

Minnesota Department of Transportation Consultant Specifications for Soils Surveys, Engineering Analysis, Laboratory and Field Soils Tests

Section 1.0 Character of Work

1.10 General

The services to be provided under this agreement are for the performance of soils surveys, engineering analysis, laboratory and field soils testing as required by the State. The Contractor will be required to perform any or all of the services identified in Section 2.0 of this agreement. Designs, plans, soils boring logs, plotted soils profiles and cross-sections, and reports prepared in accordance herewith will be prepared by, or under the direct supervision of a Professional Engineer (P.E.) registered in the State of Minnesota, and said items will be certified by a P.E. as required by law.

1.20 Soils Surveys

The purpose of the survey is to define the in-situ soil, rock, ground water, existing pavement/subgrade conditions, and to identify the material types and their engineering character, to the extent necessary for the design of the most economical, uniform and stable roadway. A sufficient number of tests, borings and thicknesses will be obtained to enable the preparation of the Materials Design Recommendation letter, estimated quantities and contract specifications. Enough testing should be performed to confirm that the proposed soil slopes are safe.

1.21 Laboratory and Field Testing

The purpose of soils classification, field and laboratory testing is to ascertain the nature, suitability, strength, conditions, stability, and consolidation characteristics of soils encountered. The field and laboratory testing is described in Chapter 3-2.0 in the MnDOT "2007 Pavement Design Manual", incorporated herein by reference. Soils encountered will be classified with the MnDOT "Triangular Textural Classification Chart" shown in figure 3-2.1.

The laboratory procedures to follow should conform to those set forth in the departments' lab manual available on the web at:

<http://www.dot.state.mn.us/materials/labmanual.html>

1.22 Engineering Analysis

The purpose of engineering analysis is to analyze field boring work and laboratory soils tests to develop recommendations that include but are not limited to muck excavation, subgrade excavation, embankment construction, subsurface drainage, dewatering, ponding, berms, shrinkage factors, use of onsite materials and grading, base and

surfacing design. The recommended outline for the Materials Design Recommendation letter is included in Chapter 6 of the MnDOT “2007 Pavement Design Manual”.

Section 2.0 Scope of Work

2.10 General

The work and services to be provided under this agreement are for the performance of soils engineering and related work as required by the State. The Contractor will, at the direction of the State, perform any or all of the following tasks. These tasks will be accomplished in conformance with the standards and specifications of the MnDOT “2007 Pavement Design Manual” including modifications and/or new additions thereof, unless otherwise specified.

A Preliminary Soils Survey and/or a Detailed Soils Survey could be required depending on the type of project involved.

2.11 Preliminary Soils Survey

A preliminary soils survey will have a sufficient number of soils borings and R-value samples to obtain data for the pavement selection process. In addition, piezometers will be set in low areas to monitor ground water elevations. As part of the pavement type selection process, borings generally are 5 to 10 feet below the existing ground surface or below the proposed profile grade, whichever is deeper. They are generally drilled on 500 to 1000 foot centers. The frequency of the drilling depends upon the variability of the subgrade and terrain encountered. Problem areas will require a more detailed drilling program. Such problem areas include swamp crossings, deep cuts or fills and observed seepage areas.

As part of the preliminary soils survey, the Contractor will be requested to develop an estimate of soil exploration necessary to perform the activities as required for a Detailed Soils Survey. This estimate will include all or some of the activities of Sections 2.12 Detailed Soils Survey, 2.13 Rock, 2.14 Swamps, 2.15 Existing Pavements, 2.16 Hazardous Substances, 2.17 Classification and Testing, 2.18 Undisturbed Samples, Rock Cores and Specialized Equipment, 2.19 Laboratory Soils Testing and 2.20 Engineering Analysis.

2.12 Detailed Soils Survey

The detailed soils survey is intended to provide soils and ground water information for the preparation of recommendations for grading, base and surfacing for the designer of the project. The Contractor will be provided with an approved layout and preliminary grade line.

The Contractor will perform sufficient survey work on the centerline to locate holes approximately 5 feet horizontally and approximately 0.5 feet vertically.

Auger borings will be taken approximately every 100 feet along the proposed alignment. On divided highways, the borings on the two roadways can be staggered. Where non-uniform soils or water conditions are encountered, boring intervals should be decreased. Borings will provide a continuous profile of the subsurface soil conditions. Borings will be taken to a depth of at least 10 feet below the proposed profile grade line in cut areas and at least 5 feet below natural ground in fill sections. At least one boring in each fill section will extend to a depth equal to the height of the proposed fill. Where soils are encountered that are considered unsuitable for roadway embankment construction, the requirements of Section 2.14 Swamps will be followed.

