
SWReGAP 2011

3.4 Soils

3.4.1 Affected Environment

The study area for soils includes the proposed ROWs and groundwater development areas associated with surface disturbance from the Proposed Action and other alternatives (**Figure 3.0-1**). In addition, the overall region of study includes areas of hydric soils associated with surface water features such as wetlands, springs, seeps, and riparian areas.

3.4.1.1 Overview

Soil resources within the project area have formed within four major land resource areas (MLRAs) (USDA NRCS 2006a) (**Figure 3.4-1**). Generally from north to south, these include:

- MLRA 28A – The Great Salt Lake Area;
- MLRA 28B – Central Nevada Basin and Range;
- MLRA 29 – Southern Nevada Basin and Range; and
- MLRA 30 – Mohave Basin and Range.

Each of these MLRAs contains one or more of the following soil orders: Aridisols, Entisols, and Mollisols. Aridisols are soils that develop in arid ecosystems. Entisols lack soil development and typically are shallow or sandy. Mollisols have a thick, dark, fertile surface layer.

QUICK REFERENCE

Alluvial – Composed of, or found in alluvium.

Soil Horizon – The layers in the upper crust of the earth. The differences in the horizons are most easily seen in soils that have not been touched in decades. The A horizon is topsoil, where most roots grow; B is the subsoil; and C is the parent material from which soil is formed. Although some roots can penetrate into the C horizon, few microorganisms live there.

Soil Orders – Aridisols are soils that develop in arid ecosystems

Entisols lack soil development and typically are shallow or sandy

Mollisols have a thick, dark, fertile surface layer

Great Salt Lake Area (MLRA 28A)

The Great Salt Lake Area is comprised of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes, and are not well dissected because of low rainfall. A large salt desert playa is located south and west of Great Salt Lake. Most of the valleys are closed basins containing sinks or playa lakes (USDA NRCS 2006a).

The dominant soil orders are Aridisols, Entisols, and Mollisols. The soils in this area generally are well drained or somewhat excessively drained, loamy or loamy skeletal (lacking soil horizons and rocky), and very deep. The soils developed from sedimentary and igneous parent materials. Soils in this area commonly contain high calcium carbonate contents. Alkalinity commonly increases with depth. Soils along alluvial fans, lake plains, and flats often have high concentrations of salts and sodium.

Figure 3.4-1 Major Land Resource Areas

Central Nevada Basin and Range (MLRA 28B)

The Central Nevada Basin and Range is an area of nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by long, gently sloping to strongly sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. Many of the valleys are closed basins containing sinks or playas. The mountains in the southern half of this area are dominated by igneous parent materials. Sedimentary carbonate parent materials are prominent in the mountains to the north. The valleys consist mostly of alluvial fill. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Finer textured materials are found on the fan edges (USDA NRCS 2006a).

The dominant soil orders are Aridisols, Entisols, and Mollisols. They generally are well drained, loamy or loamy-skeletal, and shallow to very deep. Soils in this area commonly contain high calcium carbonate contents due to the carbonate parent materials. Soils along alluvial fans, lake plains, and flats often have high concentrations of salts and sodium.

Southern Nevada Basin and Range (MLRA 29)

The Southern Nevada Basin and Range is an area of broad, nearly level, aggraded desert basins and valleys between a series of mountain ranges trending north to south. The basins are bordered by sloping fans and terraces. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys in this MLRA are closed basins containing sinks or playa lakes. The mountains in this area are dominated by igneous and sedimentary carbonate rocks. The valleys consist mostly of alluvial fill. The alluvial valley fill consists of cobbles, gravel, and coarse sand near the mountains in the apex of the alluvial fans. Finer textured materials are found on the fan edges (USDA NRCS 2006a).

The dominant soil orders are Aridisols and Entisols. Mollisols also are important in the mountainous areas. They generally are very shallow to very deep, well drained or somewhat excessively drained, and loamy-skeletal or sandy-skeletal. Soils in this area commonly contain high calcium carbonate contents due to the carbonate parent materials. Soils found in sinks and playa lakes typically have high concentrations of salts and sodium.

Mohave Basin and Range (MLRA 30)

The Mohave Basin and Range consists of broad basins, valleys, and old lakebeds with widely spaced mountains trending north to south. Isolated, short mountain ranges are separated by an aggraded desert plain. The mountains are fault blocks that have been tilted up. Long alluvial fans coalesce with dry lakebeds between some of the ranges. Most of this area is underlain by alluvial deposits on alluvial fans and valley floors. Recent alluvial fans and remnant alluvial fan terraces typically grade from boulder-strewn deposits and coarse desert pavement near the fan apex to finer grained sands, silts, and clays at the lower ends. Playas are at the lowest elevations in the closed basins. Wind-blown deposition commonly occurs along playa downward fringes. Water from shallow subsurface flow (and from surface flows that periodically fill the playa basins) evaporates, leaving accumulations of evaporite minerals, including salts and borates (USDA NRCS 2006a).

The dominant soil orders are Aridisols and Entisols. The soils generally are well drained to excessively drained, loamy-skeletal or sandy-skeletal, and shallow to very deep. They developed from metamorphic, igneous, carbonates, granitics, and nonmarine sedimentary and volcanic deposits. Saline and sodic soils are common.

3.4.1.2 Right-of-way Areas

The soil baseline characterization described in this section presents an overview of the soils within the basins that are projected to be disturbed by construction of pipelines and ancillary facilities within ROWs. The information is based on review and analyses of the Soil Survey Geographic Database (SSURGO) database for the region. SSURGO is the most detailed level of soil mapping done by the USDA, NRCS. SSURGO data are not available where soil surveys have not been completed. General Soil Map data based on the U.S. General Soil Map (STATSGO) data set (USDA NRCS 2006c) are used for those areas where SSURGO data are unavailable. New soil mapping is underway in Snake Valley (Soil Survey Area UT617).

Figure 3.4-2 displays the various soil survey areas crossed by the ROWs associated with the Proposed Action and alternatives. SSURGO/STATSGO soils maps generally are grouped for mapping into units known as soil complexes and soil associations. A soil complex has a characteristic pattern that is so intricately mixed or small in size that it is not

Figure 3.4-2 SSURGO Soil Survey Areas

practical to separate the soils at the standard mapping scale. A soil association has a characteristic pattern of soils on the land surface, largely determined by relief, drainage, slope aspect, or other soil-determining factors. The percentage of the soils characteristics was determined by calculating the percentage of soils within a map unit with a specific characteristic and multiplying that percentage by the total miles crossed by the ROW or acres within the groundwater development areas.

Table 3.4-1 summarizes soil characteristics within the hydrologic basins that may be disturbed by construction. Important constraints relevant to surface disturbance and stabilization include low reclamation potential, erosion prone, compaction prone, shallow soils, and hydric soils. The amount of soil classified as prime farmland also is an important consideration relevant to surface disturbance and stabilization.

Table 3.4-1 Important Soil Characteristics by Hydrologic Basin[1]

Hydrologic Basin	Total Acres	Characteristics of Hydrologic Basin Area							
		Compaction Prone	Shallow Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farm-land[5]
Cave	229,646	10	54	2	11	75	<1	29	14
Coyote Spring	392,730	2	23	0	<1	27	1	13	0
Delamar	231,443	23	41	1	8	86	0	36	18
Dry Lake	573,399	4	46	1	8	69	1	20	15
Garnet	100,936	1	27	1	4	13	0	27	0
Hamlin	520,085	14	20	<1	1	45	<1	13	1
Hidden	53,475	<1	10	1	6	0	0	10	0
Lake	354,464	11	33	1	7	74	2	20	9
Las Vegas	987,568	<1	1	<1	0	2	<1	<1	0
Lower Meadow Wash	605,291	29	52	<1	1	82	1	46	0
Pahranagat	495,042	1	51	<1	9	80	2	44	2
Snake	1,766,192	<1	7	2	3	8	<1	7	0
Spring (184)	1,066,063	19	22	3	12	34	<1	15	3
Steptoe	1,248,646	11	34	3	8	62	<1	27	1

[1] Portions of Coyote Spring, Las Vegas, Pahranagat, Spring (184), and Steptoe valleys have no soils data or are limited to the more general STATSGO data. STATSGO are included in the table when more specific data are not available.

[2] Shallow bedrock soils were identified by querying the SSURGO database for component soil series that have a bedrock contact less than 60 inches from the surface.

[3] LRP = Low reclamation potential.

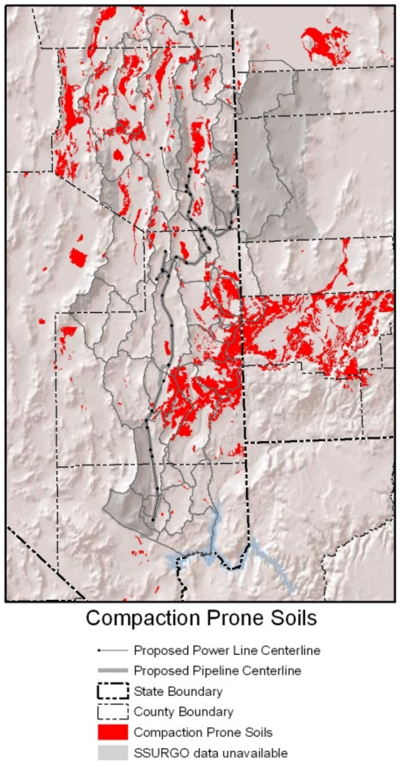
[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained. The database for survey area NV780 (Western White Pine County and parts of White Pine and Eureka counties) did not have soil textures populated so only the drainage class was used.

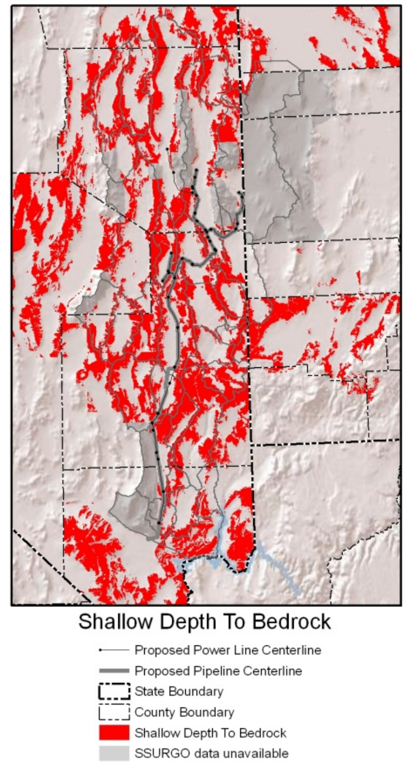
[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses. Not all soils in all hydrologic basins were rated for Prime Farmland classification.

