3.1 Geological Resources

No Action Alternative

Under the No Action Alternative, the 1999 Congressional land withdrawal of 201,933 acres from public domain (Public Law 106-65) would expire on November 5, 2021, and military training activities requiring the use of these public lands would cease. Expiration of the land withdrawal would terminate the Navy's authority to use nearly all of the Fallon Range Training Complex's (FRTC's) bombing ranges, affecting nearly 62 percent of the land area currently available for military aviation and ground training activities in the FRTC.

Alternative 1 – Modernization of the Fallon Range Training Complex

Under Alternative 1, the Navy would request Congressional renewal of the 1999 Public Land Withdrawal of 202,864 acres, which is scheduled to expire in November 2021. The Navy would request that Congress withdraw and reserve for military use approximately 618,727 acres of additional Federal land and acquire approximately 65,157 acres of non-federal land. Range infrastructure would be constructed to support modernization, including new target areas, and expand and reconfigured existing Special Use Airspace (SUA) to accommodate the expanded bombing ranges. Implementation of Alternative 1 would potentially require the reroute of State Route 839 and the relocation of a portion of the Paiute Pipeline. Public access to B-16, B-17, and B-20 would be restricted for security and to safeguard against potential hazards associated with military activities. The Navy would not allow mining or geothermal development within the proposed bombing ranges or the Dixie Valley Training Area (DVTA). Under Alternative 1, the Navy would use the modernized FRTC to conduct aviation and ground training of the same general types and at the same tempos as analyzed in Alternative 2 of the *2015 Military Readiness Activities at Fallon Range Training Complex, Nevada, Final Environmental Impact Statement* (EIS). The Navy is not proposing to increase the number of training activities under this or any of the alternatives in this EIS.

Alternative 2 – Modernization of Fallon Range Training Complex with Managed Access

Alternative 2 would have the same withdrawals, acquisitions, and SUA changes as proposed in Alternative 1. Alternative 2 would continue to allow certain public uses within specified areas of B-16, B-17, and B-20 (ceremonial, cultural, or academic research visits, land management activities) when the ranges are not operational and compatible with military training activities (typically weekends, holidays, and when closed for maintenance). Alternative 2 would also continue to allow grazing, hunting, off-highway vehicle (OHV) usage, camping, hiking, site and ceremonial visits, and large event off-road races at the DVTA. Additionally under Alternative 2, hunting would be conditionally allowed on designated portions of B-17, and geothermal and salable mineral exploration would be conditionally allowed on the DVTA. Large event off-road races would be allowable on all ranges subject to coordination with the Navy and compatible with military training activities.

Alternative 3 – Bravo-17 Shift and Managed Access (Preferred Alternative)

Alternative 3 differs from Alternative 1 and 2 with respect to the orientation, size, and location of B-16, B-17, B-20 and the DVTA, and is similar to Alternative 2 in terms of managed access. Alternative 3 places the proposed B-17 farther to the southeast and rotates it slightly counter-clockwise. In conjunction with shifting B-17 in this manner, the expanded range would leave State Route 839 in its current configuration along the western boundary of B-17 and would expand eastward across State Route 361 potentially requiring the reroute of State Route 361. The Navy proposes designation of the area south of U.S. Route 50 as a Special Land Management Overlay rather than proposing it for withdrawal as the DVTA. This Special Land Management Overlay would define two areas, one east and one west of the existing B-17 range. These two areas, which are currently public lands under the jurisdiction of BLM, would not be withdrawn by the Navy and would not directly be used for land-based military training or managed by the Navy.

Environmental Impact Statement

Fallon Range Training Complex Modernization

TABLE OF CONTENTS

3.1 GEOLOGICAL RESOURCES 3.1-1
3.1.1 METHODOLOGY 3.1-1
3.1.1.1 Region of Influence 3.1-1
3.1.1.2 Regulatory Framework 3.1-1
3.1.1.3 Public Concerns 3.1-2
3.1.2 AFFECTED ENVIRONMENT 3.1-2
3.1.2.1 Overview 3.1-2
3.1.2.2 Bravo-16 ..... 3.1-17
3.1.2.3 Bravo-17 ..... 3.1-21
3.1.2.4 Bravo-20 ..... 3.1-25
3.1.2.5 Dixie Valley Training Area 3.1-28
3.1.3 ENVIRONMENTAL CONSEQUENCES 3.1-32
3.1.3.1 No Action Alternative 3.1-33
3.1.3.2 Alternative 1: Modernization of the Fallon Range Training Complex 3.1-34
3.1.3.3 Alternative 2: Modernization of the Fallon Range Training Complex and Managed Access 3.1-45
3.1.3.4 Alternative 3: Bravo-17 Shift and Managed Access (Preferred Alternative) 3.1-46
3.1.3.5 Proposed Management Practices, Monitoring, and Mitigation 3.1-53
3.1.3.6 Summary of Effects and Conclusions 3.1-54

