 11214 - Vertical Turbine Pumps

In this example, Equipment, General is a grandparent section; Pumps, General is a parent section; and Horizontal Split Case and Vertical Turbine Pumps are child sections. Accordingly, all common requirements applicable to both child sections are covered in the section above them in the hierarchy. Similarly, the requirements common to two or more parent sections are included in the related grandparent section and only referenced in the two or more parent sections. Only requirements unique to a section are included in that section, otherwise they are

included in the applicable section highest in the hierarchy, the parent or grandparent, but not both.

This hierarchal system of presentation is also applicable to the Related Sections, Codes, and other paragraphs.

Additional examples of hierarchies in the guide specifications include:

11000 Equipment, General
- 11030 Variable Speed Drives, General
  - 11032 Variable Frequency Drives
  - 11033 Large Variable Frequency Drives
- 11175 Pumps, General
  - 11200 Horizontal Split Case Pumps
  - 11209 Submersible Sump Pumps (Less than 10 hp)
  - 11214 Vertical Turbine Pumps
- 11281 Chlorination Equipment
- 11290 Hydraulic Gates, General
  - 11291 Flap Gates
  - 11292 Slide and Stop Gates
  - 11293 Sluice and Shear Gates
- 11328 Dumpsters and Receptacles
- 11370 Compressors, General
  - 11373 Compressors, Base-Mounted
  - 11375 Compressor Aftercooler
- 11376 Air Dryers
- 11500 Engine Generator
- 14600 Hoists and Cranes, General
  - 14605 Electric Monorail Systems
  - 14630 Bridge Cranes

15000 Piping Components
- 15010 Mill Piping - Exposed and Buried
- 15015 PVC Pressure Pipe
- 15017 Fiberglass Reinforced Plastic Pipe
- 15020 Pipe Supports
- 15025 Cathodic Protection System
- 15030 Pipe Identification System
- 10531 Strainers
- 10534 Gages
- 10550 Vibration Isolators
- 15100 Valves, General
  - 15101 Valve Operators
  - 15104 Butterfly Valves
  - 15105 Check Valves
  - 15106 Ball Valves
  - 15107 Diaphragm Valves
  - 15109 Gate Valves
  - 15110 Plug Valves
  - 15113 Air Release and Vacuum Valves
  - 15114 Pressure Regulating Valves
  - 15115 Miscellaneous Valves

15150 Meters, General
15156 Magnetic Flow Meters
15157 Venturi Meters

17.8 Coordination Between Specifications and Standard Details

The Guide Construction Specifications (Book 4) and Standard and Guide Details (Book 3) must be fully coordinated. Although all attempts have been made to ensure conformity and compatibility between these two documents, the DESIGN CONSULTANT must examine both documents to ensure consistency. The DESIGN CONSULTANT immediately brings any inconsistencies to the attention of the CIP Program Manager in writing with recommended changes, including reasons and justification for such recommendations.

17.9 Acceptable Manufacturer's Names and Equipment Model Numbers

Guide specifications contain acceptable manufacturers' names in some sections. In other sections, the space for the manufacturer's name is left blank (i.e., [ ]) and the DESIGN CONSULTANT can enter manufacturer's names to define a standard of quality. DESIGN CONSULTANTS must verify manufacturers' names and ensure that the information is current and up-to-date and that they are still in business and manufacture the specified product(s). However, this does not relieve the manufacturer of responsibility to provide the equipment that meets the specified operating conditions and other product material requirements.

Book 1

General Design Guidelines

Chapter 18
Bid Phase

City of San Diego Water Department
Capital Improvements Program

Chapter 18
BID PHASE

18.1 Introduction

The Bid Phase period begins with the DESIGN CONSULTANT's submittal of the 100% complete bid documents, including any recommended modifications to Part 1 of the bid/contract package, and ends with the notice to proceed to the Construction Contractor.

The DESIGN CONSULTANT's potential role during the Bid Phase process, as shown in Figure 18-1 and Figure 18-2, includes the following tasks:

1. Providing technical information for the Part 1 - Special Provisions - General
2. Participating in the pre-bid conference and site tour
3. Providing technical revisions and responses to technical inquiries for addenda
4. Assisting the CIP Project Manager in bid review and evaluation.
5. Assisting the CIP Project Manager, as required, to prepare the bid package for submittal to the Contracts Services Division of the Engineering and Capital Projects Department

The Contracts Services Division logs pertinent information about requests for Bid Documents, collects appropriate fees, and distributes the Bid Documents. The CIP Project Manager receives and records questions from plan holders. The DESIGN CONSULTANT provides technical assistance and clarification only to the CIP Project Manager, referring any inquiries received from plan holders directly to the CIP Project Manager.

18.2 Bidding Documents

At the time of bidding, the Contract Documents include the Notice Inviting Bids, Instructions to Bidders, Bid Forms (Bid and Bid Schedule, Information Required of Bidder, Noncollusion Affidavit, and Bid Bond), Construction Contract, Performance Bond, Payment Bond, and Technical Specification and Drawings.

18.3 Bidding and Contracting Procedures

The DESIGN CONSULTANT must understand the construction contracting process to appreciate the administrative and regulatory clearances required, the timing and scheduling impacts of the process, and the importance of Bid Document completeness. For a description of the contracting process and its timeline, the DESIGN CONSULTANT may refer to the procedures document for processing City construction contracts entitled "Contract Administration Construction Contract Processing" (copy not included). The CIP Project Manager and the Contract Services Division of the Engineering and Capital Projects Department (E&CPD) are responsible for bid packaging. The DESIGN CONSULTANT's role in supporting the construction contracting process is described in the DESIGN CONSULTANT's scope of work. The DESIGN CONSULTANT should be familiar with the time required by the City to process a construction contract, including bid package preparation, approval, advertising, time for plan holder bid preparation, bid submittal and opening, bid evaluation, contract award and notice to proceed. The DESIGN CONSULTANT obtains and reviews a copy of the Contract

Administration Construction Contract Processing procedure for information on processing time requirements.

18.4 Advertising and Addenda

18.4.1 Bid Document Preparation for Advertising

The DESIGN CONSULTANT gives the CIP Project Manager technical input to prepare the Drawings and Specification, Bid Forms (Bid and Bid Schedule, Information Required of Bidder, Noncollusion Affidavit, and Bid Bond), Division 00, Construction Contract, and Supplemental General Conditions. These DESIGN CONSULTANT deliverables are often referred to informally as the "technicals."

