3.2 Geology, Soil, and Seismicity

The proposed Energy Facility would be located in a subbasin of the Klamath Basin. The Energy Facility site, the natural gas pipeline, and the water supply pipeline would not have substantial changes in elevations where they are sited but the electric transmission line would. Two landslide areas have been observed in the vicinity of the electric transmission lines, and the transmission towers have been sited away from them.

Earthquakes are likely within the basin. However, the risk to human safety and the destruction of improvements would be minimized through the design and construction of the Facility, so impacts would be low.

The Energy Facility would cause the permanent disturbance during the 30-year operating life of the Energy Facility to approximately 13.1 acres of nonirrigated, high-value farmland soil. However, this soil is not considered prime farmland by the Natural Resources Conservation Service (NRCS) because it is not irrigated. Construction and operation of the Energy Facility could cause wind and water erosion. However, the implementation of BMPs and the National Pollutant Discharge Elimination System (NPDES) permits during construction and operation would minimize those impacts.

The information presented in this section is based on the studies and analysis conducted for the SCA as amended by Amendments No. 1 and No. 2, filed with EFSC on July 25, 2003, and October 15, 2003, respectively.

3.2.1 Affected Environment

The Energy Facility site is located in a subbasin of the larger Klamath Basin in south-central Oregon. The Klamath Basin is a composite graben that forms the westernmost structural trough of the Basin and Range physiographic province. The Klamath graben is bounded by predominantly north- to northwest-striking normal faults. The geology and topography of the Facility site are summarized below and shown in Figure 3.2-1.

3.2.1.1 Topography

Energy Facility Site. Most of the Energy Facility site is proposed in relatively flat agricultural fields. The site slopes gently upward towards the northeast to a low ridge. The total elevation difference is about 135 feet from the low point at elevation 4,205 feet in a field on the southeast end of the site to the top of the low ridge at elevation 4,340 feet at the northern end of the site.

Electric Transmission Line Easement. The electric transmission line easement would have substantial topographic relief. From the Energy Facility site, the alignment would extend southwestward up the steep slope of the Bryant Mountain ridge. From the top of the ridge, the alignment would trend generally south-southwestward, crossing a number of gently sloping upland ridges. The alignment would then turn south-southeastward and run subparallel to an upland ridge. Near its southern terminus, the alignment would cross a 30-foot-high rock cliff. The total elevation change along the alignment would be about 590 feet, with the low point of 4,290 feet elevation at the Energy Facility site and a high point of 4,880 feet elevation near the southern end of the alignment.

Natural Gas Pipeline Easement. The natural gas pipeline easement would follow along West Langell Valley and Harpold Roads. The easement would cross county roads in three places, and an irrigation canal in one place. The slopes would be very gentle, with a total elevation difference along the alignment of about 185 feet. The low point of 4,120 feet elevation would occur within the floodplain of the Lost River along Harpold Road. The high point of 4,305 feet elevation would occur along West Langell Valley Road just southwest of the Energy Facility site.

Water Supply Pipeline Easement. The water supply pipeline easement would cross several low ridges and basins from the raw water supply storage tank to the existing water supply well. In addition, the alignment would cross two paved Klamath County roads and three irrigation ditches. The alignment would also cross under the existing electric transmission lines that extend through the proposed Energy Facility site. The total elevation change would be about 235 feet, with the low point of 4,130 feet elevation at the water supply well and the high point of 4,365 feet elevation along the low ridge just north of the proposed Energy Facility site.

3.2.1.2 Geological Features

The following summarizes the geological features of the Energy Facility.

Energy Facility Site. Information provided on the Energy Facility site is based on the *Preliminary Geotechnical Engineering Report, COB Energy Facility, Bonanza, Oregon* (GeoEngineers, 2002).

The Energy Facility site would be partially underlain by Tertiary-age basalts that erupted from 15 million to 4 million years ago from multiple volcanic vents. The intact basalt is generally highly to closely fractured, hard, moderately weathered, blocky to massive, and moderately strong. Individual flows are typically 10 feet thick. The tops of flows are fractured and weathered. In addition, the top 5 to 10 feet of basalt are highly fractured and locally weathered to a gravelly soil.

Overlying and interbedded with the basalt units is a volcaniclastic rock that is massive, soft to moderately hard, severely to moderately weathered, blocky, and weak to moderately strong. The uppermost portion of this unit is highly weathered and has the properties of a very dense soil.

A very generalized distribution of these units is that basalt directly underlies steep slopes and upland areas and the volcaniclastic rock is the uppermost unit underlying the flatter basins and areas with agricultural fields.

Overlying the volcaniclastic rock in the flat-lying basins is a volcanic ash that is attributed to the eruption of Mount Mazama (Crater Lake). The ash has an age of about 6,000 years. The ash is a fine elastic silt that is slightly cemented giving it a stiff and to hard consistency. It ranges in thickness from 0 feet thick at the fringes of the basins to more than 39 feet thick in the middle of the basins.

Recent surficial soil mantles the other geologic units. In the steeply sloping and upland areas where basalt bedrock is exposed or close to the surface, the soil consists of a mixture of silt, sand, gravel, cobbles and boulders. The thickness ranges from 0 feet to about 5 feet. Within the flatter lying basins, the surficial soil ranges from a silty sand to a silt with sand.

This soil also contains occasional to some gravel. The thickness of the basin surficial soil is 5 to 13 feet in the vicinity of the proposed Energy Facility site. In the agricultural fields, the upper 18 inches of soil has been loosened by tilling activities.

An unmapped normal fault occurs along the base of Bryant Mountain, immediately to the southwest of the Energy Facility site. The inferred trace of the fault is shown in Figure 3.2-1. The fault trends northwest-southeast and is at least 10 miles in length. The bedrock has been uplifted on the southwest side of the fault, giving rise to Bryant Mountain, and down-dropped on the northeast side, resulting in the basin where the Energy Facility site would be located. The fault likely dips to the northeast, extending beneath the proposed Energy Facility site.

Natural Gas Pipeline Easement. Rock and soil units along the natural gas pipeline easement appear to be similar to those at the proposed Energy Facility site. However, no subsurface information currently exists for the easement. Shallow basalt bedrock occurs along only 20 percent of the alignment, mostly near the Energy Facility site. The subsurface soil is presumably similar to the agricultural fields at the proposed Energy Facility site. There may be recent alluvial sands and silts located along Harpold Road, which roughly parallels the Lost River.

The extension of the fault along the base of Bryant Mountain ridge crosses the proposed natural gas pipeline along Harpold Road. The trace of the fault is not apparent as it crosses under the Lost River floodplain north of Harpold Road.

Electric Transmission Line Easement. The rock and soil units along the proposed electric transmission line easement appear to be similar to the proposed Energy Facility site. However, no subsurface information currently exists for the easement. More than 90 percent of the easement has shallow bedrock. The rock is mostly basalt, although some volcani-clastic rock could also be present. Soil is shallow and consists of mixtures of silt, sand, gravel, cobbles, and boulders.

An ancient landslide has been identified where the northern section of the proposed electric transmission line easement would extend up the steep slope that forms the Bryant Mountain Ridge, southwest of the Energy Facility. No signs of recent movement were observed in the field or on air photos. The electric transmission line route was relocated around the ancient landslide.

The alignment would cross a cliff created by resistant basalt. The cliff is about 30 feet high and consists of columnar jointed basalt. The columns are wide and are up to about 8 feet in diameter. In addition, it is common for the columnar joints to be open by as much as several feet. This indicates that the columns are slowly toppling. Transmission towers would be located to span over this cliff area. The landslide and rock cliff are shown in Figure 3.2-1.

The electric transmission line easement would traverse several faults. The fault along the base of Bryant Mountain ridge would cross the easement on the far north end near the Energy Facility. At its southern end the transmission line would cross a mapped fault (Walker and MacLeod, 1991). This is a normal fault that is down-dropped to the northeast, similar to the Bryant Mountain ridge fault. It runs subparallel to the easement for a short distance. These faults are shown in Figure 3.2-1. There are undoubtedly other unmapped normal faults crossing the easement that have less obvious topographic expression.

Water Supply Pipeline Easement. The rock and soil units that would be along the water supply pipeline easement appear to be similar to the Energy Facility site composition. However, no subsurface information currently exists for the easement. Sloping and upland areas are underlain by basalt. Flat-lying basins with agricultural fields are likely underlain by volcaniclastic rock and volcanic ash. Shallow basalt bedrock occurs along about 50 percent of the easement. Shallow and deep soil both occur and are assumed to be similar to soil at the Energy Facility site.