Source: USDA NRCS 2006c,d, 2007b,c,d,e,f,g,h, 2008, 2009a,b.

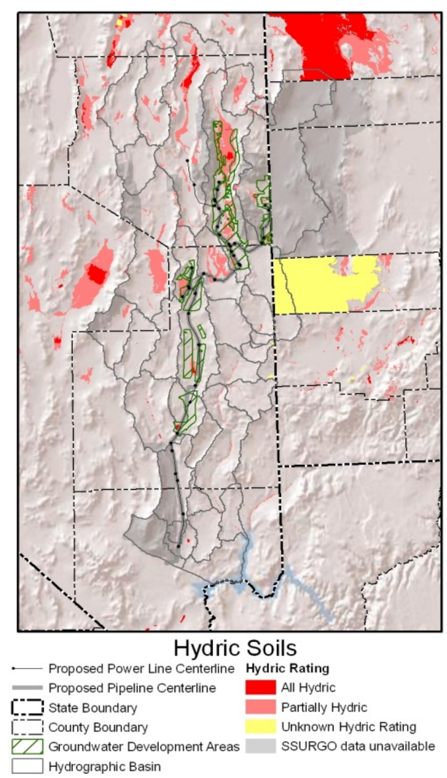
Descriptions and figures of the soil characteristics relevant to management of soils in the region are summarized below.

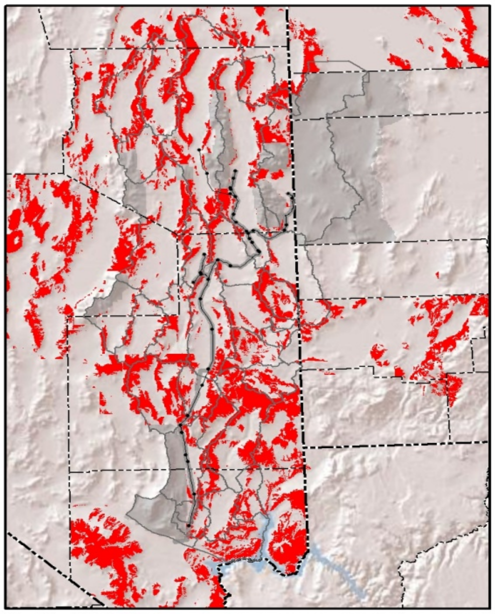
- Compaction Prone are fine-textured soils that have clay loam or finer textures. These soils are especially prone to compaction when moist or wet.
- Shallow Bedrock soils are listed because they may affect excavation for foundations and pipelines.



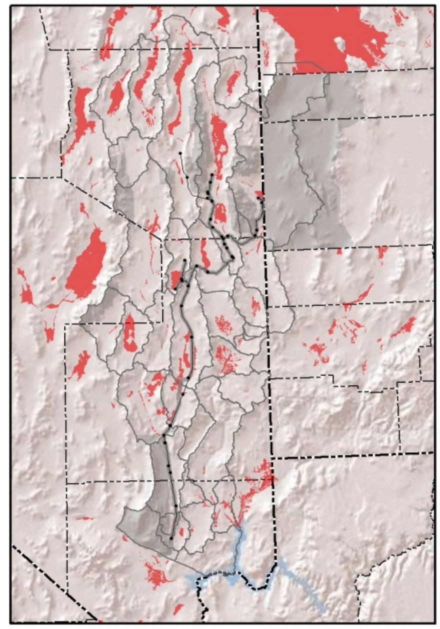


- Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, and with riparian areas, wetlands, springs, and seeps. Nearly all hydric soils exhibit characteristics that result from repeated periods of saturation or inundation for more than a few days during the growing season, resulting in a depletion of oxygen. This promotes biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, and/or accumulation of iron and other elements (USDA NRCS 2006b). Hydric soils are rare in the region due to the arid climate. There are small, localized areas
- showing evidence of the past occurrence of hydric soils (relict hydric soils) in Snake Valley where water tables have lowered due to drought and water usage (Bryant 2010).
- Severe Water Erosion Potential rates the erodibility of the whole soil by surface water runoff. The estimates are modified by the presence of rock fragments and slope.
- Low Reclamation (Revegetation) Potential. Soils that are saline, sodic, or strongly alkaline/acid have low potential for successful stabilization if disturbed. These chemical characteristics are likely to adversely affect plant re-establishment and growth.
- Droughty soils are coarse-textured soils with poor water holding capacity that can be difficult to revegetate during periods of low precipitation.





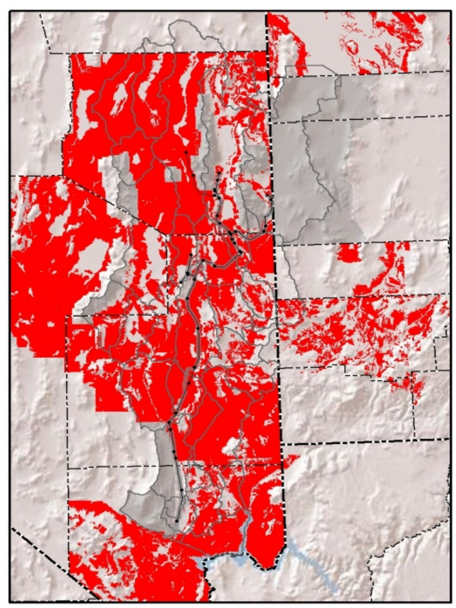
Soils with Severe Water Erosion Potential



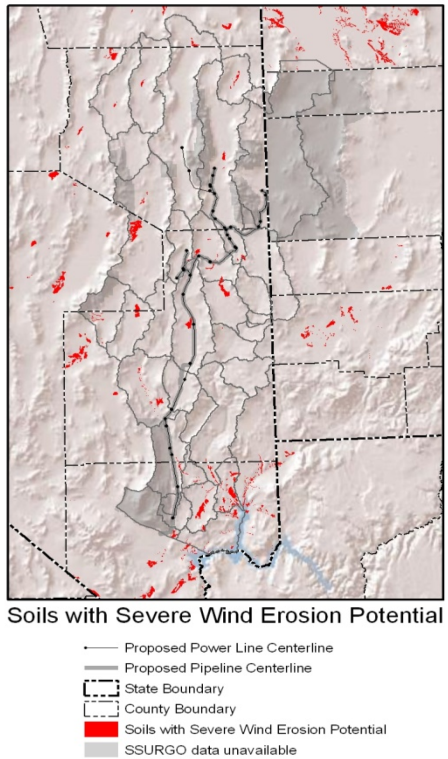
Soils with Low Revegetation Potential

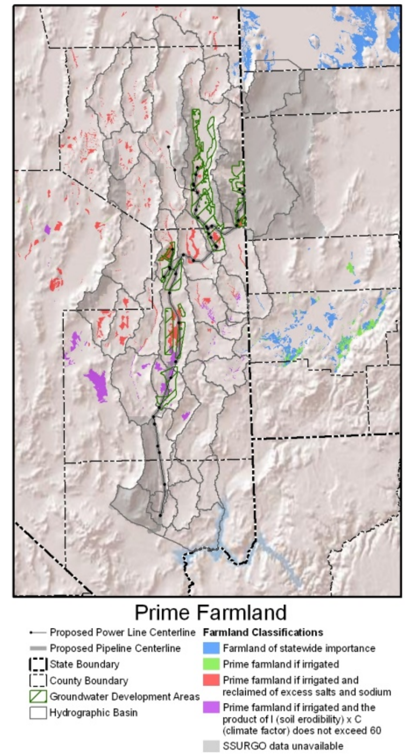
- Severe Wind Erosion Potential. Wind erodibility is expressed as a soil grouping index of 1 to 8. The group number is based on sand, silt, and clay content and the susceptibility of soils to being blown by wind. Sandier soils have the highest wind erodibility potential and are assigned to Group 1. Soils with the lowest wind erodibility are assigned to Group 8 (USDA 2007a). While soils in other groups would be subject to wind erosion, the soils in Groups 1and 2 were characterized in this analysis as having severe wind erosion potential to represent the acreage most likely to erode.

- Prime farmland is land that has the best combination of physical and chemical characteristics and is available for producing crops. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. Based on an aerial photo interpretation, no mapped prime farmland soils in the project area are currently irrigated and farmed, but there are prime farmland soils in the region.



Droughty Soils





Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. The southern portion of the project area (the northeast portion of the Mojave Desert) has a relatively high cover of biological soil crusts. No site-specific data are available on soil crust coverage in the study area; however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003). Radionuclide testing was conducted to investigate the possibility of radioactivity in the soils due to airborne transport of particulates associated with nuclear testing conducted at the NTS in the 1950s and 1960s. Forty-seven surface and subsurface samples were collected along the proposed mainline ROW for analysis. The samples were analyzed for Cesium-137 by spectral analysis of gamma radiation. Cesium-137 is a radioactive product that does not occur naturally, and is specific to nuclear testing. The results indicate that any fallout from nuclear testing conducted in the past has decayed to low levels that are not considered harmful to human health (Converse Consultants 2007).

Erionite is described in Section 3.2, Geology, as a mineral occurring in some volcanic tuff deposits that may be hazardous to human health if inhaled. While some of the shallow soils in the project area overlie volcanic tuff, no erionite occurrences are known in the project area (Sweetkind 2009). Therefore, the excavation of shallow soils during installation of pipelines or other construction activities would not cause erionite particles to be released.

3.4.1.3 Groundwater Development Areas

The construction activity within the proposed groundwater development areas falls within Cave, Delamar, Dry Lake, Snake, and Spring (184) valleys. The soil characteristics within these valleys are summarized in **Table 3.4-1** and explained in Section 3.4.1.2 above.

3.4.1.4 Region of Study

The region of study for soils encompasses those basins in which soils would be disturbed during construction and maintenance operations for the proposed facilities, as well as those areas where the soils may be affected by groundwater drawdown. **Table 3.4-1** shows the important soil limitations within the basins where surface disturbance is anticipated. There are up to 14 hydrologic basins (depending on the pumping scenario in each alternative) in which hydric soils may be altered if groundwater levels were lowered due to pumping. The basins and the acreage considered are listed in **Table 3.4-1** and essentially are the Water Resources Region of Study described in more detail in Section 3.3, Water Resources.

3.4.2 Environmental Consequences

3.4.2.1 Rights-of-way

Issues

The following issues for soil resources are evaluated for ROW construction and operation:

- Potential disturbance to soils causing accelerated erosion;
- Potential disturbance to soils causing compaction due to vehicle traffic;
- Reclamation in areas with poor vegetation growth characteristics; and
- Long-term soil quality concerns.

