

3.2 SOILS AND SEDIMENTS

3.2.1 Affected Environment

Soil types are highly variable along the length of the proposed Keystone Project. Most of the soils along the proposed route have developed in glacial and alluvial deposits. Soil textures vary widely depending on location and parent material. Some soils have been heavily modified by agriculture. In determining the environmental impact of the proposed Keystone Project, the main concerns with respect to soils are the extent to which a given soil has any of the following characteristics:

- Highly erodible soils—these soils are prone to high rates of erosion when exposed to wind or water by removal of vegetation.
- Prime farmland soils—these soils have combinations of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if they are treated and managed according to acceptable farming methods. (<http://soils.usda.gov/technical/handbook/contents/part622.html>.)
- Hydric soils—these soils “formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.” (Federal Register, July 13, 1994.)
- Compaction-prone soils—these soils have clay loam or finer textures in somewhat poor, poor, and very poor drainage classes.
- Stony/rocky soils—these soils have (1) a cobbly, stony, bouldery, gravelly, or shaly modifier to the textural class; or (2) >5 percent (weight basis) of stones larger than 3 inches in the surface layer.
- Shallow-bedrock soils—these soils typically are defined as soils that have bedrock within 60 inches of the soil surface. For the purpose of the proposed Keystone Project, however, shallow-bedrock soils are defined as those with bedrock within 80 inches of the surface, because trenching typically would be done to that depth.
- Drought-prone soils—these soils include coarse-textured soils (sandy loams and coarser) that are moderately well to excessively drained.

Keystone provided information regarding the soil types occurring in the Keystone Project area that was derived from NRCS STATSGO and SSURGO databases (available online at <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>). The soil characteristics of concern are erosion potential (wind and water), designation as prime farmland, compaction potential, percentage of stones/rocks, droughty soil, hydric soil, and potential for shallow bedrock. Because the proposed Keystone Project would not cross any drought-prone soils, this soil constraint is not a concern and is not discussed further.

Table 3.2.1-1 is a summary of approximate pipeline miles by state that would cross soils with the above properties. More detail is provided in Appendix F, a table provided by Keystone that lists soil associations from the STATSGO database by milepost along the proposed route—along with the proportion of each map unit that has specific soil limitations.

**TABLE 3.2.1-1
Approximate Miles of Sensitive Soils Crossed by the Keystone Project**

State	Total Miles Affected^a	Highly Erodible	Prime Farmland	Hydric	Compaction-Prone	Stony/Rocky	Shallow Bedrock
North Dakota	218	19	115	28	14	3	30
South Dakota	220	12	100	27	28	12	NA
Nebraska	215	44	135	9	11	1	4
Kansas	99	24	46	2	9	>1	30
Missouri	274	49	146	52	140	17	80
Illinois	57	5	41	16	35	>1	>1
<i>Mainline Project subtotal</i>	1,082	153	583	134	237	33	144
Nebraska	3	1	1	0	0	0	0
Kansas	210	13	157	1	11	10	140
Oklahoma	83	4	53	>1	>1	8	47
<i>Cushing Extension subtotal</i>	296	18	211	>2	11	18	187
Keystone Project total	1,378	171	794	135	248	51	331

Sources: ENSR 2006a, TransCanada 2007d updated total miles; rounded to nearest whole mile

NA – Not available

^aTotal miles affected include non-sensitive soils and other substrate.

3.2.1.1 North Dakota

Along the proposed pipeline route in North Dakota, most soils have thick, dark topsoil and mixed mineralogy. They range from well drained undulating soils on upland plains, to very poorly drained soils in “prairie potholes” and along streams. Sodic soils are present in places on glacial lake plains. Soil fertility is naturally high, and prime farmland soils are extensive—occupying approximately half of the proposed ROW. The average freeze-free period ranges from 100 to 120 days at the U.S.-Canada border to 120 to 140 days in the southern portion of the state.