The water supply pipeline easement would cross several unmapped normal faults. These faults trend northwest-southeast and are down-dropped on the northeast side similar to the Bryant Mountain ridge fault. The inferred fault traces are shown in Figure 3.2-1.

3.2.1.3 Soil

The near-surface soil at the Energy Facility site and vicinity was identified using the Natural Resources Conservation Service (NRCS, formerly Soil Conservation Service) Soil Survey of Klamath County, Oregon, Southern Part (NRCS, 1985). The soil survey describes soil conditions in the upper 5 feet and classifies land capability. Figure 3.2-2 shows the NRCS soil map units for the vicinity.

A preliminary soil investigation and shallow groundwater assessment was conducted in December 2002. Soil borings were made at 15 locations to a depth of 48 inches, where borings were not otherwise restricted by shallow bedrock or hardpan. Figure 3.2-3 shows the field sampling locations. Soil properties recorded for each boring included texture, moisture, effervescence (using 10 percent hydrochloric acid), and presence of cementation, hardpan, bedrock, and redoximorphic features. At selected boring locations, composite soil samples were collected to establish background soil chemical characteristics. A summary table of soil properties is presented in Table 3.2-1.

Soil Units. Sixteen soil map units were identified within the Energy Facility site footprint and the natural gas pipeline, water supply pipeline, and electric transmission line easements. A breakdown of soil areas by Facility feature for permanent and temporary disturbance is presented in Tables 3.2-2 and 3.2-3, respectively. General soil descriptions are provided below.

6B Calimus fine sandy loam, 2 to 5 percent slopes. This well-drained soil can be found on terraces and alluvial fans near the edge of warmer basins. It formed in alluvial and lacustrine sediment weathered mainly from diatomite, tuff, and basalt. Permeability is moderate, runoff is slow and erosion hazard is slight. The soil is used for irrigated crops such as Irish potatoes, alfalfa hay, barley, wheat, oats, and pasture crops.

7 Calimus loam, 0 to 2 percent slopes. This well-drained soil can be found on terraces near the edge of warmer basins. It formed in loamy sediment weathered mainly from diatomite, tuff, and basalt. Permeability is moderate, runoff is very slow, and erosion hazard is slight. The soil is used for irrigated crops such as Irish potatoes, alfalfa hay, barley, wheat, oats, and pasture crops.

7B Calimus loam, 2 to 5 percent slopes. This well-drained soil can be found on terraces and alluvial fans near the edge of warmer basins. It formed in alluvial and lacustrine sediment weathered mainly from diatomite, tuff, and basalt. Permeability is moderate, runoff is slow, and erosion hazard is slight. The soil is used for irrigated crops such as Irish potatoes, alfalfa hay, barley, wheat, oats, and pasture crops.

7C Calimus loam, 5 to 15 percent slopes. This well-drained soil can be found on terraces and alluvial fans near the edge of warmer basins. It formed in alluvial and lacustrine sediment weathered mainly from diatomite, tuff, and basalt. Permeability is moderate, runoff is medium, and erosion hazard is moderate. The soil is used for irrigated crops such as alfalfa hay, barley, wheat, oats, and pasture crops.

9B Capona loam, 2 to 5 percent slopes. This well-drained soil can be found on terraces and rock benches near the edge of warmer basins. It formed in material weathered mainly from tuff, diatomite, and basalt. Permeability is moderate, runoff is medium, and erosion hazard is moderate. The soil is used for irrigated and dryland crops such as Irish potatoes, alfalfa hay, barley, wheat, oats, pasture crops, and dryland wheat. Bedrock is at a depth of 20 to 40 inches.

23B Harriman loam, 2 to 5 percent slopes. This well-drained soil can be found on terraces near the edge of warmer basins. It formed in lacustrine sediment weathered mainly from tuff, diatomite, and basalt. Permeability is moderately slow, runoff is slow, and erosion hazard is slight. The soil is mainly used for irrigated crops such as Irish potatoes, alfalfa hay, barley, wheat, oats, pasture, and cereal hay. Lacustrine bedrock is at a depth of 40 to 60 inches.

23C Harriman loam, 5 to 15 percent slopes. This well-drained soil can be found on terraces near the edge of warmer basins and below escarpments. It formed in lacustrine sediment weathered mainly from tuff, diatomite, and basalt. Permeability is moderately slow, runoff is medium, and erosion hazard is moderate. The soil is mainly used for irrigated and dryland crops such as alfalfa hay, barley, wheat, oats, pasture, and cereal hay. Lacustrine bedrock is at a depth of 40 to 60 inches.

26 Henley loam. This somewhat poorly drained soil can be found on low terraces. It formed in alluvial and lacustrine sediment. Zero to 2 percent slopes are most common. Permeability is moderate, runoff is very slow, and erosion hazard is slight. The soil is most commonly used for irrigated pasture. Where the soil has been drained and alkali has been removed, alfalfa hay, barley, wheat, oats, and cereal hay are grown. Hardpan is at a depth of 20 to 40 inches.

28 Henley-Laki loam. This somewhat poorly drained (Henley) to moderately well-drained (Laki) soil can be found on low terraces. It formed in mixed alluvial and lacustrine sediment. Zero to 2 percent slopes are common. Permeability is moderate, runoff is very slow, and erosion hazard is slight. The soil is used for irrigated crops such as pasture, alfalfa hay, barley, wheat, oats, and cereal hay. Hardpan is at a depth of 20 to 40 inches underneath the Henley soil.

38 Laki loam. This moderately well-drained soil can be found on low terraces. It formed in very deep alluvial and lacustrine sediment weathered from basalt, diatomite, tuff, and ash. Zero to 2 percent slopes are common. Permeability is moderate, runoff is very slow, and erosion hazard is slight. The soil is used for irrigated crops such as Irish potatoes, barley, wheat, oats, cereal hay, and pasture.

40 Laki-Henley loam. This moderately well-drained (Laki) to somewhat poorly drained (Henley) soil can be found on low terraces. It formed in alluvial and lacustrine sediment weathered from diatomite, tuff, basalt, and ash. Zero to 2 percent slopes are common. Permeability is moderate, runoff is very slow, and erosion hazard is slight. The soil is used for irrigated crops such as pasture, alfalfa hay, barley, wheat, oats, cereal hay, and Irish potatoes. Hardpan is at a depth of 20 to 40 inches.

50E Lorella very stony loam, 2 to 35 percent south slopes. This well-drained soil can be found on escarpments at the edge of warmer basins that mostly face south. It formed in very cobbly and gravelly material weathered from tuff and basalt. Permeability is slow, runoff is rapid, and erosion hazard is high. The soil is used for range and wildlife habitat. Tuffaceous bedrock is at a depth of 19 inches.

51E Lorella-Calimus association, steep north slopes. This well-drained soil can be found on escarpments at the edge of warmer basins that dominantly face north. It formed in very cobbly and gravelly material weathered from tuff and basalt. Permeability is slow (Lorella) to moderate (Calimus), runoff is rapid (Lorella) to medium (Calimus), and erosion hazard is high (Lorella) to moderate (Calimus). The soil is used for range and wildlife habitat. Tuffaceous bedrock is at a depth of 19 inches.

58B Modoc fine sandy loam, 2 to 5 percent slopes. This well-drained soil can be found on terraces near the edge of basins. It formed in lacustrine sediment weathered mainly from tuff, diatomite, basalt, and a small amount of ash. Permeability is moderately slow, runoff is slow, and erosion hazard is slight. The soil is mainly used for irrigated crops such as alfalfa hay, barley, wheat, oats, pasture, cereal hay, and Irish potatoes. An indurated hardpan is at a depth of 20 to 40 inches.

74B Stukel-Capona loam, 2 to 15 percent slopes. This well-drained soil can be found on rock benches around the edges of warmer basins. It formed in material weathered mainly from tuff and diatomite. Permeability is moderate, runoff is rapid (Stukel) to medium (Capona), and erosion hazard is high. The soil is mainly used for range and irrigated crops such as pasture, barley, wheat, oats, and cereal hay. Tuffaceous bedrock is at a depth of 17 inches (Stukel) and 25 inches (Capona).

74D Stukel-Capona loam, 15 to 25 percent slopes. This well-drained soil can be found on rock benches around the edges of warmer basins. It formed in material weathered mainly from tuff and diatomite. Permeability is moderate, runoff is rapid (Stukel) to medium (Capona), and erosion hazard is high. The soil is mainly used for range and wildlife habitat. Tuffaceous bedrock is at a depth of 17 inches (Stukel) and 25 inches (Capona).

Identification of Farmland Soil. Prime and unique farmlands are protected under the Federal Farmland Protection Act (FFPA) of 1984 (7 CFR Part 658.2). The FFPA recognizes that lands within the urban growth boundary (UGB) are committed to urban development, regardless of soil type. However, proposed projects outside the UGB are subject to evaluation by the Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS).

