Geotechnical Design Reports

January 2026

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

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1 INTRODUCTION

The intent of this document is to define the Department's standard of practice for preparation of the District Preliminary Geotechnical Report (DPGR), Preliminary Geotechnical Design Report (PGDR), and the Geotechnical Design Report (GDR).

1.1 Reporting for Project Delivery

Geotechnical investigation and reporting generally occurs at three stages of the project development process:

- A DPGR provides preliminary recommendations to District Project Engineers and is used to develop the Project Initiation Document (PID), Environmental Impact Report (EIR), Environmental Impact Statement (EIS), Project Study Report (PSR), and/or Project Report (PR). (WBS 150.15.20 or WBS 160.10.80).
- A PGDR describes existing site conditions, provides subsurface information from the geotechnical investigation, and presents preliminary geotechnical design recommendations to District Project Engineers. The PGDR is issued prior to the end of Project Approval and Environmental Document (PA&ED) (WBS 160.10.82).
- A GDR provides subsurface information from the geotechnical investigation, analyses and design, geotechnical recommendations, and notes for editing the Special Provisions. (WBS 230.05.70.15)

A single report (DPGR, PGDR, GDR) should be prepared for a project and should contain all recommendations relating to the District PS&E.

Prepare reports to succinctly communicate information pertinent to the recommendations in accordance with the report preparation requirements. The following rules must be followed:

- Present specific information that is relevant to the recommendations.
- Reference or cite existing standards, specifications, or policy only when clarifying, modifying, or disallowing the standard, specification, or policy.
- Do not include unsubstantiated disclaimers.
- Provide titles and numbers for all figures and tables.
- Tables and figures must be included within the body of the report and located as near as possible to the place where they are first referenced.
- All depth references must have a corresponding elevation in parenthesis.
- Elevations presented in the PGDR/GDR must be presented using the datum shown on the project plans.

1.1.1 Reports Prepared by Caltrans Staff

Geotechnical Design Reports are written to the District Project Engineer, Specification Engineer, and District Construction, and are part of the contract.

Reports prepared by Geotechnical Services staff must use the current departmental memorandum format with the subject line of "Geotechnical Design Report for *Project Name*" or "Preliminary Geotechnical Design Report for *Project Name*" or "District Preliminary Geotechnical Report for *Project Name*".

Do not include section numbers in the report. First-level section titles presented in this document (e.g., Geotechnical Conditions) must be included in the report. Second-level section titles (e.g., Geology, Surface Conditions) are optional. Include only those topics within each section that are relevant to the work. To address project-specific unique design issues that are not covered in this document, add additional sections or subsections.

Include Boring Records in the appendix of the GDR when Log of Test Borings (LOTB) are not included in the Plans. Do not include LOTB or As-built LOTB in the Geotechnical Design Report. For As-built LOTB, send the MicroStation files or scanned copies of the As-built LOTB sheets to the Project Engineer to be included in the Contract Plans.

Sign and stamp reports in accordance with the *Communications and Reporting* section of the *Offices of Geotechnical Design – Quality Management Plan*.

1.1.2 Reports Prepared by Consultants

Reports must include the following: cover sheet, table of contents, main contents per this document, and appendices. The cover of the report and any addenda/amendments to the report must include the following information: project name, Caltrans District, County, Route, begin and end Post Miles, Project ID, Expenditure Authorization (EA) number, project component ID, project component name(s), author, and date.

Submit either the Boring Records or LOTB/As-built LOTB as part of the GDR. Refer to the Caltrans *Soil and Rock Logging, Classification, and Presentation Manual* for direction on the preparation of the LOTB and As-built LOTB.

2 DISTRICT PRELIMINARY GEOTECHNICAL REPORT (DPGR)

The DPGR is required during the early stages of a project to assist the District in the preparation of the PID, EIR/EIS, and the PSR/PR. Often the number, location, and types of improvements are not completely known. As a result, recommendations may be general, and detailed field investigations are usually not warranted. Typical fieldwork consists of a site visit only. A DPGR typically includes evaluation of existing site conditions, seismicity and geologic hazards, site geology, and feasibility of identified geotechnical options. The assessment and recommendations provided in the DPGR can influence the scope, cost, and selection of project components. If applicable, the DPGR should also discuss the anticipated field and laboratory work required to support the PGDR and GDR.

The following topics should be addressed in all District Preliminary Geotechnical Reports.

