Guidelines for the Preparation

Of

Geotechnical Design Reports for Earth Retaining Systems

CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

GEOTECHNICAL SERVICES

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PREFACE

This document provides guidelines for preparing Geotechnical Design Reports (GDR) for projects involving Earth Retaining Systems (ERS). However, this document does not provide guidance on how to perform geotechnical analyses and design of ERS. For guidelines on performing geotechnical analyses or design of ERS, please refer to other corresponding documents.

Information to be included in a GDR depends on the complexity and scope of the ERS. Not all topics in this document are necessary to be included in a GDR. Conversely, to address unique design issues that are not covered in this document, a GDR may need to include additional sections. The geotechnical project engineer should evaluate and identify project-specific needs and provide necessary geotechnical design information in the GDR.

The content of the GDR, especially for a GDR covers multiple structures and items, should be organized and presented in a way that ensure readability and easy access of information. Consult with the project engineer to decide whether to produce one report or multiple reports for a project with multiple ERS.

In addition to design and analysis results, diagrams showing essential design and geotechnical features can substantially enhance the clarity of the design and construction recommendations and assist structure designers and specification engineers in preparing project plans, specifications, and estimates. Provide diagrams to scale whenever possible.

Recommendations provided in the GDR should be based on data, supported by appropriate analyses and references. Diagrams of geotechnical models including subsurface profile, interpreted soil parameters, and the probable failure modes, should be included in the GDR.

Recommendations included in the GDR should provide adequate geotechnical design information that can be used and implemented by the project engineer and the specification engineer to produce the PS&E package. To incorporate geotechnical recommendations effectively into specifications, instructions on editing Standard Special Provisions (SSPs) and developing nonstandard special provisions (NSSPs) should be included in Section 7, Construction Considerations. Please refer to Section 7 of this document on what instructions should be provided to the specification engineer and the designer.

GDR prepared in the report format should include a cover page with the project name, project ID, and other identification information. Following the cover page, include a professional certification and signature page.

During project development, e-mails or Geotechnical Design Report - Draft can serves as communication tools to convey design information to project engineers and others. Geotechnical Design Report - Draft should be issued as early in the design phase as possible, and as many as needed to facilitate design iterations.

To facilitate the delivery of Structure P&Q by DES Structure Design and 95% PS&E by district Design, deliver Geotechnical Design Report - Draft for Structure P&Q or Geotechnical Design Report - Draft for 95% PS&E in a timely manner. These reports are not final and should not be stamped since revisions may be required after review by the designers and specification engineer.

The Geotechnical Design Report and addenda are to be included in the Supplemental Project Information / Information Handout under Standard Specifications Section 2-1.06B, and listed in the accompanying Standard Special Provisions. Since the Geotechnical Design Report is part of the contract document, the report can only be signed and stamped until the geotechnical review has been performed, and all the geotechnical related design issues have been reconciled and there is no further change to both the Plans and Special Provisions.

Please refer to the Attachment: Earth Retaining System Geotechnical Reports Activity Network Diagram for the delivery sequence of geotechnical work items.

This document will be updated as needed to incorporate suggestions, advances in the state-of-practice, and updates in standards. Comments can be provided via the Geotechnical Services Discussion Board.

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1.0 INTRODUCTION

Include a concise introduction of the project and its location on the State Highway System. State the type and purpose of the report. Refer to the request or contract received for the preparation of this report and additional information that may be of significant value to understand the background, purpose and content of the project.

1.1 Project Description

Provide a brief description of the project and proposed Earth Retaining Systems (ERS). Include a figure showing the project site location on regional or local highway.

1.2 Proposed Earth Retaining Systems

Describe the proposed type and location of each ERS. Show the proposed ERS alignments on a detailed topographic map, if available.

Provide ERS information listed in the following table, including the longitude and latitude (in degrees to 5 decimal places) of the beginning and end points of the ERS layout line.

Table 1: Description of the Proposed ERS

ERS ID No.	ERS Type	Begin			End			Length, feet	Design Height, feet		Notes
		Sta.	Latitude	Longitude	Sta.	Latitude	Longitude		Min.	Max.	

Briefly describe the basis of and the background information for the selection of the proposed ERS type.

1.3 Project Constraints and Requirements

Include known non-geotechnical project constraints and requirements such as those related to geometry, topography, right-of-way, site accessibility, conflicts with existing facilities, environmental, utilities, aesthetics requirements, cost, design/construction schedule, noise, vibrations, and planned land use.

Identify, address, and document geotechnical constraints and requirements in the relevant sections of the GDR.

2.0 SCOPE OF WORK

Present the geotechnical scope of work performed. Include major tasks performed leading to the delivery of the GDR for ERS such as:

- Review of the project scope requirements and relevant existing geotechnical information – Provide a list of existing geotechnical information and reports reviewed,
- Site visit,
- Planning and executing a subsurface exploration program,
- Laboratory test,
- Geotechnical data review and interpretation,
- Analysis and development of the geotechnical design recommendations and construction recommendation,
- Communication with the other functional units, and
- Preparation of the GDR

3.0 SITE EXPLORATION

Describe the significant tasks performed during the planning and execution of the geotechnical site exploration. List the standards followed for each of the tests performed.

3.1 Subsurface Exploration

Present and describe tasks performed for subsurface exploration such as trenching, boring, Standard Penetration Test (SPT), Cone Penetration Test (CPT), and geophysical tests. Follow *Soil and Rock Logging, Classification and Presentation Manual* when presenting results of the subsurface exploration. Include Log of the Test Borings (LOTB) in Appendix B. Include Boring Records (BR) if LOTB are not available when issuing the GDR.

Present information on the selection, installation, measurement, and monitoring of any installed field instruments including those monitoring groundwater.

3.2 Laboratory Test

List the laboratory soil or rock tests performed, including corrosion tests. Summarize and provide the interpretation of the laboratory test results.

Include summary tables and graphs of the laboratory test results provided by the laboratory in Appendix C. Unreliable data should be noted or not included.

4.0 SITE CONDITIONS

Present and describe the site surface, geologic, and geotechnical conditions based on the results of the site exploration presented in the previous section. In other relevant sections of the GDR, provide discussion and recommendations that address site conditions that affect the design and construction of the ERS.

4.1 Surface Conditions

Provide land use history, existing topography, surface water and drainage conditions, and other significant natural engineering features.

Describe the observed or known past performance of existing cut, fill, and natural slopes, including soil erosion and scour that may affect the proposed ERS. Describe the presence of any existing structures, above and below ground utilities, highway facilities, and other improvements within or adjacent to the proposed ERS.

4.2 Subsurface Soil and Rock Conditions

Summarize the subsurface condition based on information obtained from subsurface exploration, laboratory tests, and literature study. Provide a summary of

- Soil characteristics, shear strength, density, consistency, and compressibility, and
- Rock strength, composition, weathering, bedding, and degree of fracturing

Describe longitudinal subsurface profiles along the ERS layout line and representative cross sections of subsurface profiles where analysis and evaluation was performed to design the ERS.

4.3 Groundwater and Seepage

Describe groundwater characteristics of the job site that may influence or be influenced by the project. Include history and observation of groundwater presence, seepage, artesian or perched water in boreholes, wells, trenches and slopes, general depths, and flow direction.