The following soil types encountered at the Energy Facility site are classified as prime farmland by the NRCS under certain conditions:

Class 1 Soil. No soil listed by the state of Oregon as Class 1, nonirrigated, high-value farmland soil for southern Klamath County (OAR 660-033-0020) would be permanently disturbed by construction of the Energy Facility site.

A total of 9.6 acres along the electric transmission line route is listed as prime or Class 1, nonirrigated, high-value soil for southern Klamath County (OAR 660-33-020). The soil type is 23B Harriman loam, 2 to 5 percent slopes.

Class 2 Soil. The following soil types listed by the state of Oregon as Class 2, nonirrigated, high-value farmland soil for southern Klamath County (OAR 660-33-020) can be found at the Energy Facility site and the electric transmission line:

- 6B Calimus fine sandy loam, 2 to 5 percent slopes
- 7A Calimus loam, 0 to 2 percent slopes
- 7B Calimus loam, 2 to 5 percent slopes

The NRCS identifies these soil types as prime farmland only if they are irrigated. A total of approximately 17.7 acres of these soil types fall within the Facility permanent disturbance areas. This number represents about 17 percent of the 108.7 acres of permanent disturbance during the 30-year operating life of the Energy Facility.

3.2.1.4 Seismicity

The following describes the faults present within 50- and 100-mile radii of the Energy Facility. Also described are the seismic forces at work within the project area.

Faults. Figure 3.2-1 shows inferred faults and landslides in the immediate vicinity of the proposed Energy Facility site, including one fault mapped by a CH2M HILL engineering geologist; the fault runs within a few hundred feet of the proposed Energy Facility. These faults have not previously been identified as having seismic activity and are not known to be active. One ancient landslide was observed in the vicinity of the proposed Energy Facility. The landslide shows no apparent signs of recent instability. Areas of shallow bedrock are not shown in Figure 3.2-1 because of the prevalence of shallow bedrock along the alignments. Although the faults could pose hazards, the risk to human safety and the destruction of property would be minimized through the design and construction of the Facility.

In addition to the inferred faults shown in Figure 3.2-1, faults within a 50-mile radius of the Energy Facility are summarized below. Only mapped faults are discussed. The assessment of activity is based on historical seismicity. If there is evidence for possible late Quaternary (less than 780,000 years) fault movement, the fault is considered potentially active and a probability of activity is assigned to it. Quaternary faults for which there is no evidence of displacement are not considered potentially active sources and the probability of activity is considered zero. Therefore, the lowest probability of activity is 0 and the highest probability of activity is 1.

The **West Klamath Lake Fault**, the **South Klamath Graben Zone** and the **East Klamath Graben Fault** are subdivisions of the **Klamath Graben**. The Klamath Graben is at the northwestern end of a set of complex northwest-trending horsts and grabens at the west edge of the Basin and Range structural province.

The **West Klamath Lake Fault** is located approximately 35 miles northwest of the site. It has a probability of activity of 1.0 and a total length of 40 miles.

The **South Klamath Graben Zone** has a probability of activity of 1.0 and a total length of 31 miles. It is approximately 17 miles west of the site.

The **East Klamath Graben Fault** has a probability of activity of 0.5. The total length of the fault is 12 miles. It is located approximately 42 miles north to northwest of the site.

The **Sky Lakes Fault** is a series of several 3- to 8-mile-long north-trending normal faults lying approximately 40 miles from the site. The probability of activity is 0.6. The total length of the feature is about 37 miles.

The **Mahogany Mountain Fault Zone** is a zone of northwest-trending normal faults along the northeast side of Butte Valley in north-central California near the Oregon border. The probability of activity of the Mahogany Mountain Fault Zone is 1.0 and the total length is about 17 miles. This fault zone lies approximately 30 miles southwest of the site.

The **Cedar Mountain Fault Zone** is a complex, 27-mile-long zone of north-trending normal faults in northern California near the Oregon border, approximately 23 miles southwest of the site. The probability of activity is 1.0.

The **Winter Ridge-Ana River-Slide Mountain Fault Zone** is a northwest-trending normal fault zone located about 50 miles northeast of the site. The probability of activity is 1.0. The total length of the fault zone is about 43 miles. Maximum rupture lengths considered are between 10 and 43 miles.

The **Goose Lake Graben** is a north-trending graben located along the Oregon-California border west of Warner Mountain, about 50 miles east of the site. The probability of activity is 0.8. Maximum rupture lengths of the normal fault considered are between 12 and 37 miles.

Faults within a 100-mile radius of the Energy Facility site are summarized below:

The **Southeast Newberry Zone/Crack-in-the-Ground Fault/Viewpoint Fault Zone** is a discontinuous northwest-trending fault zone located about 58 miles northwest of the site and mapped at about 40 miles in total length. Maximum rupture lengths are mapped between 16 and 25 miles. The probability of activity is 1.0.

The **Southwest Newberry Fault Zone** is an east- and west-facing group of normal faults located about 62 miles south of the Energy Facility site. The probability of activity is 0.8. A range of maximum surface rupture lengths of 6 to 16 miles is expected.

The **Chemult Graben (Western Margin)** is a discontinuous north- to northeast-trending normal fault zone located about 93 miles southwest of the site and mapped at about 34 miles in total length. Maximum rupture lengths are mapped between 19 and 34 miles. The probability of activity is 0.8.

The **Walker Rim Fault (Eastern Margin)** is located about 93 miles southwest of the site. Maximum rupture lengths are mapped between 14 and 37 miles. The probability of activity is 0.3.

The **Paulina Marsh Fault** is a northwest-trending strike slip fault located about 70 miles north of the site and mapped at about 7 miles in length. Maximum rupture lengths are expected to be between 6 and 19 miles. The probability of activity is 1.0.

The **Abert Rim Fault** is a north 15° east-trending normal fault located about 65 miles to the northeast of the site and mapped at about 30 miles in length. Maximum rupture lengths are expected to be 19 and 28 miles. The probability of activity is 1.0.

The **Surprise Valley Fault** is a normal fault located in the north-south bounded basin in northeastern California, approximately 67 miles to the southeast of the site. The fault has a mapped length of about 52 miles. Maximum rupture lengths are expected to be 19 and 52 miles. The probability of activity is 1.0.

The **Warner Valley Graben** is a predominantly normal-faulting graben that extends for a distance of more than 62 miles from northern California into southern Oregon. The fault along the eastern margin of the valley is divided into two faults sources, the East Warner Valley north and south. These faults are assigned a probability of activity of 0.5 and maximum rupture lengths between 12 and 37 miles. The fault along the western margin of the valley is characterized separately. It was assigned a probability of activity of 0.2 and maximum rupture lengths between 12 and 28 miles.

Seismic Hazard. The seismic hazard in the project area results from three seismic sources: interplate events, intraslab events, and crustal events (Geomatrix Consultants, 1995). Each of these sources has a different cause and therefore produces earthquakes with different characteristics (that is, peak ground accelerations, response spectra, and duration of strong shaking). Each source is capable of generating a peak ground acceleration (PGA) on rock at the site larger than 0.05g.

Two of the potential seismic sources, interplate and intraslab events, are related to the subduction of the Juan De Fuca plate beneath the North American plate. Interplate events occur as a result of movement at the interface of these two tectonic plates. Intraslab events originate within the subducting tectonic plate, away from its edges, when built-up stresses within the subducting plate are released. These source mechanisms are referred to as the Cascadia Subduction Zone (CSZ) source mechanism. The CSZ originates off the northern coast of California, extends along the coast of Oregon and Washington, and subducts beneath both states. The two source mechanisms associated with the CSZ are currently thought to be capable of producing moment magnitudes of about 9.0 and 7.5, respectively (Geomatrix Consultants, 1995). These moment magnitudes are the largest postulated magnitudes for the two source mechanisms. They are used as limiting values in the probabilistic model for estimating ground motions or as the source magnitude for deterministic estimates of ground motion. Interplate earthquakes are usually thrust events occurring on relatively shallow dipping faults at depths of less than about 30 miles (Geomatrix Consultants, 1995). Intraslab events are typically deeper, 25 to 45 miles, and have normal faulting mechanisms.

Earthquakes caused by movements along crustal faults, generally in the upper 10 to 15 miles, are the third source mechanism. In the vicinity of the Facility, these movements occur on the crust of the North America tectonic plate when built-up stresses near the surface are released. Several crustal faults are in the vicinity of the Energy Facility site. Faults within a 50-mile and 100-mile radius around the Facility are listed under Faults above

(Geomatrix Consultants, 1995). A magnitude 6.5 earthquake at the Klamath Graben fault zone near Klamath Falls and a magnitude 6.0 earthquake, randomly picked, 6 miles away from the Facility are considered appropriate to represent the maximum credible earthquake in the vicinity of the Facility. The selected magnitude of these events is equal to or greater than the magnitude of recorded events in southern Oregon.