2.1 Introduction

Summarize the purpose of the report by referencing the request memo and preliminary plans by date. Do not present an exhaustive list of tasks performed.

2.2 Project Description

Identify the project components that require geotechnical recommendations. For projects with multiple geotechnical components, use a table to provide summary information for project components. When presenting locations based on station and offset, reference the highway/project alignment, instead of individual component alignments. For project components that traverse the highway, such as culverts, reference the component alignment.

Maps may also be included to further delineate locations and alignments of the project components. Drawings and plans, referenced by revision date, may also be included to supplement information provided in the table.

Table X – Description of Planned Improvements

Planned Improvement	Begin Station or PM	End Station or PM	Length (feet)	Maximum Design Height (feet)	Notes
Widening					
Type 1 RW					
Sound Wall					
CMS					

Not all columns apply to all geotechnical components, e.g., CMS would have "Begin Station" only.

<Edit column heading to properly identify the location information presented. Do not modify the other table headers>

2.3 Exceptions to Policies and Procedures

List exceptions to Departmental policies and procedures relating to the DPGR. Approved *Request for Exception* forms must be included in the Appendix. Omit this section if there are no exceptions.

2.4 Geotechnical Investigation

Provide an overview of the geotechnical investigation(s) that support the preliminary recommendations.

2.5 Geotechnical Conditions

Present only factual information in this section, not how it relates to design and construction. Discussion of the geotechnical conditions as they relate to design and construction must be placed in the *Evaluation and Recommendations* section.

2.5.1 Geology

Identify the referenced geologic map and the geologic unit(s) at the project site. Optionally, include referenced geologic maps (here or in the appendix) showing:

- Relevant geologic features, such as faults, bedding, major joint attitudes, and folds
- Location or layout line of project components

2.5.2 Surface Conditions

Describe site topography, surface water and drainage conditions, cuts and fills, rock exposures, geologic hazards such as landslides and rockfall, and land use history that may affect the components.

Describe soil erosion, scour, and historical maintenance issues that may affect the project components.

Discuss the soil survey review performed. Provide a list of soil survey reports and maps reviewed and the base map used, such as the maps of California Soil/Vegetation Survey, or USDA Soil Survey. Present the depth and lateral distribution of the erodible soil, and engineering classification.

2.5.3 Subsurface Conditions

Provide a generalized description of the known subsurface conditions. The description may include:

- Types of soil/rock, depths to generalized layer breaks, and corresponding elevations.
- Pertinent soil/rock conditions such as unsuitable materials (collapsible, expansive foundation materials).

Do not re-create an As-built LOTB in detail in this section. A generalized discussion or table is sufficient.

2.6 Groundwater

Report groundwater elevation(s) and dates of measurements. Use of a table is recommended if there are numerous boreholes and/or measurements.

Table X: Summary of Groundwater Data

Location or Hole ID	Closest Project Component	Distance to Closest Project Component (feet)	Ground Surface Elevation (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Date Measured

2.7 Existing Facilities and As-built Data

Identify and include brief discussion of relevant existing facilities and applicable As-built data, such as:

- Existing facilities/utilities within the planned work area
- Existing foundation types and details (e.g., pile tip elevations)
- As-built geotechnical capacities or resistances.
- Construction reports or records

2.8 Corrosion Evaluation

Report and discuss pertinent site corrosion data. Use the following table to report archive data.

Table X: Soil Corrosion Test Summary

Hole ID	Elevation (feet)	Minimum Resistivity (Ohm-Cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)	Corrosive?

Caltrans currently defines a corrosive environment as an area where the soil has either a chloride concentration of 500 ppm or greater, a sulfate concentration of 1500 ppm or greater, or has a pH of 5.5 or less. With the exception of MSE, soil and water are not tested for chlorides and sulfates if the minimum resistivity is greater than 1500 ohm-cm.

2.9 Seismic Information

Report all information required in Section 2.9.1 in the DPGR. Information required in Section 2.9.2 should be summarized while referencing the reader to the applicable report (e.g., Fault Rupture Report).

2.9.1 Ground Motion Hazard

Include the following information:

a. Ground Motion Parameters table
b. State how the estimated time-average shear wave velocity V_{S30} was determined (e.g., CPT, SPT correlations, or geophysics).