Present and describe results for seepage or flow analyses and include interpreted groundwater conditions for design. Describe expected variations of the groundwater condition during construction.

Provide a summary of measured groundwater table in Table 2 below. Describe the methods and equipment used to determine ground water table level and observe flow and seepage.

Table 2: Measured Groundwater

Location or Borehole No.	Ground Surface Elevation (feet)	Groundwater Table or Piezometric Elevation		Date Measured	Notes
		Depth Below Ground Surface (feet)	Elevation (feet)		

4.4 Faulting and Seismicity

Describe regional and local faulting and seismicity. List nearby faults considered active under Seismic Design Criteria (SDC) in Table 3 below. Present past significant earthquake activity in the area and include, if known, the maximum peak ground acceleration (PGA) the site may have experienced. When appropriate, identify the causative earthquake magnitude and the fault. Describe the performance of existing facilities.

Table 3: Summary of Faults

Fault	Fault Style	Magnitude (M_W)	Distance (miles)	PGA (g)

5.0 ANALYSIS AND DESIGN

Present and describe the geotechnical analyses and design performed. These may include:

- Evaluation of bearing capacity, and global and local slope stabilities,
- Evaluation of ERS deformations, where necessary, due to design Service Loads, evaluated based on LRFD Service I Load Combination and Factors
- When an ERS from the Standard Plans is proposed, verification of the geotechnical site conditions and soil engineering properties meet or exceed those assumed and shown in the Standard Plans,
- Evaluation of seismic hazards and seismic design parameters,
- Design decisions made with project engineer

5.1 ERS Geometry and External Loads

Present and describe the representative cross sectional geometry of the ERS sections and external loads, including staged construction where applicable, for the geotechnical analyses. When available, include the relevant plans and cross sections used for the preparation of the proposed ERS in the appendix of the GDR, or reference to and provide directions to the General Plans, Wall Plans, and cross sections.

5.2 Foundation Materials

Describe the foundation materials underlying the proposed ERS. Present and describe interpreted engineering properties of the foundation materials used in analyses and design. Include a list of options for ground improvement with deliberation and selection of the options in Section 6, Recommendations.

5.3 Backfill and Retained Materials

Describe retained materials or the proposed ERS backfill if the borrow source is known. Provide recommendations for ERS backfill and improvement of the retained materials in Section 6, Recommendations. Include applicable soil engineering properties for the backfill and retained materials to be used in the subsequent analyses and designs.

5.4 Effects of Water

Describe the potential effects of both surface water and groundwater including scour and erosion in analysis and design for each of the LRFD Limit States. Include the interpreted representative groundwater conditions for each of the LRFD Limit State analyses and design.

Present and describe groundwater seepage analyses when appropriate. Provide recommendations for subsurface drainage design in Section 6, Recommendations.

5.5 Landslide Hazards

Present and describe landslide hazards. Provide recommendations for remediation of landslide hazards in Section 6, Recommendations. For landslide stabilization projects, refer to the landslide investigation report if available and summarize the finding and assessments.

5.6 Effects on Existing Facilities

Describe the effects of the proposed ERS on existing structures and other facilities, including both above and below ground utilities. Such effects may be both short-term during construction and long-term, sustained stress increase or release due to the proposed ERS. Include and describe potential effects of construction induced ground movements, dewatering, noise, and vibrations. Include also any effects on existing natural slopes and surface drainage.

Include potential effects of any known planned development adjacent to the ERS.

Provide recommendations for remedial measures, pre-construction survey and documentation of the conditions of existing structures, and instrumentation and monitoring during and after construction in Section 6, Recommendations.

5.7 Structural Design Information

Document structural design information provided by structure designer that is necessary as the basis for geotechnical design. Much of this design information will be developed via design iterations. Such design information may include:

Soldier Pile Wall (Section 6.2.2.4.1)

1. Design pile type, diameter or width and center-to-center spacing,
2. Facing details and features, such as lagging type; and material, such as wood, reinforced concrete, pre-cast or CIP concrete panels, and wire-mesh reinforced shotcrete

Tangent Pile and Secant Pile Wall (Section 6.2.2.4.2)

Design pile diameter or width

Ground Anchor Wall (Section 6.2.2.4.3)

1. Design pile type, diameter or width and center-to-center spacing,
2. Structural elements, such as soldier piles, whalers, isolated reinforced concrete bearing block, wire mesh with shotcrete, reinforced concrete diaphragm,
3. Types of reinforcement for drilled shafts, such as rebar and H-beam; and types of driven piles, such as pre-cast pre-stressed reinforced concrete piles, H-piles, steel pipe piles, and CISS piles

Soil Nail Wall (Section 6.2.2.4.4)

Factored structural resistance of the selected wall facing design at soil nail head – punching shear resistance or bending moment resistance, whichever controls

Slurry Diaphragm Wall (Section 6.2.2.4.5)

1. Design wall thickness,
2. Type of the diaphragm, such as steel reinforced CIP and pre-cast concrete panels

Soil-Cement Mix Wall (Section 6.2.2.4.6)

Design wall thickness

5.8 Static Design Analyses

Include geotechnical static analyses performed to evaluate and/or design the proposed ERS that meet the LRFD Service and Strength Limit State requirements. Provide the developed design recommendations and findings in Section 6, Recommendations.

5.8.1 Lateral Earth Pressures and Passive Resistances

For ERS using Standard Plan Wall, there is no need to analyze and provide recommended design lateral earth pressures and passive resistances.

For ERS that requires modified Standard Plans or Special Design, analyze and provide stress distribution diagrams of the recommended lateral earth pressures and passive soil resistances in Section 6, Recommendations.

For long-term stability of an ERS, include interpreted effective-stress shear strength properties. When retained and foundation soil consists of soft to medium stiff cohesive soils, also include interpreted lateral earth pressure and resistances applicable to short-term stability based on the interpreted undrained or total-stress soil shear strength properties.

Include schematic cross section(s) of geotechnical models showing soil layers, density, coefficients of lateral earth pressure, groundwater and seepage, and direction, magnitude, and extent of applicable loads. Include lateral earth pressures due to compaction when necessary.

Include active and passive earth pressure distribution diagrams for both the LRFD Service Limit State and Strength Limit State designs. Describe the use, applicability, and limitations of the distribution diagrams for each of the applicable LRFD Limit States analyses.

5.8.2 Service Limit States

Present and describe the following analyses for the proposed ERS:

- Global and local slope stability,
- Basal stability,
- Displacement, including settlement, lateral displacement, and rotation

Include evaluation of options to increase stabilities and reduce deformations to meet the design requirements.

5.8.3 Strength Limit States

Present and describe the analyses and design performed for the Strength Limit State of the proposed ERS. Include the following geotechnical stability conditions as applicable to the proposed ERS:

1. Soil nominal bearing resistance,
2. Lateral stability, when performed,
3. Rotational (or "Overturning") stability, and
4. Hydraulic stability, including erosion, scour, piping, heaving, and boiling

For ERS using a Standard Plan Wall present and describe soil engineering properties, soil nominal resistances, geotechnical stability analyses, and evaluations performed to verify that site conditions meet or exceed requirements shown on Standard Plans.