Two earthquakes struck the Klamath Falls area in September 1993. Recorded magnitudes were 5.9 and 6.0. The 6.0 quake, located more than 67 miles away, was the most distant event to affect the proposed Energy Facility site.

3.2.2 Environmental Consequences and Mitigation Measures

As described below, the Energy Facility would have no significant unavoidable adverse impacts on geology, soil, or seismicity.

Impact 3.2.1. Landslides present a low risk to the proposed Energy Facility.

Assessment of Impact. One existing ancient mass landslide and one small toppling-type landslide were identified along the route of the electric transmission line during the site reconnaissance. The route has been modified to miss the ancient landslide based on visual observation and review of aerial photographs; the overall stability of the ancient landslide mass would be evaluated during the geotechnical investigation. Stability of the toppling landslide has already been evaluated and the transmission towers would be set back far enough from the top of the slope and the toe of the slope to avoid the unstable area.

Recommended Mitigation Measures. If upon further evaluation, the stability of the ancient landslide mass was found to be lacking, additional mitigation measures would be implemented, including further adjustment of the transmission tower locations and installation of instrumentation on the towers to monitor for movement.

Impact 3.2.2. The Energy Facility would have a low impact on land identified as high-value soil in Klamath County.

Assessment of Impact. The Energy Facility site would be located on a fallow field that was used for dryland grain farming until 1999, but the crop was not economical due to low productivity. The Energy Facility site has been heavily grazed and soil and vegetation productivity are low. Approximately 13.1 acres of high-value farmland soil would be permanently disturbed on the Energy Facility site.

Approximately 10.9 acres of the land within the natural gas pipeline construction easement is classified as high-value soil if irrigated. This soil would be temporarily disturbed during construction, and fully restored after pipeline installation. Because this soil is not irrigated in this location, it is not considered prime, high-value farmland soil.

Along the electric transmission line easement, 0.4 acre of land classified as high-value farmland if irrigated would be permanently disturbed. The soil along the electric transmission line easement would not be irrigated and thus is not considered prime, high-value farmland soil.

Class 1 Soil. No soil listed by the state of Oregon as Class 1, nonirrigated, high-value farmland soil for southern Klamath County (OAR 660-033-0020) would be permanently disturbed by construction of the Energy Facility site.

A total of 9.6 acres along the electric transmission line route is listed as prime or Class 1, nonirrigated, high-value soil for southern Klamath County (OAR 660-33-020). The soil type is 23B Harriman loam, 2 to 5 percent slopes.

Class 2 Soil. The following soil can be found at the Energy Facility site and the electric transmission line and is listed as Class 2, nonirrigated, high-value farmland soil for southern Klamath County (OAR 660-33-020):

- 6B Calimus fine sandy loam, 2 to 5 percent slopes
- 7A Calimus loam, 0 to 2 percent slopes
- 7B Calimus loam, 2 to 5 percent slopes

A total of approximately 23.7 acres of this soil falls within the Facility impact areas. This number represents about 23 percent of the 108.7 acres of permanent disturbance during the 30-year operating life of the Energy Facility.

A facility retirement and site restoration approach would support restoration of the Energy Facility site, to its current agricultural use. This is consistent with the current zoning of Exclusive Farm Use-Cropland (EFU-C). The approach uses topsoil salvaging and replacement, and standard farming practices.

<u>Recommended Mitigation Measures</u>. The following measures would be employed to minimize construction impacts on highly-valued soil and agricultural practices:

- Consult with landowners and farmers to address field access, revegetation, timing, and other sensitive cropping issues.
- Consult with landowners to identify the locations of drainage and irrigation systems.
- Flag tile and irrigation lines prior to construction.
- Maintain the flow of irrigation water during construction or coordinate a temporary shutoff with affected parties.
- Coordinate with farm operators to provide access for farm equipment to fields isolated by construction activities.
- The natural gas pipeline and water supply pipeline would be buried with 4 feet of topcover; the pipelines would be installed under drain tiles unless the drain tiles are located deep enough to allow the pipelines to be installed above the drain tile with at least 4 feet of topcover over the pipelines and, where feasible, a 12-inch clearance between the tile and the pipelines; where feasible and practicable, install the pipelines with greater than 4 feet of topcover where specifically requested by the landowner to allow for certain site-specific conditions or practices; and install plastic warning ribbon approximately 12 inches above the buried pipelines to provide a greater level of safety for potential future excavation activities.

- Follow an erosion and sediment control plan as part of NPDES General Construction Permit 1200-C; control the discharge from trench dewatering to avoid damaging adjacent agricultural land, crops, or drainage systems.
- Control dust emissions generated during construction, as necessary, by the control of vehicle speed, by wetting the construction area or by other means; and coordinate with farm operators to provide adequate dust control in areas where specialty crops are susceptible to damage from dust contamination.
- Identify potential noxious weed and soil-borne pathogen threats before construction and develop appropriate plans.
- Require contractors to thoroughly clean construction equipment prior to the moving into a new construction area or relocating from one construction area to another.
- Consult with the appropriate agencies to determine the location of noxious weeds.
- Make reasonable efforts to obtain straw bales for erosion control and straw for mulch that are free of noxious and nuisance weed contamination.
- Use Oregon-certified seed or equivalent for revegetation.
- Construct linear facilities adjacent to public rights-of-way and along property lines, and avoid bisecting fields.
- Where possible, strip and segregate topsoil from subsoil over the trench, from the trench spoil storage area and from areas subject to grading in agricultural lands; store topsoil immediately adjacent to the stripped area to the extent practical; replace the segregated topsoil after the trench is backfilled and the subsoil is restored to grade.
- Take suitable precautions to minimize the potential for oversize rock to be introduced into the topsoil and to become interspersed with soil that is placed back in the trench and remove excess surface rock from agricultural soil following construction activities.
- Locate temporary access roads used for construction purposes in coordination with the landowner and any tenants; attempting to identify existing farm lanes as preferred temporary access roads for construction; and designing and constructing temporary roads with proper drainage and to minimize soil erosion.
- Restrict the operation of vehicles and heavy equipment, or take other appropriate action, on excessively wet soil on the portion of the construction work area in agricultural land where the topsoil is not stripped and segregated so that deep rutting does not result in the mixing of topsoil and subsoil.

The following measures would be employed to mitigate temporary construction impacts on agricultural practices:

- Restore and return to agricultural use the areas temporarily impacted by construction.
- Deep root, invasive crops that can cause damage to the buried pipelines would be restricted within a 10-foot-wide area (centered over the centerline) directly over the pipelines.

- Restore drainage patterns to prevent ponding of water.
- Implement additional restoration efforts if visual crop deficiencies occur on the construction area.
- Inspect the construction areas for noxious weed infestations following construction and treat new infestations resulting from construction activities.
- Use appropriate tillage on compacted agricultural land to relieve soil compaction and follow tillage with revegetation of affected areas.
- Repair or replace damaged irrigation lines or drainage tiles.

Impact 3.2.3. Limited erosion would occur during construction with the implementation of BMPs.

Assessment of Impact. Generally, construction activities introduce the potential for increased erosion; however, the implementation of BMPs through the proposed project's erosion and sediment control plan, regulated under NPDES General Construction Permit 1200-C, would be employed to minimize soil loss. Construction activities would disturb vegetation in some areas; however, following construction, revegetation of disturbed areas would be completed in conformance with a revegetation plan.

The natural gas pipeline would parallel county roads to minimize traffic disturbance during construction. Lands temporarily affected by the natural gas pipeline construction would include irrigated and nonirrigated cropland and rangeland. Some soil and vegetation disturbance within the 80-foot construction easement would be required for equipment access, excavation, soil stockpiling, and laydown areas. Additional temporary work space of 40 feet (for a total of 120 feet) would be required along the north side of West Langell Valley Road near the Energy Facility site, where the natural gas pipeline route goes through an approximate 2,200-foot section of steep topography. The extra width is needed for soil storage when leveling the easement to create a safe working platform for workers and equipment.

Soil removed from the excavations would be temporarily stockpiled within the construction easement and would be exposed to wind and water erosion during construction. Dust and erosion control mitigation measures would be used. Following pipeline installation, trenches would be backfilled with native soil to the surface and revegetated according to the project's revegetation plan.

