Chapter 420 Earth (Geology and Soils)

420.01 Introduction

Geology and soils discussions are primarily focused on hazards to the highway or hazards that the highway may pose on existing hazards. However off-highway activities such as development of borrow pits or mitigation sites also need to be evaluated.

Geologic hazards include seismic activity: ground shaking, surface rupture, liquefaction and differential settlement that must all be considered in the design of highway structures. Other geologic hazards include shallow and deep landslides. Soil related hazards my include high shrink-swell soils and saline soils that require consideration when designing highway structures.

Highway projects may cause or reactivate landslides by removing materials that support the slope or removing the vegetation and changing the local runoff patterns so that slopes vulnerable to landslides receive additional water.

Highway development may cover over mineral resources or important farmlands, irreversibly committing the resources to the highway system.

Finally, off-highway development is sometimes needed to create borrow pits, mitigation sites, and construction sites. Geologic hazards and resources effects need to be evaluated at these locations as well as within the highway corridor.

Although soil erosion is a concern, protecting soils and stabilizing them to prevent erosion is a covered in the surface water chapter of this manual (Chapter 430) and the design of temporary and permanent erosion control and stormwater facilities are covered in the *Hydraulics Manual* M 23-03 and the *Highway Runoff Manual* M 31-16.

420.02 Applicable statutes, regulations, executive orders, & agreements

- 42 United States Code (USC) Chapter 55. National Environmental Policy Act of 1969 (NEPA)
- 23 CFR 771 Environmental Impact and Related Procedures
- 40 CFR 1500-1508 National Environmental Policy Act Implementing regulations
- 7 CFR 658 Farmland Protection Act
- 30 CFR 700 Surface Mining Reclamation and Enforcement
- USDOT Policy statement on climate change adaption. (2011)

- USDOT Climate Adaption Plan - Ensuring Transportation Infrastructure and System Resilience (2014)
- FHWA Order 5520. Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events (2014)
- Executive Order 12898 - Environmental Justice

420.02(1) State

- RCW 47.01.260 Authority of WSDOT on state highway system design
- WAC 197-11 SEPA Rules
- WAC 468-12 Transportation Commission and Transportation Department State Environmental Policy Rules
- Governor's Directive on Acquisitions of Agricultural Resource Land

420.02(2) Local

- Grading Permit – Specifics vary for each jurisdiction

420.03 Considerations during project development

420.03(1) Planning

During the planning phase it would be expected that the Regions use geologic and soil mapping to identify areas of potential geologic hazards and prime and important farmlands, as well as soil indicators such as soil chemistry, depth to groundwater, etc. that may influence the engineering design of the project. Hydric soils may serve as gross level mapping of wetlands if other wetland mapping is not available. It would be expected that the Region would use the information to develop alternatives that minimized impacts to resources as well as limited threats to the highway from geologic hazards to the greatest extent possible.

The Region would also be expected to identify possible local permits that may be required.

420.03(2) Scoping

During scoping it would be expected that the Regions would use the information developed in planning to develop a project concept that considered the constraints put forward and identify additional specialized studies or permitting that were needed to move to design.

420.03(3) Design

It would be expected that the Region would use the preliminary and specialized studies to develop a design using the guidance provided in the *Geotechnical Design Manual* M 46-03 and other applicable design manuals to develop a project that that that is resilient through its design life. It would be expected that the Region develop information: drawings quantities and other information needed for local permitting efforts.

Construction

During construction best management practices are implemented to prevent and minimize erosion of soil to protect water resources. Certified inspectors check the BMPs regularly and after precipitation events. These are practices are described in greater detail in Chapter 430 as well as the *Highway Runoff Manual* M 31-16.

Maintenance and Operations

Maintenance and operations requirements for geology and soil are generally limited to the safety of the public and WSDOT structures. For example, a seismic event would trigger the need for bridge inspections, the depending on the severity of the event, the highway may need to be closed until it is inspected and deemed to be safe. Similarly, landslides may force a highway closure until the site can be inspected and determined to be safe before debris can be removed and the highway reopened.

420.04 Analysis & documentation requirements

This section describes analysis and documentation requirements based on regulatory requirements. Determine level of detail based on complexity/size of project, expected severity of impacts, and potential for public controversy.

420.04(1) Analysis & documentation for NEPA

The National Environmental Policy Act (NEPA) requires that all actions sponsored, funded, permitted, or approved by federal agencies undergo planning to ensure that environmental considerations are given due weight in project decision making.

