Table of Contents

Section **Page**

Table of Contents
(Continued)

Section **Page**

Chapter 4
GEOTECHNICAL
PROJECT DEVELOPMENT PROCESS

4.1 GENERAL

4.1.1 Project Management System

MDT uses a Project Management System (PMS) to schedule, forecast, monitor and coordinate project development and resources. Projects are broken down into defined activities with estimated duration and person-hours required for completion. Duration is the number of working days required to complete each activity. Activity durations are used to estimate the length of time to develop a project. Person-hours are the anticipated number of hours that will be expended toward the completion of the activity. Person-hours are used to estimate the cost and budget required to develop a project.

Each activity has predecessor and successor activities. Arranging the activities in order from predecessor to successor creates the project schedule or flowchart. A list of defined activities with standard flowcharts for typical MDT projects has been developed by the Engineering Information Services Section (EISS) and is located on EISS intranet site.

MDT uses OPX2 software for PMS scheduling. For further information on OPX2, review the *OPX2 Manual* and/or consult with EISS.

4.1.2 Project Manager

After a project is nominated and approved by the Highway Commission, EISS is initially responsible for inputting the project into OPX2 and for assigning standard person-hours and durations. The Project Manager is responsible for reviewing the system information to ensure it is correctly assigned based on the initial project nomination. The Project Manager will schedule and conduct a Preliminary Field Review to better define the project scope. After the Preliminary Field Review Report is approved, transmitted to EISS and placed in the Document Management System (DMS), the initial assumptions will be adjusted and the project will be sent out for overrides to the functional managers (i.e., District Geotechnical Managers for the Geotechnical Section) or turned over to Consultant Design. The override process is where functional managers review the project and estimate durations and person-hours for their activities. If the Project Manager does not accept the overrides as returned, the Project Manager has the responsibility to negotiate with the functional manager in question until both Project Manager and functional managers agree to acceptable values.

4.1.3 Geotechnical Section

A typical project can include hundreds of individual activities for all the various design and supports units. Because the Geotechnical Section is a support unit to the project designer (Road Design, Bridge Design, Traffic Engineering), only a few of the OPX2 activities are directly

applicable to the Geotechnical Section. Figure 4.1-A only illustrates the OPX2 flowchart activities that are directly applicable to the Geotechnical Section and those activities preceding and succeeding the Geotechnical Section Activities. For complete project flowcharts and description of the activities for all the Units and Sections, the user should review the activity numbers and titles located on the EISS intranet site. In using Figure 4.1-A, the user should consider the following:

1. Precedence Activity Network. The network or flowchart in Figure 4.1-A is a precedence activity network. An "activity" occurs when a significant, discrete event occurs and/or when the responsibility for the project (activity) is transferred from one unit to another. The "precedence" nature of the network implies that an activity cannot occur until all activities preceding that one have been completed. However, the user must be aware that some flexibility is necessary to apply this network to project development.

2. Project Application. The network represents the typical process where the Geotechnical Section would be involved in the project. Not every activity will be applicable to every project; i.e., some activities will represent "zero" time on relatively minor projects or some activities only apply to structures projects and others only to roadway projects. However, the user should find that projects developed according to this process will have fewer management problems.

3. Lines of Communication. The rigid application of the network leads to predetermined, precise points where communication occurs between units. This is neither realistic nor desirable. Communication between units must be continuous, resulting in fewer problems and fewer "surprises" during the project development.

4. Other Manual Chapters. The *MDT Geotechnical Manual* contains several other chapters that provide complementary information to Chapter 4. The user should review these chapters for more information on the project development process. In particular, Chapter 4 should be used in combination with Chapters 2 and 5.

4.1.4 District Geotechnical Manager

4.1.4.1 Responsibilities

The District Geotechnical Manager is responsible for:

- estimating the duration and person-hours to complete their activities during the override process,
- updating the status of activities on the OPX2 bi-weekly to keep project schedules current, and
- notifying the Project Manager of changes that will require additional resources or activities.