Assumptions

The following assumptions were made to support the analysis of the impacts to soils from implementation of the alternatives.

- SSURGO data are more accurate than the general STATSGO soil mapping. SSURGO is the most detailed level of soil geographic data, collected based on field mapping. STATSGO consists of a broad-based inventory using data on geology, topography, vegetation, and climate at a coarse resolution. Therefore, the percentages of the hydrologic basins with specific soil characteristics were derived from SSURGO data, which were assumed to represent those areas that are currently without detailed soil mapping.
- BMPs and management direction listed in the Ely and Las Vegas BLM RMPs and the ACMs related to soils in **Appendix E** will be implemented during construction, operation, and maintenance of the proposed project. In reality, measures will have varying degrees of success due to variable climatic conditions, soils limitations, and a range of factors. Monitoring of these measures and maintenance or reestablishment where needed, as addressed in ACMs A.2.9 and A.2.10, will be important to improve the probability of success.
- Where the ACMs require review and approval by the BLM, their review will ensure compliance with the applicable RMP objectives and management direction intended to minimize adverse impacts to soils.
- In general, it was assumed for purposes of this analysis that the BMPs and ACMs implemented for erosion control will be effective if established using recommended guidelines and maintained. Because there are no guaranteed methods of reestablishing vegetative cover and stabilizing disturbed soils in the arid climate present in the study area, it is likely that a portion of the reclamation efforts may not be successful or may take many years to be stabilized. Careful monitoring of reclaimed areas as part of the Restoration Plan will be important to achieve success in stabilizing problem areas.
- Soils that are highly erodible or with low revegetation potential will require more extensive and aggressive erosion control measures and more frequent maintenance than other soils without those characteristics in order to minimize erosion and downstream sedimentation. Some soils may not be successfully stabilized following disturbance or may take many years for reclamation to be successful.
- Soils disturbed during construction (vegetation damage or removal, excavation, grading) will be susceptible to wind and water erosion until they are stabilized, which is likely to take several growing seasons due to the arid climate. Some sites may not be fully reclaimed or stabilized following surface disturbance.
- Short-term impacts such as minor soil compaction from equipment traffic, excavation and handling, and spills of fuels and lubricants may alter the functioning of these soils temporarily following construction.

Methodology for Analysis

Impact assessments were based on a range of soil characteristics using the SSURGO spatial and tabular data using the following method:

- The acreage of each soil map unit that would be disturbed within the proposed facility footprints and ROWs within each hydrologic basin was calculated using GIS.

- Some soil characteristics are important because they influence the magnitude of construction impacts, success of BMPs, and the potential for reclamation. The extent that the disturbed soils with these important characteristics are relevant to the project was identified.
- The BLM RMP management actions, BMPs, and ACMs available to limit the extent and duration of predicted impacts were evaluated.
- Additional mitigation measures to reduce or offset impacts were proposed. Mitigation measure effectiveness was described.

3.4.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

All Impact Issues

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-2** by hydrologic basin. The following discussions present the data in **Table 3.4-2** as a percentage of the total project area (rather than by basin).

Approximately 5 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 12 percent is susceptible to severe wind erosion. Soils that lose surface roughness or crusts (biological or salt) would be damaged by construction activities (i.e., clearing, grubbing, excavation, vehicle traffic) and are likely to be susceptible to wind or water erosion even if they are not rated as severe. Disturbed soils that are not successfully reclaimed or stabilized are likely to lose productivity and the ability to sustain vegetation over the long term, which would reduce watershed health and contribute to sedimentation in surface water or degradation of local air quality. It is not possible to quantify or locate all of the areas where this may occur. However, the BLM reports that exceedance of soil loss thresholds and losses in soil productivity due to wind erosion are most likely to occur on soils that are saline or alkaline, fine-textured, and formed in some lake sediments (Bryant 2010).

Overall, approximately 19 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland. Some of these soils would be permanently altered due to the construction of permanent facilities.

While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone. Soil compaction and rutting likely would result from the movement of heavy construction vehicles in the construction ROWs. The degree of compaction would depend on the moisture content and texture of the soil at the time of construction. Compaction would be most severe where heavy equipment with rubber tires operates on moist to wet soils with high clay content. Compaction also can occur on soils of various textures and moisture contents if multiple passes are made by high ground weight equipment. If soils are moist or wet where topsoil trenching has occurred, topsoil would likely adhere to tires and/or tracked vehicles and be carried away.

Typically, soils that are compaction prone also are likely to become rutted or displaced when saturated. Rutting occurs when the soil strength is not sufficient to support the applied load from vehicle traffic. Rutting affects the surface hydrology of a site as well as the rooting environment. The process of rutting physically severs roots and reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting also disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, creating gully erosion. Rutting is most likely to occur on moist or wet fine-textured soils, but also may occur on dry sandy soils due to low soil strength.

Table 3.4-2 Summary by Basin of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Proposed Action and Alternatives A through C[1]

Hydrologic Basin	Disturbance Footprint (ac.)	Percent of Hydrologic Basin Area							
		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farm-land[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	384	0	0	0	100	100	0	1	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake	879	0	0	0	97	96	0	1	0
Spring (184)	2,568	0	0	0	77	79	12	3	2
Steptoe	327	0	0	0	10	29	0	56	<1
Summary of ROW Footprint[6]	**12,303**	**1**	**2**	**<1**	**83**	**86**	**12**	**5**	**19**

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so they were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations.

Source: USDA NRCS 2006c,d, 2007b,c,d,e,f,g,h,i, 2009a,b.

In areas of shallow bedrock, excavation may result in rock fragments remaining on the surface or within the trench backfill at levels that would limit the success of restoration efforts. Shallow bedrock occurs on approximately 2 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.

Soils with low reclamation potential disturbed during construction would be prone to wind erosion and would be more difficult to successfully stabilize and revegetate following construction. Overall, 83 percent of soils affected have chemical or physical characteristics which may inhibit revegetation after disturbance. Saline or sodic soils often have drainage limitations and may undergo compaction impacts similar to the hydric or compaction prone soils. The success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils.

A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities. Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs. Impacts related to excavation and topsoil handling would be limited to small areas where certain maintenance activities take place. These impacts would be temporary because BMPs would be implemented and all areas would be stabilized following surface disturbance. However, due to the high percentage of soils that are droughty or have low reclamation potential, successful revegetation to stabilize soils may be a lengthy process.

Drain valves, if utilized during hydrostatic testing or in an emergency situation, would discharge the water in the pipe to an existing dry wash. The wash typically would be protected by an energy dissipater at and immediately below the discharge location to minimize the potential for scouring, as described in ACMs A.1.62, A.1.64, and B.2.3. A detailed hydrologic analysis would be conducted during facility design for each discharge point to provide sufficient erosion control measure and prevent scouring; however, it currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages. If, in an emergency situation, flows exceed these rates, the potential for erosion and scour would increase, resulting in deposition of sediment downstream.

The SNWA plans to minimize potential impacts to soils by implementing the ACMs A.1.20, A.1.23, A.1.24, A.1.25, A.1.54, A.1.57, A.1.58, A.1.59, A.1.62, A.1.63, A.1.64, A.1.66, A.1.67, A.1.68, and A.1.77, as well as the measures listed for Restoration Monitoring. The measures include procedures for segregating and replacing topsoil, trench backfilling, relieving areas compacted by heavy equipment, removing surface rock fragments, and implementing water and wind erosion control practices.

SNWA plans to minimize potential impacts to soils by:

- Segregating and replacing topsoil,
- Trench backfilling,
- Relieving areas compacted by heavy equipment, and
- Implementing water and wind erosion control practices.

<u>Conclusion</u>. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 12 percent of the soils that are highly wind erodible, approximately 5 percent of the soils that are very susceptible to water erosion, and approximately 19 percent of the soils within the ROWs is designated by the NRCS as prime farmland, some of which would be permanently altered. Approximately 83 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

During construction, the soil profiles may be mixed, with a corresponding loss of soil structure. Soils may be compacted and crusts would be disturbed due to repeated vehicle and foot traffic.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

Compliance with the ACMs and the BLM RMP management actions would minimize the impacts to soils resulting from construction and facility maintenance under the Proposed Action and Alternatives A, B, and C. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the potential for successful site restoration. A detailed reclamation plan will be submitted to the BLM prior to the start of construction activities. The plan will specify methods for successful reclamation.

Soils would be altered by surface disturbance, excavation, compaction, and reclamation, primarily during construction activities, but the implementation of the BLM management actions and the proposed ACMs would stabilize disturbed soils and minimize offsite erosion. Because many of the soils are difficult to revegetate and stabilize due to their physical and chemical characteristics, monitoring and maintenance of ACMs for as long as needed to ensure successful soil stabilization is critical to effectively minimizing adverse impacts to soils.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.3 Alternative D

Construction and Facility Maintenance

All Impact Issues

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline and 208 miles of power line ROWs in Clark and Lincoln counties, Nevada.

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-3** by hydrologic basin. The bullet items below recapture the data presented in **Table 3.4-3** as a percentage of the total project area (rather than by basin).

The following types of soils would be disturbed for Alternative D:

- Approximately 4 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 17 percent is susceptible to severe wind erosion.
- Overall, approximately 26 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland.
- While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone.
- Shallow bedrock occurs on approximately 3 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.
- Soils with low reclamation potential (86 percent) disturbed during construction would be prone to erosion and would be more difficult to successfully stabilize and revegetate following construction.
- Overall, approximately 90 percent of soils affected are droughty, which may inhibit revegetation after disturbance.
- A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities.

The same RMP BMPs and ACMs as under the Proposed Action would be applied to Alternative D to reduce construction-related impacts to soils.

Table 3.4-3 Summary by Basin of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Alternative D[1]

	Distur-bance Footprint (acre)	Percent of Hydrologic Basin Area							
Hydrologic Basin		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farm-land[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	0	0	0	0	0	0	0	0	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake	0	0	0	0	0	0	0	0	0
Spring (184)	698	0	0	0	100	100	45	3	1
Steptoe	0	0	0	0	0	0	0	0	0
Summary of ROW Footprint[6]	**8,843**	**1**	**3**	**<1**	**86**	**90**	**17**	**4**	**26**

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations.

Source: USDA NRCS 2006c,d; 2007b,c,d,e,f,g,h,i; 2009a,b.