Piezometers will be set in low areas wherever ground water conditions are encountered within 10 feet of the proposed grade line. They will be read and recorded weekly for the first month and then monthly thereafter for as long as the contract is open.

2.13 Rock

If evidence of bedrock or auger refusal is found in any boring, additional borings or soundings will be made in the immediate area to determine the cause of refusal.

Where evidence suggests that buried bedrock will lie above the proposed grade line, the Contractor will notify the State of the need for core borings. The number of borings will depend on anticipated rock variability and length of cut. On side-hill cuts, additional borings will be taken on the uphill side to reflect maximum rock cut and possible ground water problems.

All borings used to determine the depth to bedrock will be shown on the soil profile, along with a notation indicating the number of additional unsuccessful attempts in cases of refusal. Rock outcrops will also be shown on the profile and cross-section sheets.

2.14 Swamps

The soils boring operations are to determine the character and depth of the swamp material. Enough borings should be performed to identify the area, extent and profile of the swamp bottom. Resistance soundings or cone penetration tests (CPT) could be used to supplement information obtained from borings. Where deep deposits of

compressible soils are encountered, that will not likely be excavated, laboratory testing for consolidation and slope stability will be required.

All swamp soundings, borings, and water elevations will be plotted on a layout and properly identified on the soils profile and cross-sections. When the swamp bottom is reasonably uniform three borings will be adequate for each cross-section. The borings will be taken at centerline and halfway between the shoulder P.I.'s and the toe of slope. All borings will extend through unstable material to a point 10 feet into firm mineral soil. Where the swamp section has a sloping bottom or the location alignment encounters the swamp area at a point where the roadbed will be partially on unstable foundation materials and partially on higher more stable ground, additional soil borings are necessary. Sufficient information will be obtained to present a true picture of subsurface conditions. In all swamps, at least one boring will be taken at least 20 feet below the apparent swamp bottom to provide adequate evidence against a false bottom.

When undisturbed sampling and testing is required to provide soil strength criteria for special designs they will be provided in accordance with the "Consultant Specifications for Subsurface Investigation and Geotechnical Analysis and Design Recommendations". This document can be viewed and downloaded from the following web address:

<http://www.mrr.dot.state.mn.us/geotechnical/foundations/tcontract.asp>

Refer to the MnDOT "Geotechnical Manual" and the "2007 Pavement Design Manual" for additional guidelines, procedures and requirements of soils surveys.

2.15 Existing Pavements

Core borings of existing concrete and bituminous pavements will be required. Cores will be taken to verify thickness and structural integrity of the existing pavement. The borings will extend through the in place pavement and base into the subgrade soils so that base, aggregate samples, soil samples and moisture samples can be taken. The borings will extend at least 5 feet below proposed finished grade. Cores will be taken in all pavements, including shoulders areas, where it can be reasonably ascertained that a change in material type or thickness exists.

2.16 Hazardous Substances

Sites within a project that include hazardous substances will require a separate agreement for the survey, identification, extent and possible cleanup methods. The agreement will be administered through the MnDOT Office of Environmental Stewardship.

If a previously unidentified or hazardous substance is encountered during what was thought to be a routine exploration, the drilling will be immediately stopped and the MnDOT Environmental Stewardship Unit contacted for instructions.

2.17 Classification and Testing

Soils will be classified by texture, color, moisture and organic content in accordance with State criteria as outlined in the MnDOT “2007 Pavement Design Manual”. The MnDOT “Triangular Textural Classification Chart”, incorporated herein by reference, will be used for mineral soils. The Unified System is not adequate and will not be accepted. Organic soils will be described as indicated below

Percentage of Organic Matter (by weight)	Description
2-5	Slightly Organic
6-10	Organic
11-25	Highly Organic
>25	Peat

Soil described as Peat can be further subdivided on pages 59 and 60 in the MnDOT “Geotechnical Manual”. It can be found at the following website:

<http://www.dot.state.mn.us/materials/geotmanual.html>

At least two representative samples of each major soil type (textural class) will be obtained for laboratory testing and identification. The laboratory tests will be used to confirm field identification. Representative samples of each major soil type will be retained by the Contractor and available for inspection until the project is terminated by the State.

Minimum sample quantities required for disturbed boring tests are listed in Table 4-2.1 of the MnDOT “2007 Pavement Design Manual”. Table 5-3.2 establishes guidelines for the frequency of sampling for the determination of R-values.

The Contractor will make all necessary arrangements with, and obtain permission from, public and private landowners prior to making any borings.

Right-of-entry will be arranged by the State when the Contractor is refused permission. Any permit fees and/or railroad charges, such as for flagging, will be the responsibility of the Contractor.