For ERS that requires modified Standard Plans or Special Designs, present and describe analyses performed to evaluate interpreted soil parameters and nominal resistances, and other geotechnical parameters needed by the structure designer to perform additional Strength Limit State analyses and design for the ERS. Provide the recommended geotechnical parameters for Strength Limit State analyses and design in Section 6, Recommendations.

5.9 Seismic Design Analyses

5.9.1 Seismic Hazard Analyses

Present and describe fault surface rupture and ground motion hazard evaluations performed under existing requirements and guidelines for structure designer.

Present and describe soil liquefaction, seismic-induced ground settlement and lateral spreading hazards.

Provide the following information in Section 6, Recommendations:

1. Seismic design recommendations, including fault surface displacement, Peak Horizontal Ground Acceleration (PHGA), and if necessary, the spectral acceleration at structure period 1.0 sec (S_1),
2. Acceleration Response Spectrum (ARS), if requested by structure designer,
3. Corresponding design earthquake magnitude (M_w) and the site-fault-rupture surface distance (R_{rup}),
4. Recommended soil engineering properties for foundation soil, backfill, and retained soils for use in the subsequent seismic analyses and design

5.9.2 Seismic Lateral Earth Pressures and Passive Soil Resistances

Present and describe analyses performed to evaluate the recommended design lateral earth pressures and passive resistances for seismic design.

Provide magnitude and distribution of the recommended total lateral earth pressure and passive resistances, or those separately for both the static and seismic components in Section 6, Recommendations.

5.9.3 Analyses for Seismic Design

Present and describe seismic global and local slope stability analyses. Include and describe the geotechnical models and methods used for the analyses. Provide recommendations for remediation in Section 6 Recommendations.

Present and describe the analysis methods used and analyses performed to determine soil strength properties and geotechnical nominal resistances for applicable stability analyses.

Provide the following information in Section 6 Recommendations:

1. For ERS located on spread or shallow foundations:

    - Factored nominal bearing resistance (q_N and q_R) as a function of the foundation effective width (B') for bearing and rotational stability evaluations. For recommendations for bearing stabilities, refer to MTD 4-1.

    - Factored friction factor (f_s) and unit adhesion (c_a) of the interface between the foundation of ERS and the underlying materials, and the total passive soil resistances and its location or the corresponding passive resistance distribution diagram

2. For ERS located on deep foundations, design recommendations for foundations in accordance with MTD 3-1

6.0 RECOMMENDATIONS

Provide geotechnical design recommendations for ERS in accordance with MTD 3-1 and MTD 4-1. For guidance on spread footing and deep foundation design, refer to the Geotechnical Services design guidelines for Foundation Report (FR) Preparation.

Include design recommendations for each of the LRFD limit states. For the LRFD Strength Limit State design, include recommended soil strength properties for both short- and long-term design.

6.1 Recommendations for all ERS Types

Provide geotechnical design recommendations generally applicable to all ERS types.

6.1.1 Interpreted Subsurface Profiles

Include or refer to the representative cross section(s) presented in previous sections showing the description or interpreted subsurface profiles with soil and rock engineering properties. The profiles should include sufficient information and data to substantiate the recommended soil resistance parameters provided in this section and allow the structure designer to perform additional analysis and design.

Provide soil properties for both static and seismic conditions. Include interpreted groundwater and seepage conditions.

6.1.2 Backfill and Retained Materials

If borrow source was identified, provide recommendations for the ERS backfill, extent, and material properties. Present diagrams to show details.

6.1.3 Foundation

Provide recommended ERS foundation types and ground improvement recommendations. Include diagrams showing materials, dimensions and other details of the recommendations.

6.1.4 Global Stability

Present and describe the global and local slope stability analyses. Include stability analysis results in the appendix. Include and describe geometry, loads, and soil parameters used in the analyses. Summarize the findings and provide recommendations on remediation, where necessary. Include summary of the estimated resistance factors against global and local slope instabilities. Currently, AASHTO considers static global stability analysis as a Service Limit State analysis and not a Strength Limit State analysis.

Include seismic global stability analyses. Where applicable, present and describe estimated permanent lateral displacement due to the design seismic ground motion using Newmark method or more sophisticated methods when appropriate. Include the estimated coefficient of critical or

yield (k_y) corresponding to the estimated lateral displacement or permissible displacement that should be used for design. If the estimated seismic displacement exceeds acceptable limit(s), provide recommendations for remediation to prevent collapse of the ERS and supported structures and meet other project specific requirements.

6.1.5 Basal Stability

Where soft soils are under the ERS, present basal stability or the estimated resistance factors (Factors of Safety) for global and local slope stabilities for both LRFD Strength Limit State and Extreme (seismic) Limit State designs.

6.1.6 Deformation

Summarize the estimated ERS deformations based on the analysis performed and presented above, if any, for the LRFD Service Limit State design. Provide recommendations to reduce settlement and time of settlement.

6.1.7 Scour and Erosion

Provide recommendations to mitigate scour and erosion problems.

6.1.8 Drainage and Filters

Include recommendations for subsurface drainage and filter design to reduce potential for the buildup of excessive hydrostatic pressures and loss of fines from the surrounding soils. Include maintenance and performance monitoring recommendations.

6.1.9 Corrosion

Present the corrosion test results and describe corrosion potential and the need for corrosion protection. Consult with DES/METS Corrosion Branch when necessary.

6.1.10 Instrumentation and Monitoring

Include recommended plan for instrumentation and monitoring program.

6.2 ERS Type-Specific Recommendations

Include the following type-specific ERS design recommendations, related considerations, and findings from the analysis and design performed.

6.2.1 Standard Plans ERS

The ERS published in the Standard Plans include cantilever semi-gravity type reinforced concrete retaining walls, and crib walls with certain assumed soil properties and finish grade gradients below and above the walls.

1. Present a summary of the evaluation that verifies site conditions, including the geometry of the retained soils mass; foundation and backfill soil types, interpreted soil engineering properties, and groundwater conditions that meet or exceed the requirements shown on the Standard Plans.
2. Include foundation design data and recommendations in accordance with MTD 3-1 and 4-1 for ERS supported on deep foundation and spread foundation, respectively.
3. For deep foundations, include allowable horizontal resistance for the piles for LRFD Service Limit State and the factored nominal horizontal resistance for LRFD Strength and Extreme (Seismic) Limit States. Include soil parameters for the p-y type of analysis. Include required minimum pile length for lateral demand.

6.2.2 Special Design ERS

ERS not shown on the Standard Plans are Special Design ERS. Most Special Design ERS are jointly designed by structure and geotechnical design.

As described in Topic 210 of the Highway Design Manual, District and Geotechnical Services may design Special Design ERS that do not include significant structural components.

For Special Design ERS designed by Districts and Geotechnical Services, include stability and design/sizing analyses performed to meet LRFD Strength and Extreme (Seismic) Limit States requirements. Provide description or interpreted soil profiles and soil strength and resistance parameters used.

Provide additional ERS design information, recommendations, and diagrams needed by District Project Engineers to complete the project PS&E package.

For Special Design ERS, especially those designed by Structure Design and Geotechnical Services, include the following ERS type-specific design parameters and recommendations.