List of Figures

FIGURE 3.1-1: SHADED RELIEF MAP OF NEVADA BASIN AND RANGE TERRAIN 3.1-3
FIGURE 3.1-2: SHADED RELIEF MAP OF FRTC 3.1-4
FIGURE 3.1-3: GENERIC CROSS-SECTION SHOWING GEOLOGIC STRUCTURE AND FAULT GEOMETRIES TYPICAL OF THE BASIN AND RANGE PROVINCE 3.1-5
FIGURE 3.1-4: GENERALIZED GEOLOGIC MAP 3.1-9
FIGURE 3.1-5: TERRAIN AND TOPOGRAPHY OF THE AFFECTED ENVIRONMENT FOR BRAVO-16 FOR ALTERNATIVES 1 AND 2 ..... 3.1-19
FIGURE 3.1-6: GEOLOGIC MAP OF THE AFFECTED ENVIRONMENT FOR BRAVO-16 FOR ALTERNATIVES 1 AND 2 ..... 3.1-20
FIGURE 3.1-7: TERRAIN AND TOPOGRAPHY OF THE AFFECTED ENVIRONMENT FOR BRAVO-17 FOR ALTERNATIVES 1 AND 2 ..... 3.1-22
FIGURE 3.1-8: GEOLOGIC MAP OF THE AFFECTED ENVIRONMENT FOR BRAVO-17 FOR ALTERNATIVES 1 AND 2 ..... 3.1-23
FIGURE 3.1-9: TERRAIN AND TOPOGRAPHY OF THE AFFECTED ENVIRONMENT FOR BRAVO-20 FOR ALTERNATIVES 1 AND 2 ..... 3.1-26
FIGURE 3.1-10: GEOLOGIC MAP OF THE AFFECTED ENVIRONMENT FOR BRAVO-20 FOR ALTERNATIVES 1 AND 2 ..... 3.1-27
FIGURE 3.1-11: TERRAIN AND TOPOGRAPHY OF THE AFFECTED ENVIRONMENT FOR THE DIXIE VALLEY TRAINING AREA FOR ALTERNATIVES 1 AND 2 ..... 3.1-29
FIGURE 3.1-12: GEOLOGIC MAP OF THE AFFECTED ENVIRONMENT FOR DIXIE VALLEY TRAINING AREA FOR ALTERNATIVES 1 AND 2 3.1-30
FIGURE 3.1-13: TERRAIN AND TOPOGRAPHY OF THE AFFECTED ENVIRONMENT FOR BRAVO-17 FOR ALTERNATIVE 3 ..... 3.1-48

List of Tables

TABLE 3.1-1: GEOLOGIC TIME SCALE WITH MAJOR EVENTS IN NEVADA HISTORY 3.1-7
TABLE 3.1-2: GEOLOGIC UNITS WITHIN THE REGION OF INFLUENCE 3.1-10
TABLE 3.1-3: ALTERNATIVES 1 AND 2: SOILS WITHIN NEW TARGET AREAS ON BRAVO-16 ..... 3.1-36
TABLE 3.1-4: ALL ACTION ALTERNATIVES: ESTIMATED CONSTRUCTION IMPACT ACREAGES FOR BRAVO-16 ..... 3.1-37
TABLE 3.1-5: ALTERNATIVES 1 AND 2: SOILS WITHIN NEW TARGET AREAS ON BRAVO-17 ..... 3.1-39
TABLE 3.1-6: ALTERNATIVES 1 AND 2: ESTIMATED CONSTRUCTION IMPACT ACREAGES FOR BRAVO-17 ..... 3.1-41
TABLE 3.1-7: ALTERNATIVES 1 AND 2: ESTIMATED POTENTIAL CONSTRUCTION IMPACT ACREAGES FOR THREE NOTIONAL RELOCATION OPTIONS FOR STATE ROUTE 839 ..... 3.1-42
TABLE 3.1-8: ALL ACTION ALTERNATIVES: GEOLOGIC UNITS AND SOILS WITHIN NEW TARGET AREAS ON BRAVO-20 ..... 3.1-43
TABLE 3.1-9: ALL ACTION ALTERNATIVES: ESTIMATED CONSTRUCTION IMPACT ACREAGES FOR BRAVO-20 ..... 3.1-43
TABLE 3.1-10: ALL ACTION ALTERNATIVES: CONSTRUCTION IMPACT ACREAGES FOR THE DIXIE VALLEY TRAINING AREA 3.1-45
TABLE 3.1-11: ALTERNATIVE 3: GEOLOGIC UNITS AND SOILS WITHIN NEW TARGET AREAS ON BRAVO-17 ..... 3.1-49
TABLE 3.1-12: ALTERNATIVE 3: ESTIMATED CONSTRUCTION IMPACT ACREAGES FOR BRAVO-17 ..... 3.1-50
TABLE 3.1-13: ALTERNATIVE 3: ESTIMATED POTENTIAL CONSTRUCTION IMPACT ACREAGES FOR STATE ROUTE 361 ..... 3.1-51
TABLE 3.1-14: SUMMARY OF EFFECTS FOR GEOLOGICAL RESOURCES 3.1-55