Soils borings will be made in accordance with the MnDOT “2007 Pavement Design Manual” and will have a minimum diameter of 3.75 inches.

Soil borings taken in saturated, organic or thin layered soils will be “pulled dead” instead of being augered to the surface. The augered method is acceptable in most other situations. However, no more than 2.5 feet of material will be brought to the surface at one time.

The ground water level will be measured and recorded in all borings. The Contractor will measure any water level immediately after completion of a boring. Subsequent measurements will be made after a minimum of 2 hours in order to obtain water table readings. All open test holes will be temporarily covered, identified with proper warning devices, and/or protected so that they are not hazardous. All water measurements will be noted on the field boring log and will include the date, time including subsequent measurements, depth of hole, condition of hole, method of measurement and other pertinent information.

All test holes will be backfilled in such a manner as to insure against subsequent settlement of the backfill resulting in a hole hazardous to persons, animals or equipment. Upon completion of the field investigation work, all surplus material, temporary structures and debris resulting from work will be removed and the premises left in a neat, orderly condition. Any improvements disturbed during boring operations will be restored in kind and character existing before the work started. All restoration work will be the responsibility of the Contractor and must be completed prior to the termination of the contract.

Borings that meet Minnesota Department of Health criteria for Environmental Bore Holes will not be drilled with solid stem augers because they cannot properly allow grouting of the hole. Where Environmental Bore Holes are drilled they will be sealed in accordance with the Minnesota Department of Health regulations under the direction of a registered Monitoring Well Contractor.

If flowing artesian conditions are encountered it will be the Contractor's responsibility to see that the flow is stopped, that the source is properly sealed against future leakage, and to prevent water from infiltrating other strata.

A field boring log will be prepared by the Contractor for each boring. Field boring logs will be prepared in ink and a copy will be included in the final report along with any edited final reports. The field boring logs will include the following information:

- The project identification number
- Location of the boring referenced to the centerline survey stationing to the nearest foot and coordinates using the County Coordinate System with NAD83 (1996 adj.) for x and y coordinates and NAVD88 for elevations
- Boring log number
- Method of drilling and sampling
- Diameter of bore hole
- Date boring is taken
- Name of driller and crew members
- Ground surface elevation measured to the nearest 0.5 feet

- Sheet number and total number of log sheets for the boring
- Definition of all symbols that are not otherwise self explanatory
- Classification, thickness, color, moisture condition (dry, moist, wet, saturated), composition and degree of compactness
- Field number of any samples taken, type of sample and depth taken
- Depth at which obstacles were encountered in advancing the boring
- Any other unusual conditions encountered during drilling and sampling

Unless otherwise provided for, the Contractor will number and plot the location of each boring on plan sheets furnished by the State. The Contractor will also plot each boring on profiles and cross-sections furnished by the State. In addition to soil types, groundwater elevations will be noted along with wet or saturated conditions.

An electronic copy of the final boring logs will be submitted to the State's Project Manager (see Section 3.10 below).

2.18 Undisturbed Samples, Rock Cores and Specialized Equipment

Foundations investigations include performing borings for Standard Penetration Tests, Cone Penetration Tests, rock coring, field vane shear, pressuremeter or dilatometer and use of geophysical methods. When foundation type borings and testing are required they will be in accordance with the "Consultant Specifications for Subsurface Investigation and Geotechnical Analysis and Design Recommendations". This document can be viewed and downloaded from the following website:

www.mrr.dot.state.mn.us/geotechnical/foundations/tcontract.asp

2.19 Laboratory Soils Testing

The Contractor could be required to perform laboratory soils tests. If no laboratory tests are required of the Contractor, it will be the responsibility of the Contractor to deliver the necessary soils samples to the State's Project Manager or State laboratory as directed, in a timely manner.

Laboratory testing for Foundation type tests designated in Section 2.18 will be in accordance with the "Consultant Specifications for Subsurface Investigation and Geotechnical Analysis and Design Recommendations". Laboratory tests for roadway "Soils Surveys" designated in Section 1.21 will be in accordance with, but not limited to the following:

The Contractor will maintain a receiving record of samples obtained on the project as they are received in the laboratory for the purpose of cross referencing samples with sequence and classification indicated on the field boring log.

Laboratory tests that could be required are Atterberg limits, particle size (percent sand, silt and clay), R-value, organic content, Proctor density and in-place moisture-density

properties. The laboratory procedures to follow should conform to those set forth in the State's Laboratory Manual.

2.20 Engineering Analysis

If an engineering analysis is required for the soils surveys such analysis will be in accordance with the following:

The recommended outline for the Material Design Recommendation letter is included in Chapter 6 of the MnDOT "2007 Pavement Design Manual". Design recommendations will include recommendations for muck excavation, subgrade excavations, embankment construction (including need for special materials, controlled rate of fill, etc.), need for perforated pipe or dewatering, frost treatments, shrinkage factors, noise walls, turf establishment and base and surfacing design.