6.2.2.1 Modified Standard Plans ERS

These ERS involve the modification of the ERS published in the Standard Plans. The modifications may be due to geometry, foundations, loading, and resistance conditions not meeting the design requirements of the ERS published in the Standard Plans.

Include the following design information and recommendations for this type of ERS:

1. Conditions (e.g., modified wall geometry, foundations and backfill soils, presence of groundwater, seismic and other load conditions, right-of-way limitations, etc.) that require modifications to the Standard Plans ERS,
2. Effects of the influencing conditions on the design of the proposed ERS,
3. Proposed modifications,
4. Recommended lateral active and passive earth pressure coefficients with soil total unit weights, shear strength parameters, groundwater conditions, and pressure distribution diagrams according to Section 3.11.5.1 through 3.11.5.5 of the LRFD BDS,

5. Soil nominal resistance or foundation geotechnical capacity parameters for axial and lateral bearing,
6. Sliding and overturning resistance

6.2.2.2 Conventional Retaining Wall

Caltrans' use of conventional retaining wall application is generally limited to reinforced concrete cantilever semi-gravity walls founded on shallow or deep foundations. Any application of this type of ERS will normally fall into the "Modified Standard Plans ERS" included above.

6.2.2.3 Gravity Wall

6.2.2.3.1 Mechanically Stabilized Embankment Wall

This ERS refers to the MSE Wall included in the Standard Detail XS Sheets.

1. Evaluation of whether the soil parameters meet the requirements of the assumed design soil parameters listed in the XS Sheet General Notes; and whether the site is corrosive, which will render the MSEW systems with steel reinforcement not suitable,
2. Minimum base width and toe cover resulted from global stability analysis,
3. Permissible net contact stress (q_{pn}) if permissible settlement is specified,
4. Factored nominal bearing resistance for both Strength Limit State and Extreme Event,
5. Effective friction angle (ϕ') and, where necessary, the apparent cohesion (c) or undrained shear strength (S_u) of foundation soil,

6.2.2.3.2 Gabion Wall

1. Description or interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, adhesion and coefficient of friction between wall and soil,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p),
3. Geometry of the gravity block(s),
4. Permissible net contact stress (q_{pn}) if permissible settlement is specified,
5. Effective friction angle (ϕ') and apparent adhesion (c_a) between foundation soil and wall base, and undrained shear strength (S_u) where applicable,
6. Factored gross nominal bearing resistance for both Strength Limit State and Extreme Event 1

6.2.2.3.3 Geosynthetic Reinforced Wall

1. Description or diagram of interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, adhesion and coefficient of friction between wall base and foundation soil, and groundwater conditions,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p),
3. Minimum base width from global stability analysis,

4. Effective friction angle (ϕ') and, where necessary, the apparent cohesion (c) or undrained shear strength (S_u) of foundation soil,
5. Base sliding friction factor and adhesion,
6. Permissible net contact stress (q_{pn}) if permissible settlement is specified,
7. Factored nominal bearing resistances for both Strength Limit State and Extreme Event I,
8. Cross sections at different wall heights showing the geosynthetic reinforcement design,
9. Wall face batter,
10. Wall face design,
11. Wall face to reinforcement connection,
12. Required engineering properties of backfill material,
13. Evaluation of borrow source for backfill materials including on-site excavated soils that comply with Standard Specifications,
14. List of geosynthetic reinforcement types, with corresponding Long Term Design Strength (LTDS) used for design,
15. Elevation view of the wall presenting geosynthetic reinforcement layouts with reinforcement types, lengths, elevation, and beginning and ending stations

6.2.2.3.4 Mortar-less Concrete Block Gravity Walls

1. Description or diagram of interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, adhesion and coefficient of friction between wall base and foundation soil, and groundwater conditions,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p),
3. Minimum base width from global stability analysis,
4. Wall batter,
5. Minimum wall embedment depth,
6. Permissible net contact stress (q_{pn}) if permissible settlement is specified,
7. Factored nominal bearing resistances for both Strength Limit State and Extreme Event I,
8. Surface and channel water flow, as this wall type is susceptible to water infiltration and freeze-thaw cycle damage,
9. State if partial reinforcement coverage is allowed,
10. Design details of reinforcement similar to those in the geosynthetic reinforced wall,
11. Excavation, backfill, and other ground improvement requirements,
12. Borrow source for backfill,
13. Instrumentation and monitoring plan,

6.2.2.4 Non-Gravity Cantilever Wall

6.2.2.4.1 Soldier Pile Wall

1. Description or interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, adhesion, and groundwater conditions,

2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p) and the corresponding lateral active earth pressure and passive resistance distribution diagrams,
3. Recommended soldier pile type, such as driven piles or CIDH, including materials such as steel or concrete,
4. Minimum diameter or width of the piles and center-to-center pile spacing (S_{min}),

5. Minimum lagging embedment depth below the Finish Grade (FG) in front of the ERS,
6. Effective pile width for calculation of passive and active pressure along the embedded length of the pile,
7. Drainage elements,
8. Factored lateral pile geotechnical resistance or the soil spring coefficients for p-y types of analyses, if requested by the structure designer,
9. Minimum pile embedment depth based on geotechnical requirements

6.2.2.4.2 Tangent Pile and Secant Pile Wall

1. Description or interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, adhesion and groundwater conditions,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p) and the corresponding lateral active earth pressure and passive resistance distribution diagrams,
3. Minimum diameter or width of the piles,
4. Type of pile. The selection of pile type is a shared responsibility of the structure designer and geotechnical designer,
5. Construction sequence, such as drilling and installation sequence,
6. Drainage elements,
7. Factored lateral pile geotechnical resistance or the soil spring coefficients for p-y types of analyses, if requested by the structure designer,
8. Minimum pile embedment depth based on geotechnical requirements

6.2.2.4.3 Ground Anchor Wall

1. Description or schematic design cross sections showing the structure elements, loads, and interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, and groundwater conditions
2. In the above cross sections, show probable sliding or actual failure surfaces,
3. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p) and the corresponding lateral active earth pressure and passive resistance distribution diagrams,
4. Recommended lateral earth pressure distribution diagrams if the Apparent Earth Pressures (AEP) according to Section 3.11.5.7 of the LRFD BDS are not applicable,
5. Location of the uppermost and lowermost rows of ground anchors,
6. Minimum unbonded lengths of the ground anchors, including the minimum unbonded length beyond the interpreted failure surface,
7. Maximum vertical and horizontal spacing of the ground anchors,
8. Inclination of ground anchors measured from horizontal,

9. Minimum overburden depth of the bonded zone of the uppermost row of the ground anchors measured from the ground surface,
10. Pile type, such as drilled shafts or driven piles when soldier piles are used. The selection of pile type is a shared responsibility of the structure designer and geotechnical designer,
11. Design tip elevation of the vertical load support elements, such as soldier piles, based on the factored axial compressive load,
12. Minimum pile embedment depth based on geotechnical requirements,
13. Minimum lagging embedment depth below the Finish Grade (FG) in front of the ERS,
14. Factored bearing resistance for pile, grade beam, anchorage bearing plate or block based on permissible displacement due to compression,
15. Minimum embedment depth for elements bearing directly on the ground,
16. Factored nominal bearing resistance and reduction factor for anchorage support elements