The proposed electric transmission line would require the construction of approximately 38 transmission towers and a gravel surfaced access road for travel by wheeled vehicles during construction and to access the new transmission line for maintenance during operation. Grading would occur as needed within the easement to construct the footings and foundations of the transmission towers and to construct the 14- to 16-foot-wide access road. Prior to grading for these features, trees, brush, stumps, and snags would be removed, including root systems. During construction, staging areas would be needed for storage. During construction, dust and erosion control mitigation measures would be employed. Culverts would be installed where the access road crosses an intermittent creek to facilitate flow of stormwater or snow melt runoff and to minimize erosion.

The water supply pipeline would cross irrigated and nonirrigated land used for crop production and rangelands. The total width of temporary construction easement would be 60 feet. Surface vegetation within the temporary construction easement would be temporarily impacted. A portion of the water supply pipeline would follow an existing unimproved road in order to minimize disturbances to agricultural soil. During construction, dust and erosion control mitigation measures would be employed. The water supply pipeline would be placed under the three identified agricultural canals using conventional bore construction techniques. After construction, the temporary disturbed areas would be revegetated in accordance with the Facility revegetation plan.

Recommended Mitigation Measures. No measures beyond those included in the proposed project are recommended.

Impact 3.2.4. Soil erosion during operation of the Facility would be limited by stormwater control features, implementation of BMPs, and an erosion and sediment control plan.

Assessment of Impact. Operations activities would be limited to those areas directly related to the Facility (i.e., access roads, the Energy Facility site). Some stormwater would be shed from paved and gravel surfaces and structures during periods of precipitation. Drainage collection procedures would be used to capture and route this runoff to a stormwater pond and an infiltration basin. Quarry stone or other similar materials would be used in onsite drainage ditches leading to the stormwater pond to reduce the potential for soil erosion.

During operations, gravel access roads along electric transmission line would be used for maintenance and repairs. Gravel roads and associated stormwater control features would be maintained so road surfaces do not create soil erosion and sediment transport. Heavy equipment used for vegetation control under the electric transmission line would be restricted to the access roads and transmission tower sites where possible.

If the alternative of stormwater disposal into the West Langell Valley Road side ditch is selected, NPDES General Stormwater Permit 1200-Z and an erosion and sediment control plan would specify BMPs to use.

Recommended Mitigation Measures. No measures beyond those included in the proposed project are recommended.

Impact 3.2.5. The risk to human safety and harm to physical property as a result of seismic hazard would be minimal at the Energy Facility.

Assessment of Impact. The Energy Facility would be located in an area subject to earthquakes. The Energy Facility would be designed to sustain no permanent structural damage under ground-shaking conditions. By limiting structural damage through design and engineering, the risk to human safety would be minimal. Based on the analysis contained in the SCA, and subject to verification of assumptions through further geotechnical work, the Energy Facility and related pipelines and electric transmission line could be designed, engineered, and constructed without danger to human safety arising from seismic events. The *Preliminary Geotechnical Engineering Report* indicates that Uniform Building Code design parameters for seismic design address peak ground acceleration greater than that likely at the Energy Facility (GeoEngineers, 2002). (USGS earthquake hazards data indicate that there is a 10 percent chance of exceeding a PGA of 0.17g in

50 years in the site area.) Furthermore, based on the relative density of the onsite soil and current accepted analyses, there is low potential for liquefaction at the site. Consequently, lateral spread is not considered to be a hazard.

Buried pipelines with welded joints have low vulnerability to ground shaking that does not cause permanent deformations. Such permanent deformations would occur only from actual fault displacement along the pipelines or substantial soil movement resulting from seismically induced liquefaction, lateral spreading, subsidence, or landslides. Based on expected soil and rock responses at the Facility, no movements sufficient to damage the buried pipelines would be likely.

Liquefaction refers to the loss of shear strength that saturated soil deposits can experience during undrained cyclic loading, such as earthquake loading. The susceptibility of a soil deposit to liquefaction is a function of the degree of saturation, soil grain size, relative density, percent fines, age of deposit, plasticity of fines, earthquake ground motion characteristics, and several other factors. Based on the relative density of the onsite soil at the Energy Facility site, the potential for liquefaction at the site would be low.

The probability of fault displacement within the Facility would be low for faults that are mapped and identified as active. The closest known active faults are 15 miles to the southwest, 5 miles to the north, and 10 miles to the east of the Energy Facility site (Geomatrix Consultants, 1995). Fault displacement from the fault adjacent to the Facility may be as great as 4 inches. Pipelines and electric transmission lines that cross the fault could be designed for this level of displacement, if this fault is determined to be active.

The Oregon Structural Specialty Code (OSSC) uses the UBC, 1997 edition, with current amendments by the state of Oregon and local agencies. The Energy Facility would be designed to meet or exceed the minimum standards in UBC chapter 16, divisions IV and V, Earthquake Design and Soil Profile Types, respectively, with slight modifications by the current amendments of the state of Oregon and local agencies. The Facility could be designed to the OSSC so that no damage would occur during the design earthquake.

<u>Recommended Mitigation Measures</u>. No measures beyond those included in the proposed project are recommended.

<u>Impact 3.2.6. Process wastewater management alternative by beneficial use of the water for irrigated pasture.</u>

<u>Assessment of Impact</u>. Agricultural soil would not be adversely impacted by the land application of process wastewater. The process wastewater would be applied to the pasture at agronomic rates during the irrigation season and at an instantaneous application rate less than the infiltration rate of the soil. Irrigation would not be conducted during periods of frozen or saturated soil to prevent erosion and generation of surface runoff. The process wastewater quality would generally be of equal or better quality than the shallow groundwater and Lost River water used for irrigation to lands around the beneficial use area. Fertilization would be conducted according to Oregon State University fertilization guidelines and typical pasture management activities would be conducted as described in Amendment No. 2 to the SCA, Attachment I-2 (*COB Energy Facility Land Application Plan*).

The high-quality process wastewater would be applied at rates preventing buildup of applied water constituents to harmful levels. With irrigation to full crop water requirements and the natural winter precipitation-driven leaching, a suitable leaching fraction would be provided. At 28.6 inches of irrigation and 6.7 inches of deep percolation, the annual leaching fraction is 23 percent. With this leaching fraction and the estimated process wastewater electrical conductivity (EC) of 0.32 deciSiemens per meter (dS/m), the maximum increase in EC of the soil saturation paste extract (EC_e) at the bottom of the root zone is estimated at 0.7 dS/m. The average root zone EC_e increase would be about 0.33 dS/m. The background EC_e of Calimus soil types from samples collected at the Energy Facility site by CH2M HILL in November 2002 was 0.25 dS/m (0 to 20 inches depth). Even the most salt sensitive of pasture grasses are not negatively affected by soil salinity until the average root zone EC_e is increased to above 1.5 dS/m (Ayars and Westcot, 1989). Under the condition of partial irrigation, where the leaching fraction has been reduced by curtailing late season irrigation, the soil salinity would increase slightly. At 14.3 inches of irrigation and 1.9 inches of deep percolation, the annual leaching fraction would be reduced to about 13 percent and the maximum increase in EC_e at the bottom of the root zone would be 1.2 dS/m. The average root zone EC^e increase would be about 0.59 dS/m. Using a threshold EC_e of 1.5 dS/m and a background EC_e of 0.25 dS/m, the minimum leaching requirement necessary to keep the average root zone EC_e below the threshold EC_e is about 5 percent. All water balance scenarios meet this minimum condition.

The sodium hazard of the irrigation water, which influences soil infiltration, and as indicated by the sodium adsorption ratio (SAR) and EC, is considered slight to moderate. The EC and SAR of the process wastewater are virtually identical to the EC_e and SAR of the Calimus soil types onsite as determined on samples collected at the Energy Facility site by CH2M HILL in November 2002. The Calimus soil EC_e and SAR were 0.25 dS/m and 0.8 respectively, compared to the process wastewater EC and SAR of 0.32 dS/m and 0.8. Given these results, the sodium hazard of the process wastewater is lower than that of the pore water in the Calimus soil and no changes to sodium hazard of the site soil are anticipated.

Restrictions on use of the process wastewater were evaluated against standard irrigation water quality criteria (Table 3.2-4). Process wastewater sodium, chloride, boron, EC, and TDS were all within the range of concentrations under which no restriction is placed on irrigation uses (Ayars and Westcot, 1989). In addition, sulfate concentrations of 6.29 mg/L or 0.13 milliequivalents per liter (m_{eq}/L) are low enough that excess gypsum formation would not be a concern. At the projected irrigation rates, 41 lbs/ac of sulfate would be applied annually. The OSU pasture fertilizer guide recommends application of 20 to 30 lbs/ac of sulfur per year, which equates to 60 to 90 lb/ac of sulfate per year. No additional sulfur fertilizer would be applied to the site and low sulfur analysis fertilizer for addition of nitrogen, phosphorous, and potassium would be used. A specific fertility management program would be outlined in the irrigation management plan submitted to ODEQ prior to irrigation of process wastewater.