Table X. Ground Motion Parameters

Project Component	Site Parameters			Design Ground Motion Parameters[1] (Return Period = 975 years)		Horizontal Seismic Coefficient for Seismic Stability Analysis
	Latitude (degrees)	Longitude (degrees)	Shear-Wave Velocity[2] V_{S30}, (m/sec)	Horizontal Peak Ground Acceleration (g)	Deaggregated Mean Earthquake Moment Magnitude for PGA	
	XXX.XXXX	XXX.XXXX	XXX.X	X.XX	X.X	X.XX

1. Based on Caltrans web tool ARS Online (Version 4.xx).
2. Shear wave velocity determined by *<edit as appropriate e.g., CPT, SPT correlations, geophysics>*

2.9.2 Other Seismic Hazards

Discuss potential for the following seismic hazards, as applicable at the site:

- Surface fault rupture (see *Fault Rupture Screening* module)
- Liquefaction (see *Liquefaction Evaluation* module)
- Liquefaction-induced total ground settlements
- Lateral spreading (see *Lateral Spreading* module)
- Downdrag (see *Downdrag* module)
- Seismic global stability (see *Embankments* module)

2.10 Evaluation and Recommendations

Recommendations must be presented in the order of preference with the recommended option presented first; followed by feasible, but not preferred, alternatives. For each project component, discuss the following.

- Known/anticipated geologic condition.
- Preliminary feasibility and evaluation performed.
    - Appropriateness of standard plan alternatives/design.
    - Geotechnical/Foundation options considered (e.g., wall types, foundation type, slope ratio).
    - Constraints or issues that may adversely impact design/construction (e.g., right-of-way, traffic control, environmental considerations, allowable construction window, and constructability).

2.11 Additional Field Work and Laboratory Testing

Describe the anticipated scope and types of fieldwork and testing that may be required to complete the geotechnical investigation. Discuss the potential need for entry permits, task orders, groundwater monitoring, access road construction, lane closures, etc.

2.12 Report Copy List

The DPGR must be addressed to the District Design Engineer and copies provided to:

- District Project Manager
- District Materials Engineer
- District Environmental Planning (optional)

2.13 Appendix

Reports may include the following:

- Appendix I: Geologic Map(s)

Consultants must submit the following individually (i.e., not attached to the report) for all District Preliminary Geotechnical Reports:

1. As-built Log of Test Borings (if available)

2. Comment Matrix with consultant responses (if available)

3 PRELIMINARY GEOTECHNICAL DESIGN REPORT (PGDR) and GEOTECHNICAL DESIGN REPORT (GDR)

The PGDR is prepared after completion of the DPGR and prior to the end of Project Approval and Environmental Document (PA&ED). The PGDR presents the geotechnical and geologic evaluation of project alternatives under consideration to support project scoping and cost estimating. The project information and types of improvements will be provided in a request by the District, with expectation that the geotechnical investigation be completed and those findings be incorporated into the PGDR.

The GDR is prepared after completion of the PGDR and presents the geotechnical and geologic recommendations that will be used to prepare the PS&E. The GDR becomes part of the contract documents via its inclusion in the Information Handout per Standard Special Provision 2-1.06B, “Supplemental Project Information.”

The scope and content of the PGDR depend on the project specifics and information in hand at the time of preparation. The PGDR should present as much information as possible given the completeness of the geotechnical investigation. If the geotechnical investigation is complete, there should be little difference between the PGDR and the GDR.

The scope of work addressed by a PGDR/GDR may vary significantly (e.g., lengthy highway widening versus one changeable message sign). The PGDR/GDR should be tailored to provide the information required for PS&E development only and not be overly comprehensive when addressing a simple improvement, such as a sound wall or overhead sign.

The following topics, if applicable, must be addressed in the Preliminary Geotechnical Design Report and Geotechnical Design Report.

3.1 Introduction

Summarize the purpose of the report by referencing the request memo and preliminary plans by date. Do not present an exhaustive list of tasks performed.

Geotechnical Design Report only: Include a statement that the current report supersedes all previous reports.

3.2 Project Description

Identify the project components that require geotechnical recommendations. For projects with multiple geotechnical components, use a table to provide summary information for project components. When presenting locations based on station and offset, reference the highway/project alignment, instead of individual component alignments. For project components that traverse the highway, such as culverts, reference the component alignment.

Maps may also be included to further delineate locations and alignments of the project components. Drawings and plans, referenced by revision date, may also be included to supplement information provided in the table.