Conclusion. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 17 percent of the soils that are highly wind erodible, approximately 4 percent of the soils that are very susceptible to water erosion, and approximately 26 percent of the soils within the ROWs is designated by the NRCS as prime farmland, some of which would be permanently altered. Approximately 86 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

Compliance with the ACMs and the BLM RMP management actions would minimize the impacts to soils resulting from construction and facility maintenance under Alternative D. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the chances for site restoration to be successful. The depth of ripping or soil mixing could be crucial to successful reclamation.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.4 Alternative E

Construction and Facility Maintenance

All Impact Issues

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative E, which would require 263 miles of pipeline and 280 miles of power line ROWs in Clark, Lincoln, and White Pine counties, Nevada.

Grading and excavating for the proposed pipelines and ancillary facilities would disturb a variety of soils. Certain inherent soil characteristics influence the productivity and revegetation potential after disturbance. The major soil characteristics of concern and the percentages encountered of each type within each hydrologic basin are listed in **Table 3.4-1**. An estimate of the amount of soils with characteristics of importance to construction and reclamation that are projected to be disturbed due to construction is included in **Table 3.4-4** by hydrologic basin. The bullet items below recapture the data presented in **Table 3.4-4** as a percentage of the total project area (rather than by basin).

Table 3.4-4 Summary of Soils of Concern Projected to be Disturbed during Right-of-way Construction under Alternative E[1]

Hydrologic Basin	Disturbance Footprint (acre)	Percent of Hydrologic Basin Area							
		Compaction Prone	Shallow Depth to Bedrock[2]	Hydric	LRP[3]	Droughty[4]	Severe Wind Erosion	Severe Water Erosion	Prime Farmland[5]
Cave	712	1	0	1	99	80	0	0	79
Coyote Spring	1,727	0	0	0	95	95	28	3	0
Delamar	891	1	0	1	67	92	0	0	51
Dry Lake	2,631	0	8	0	83	99	24	0	42
Garnet	306	0	0	0	94	94	0	6	0
Hamlin	0	0	0	0	0	0	0	0	0
Hidden	478	0	0	0	97	61	0	2	0
Lake	804	7	2	0	80	76	1	0	17
Las Vegas	223	0	0	0	21	21	0	12	0
Lower Meadow Wash	121	0	0	0	95	95	0	10	10
Pahranagat	252	0	0	0	93	100	5	65	3
Snake		0	0	0	0	0	0	0	0
Spring (184)	2,224	0	0	0	74	76	14	3	3
Steptoe	327	0	0	0	10	29	0	56	0
Summary of ROW Footprint[6]	**10,696**	**1**	**2**	**<1**	**81**	**84**	**14**	**5**	**22**

Note: To generate the information in this table, SSURGO data queries included only major components of soil map units within the areas that would be disturbed for construction.

[1] Small portions of Coyote Spring, Las Vegas, Spring (184), and Steptoe valleys have no detailed soils data so were excluded from this table. The percentages are assumed to be representative of the entire basin where affected by construction.

[2] Shallow bedrock soils are those that have bedrock contact less than 40 inches from the surface.

[3] LRP = Low reclamation potential; includes soils that are very saline, sodic, or alkaline.

[4] Droughty soils were identified by querying the SSURGO database for coarse textured soils (sandy loams and coarser) that are well drained to excessively drained.

[5] These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses.

[6] Percentages in summary row are not totals of the column but represent the overall proportion of the footprint with the listed limitations.

Source: USDA NRCS 2006c,d, 2007b,c,d,e,f,g,h i, 2009a,b.

The following types of soils would be disturbed under Alternative E:

- Approximately 5 percent of the overall project surface disturbance would affect soils that are highly erodible by water, and 14 percent is susceptible to severe wind erosion.
- Overall, approximately 22 percent of the proposed ROW and facility construction would have short-term impacts on soils designated by the NRCS as prime farmland.
- While compaction may occur on any soils under some conditions, approximately 1 percent of the proposed surface disturbance would occur on soils that are especially compaction prone.
- Shallow bedrock occurs on approximately 2 percent of the soils within proposed ROWs and other construction areas. Where the pipeline route crosses soils with hard bedrock, blasting or rock saws may be required for trenching.
- Soils with low reclamation potential (81 percent) disturbed during construction would be prone to wind erosion and would be more difficult to successfully stabilize and revegetate following construction.

- Overall, approximately 84 percent of soils affected are droughty, which may inhibit revegetation after disturbance.
- A long-term loss of soil productivity and quality would occur in association with permanent ancillary facilities.

The same RMP BMPs and ACM as under the Proposed Action would be applied to Alternative E to reduce construction-related impacts to soils.

Conclusion. Grading and excavating during construction of the proposed pipelines, power lines, and ancillary facilities would disturb a variety of agricultural, rangeland, desert, riparian, playa, or wetland soils. This surface disturbance within the ROWs and construction areas would affect 14 percent of the soils that are highly wind erodible, approximately 5 percent of the soils that are very susceptible to water erosion, and approximately 22 percent of the soils within the ROWs is designated by the NRCS as prime farmland. Approximately 81 percent of soils within the ROWs and construction areas have chemical characteristics that may inhibit revegetation, which would be difficult to reclaim and revegetate to stabilize.

The soils within the ROWs consist of 1 percent that are compaction prone and likely to be subject to rutting or displacement from vehicle traffic when wet. Rutting disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, potentially creating accelerated erosion and sedimentation.

The hydrologic basins with the most acreage to be disturbed and the highest percentages of soils with low reclamation potential and severe erosion limitations have the potential to be the most affected over the long term because successful stabilization and reclamation would be the most difficult to achieve. The basins where the most surface disturbance is projected that also have the highest percentage of problem soils that would be affected by construction and facility maintenance include Coyote Spring, Dry Lake, and Spring (184).

Temporary, isolated surface disturbance impacts may result in accelerated erosion, soil compaction, and related reductions in the productivity of desirable vegetation or crops due to operation and maintenance traffic and occasional repairs.

Compliance with the ACMs and the BLM RMP management actions would minimize the impacts to soils resulting from construction and facility maintenance under Alternative E. Monitoring and maintenance of these ACMs would be important to achieve the desired goal of minimizing impacts. In soils that are very saline or alkaline, soil ripping to relieve compaction (ACM A.1.77) may not be beneficial because mixing the soil layers may bring subsoil with undesirable chemical properties to the surface, reducing the chances for site restoration to be successful. The depth of ripping or soil mixing could be crucial to successful reclamation.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

3.4.2.5 Alignment Options 1 through 4

Table 3.4-5 presents impacts for the alignment options (1 through 4) in relation the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.4-5 Soils Impact Summary for Alignment Options 1 through 4, Compared to Proposed Action

Alignment Option	Analysis
Alignment Option 1 (Humboldt-Toiybe Power Line Alignment) **Option Description:** Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley (184). **Applicable To:** Proposed Action and Alternatives A through C and E.	• Impacts associated with Alignment Option 1 would be the same as the comparable Proposed Action segment on 96 fewer acres.
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C and E.	• Impacts associated with Alignment Option 2 would result in similar impacts to the comparable Proposed Action segment. • Approximately 51 more acres would be affected by surface disturbance, but the percentage of the disturbed soils with severe limitations related to wind erosion, water erosion, and low reclamation potential would be about 1% less than the Proposed Action.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line, and construct a substation with an interconnection with an interstate, high voltage power line in Muleshole Valley. **Applicable To**: Proposed Action and Alternatives A through C and E.	• This alternative would result in 364 acres less surface disturbance relative to the Proposed Action. • The different route would disturb a slightly higher percentage (85%) of soils with low reclamation potential, compared to the Proposed Action (83%). • The relative percentages of soils susceptible to wind erosion would be the same as that described for the Proposed Action, and slightly less for water erosion (3% compared to 5% for the Proposed Action). • The proportion of prime farmland that would be disturbed is slightly higher (20%) than under the Proposed Action (19%).
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• This alternative would result in 52 acres less surface disturbance relative to the Proposed Action. • The proportions of soils with severe limitations affected by construction would be the same as under the Proposed Action.

3.4.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or operated. No project-related disturbance would occur to soils. Impacts would continue at present levels as a result of natural conditions and existing development in the project area. Soils would continue to be impacted to varying degrees as a result of grazing, wildfire, drought, recreation, and other land use activities. Surface disturbance to soils associated with development in the area is anticipated to increase as population grows.

3.4.2.7 Comparison of Alternatives

Table 3.4-6 provides a comparison of impacts to key soils parameters across the primary ROW and facility maintenance alternatives.

Table 3.4-6 Comparison of Important Soils Parameters across Alternatives

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternative E
Disturbance Area (Acres)	12,303	8,843	10,696
Low Revegetation Potential Soils Disturbed (Percent of Total Disturbance)	83	86	81
High Wind Erodible Soils Disturbed (Percent of Total Disturbance)	12	17	14
High Water Erodible Soils Disturbed (Percent of Total Disturbance)	5	4	5
Prime Farmland Disturbed (Percent of Total Disturbance)	19	26	22

3.4.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Development Construction and Facility Maintenance

- Potential disturbance to soils causing accelerated erosion.
- Potential disturbance to soils causing compaction due to vehicle traffic.
- Reclamation in areas with poor vegetation growth characteristics.
- Disturbance to soils containing contaminants.
- Long-term soil quality concerns.

Groundwater Pumping

- Potential effects of groundwater drawdown on hydric soils and the vegetation supported by these soils.

Assumptions

Groundwater Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP management actions and best management practices would be applied to all proposed construction activities, based on the most current RMPs – Ely 2008 and Las Vegas 1998.
- The ACMs included in the SNWA POD to manage surface disturbance effects for ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of the impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to ROW construction in groundwater development areas.

Groundwater Pumping

- Existing hydric soils located within areas where saturated conditions during the growing season no longer occur for a period of 30 years are likely to exhibit morphological changes in soil color and ferrous iron content (Hayes and Vepraskas 2000). One cause of change in the source of water that creates saturated conditions is the drawdown of shallow groundwater. In some cases, it may take longer than 30 years of lowered groundwater levels to observe these morphological changes.
- The soil surveys in the region identify soil map units that are partially hydric (often a small percentage of the map unit is hydric) and fully hydric soil map units. For analysis purposes, for the percentage of each hydric soil map unit component that is partially hydric, map units was used to estimate the acreage of hydric soils in each basin.
- The analysis of hydric soils affected by drawdown was limited to those areas most likely to be affected by groundwater drawdown in the High and Moderate Risk Zones within the projected 10-foot drawdown contours (described in the Water Resources, Section 3.3). The 10-foot drawdown contour, calculated from the water model, is used as an indicator of the spatial extent of impacts resulting from pumping. Limiting the spatial extent of the hydric soils in this way is consistent with the analysis for Vegetation (Section 3.5) and facilitates the comparison of impacts to hydric soils by basin across all alternatives on a programmatic, broad-based scale.
- In the hydrologic basins where most of the existing groundwater elevations are deep, such as Delamar and Dry valleys, it is likely that most of the water supplying hydric soils comes from localized perched water tables or overbank flooding of waterways rather than the existing groundwater table. For this reason, the hydric soils in these basins are not likely to be greatly affected by the projected groundwater drawdown.
- Assumptions about the potential changes in soil characteristics (primarily hydrc soils) from groundwater pumping do not incorporate additional assumptions about the effects of climate change because specific long term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A general discussion of climate change effects is provided in Section 3.1.3.2 Climate Change Effects to All Other Resources.