The Contract Services Division of the E&CPD uses Part 1, Special Provisions - General , from the Standard Specifications for Public Works Construction (GREENBOOK, latest edition) for all contracts. Projects within public rights-of-way (e.g., pipeline projects) conform to GREENBOOK specifications. Projects outside public rights-of-way (e.g., pumping stations and reservoirs) with technical provisions somewhat different from the standard specifications are oriented to the GREENBOOK.

18.4.2 Pre-Bid Conference and Site Tour

The Notice Inviting Bids cites the date of the pre-bid conference and site tour. The DESIGN CONSULTANT attends both to better understand the plan holder's questions. The CIP Project Manager logs plan holders' questions for follow-up after the conference is completed. The DESIGN CONSULTANT does not answer questions of the plan holders directly. The CIP Project Manager requests that the DESIGN CONSULTANT prepare a draft addendum or a written answer to any appropriate questions. Draft addenda (including written responses to plan holder questions) are forwarded to the CIP Project Manager for finalization and forwarding to Contract Services. Contract Services distributes addenda to the plan holders.

18.4.3 Bid Phase Questions

The DESIGN CONSULTANT does not respond orally to direct questions from the plan holders. Instead, the DESIGN CONSULTANT responds to questions in writing (either by memorandum or draft addendums), and submits those responses to the CIP Project Manager. The CIP Project Manager reviews and approves the responses and distributes the guidelines with annotated responses to all plan holders.

18.4.4 Addenda

An addendum is the only method to be used to notify plan holders of changes in the Bid Documents between advertisement and bid opening. Addenda may change bidding requirements, correct errors or omissions, change specifications or drawings for clarity or for technical reasons, or add to or reduce the scope of work.

Figure 18-1
Organization Chart and Areas of Responsibility During the Bid Phase

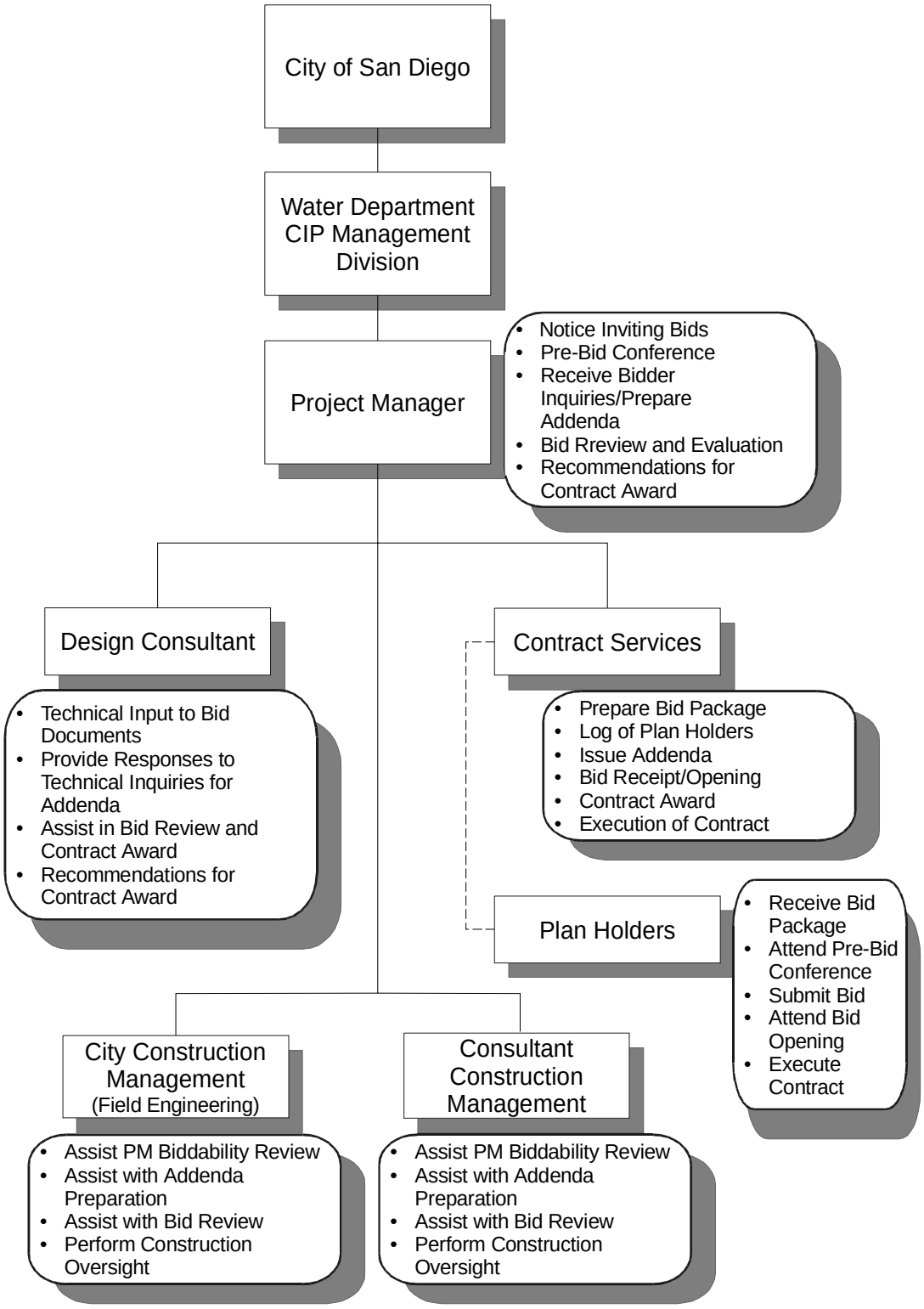


Figure 18-2
Responsibility Assignment Matrix During Bid Phase

Project Team Participant	Areas of Responsibility					
	BID and Contract Package	**PRE-BID CONFERENCES**	**ADDENDA**	**BID RECEIPT/OPENING**	**BID REVIEW**	**AWARD and EXECUTION OF CONTRACT**
City of San Diego Water Department CIP Management Division Project Manager (PM)	Review technical package and provide to Contract Services. Complete the Form 1472.	CONDUCT CONFERENCE, RECORD AND PREPARE minutes of conference meeting.	RECEIVE bidders inquiries. REVIEW DC draft responses/addenda. Pass to Contract Services.	RECEIVE bid and CONDUCT bid opening. RECORD bid.	NEGOTIATE PHASED FUNDING if applicable. Complete the PA700 Form.	PREPARE supporting documents for approval to award contract (PA 700). ASSIST in resolution of bid protests.
City Engineering and Capital Projects Department Contract Services	ASSEMBLE bid package. Get City APPROVALS. ADVERTISE and ISSUE bid documents		APPROVE addenda and ISSUE.	RECEIVE bid and CONDUCT bid opening. RECORD bid.	PREPARE bid evaluation tables and VALIDATE bids for compliance. NOTIFY APPARENT LOW BIDDER.	OBTAIN City approvals for award of contract. AWARD contract. RESOLVE bid protests. EXECUTE contract.
Project-Specific Design Consultants (DC)	PROVIDE technical package to PM	ATTEND and PARTICIPATE if requested by PM.	PREPARE and submit draft responses to technical inquiries and technical revisions to PM.		PARTICIPATE in bid evaluation if requested by PM.	PROVIDE recommendations for contract award if requested by PM.
Consultant Construction Manager OR City Construction Manager (Field Engineering)	Constructability Review, if requested by PM	ATTEND if requested by PM.	Assist if requested by PM.	ATTEND bid opening.	ASSIST PM on Bid Evaluation if needed.	ASSIST PM on Bid Protests if needed.
Project-Specific Bidders/Equipment Suppliers			RECEIVE addenda and ACKNOWLEDGE addenda in bid.	SUBMIT bid.		PROVIDE required documents. EXECUTE contracts and DELIVER to City.