3.1 Geological Resources

This discussion of geological resources includes topography, geology, and soils of the given area. Topography is typically described with respect to the elevation, slope, and surface features found within a given area. Geology is the study of the physical features of the earth and includes discussion of rock type, geologic structure (e.g., faults, folds, and tilting of rocks), mineral deposits, and fossil remains. A key purpose of this section is to lay the foundation for understanding why mineralization, geothermal potential, mining, and the potential for mineral resources such as gold and silver are located in specific parts of the region of influence (Mining and Mineral Resources are discussed in Section 3.3). The principal geological factors influencing the stability of structures are soil stability and seismic properties. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material. Soils are typically described in terms of their type, slope, physical characteristics, and relative compatibility or limitations with regard to particular construction activities and types of land use. This analysis addresses impacts on geological resources (e.g., topography, geology, and soil) within the areas proposed for the Fallon Range Training Complex (FRTC) expansion.

3.1.1 Methodology

The Navy performed a desktop/literature review of relevant and available published and unpublished reports, journal articles, and historical archives pertaining to topography, geology, and soils. No field work was performed during this effort. Information regarding geological resources within the region of influence were obtained by reviewing available literature and online databases. Geology information was primarily obtained from the Nevada Bureau of Mines and Geology Map Services and Datasets Open Data Page (Nevada Bureau of Mines and Geology, 2018) and U.S. Geological Survey's (USGS) online spatial database for the State of Nevada (U.S. Geological Survey, 2016). Soil data was obtained from the National Resource Conservation Service's (NRCS) Web Soil Survey in October 2017, which is the single authoritative source of soil information in the United States (Natural Resources Conservation Service, 2017a). The Web Soil Survey uses the NRCS Soil Survey Geographic data, which superseded the State Soil Geographic data set published in 1994. Faults were identified using USGS's Quaternary Fault and Fold Database of the United States, which is the basis for the National Seismic Hazards Maps (U.S. Geological Survey, 2017a). This section identifies areas using the USGS's Public Land Survey System.

3.1.1.1 Region of Influence

The region of influence for geological resources includes the topography, rocks, geologic structure, and soil within the proposed withdrawal areas as well as any mining claims or portions of historical mining districts/revised mineral resource areas that may be affected by the alternatives carried forward for analysis. Because the region of influence is defined as the land boundary of the "withdrawal areas," these terms are used interchangeably.

3.1.1.2 Regulatory Framework

The following federal regulations and policies are relevant to the analysis of geological resources:

- Farmland Protection Policy Act of 1981 (7 United States Code [U.S.C.] section 4201 et seq.)
- Earthquake Hazards Reduction Act of 1977 (42 U.S.C. section 7701 et seq.)
- Federal Cave Resources Protection Act of 1988 (16 U.S.C. section 4301 et seq.)
- Paleontological Resources Preservation Act of 2009 (16 U.S.C. section 470aaa et seq.)

- Unified Facilities Criteria (UFC) (e.g., section UFC 3-220-01 [Geotechnical Engineering], section UFC 3-310-04 [Seismic Design of Buildings], and section UFC 3-220-10N [Soil Mechanics])

The UFC provide planning, design, construction, sustainment, restoration, and modernization criteria for applicable projects. Construction plans would be reviewed for conformance with UFC and the provisions of state and local building codes once completed. Section 3.3 (Mining and Mineral Resources) identifies rules and regulations regarding the management of mineral resources.

3.1.1.3 Public Concerns

During public scoping, members of the public expressed concerns regarding the potential for the Proposed Action to contaminate soil, which is addressed in Section 3.14 (Public Health and Safety and Protection of Children). The public was also concerned about the impact the Proposed Action would have on mining and mineral resources (including geothermal resources), which is discussed in Section 3.3 (Mining and Mineral Resources). For more information on concerns expressed by the public during the scoping process and during the comment period for the Draft Environmental Impact Statement (EIS), refer to Section 1.9.1 (Public Scoping), Section 1.10 (Draft Environmental Impact Statement Public Participation: Comment Themes), and Appendix F (Public Comments and Responses).

3.1.2 Affected Environment

This section describes the geological resources within the region of influence. In doing so, this section first gives a general overview of the physiography, geologic units, caves and karsts, soils, farmland, seismicity and seismic hazards, and paleontological resources within this region. Then, it provides a more in-depth discussion on the geology, soils, and farmland within Bravo (B)-16, B-17, B-20, and the Dixie Valley Training Area (DVTA).

3.1.2.1 Overview

3.1.2.1.1 Physiography

Nevada is located in the heart of the Basin and Range (Great Basin) Physiographic Province, which encompasses much of the inland western United States and northwestern Mexico (U.S. Geological Survey, 2017b). The province is characterized by elongated northeast-southwest trending mountain ranges alternating with low-lying valleys or basins. This structure is the result of a series of tilted normal fault-blocks, most of which are tilted either to the southeast or northwest. The high ends of fault blocks form the characteristic northeast-southwest trending mountain ranges, and the lowered ends of the fault blocks form the down-dropped basins. The mountains can extend up to high alpine glaciated ridges and peaks with runoff and snowmelt traveling down to relatively low elevation enclosed basin bottoms with no outlet to the ocean. Often, playas occur in the lowest part of the basins, and exhibit shallow lakes characterized by high chemical concentrations of various elements and minerals. Figure 3.1-1 is a shaded relief map that shows the characteristic basin and range landforms in Nevada, and Figure 3.1-2 is a shaded relief map of the FRTC withdrawal area.