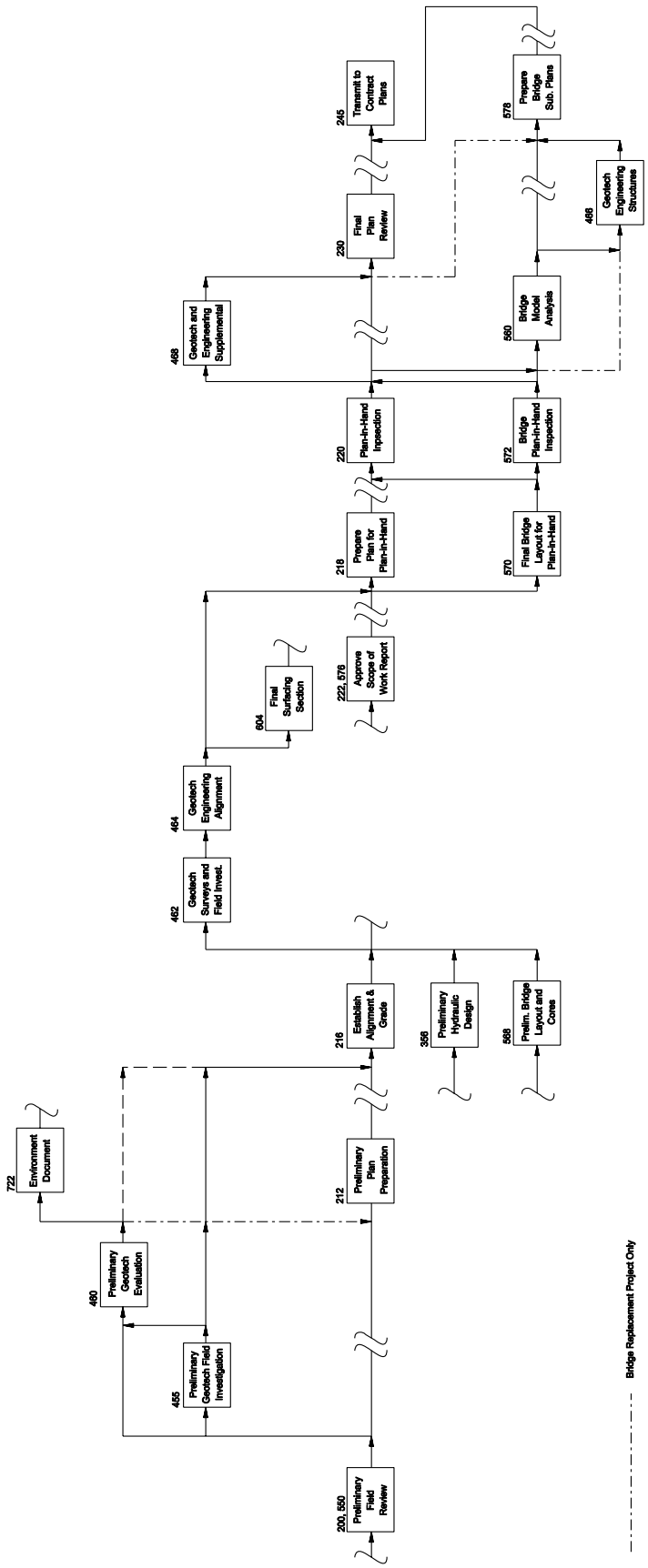

Figure 4.1-A — GEOTECHNICAL PROJECT ACTIVITIES

4.1.4.2 Standard Planning Values

Standard planning values for all activity durations and person-hours have been developed by EISS and are provided in OPX2. These values provide a baseline of an "average project" and are periodically reviewed and updated by EISS. Durations are based on working days not calendar days. Standard person-hour values are determined by averaging actual person-hours spent to complete an activity over several projects. For activities that have highly variable durations, standard planning values will not provide a very accurate estimate.

4.1.4.3 Estimating Duration

To estimate the duration of an activity, consider the project scope, constraints, required person-hours, identified risks, historical data and standard planning value. The project scope indicates the level of complexity of a particular activity. An activity with higher complexity may increase the duration due to increased person-hours for completion, increased coordination efforts or increased decision time. Duration constraints include elapsed time or production rate for the completion of activities. Example duration dependent on elapsed time is the activity "Approve Scope of Work" that requires few person-hours but requires 3 to 4 weeks to provide time for comments and approvals. Example duration activity dependent on production rate is "Activity 462 – Geotechnical Surveys and Field Investigation" that requires many person-hours. Production rates vary depending on how many people will be working on the activity, work that can be done concurrently and other competing priorities. Identified risks may include project delays, competing projects for resources, lower production rates, change in scope or poor estimate of person-hours.

Duration may need to account for both elapsed time and production rates. Standard planning values are typically close for activity durations that are dependent on elapsed time. Standard planning values of durations dependent on production rate should be adjusted based on the man-hour estimate.

Multiply an average production factor of 0.2 times person-hours to determine duration based on production. For example, the duration for 40 person-hours would be equal to 8 working days. The production factor assumes one person working on an activity with allowance for other tasks, vacation, etc.