ATTEND

The DESIGN CONSULTANT takes extra precautions to ensure that portion(s) of the work covered by the addendum are clear and informs the CIP Project Manager. When requested, the DESIGN CONSULTANT includes the following specific information in a typical draft addendum: the number of pages and design sheet(s) in the addendum; new drawing(s) with number and reference to the current drawing number(s); instructions to bidders on how to insert or delete text; and identification of the pertinent specification, section, paragraph and line to be modified.

Addenda always adhere to the following rules:

- Contract Documents being changed are listed in the order of appearance in the documents, except for previous addenda, which are listed first.

- Each change is referenced and clearly explained. For changes to text, the document, paragraph, paragraph title, and subparagraph are listed, as a minimum. For changes to drawings, alphanumeric information can be changed by addendum wording. Changes to graphical information are made by describing the change in addendum wording and reissuing the drawing with a new revision date.

- Addenda may not modify the proposal in the bidding documents.

18.4.5 Issuing Addenda

If during the bid process the DESIGN CONSULTANT determines that a technical addendum is necessary, it notifies the CIP Project Manager immediately. All addenda is drafted expeditiously by the DESIGN CONSULTANT when requested by the CIP Project Manager. If the DESIGN CONSULTANT cannot draft the addendum for issuance at least 10 working days before the bid opening, it will immediately notify the CIP Project Manager and await further instructions.

The DESIGN CONSULTANT does not issue addenda. Only the Contract Services Division issues addenda to the plan holders.

18.5 Bid Evaluation and Award of Contract

The CIP Project Manager administers this phase of the bid process. The DESIGN CONSULTANT may be asked to participate as needed.

18.6 Conformed Set of Contract Documents

In the DESIGN CONSULTANT's scope of work, the CIP Project Manager may require it to incorporate all addenda issued on the "as advertised" Contract Documents into a "conformed" Contract Document set. This approach may be necessary if the CIP Project Manager determines that the contract addenda are excessively numerous or complicated.

Book 1

General Design Guidelines

Chapter 19
Construction Phase

City of San Diego Water Department
Capital Improvements Program

Chapter 19
CONSTRUCTION PHASE

19.1 Introduction

The construction period begins with Notice to Proceed to the Construction Contractor and ends with the Notice of Completion. This chapter covers potential DESIGN CONSULTANT responsibilities from the Notice to Proceed to the beginning of startup and testing.

If required by its scope of work, the DESIGN CONSULTANT provides construction phase assistance to the Construction Manager and the CIP Project Manager. This assistance may include:

- Attending regular construction progress meetings
- Responding to requests for information
- Assisting with change order preparation
- Reviewing contractor submittals
- Providing engineering support for planning shutdowns for tie-ins
- Reviewing "or equal," "substitute" or "value engineering" items
- Providing field evaluation of construction, and assisting with claims management
- Preparing construction as-built drawings

Other potential assistance required of the DESIGN CONSULTANT may include:

- Meeting with the Construction Contractor to resolve RFI, submittal, shop drawing, and substitution issues.

- Periodic inspections of work progress and Construction Contractor record drawings.

- Witnessing factory and field testing of components, equipment, and systems.

- Conducting final site inspections and preparing Construction Contractor punchlists.

The DESIGN CONSULTANT takes direction only from the CIP Project Manager unless it is otherwise delegated. One of two different construction management entities, City staff or a consultant, could be assigned project construction management (CM) responsibility.

19.2 Construction Progress Meetings

Regular progress meetings are held throughout the construction phase of a project. Typically, the meetings are held weekly or biweekly at the project site to discuss construction needs, issues, requests for information (RFIs), submittal reviews, change orders and construction progress. The DESIGN CONSULTANT may designate a representative to attend any or all regular construction progress meeting(s). Additional DESIGN CONSULTANT personnel attend if so requested by the CIP Project Manager. If necessary, special meetings are held in addition to, and separate from, the regular progress meetings to address specific issues.

19.3 Requests for Information

The DESIGN CONSULTANT may be asked to assist the Construction Manager during construction to answer questions from the Construction Contractor about the Contract Documents. Questions from the Construction Contractor are transmitted through a formal RFI. The procedure for processing RFIs is in accordance with City standards.

19.4 Change Order Processing

The DESIGN CONSULTANT assists the Construction Manager to review Preliminary Change Orders (PCOs) and make recommendations to either terminate PCOs or to elevate them to Contract Change Order (CCO) status. For CCOs, the DESIGN CONSULTANT assists the Construction Manager to evaluate the Contractor's cost proposal, if requested. The DESIGN CONSULTANT will verify by signing the CCO, that agreed changes will not adversely impact the design.

19.5 Construction Contractor Submittals

The DESIGN CONSULTANT reviews submittals from the Construction Contractor. The Construction Contractor submits all submittals (e.g., shop drawings, samples, certificates or other items) directly to the Construction Manager. The Construction Manager logs and forwards each submittal to the DESIGN CONSULTANT following established routing procedures. The submittal turnaround time is generally 2 to 4 weeks, depending on specific project contract requirements. The turnaround time and other submittal review parameters are defined in the Contract Documents. The DESIGN CONSULTANT will return submittals to the Construction Manager indicating submittal status in accordance with paragraph 3.4.12.C.5 of Book 6.

19.6 Shutdowns and Facility Tie-Ins

Water facility shutdowns are the responsibility of the Water Operations Division. The Construction Manager coordinates with the City's Senior Liaison Engineer for shutdowns for facility tie-ins. The DESIGN CONSULTANT reviews the proposed plans for shutdown and tie-in and may be asked to support the CIP Project Manager, Construction Manager and Senior Liaison Engineer in presenting proposed shutdown plans to the Water Operations Division.