The genesis of the basin and range terrane is due to broad regional crustal extension where major low angle and associated high angle normal faults caused fault blocks to form, rotate with time, and accommodate the extensional strain through dropping one side of the fault down relative to the other. The result of the crustal extension is the province has thinner crust than surrounding areas. Because the earth's crust is thinner, the surface is closer to the earth's mantle, resulting in the well-documented high

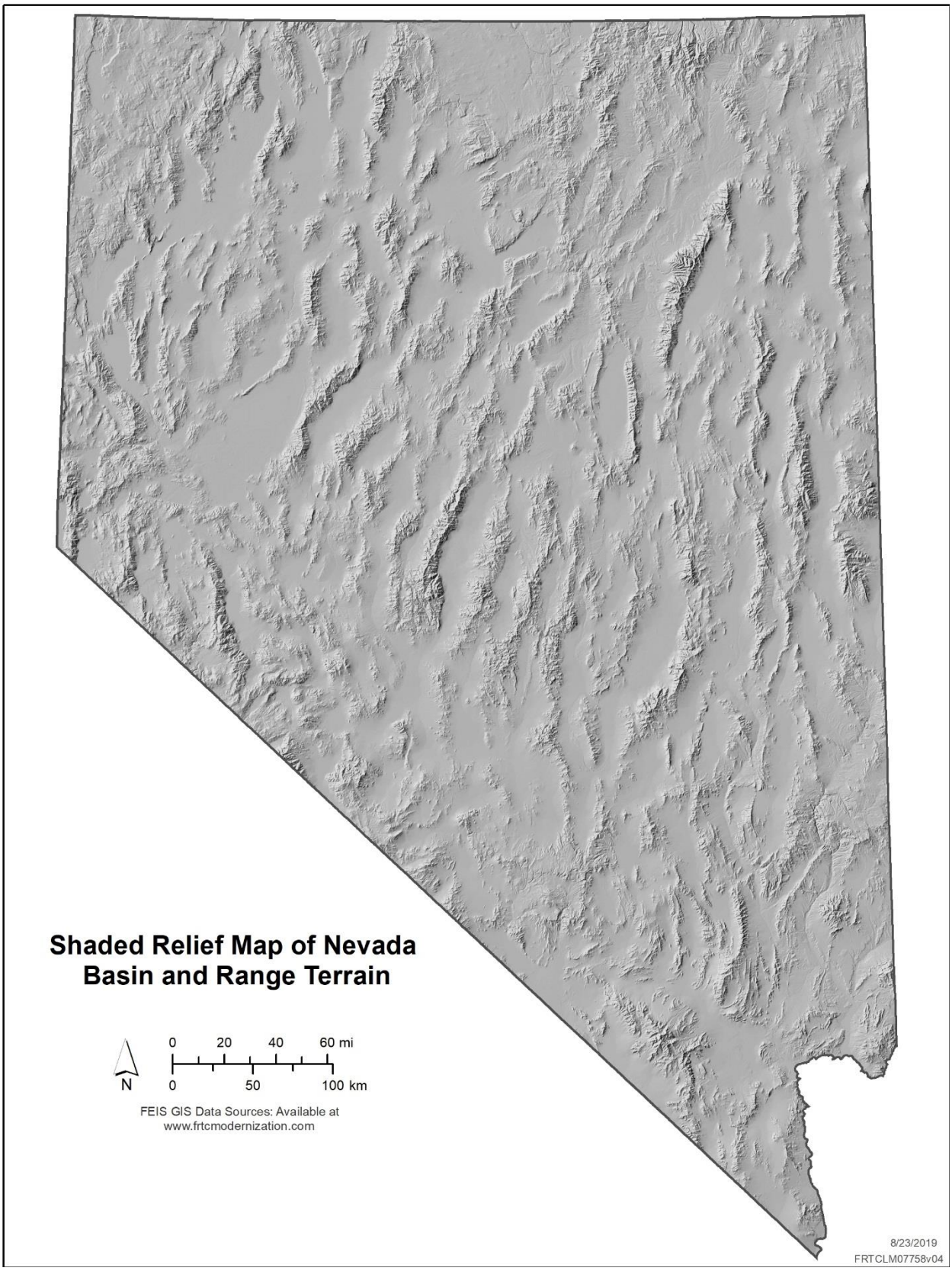

Figure 3.1-1: Shaded Relief Map of Nevada Basin and Range Terrain

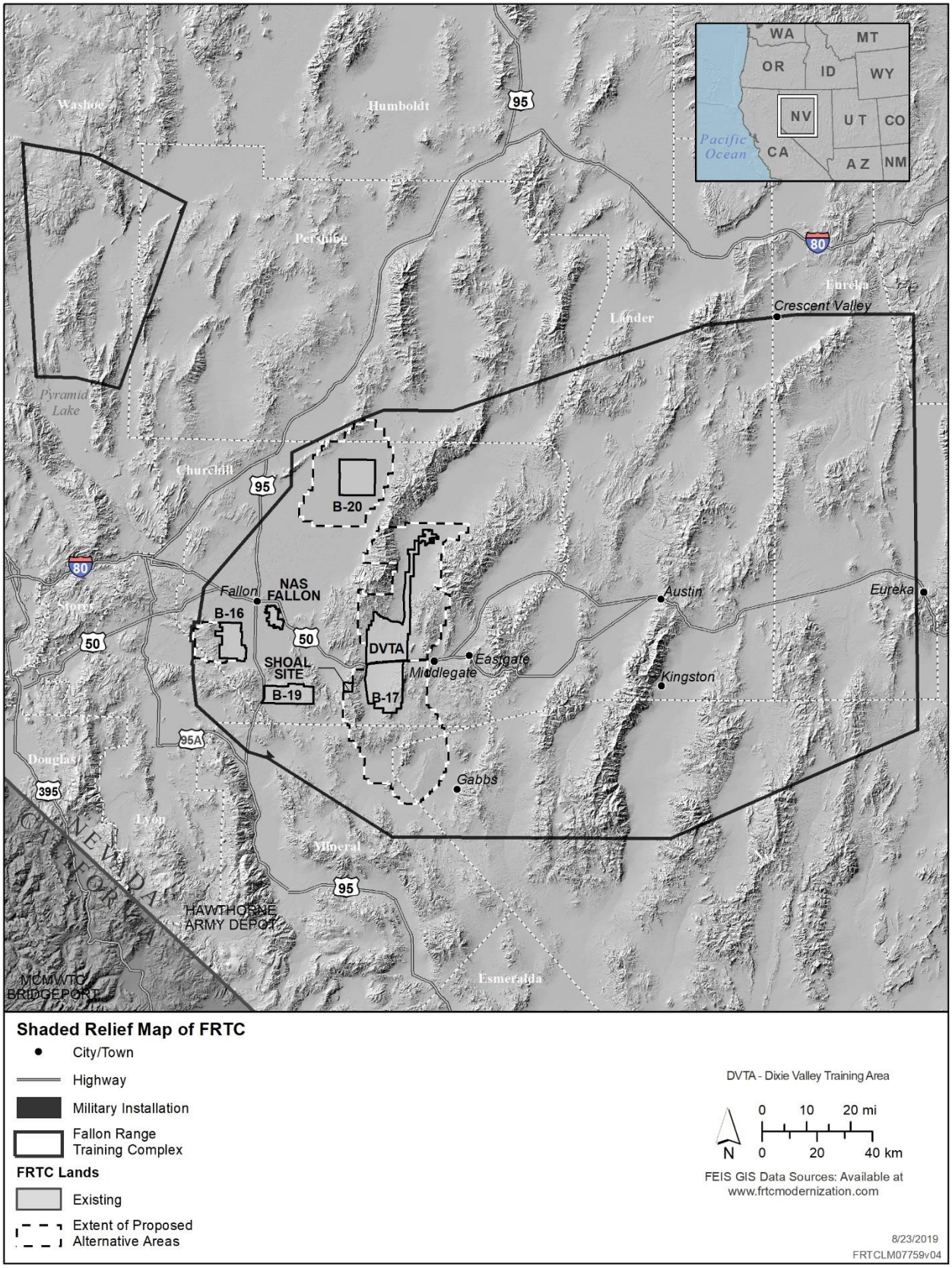

Figure 3.1-2: Shaded Relief Map of FRTC

heat flow of the region. The high heat flow is conducive to mineral enrichment by introducing hot mineral-rich fluids to the already fractured rock. The hot fluids (groundwater) also provide an outstanding source for geothermal energy development. As discussed in Sections 3.1.2.2 (Bravo-16) through 3.1.2.5 (Dixie Valley Training Area), there is a distinct relationship between the thin crust, abundant faults, migrating superheated fluids (often along fault planes), high concentration of ore bodies, and geothermal energy potential; all of these processes allow for mineral resources to be accessed at or near the surface of the earth.

3.1.2.1.2 Geologic Setting

The rocks of the Basin and Range Province are well known for documenting volcanic and intrusive igneous activity intermittently and repeatedly from earth's earliest geologic history up to a few thousand years ago. Older igneous or metamorphic "core complex" rocks are mostly associated with the uplifted mountains. These core complex rocks are often highly deformed, tilted, and altered in places due to movement and transport along the many major faults. Figure 3.1-3 is a cross-section showing the thinned crust, typical fault geometries, core complex, peaks of the mountains, and low areas that represent the basin sedimentary fill. Most of the ore deposits in Nevada are associated with hard igneous rocks associated with the mountain ranges. The source of the metallic and non-metallic minerals could have been from the magma itself (e.g., gold can sometimes form with quartz veins) or associated with magmatic heat causing circulation of hot water altering the rocks and depositing minerals in veins or nearby fractured sedimentary rock. In the Basin and Range, often individual faults or fault systems provide a preferential pathway for mineralizing fluids or hot groundwater used for geothermal energy production. These fault-controlled processes are ongoing and continuing today.