3.2.1.2 South Dakota

In the northern portions of South Dakota, the soils are similar to those of North Dakota but experience warmer mean annual temperatures. In the southern portion of the state, upland soils are formed from both loess and medium-textured glacial till. Most of the soils are deep, silty or loamy, with thick, organically enriched topsoil layers. Poorly drained upland depressions contain wet, dark soils. In the Missouri River region, stream valley floors and bottomlands contain poorly-drained soils with thick, dark topsoil, interspersed with the well drained to poorly drained highly stratified soils formed in mixed sediments. Approximately 45 percent of the proposed route within South Dakota consists of prime farmland soils. The average freeze-free period is between 135 and 165 days.

3.2.1.3 Nebraska

From the border with South Dakota into central Nebraska, soil characteristics along the proposed pipeline are similar to those described for southern South Dakota. From Butler County to northeastern Kansas, most of the soils are deep, silty, and loamy—with relatively thick, dark, fertile topsoil. These soils formed in thick loess deposits that lie over glacial deposits buried tens of feet deep. Highly erodible soils are present on slopes in the dissected topography of southern Nebraska. Prime farmland soils occupy approximately 63 percent of the proposed route in Nebraska. The average freeze-free period is between 160 and 180 days.

3.2.1.4 Kansas

In southern Nebraska and northeastern Kansas, shallow soils form where sedimentary bedrock outcrops along valley side slopes and ridge crests. Elsewhere along the western part of the proposed route in Kansas, deep soils with fertile topsoil and loamy or clayey subsoil occur on the silty uplands. East of central Marshall County, the soil moisture regime becomes wetter; loess-mantled ridge tops and side slopes have deep, silty soils with fertile, dark topsoil. Soils in flatter landscape positions have more clayey subsoil. All of these soils have thick topsoil layers. Soils with internal drainage limitations occur in bottomlands. About 46 percent of the proposed route in Kansas consists of prime farmland soils. The average freeze-free period is from 160 to 190 days.

Along the proposed Cushing Extension route in Kansas, shallow soils are found in places where sandstones and limestones are exposed along valley side slopes and ridge crests. Deep soils with fertile topsoils and loamy or clayey subsoils are found in upland areas where loess mantles the bedrock. Deep stratified soils with fertile topsoils are found along smaller streams, while deep loamy, silty, or clayey soils with fertile enriched topsoils that may be wet near the surface during parts of the year are found along major streams. In some locations, the topsoil may be as thick as 20 inches or more. The average freeze-free period is from 170 to 190 days.

3.2.1.5 Missouri

Deep, highly erodible soils formed in thick loess and alluvial deposits are found near the Missouri River in both Kansas and Missouri. Loess deposits thin as the route progresses eastward into Missouri; in places, the route crosses soils formed in clay-rich glacial till. Erosion hazard remains high for several miles into the uplands on either side of the Missouri River floodplain. Poorly drained and very poorly drained soils occur in the Missouri River bottomlands and along tributary drainages. Deep, well drained and moderately well drained soils occur on Missouri uplands, but so do soils with claypan layers; and some soils lack the highly fertile, dark topsoil found further north. In addition, poor soil drainage is common along much of the proposed route in central and eastern Missouri, and shrink-swell potential may be severe in upland areas. About 54 percent of the proposed route in Missouri crosses soils classified as prime farmland. The average freeze-free period ranges from 180 to 190 days.

3.2.1.6 Illinois

Soil characteristics vary widely along the proposed route in Illinois. From the Mississippi River eastward to its terminus in Patoka, the proposed route crosses wide river bottomlands with poorly drained, very deep, and fertile alluvial soils and bordering hillslopes—where shallow to moderately deep limestone-derived soils occur along the edge of the river valley. Upland soils are derived from glacial till and other parent materials; depths range from shallow to deep and textures from sandy to clayey. Most of the upland soils near the Mississippi River are medium textured, well drained or moderately well drained, and lack highly fertile dark topsoil layers. Inland toward Patoka, soils are generally deep and soil wetness is a major land use problem. About 93 percent of the proposed route within Illinois consists of prime farmland. The average freeze-free period ranges from about 180 to 200 days.