19.7 "Or Equal," "Substitute" and "Value Engineering" Items

If requested by the CIP Project Manager, the DESIGN CONSULTANT reviews "or equal" and "substitute" submittal items as well as value engineering proposals from the Construction Contractor.

19.8 Field Evaluation of Construction

Inspection and testing are the overall responsibility of the Construction Manager and are performed to ensure that construction work and materials furnished conform with drawings and specifications. The DESIGN CONSULTANT, if directed in its scope of work, is available to assist the Construction Manager at any time to perform field evaluation of the construction. This also includes availability to visit a mill, batch plant or manufacturing facility to verify compliance of the manufactured product or material or witness an equipment factory test.

19.9 Claims Management

If claims arise during construction, the DESIGN CONSULTANT assists the CIP Project Manager or Construction Manager in claims review and resolution upon request.

19.10 Construction As-Built Drawings

If directed in its scope of work, the DESIGN CONSULTANT incorporates all changes made during construction into the as-built drawings. Redline drawing sets (record drawings) prepared by the Construction Contractor are submitted to the Construction Manager and furnished to the DESIGN CONSULTANT.

19.11 Communication Procedures Between the Design and Construction Management Staff

If directed its scope of work, the DESIGN CONSULTANT prepares a report that establishes a basis for communication and coordination between design and construction management staff. The report highlights special design concepts or unique features of the design, so that the Construction Manager can identify and properly inspect these special items of work. Attachment 19-1 shows the requirements for this report.

Attachment 19-1
Engineering Considerations and Instructions For Construction Field Personnel

1. *Purpose.* The DESIGN CONSULTANT prepares the Engineering Considerations and Instructions for Field Personnel report to transmit special design concepts, assumptions and instructions about unique design details to field personnel. The report establishes a basis for communication and coordination between design and the construction management team. The scope of work prepared by the Water Department CIP Program Management Division defines whether this report is required for each project.

2. *Report Format and Content.* As applicable, include the following information for a project.

a. Title Page. List project title, location and date of report.

b. List of Design Personnel. List key design personnel that can be contacted for technical assistance during construction. Include name, design specialty and telephone number.

c. Special Design Considerations. Provide a clear, concise explanation of special design concepts and/or unique features by discipline; Civil, Architectural, Structural, Mechanical, Electrical, etc., so that the Construction Manager can identify and properly inspect these special items of work. Examples of items to discuss include:

- Special testing requirements involving design personnel.
- Critical or unusual products and performance specifications such as high pressure, temperatures or capacities.
- Situations where a manufacturer should oversee equipment installation.
- Long-lead procurement items, receipt, storage, preservation.
- Special operational constraints, i.e., utility outage periods, special construction phasing required.
- Any permits that must be obtained before and during construction.
- Critical safety precautions required or other minimum quality assurance testing amount/frequency for critical items.

d. *Schedule of Required Site Visits by Design Personnel.* If site visits on certain proposed phases of construction are necessary, a site visitation schedule is prepared that identifies the critical construction stages and the number of days of notification required from the CIP Program Management Division.

Book 1

General Design Guidelines

Chapter 20
Startup and Closeout

City of San Diego Water Department
Capital Improvements Program

Chapter 20
STARTUP AND CLOSEOUT

20.1 Introduction

If directed in its scope of work, the DESIGN CONSULTANT provides project closeout assistance to the CIP Project Manager. This assistance may include providing system integration and testing support, assisting the Construction Manager to prepare punchlist and final inspection procedures, and providing project closeout support.

Facility closeout includes the DESIGN CONSULTANT's review and reporting of the Construction Contractor's functional testing of equipment, successful startup and operational test of systems, final acceptance, completion and submittal of the Operation and Maintenance Manuals, and submittal of as-built drawings.

Following startup and successful operational testing and turnover, the Construction Manager and the DESIGN CONSULTANT prepare the final acceptance and Notice of Completion.

20.2 System Integration Support

If the Construction Contractor is required to submit a plan for integrating the constructed facility into an existing system, the DESIGN CONSULTANT reviews the work plan for tie-in and integration.

20.3 Startup and Testing Support

If requested by the CIP Project Manager, the DESIGN CONSULTANT reviews and comments on the CIP Construction Manager submittals of its proposed plan for startup and testing of the constructed facility. The DESIGN CONSULTANT observes the system startup test, reviews startup and preliminary operational data during system tests, and reports to the Construction Manager and the CIP Project Manager on the system performance with respect to the intent of the design.

20.4 Project Closeout Support

If directed in its scope of work, the DESIGN CONSULTANT assists the CIP Project Manager during project closeout and supports the project closeout process. Typical tasks include:

- Preparing punchlist and final inspection procedures.
- Preparing as-built drawings.
- Preparing technical manuals.
- Preparing equipment record forms and spare parts list checkoff.
- Assisting with warranty administration.
- Organizing and conducting operator training and startup/checkout certifications.

20.4.1 As-Built Drawing Support

If requested by the CIP Project Manager, the DESIGN CONSULTANT incorporates all changes made during construction into the original design drawings and produces an original set of as-built drawings. If directed in its scope of work, the DESIGN CONSULTANT also produces a specified number of copies of the as-built drawings for the CIP Project Manager. As described in Chapter 19, drawing updates may take place during construction.

20.4.2 Operator Training

If directed in its scope of work, the DESIGN CONSULTANT organizes and conducts training for Water Department Operations staff in a program of classroom training and hands-on operating instruction. The program is developed to conform with current Water Department training guidelines. The DESIGN CONSULTANT submits the proposed program to the Water Operations Division via the CIP Project Manager for approval. Training consists of (1) an overview and summary of system equipment, controls, and operational processes with appropriate visual illustrations, (2) hands-on operational training, and (3) appropriate student handouts that support the training. The City, at its option, may videotape the DESIGN CONSULTANT and Construction Contractor/vendor training sessions. The project Operation and Maintenance Manuals should be available for this training/instruction (see Chapter 8).

Book 1

General Design Guidelines

Chapter 21
Records Management and Document Control

City of San Diego Water Department
Capital Improvements Program

Chapter 21
RECORDS MANAGEMENT AND DOCUMENT CONTROL

21.1 Overview

Managing and controlling project records and documents are important aspects of designing and constructing facilities in the Water CIP. The reasons for managed records include:

- Reconstructing the events that developed the project to the as-designed and/or as-constructed configurations, including conceptual design, predesign, design criteria, detailed design and value engineering. This information may provide determinations of responsibility, if required, for various aspects of a project, and determinations of how specific actions affected the ultimate design of a project.