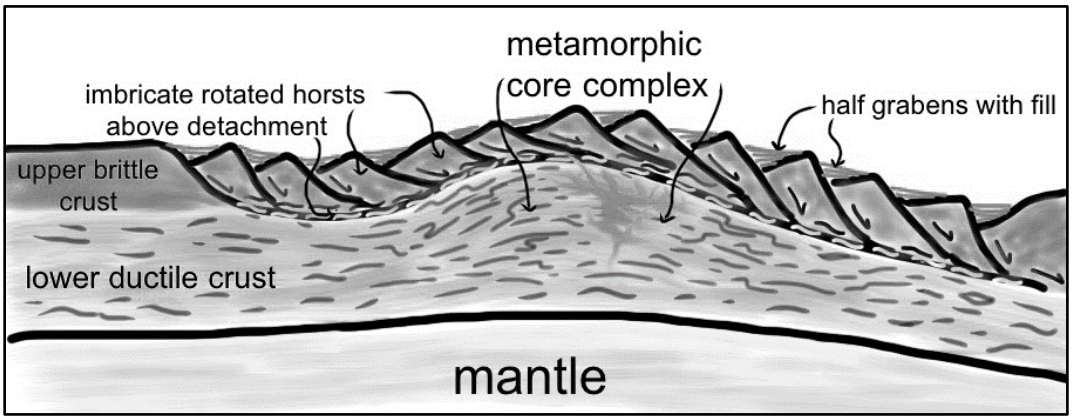

Figure 3.1-3: Generic Cross-section Showing Geologic Structure and Fault Geometries Typical of the Basin and Range Province

Sedimentary rocks are typically associated with wind, rain, and snow-caused erosion from the mountains, followed by deposition in the valley bottoms of the enclosed basins. Sedimentary rocks are wide ranging in the great basin from alluvial fans with boulders, cobbles, gravel, sand, and silt to dry lake bottoms consisting of the finest clays and non-carbon salts. Pleistocene lakes (2.6 million years ago to 11,700 years ago), including Ancient Lake Lahontan, inundated the basins during times of abundant rain and snow and deposited thick clay beds. Lake Lahontan is notable because it extended across much of northwestern Nevada and left behind several existing watersheds within or near the region of influence, including the Carson Sink. The sediments that form the basin bottoms can be tens of thousands of feet thick.

Often overlying or mixed with the igneous hard rocks of the mountains and softer sedimentary rocks of the valleys are extrusive hard volcanic rocks like basalt, andesite, and ash-flow tuff. Often, these rocks are relatively young (a few thousand years old) similarly associated with relatively shallow magma bodies that intruded into or covered the overlying faulted and deformed crustal basement rocks. Table 3.1-1 highlights the geologic setting of the region by showing some major events in Nevada history in a scale of geologic time (Nevada Bureau of Mines and Geology, 2018). Figure 3.1-4 is a generalized geologic map, and Table 3.1-2 summarizes the geologic units in the region of influence; this information is based on data compiled by USGS in cooperation with the Nevada Bureau of Mines and Geology (Stewart & Carlson, 1978).

Table 3.1-1: Geologic Time Scale with Major Events in Nevada History

Million Years Before Present	Description
CENOZOIC	
1.6	Quaternary: Modern earthquakes, mountain building, volcanism, and geothermal activity are expressions of Basin and Range extension that began in the Tertiary Period. The crust is being pulled apart in Nevada, causing valleys to drop relative to mountains. Prior to 10,000 years ago, ice ages caused glaciers to form in the higher mountains and large lakes to develop, in places connecting today's valleys.
65	Tertiary: Tertiary Basin and Range extension began about 30–40 million years ago. Igneous activity during the Tertiary Period was caused not only by extension but also by subduction (descent of oceanic crust into the Earth's mantle) of oceanic plates beneath the North American Plate and, in northern Nevada, by motion of the crust over the Yellowstone hot spot in the mantle. Numerous Nevada ore deposits, including most major gold and silver deposits and the copper ores near Battle Mountain, formed during this time. Gypsum deposits formed from evaporating lakes in southern Nevada.
MESOZOIC	
144	Cretaceous: The Cretaceous Period and Mesozoic Era ended abruptly with the extinction of dinosaurs and many marine species; chemical, mineralogical, and other geological evidence suggests that these extinctions were caused by a large meteorite striking the Earth. Numerous granitic igneous intrusions, scattered throughout Nevada, originated from subduction along the west coast of North America. Much of the granite in the Sierra Nevada formed at this time. The igneous activity caused many metallic mineral deposits to form, including the copper-gold-silver-lead-zinc ores at Ruth, near Ely in White Pine County; copper-molybdenum ores north of Tonopah in Nye County; and tungsten ores in several mining districts. In southern and eastern Nevada, sheets of rocks were folded and thrust from the west to the east during the Sevier Orogeny (mountain building), which began in Middle Jurassic time and ended at or beyond the end of the Cretaceous Period.
208	Jurassic: A subduction zone to the west caused igneous intrusions, volcanism, and associated ore deposits, including copper deposits near Yerington. Sandstones, including those in the Valley of Fire, were deposited in southeastern Nevada, and sedimentary gypsum deposits formed in northwestern Nevada.
251	Triassic: The general geography of Nevada during the Triassic Period was similar to that during the Jurassic Period—igneous activity in the west and deposition of sedimentary rocks in continental to shallow marine environments to the east. Explosive volcanism produced thick ash-flow tuffs in west-central Nevada. Economically important limestone, gypsum, and silica-sand deposits formed in southern Nevada. The Sonoma Orogeny, which began during Late Permian time and ended in Early Triassic time, moved rocks from the west to the east along the Golconda Thrust in central Nevada. The large marine reptiles at Berlin-Ichthyosaur State Park lived during the Triassic Period.