<Edit column heading to properly identify the location information presented. Do not modify the other table headers>

Table X – Description of Planned Improvements

Planned Improvement	Begin Station/ Offset or Northing /Easting	End Station/ Offset or Northing /Easting	Length (feet)	Maximum Design Height (feet)	Notes
Widening					
Type 1 RW					
Sound Wall					
CMS					

Not all columns apply to all geotechnical components, e.g., CMS would have “Begin Station” only.

Provide project vertical datum. When reporting older as-built elevations, state conversion used in the table below.

Table X: Project Vertical Datum

Project Vertical Datum	
Conversion	(NGVD29)+”conversion factor”=___(NAVD88)

3.3 Exceptions to Policies and Procedures

List exceptions to Departmental policies and procedures relating to the PGDR/GDR. Approved *Request for Exception* forms must be included in the Appendix. Omit this section if there are no exceptions.

3.4 Geotechnical Investigation

Provide an overview of the geotechnical investigation(s) performed to support the geotechnical recommendations including geologic mapping, the number of boreholes/CPT soundings, and the types of field and/or downhole testing (e.g., in-situ, geophysical). Briefly describe the type, installation, and monitoring of in-situ instrumentation, such as slope indicator and survey monitoring points, and recorded data. Use the following table:

Table X: Summary of Subsurface Explorations

Hole ID	Adjacent Project Component	Northing	Easting	Ground Surface Elevation (feet)	Depth (feet)	Date Completed

3.5 Laboratory Testing Program

Provide an overview of the laboratory testing program, if performed, to support the geotechnical recommendations. Briefly explain what the tests were used for (e.g., soil classification, settlement, strength parameters).

3.6 Geotechnical Conditions

Present only factual information in this section, not how it relates to design and construction. Discuss unique geotechnical conditions at specific project component locations as needed.

3.6.1 Geology

Identify the pertinent geologic map and the geologic unit(s) at the project site. Optionally, include pertinent geologic maps (here or in the appendix) showing:

- Relevant geologic features, such as faults, bedding, major joint attitudes, and folds
- Layout line of project components

3.6.2 Surface Conditions

Describe site topography, surface water and drainage conditions, cuts and fills, rock exposures, geologic hazards such as landslides and rockfall, and land use history that may affect the proposed improvements.

Describe soil erosion, scour, and historical maintenance issues that may affect the proposed project components.

3.6.3 Subsurface Conditions

Provide a generalized description of the subsurface conditions. The information included within this section may include:

- Types of soil/rock, depths to generalized layer breaks, and corresponding elevations.
- Pertinent soil/rock conditions such as unsuitable materials (collapsible, expansive foundation materials).

Do not re-create the LOTB(s) in detail in this section. A generalized discussion or table is sufficient.

3.7 Groundwater

Report groundwater elevation(s) and dates of measurements. Use of the following table is recommended if there are numerous boreholes and/or measurements.

Table X: Summary of Groundwater Data

Location or Hole ID	Closest Project Component	Distance to Closest Project Component (feet)	Ground Surface Elevation (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Date Measured

3.8 Existing Facilities and As-built Data

Identify and include brief discussion of relevant existing facilities and applicable As-built data, such as:

- Existing facilities/utilities within the planned work area
- Existing foundation types and details (e.g., pile tip elevations)
- As-built geotechnical capacities or resistances.
- Construction reports or records

3.9 Corrosion Evaluation

Include and update the corrosion data from the DPGR based on new findings and field investigations.

Table 1: Soil Corrosion Test Summary

Hole ID	Elevation (feet)	Minimum Resistivity (Ohm-Cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)	Corrosive?

Caltrans currently defines a corrosive environment as an area where the soil has either a chloride concentration of 500 ppm or greater, a sulfate concentration of 1500 ppm or greater, or has a pH of 5.5 or less. With the exception of MSE, soil and water are not tested for chlorides and sulfates if the minimum resistivity is greater than 1,500 ohm-cm.

3.10 Seismic Information

Update the seismic information required for the DPGR based on new findings and/or investigations. Summarize analyses and evaluations performed, and recommendations relating to seismic design.

3.10.1 Ground Motion Hazard

Include the following information:

a. Ground Motion Parameters table
b. State how the estimated time-average shear wave velocity V_{S30} was determined (e.g., CPT, SPT correlations, or geophysics).

