4.13 GEOLOGY AND SOILS

4.13.1 INTRODUCTION

This chapter presents an overview of the physical environment found within the study area of the South Coast Rail alternatives, focusing on physical geography, bedrock and surficial geology, and soils. The chapter evaluates potential impacts of the proposed alternatives to geology and soils, including long-term changes to geologic structures or faults, to bedrock, soils, or geologic stability, to seismicity, or to the rock and soil units surrounding excavations.

4.13.2 EXISTING CONDITIONS

4.13.2.1 GEOLOGY

The South Coast Rail alternatives are situated within the Seaboard Lowland physiographic province of southern New England. The present topography of this region is the result of preglacial, glacial, and postglacial erosion and deposition. During the Wisconsin Period, approximately 17,500 years ago, the advance and retreat of the continental ice mass eroded and picked up bedrock, realigned drainages, and deposited till, erratics, and other glacial material along its course. The slow retreat of the ice sheet, estimated to have been about 2 miles thick at its maximum stage in this region, depressed, shaped, and scoured the landscape, leaving widespread glacial deposits. This resulted in a moderately thick veneer of ice-deposited glacial till, a heterogeneous mix of clay, silt, sand, gravel, and boulders through which bedrock occasionally outcrops. The melting of the Wisconsin ice sheet redeposited meltwater and carried stratified drift throughout the river valleys and lowland areas, which resulted in a variety of small-scale landforms.

Flat-topped terraces of sand and gravel, known as kame terraces, were formed along valley walls by meltwater streams. Sinuous, low ridges of sand and gravel, known as eskers, were deposited by streams running through channels in the ice mass. Stratified deposits of glacial outwash formed broad areas called outwash plains. These plains are typically flat topped, well drained, relatively free of boulders, close to water, and clustered in riverine valley settings. Masses of stagnant ice that had become detached from the glacier were surrounded or partly covered by sand and gravel outwash from the melting glacier. When the detached mass of ice melted, the drift settled and left crater-like pits or kettle holes (MHC 1982b).

The northern portion of the rail alternatives is situated near the Fowl Meadow section of the Neponset River drainage, which is underlain by sedimentary and igneous rocks belonging to several formations. The primary bedrock units near the project are the Pondville conglomerate and the Wamsutta formation. The Pondville conglomerate consists of cobble and boulder conglomerate and some gray coarse sandstone. The Wamsutta formation is mostly a fine-grained red sandstone with interbedded shale and some gray pebble conglomerate. These sedimentary formations extend in a broad band about 2 miles wide, oriented roughly east/west across the Fowl Meadow area.

The primary bedrock unit of igneous rocks to the north and west of the Fowl Meadow area is the Dedham Granodiorite, a medium- to coarse-grained, light pinkish gray granite rock. Within this formation are small intrusions of the Mattapan Volcanic Complex, which consists of felsite flow, pyroclastic rocks (gray/pink felsite) and small dikes of felsite. To the north of the project area in Canton are the Blue Hills outcrops of volcanic (rhyolite) and contact metamorphic rocks (hornfels) that represent a lithic source area of regional significance in the prehistory of southern New England.

The Whittenton Branch (Whittenton Alternative) is situated in the Narragansett Basin, a structural basin extending from the headwaters of the Taunton River near the Norfolk and Bristol County line south to Narragansett Bay. The Narragansett basin is composed of a sedimentary rock base overlain by glacial deposits. It is one of five Pennsylvania-age basins in eastern Massachusetts, all of which are characterized by generally low-grade metamorphism and by graywacke suites with arkose, plutonic pebbles in the coarser sedimentary rocks, and few orthoquartzites. Volcanic rocks are virtually lacking in this basin with the exception of the Wamsutta Formation. The bedrock geology of the project area is characterized by a substratum of the basin known as the Rhode Island Formation. This formation consists of shale and slate coal-bearing beds intercalated with sandstone and conglomerates (Emerson 1917; Hartshorn 1960, 1976; Zen et al. 1983).

During the Wisconsin Period, the final glacial episode, the glacier stagnated during its retreat and deposited outwash sands and gravels over the till deposit. Large glacial lakes formed as ice dams trapped glacial meltwaters. The glaciolacustrine and glaciofluvial (types of sediments indicating glacial lakes) deposits formed kame deltas, varved (laminated) clay deposits, and kame terraces, consisting of medium to coarse sand. Glacial Lake Taunton, which covered most of the Taunton River drainage basin (Hartshorn 1967:39) also formed. Upon drainage of this lake, large quantities of sediment were transported across the area's low-lying sections and wind redeposited fine sediments to eventually cover topographic features. This wind-blown mantle is as deep as 180 cm in some locations (Hartshorn 1967). Glacially deposited materials within the project area consist of sediments deposited by glacial outwash, with nearly level (0 to 3 percent) and gently sloping (3 to 8 percent) surfaces.

