

610 Geotechnical Analysis

610.1 General

The geotechnical analysis and reports are developed during distinct project phases—Scoping or Phase IA/IB; Phase ID, Preliminary Design; and Phase II, Final Design. These reports are used to assist in the development of the Preliminary Design, Grade and Drain, Plan-in-Hand, and PS&E submittals. The initial phases include early planning, inventory review of existing conditions, and site reconnaissance, to determine potential geotechnical constraints, design considerations, and the scope of work for subsequent studies for the project. Subsequent phases include detailed field investigation, laboratory testing, and engineering analysis to generate preliminary and final design criteria and recommendations for the project.

The geotechnical analysis, reports, and phases for New Mexico Department of Transportation (NMDOT) projects typically include the following:

- Geotechnical Scoping Report - Occurs during the Scoping Phase or Phase IA/IB if Location Study Procedures apply.
- Preliminary Geotechnical and Foundation Reports - Occurs during Phase ID, Preliminary Design.
- Final Geotechnical and Foundation Reports - Occurs during Phase II, Final Design.

Depending upon the timing of the project deliverables, the phases and reports may be combined or performed concurrently.

NMDOT has adopted the geotechnical practices identified in the current edition of the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, which designers should refer to when preparing geotechnical reports for the NMDOT.

610.2 References

- AASHTO LRFD Bridge Design Specifications, current edition - NMDOT uses the current edition of the AASHTO LRFD Bridge Design Specifications and the current interim editions as the primary standards for the design of bridges in New Mexico.
- Federal Highway Administration (FHWA) Publication No. FHWA-NHI-10-024, [Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Slopes - Volume I](#), November 2009.
- FHWA Publication No. FHWA-NHI-10-025, [Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Slopes, Volume II](#), November 2009.
- NMDOT Geotechnical Manual - Requirements and Guidelines for Highway Structure Foundation Investigation and Subsurface Exploration, 1990 - This document includes NMDOT requirements and guidelines for highway structure foundation investigation and subsurface exploration. This manual is outdated and the NMDOT is currently in the process of updating the manual. Until the NMDOT Geotechnical Manual has been updated and approved, geotechnical investigations conducted on behalf of the NMDOT should use the AASHTO LRFD Bridge Design Specifications, most current edition.
- NMDOT Special Provision Section 506, Engineered Retaining Wall System. This Special Provision is currently being used for gravity and mechanically-stabilized earth (MSE) retaining walls and is being modified on a project-by-project basis.

610.3 Geotechnical Scoping Report (Scoping Phase or Phase IA/IB)

The purpose of the Geotechnical Scoping Report is to review available information, plans, and reports to be used in assessing potential geological and geotechnical issues and constraints that may impact the proposed structures and/or roadway alignment or corridor. The information generated during this phase will be used to establish the detailed scope of work for additional future phases and reports.

Geotechnical tasks in this phase include the following:

- Participation in early planning meetings with the NMDOT Project Development Engineer (PDE) and other staff to define the objectives, goals, and scope of the project.
- Reviewing available information, aerial photos, geological maps, survey data, as-built plans, pavement reports, geotechnical reports, and structural/bridge inspection reports.
- Reviewing the existing conditions inventory.

The Geotechnical Scoping Report shall be performed in accordance with guidance from the current version of the AASHTO LRFD Bridge Design Specifications and the NMDOT Geotechnical Manual. The Geotechnical Scoping Report shall be prepared by a Professional Engineer (P.E.) registered in New Mexico and will consist of the following:

- Summary and discussion of available information, plans, and reports
- Summary of the existing conditions inventory
- Potential geologic hazards
- Potential impacts, effects, and possible mitigation measures
- Recommendations for the future scope of work

610.4 Preliminary Geotechnical Report (Phase ID, Preliminary Design)

The purpose of the Preliminary Geotechnical Report is to use the information generated from the Geotechnical Scoping Report and further evaluate potential issues impacting project design and construction that will need to be evaluated with subsequent

geotechnical phases and reports. Geotechnical and geophysical investigation may need to be conducted during this phase of the project.