Recommended Mitigation Measures. No mitigation measures are recommended.

3.2.3 Cumulative Impacts

The proposed Energy Facility would result in the permanent disturbance of 108.7 acres of land during its 30-year operating life. Of this total, approximately 13.1 acres of high-value soil would be permanently disturbed. Table 3.2-2 shows the permanent impact in acres by soil type.

Cumulative impacts to soil can result from past, present, and reasonably foreseeable actions such as cultivation, livestock grazing, and urban and industrial development. Operation of the proposed Energy Facility would not contribute to cumulative impacts to seismicity or other geologic conditions or hazards. Because of increased impervious surfaces resulting from conversion of the land to industrial use, operation of the proposed Energy Facility would result in a minor loss of soil productivity. There are no other known or proposed industrial facilities in the vicinity of the project so no cumulative impacts are anticipated.

Another potential impact to the soil resource is erosion by wind or water. Stormwater and wastewater would be managed for beneficial use, either as irrigated pasture or groundwater recharge (infiltration basin). Therefore, erosion caused by wind and water from the Energy Facility would have minor or no cumulative impacts. The following mitigation actions would be implemented to minimize potential cumulative impacts:

- Prior to construction, an erosion control plan and measures would be implemented to minimize water and wind erosion.
- During Energy Facility operation, stormwater would be strictly controlled and managed onsite.
- Permeable surfaces or exposed soil at the operational Facility would be landscaped and planted to minimize wind erosion.
- Land application would minimize soil erosion by applying the wastewater through a sprinkler system in agronomic-controlled rates.

TABLE 3.2-1
Summary of Soil Properties by Sampling Location

Sample Location	Soil Map Unit	Depth to Bedrock (inches)	Depth to Hardpan (inches)	Zone of Induration (inches)[a]	ECe (dS/m)[b]	SAR [b]	ESP[b]	Fluoride (mg/kg)[b]
20	50E	9	-	-	0.3	0.5	<0.1	< 0.1
21	50E	13	-	-	-	-	-	-
22	50E	11	-	-	0.2	0.3	<0.1	-
23	50E	11	-	-	0.4	1.2	0.4	-
24	7C	35	-	-	0.3	0.7	<0.1	-
25	40	22	-	-	-	-	-	-
26	40	>48	-	-	0.3	0.6	<0.1	< 0.1
27	40	-	32	29-32	0.8	7.5	8.9	-
28	40	>48	-	37-48	-	-	-	-
29	40	>48	-	38-48	0.4	1.1	0.3	-
30	40	>48	-	-	-	-	-	-
31	40	46	-	-	-	-	-	-
32[c]	7A	-	-	-	0.3	0.8	<0.1	< 0.1
33[c]	7A	-	-	-	0.2	0.8	<0.1	-
34	40	-	16	-	-	-	-	-
35	40	>48	-	33-48	-	-	-	-
36	40	-	25	9-25	-	-	-	-

[a] Induration is the cementation of soil particles by humus, carbonates, or oxides of silica, iron, or aluminum resulting in a hard and brittle soil consistence. Due to the effervescence of indurated materials at this site when applying 10% hydrochloric acid, it was determined that the cementing agent was in fact a carbonate material.

[b] Composite samples were collected from a 0-20” depth except at locations 20, 22, and 23 where sample depth was limited by the depth of bedrock.

[c] Samples were collected for soil analysis but no profile descriptions were made.

Soil map units referred to include:

7A Calimus loam, 0 to 2 percent slopes
7C Calimus loam, 2 to 5 percent slopes
40 Laki-Henley loams
50E Lorella very stony loam, 2 to 35 percent south slopes

TABLE 3.2-2
Soil Area by Facility Feature—Permanent Disturbance During the 30-Year Operating Life of the Energy Facility (in Acres)

Symbol	Map Unit Name	Energy Facility Site	Water Supply Well System	Water Supply Pipeline	Natural Gas Pipeline	Electric Transmission Line	Irrigated Pasture Access Road	Total Facility
6B	CALIMUS FINE SANDY LOAM, 2 TO 5 PERCENT SLOPES					4.1		4.1
7A	CALIMUS LOAM, 0 TO 2 PERCENT SLOPES	17.7					0.4	18.1
7B	CALIMUS LOAM, 2 TO 5 PERCENT SLOPES	4.7				1.9		5.4
7C	CALIMUS LOAM, 5 TO 15 PERCENT SLOPES	2.9				5.3		8.2
9B	CAPONA LOAM, 2 TO 5 PERCENT SLOPES							0.0
23B	HARRIMAN LOAM, 2 TO 5 PERCENT SLOPES					8.3		8.3
23C	HARRIMAN LOAM, 5 TO 15 PERCENT SLOPES					5.3		5.3
26	HENLEY LOAM							0.0
28	HENLEY-LAKI LOAMS							0.0
38	LAKI LOAM							0.0
40	LAKI-HENLEY LOAMS	18.9				1.3		20.2
50E	LORELLA VERY STONY LOAM, 2 TO 35 PERCENT SOUTH SLOPES	6.4	0.3			26.4		33.1
51E	LORELLA-CALIMUS ASSOCIATION, STEEP NORTH SLOPES					4.5	0.1	4.6
58B	MODOC FINE SANDY LOAM, 2 TO 5 PERCENT SLOPES					0.2		0.2
74B	STUKEL-CAPONA LOAMS, 2 TO 15 PERCENT SLOPES							0.0
74D	STUKEL-CAPONA LOAMS, 15 TO 25 PERCENT SLOPES							0.0
	TOTALS	**50.6**	**0.3**	**0.0**	**0.0**	**57.3**	**0.5**	**108.7**

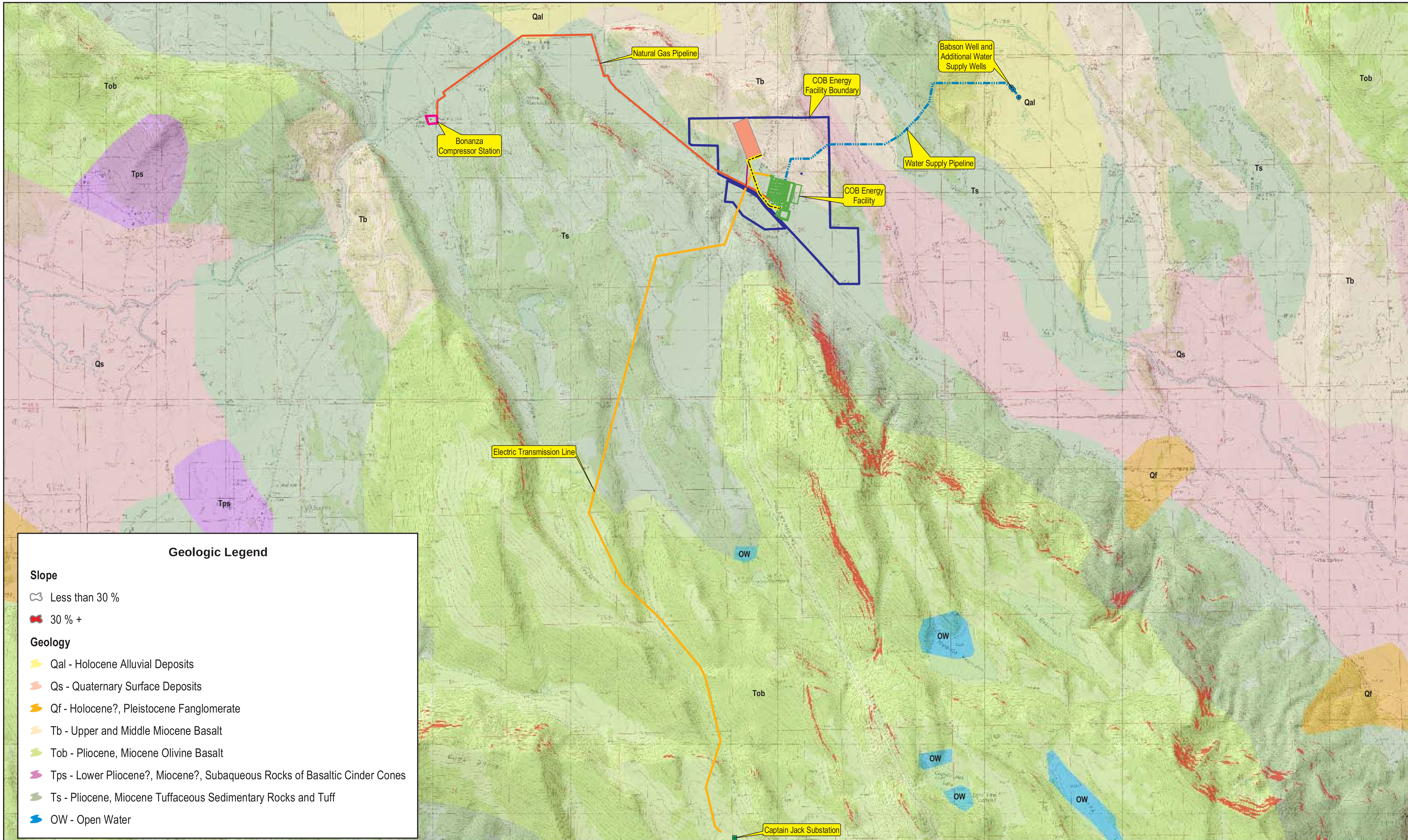
TABLE 3.2-3
Soil Area by Facility Feature—Incremental Temporary Disturbance (in Acres)