4.1.4.4 Estimating Person-Hours

To estimate the person-hours to complete an activity, consider the project scope, identified risks, historical data and standard planning value. The project scope indicates the level of complexity of a particular activity (e.g., deep foundation, shallow foundation). Identified risks may include context sensitive issues, resource agencies, railroad involvement, public involvement, environmental impacts and change in scope. A project with high risks may require more development hours. Historical data of actual hours spent on similar projects can be accessed on Oracle. Standard planning values are provided in OPX2. These values provide a baseline of an "average project."

4.2 ROAD AND BRIDGE PROJECT ACTIVITIES

4.2.1 Preliminary Field Review

The purpose of the Preliminary Field Review (PFR) activity is to request, gather and develop information to define the project type, scope and process for the project's development. The Project Manager is responsible for scheduling and conducting the PFR (Activity 200 for Road Design projects and Activity 550 for Bridge projects) and for preparing the Preliminary Field Review Report.

The Project Manager will gather and review background information on the proposed project (e.g., traffic and crash data, preliminary hydraulics, aerial photos, as-built plans). Based on this review, the Project Manager will invite the appropriate individuals to attend the PFR (e.g., District Administrator, Geotechnical District Manager/project geotechnical specialist, Maintenance Chief, Right-of-Way, Hydraulics, Construction). During the field review, the group will consider alternative locations to be studied, project limits, major design features, preliminary determination of the environmental documentation required, extent of field survey or mapping, major geotechnical considerations, public involvement process, etc. Section 8.2.3 provides guidance on issues the Geotechnical District Manager and/or the project geotechnical specialist should consider during the PFR.

After the field review, the Geotechnical District Manager may be asked to prepare the geotechnical portion of the PFR. The Project Manager will prepare the full PFR Report. The PFR Report documents the decisions made during the field review and requests in-house or FHWA approvals on the project scope and general intent. The project geotechnical specialist or Geotechnical District Manager will review and comment on the PFR Report about elements that affect or may affect the geotechnical design (e.g., embankment slopes, rock cuts, earth retaining structures).

Upon approval of the PFR Report, the various design and support units begin work on their respective responsibilities (e.g., District obtains the right-of-entry permission, Hydraulic Section begins the hydraulic study and report, Right-of-Way Bureau reviews the status of the right-of-way). After approval of the PFR Report, the project geotechnical specialist will setup the project file and initiate the preliminary geotechnical field investigation (Activity 455 or Activity 460).

4.2.2 Activity 455 – Preliminary Geotechnical Field Investigation

4.2.2.1 Purpose

The purpose of Activity 455 is to conduct a preliminary field geotechnical exploration and investigation along the proposed road alignment, if required. This activity is typically only conducted to identify the location of major features (e.g., known landslides) that may affect the final roadway alignment or bridge pier locations. The project geotechnical specialist coordinates with the Field Investigation Unit to conduct the necessary subsurface investigations. Chapter 8 provides guidelines on the necessary pre-field activities (e.g., site research, development of the subsurface exploration plan) and fieldwork activities (e.g., drilling requirements, sampling methods).

Upon completion of Activity 455, the project geotechnical specialist will coordinate with the applicable design units to identify features that may affect the final roadway alignment or bridge pier locations

4.2.2.2 Tasks

The tasks involved with Activity 455 typically include:

- conducting field investigations, geologic surveying and mapping, geophysical surveys or other surficial inspections for engineering studies;
- performing subsurface exploration to obtain soil and rock samples, performing in-place test for soils and/or groundwater and installing geotechnical monitoring devices;
- prepare the preliminary boring log using the field results, and
- determining the applicable laboratory testing required for the recovered samples.

4.2.3 Activity 460 – Preliminary Geotechnical Evaluation

4.2.3.1 Purpose

The purpose of Activity 460 is to conduct an office review of applicable published information and a preliminary investigation of the project site. Section 8.2.2 provides guidance on existing data that should be reviewed. Section 8.2.3 provides guidance on issues to consider during the preliminary site review. PFR/460 Field Notes Form, or a different form containing similar information, should be completed as this can be very useful in planning for Activity 462. A copy of this Form is provided at the end of Section 4.2.

Based on these evaluations, the project geotechnical specialist will prepare a design memorandum for the applicable design teams (e.g., Road Design, Bridge, Hydraulics, District, Consultant Design) describing any findings and recommendations that may affect the alignment, right-of-way or other design considerations. If Activity 455 has been completed prior to Activity 460, the design memorandum may include the preliminary boring log and other information obtained during the Preliminary Geotechnical Field Investigation.