Table 3.1-1: Geologic Time Scale with Major Events in Nevada History (continued)

Million Years Before Present	Description
PALEOZOIC	
290	Permian: Volcanism to the west and deposition of thick limestones to the east were characteristics of much of the Paleozoic Era in the Great Basin. Some marine gypsum deposits formed in southern Nevada
320	Pennsylvanian: The Antler highland, formed earlier, was eroded and shed sediments into the basins to the east. Carbonate rocks were deposited in eastern and southern Nevada.
360	Mississippian: During the Antler Orogeny, from Late Devonian to Early Mississippian time, rocks were folded and thrust from the west to the east. The Roberts Mountains Thrust, below which many of the gold deposits in north-central Nevada occur, formed at this time. Conglomerate, sandstone, siltstone, and shale were deposited in the thick basin of sediments derived from the Antler highland, and carbonate rocks were deposited further east
418	Devonian: Limestone was deposited in eastern Nevada, and shale, chert, and economically important barite were deposited in northeastern and central parts of the state. No record of middle to lower Paleozoic rocks exists in the western part of the state. The quiet, shallow-marine tectonic setting that persisted earlier in the Paleozoic Era began to change, as small land masses from the Pacific Ocean collided with western North America.
438	Silurian: Carbonate rocks (dolomite and limestone) in the eastern part of the state and silica-rich rocks (shale, sandstone, and chert) in the central part of the state record similar deposition to that during the rest of the middle-to-early Paleozoic Era.
490	Ordovician: Marine deposition during the Ordovician Period was similar to that during the rest of the early Paleozoic Era, with the exception of basalts (metamorphosed to greenstones) locally interbedded with sedimentary rocks found today in the central part of the state. Some sedimentary barite deposits and copper-zinc-silver ores formed in sea-floor sediments during this time.
543	Cambrian: Middle and Upper Cambrian deposition resembled that during much of the Paleozoic Era, with carbonate rocks to the east and shale plus sandstone to the west. Lower Cambrian and uppermost Precambrian rocks are characterized by quartzite and metamorphosed siltstone throughout much of Nevada.
PRECAMBRIAN	
600	The oldest rocks in Nevada (at least 2,500 million years old in the East Humboldt Range in northeastern Nevada and at least 1,700 million years old in southern Nevada) are metamorphic rocks (including gneiss, schist, marble, metamorphosed granite, pyroxenite, hornblendite, and pegmatite). Precambrian rocks also include granites (about 1,450 million years old) and younger sedimentary rocks. Beginning approximately 750 million years ago, Antarctica and Australia may have drifted away from western North America, setting the stage for the development of a western continental margin that is similar to the Atlantic coast of today. A shallow marine, tectonically quiet setting persisted in eastern Nevada for the next 700 million years