6.2.2.4.4 Soil Nail Wall

1. Description or schematic design cross sections showing the structure elements, loads, and interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, and groundwater conditions,
2. Instruction for placement of soil nails, including nail array pattern, maximum horizontal and vertical soil nail spacing, the maximum vertical distance of the soil nails from the top of the wall, the bottom of the wall, and the maximum horizontal distance from the ends of the wall,
3. Schedule of soil nail lengths,
4. Inclination of the soil nails measured from horizontal,
5. Wall face batter measured from vertical,
6. Calculated resistance factor for global and local slope stability,
7. Estimated lateral displacement,
8. Design pullout resistance Q_d of grouted hole in force/unit length,
9. Soil nail bar ASTM designation, grade, and diameter based on the calculated maximum soil nail tensile force (T_{max}),
10. Maximum soil nail tensile force at wall face (T_0),
11. Layout of proof test nails, on the provided elevation view sheets of the wall, that are 8 percent of the total number of production soil nails

6.2.2.4.5 Slurry Diaphragm Wall

1. Description or diagram of interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, and groundwater conditions,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p) and the corresponding lateral active earth pressure and passive resistance distribution diagrams,
3. Maximum length of open slurry trench at any time during construction,
4. Minimum slurry wall thickness,
5. Minimum wall embedment depth based on geotechnical requirements,

6.2.2.4.6 Soil-Cement Mix Wall

1. Description or diagram of interpreted subsurface profiles with soil types and layers. For each soil layer, include interpreted soil total unit weights, shear strength parameters, and groundwater conditions,
2. Active earth pressure coefficient (k_a) and passive earth pressure coefficient (k_p) and the corresponding lateral active earth pressure and passive resistance distribution diagrams,
3. Minimum thickness of the wall or soil-cement column diameters based on geotechnical requirements,
4. Minimum and maximum overlap between adjacent soil-cement columns,
5. Required soil-cement mix wall depths,
6. Required factored compressive strength of soil-cement mix elements,

6.2.3 Other ERS

Reports for ERS not covered here should include applicable items listed above for various ERS and any additional ERS-specific information necessary to evaluate and design in compliance with LRFD design specifications.

6.2.4 Proprietary ERS

Caltrans has reviewed and pre-approved the designs of the pre-approved proprietary systems. These proprietary systems meet or exceed Caltrans design and construction requirements, so that during construction the contractor may propose them as an alternative system. Therefore, the Geotechnical Design Report does not need to address the design of these systems.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Notes for Specification Development

Provide instructions and recommendations to the specification engineer for the editing of SSPs, development of nonstandard Special Provisions, and compilation of project Special Provisions. Do not refer to or quote the sentences in the Standard Specifications. Standard Specifications are applicable to all construction contracts. Referring to or quoting from Standard Specifications in the Geotechnical Design Report creates duplication and potential erroneous interpretation of the Standard Specifications.

To prevent erroneous interpretation and misuse of information provided in this section, instruct the reader of the Geotechnical Design Report to read Sections 5 and 6 of the report before using the information provided in this section.

The following subsections describe the information that should be included in the Geotechnical Design Report in order for the specification engineer to edit the SSPs. Organization of these subsections are based on the sequential order of contract items listed in Standard Specifications and the list of Standard Special Provisions (SSPs) that are related to geotechnical engineering. They are not organized based on ERS types. Because each ERS type has different combination of primary and ancillary work items described in different sections of the Standard Specifications and SSPs, it is impossible to arrange the following subsections based on ERS types without substantial duplications.

Existing SSPs are updated on an as-needed basis and new SSPs are periodically developed and entered into the SSPs list. For up-to-date SSPs, please refer to the following website:

http://www.dot.ca.gov/hq/esc/oe/standards.php

SS Section 2 Bidding

Section 2-1.06B Supplemental Project Information

- Verify the list and contents of geotechnical reports and additional geotechnical information, such as digital photo logs, included in the Supplemental Project Information / Information Handout of the Draft PS&E package,
- Provide a list of materials, such as rock cores, and information available for inspection at the Transportation Laboratory or other District offices. For materials and information available at District office, provide address and contact phone number.

SS Section 19 Earthwork

SS 19-3 Structure Excavation

Section 19-3.01A (3)(b) Soil Nail Wall and Ground Anchor Wall Zones:

- Provide wall zones for each soil nail wall and ground anchor wall using the following format:

Wall zone	Beginning station	End station	Upper elevation (feet)	Lower elevation (feet)
1				
2				
3				
…				

Section 19-3.03A Unstable Material below the Footings:

- Indicate whether removal of unstable material below the bottom of earth retaining system footings is required.
- If material below the bottom of excavated unstable material must be compacted, indicate and provide the locations in the following table:

Structure No.	Begin Station	End Station

Section 19-3.03B(1) Surface or Ground Water is Expected during Structure Excavation

Ensure that recommendation on the structure excavation (with seal courses, Type A), (without seal courses, Type D) or (without seal courses and with hazardous materials, Type DH) and the structure excavation locations are included in Section 6, Recommendations.

Note: This above information should be provided in Section 6 Recommendations, so that it can be incorporated in the Plans; and the specification engineer can edit the paragraph according to the Plans.

Section 19-3.03E(3) When Minimum Compacted Backfill behind the Lagging of a Soldier Pile Wall is other than 5 Feet above the Ground Anchors

- Provide the required minimum height of compacted backfill above the level of the ground anchors before drilling.

SS 19-4 Rock Excavation:

Section 19-4.01A Authorize Different Rock Excavation Methods

Provide instruction on whether:

- Pre-splitting is allowed,
- Blasting is allowed, or
- Rock excavation performed with controlled blasting is needed

Section 19-4.04 Assist in Quantity Estimate for Payment

- Provide estimated quantity for rock excavation if requested.

SS 19-5 Compaction

Section 19-5.03A Water is Scarce for Compaction

- Provide recommendations if specified relative compaction is obtainable without the use of water, and water is scarce in the area.

SS 19-6 Embankment Construction

Section 19-6.02B Geosynthetic Reinforced Embankment

- Provide the identifications such as Type 1, Type 2, of geosynthetic reinforcement materials and their Long-Term Design Strengths (LTDS) used in the design.
- If backfill material must have different requirements than those specified in the Standard Specifications, provide recommended particle size distribution, plasticity index, and pH. Please note the LTDS of geosynthetic reinforcement material can be significantly affected by the properties of selected backfill materials.

Section 19-6.03B Subsidence

- Include a note if subsidence of ground surface is anticipated due to embankment construction and provide estimated subsidence and subsidence profile so that the additional quantity and cost of embankment and import borrow, if used, can be estimated.

Section 19-6.03D Settlement Periods and Surcharges

- If settlement periods and surcharges are required for roadway embankments at the earth retaining structures, provide instruction and values in a table as shown below.
- If only settlement periods are required and no surcharge is required, enter "0.0" in the "Surcharge height" column.

Earth retaining structure	Surcharge height (feet)	Settlement period (days)

Section 19-7.02B Local Borrow:

- If requested, provide geotechnical assessment of local borrow identified by District.