3.2.1.7 Oklahoma

Along the Cushing Extension route in Oklahoma, deep soils with dark topsoil layers above subsoil clay accumulations are found in gently sloping upland areas. Shallow to deep well drained soils occur on steeper slopes. Soil erosion potential can be high on these steeper slopes. In small drainages and river valleys, deep, clayey, or loamy soils are found. In these areas, the topsoil can be over 20 inches in depth, and some soils are saturated at depths of 2 feet or more below the surface during part of the year. The average freeze-free period is from 190 to 230 days.

3.2.2 Potential Impacts and Mitigation

3.2.2.1 Construction Impacts

Pipeline construction activities, including clearing, grading, trench excavation, backfilling, heavy equipment traffic, and restoration along the construction ROW, may adversely affect soil resources. Potential impacts include temporary and short-term soil erosion, short-term to long-term soil compaction, permanent increases in the proportion of large rocks in the topsoil, and short-term to permanent soil contamination. Pipeline construction also may result in damage to existing tile drainage systems. In its CMR Plan (see Appendix B), Keystone has proposed construction procedures that are designed to minimize the likelihood and severity of these impacts, and to mitigate where impacts are unavoidable. Additionally, Keystone will develop a comprehensive conservation and reclamation document for construction, operation, and maintenance of the proposed pipeline. This document will contain information from pertinent NRCS Field Office Technical Guides. The specific practices (listed by state) are presented in Appendix M.

Pre-construction clearing of the temporary ROW would remove protective vegetative cover and could potentially increase soil erosion and the transport to sensitive areas. Approximately 14 percent of the overall project surface area would be constructed where the soils are listed as highly erodible. In these areas, some temporary and short-term increases in soil erosion may occur. Where agricultural soils are subject to a construction-related increase in erosion, receiving water bodies may be affected by hazardous substances (such as pesticide or herbicide residues) that might be present in the eroded material. In its CMR Plan (Appendix B), Keystone has proposed construction methods that are designed to minimize impacts resulting from soil erosion. These methods include installation of sediment barriers, temporary slope breaks, erosion control mats, and installation of temporary mulch in the event that construction activities are interrupted. In addition to the measures described in the CMR Plan, Keystone would designate at least one Environmental Inspector (EI) per construction spread, who would have the authority to stop work and/or order corrective action in the event that construction activities violate the provisions of the CMR Plan, landowner requirements, or any applicable permit. The EI will inspect temporary erosion control measures on a daily basis in areas of active construction or equipment operation, on a weekly basis in areas without active construction or equipment operation, and within 24 hours of continuous rainfall greater than 0.5 inch. The EI will have the authority to ensure the repair of any ineffective erosion control measures within 24 hours of their detection, and will keep records of compliance with provisions of the CMR Plan and applicable regulations and permits.

Farmland within the proposed ROW would be removed from production for the duration of construction. In total for both the Mainline Project and the Cushing Extension, agricultural and rangeland production on approximately 22,237 acres would be lost from the construction ROW for the construction season. During the next growing season, production may be reduced but not completely lost. Long-term productivity is not expected to be impaired.

The structure of farmland soils may be degraded by construction. Grading and equipment traffic may compact soil, reducing porosity and percolation rates, which can result in increase runoff potential. As detailed in Appendix B, Keystone has proposed construction methods that are designed to minimize these impacts. These include removing and storing the top 12 inches of topsoil from the trench line and any areas to be graded, ripping to relieve compaction in all areas from which topsoil has been removed, removing all excess rocks exposed due to construction activity, and adding soil amendments to return topsoil as warranted by conditions and agreed to by landowners. Although Keystone plans to minimize impacts to soil productivity that may result from construction activities, some short- to long-term decreases in agricultural productivity are possible. Keystone is negotiating easement agreements with landowners that would require Keystone to restore the productivity of the ROW and compensate landowners for demonstrated losses from decreased productivity resulting from pipeline operations.