At a minimum the general topographic and geologic setting, significant features and landforms, soil types and their properties, and known geologic hazards within the project area should be identified. Geologic hazards include such things as highly erodible soils, landslides, debris flows, seismic hazards (e.g., faults and areas subject to liquefaction), volcanic hazards, subsidence, rockfall and other critical/sensitive areas.

The analysis evaluates the potential for direct construction and operations impacts on identified geologic and soil conditions for all project alternatives, including the “no-build” option. Potential impacts to mineral resources and prime farmlands should also be evaluated.

The analysis should also describe the potential for identified geologic hazards to impact project alternatives. Mitigation measures, commitments, and monitoring procedures associated with geologic hazards should be described. If no geologic hazards or potential impacts are anticipated, the conclusion should be stated in the environmental documents.

The results of the analysis should be written directly into the project’s environmental document (EIS, EA or CE) with supporting information included in the appendices if needed. In rare cases when warranted by the nature of the project, the analysis can be documented in a separate discipline report, which supplements the environmental document.

420.04(2) Analysis & documentation for SEPA only (No federal nexus)

The SEPA requirements are the same as the federal requirements.

420.04(3) Analysis & documentation for local permits

Off highway actions may be subject local critical area ordinance or grading permits. Specific local permit requirements vary throughout the state. Additional permitting information can be found in Chapter 500.

420.05 External engagement

Geology and soils impact analyses do not require a specialized external engagement process beyond the standard NEPA/SEPA scoping, public noticing, accepting agency and public comments, and responding to comments appropriate to the level of the environmental review process.

420.06 Internal roles and responsibilities

420.06(1) Region/Modal Environmental Manager

The Region/Modal environmental manager's role is to oversee the general preparation of environmental review documents, providing expert guidance to Region staff to as to the type of analysis needed and identifying need for specialized analysis. The manager provides quality assurance and quality control. The manager is responsible for disseminating new or updated guidance and verifying that the guidance is being followed. The manger is also responsible for reporting to ESO when guidance is not adequate, confusing, or in need of revision.

420.06(2) Project Engineer

It is the project engineer's role and responsibility to oversee that all engineering studies and technical reports are prepared consistent with *Geotechnical Design Manual* M 46-03 and provide appropriate levels of analysis to support the environmental review process and permitting activities to the environmental staff.

420.06(3) Region Environmental Coordinator

The region environmental coordinator role is to oversee the development of the environmental review documents. The coordinator is responsible to for exchange of information between the project engineer and the environmental review specialists on the team and to ensure that any environmental requirements are incorporated into the project design as well as engineering information needed for permits and other agency approvals is provided.

420.06(4) ESO

ESO role is primarily to keep the guidance current with evolving and changing rules and regulations. ESO staff also provide expert assistance for developing scopes of work for consultants and internal WSDOT staff as well as reviewing environmental documents.

420.07 Applicable permits & approval process

Generally, there are no local permits or approvals needed to address geologic and soil resources. Highway projects are exempt from local agency critical areas ordinances and grading permits.

However off-highway projects may need to local agency and/or Tribal approvals. For example, when WSDOT replaced the SR520 floating bridge, the site that was used to build the pontoons was subject to local permitting. Similarly, if WSDOT developed a borrow pit to provide fill, that borrow pit would likely be subject to local critical areas ordinances and require grading permits.

For more information on the permitting process, see Chapter 500.

420.08 Mitigation

Impacts to geologic and soil resources are usually minimized to the extent practicable by adjusting the project alignment to avoid these resources. Mitigation of any residual impacts is usually in the form of financial compensation to the owner of the property for loss of future income. For example, a highway project may bisect a farmer's land, leaving a portion of his land inaccessible to his equipment. If the farmland could not be avoided by a realignment, the mitigation would likely to purchase the land and/or provide compensation for lost revenue. In more extreme cases segregating a farmer's land may make the whole operation not feasible from a financial perspective and the entire site may need to be purchased.

Geologic hazards are usually avoided to the extent practicable by adjusting the alignment, but many hazards such as ground shaking are regional and not avoidable. The *Geotechnical Design Manual* M 46-03 provides specific guidance on engineering solutions to address geologic hazards.

420.09 Abbreviations and acronyms

420.10 Glossary

Hydric soil – a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Prime and important farmland – includes all land that is defined as prime, unique, or farmlands of statewide or local importance.

Saline soils – Soils with high concentrations of salts in the soil profile

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