Methodology for Analysis

Groundwater Development Construction and Facility Maintenance

- The methods listed under ROWs were applied to project groundwater development activities.

Groundwater Pumping

- GIS was used to identify the acreage of each SSURGO soil map unit within the 10-foot drawdown contours of all delineated Risk Zones in each hydrologic basin.
- The GIS datasets were imported into the SSURGO tabular database to identify the hydric soils and to calculate the acreage by using the percentage of each hydric component within each soil map unit.
- The data were summarized to compare the total acreage of hydric soils in the 10-foot drawdown area of each hydrologic basin under each alternative and time period to the existing acreage of hydric soils within the High Risk Zones in order to compare the percent change under each alternative.

3.4.2.9 Proposed Action

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of ROWs and ancillary facilities. Maximum total surface disturbance would be approximately 8,300 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 1,680 acres, would be committed to long-term industrial use. Where well pads are developed, grading and leveling would be required to construct these facilities, with the greatest level of effort required on more steeply sloping terrain. Where connector pipelines are added, impacts would be similar to what is described for the ROW Areas associated with the main pipeline.

During construction, the soil profiles would be mixed with a corresponding loss of soil structure. Soils may be compacted as a result of the construction of wells and associated facilities due to continued vehicle and foot traffic. The types of impacts associated with the maintenance of groundwater development areas would be similar to those described for operation and maintenance of ROWs and ancillary facilities. The extent of the impacts would be less because a smaller acreage would be affected. Where they occur, the impacts to soils would be limited to small areas where pipeline or well maintenance activities are performed.

Over 30 years or more, an eventual change in the morphology of hydric soils and the plant communities they support would be anticipated in areas where existing shallow groundwater would be lowered due to pumping.

A long-term loss of soil productivity and quality would occur on the acreage of permanent facilities and permanent access roads. These impacts would begin as the soils are subjected to grading and construction activities. Rutting and soil mixing could occur from vehicle traffic on access roads especially when moist or wet. Rutting disrupts the natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows, and may create accelerated erosion adjacent to the roads.

Proposed mitigation measures: No additional mitigation measures are needed.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

Groundwater Pumping

Hydric soils that do not have an alternative source of water, such as overbank flooding near streams or a perched water table, are likely to have morphological changes where drawdown lowers the shallow water table more than 10 feet. Over 30 years or more, the lack of intermittent saturation of soils during the growing season would cause hydric soils to no longer meet the hydric criteria, which may result in an eventual change to plant communities, especially in wetlands.

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-7** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-7 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for the Proposed Action

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	99
Lake Valley	3,852	—	—	3,221
Lower Meadow Valley Wash	825	—	—	11
Pahranagat Valley	1,178	—	—	157
Snake Valley	42,641	—	1,838	1,976
Spring Valley (184)	26,766	1,862	11,304	14,600
Steptoe Valley	40,282	—	—	13
Total acres	**119,461**	**1,862**	**13,143**	**20,077**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Based on a literature review of phreatophytic vegetation responses to groundwater drawdown (Section 3.5, Vegetation), it is expected that there would be changes in species composition, but overall plant cover would likely remain similar to baseline conditions over time. Therefore, it is unlikely that there would be an increase in soil erosion due to decreases in hydric soils and associated changes in plant communities. The maintenance of a relatively constant plant canopy cover and soil stabilization by plant roots may vary from place to place, depending on the soil chemistry and texture, alterations of soil biological and physical crusts, and the proximity of seed sources of plants that are adapted to changing soil moisture conditions.

Hydric soils may underlie small wetland and riparian communities associated with smaller springs and the riparian zone along perennial stream channels. Groundwater drawdown could reduce the soil moisture availability in these areas, with consequent changes in hydric soil morphology over the long term, depending on the reliability of spring and stream flows. The location and magnitude of flow effects of springs and streams are addressed by alternative in Water Resources, Section 3.3, and potential drawdown effects on wetland and meadow plant communities are discussed in Section 3.5, Vegetation.

ACMs would be implemented to reduce groundwater pumping effects on environmental resources. Several of the adaptive management measures could reduce impacts on hydric soils, as described below.

- Modify use of SNWA's agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley (ACM C.2.15).
- Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring (184) and Snake valleys (ACM C.2.5). This measure would provide soil stability.
- Conduct facilitated recharge projects to offset local groundwater drawdown (ACM C.2.21).

Proposed mitigation measures:

None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Spring (184), Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects could be applied to Proposed Action pumping to reduce effects on environmental resources including hydric soils.

3.4.2.10 Alternative A

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. Maximum total surface disturbance would be approximately 4,700 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 960 acres would be committed to long-term industrial use.

Proposed mitigation measures:

None.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-8** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-8 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative A

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Lake Valley	3,852	—	—	1,767
Snake Valley	42,641	—	1,788	1,958
Spring Valley (184)	26,766	655	5,586	8,199
Total acres	**73,259**	**655**	**7,374**	**11,924**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed mitigation measures: None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Snake, and Lake valleys would have potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.2.11 Alternative B

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would be approximately 4,600 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 930 acres would be committed to long-term industrial use.

Proposed mitigation measures:

None.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-9** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Table 3.4-9 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative B

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	99
Lake Valley	3,852	—	332	3,248
Lower Meadow Valley Wash	825	—	—	11
Pahranagat Valley	1,178	—	—	157
Snake Valley	42,641	—	1,973	2,005
Spring Valley (184)	26,766	1,047	4,499	6,460
Steptoe Valley	40,282	—	12	25
Total acres	**119,461**	**1,047**	**6,817**	**12,005**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

Proposed mitigation measures:

None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Spring (184), Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.2.12 Alternative C

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would be approximately 4,800 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 960 acres would be committed to long-term industrial use.

Proposed mitigation measures:

None.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-10** summarizes the amount of hydric soils that are at risk from drawdown. “At risk” means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-10 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative C

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre)[1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Snake Valley	42,641	—	1,380	1,748
Spring Valley (184)	26,766	655	1,246	1,246
Total acres	**69,407**	**655**	**2,626**	**2,995**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA’s use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed mitigation measures:

None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Snake and Spring (184) valleys would have potential impacts to hydric soils. ACMs involving modification of the SNWA’s agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.2.13 Alternative D

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would be approximately 4,000 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 800 acres would be committed to long-term industrial use.

Proposed mitigation measures:

None.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-11** summarizes the amount of hydric soils that are at risk from drawdown. “At risk” means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-11 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative D

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Cave Valley	3,916	—	—	45
Lake Valley	3,852	8	196	3,248
Snake Valley	42,641	—	41	714
Spring Valley (184)	26,766	98	906	2,358
Steptoe Valley	40,282	—	—	11
Total acres	**117,458**	**106**	**1,143**	**6,377**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA’s use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed mitigation measures:

None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Lake, Spring (184), and Snake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA’s agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.2.14 Alternative E

Groundwater Development Area

All Impact Issues

The types of impacts associated with the construction of groundwater development areas would be similar those described for construction of Proposed Action ROWs and ancillary facilities. The maximum extent of the surface disturbance impacts would be approximately 4,000 acres. It is assumed that approximately 20 percent of the construction surface disturbance, or 820 acres would be committed to long-term industrial use.

Groundwater Pumping

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table currently is within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-12** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and **Appendix F3.3.8**).

Table 3.4-12 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for Alternative E

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre) [1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Lake Valley	3,852	—	—	1,597
Spring Valley (184)	26,766	655	5,586	8,088
Steptoe Valley	40,282	—	—	11
Total acres	**70,900**	**655**	**5,586**	**9,696**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include the SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Proposed mitigation measures:

None.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Spring (184) and Lake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.2.15 No Action

Groundwater Development Area

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Soils would continue to be influenced by natural events such as drought and fire, and land use activities including grazing and existing water diversions. Management activities on public lands would continue to be directed by the Ely and Las Vegas RMPs, which include measures to maintain soil stability and productivity. Management guidance for other public lands in the project study area would be provided by Great Basin National Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Under the No Action Alternative, only already approved pumping would be implemented. The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table currently is within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. **Table 3.4-13** summarizes the amount of hydric soils that are at risk from drawdown. "At risk" means that the hydric soils may be morphologically altered by drawdown. The table lists the estimated total acreage of hydric soils in each basin affected and the acreage of hydric soils in each basin that would be at risk from drawdown due to pumping (within the high and moderate risk zones described in the Water Resources section **Table 3.3.2-3** and Appendix **F3.3.8**).

Table 3.4-13 Estimate of Impacts to Hydric Soils from Drawdown within High and Moderate Risk Zones for the No Action Alternative

Basins with Hydric Soils Affected by Drawdown	Total Hydric Soils in Basin (acre)[1]	Hydric Soils at Risk from Drawdown (acre)		
		Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Clover Valley	33	5	5	13
Lake Valley	3,852	619	1,342	2,589
Lower Meadow Valley Wash	825	14	19	20
Panaca Valley	138	27	85	85
Spring Valley (184)	26,766	12	70	122
White River Valley	3,562	—	51	239
Total acres	**35,175**	**676**	**1,571**	**3,068**

[1] Based on SSURGO map data.

Note: "At Risk" refers to hydric soils potentially affected by drawdown in High or Moderate Risk Zones. Where no hydric soils would be at risk, cell is marked with the — symbol.

3.4.2.16 Alternatives Comparison

Hydric soils would be affected in Spring (184) Valley under all pumping alternatives and Snake Valley under all but Alternative E to varying degrees. Drawdown lasting longer than 30 years, which is assumed to be the case for these projected long pumping scenarios, would result in morphologic changes to hydric soils causing the soils to become non-hydric. The change from hydric to non-hydric soils would mean that these soils could no longer support phreatophytes and other hydrophytic vegetation. **Table 3.4-14** provides a comparison of projected impacts to hydric soils under each pumping alternative.