Symbol	Map Unit Name	Energy Facility	Construction Parking and Laydown	Subtotal: Energy Facility Site	Water Supply Well System	Water Supply Pipeline	Natural Gas Pipeline	Electric Transmission Line	Irrigated Pasture Access Road and Pipeline	Total Facility
6B	CALIMUS FINE SANDY LOAM, 2 TO 5 PERCENT SLOPES			0.0		0.3		4.8		5.1
7A	CALIMUS LOAM, 0 TO 2 PERCENT SLOPES	17.7	9.7	27.4		0.4	2.9		0.7	31.4
7B	CALIMUS LOAM, 2 TO 5 PERCENT SLOPES	4.7	15.6	20.3		1.1	6.1	1.9	4.3	33.7
7C	CALIMUS LOAM, 5 TO 15 PERCENT SLOPES	2.9		2.9		0.8		5.5		9.2
9B	CAPONA LOAM, 2 TO 5 PERCENT SLOPES			0.0			3.4			3.4
23B	HARRIMAN LOAM, 2 TO 5 PERCENT SLOPES			0.0				9.6		9.6
23C	HARRIMAN LOAM, 5 TO 15 PERCENT SLOPES			0.0				5.6		5.6
26	HENLEY LOAM			0.0			5.9			5.9
28	HENLEY-LAKI LOAMS			0.0					0.6	0.6
38	LAKI LOAM			0.0		0.6				0.6
40	LAKI-HENLEY LOAMS	18.9	17.1	36.0		2.2	0.5	1.6		40.3
50E	LORELLA VERY STONY LOAM, 2 TO 35 PERCENT SOUTH SLOPES	6.4	26.6	35.0	1.3	5.4	15.6	30.9		88.2
51E	LORELLA-CALIMUS ASSOCIATION, STEEP NORTH SLOPES			0.0		5.7		4.7	0.1	10.5
58B	MODOC FINE SANDY LOAM, 2 TO 5 PERCENT SLOPES			0.0				0.3		0.3
74B	STUKEL-CAPONA LOAMS, 2 TO 15 PERCENT SLOPES			0.0		2.9	8.1			11.0
74D	STUKEL-CAPONA LOAMS, 15 TO 25 PERCENT SLOPES			0.0			1.3			1.3
	TOTALS	**50.6**	**71.0**	**121.6**	**1.3**	**19.4**	**43.8**	**64.9**	**5.7**	**256.7**

TABLE 3.2-4
Irrigation Water Quality Criteria

Parameter	Units	Process Water Concentration	Ceiling Concentration for No Restriction on Irrigation Use
Sodium (sprinkler irrigation)	m_{eq}/L	0.88	3
Chloride (sprinkler irrigation)	m_{eq}/L	0.12	3
Boron	mg/L	0.54	0.7
EC	dS/m	0.32	0.7
TDS	mg/L	203	450

ds/m = deciSiemens per meter
EC = electrical conductivity
m_{eq}/L = milliequivalents per liter
mg/L = milligrams per liter
TDS = total dissolved solids



Legend

- Captain Jack Substation
- Babson Well and Additional Water Supply Wells
- COB Energy Facility Boundary
- Bonanza Compressor Station
- COB Energy Facility
- Electric Transmission Line
- Natural Gas Pipeline
- Water Supply Pipeline
- Irrigation Pipeline
- Irrigated Pasture Area Access Road
- Irrigated Pasture Area

N

1 inch equals 4,123 feet

0 1,800 3,600 7,200 Feet

Figure 3.2-1
Geologic Hazards
COB Energy Facility
Bonanza, OR

PEOPLES ENERGY RESOURCES

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Figure 3.2-1
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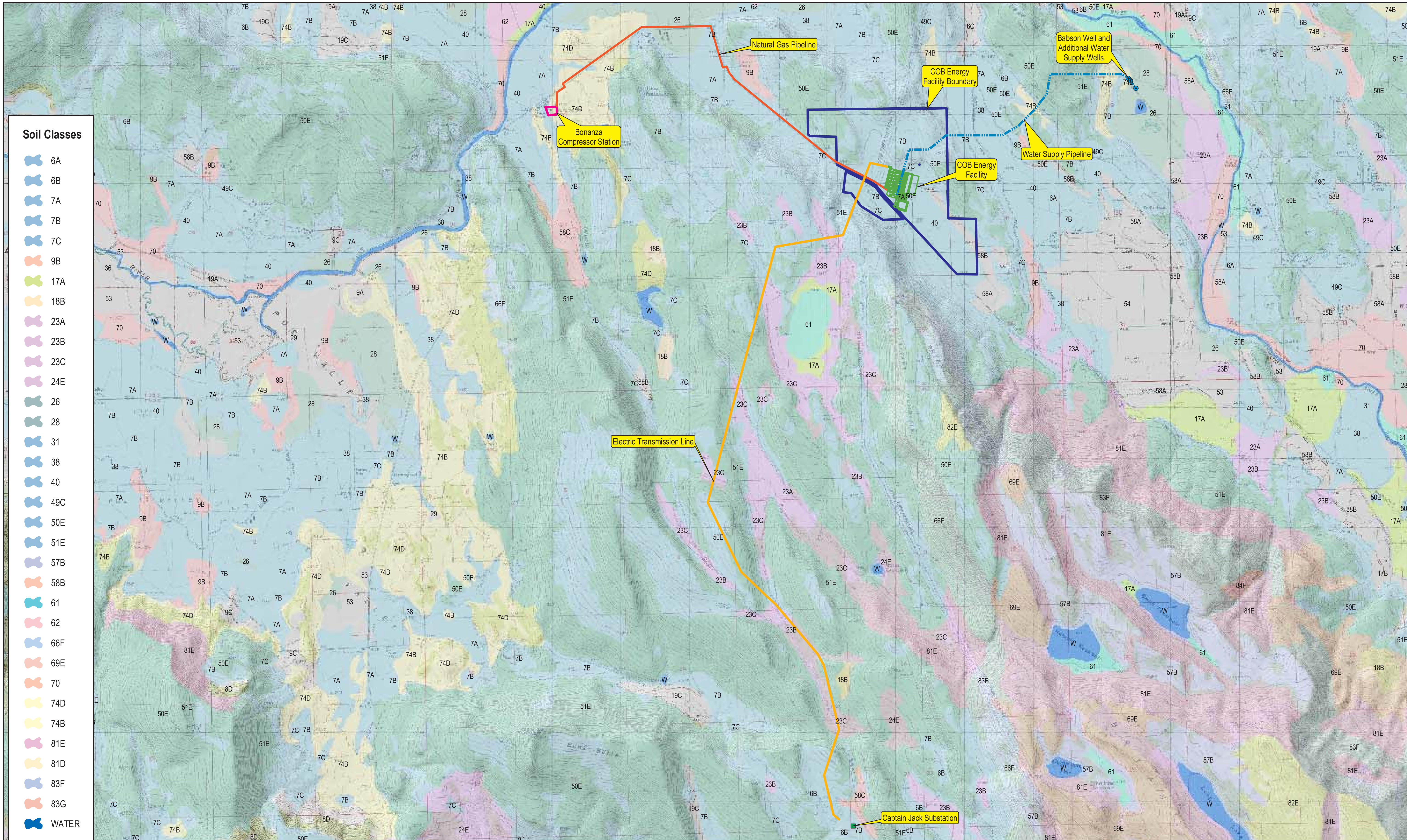

Legend

- Captain Jack Substation
- Babson Well and Additional Water Supply Wells
- COB Energy Facility Boundary
- Bonanza Compressor Station
- COB Energy Facility
- Electric Transmission Line
- Natural Gas Pipeline
- Water Supply Pipeline
- Infiltration Basin