- Providing available information for maintenance, upgrading and later expansion of facilities. This information includes structural, mechanical, electrical and other calculations; sketches and drawings; and manufacturers' data for materials and equipment provided.

- Providing as-constructed information for future construction activities, by either private or public entities, to proceed without interfering with existing buried utilities. Lack or inaccuracy of this information can delay and/or hamper future development activities, and the potential to lead to litigation.

The Water CIP Records Management System contains the following:

- Hardcopies and electronic files of all project documents, i.e., correspondence, reports, drawings, specification, calculations, meeting minutes, contracts, daily construction progress reports, change orders, clarifications issued, field orders and deviations and similar items.

- All documents necessary to recreate and reconstruct events that led to the development of a project constitute the CIP record and are addressed by this Guideline.

- The latest version of Water CIP Guidelines and Standards.

The City owns all documents generated by DESIGN CONSULTANTS, Construction Managers, Contractors, and other entities entered into contractual agreements with the City for the design and construction of Water CIP projects. The City requires that all documents be logged, recorded and filed as defined in this Guideline, and that their locations be known and identified.

The Water CIP Records Management Unit (RMU) records the existence and location of each document. The RMU may not, however, be in possession of all documents. Therefore, it is important that:

1. The RMU be copied on all correspondence generated by Water Department staff.

2. All documents generated by outside entities, (e.g., DESIGN CONSULTANTS, Construction Managers, etc.) be transmitted or copied to the RMU. The RMU routes these documents to the appropriate Water Department staff.

    - For example, DESIGN CONSULTANT drawing submittals are transmitted first to the RMU. The RMU records and logs the submittal, then forwards it to the specific CIP Project Manager and others on the distribution list.

    - If the DESIGN CONSULTANT hand delivers a document or submittal directly to the CIP Project Manager, the CIP Project Manager takes it to the RMU to be recorded, logged and distributed before action on the submittal.

    - After the RMU records and logs a submittal, the CIP Project Manager becomes the focal point for records management and document control.

    - The RMU is the ultimate repository for all Construction Documents except for the original mylar design drawings, including bid, as-bid, and as-built drawings, which are stored at Engineering Maps and Records.

21.2 Records Management System

This guideline defines the duty of outside organizations and entities to collect, identify, store and maintain the records developed by or on behalf of the City.

The Records Management System procedure ensures:

- Consistency in the identification and control of documents.

- Consistency in the manner in which documents are prepared, including format and media.

- Consistency in the manner in which documents are filed.

- That documents received from DESIGN CONSULTANT and others comply with Water CIP requirements.

- That records required to operate and maintain Water Department facilities are properly received, recorded and logged in a computerized database, and are readily retrievable when needed.

The following list provides examples of the types of documents covered by the guidelines in this chapter. Other types of documents may also be covered.

- Design documents (specification, design drawings) and the design support documents (calculations, review comments, studies, value engineering evaluations, technical memoranda and reports).

- Addenda issued during the bidding period.

- As-awarded design documents incorporating Addenda into design documents issued for bid (i.e., a conformed set of Contract Documents).

- Shop drawings for materials, components, equipment and systems installed at Water CIP facilities.

- Responses to requests for information, shop drawing submittals, design clarifications, substitution requests, and other similar documents issued during construction.

- Change orders issued during construction.

- Equipment operations and maintenance manuals.

- Water CIP facility owner's manuals.

- Record and as-built drawings.

- Records documenting construction activities, such as concrete logs, analyses of soil samples, field reports, quality assurance/quality control documents, progress meeting minutes, field orders, inspection reports and the like.

21.2.1 Database for Records Other than Design Drawings

The DESIGN CONSULTANT prepares a computerized database for all project documents except design drawings. The database registers for correspondence, specification, and other records, except drawings, contain the following fields:

- Document control number (DCN), a unique identifier.
- Document title (subject or description).
- Document date.
- Issued revision(s) and revision date.
- Project/subproject name.
- Capital improvement program/sub-CIP project number.

21.2.2 Database for Design Drawings

The DESIGN CONSULTANT prepares the design drawings on drafting mylar film media in accordance with Book 5, CADD Standards. Each drawing is assigned a unique identifying number before initial submittal to the CIP RMU. The DESIGN CONSULTANT maintains a computerized design drawing register. The minimum design drawing register fields include:

- Document control number (DCN), a unique identifier.
- Document title (subject or description).
- Date issued.
- Revision number.
- Revision description.
- Date revision issued.
- City-issued DCN.
- Project name.
- Status (issued for bid, issued for construction, issued as-built, VOID, canceled, supersedes/superseded by, with cross-reference information to old/new documents).
- Capital improvement program/sub-CIP project number.

21.3 Records of the Design Process

21.3.1 Design Drawings

All design drawings are prepared using the latest version of Intergraph CADD software according to Book 5, CADD Standards. At the end of the project design phase and after final approval of the design drawings, the DESIGN CONSULTANT signs and stamps the original mylar drawings and signs and dates the appropriate places in the drawing title blocks. The signed mylar drawings and CADD files of the drawings are then transmitted to the RMU.

The procedure below must be followed to ensure orderly processing and completion of mylar design drawings. Refer to Figure 21-1.

1. The RMU records and logs the design drawings and transmits them to the CIP Project Manager.

2. The CIP Project Manager reviews the design drawings and verifies that:

   - Drawings accurately and completely show the intended project design.

   - Drawings incorporate all agreed-upon revisions.

   - Each design mylar is stamped and signed by a Professional Civil Engineer registered in the state of California and duly designated by the DESIGN CONSULTANT as in charge of the design.

   - The drawing title, the D-sheet number assigned by the City, the work order number, and the specification section number are correct and placed appropriately in the title block.

   - Each sheet, including the cover sheet, is sequentially numbered.

   - No self-adhesive tapes or sticky backs are used on the mylar drawings.

3. The CIP Project Manager signs and dates each mylar drawing to indicate that all information is correct.

4. The CIP Project Manager submits the mylar design drawings to the Senior Civil Engineer and/or Chief Engineer, who signs the cover sheet and the sheet(s) containing the list of drawings. This signature indicates that the design substantially conforms to the scope of the contract and that mylar design drawings are authorized to be issued for construction.

5. After the mylar design drawings are signed, the CIP Project Manager returns the signed drawings to RMU. The RMU then transmits the original signed mylar design drawings to the Contract Services Division of the Engineering and Capital Projects Department.

6. The Contract Services Division forwards the mylar design drawings to the City print shop to make the necessary number and sizes of copies for bid and distribution purposes.