4.2.3.2 Tasks

The tasks involved with Activity 460 typically include:

- reviewing existing published information (e.g., as-built plans, near-by projects, USGS maps, soil maps, earthquake data);
- conducting an on-site visit to identify topographic and geological features of the site and becoming knowledgeable of access and working conditions; and

- preparing a design memorandum for the design teams describing the results of the office review and field observations, including any preliminary recommendations.

4.2.4 Activity 462 – Geotechnical Surveys and Field Investigation

4.2.4.1 Purpose

The purpose of Activity 462 is to conduct field investigations, including geologic surveying and mapping, geophysical surveys and subsurface investigations. For large projects, portions of this activity may have occurred during Activity 455. The project geotechnical specialist coordinates with the Field Investigation Unit to conduct the necessary subsurface investigations. Chapter 8 provides guidelines on the necessary activities for conducting these studies.

Upon completion of Activity 462 and only for relatively large or critical projects, the project geotechnical specialist will prepare and submit to the design teams a design memorandum outlining the exploration findings and any potential issues that may affect the project. See Section 5.2.2 for guidance on elements to be included in the design memorandum. For smaller or non-critical projects, this information is included in Activities 464 or 466.

4.2.4.2 Tasks

The tasks involved with Activity 462 typically include:

- conducting field investigations including geologic surveying and mapping, geophysical surveys or other surficial inspections for engineering studies;
- conducting the subsurface investigation;
- performing in-situ tests;
- installing geotechnical monitoring instrumentation;
- installing horizontal or vertical drains and wells;
- preparing preliminary boring log;
- determining laboratory testing assignments for the recovered samples; and
- preparing a design memorandum outlining the exploration findings and any preliminary recommendations, see Section 5.2.2.

4.2.5 Activity 464 – Geotechnical Engineering – Alignment

4.2.5.1 Purpose

The project geotechnical specialist will conduct geotechnical engineering analyses (Activity 464) based on the findings of the field investigations (Chapter 8), laboratory tests (Chapter 9) and the analysis of the soil and rock engineering properties (Chapter 10) as related to the intended

project scope of work. Part III of this *Manual* discusses the various engineering studies and analyses that may occur for the alignment design.

Upon completion of Activity 464, the project geotechnical specialist will prepare and submit to the design teams a detailed Geotechnical Report outlining the findings of the field and laboratory investigation, results from the geotechnical engineering analyses, designs for geotechnical features and recommendations for potential issues that may affect the project alignment or construction. Section 5.3 provides additional guidance on the content of the Geotechnical Report.

4.2.5.2 Tasks

The tasks involved with Activity 464 typically include:

- reviewing the field investigations, laboratory tests and the rock and soil engineering properties;
- conducting various engineering analyses and designs based on the investigation findings and proposed project design; and
- preparing the Geotechnical Report, see Section 5.3.

4.2.6 Activity 466 – Geotechnical Engineering – Structures

4.2.6.1 Purpose

The project geotechnical specialist will conduct geotechnical engineering analyses for structures (Activity 466) based on the findings of the field investigations (Chapter 8), laboratory tests (Chapter 9), the analysis of the soil and rock engineering properties (Chapter 10), bridge layout plans and results from the Bridge Design's bridge model analysis. Part III of this *Manual* discusses the various engineering studies and analyses that may occur for structures.

Upon completion of Activity 466, the project geotechnical specialist will prepare and submit to the design teams a detailed Geotechnical Report outlining the findings of the field and laboratory investigation, results from the geotechnical engineering analyses, designs for geotechnical features and recommendations for potential issues that may affect the structural design. Section 5.3 provides additional guidance on the content of the Geotechnical Report.

4.2.6.2 Tasks

The tasks involved with Activity 466 typically include:

- reviewing field investigations, laboratory tests and the rock and soil engineering properties;
- reviewing information provided by the Bridge Bureau;

- conducting various engineering analyses and designs based on the investigation findings and proposed project design; and
- preparing the Geotechnical Report, see Section 5.3.

4.2.7 Activity 468 – Geotechnical Engineering – Supplemental

4.2.7.1 Purpose

If there are changes to the design since the preparation of the Geotechnical Report (Activities 464 and/or 466), a Supplemental Geotechnical Report may be required detailing revised geotechnical analyses, calculations and designs.

Upon completion of Activity 468, the project geotechnical specialist will prepare and submit to the design teams, a supplement to the Geotechnical Report outlining the results of the additional analyses and engineering designs. Section 5.3 provides further guidance on the content of the supplement Geotechnical Report.