N

1 inch equals 4,210 feet

0 1,100 2,200 4,400 Feet

Figure 3.2-2
Soil Map
COB Energy Facility
Bonanza, OR

PEOPLES ENERGY RESOURCES

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Figure 3.2-2
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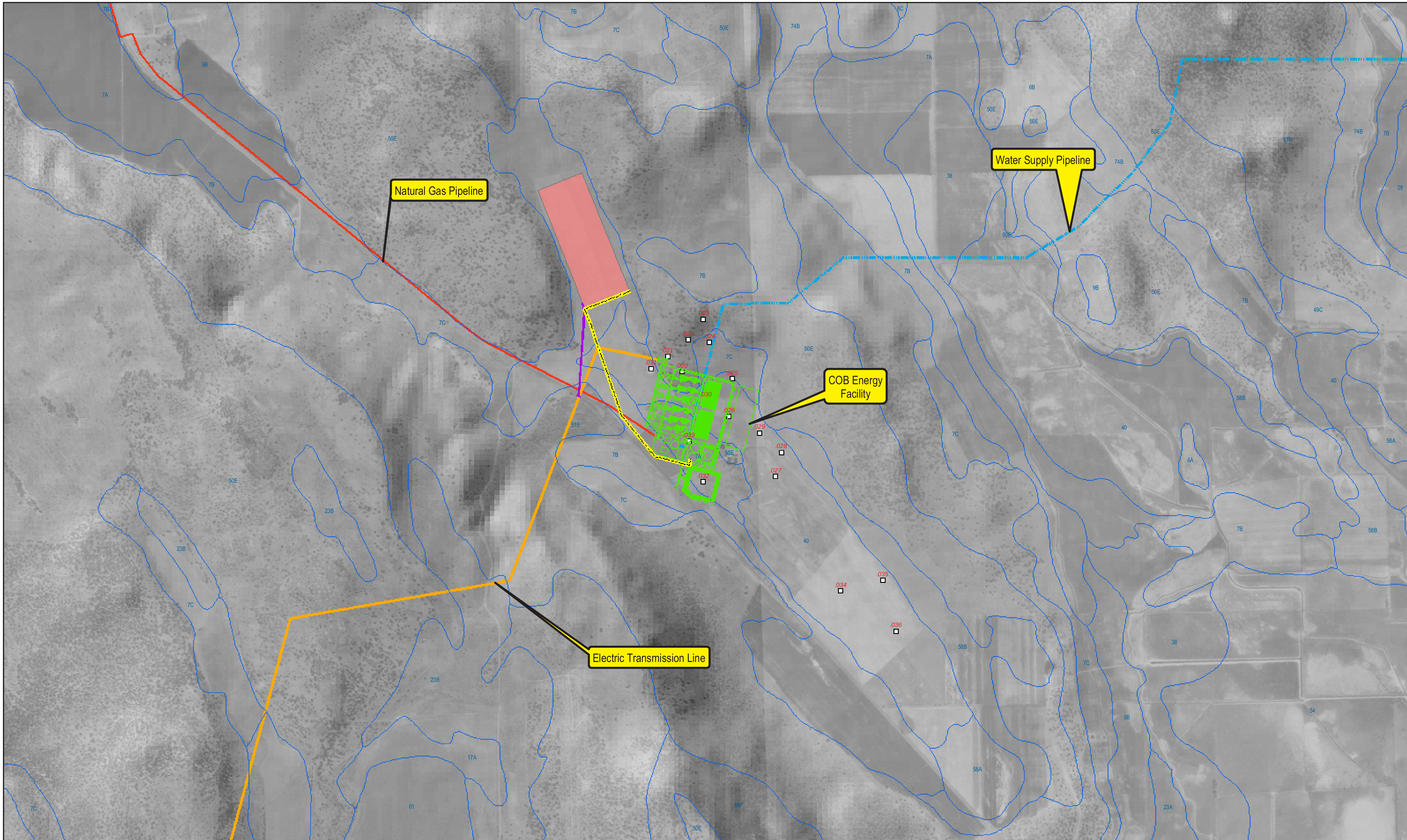

Legend

- Field Sampling Locations
- COB Energy Facility
- Electric Transmission Line
- Natural Gas Pipeline
- Water Supply Pipeline
- Irrigation Pipeline
- Irrigated Pasture Area Access Road
- Irrigated Pasture Area

N

1 inch equals 1,299 feet

0 550 1,100 2,200 Feet

Figure 3.2-3

Soil Investigation Sample Locations

COB Energy Facility

Bonanza, OR

PEOPLES ENERGY RESOURCES

Figure 3.2-3
11 x 17
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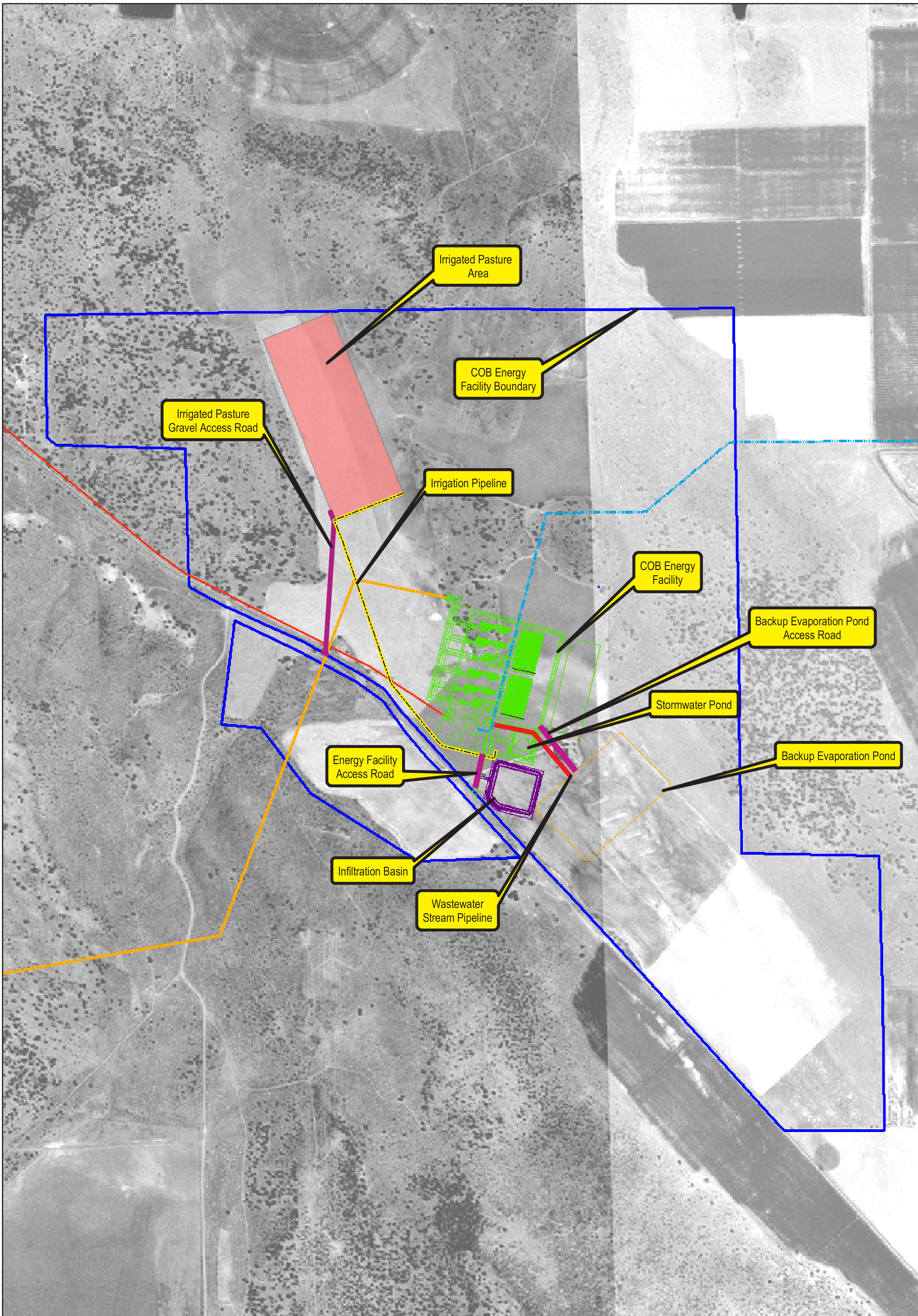

Figure 3.2-4

Energy Facility Site Layout

COB Energy Facility
Bonanza, OR

PEOPLES ENERGY RESOURCES

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Figure 3.2-4
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