4.13.2.2 SOILS

Soil is produced "through the action of climate, plant and animal life, and man on parent material in different topographic locations over time" (USDA 1989:111). Parent material determines the mineralogical composition and contributes largely to the physical and chemical characteristics of the soil. Glacial ice picked up and ground bedrock, which it then transported and deposited as a jumbled mixture of fresh unweathered rock particles of varying sizes. These sediments were separated and sorted by glacial meltwater and strong winds that distributed fine particles. Vegetation became established, chemical processes of weathering increased, and rock sediments developed into soils. Differences in regional soils are primarily attributed to the interaction of the five factors of soil formation: the parent material, climate, living organisms, relief, and time. The soils in the region have developed over a relatively short span of time, in the approximately 15,000 years since the final retreat of the glaciers. A detailed description of soils and their characteristics is provided in Chapter 4.11 – *Farmland soils*

Attleboro Alternative

Soils within and along the Northeast Corridor portion of the Attleboro Alternative consist primarily of various well-drained sandy soils formed in glacial outwash plains and till, having less than 35 percent slopes. The majority of the terrain along the corridor is relatively level with slopes ranging mostly between 0 and 15 percent. There are also a number of low-lying areas of wetlands and stream drainages as well as areas of Udorthents and Urban Land through developed portions of the railroad corridor (United States Department of Agriculture [USDA] 1978, 1989). The locations of mapped Udorthents and Urban Land soils are primarily all of the Readville section of Boston to the Dedham line, in Dedham south of I-95, near Canton Junction in Canton, in Sharon just north of Sawmill Pond and northeast of Sharon Heights, and in Mansfield Center.

Soils along the proposed Attleboro Bypass (Attleboro Alternative) consist primarily of Woodbridge, Whitman, Paxton and Hinckley series soils, as well as small areas of Ridgebury and Deerfield and of Swansea and Freetown mucks (USDA 1978). The Woodbridge series consists of deep, moderately well-drained soils on uplands and the Whitman series consists of deep, very poorly drained soils on uplands. These soils consist of fine sandy loam and formed in glacial till derived mainly from granite and gneiss. The Paxton series consists of very deep, well-drained soils on drumlins that formed in friable glacial till over a firm substratum. The Hinckley series consists of excessively drained soils that formed in thick deposits of sand and gravel derived principally from granite and gneiss.

The Ridgebury series consists of very deep, poorly drained soils on uplands that formed in friable glacial till over a firm substratum. The Deerfield series consists of very deep, moderately well drained soils on deltas, kame terraces, and outwash plains. These soils formed in water-deposited sands (USDA 1978).

Swansea Muck and Freetown Muck soils are level, deep, and very poorly drained and found in depressional areas on uplands and outwash plains. The soils formed in highly decomposed organic material underlain by sandy or gravelly mineral material (USDA 1978).

Stoughton Alternative

The Stoughton Line (Stoughton Alternative) rail right-of-way and related stations are situated in a wide range of soil classifications, most of which were formed on glacial outwash plains. Major soil types classified along the right-of-way include Windsor, Hinckley, and Agawam series along with Udorthents and Mucks. The range of soil types is variable within specific microenvironments along the project corridor.

Windsor series consists of excessively drained loamy sands on outwash plains. These soils formed in medium and fine sand. Most areas are wooded with white pine and oak. Hinckley series soils formed in thick deposits of water-sorted sand and gravel and occur mainly on terrace escarpments, eskers and kames. Subsoils in this series contain sand, gravel, and cobblestones. These soils are gravelly and low in moisture-holding capacity and are low in organic-matter content. Slope and droughtiness severely limit the use of this soil type for crops or pasture.

Agawam series consists of well-drained, nearly level or gently sloping soils that formed in thick deposits of water-sorted sandy material. These soils are nearly free of gravel to a depth of 1 meter. They occupy plains and terraces along the Taunton River and its tributaries (USDA 1981). The Udorthents consist of areas of mineral soils that have been drastically altered by grading and cut-and-fill operations in construction of highways, schools, shopping centers and industrial parks (USDA 1981).

Muck consists of very poorly drained soils that formed in an accumulation of organic material decomposed to the extent that the original plant material cannot be readily identified. These soils occupy low areas or depressions that receive surface runoff from nearby higher lying areas. The water table is at or near the surface throughout much of the year (USDA 1981).