Table X. Ground Motion Parameters

Project Component	Site Parameters			Design Ground Motion Parameters[1] (Return Period = 975 years)		Horizontal Seismic Coefficient for Seismic Stability Analysis
	Latitude (degrees)	Longitude (degrees)	Shear-Wave Velocity[2] V_{S30}, (m/sec)	Horizontal Peak Ground Acceleration (g)	Deaggregated Mean Earthquake Moment Magnitude for PGA	
	XXX.XXXX	XXX.XXXX	XXX.X	X.XX	X.XX	

1. Based on Caltrans web tool ARS Online (Version 4.xx).
2. Shear wave velocity determined by *<edit as appropriate e.g., CPT, SPT correlations, geophysics>*

3.10.2 Other Seismic Hazards

State if any of the seismic hazards exist at the project site:

- Surface fault rupture
- Liquefaction
- Liquefaction-induced total ground settlements
- Lateral spreading
- Downdrag
- Seismic global stability

For seismic hazards that do exist, refer to the Reporting section of the applicable module to determine what information to present in the *Analysis and Design*, if any, and *Recommendations* sections of the report.

If requested by the District, provide mitigation recommendations for specific seismic hazards in the *Recommendations* section.

3.11 Analyses and Design

Refer to the *Reporting* section in the applicable module(s) to determine required content to include in this section.

3.12 Geotechnical Recommendations

Refer to the *Reporting* section in the applicable module(s) to determine required content to include in this section.

3.12.1 Instrumentation and Monitoring

Present recommendations for long-term instrumentation monitoring and/or construction performance evaluation. Provide a layout of instruments, the monitoring schedule, and data format (e.g., electronic or hard copy). Provide methods of data evaluation, threshold values for action, and responsible parties.

3.13 Notes for Specifications

Omit this section for the Preliminary Geotechnical Design Report.

This section provides recommendations to the Specifications Engineer for inclusion and editing of Standard Special Provisions and NSSPs. Refer to the *Geotechnical Notes for Specifications* module for guidance on preparing this section.

Report Copy List

Reports must be addressed to the District Project Engineer and copies provided to:

- District Project Manager
- District Environmental Planning (optional, PGDR only)
- District Materials Engineer

3.14 Appendices

Report appendices provide detailed information supporting foundation type selection, analyses, and recommendations. Reports prepared by Geotechnical Services staff must include the following if produced during the investigation (in the order presented, numerated as Appendix I, Appendix II, …):

- Field-generated Geologic Map and Cross-Sections: Do not include copies of published maps.
- Borehole Location Map
- Boring Records
- Laboratory Test Data (including Corrosion Test Report) – Organized by test type. In addition to the raw laboratory test results, organize and provide summary tables and graphs developed for the interpretation of laboratory test results.
- Field and in-situ test measurements and/or results (those not presented in Boring Records)
- Geophysical Test Reports
- Approved "Request for Exception" forms
- OPTIONAL: Photos relevant to the investigation findings, design recommendations, and construction. Photos that illustrate content presented in the text should be embedded in the report if feasible.

Reports prepared by consultants must include the following if produced during the investigation (in the order presented, numerated as Appendix I, Appendix II, …).

- Field-generated Geologic Map and Cross-Sections: Do not include copies of published maps.
- Borehole Location Map
- Boring Records
- Laboratory Test Data (including Corrosion Test Report) – Organized by test type. In addition to the raw laboratory test results, organize and provide summary tables and graphs developed for the interpretation of laboratory test results.
- Field and in-situ test measurements and/or results (those not presented in Boring Records)
- Geophysical Test Reports
- Approved "Request for Exception" forms
- OPTIONAL: Photos relevant to the investigation findings, design recommendations, and construction. Photos that illustrate content presented in the text should be embedded in the report if feasible.

Additionally, the following must be submitted individually (i.e., not attached to the report) for all Preliminary Geotechnical Design Reports and Geotechnical Design Reports:

1. Calculation Package
    - The objectives of each calculation, such as bearing resistance or time rate of settlement.
    - Calculation assumptions
    - Design Parameters for all geomaterials used in analyses and design.
    - Geotechnical model used for each calculation.
    - Equations used and meaning of the terms used in the equations.
    - Copies of the curves or tables used in the calculations and their source.
    - The load and resistance factors, or factors of safety, used for the design.
    - If the calculations are performed using computer spreadsheets – step-by-step calculations for one example to demonstrate the basis of the spreadsheet. A computer spreadsheet is not a substitute for the step-by-step calculation.
    - Summary of the calculation results that form the basis of geotechnical recommendations, including a sketch of the design, if appropriate.
2. Comment Matrix with consultant responses