7. The RMU transmits a complete set of prints of the signed design drawings to the Geographical Information Systems Section of the Water Department.

8. The fully executed original mylar design drawings, properly stamped, signed and dated are retained by the Contract Services Division and become the City's legal record documents for the project.

9. Changes to the project design may be issued during the bidding process in the form of Addenda. For each Addendum, the DESIGN CONSULTANT clouds the changed areas of the affected drawings, shows identifying Addendum letters in triangles, and note the Addendum number in the drawing revision block. On subsequent Addenda, clouds are removed from the previous Addendum. Each Addendum is accompanied by a transmittal memorandum that describes each change in detail.

10. At the end of the bidding process, the DESIGN CONSULTANT prepares and provides Issued for Construction (also known as conformed or as-awarded) mylar design drawings which incorporate all changes made during the bidding process.

    - All Addenda clouds, identifying letters, and triangles are removed.
    - Other changes issued by Addenda but not yet shown on the drawings are added.
    - The next available drawing revision block entry is identified as Rev 0 (zero), and contains the notation: Issued for Construction. The issue date and appropriate signatures are also indicated. Subsequent revisions are identified as Rev 1, Rev 2, and so forth.
    - Issued for Construction drawings procedures for stamping, signing and dating are as described for bid drawings.

21.3.2 Specification

The DESIGN CONSULTANT prepares the written specification in CSI format in accordance with Chapter 17, Specification, and in accordance with Book 4, Standard and Guide Specifications. Each page of the specification includes:

- The specification section name and number.
- The project name.
- The page number.
- The month and year issued.

Revised pages shall include a revision number and date consisting of the month and year.

A table of contents (TOC) is prepared for the complete specification document. The table of contents also lists figures and attachments. The TOC is included at the beginning of each specification volume.

Upon transmittal to the RMU, the specification original with electronic files is submitted with a letter of transmittal listing the specification sections included. The specification is written in the version of WordPerfect word processing software in current use by the City. A cross-reference list between the specification hardcopy and the electronic files is provided.

21.3.3 Calculations

Calculations must be prepared according to this chapter and receive the same attention to legibility and level of clarity as the design drawings or specification. Calculation sheets include the following information:

- Name of Project
- Contract Number
- Subject
- Sheet Number
- Preparer Initial and Date
- Reviewer Initial and Date
- Approver Initial and Date

Calculations are prepared on the DESIGN CONSULTANT=s preprinted 82 by 11-inch calculation forms. When the calculation is prepared on grid paper, the grid ink must be nonreproducible blue or a very light color (screened) that drops out when the page is copied.

Calculations include the following information:

- Clear statement of the problem. This may include system sketches or drawings.

- List of all assumptions.

- List of all references (textbooks, papers, and design manuals) for formulae, theory, and other data used in the calculation.

- Description of pertinent design criteria.
- Description of the methods used, including a narrative discussion if interpretation/extrapolation is necessary.
- Compilation of catalog data or other appropriate vendor information used for design. Data for all equipment listed in the specification is included.
- Name and version of any computer program used, plus verification that the program has received appropriate checking and authorization for the application.
- If not shown on the output, computer calculations are accompanied with input data, methodology and formulae used, and a description of assumptions made.
- Appropriate sketches showing the results, if required.

Calculations must have a title page. If a calculation is issued and later voided, a copy of the cover sheet with the VOID notation is maintained in the file folder for the specific calculation. Superseded/superseding calculations cross-reference each other and the title sheet of the superseded calculation is retained. Revised, superseded or voided calculations are clearly identified, dated and signed by the responsible person.

The complete calculation package, including computer printouts, calculations, sketches, catalog data, and so forth are included in the total page count of the calculation and listed in the table of contents.

Calculations are compiled either in folders or in loose leaf three-ring binders in the order of the unique identifying number assigned to them. Each calculation is separated from others by a divider page tabbed with its identifying number and identified by title pages.

For security purposes, each time a calculation is signed and dated, a record copy of the calculation is produced and filed in a separate location.

The DESIGN CONSULTANT maintains a calculation index register. The minimum information the register contains is:

- Unique calculation number identifier
- Calculation title (subject or description)
- Discipline
- Date of final review
- Revision number
- Project name
- Status (Void; Canceled; Supersedes/Superseded; and so forth)
- Referenced design documents

The calculation submittal forwarded at the end of a project includes the record copies, the current original, and the calculation index register. The calculation index register is in hardcopy and electronic media in the version of WordPerfect word processing software in current use by the City. The record copies and the original calculations are also submitted.

21.3.4 Other Design Documents

These Guidelines require specific types of design documents to be submitted to the City for review before they are completed. Each time these documents are submitted to the RMU, the following information is included on each document:

1. Title block:

    - Project identifier (DCN)
    - Unique document identifier
    - Date of issue
    - Reason for issue
    - Revision number

2. Table of contents:

    - Project identifier
    - Unique document identifier
    - Date of issue
    - Revision number
    - List of sections/chapters
    - List of tables
    - List of figures
    - List of attachments
    - List of any other items comprising the document

3. Each page/sheet:

    - Project identifier
    - Unique document identifier
    - Page/sheet number on each page/sheet
    - Indicator for last page/sheet

21.3.5 Copies of Submittals

Each design submittal must be as defined in the project scope of work. As a minimum, it consists of:

- Twelve copies of the Basis of Design Report. Letter reports are acceptable if approved by the CIP Project Manager.

- Twelve specification copies.

- Twelve half-sized design drawing sets.

- Four full-sized design drawing sets.

- Documents larger than 11 x 17 inches must be rolled with no crease lines. Documents 11 x 17 inches or smaller are placed in file folders without crease lines. The file folder label contains the unique identifier of the document. Documents are organized in order of size and, within each size, by document control number.

- A letter of transmittal accompanies the design submittal.

21.3.6 Design Review Comments

The design review comments process is described in Chapter 6. The CIP Project Manager transmits the documentation to the RMU for recording, logging and filing.

21.4 Bid and Construction Phase Records

As stated previously, the final design documents are transmitted to the RMU for processing.

- If a decision is made to proceed with bidding and construction, Figure 21-1 indicates the records management process to be followed during the project bidding and construction phases.

- If the decision is made not to proceed with the project, the CIP Project Manager returns the design documents to the RMU for retention, and the notation is added that the project is terminated.

- Each transaction is accompanied by a letter of transmittal registered in the CIP Record Management System.

21.4.1 The Specification

Key points of handling and processing the specification are listed below (refer to Figure 21-1).

1. The RMU transmits the original bid specification to the Contract Services Division to initiate the project bidding process. The bid specification resides with the Contract Services Division throughout the bid process.