Table 3.4-14 Comparison of Impacts to Hydric Soils from Groundwater Pumping

Alternative	Hydrologic Basins Most Affected (in descending order of magnitude)	Maximum area[1] (acres) of hydric soils potentially affected by 10-foot pumping drawdown within High and Moderate Risk Zones
Proposed Action	Spring (184), Lake, Snake	20,077
A	Spring (184), Snake, Lake	11,924
B	Spring (184), Lake, Snake	12,005
C	Snake, Spring (184)	2,995
D	Lake, Spring (184), Snake	6,377
E	Spring (184), Lake	9,696
No Action	Lake, White River	3,068

[1] Maximum area indicates drawdown effects from the full build out plus 200 years time frame.

3.4.3 Cumulative Impacts

3.4.3.1 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Potential disturbance to soils causing accelerated erosion.
- Potential disturbance to soils causing compaction due to vehicle traffic.
- Reclamation in areas with poor vegetation growth characteristics.
- Disturbance to soils containing contaminants.
- Long-term soil quality concerns.

Groundwater Pumping

- Potential effects of groundwater drawdown on hydric soils and the vegetation supported by these soils.

3.4.3.2 Assumptions

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Study area. The soils cumulative study area encompasses the proposed ROW project surface disturbance area (pipelines, power facilities, and roads) for each project alternative plus the total project groundwater development area surface disturbance footprint (well pads, roads, gathering pipelines, power lines) within each hydrologic basin affected. The overall rationale for this cumulative study area is that the majority of the changes in soils occur within areas where soils have been disturbed.
- Time Frames. Effects range from 2 to 5 years after surface disturbance initially occurs.
- The past and present actions footprints are based on utility ROWs and other surface disturbance activities identified in the BLM and other databases (Section 2.8).
- The RFFAs are those outlined in Section 2.9.
- When soils are disturbed, management concern include compaction, problems related to low reclamation potential, and accelerated wind and water erosion,.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations (**Figure 2.9-1**, Chapter 2).
- Time frames. Effects range from full build out of the entire project (at approximately 2050) to full build out plus 200 years. Existing hydric soils located within areas where saturated conditions during the growing season no longer occur for a period of 30 years are likely to exhibit morphological changes in soil color and ferrous iron content (Hayes and Vepraskas 2000). One cause of change in the source of water that creates saturated conditions is the drawdown of shallow groundwater. In some cases, it may take longer than 30 years of lowered groundwater levels to observe these morphological changes.

3.4.3.3 Methodology for Analysis

Rights-of-way and Groundwater Development Area Construction and Maintenance

- The cumulative surface disturbance effects to vegetation communities by hydrologic basin were estimated by overlaying the existing surface disturbances for past and present actions, RFFAs, and the development areas for the project alternative being evaluated. The estimated cumulative surface disturbance was then compared with the overall area of the hydrologic basin affected. Potential effects on vegetation communities that occupy relatively small areas within individual basins, such as wetlands, were considered.

Groundwater Pumping

- GIS was used to identify the acreage of each SSURGO soil map unit within the 10-foot drawdown contours of all delineated Risk Zones in each hydrologic basin.
- The GIS datasets were imported into the SSURGO tabular database to identify the hydric soils and to calculate the acreage by using the percentage of each hydric component within each soil map unit.
- The data were summarized to compare the total acreage of hydric soils in the 10-foot drawdown area of each hydrologic basin under each alternative and time period to the existing acreage of hydric soils within the High Risk Zones in order to compare the percent change under each alternative.

3.4.3.4 No Action

Rights-of-way and Groundwater Development Area Construction and Maintenance

Under the No Action Alternative, soils would continue to be influenced by natural events such as drought and fire and land use activities including grazing and existing water diversions. Other surface disturbing projects, such as renewable energy development projects and associated electrical transmission projects, would be constructed. An estimated 917,130 acres have been disturbed by past and present actions. Management activities on public lands would continue to be directed by the Ely and Las Vegas RMPs, which include measures to maintain soil stability and productivity. Management guidance for other public lands in the project study area would be provided by Great Basin National Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping Effects

Under the No Action Alternative, only already approved pumping would be implemented. The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term. Steptoe and Lake Valleys would have the most hydric soils affected by drawdown due to groundwater pumping for the past and present actions and RFFAs. The total acreage of hydric soils at risk would be 3,546 acres at full build out, 6,521 acres at full build out plus 75 years, and 8,798 acres at full build out plus 200 years.

3.4.3.5 Proposed Action

Rights-of-way and Groundwater Development Area Construction and Maintenance

The areas where the surface disturbance (12,303 acres) potentially would overlap with past and present actions and RFFAs (942,000 acres) (see **Figures 2.9-1** and **2.9-2**, and **Table 2.9-1**, Chapter 2) include existing road and highway crossings in all hydrologic basins affected. The projected surface disturbance amounts to approximately 9 percent of the affected basins.

Residual impacts include:

- Short-term disturbance to soils during construction would be difficult to stabilize in most of the basins.
- Unsuccessful or slow revegetation could lead to increased erosion on bare soil surfaces. Erosion of the topsoil would lead to a long-term loss of soil productivity in discrete locations.
- A long-term or permanent loss of soil productivity and quality would occur in association with permanent ancillary facilities and permanent access roads.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-3 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Proposed Action to the cumulative impacts of the Proposed Action pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just the Proposed Action compared to the Proposed Action plus the past and present actions and RFFAs (Proposed Action Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where the Proposed Action impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Proposed Action Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under the Proposed Action, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between the Proposed Action impacts and Proposed Action Cumulative impacts in Snake Valley is very small.

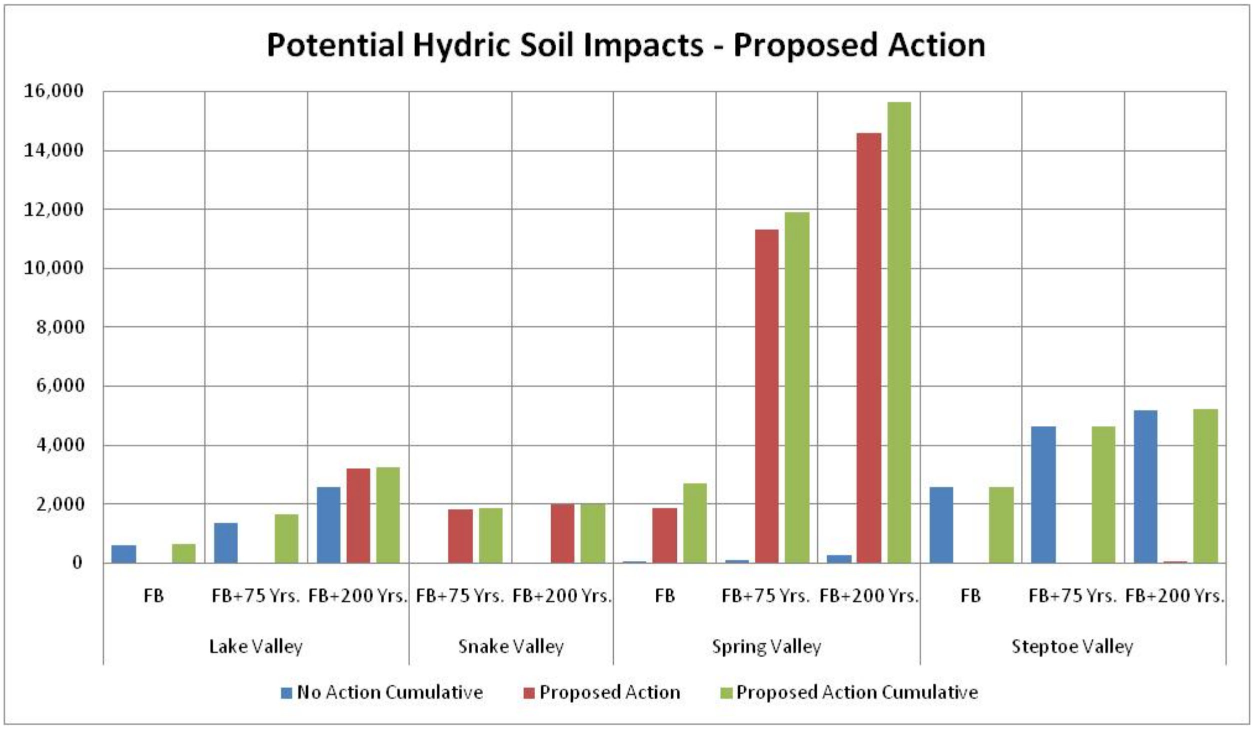


Figure 3.4-3 Potential Hydric Soil Impacts – Proposed Action

Based on a literature review of phreatophytic vegetation responses to groundwater drawdown (Section 3.5, Vegetation), it is expected that there would be changes in species composition, but overall plant cover likely would remain similar to baseline conditions over time. Therefore, it is unlikely that there would be an increase in soil erosion due to decreases in hydric soils and associated plant communities. The maintenance of a relatively constant plant canopy cover and soil stabilization by plant roots may vary from place to place, depending on the soil chemistry and texture, alterations of soil biological and physical crusts, and the proximity of seed sources of plants that are adapted to changing soil moisture conditions.

Hydric soils may underlie small wetland and riparian communities associated with smaller springs and the riparian zone along perennial stream channels. Groundwater drawdown could reduce the soil moisture availability in these areas, with consequent changes in hydric soil morphology over the long term, depending on the reliability of spring and stream flows. The location and magnitude of flow effects of springs and streams are addressed by alternative in Section 3.3, Water Resources, and potential drawdown effects on wetland and meadow communities are discussed in Section 3.5, Vegetation.

ACMs would be implemented to reduce groundwater pumping effects on environmental resources. Several of the adaptive management measures could reduce impacts on hydric soils, as described below.

- Modify use of SNWA's agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley (ACM C.2.15).
- Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring (184) and Snake valleys (ACM C.2.5). This measure would improve soil stability.
- Conduct facilitated recharge projects to offset local groundwater drawdown (ACM C.2.21).

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects could be applied to Proposed Action pumping to reduce effects on environmental resources including hydric soils.