Construction and maintenance activities may lead to localized soil compaction in soils listed as hydric or compaction prone, regardless of their suitability for farming, and this compaction may lead to slower or less successful vegetation reestablishment following construction. Approximately 13 percent of the overall proposed route is characterized by hydric soils. Locations where compaction-prone soils are crossed by the proposed ROW are shown in Appendix F. Hydric and otherwise compaction-prone soils are particularly sensitive to the impact of construction activities during wet weather. Section 2.18 of Keystone's CMR Plan (Appendix B) addresses the methodology to be utilized to determine when to restrict or stop work for wet weather and the methods to mitigate impacts of construction activities in wet conditions. Section 2.18 takes into account the depth of rutting by reference to whether rutting may cause mixing of topsoil and subsoil, on a location-specific basis. "Stop work" will be implemented when recommended by the EI. Section 2.18 of the CMR Plan also addresses construction procedures and mitigative measures to minimize compaction in wet conditions.

Construction may result in concentration of large clasts near the surface in areas where rocky soil or near-surface bedrock is found. Locations along the proposed ROW where stony/rocky soils are found are listed in Appendix F. As detailed in Section 2.2 and in Appendix B, Keystone has proposed construction methods to ensure that soils along the proposed route do not become rockier as a result of pipeline construction. These methods include topsoil removal, segregation and redistribution after construction, and removal from the ROW and off-site disposition of excess rocks and rock fragments. In short, the CMR Plan states that Keystone will restore the ROW soils to approximately the same condition they were in prior to construction. Stones of a size and in quantities greater than were present before construction that are unearthed during construction will be removed from the ROW. Revegetation establishment may be slow where stony or rocky soils are crossed in North Dakota, as well as where near-surface bedrock is present in Missouri. Where shallow bedrock is found, blasting may be required. The potential impacts of blasting, and locations where it may be necessary, are described in Section 3.1.1.2.

During construction, potential equipment spills or leakage of fuels, lubricants, and coolants could affect soils. Keystone has proposed construction methods that will minimize these impacts. These procedures include proper storage and disposal of all hazardous and non-hazardous wastes generated during the construction process, use of controlled staging areas for refueling and hazardous material loading/unloading operations, provision of adequate spill-cleanup materials and equipment, and contingency plans for spills that may pose a danger to human health or the environment (see Section 2.23 and Appendix C). In the event that a spill does occur and causes irreparable damage to soil productivity, Keystone's easement agreements with landowners would require Keystone to restore the productivity of the ROW and compensate landowners for demonstrated losses associated with decreased productivity resulting from pipeline operation. Impacts would be mitigated in compliance with applicable state cleanup standards. It is also possible that Keystone may discover previously contaminated soils during construction. In that event, Keystone would stop work immediately, contact the appropriate state agency, and consult with the agency with respect to an acceptable plan of action. While Keystone may elect to remediate areas of pre-existing contamination, Keystone is not responsible for such remediation and, in most cases, would develop a route deviation to avoid the contaminated area. Keystone also would notify the landowner if contamination is discovered.

Construction of the proposed pipeline would, in places, necessitate disruption of existing drain tile systems. In Section 5 of its CMR Plan (Appendix B), Keystone has committed to identifying and avoiding, repairing, or replacing drainage tiles that may be damaged by pipeline construction. Although these procedures should eliminate or compensate for any long-term impacts to drain tile function, unavoidable temporary impacts would be experienced during construction. Keystone's easement agreements with landowners would require Keystone to restore the productivity of the ROW and compensate landowners for demonstrated losses associated with decreased productivity resulting from pipeline operation, including flooding that could occur because of temporary disruption of drain tile systems.

In modifying or constructing electric transmission line substations to support the Keystone Project, Western would implement the following mitigation measures for Soils and Sediments:

- Topsoil would be removed, stockpiled, and respread at all heavily disturbed areas not needed for maintenance access.
- Water bars or small terraces would be constructed across all ROW and access roads on hillsides to prevent water erosion and to facilitate natural revegetation.
- Erosion control measures would be implemented on disturbed areas, including areas that must be used for maintenance operations (access ways and areas around structures).