SSP 19-7.02C Imported Borrow:

- If requested, provide geotechnical assessment of imported borrow identified by District.

SS Section 46 Ground Anchors and Soil Nails

SS 46-1 General

Section 46-1.01A Ground Anchors and Soil Nails Work Sequence

- Provide the instruction on specific work sequencing concerns related to ground anchors and soil nails construction, such as the timing of ground anchor stressing relative to the construction of other elements.

Section 46-1.01E Research Investigation

- Provide instruction for research activities, such as survey markers, slope indicator casings and other equipment. Include quantity, locations, and estimated material cost of the installed equipment.

SS 46-2 Ground Anchors

Section 46-2.01C Alternative Number of Ground Anchors

- Include a note if, from a geotechnical engineering point of view, an alternative number of ground anchors that provide the same horizontal and vertical components and distribution of the design force is allowed.

Section 46-2.01D(2)(a) Locations and Number of Ground Anchor Performance Tests

- Provide locations of ground anchors subject to performance test. If the locations cannot be determined during design, provide the minimum number of ground anchors subject to performance test.

Section 46-2.01D(2)(b) and 46-2.01D(2)(c) Ground Anchors as Wall Footing Anchors

- Provide the locations of ground anchors for wall footings that take on seismic loads and have a lock-off load at least 0.25 x factored test load. Ensure design of the ground anchors are in accordance with LRFD. For details, see the corresponding SSPs.

Section 46-2.02B Ground Anchor Bearing Plates on Materials Other than Concrete

- Include a note if the bearing plates bear on materials other than concrete. Provide a description of the materials in contact with the bearing plates and the maximum permissible bearing pressure of the materials. Ensure design of the ground anchors are in accordance with LRFD. For details, see the corresponding SSPs.

Section 46-2.03A Geotechnical Issues during Ground Anchor Installation

- Include notes if the following conditions are expected or required:
  - Difficult ground anchor installation (include the locations and a list of difficult site conditions),
  - Ground Anchors installed under a spread footing,
  - Significant voids and their locations,
  - Provide the thickness of grout cover over the corrugated sheathing if it is other than 1 inch

SS 46-3 Soil Nails

Section 46-3.01D(2)(b)(iii) Two Percent of Total Number of Production Soil Nails

- Provide the value equal to 2 percent of the total number of production soil nails for each wall or the entire project. This is the number of proof tests required with locations contractually determined by the Engineer. (Note: According to the Standard Specifications, the Engineer is the Resident Engineer.) You may provide the tentative locations to the Engineer by issuing a memo to RE Pending File. The locations of these proof test nails can also be determined during construction at locations that require special attention.

Section 46-3.02A Corrosivity of the Site

- Ensure corrosivity of the site is included in the report so that a corresponding level of corrosion protection for the soil nail reinforcing bar can be determined.

Section 46-3.03A Geotechnical Issues during Soil Nail Installation

- If difficult soil nail installation is expected, include notes with locations and a list of difficult site conditions.

SS Section 47 Earth Retaining Systems

Section 47-2.01A, 47-3.01, 47-6.01A, and 47-6.01C Alternative Earth Retaining System for Caltrans Standard Walls, MSE, or Crib Wall Designs

- Provide a note if alternative proprietary earth retaining systems are not allowed due to geotechnical considerations, and provide a list of locations where they are not allowed.

Section 47-3.02B(2)(c) Corrosivity and Marine Environment of the Site

- Ensure corrosivity or marine environment of the site is included in the report so that a corresponding level of corrosion protection for the crib wall members can be determined.

SS Section 49 Piling

SS 49-1 General

Section 49-1.01D(4) Dynamic Monitoring

- Provide instruction if pile dynamic monitoring is required to establish pile bearing acceptance criteria using pile dynamic analysis (PDA). Provide the locations of supports or control zones that require dynamic monitoring.

Section 49-1.01D(5) Test Borings to Verify Top of Rock Elevation

- Provide instruction if test borings are required during construction to verify top of rock and specified pile tip elevations. Provide locations where test borings should be performed and the minimum depths below the specified tip elevation. Refer to corresponding Standard Specifications and SSPs for details.

Section 49-1.03 Expected Difficult Pile Installation

- Include notes if difficult pile installation is expected. Provide the locations of the piles, and a list of difficult site conditions. Refer to corresponding SSPs for details.

SS 49-2 Driven Piling

Section 49-2.01A(3)(b) Driving System Submittal

- Include a note if driving system submittal is required for each pile type before installing driven piles. Include pile type and the locations of supports or control zones.

Section 49-2.01C(2) Conditions require Revised Specifications for Driving Equipment

- Include notes and provide instruction if any of the following conditions exist and revised specifications are required:
    - Low overhead clearance; provide the locations;

- Installing sheet piles or steel shells for CISS piles that have no geotechnical capacity along the length of the pile or steel shell. Where vibratory hammers, rotators, or oscillators may be used, provide the locations.
- Expected obstructions to driving steel piles, such as boulders, clay lenses, and abandoned culverts, where special driving tips, heavier pile sections, excavation below the bottom of footing, or other measures are needed to prevent damage to the pile during driving. Depth of excavation at tension piles should be limited.

Section 49-2.01C(3) Drilling for Driven Piles or Casings is not Allowed or Restricted

- Instruct whether drilling for driven piles or casing is not allowed or restricted.
- If drilling is restricted, use the following table to provide the locations of drilling allowed to attain the specified tip elevation and the bottom of the drilled hole elevation.

Structure No.	Begin Station	End Station	Bottom of hole elevation (feet)

Note: According to Standard Specifications, a "drilled hole" has a diameter less than the least dimension of the pile.

Section 49-2.01C(4) Predrilling for Driven Piles is Required

- Complete the following table if driven piles are to be installed in fills with thickness greater than 5 feet or predrilling is required due to close proximity to an obstruction, such as water or gas lines and building foundations.

Structure No.	Begin Station	End Station	Bottom of hole elevation (feet)

Note: According to Standard Specifications, a predrilled hole must be at least 6 inches larger than the greatest dimension of the pile cross section and used in embankments constructed under the Contract, or in close proximity to an obstruction.

- Include notes if piles must be driven through concrete footings that are to remain structurally functional.

Section 49-2.01C(5) Pile Set Up Period

- Include a note if pile set up period is recommended. Provide the locations.

Section 49-2.04B(1) Alternative "X" Piles for Lateral Load

- Include a note if alternative "X" piles are designed to sustain lateral loads. Structure designer should provide instruction on the edit of the SSPs. Refer to corresponding SSPs for details.

Section 49-2.04B(3) Substituting Structural Shape (H) Steel Piles for Concrete Piles

- Include a note if substituting structural shape steel piles for Classes 90, 140, and 200 concrete piles is allowed. Provide additional pile data tables for substituting Structural Shape (H) Steel Piles. Coordinate with The structure designer to include the design and plans of the substituting structural shape steel piles. Refer to corresponding SSPs for details.

SS 49-3 Cast-In-Place Concrete Piling

Section 49-3.02A(1) and 49-3.02C(4) CIDH Piles Designed as End Bearing

- Provide a note and complete the following table, if there are CIDH concrete piles designed as end bearing.