2. After processing, printing and distribution, the RMU files and maintains the Issued for Construction specification. The Issued for Construction specification is prepared by the DESIGN CONSULTANT, and incorporates all changes and addenda issued during bidding.

3. The as-built specification is turned over to the RMU with the as-built drawings.

21.4.2 Mylar Design Drawings

Key points of handling and processing mylar design drawings are listed below (refer to Figure 21-1).

1. The RMU transmits the original mylar bid set design drawings to the Contract Services Division to initiate the project bidding process. These drawings reside with the Contract Services Division throughout the project bid process and constitute the City's legal record documents for the project during bidding.

2. The mylar bid design drawings, as well as all addenda issued during bidding, reside in the Engineering Maps and Records Office of the Map Check and Records Section of the Development Services Department (Engineering Maps and Records). After processing and printing, the RMU maintains the fully executed Issued for Construction mylar design drawings.

3. During construction, the Construction Contractor prepares, maintains, and updates a set of red-marked blueline design drawing prints, known as record drawings, showing all changes and deviations from the Contract Documents as required by the project specification.

21.4.3 Shop Drawings

Shop drawings include component and equipment manufacturer catalog data, calculations, product samples, installation drawings and data, certifications, test reports, operations and maintenance manuals, spare parts lists, or any other document submitted by the Construction Contractor to the Construction Manager detailing product, material, component, equipment, system, and project layout information.

The Construction Contractor prepares and submits shop drawings based on the documentation requirements in the Contract Documents and/or applicable industry standards and local, state and federal codes, standards, and regulations. Shop drawing submittals are accompanied by a shop drawing transmittal, with all data in the transmittal form filled in and completed.

The Construction Manager maintains a detailed register for processing project shop drawing submittals that indicate the status of each shop drawing. Upon completion of the project, the most recent register update and all shop drawings are transmitted to the RMU by the Construction Manager.

21.4.4 Shop Drawings for Pipeline Projects

Shop drawing submittals for pipeline projects are incorporated into the as-built drawings. Copies of the shop drawings are scanned into the CADD system onto blank D-sheets, with the project title and drawing description included by the DESIGN CONSULTANT. Depending on the shop drawing size, multiple shop drawings may be shown on each as-built drawing sheet. A D-sheet drawing number, beginning with the next number in the drawing set sequence, is

printed on the mylar drawing. The pipeline shop drawings are included in the mylar and electronic file as-built drawing submittal to the CIP Project Manager.

21.4.5 As-Built Drawings

The project as-built drawing set is prepared as follows:

1. At the completion of project construction, the CIP Project Manager requests the return of the original mylar as-bid drawings from Engineering Maps and Records. These mylar design drawings are stamped Superseded by as-built drawings to avoid confusion with other project drawings.

2. The Construction Contractor submits the complete set of red-marked blueline record drawing prints to the Construction Manager. The Construction Manager reviews the record drawings for completeness, consulting the Construction Contractor and/or the Inspector (Resident Engineer) as necessary. To be accepted, record drawings must comply with at least the following:

   - All project Change Orders noted.
   - All project changes not requiring a formal Change Order also reflected.
   - Agree with the Inspector ′s marked-up drawing prints and other records.

3. Upon acceptance of the record drawings by the Construction Manager, the record drawings are formally transmitted to the CIP Project Manager. The CIP Project Manager inspects them for completeness and transmits them to the DESIGN CONSULTANT for preparation of the mylar as-built drawings.

4. The DESIGN CONSULTANT prepares the as-built drawings by modifying the most current version of the electronic files to reflect the as-constructed configuration of the project.

   - Data for as-built drawing preparation comes from several sources, including the Contractor's red-marked record drawing marked prints, Change Orders, RFIs, design clarifications, and the DESIGN CONSULTANT's final walk-through inspection of the project.

   - All clouds, notations and information from previous changes is removed. The next available number in the drawing status block is completed and dated to indicate as-built drawings.

   - All new information is shown on the drawing.

   - Exception 1: if an entire sheet has not been constructed, it is crossed out and labeled Deleted.

   - Exception 2: if a change is so extensive that an entire new sheet is issued via a Change Order, an entire new drawing sheet is included in the as-built drawing set.

- In the lower right corner of the drawing sheet, the words AS-BUILT DRAWING is added in letters at least one half inch high.

5. Each as-built drawing sheet contains the following electronically printed as-built drawing block. The as-built drawing block must be properly signed and dated by the DESIGN CONSULTANT.

AS-BUILT DRAWING

Revisions drawn by: _____Date: _____

This AS-BUILT DRAWING has been prepared based on information furnished by others. While this furnished information is considered reliable, the DESIGN CONSULTANT cannot ensure its accuracy. The DESIGN CONSULTANT will not be responsible for any errors or omissions which may have been incorporated into this AS-BUILT DRAWING as a result. Those relying on this AS-BUILT DRAWING shall obtain independent verification of its accuracy before applying it for any purpose.

DESIGN CONSULTANT: _____Date: _____

CONSTRUCTION MANAGER: _____Date: _____

6. Additional information required for mylar as-built drawings:

- The D-sheet title block contains the following headings: Description, By, Approved, Date, and Filmed. The following is entered on the bottom of the D-sheet title block with black opaque permanent ink:
  - The words AS-BUILT in the Description column.
  - The initials, in block letters, of the CADD operator or consulting firm who prepared the as-built drawing in the By column.
  - The signature initials of the CIP Project Manager in the Approval column.
  - The date of approval by the CIP Project Manager in the Date column.
  - The Filmed column is left blank. It is later completed by Engineering Maps and Records.
- In the section immediately below the D-sheet title block, the following information is provided in black opaque permanent ink:
  - The name of the project Construction Contractor.

- The name of the project Inspector and consulting firm, where applicable.

- The Date Started B is the date that the project Notice to Proceed is issued to the Contractor.

- The Date Completed B is the date that the project notice of completion is issued or, when approved by the CIP Project Manager, the date of substantial completion.

7. The DESIGN CONSULTANT stamps, signs, and dates the mylar as-built drawings in the manner previously described for design drawings.

8. The DESIGN CONSULTANT submits the stamped and signed as-built drawings to the Construction Manager for further processing.

9. The Construction Manager reviews the as-built drawings for accuracy and completeness. As a minimum, the information shown on the as-built drawings submitted by the Construction Contractor is included, the title block completed, and the as-built drawing block shown in item 5 above printed, signed, and dated on each drawing. After review, the Construction Manager also signs and dates the mylar drawings in the as-built drawing block, as shown in item 5 above. The Construction Manager transmits the as-built drawings to the CIP Project Manager.