Whittenton Alternative

The Whittenton Branch (Whittenton Alternative) right-of-way and related station are situated in a wide range of soil classifications. Major soil types classified along the right-of-way include Hinckley, Scarboro, Windsor, and Urban Land series with smaller amounts of Deerfield, Wareham, Pits-Udorthents, and Freetown Muck (USDA 1981). The Hinckley and Windsor series are described above. The Scarboro series consists of deep, very poorly drained soils on glacial outwash plains. The soils formed in glacial outwash material derived mainly from granite and gneiss. Urban land consists of areas covered by structures including industrial areas, shopping centers, parking lots and roads.

The Deerfield series consists of deep, moderately well-drained soils on the lower parts of glacial outwash plains. The soils are loamy sand near or adjacent to streams and rivers and formed in glacial outwash derived mainly from granite, gneiss, and quartzite. The Wareham series consists of deep, poorly drained and somewhat poorly drained soils on outwash plains, deltas, and stream terraces. The soils are loamy sand primarily found in depressions and formed in sandy glacial outwash (USDA 1981).

The Pits-Udorthents consists of areas that have been excavated for sand and gravel. Depth of excavations ranges from about 5 to 25 feet, and some extend into the water table. Included in this unit are pits that consist of loamy material or that have been used as disposal areas for a wide variety of material. Some areas, especially steep banks, have little or no vegetation while some areas are covered with native species such as bayberry, sweet fern, pitch pine, and gray birch. Freetwon Muck consists of nearly level, deep, very poorly drained soils on uplands and outwash plains. The soils formed in thick deposits of organic material and are located in depressions (USDA 1981).

Peat consists of very poorly drained soils that formed in an accumulation of partly decomposed organic material where the plant remains can be readily identified. The Gloucester and Norwell series formed in glacial till derived mainly from granite and gneiss. Gloucester soils are somewhat excessively drained and are very stony loamy sand with surface stones 1 to 3 ft in diameter. Norwell soils are poorly drained extremely stony sandy loam and occupy small, low areas on gently rolling ground moraines.

4.13.3 ANALYSIS OF IMPACTS

4.13.3.1 NO-BUILD (ENHANCED BUS) ALTERNATIVE

The No-Build Alternative (Enhanced Bus) would consist of enhancing current bus service along existing roads and highways. Construction activities would be limited to the modification of three existing Park and Ride facilities, requiring limited clearing and excavate ion No long-term changes would be expected to geologic structures or faults, to bedrock, soils, or geologic stability, to seismicity, or to the rock and soil units surrounding excavations.

Maintenance and development activities within the South Coast Rail project area would be expected to continue, and would create changes in the built environment, but would not adversely impact soils and geologic conditions. Normal geologic processes, such as erosion and sedimentation, would also continue. No specific impacts with respect to soils or geology would be anticipated under the No-Build Alternative.

4.13.3.2 BUILD ALTERNATIVES

As described in detail in Chapter 3 – *Alternatives*, the South Coast Rail Build Alternatives will involve subsurface disturbance as a result of the following construction activities:

- Minor repairs or rehabilitation of existing track in active use;
- Constructing an additional track on an existing active track segment;
- Restoring track and train traffic on out-of-service or abandoned rights-of-way;
- Constructing commuter rail or bus stations;
- Constructing overhead catenary to allow electrified train service;
- Constructing traction power stations;
- Adding new lanes in existing highway rights-of-way;
- Adding new lanes/interchange in existing highway outside of rights-of-way;
- Construction of layover and maintenance facilities;
- Creation of construction staging and laydown areas and construction access roads

Soil and rock affected by the Build Alternatives would be excavated and disturbed during construction. Once a Build Alternative is operational, no further potential long-term impacts to the underlying bedrock geology or soils would be anticipated due to the elements of the Build Alternatives, identified above, including track improvements or construction of new structures such as the trestle in the Hockomock ACEC.

None of the Build Alternatives would require tunneling or other deep excavation that would significantly affect geological conditions. Most disturbance activities would encompass a relatively small area within or adjacent to previously disturbed areas and infrastructure. These include active rail and abandoned rail beds (Stoughton line and Whittenton Branch) that have previously been established to be compatible with subsurface conditions. No long-term changes would be expected as a result of the Build Alternatives to geologic structures or faults, to bedrock, soils, or geologic stability, to seismicity, or to the rock and soil units surrounding excavations.

No long-term adverse impacts to soils and geology would occur with the Build Alternatives; therefore, no mitigation will be required.