Structure No.	Begin Station	End Station

Section 49-3.02B(7) Slurry Cement Allowed in the Annular Space

- Include a note if you allow the use of slurry cement backfill in the annular space between the soil and the casing for Type II CIDH piling and show an optional construction joint.

Section 49-3.02C(1) Drilling Sequence for CIDH Piling Center-to-Center Spacing less than 3 Pile Diameters

- Provide a drilling sequence if it is required.

Section 49-3.02C(5) Not-Allowed Installation Methods for Permanent Steel Casing

- Include a list of methods not allowed in installing permanent steel casing if any. Refer to the corresponding SSPs.

Section 49-3.02C(6) Permanent Casing for Type II CIDH Piling with Optional Construction Joint Shown

- Include notes for permanent casing for Type II CIDH piling with optional construction joint shown to indicate whether:
    - The casing must be corrugated metal pipe,
    - Slurry cement backfill is allowed in lieu of grout, or
    - Certain installation methods are not allowed; and provide the list of unallowable methods.
- Refer to the corresponding SSPs for details.

Section 49-3.03B Allow Substitution of Larger Diameter CISS Concrete Piles

- Provide locations of the CISS concrete piles that can be substituted and the maximum diameters of the substituted piles. Create a table for multiple locations and sizes.

Section 49-3.03C(2) Clean-Out Depth and Center Relief Drilling Depth for Open-Ended CISS Piles

- Provide notes and instructions if:
    - More than eight feet of the material inside and at the bottom of the pile must remain, or
    - Center relief drilling may be necessary

SS 49-4 Steel Soldier Piling

Section 49-4.03B Drilled Holes through Rock Material and Pile Substitutions

- Provide notes if extensive rock material is anticipated and conventional drilling equipment for soils may not be suitable.
- Provide notes if pile substitutions are allowed.

SS 49-5 Micropiling

Section 49-5.01 General Grouting and Micropile Length

- Include a note if the contractor determines the bond length for axial load. Also include the depth to the top of the bond length, if necessary.
- If the contractor determines the bond length for axial load, do not include a bond length in the report, except you may include a minimum length if necessary for load conditions other than axial load (e.g., group action, lateral, etc.). Make it clear what load condition this minimum length is for and that it is not for axial load.

- If the State determines the bond length for axial load, note whether grouting is assumed to be gravity grouting or pressure grouting. Typically gravity grouting is assumed, since pressure grouting is dependent on site conditions and contractor's methods and is therefore difficult to specify.

  Note: If axial load controls, typically the contractor determines the bond length and installation methods (including whether or not to pressure grout), and load tests are required to verify the contractor's bond length and installation methods.

Section 49-5.01C(3) Isolate Micropiles from Settlement of Embankment Backfill

- Include a note if micropiles need to be isolated from embankment backfill when settlement is expected.

Sections 49-5.01D(5)(a) and 49-5.01D(5)(b) Load Tests – Compression, Tension, or both; Creep; Factored Test Load; and Representative Wall Zones

- Include a note if micropiles need to be load tested in compression.
- Include a note if micropiles need to be load tested in tension.
- Include a note if micropiles need to be load tested in both tension and compression.
- Include a note if creep test is required during the load tests.
- Provide Factored Test Load (FTL) for respective load tests (compression, tension, or both), if load tests are recommended.
- Provide location of each verification test micropile and limits of the wall zone that the verification test micropile represents using the following format:

Structure No.	Wall zone	Wall zone beginning station	Wall zone end station	Verification Test Micropile Location
	1			
	2			
	3			
	…			

Notes:
1. Load tests are seldom required for slope stabilization and ERS applications.
2. For slope stabilization and ERS applications, if pressure grouting, instead of gravity grouting, is assumed to achieve design bond strength and force for axial load, include load test requirements to verify that the contractor-provided bond strength, length, and installation methods satisfy the design requirements.
3. If load tests are required, a tension load test is preferred since it is cheaper to perform and typically provides a conservative assessment of pile capacity.

Section 49-5.01D(5)(c) Number of Proof Load Tests; and the Timing of the First Proof Test

- Provide the number of micropiles per wall zone to be proof load tested.
- Provide the percentage of micropiles that must be installed per wall zone before the first proof test is performed.

Section 49-5.02F Corrosivity of the Site

- Ensure corrosivity of the site is included in the report so that a corresponding level of corrosion protection for micropiles can be determined.

Section 49-5.03A Minimum Spacing and Elapsed Time when Installing the Next Micropile

- Provide the minimum center-to-center spacing and elapsed time before starting installation of the adjacent micropile.

  Note: The default is minimum 5-foot spacing and 12 hours after initial grout has set.

Section 49-5.03B Verification Test – Providing Geotechnical Equivalence using Isolation

- Provide the locations where the verification test micropile must be lengthened and isolated down to a certain elevation. Provide the amount to be lengthened and the elevation.

  Notes:
  1. Isolation may be required due to the ground surface elevation being significantly higher than the cutoff elevation of the production micropiles, due to sloping strata layers, or due to other situations that cause a lack of geotechnical equivalence between the verification test micropile and the production micropiles that it represents.
  2. The isolation should ensure that the verification test accounts for the same engaged length and ground materials as the production micropiles. Verification test movement criteria may need to be adjusted in order to be comparable to the proof test movement criteria, due to a longer elastic length.

Section 49-5.03D Geotechnical Issues during Micropile Installation

- If difficult micropile installation is expected, include notes with locations and a list of difficult site conditions.

SS Section 51 Concrete Structures

Section 51-1.01A Alternative Earth Retaining Systems for Type 1 – 5 Retaining Walls

- Provide a note if alternative proprietary earth retaining systems are not allowed due to geotechnical considerations, and provide a list of locations where they are not allowed.

SS Section 58 Sound Walls

Section 58-2.03A Friction Angle of the Foundation Material that Determines the Dimensions of the Sound Wall Foundation

- Ensure the report provides the friction angle of the foundation material that will determine the dimensions of the sound wall foundation. Refer to the corresponding SSPs and Standard Plans for details.

SS Section 61 Culvert and Drainage Pipe Joints

Section 61-1.01D(2)(a) Drainage Pipe Settlement and the Characteristics of Surrounding Soils

- Perform the evaluation if requested and the necessary information is provided.
- Include notes if expected settlement of a pipeline is greater than three inches, which will trigger field leakage tests of the pipeline. Provide estimated lapse time after pipe installation and backfill before the leakage test is performed.
- Include notes if the materials around the pipeline are fine cohesionless (sand or silt) soils.
- Refer to the corresponding SSPs.

SS Section 65 Concrete Pipe

Section 65-2.03B Rock or Unyielding Material under the Pipe

- Perform the evaluation if requested and the necessary information is provided.
- Include notes if rock or other unyielding material may be encountered in the excavation below the bottom of the pipe bedding.

SS Section 68 Subsurface Drains

Section 68-2.02F(1) Permeable Material for Underdrains

- Provide the recommended permeable material, Class 2 or 3, for underdrains.

Section 68-5 Permeable Material Blanket

- Provide the recommended permeable material for permeable material blanket.