4.2.7.2 Tasks

The tasks involved with Activity 468 typically include:

- reviewing the final plans, cross sections and special provisions;
- as necessary, conducting additional geotechnical engineering analyses; and
- preparing a design memorandum that includes comments on the final plans, recommendations, special design and/or special provisions.

4.2.8 Construction Consultation

During project construction, the Geotechnical Section typically assists Construction personnel by conducting wave equation analysis for pile hammer approval, inspecting drilled shafts and shallow foundations, and installing and/or monitoring instrumentations. Also, as necessary, the project geotechnical specialist will assist Construction personnel if geotechnical issues (e.g., pile driving problems, drilled shaft installation problems, slope failures, soft ground conditions) arise during construction.

PFR/460 Field Notes

Project Number:		Date:		
Project Name:		Road?		
Control Number:		Bridge(s)?		
Geotech:		Bridge Posted?		
Project Scope/Intent		Posted Limit:		
		Alternative Route to opposite side?		
Prominent Geologic Features:				
		Adjacent Land Ownership		
		Public		Private
Surrounding Terrain/Topography:				
		R.O.E?		
		Yes		No
Primary Adjacent Land Use:				
Surficial Soils/Apparent Soil Types:				
Existing Conditions:				
Groundwater/Surface Water:				
Environmental Considerations:				

Major Cut/Excavation Areas:

Major Fill/Embankment Areas:

Design Options/Major Considerations:

Potential Drill Rig Needed

CME 1050 CME 850 CS 2000 Barge Horiz. Tripod

Drill Access Issues?

Other subsurface investigation methods anticipated

Roctest Vane Geonor Vane Other: _____

Nearest Crossroad/Street Intersection(s)

Distance to Nearest Crossroad/Intersection(s)

Nearby Drill Offloading/Parking?

Alternative Route Description (if required):

Is water readily available for coring/casing advancer?

Nearest Water Source(s):

Traffic Control Required?

Project Location Sketch	North Arrow

General Pavement/Subgrade Conditions

Roadway Drainage Issues

Culvert Conditions

Misc. Notes:

4.3 CONSULTANT-DESIGNED PROJECTS

For consultant-designed projects, the project geotechnical specialist will be responsible for reviewing the consultant's work to ensure it is complete. However, the project geotechnical specialist is not responsible for conducting a detailed analysis of the consultant's work to ensure it is correct. The project geotechnical specialist is involved with consultant-designed projects on the following activities:

1. Activity 106 – Preliminary Geotechnical and Materials. For this consultant activity, the project geotechnical specialist is responsible for providing the consultant with any known geotechnical information relative to the project (e.g., nearby landslides, boring logs from adjacent projects). The consultant will use this information to begin the preliminary field geotechnical investigations.

2. Activity 440 – Preliminary Geotechnical and Material Review. After the preliminary field geotechnical investigations have been completed, the consultant will prepare the Preliminary Geotechnical and Materials Report and submit the Report to the Department for review. Section 5.2.3 provides guidance on what should be included in the consultant's preliminary Report. The project geotechnical specialist is responsible for reviewing the consultant's Report to ensure all the applicable investigations, tests and reports have been completed.

3. Activity 442 – Geotechnical and Materials Report Review. As part of the consultant Activity 130, the consultant will prepare the Final Geotechnical and Materials Report. Section 5.3.6 provides guidance on what information should be included in the Report. The project geotechnical specialist is responsible for reviewing the consultant's Report to ensure all the applicable investigations, tests and reports have been completed.

4. Activity 444 – Final Geotechnical and Materials Review. If there are changes to the design since the preparation of the Final Geotechnical and Materials Report discussed in Item #3, the consultant will be required to submit a Report detailing revised geotechnical analyses, calculations and designs. The project geotechnical specialist will review the consultant's report to ensure it is complete.

4.4 ENVIRONMENTAL ACTIVITIES

Where wetlands mitigations on a project are required or where a new wetland development is proposed, the Environmental Services Bureau may request the Geotechnical Section to assist in the investigation of soils and wetland designs. The design activities generally follow those for a typical project discussed in Section 4.2; however, they are only conducted at the request of the Environmental Services Bureau. The following project activities are used for geotechnical investigations for wetland mitigations:

- Activity 480 – Preliminary Geotechnical Evaluation – Wetland,
- Activity 482 – Geotechnical Field Investigation – Wetland,
- Activity 484 – Geotechnical Engineering – Wetland, and
- Activity 488 – Supplemental Geotechnical Engineering – Wetland.

Review the OPX2 activity descriptions for guidance on purpose and tasks involved for these activities.