10. With the mylar as-built drawing submittal to the Construction Manager, the DESIGN CONSULTANT also submits the updated electronic files of drawings, reflecting the as-constructed status of the project. Via the CIP Project Manager, these electronic files are received by the RMU. The electronic drawings are prepared using the latest version of Intergraph software.

11. The DESIGN CONSULTANT returns the Contractor's red-marked record drawings to the Construction Manager. The Construction Manager shall forward them to the RMU with all the other required field information indicated in Figure 21-1.

12. After review, the CIP Project Manager obtains all required Water Department signatures and dates on the as-built drawings and transmits them to the RMU.

13. In a manner similar to that described for drawings, the RMU transmits the fully executed mylar as-built drawings to Engineering Maps and Records section for microfilming and archiving. The as-built drawings become the City's legal record documents for the project. This step completes the as-built drawing process.

14. The RMU transmits a complete set of prints of the fully executed as-built drawings to GIS.

15. The RMU transmits a complete set of prints of the fully executed as-built drawings to the Water Operations Division.

21.5 Letters of Transmittal

Documents transmitted between City and other organizations involved in a project are accompanied by a letter of transmittal containing:

- A list of all documents included in the transmittal
- The date of transmittal
- The unique identifier number of each document transmitted
- The document sheet number
- The document revision number
- The document media
- The purpose of the transmittal

The letter of transmittal shall be signed by an authorized person responsible for initiating the communication. A file copy of the transmitted document and letter of transmittal is retained by the originating organization

21.6 Samples

Product samples, including electrical components, valves, gaskets, pipe identifying markers, HVAC dampers and registers, etc., are submitted by the Construction Contractor as shop drawings. Each sample is clearly identified and submitted with an analysis or description. The analysis or description is identified by a Water CIP unique identifier number and status stamp.

If the sample cannot be physically transmitted for review, the submittal must include the analysis or description and the transmittal form must indicate the location of the sample. The sample must have its unique identifier affixed to it or to its container. The City may ask for samples of individual items to be turned over to it upon completion of the project. The sample is retained for the life of the Construction Contract or until all claims and backcharges are settled, whichever occurs later.

21.7 Construction Documents

Standard construction forms provide documented evidence of the quality of the constructed facility or of individual items, equipment or processes of the facility. As such, they are facility records and are turned over at the completion of the facility. These records include the following:

- Project directory
- Testing and inspection plans, results and reports
- Right-of-way agreements and encroachment permits
- Construction photographs
- Field diaries
- Punchlists

21.8 Correspondence

Correspondence (i.e., incoming, outgoing, and internal letters; memoranda; facsimile and e-mail letters and memoranda; and letters of transmittal) are registered using a unique alphanumeric sequenced document control number (DCN). The DCN is assigned to outgoing and internal documents after the document is signed and dated and immediately upon receipt for incoming documents.

Documents containing more than one page are paginated, indicate the total number of pages, and indicate the final page. Exhibits, figures, attachments and/or appendixes are listed in a table of contents. Attachments, or other such items, are listed on the letter by title or, if applicable, by registered number.

Facsimiles and e-mail transmitted outside the organization include the same information and are given the same attention to detail as a letter. Facsimiles and e-mail are registered before transmittal, and are signed by a person of appropriate authority.

Correspondence hardcopies are filed in the applicable project file and in a separate chronological file. The Construction Manager maintains and updates a computerized log of all project correspondence.

21.9 Capital Improvement Program Guidelines and Standards

All entities involved in Water Department projects must maintain the most current version of the Water CIP Guidelines and Standards and pay special attention to periodic revisions.

A. Control of Annual Revisions

Although Guidelines and standards revisions may be made progressively at any time during the course of the year, scheduled revisions to the Water CIP Guidelines and Standards are issued annually during the fourth quarter of the calendar year. Control procedures for annual revisions include:

- The date (month and year) of the original Water CIP Guidelines issue is shown in the footer of each page.
- For subsequent revisions, each affected chapter page shows the revision number and date of the current revision.
- Each volume includes a revision table indicating the date and number of each chapter revised. This revision table is updated and re-issued with each annual revision.
- New chapters of Water CIP Guidelines are provided with tabbed index dividers.
- The table of contents of each affected volume of the Water CIP Guidelines is updated to incorporate changes each time a revision is made. A copy of the applicable table of contents for each volume is

included in the appropriate location of the revision package to facilitate updating of Water CIP Guidelines manuals.

- Added text is indicated by highlighting or by redlining, and deleted text is shown by striking out. If an entire chapter is added, it is shown without highlighting or striking out.

- Only changes that are part of a current revision are highlighted or stricken out. Highlights and strikeouts from previous revisions are removed.

The CIP Project Manager immediately transmits interim revisions that require urgent compliance to the DESIGN CONSULTANT.

B. Revision Distribution

The CIP Program Manager distributes each revision package to Guidelines holders for updating their respective Guidelines volumes. The revision package includes the following:

- A cover letter that includes an acknowledgment page for receipt of the revisions.

- An instruction memorandum to Guidelines holders for incorporating the annual revisions to the Water CIP Guidelines.

- Copies of the current revision to the Water CIP Guidelines.

C. Controlled Distribution

Each set of Water CIP Guidelines is assigned a control number and each Water CIP Guidelines set is specifically assigned to each holder. The Water CIP Guidelines controlled distribution list, a list of the names, addresses and Water CIP Guidelines set numbers, is retained by Water Department. Acknowledgments of revision receipts are tracked to ensure that each Water CIP Guidelines set holder received current revisions. Follow-up on acknowledgments not received is made after 30 calendar days from the date of revision issuance.

The City establishes a price for each Water CIP Guidelines revision based on reproduction and distribution costs. An invoice is transmitted with each revision.

A list of payments not received within 60 calendar days after the date of Water CIP Guidelines revision issuance is developed. This list is compared to the active contract agreements.

- If the revision recipient is actively involved with work for the Water Department, the Accounts Section deducts the amount due from a future invoice of that organization.

- If the revision recipient no longer has an active agreement with the Water Department, a notation is made to the Water CIP Guidelines controlled

distribution list and future revisions are not transmitted to that Water CIP Guidelines set holder.

D. Water CIP Guidelines and Standards Copies in Stock

In addition to sets issued to Water CIP Guidelines holders, the City maintains an additional inventory of CIP Guidelines sets. Each set of Water CIP Guidelines in the inventory is assigned a sequential control number. Each time a revision is made, each Water CIP Guidelines set in stock is updated. After each Water CIP Guidelines set is revised, the acknowledgment is signed by the person performing the updating and returned for filing and recording.