Section 68-6 Drainage Wick

- Provide the recommended maximum area of the driving sleeve if it must be less than 12 square inches.

SS Section 72 Slope Protection

Section 72-2.02B Nonstandard Fabric for Rock Slope Protection

- Provide recommended Fabric Class. Refer to section 88-1.02I Rock Slope Protection Fabric for material properties of the Classes.

SS Section 76 Wells

Refer to SSPs in this section, which include water wells, exploratory holes and monitoring wells.

SS Section 88 Geosynthetics

Section 88-1.02B Filter Fabric

- Provide recommended filter fabric Class.

SS Section 90 Concrete

Section 90-1.02G(6) Concrete Placed in Soil or Water with a Corrosive Environment

Section 90-1.02H Concrete in Direct Contact with a Corrosive Environment

- If the soil or water of the site is corrosive, provide the sites or locations identified as having the corrosive soil or water. Provide the sulfate content (ppm), chloride content (ppm), and pH value of the soil.

7.2 Non-Standard Special Provisions (NSSPs)

If NSSPs are required, notify the specification engineer as soon as possible. The development, review, and approval of NSSPs can take several months.

The geotechnical designer must provide technical content of the NSSPs and work with the specification engineer to develop NSSPs that are biddable and buildable. The geotechnical designer is professionally responsible for the technical content of the NSSPs.

7.3 Notes for Construction

Notify Structure Representative during Design

During project development, if there are design or construction considerations that the Structure Representative should be informed of, but the information is not suitable to be placed in the Plans or Special Provisions, issue memoranda to:

RE Pending File/HQ/Caltrans/CAGov

Standard Specifications section 5-1.23A Action Submittals under Section 5 Control of Work requires the Contractor to submit quality control plans before the start of the affected work. If there are geotechnical related quality control plans for the Contract, notify, by placing a note in this section or via RE Pending File, the Engineer, or Structure Representative to send the quality control plans to you for review.

Standard Specifications section 8-1.03 Preconstruction Conference under Section 8, Prosecution and Progress, requires the Contractor to attend a preconstruction conference. If geotechnical engineer's participation in the preconstruction conference is needed, notify, by placing a note in this section or via RE Pending File, the Engineer, or Structure Representative to invite you to the preconstruction conference.

8.0 REFERENCES

Include complete references of the supporting documents mentioned in the report and sources of the information provided. Do not include documents that are not specifically referenced elsewhere in the report.

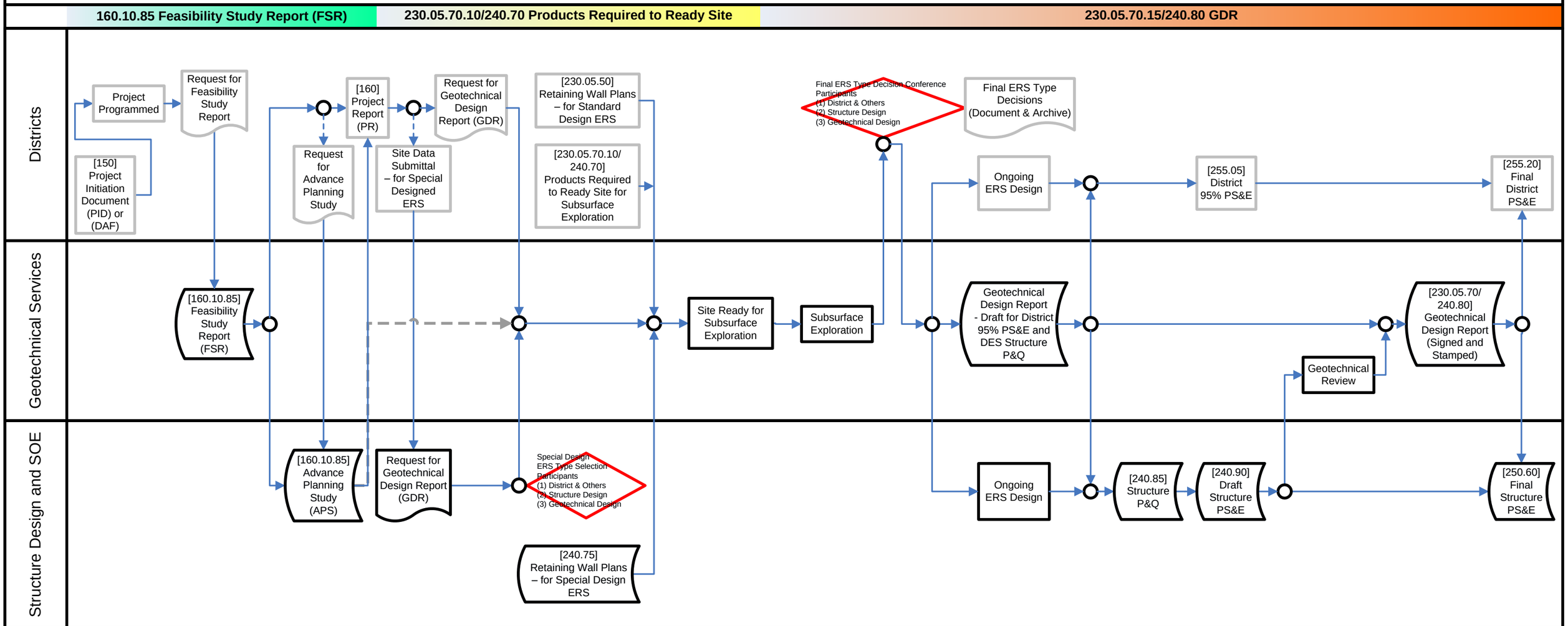
9.0 APPENDICES

- APPENDIX A: FIGURES AND LAYOUTS
- APPENDIX B: SUBSURFACE EXPLORATION
- APPENDIX C: LABORATORY TEST RESULTS
- APPENDIX D: ANALYSES AND CALCULATIONS
- APPENDIX E: MISCELLANEOUS

ATTACHMENT

Earth Retaining System Geotechnical Reports Activity Network Diagram

Earth Retaining System Geotechnical Reports (FSR and GDR) Activity Network Diagram



Work Flow

Contingent Work Flow

Information Route

Info. Distrib

Conference, Meeting, Decision Point

Work Product (WBS Element)

Major DES Deliverables

Comments, Responses, Requests

Feasibility Study Report
- Feasible Earth Retaining System Types
- Advantages and Disadvantages
- Cost Comparison
- Recommended Earth Retaining Systems

Geotechnical Design Report
- Geotechnical Data
- Geotechnical Analysis and Evaluation
- Design Recommendations
- Construction Considerations

Note: 1 The activity network diagram only shows the sequence of deliveries. It does not imply a work element can not start before the delivery of preceding work elements. For example, subsurface exploration can start as early as possible, such as in the planning phase, if it is allowed and necessary, and can extend way into GDR preparation activity.

2 Similarly, geotechnical designer should start communicating and working with structure designer as early as possible, and issue GDR-Draft as early as possible to facilitate design of the ERS. Issuance of multiple GDR-Drafts may be necessary to update design information and document design decisions.

3 For other geotechnical deliverables, please contact corresponding GS geotechnical teams.