- When no longer required, construction roads would be restored to their original condition. Surfaces of construction roads would be scarified to facilitate natural revegetation, provide for proper drainage, and prevent erosion. If revegetation is required, Keystone would provide native seed mixes.

3.2.2.2 Operations Impacts

Operational maintenance of cleared areas may lead to increased erosion by wind or water. Maintenance activities may lead to localized compaction due to vehicular traffic. Incidental soil contamination due to minor leaks from maintenance vehicles also may occur. None of these impacts are expected to be extensive or severe. In the event that agricultural productivity is impaired, Keystone's easement agreements with landowners would require Keystone to restore the productivity of the ROW and compensate landowners for demonstrated losses associated with decreased productivity resulting from pipeline operation. Potential impacts to soil resources from the accidental release of transported oil are discussed in Section 3.13.5.2.

During scoping meetings prior to development of the EIS, a concern was expressed that soils may be prone to settling in the permanent ROW either during the Keystone Project's operational life or after its retirement. Keystone has committed to returning the ROW to its pre-construction topography. Once construction is complete, the permanent ROW would not be fenced; therefore, the same traffic that is experienced by neighboring soils would be experienced by those within the ROW. Consequently, differential settling is not expected. It is possible, however, that procedures to alleviate soil compaction implemented under Keystone's CMR Plan (Appendix B) may result in relatively excessive soil aeration and subsequent settling of soils within the ROW. In the first year after construction, Keystone would inspect the ROW to identify areas of erosion or settling. Subsequently, Keystone would monitor erosion and settling through aerial patrols, which are part of Keystone's Integrity Management Plan, and through landowner reporting. Landowner reporting would be facilitated through use of Keystone's toll-free telephone number, which would be made available to all landowners on the ROW. Landowner reporting also may be facilitated through contact with Keystone's regional offices.

Also expressed during scoping meetings was a concern that increased soil temperatures resulting from the relatively high temperature of the oil in the pipeline might cause decreases in soil moisture content. Keystone conducted a detailed analysis of the effects of pipeline operations on winter and summer soil temperatures along the proposed route, based on operating volumes of 435,000 and 591,000 bpd (TransCanada 2007c). They found that near-surface soil temperatures would continue to be influenced mainly by climate, with minimal effects from pipeline operations. For the lower operating volume, soil temperatures at 6 inches depth within 3 feet of the pipe centerline would be elevated by less than 5 °F in early March, less than 2 °F for the rest of the spring and early summer, and by negligible amounts from mid-June through late February. Increases in soil temperature at distances of 7 feet or more from the centerline would be negligible. For the operating volume of 591,000 bpd, the same general pattern was found; but the temperature elevation within 3 feet of the pipe centerline in early March would be approximately 5 °F, and the period of approximately 2-°F temperature increase would begin in late December and extend to late August. Direct temperature effects on vegetation are expected to be minimal, and may even result in enhanced growth. Although decreases in soil moisture content within 3 feet of the pipe centerline may occur, no drought-prone soils have been identified along the proposed route, and any impacts to agricultural productivity would be addressed by Keystone's easement agreements that would require Keystone to restore the productivity of the ROW and compensate landowners for demonstrated losses associated with decreased productivity resulting from pipeline operation.

3.2.3 References

ENSR. 2006a. Keystone Pipeline Project Environmental Report. Updated November 15, 2006.

TransCanada. See TransCanada Keystone Pipeline, L.P.

TransCanada Keystone Pipeline, L.P. 2007c. Response to Data Request #2. Submitted to U.S. Department of State by TransCanada Keystone Pipeline, L.P. Application for Presidential Permit. April 4.

TransCanada Keystone Pipeline, L.P. 2007d. Filing #9. Submitted to U.S. Department of State by TransCanada Keystone Pipeline, L.P. Application for Presidential Permit. September 10, 2007