3.4.3.6 Alternative A

Rights-of-way Groundwater Development Area Construction and Maintenance

The types and acreage of cumulative impacts to soils associated with the construction of ROWs and groundwater development areas would be similar those described for the Proposed Action.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-4 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative A to the cumulative impacts of Alternative A pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative A compared to the Alternative A plus the past and present actions and RFFAs (Alternative A Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative A impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative A Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative A, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between Alternative A impacts and Alternative A Cumulative impacts in Snake Valley is very small.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

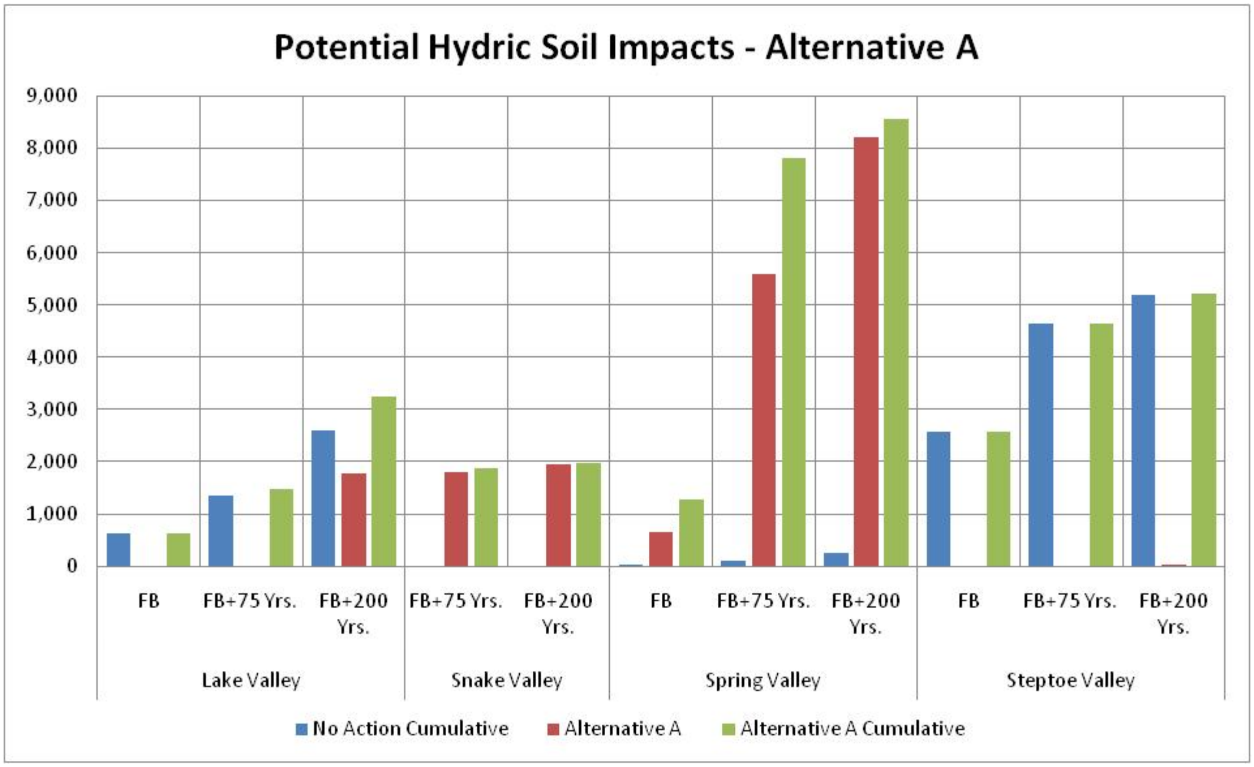


Figure 3.4-4 Potential Hydric Soil Impacts – Alternative A

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.7 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

All Impact Issues

The types and acreage of cumulative impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities. Overall surface disturbance within the groundwater development areas would be slightly less than the Proposed Action.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-5 visually compares the quantity of hydric soils at risk due to groundwater pumping from Alternative B to the cumulative impacts of Alternative B pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative B compared to Alternative B plus the past and present actions and RFFAs (Alternative B Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative B impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative B Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative B, Lake Valley has greater amounts of hydric soils at risk at full build out plus 75 years than Alternative B, and the incremental difference between Alternative B impacts and Alternative B Cumulative impacts in Snake Valley is very small.

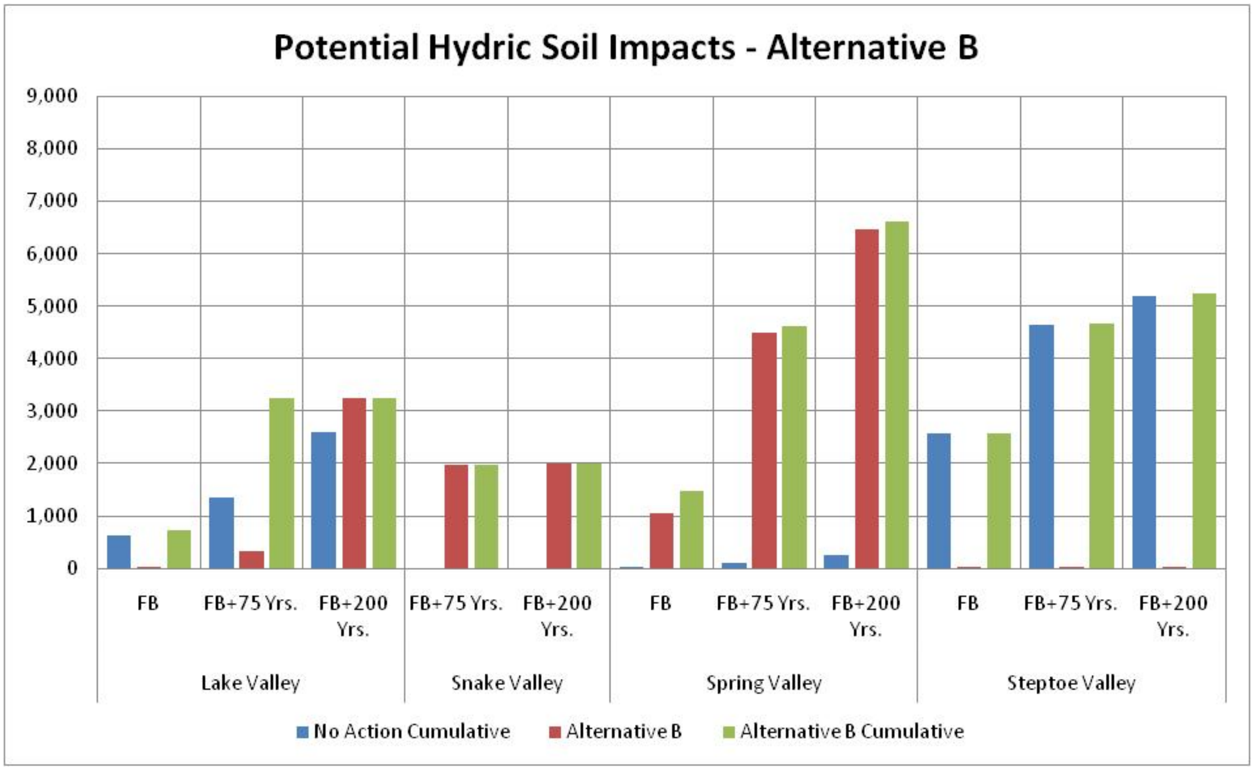


Figure 3.4-5 Potential Hydric Soil Impacts – Alternative B

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.8 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types and acreage of cumulative surface impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-6 visually compares the quantity of hydric soils at risk due to groundwater pumping from Alternative C to the cumulative impacts of Alternative C pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative C compared to Alternative C plus the past and present actions and RFFAs (Alternative C Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative C impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative C Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Snake Valley would be the most affected under Alternative C, closely followed by Spring Valley, Lake Valley has minor amounts of hydric soils at risk, and the incremental difference between Alternative C impacts and Alternative C Cumulative impacts in Snake Valley is very small.

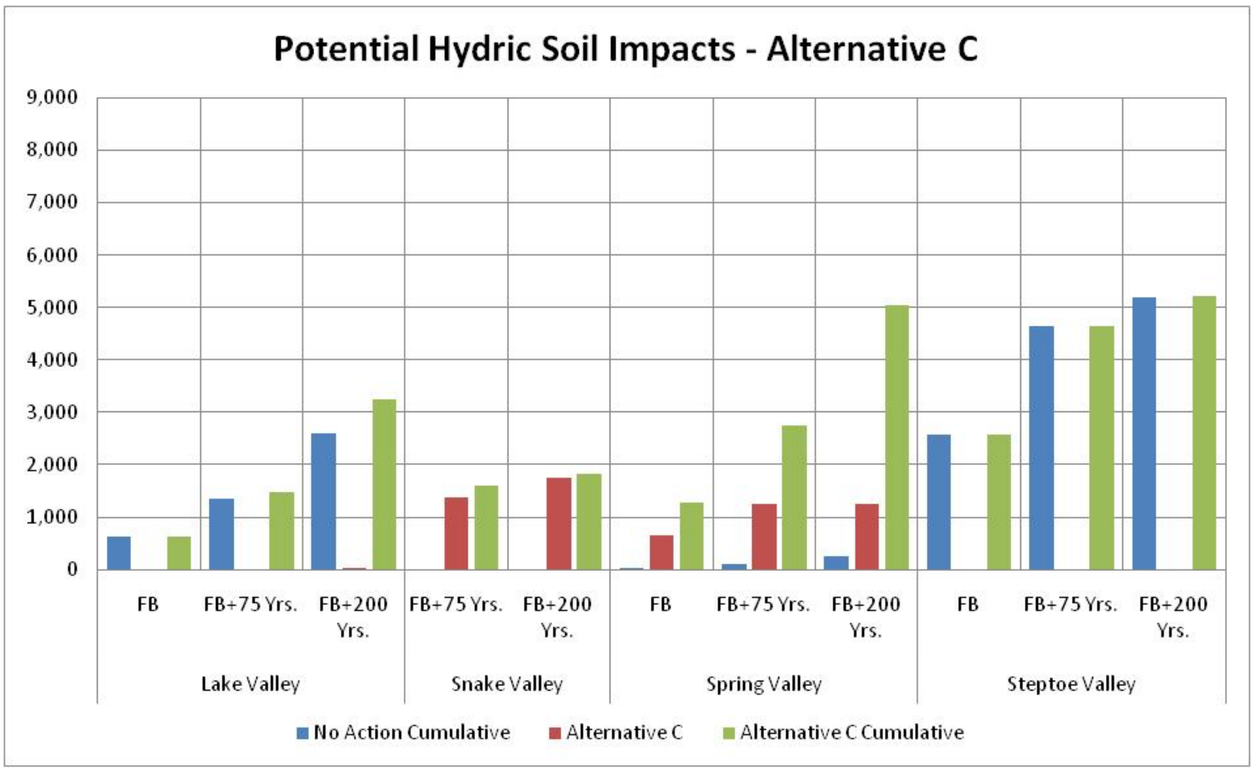


Figure 3.4-6 Potential Hydric Soil Impacts – Alternative C

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Steptoe, Spring (184), Lake, and Snake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.9 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types of cumulative impacts to soils would be similar to those described for construction of Proposed Action ROWs and ancillary facilities. Overall acreage of surface disturbance would be less because groundwater development would not occur in northern Spring (184) and Snake valleys.