The MnDOT "2007 Pavement Design Manual" is available at:

<http://www.dot.state.mn.us/materials/pvmtdesign/manual.html>

All are incorporated herein by reference.

The Contractor will notify the State of changes in the design relating to soil mechanics which, in the Contractor's opinion, would result in a better end result, result in easier construction, and/or be more economical. Problems of design and construction will be anticipated and recommendations made for their solution.

Section 3.0 Reports and Records

3.10 General

The Contractor will submit a written report for Soils Surveys that would include, but not be limited to, the following:

The Contractor will submit a final report to the State's Project Manager. The report will include a letter which contains: project reference, a brief description of the proposed design, the number of borings taken, a brief description of the soils and ground water conditions encountered, a table of samples taken which includes both field and laboratory identification, and if required, conclusions of an engineering analysis and design recommendations. The report will also include soil boring logs which are plotted on plan view, profiles and cross-sections. The borings will be identified with a number. The Contractor will also submit all other pertinent information and test results gathered during their investigation.

In addition, the contractor will provide data from the field boring logs in accordance with the following:

Soil boring information will be collected using Trimble G.P.S. and MnDOT's "Soils Data Dictionary", incorporated herein by reference. The Soils Data Dictionary is a list of questions (borehole location, strata (material info), water depths, and refusal depths) that is used to collect soils strata information using a Trimble data collector. Abbreviations for soils terms, as defined in

Table 3-2.17 of the MnDOT "2007 Pavement Design Manual" Section 3-2.05, are built into the "Soils Data Dictionary".

Data from the data collector will be uploaded to computer by using Trimble's Pathfinder Office software. Output files (.ssf), will be given to the Project Manager (no more than one file per two week period) and within 10 working days the Project Manager will provide the Contractor with: (1) data files that will be loaded to GEOPAK's Geotechnical tool. (2) Summary reports of field data collected for each borehole, which will include county coordinates and strata information.

The Contractor will provide the Project Manager one G.P.S. output file (.ssf) per day for the first week to verify that the files are compliance with MnDOT standards.

The State's Project Manager will provide an electronic file copy of the boring logs in an accurate, properly formatted MS ACCESS database that can be uploaded into the Bentley GEOPAK's Geotechnical tool, when requested by the Contractor. The template for this database will be provided by MnDOT. Borehole data will follow the MnDOT Soils Data Dictionary format. The transfer of output files and timelines will be the same as above.

All reports and information submitted will be the property of the State and retained by the State.

Designs, plans, soils boring logs, plotted soils profiles and cross-sections, and reports prepared in accordance herewith will be prepared by, or under the direct supervision, of a Professional Engineer registered in the State of Minnesota and said items will be certified by the Contractor's engineer as required by law.

Section 4.0 Data and Services Provided by the State

4.10 General

The State will furnish maps, preliminary plans, layouts, profiles, cross-sections, topographic maps, reports and any other data in possession of the State, requested by the Contractor and having a bearing on the study. All data furnished to the Contractor by the State will remain the property of the State and will be returned to the State when so requested. The Contractor will make an analysis of all data and information

furnished by the State. If any data or information is found to be incorrect or incomplete, the Contractor will bring the facts to the attention of the State before proceeding further with that part of the project. The State will investigate the matter, and if it finds that reported incorrectness or incompleteness exists, it will promptly furnish corrected data or information. Delay in furnished data will not be considered justification for an adjustment in compensation.

4.11 Traffic Control

Unless otherwise indicated, the Contractor will furnish necessary flagmen and traffic control devices to ensure safety of the traveling public when lane closures are required. The Contractor will notify the MnDOT Permits Section of the need for traffic control at least two weeks prior to starting the work. The Contractor will follow the procedures required by the MnDOT Permits Section and the Manual on Uniform Traffic Control Devices (including Appendix B). The Contractor will also use the Lane Closure Manual for projects in the Metro District. The "Lane Closure Manual" is available at:

<http://www.dot.state.mn.us/metro/trafficeng/laneclosure/index.html>

4.12 Survey Line

Unless otherwise indicated the Contractor will provide a survey line or base line from which to work.

4.13 Inspections

Duly authorized representatives of the State will have the right to inspect the work and facilities of the Contractor on a routine basis or whenever it is deemed necessary.

4.14 Conferences

The Contractor will confer with the State as is necessary in regard to the work to be done under this agreement and perform the travel necessary for such conferences. When requested by the State, the Contractor will also assist the State in negotiations with other interested parties.