The geotechnical tasks during this phase include the following:

- Field reconnaissance
- Field geologic mapping
- Soil sampling and testing (where appropriate)
- Geophysical testing (where appropriate)
- Performing limited subsurface investigation and lab testing per Chapter 600 of the Design Manual (where appropriate).
- Obtaining grading and earthwork information from the project's civil engineer
- Preparing a geotechnical exploration plan for future studies

The Preliminary Geotechnical Report shall be performed in accordance with the current version of the AASHTO LRFD Bridge Design Specifications and the NMDOT Geotechnical Manual. The Preliminary Geotechnical Report shall be prepared by a P.E. registered in New Mexico and include the following:

- Summary of field reconnaissance activities
- Field geologic map(s)
- Results of subsurface investigation and lab testing (if applicable)
- Results of geophysical testing – assess excavation difficulties and seismic site class
- Results of limited subsurface investigation and lab testing (if applicable)
- Geologic hazards – including slope stability, slope creep, consolidation, soil stabilization, excavation difficulties, and rockfall
- Recommended structures – bridges, retaining walls, etc.
- Impacts, effects, and possible mitigation of geotechnical issues
- Special treatments (geotextiles, soil nails, pressure grouting, etc.)

610.5 Preliminary Foundation Report (Phase ID, Preliminary Design)

The purpose of the Preliminary Foundation Report is to use the information generated from the Geotechnical Scoping Report and Preliminary Geotechnical Report to develop potential foundation options, evaluate construction feasibility, develop preliminary cost comparisons, and provide preliminary foundation design parameters.

The geotechnical tasks for this phase include the following:

- Performing subsurface investigation and lab testing per the Geotechnical Exploration Plan and Chapter 600 of the Design Manual
- Compiling and reviewing project information, subsurface investigation logs, geophysical data, geologic mapping, and lab test data
- Obtaining structural loading conditions from the project's structural engineer
- Generating foundation alternatives
- Conducting constructability evaluations of foundation alternatives
- Developing cost comparisons of foundation alternatives
- Completing preliminary engineering analyses for proposed structures or elements
- Specifying a recommended foundation alternative

The Preliminary Foundation Report shall be performed in accordance with the current edition of the AASHTO LRFD Bridge Design Specifications. The Preliminary Foundation Report shall be prepared by a P.E. registered in New Mexico and include the following:

- Description of investigations, laboratory testing, findings, analyses, and recommendations
- Two conceptual bridge foundations
- Foundation capacity graphs
- Preliminary points of fixity

- State of stress lateral, earth pressures, and equivalent spring constants
- Drivability analysis (WEAP) for driven piles
- The most suitable wall alternative
- L-Pile parameters

610.6 Final Geotechnical Report (Phase II, Final Design)

The purpose of the Final Geotechnical Report is to use the information generated from the Geotechnical Scoping Report and Preliminary Geotechnical Report to develop final design parameters and recommendations for the proposed construction and the earth-connected portions of the project.

The geotechnical tasks for this phase include the following:

- Performing subsurface investigation and lab testing per the Geotechnical Exploration Plan and Chapter 600 of the Design Manual
- Compiling and reviewing project information, subsurface investigation logs, geophysical data, geologic mapping, and lab test data.
- Confirming final grading and earthwork information from the project's civil engineer
- Confirming final structural loading conditions and configurations
- Performing final engineering analyses for the proposed structures or elements

The Final Geotechnical Report shall be performed in accordance with the current version of the AASHTO LRFD Bridge Design Specifications and the NMDOT Geotechnical Manual. The Final Geotechnical Report shall be prepared by a P.E. registered in New Mexico and include the following:

- A description of investigations, laboratory testing, findings, analyses, and recommendations
- Stabilization/densification of unstable embankment or native soils

- Slope stability/steepened slope design
- Suitability of soils/rock for support and settlement mitigation
- Rock excavation and blasting requirements, if applicable
- Rockfall mitigation, if applicable
- Maximum cut and fill slope angles
- Shrink/swell factors for earthwork
- Dewatering requirements

610.7 Final Foundation Report (Phase II, Final Design)

The purpose of the Final Foundation Report is to use the information generated from the Geotechnical Scoping Report, Preliminary and Final Geotechnical Reports, and the Preliminary Foundation Report to develop final design parameters and recommendations for the proposed structures.

The geotechnical tasks for this phase include the following:

- Compiling and reviewing project information, subsurface investigation logs, geophysical data, geologic mapping, and lab test data
- Confirming structural loading conditions and configurations
- Performing detailed engineering analyses for the proposed structures or elements

The Final Foundation Report shall be performed in accordance with the current edition of the AASHTO LRFD Bridge Design Specifications and the NMDOT Geotechnical Manual. The Final Foundation Report shall be prepared by a P.E. registered in New Mexico and address the following:

- Bearing capacity and axial capacity
- Settlement
- Global stability
- Lateral resistance
- Seismic considerations
- Drivability analysis (WEAP) for driven piles

- L-Pile parameters
- Construction considerations

610.8 Documentation

The following reports document geotechnical analysis during the design process:

- Geotechnical Scoping Report
- Preliminary and Final Geotechnical Reports
- Preliminary and Final Foundation Reports