Residual impacts include:

- Same as those described for the Proposed Action.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-7 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative D to the cumulative impacts of Alternative D pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative D compared to the Alternative D plus the past and present actions and RFFAs (Alternative D Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative D impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative D Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Lake Valley would be the most affected under Alternative D, followed by Spring Valley, and the incremental difference between Alternative D impacts and Alternative D Cumulative impacts in Snake Valley is very small.

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

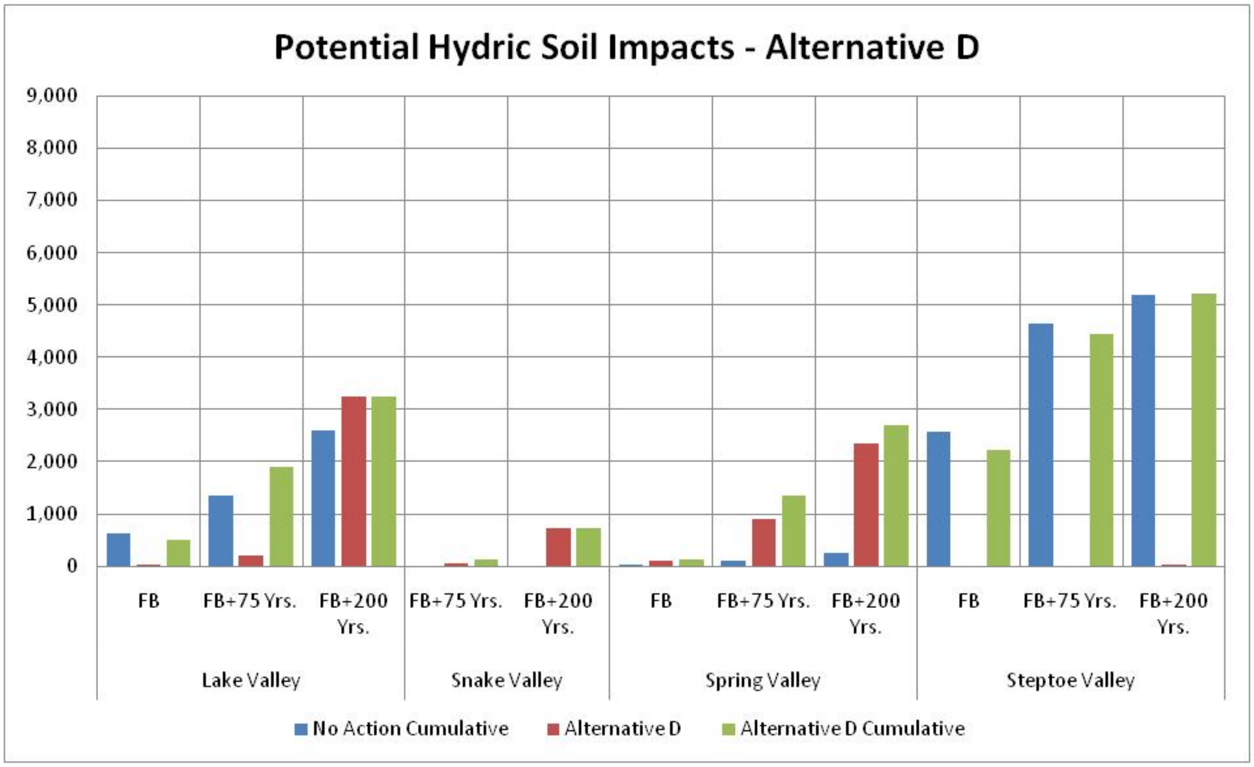


Figure 3.4-7 Potential Hydric Soil Impacts – Alternative D

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Steptoe, Lake, and Spring (184) valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.10 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

The types of cumulative impacts to soils would be similar to those described for construction of ROWs and ancillary facilities. Overall acreage of surface disturbance would be less because groundwater development would not occur in Snake Valley.

Groundwater Pumping Effects

The areas most likely to have changes in hydric soils are those in the High and Moderate Risk Zones where the groundwater table is currently within 10 feet of the surface and would be deeper than 10 feet below the surface after drawdown due to pumping. Drawdown of groundwater levels would reduce the source of water that sustains hydric soils over the long term.

Figure 3.4-8 visually compares the quantity of hydric soils at risk due to groundwater pumping from the Alternative E to the cumulative impacts of Alternative E pumping with all past and present actions and RFFAs included. Also displayed is the amount of hydric soils that would be affected by just the past and present actions and RFFAs under No Action (Cumulative) into the future. For display purposes, any valleys with less than 500 acres of hydric soils affected are not shown. The incremental differences in the extent of hydric soils affected by just Alternative E compared to the Alternative E plus the past and present actions and RFFAs (Alternative E Cumulative) and No Action Cumulative pumping is readily visible. Note that in the basins where Alternative E impacts to hydric soils are minor (shown by a blank space or very small red bar), the bars for No Action and Alternative E Cumulative are equal or close to equal, indicating little or no contribution to impacts on hydric soils due to drawdown in those valleys during the projected time periods. The chart shows that Spring Valley would be the most affected under Alternative E, Lake Valley has minor amounts of hydric soils at risk until full build out plus 200 years, and the incremental difference between Alternative E impacts and there would be no effect on hydric soils in Snake Valley due to pumping.

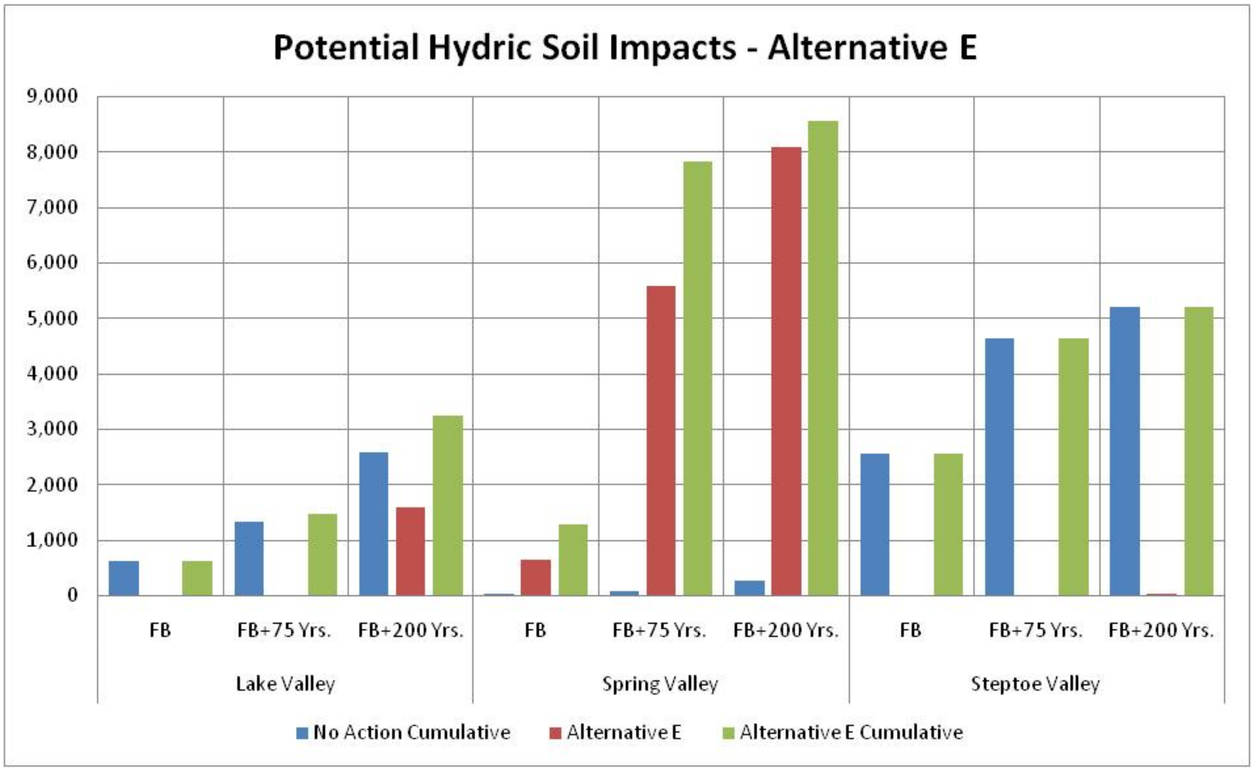


Figure 3.4-8 Potential Hydric Soil Impacts – Alternative E

The same ACMs would be implemented to reduce groundwater pumping effects on environmental resources including hydric soils. The adaptive management measures that would reduce effects on hydric soils include SNWA's use of agricultural water rights in Spring Valley (184) to offset changes in spring discharges needed to maintain wet meadows in the northwest and southeast portions of the valley, large-scale seeding, and facilitated recharge projects.

Residual impacts include:

- Based on the model simulations and the 10-foot drawdown contour, pumping would reduce the source of water that sustains hydric soils. Spring (184), Steptoe, and Lake valleys would have the most extensive potential impacts to hydric soils. Long-term drying of hydric soils may permanently reduce the ability of these soils to support wetland vegetation. ACMs involving modification of the SNWA's agricultural water rights, large scale seeding, and facilitated recharge projects would be applied to reduce effects on environmental resources including hydric soils.

3.4.3.11 Comparison of Cumulative Impacts to Hydric Soils

Table 3.4-15 summarizes the maximum acreage of hydric soils that may be affected by groundwater drawdown when considering the total contribution of the proposed project pumping alternatives in combination with the past and present actions and RFFAs that involve groundwater pumping.

Table 3.4-15 Comparison of Cumulative Impacts to Hydric Soils from Groundwater Pumping

Project Alternative plus RFFAs and Past and Present Actions (Cumulative)	Hydrologic Basins Most Affected (in descending order of magnitude)	Maximum area[1] (acres) of hydric soils potentially affected by 10-foot pumping drawdown within High and Moderate Risk Zones
Proposed Action	Spring (184), Steptoe, Lake	26,936
A	Spring (184), Steptoe, Lake, Snake	19,839
B	Spring (184), Steptoe, Lake, Snake	18,022
C	Steptoe, Spring (184), Lake, Snake	16,110
D	Steptoe, Lake, Spring (184)	12,712
E	Spring (184), Steptoe, Lake	17,854
No Action	Steptoe, Lake	8,798