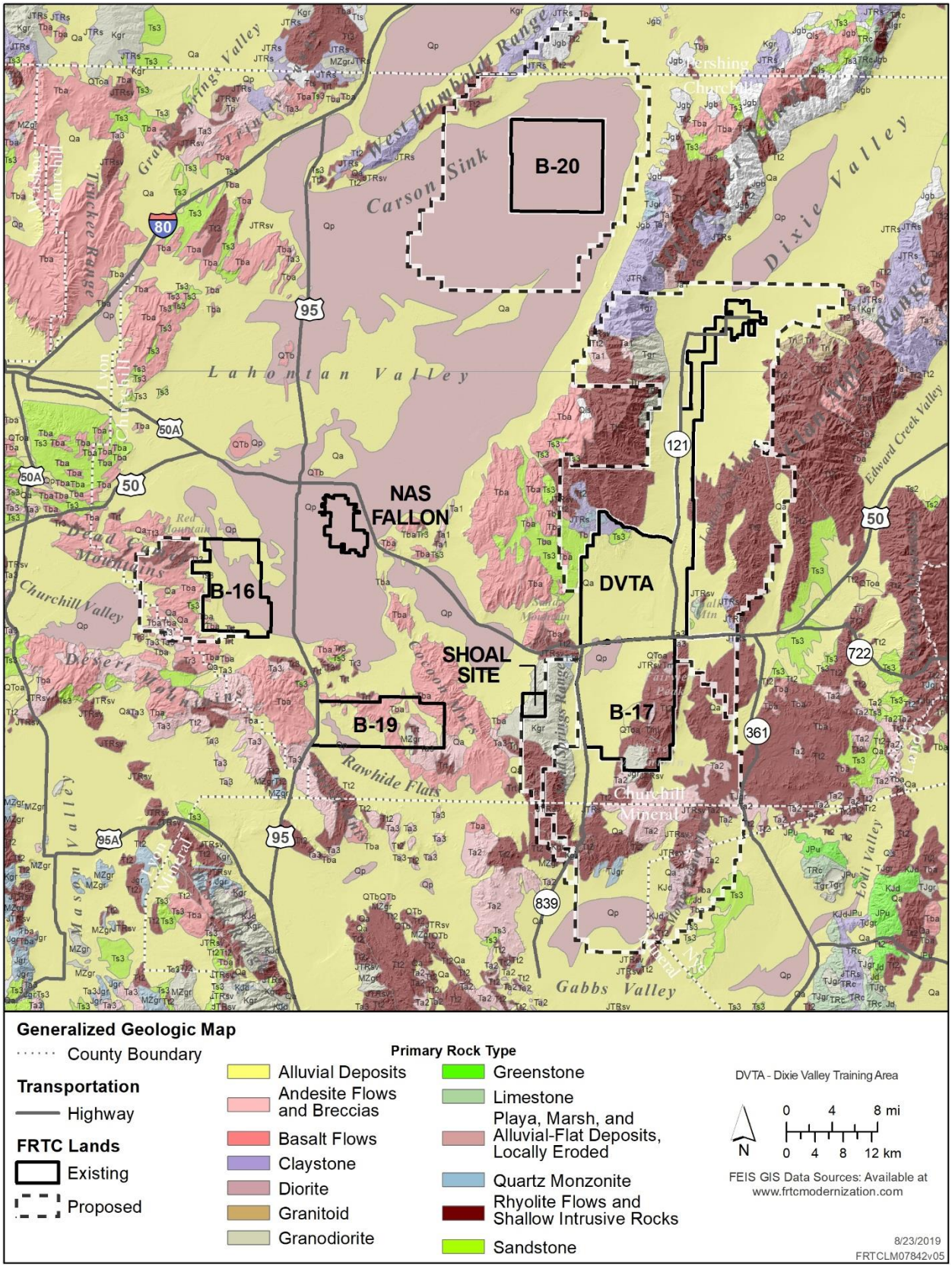

Figure 3.1-4: Generalized Geologic Map

Table 3.1-2: Geologic Units Within the Region of Influence

Unit	Geologic Age	Name	Description	Affected Environment
Qa	Quaternary	ALLUVIAL DEPOSITS	Unconsolidated sand, silt, talus and other surficial deposits; locally includes beach and sand dune deposits	B-16, B-17, B-20, DVTA
Qp	Quaternary	PLAYA, MARSH, AND ALLUVIAL-FLAT DEPOSITS, LOCALLY ERODED	Playa, marsh, and alluvial-flat deposits, locally eroded	B-16, B-17, B-20, DVTA
Qtoa	Miocene to Quaternary	OLDER ALLUVIAL DEPOSITS	Unit consists mostly of older alluvium and alluvial fans. It also includes various stream deposits, gravel, fanglomerates, and older gravels.	B-17
QTb	Miocene to Quaternary	BASALT FLOWS-LOCALLY INCLUDES MAAR DEPOSITS	Olivine basalt and basaltic and andesitic rocks	B-20
Tri	Eocene to Miocene	RHYOLITIC INTRUSIVE ROCKS	Rhyolitic intrusive rocks with aphanitic groundmass; includes many rocks mapped as rhyolite or rhyolite porphyry, rhyolite intrusive rocks, rhyolite plugs or flows, microgranite dikes, and many other undifferentiated intrusive rocks	DVTA
Tmi	Eocene to Miocene	INTRUSIVE ROCKS OF MAFIC TO INTERMEDIATE COMPOSITION	Mafic phaneritic intrusive rocks; includes rocks mapped as dacite and rhyodacite, diorite, quartz latite, and numerous undivided intrusive rocks	B-17
Tt3	Middle Miocene to Late Miocene	WELDED AND NON-WELDED SILICIC ASH-FLOW TUFFS	Younger silicic ash flow tuffs. Locally it includes tuffaceous sedimentary rocks interstratified with tuffs.	B-16
Trt	Middle Miocene to Late Miocene	ASH-FLOW TUFFS, RHYOLITIC FLOWS, AND SHALLOW INTRUSIVE ROCKS	Ash-flow tuffs, rhyolitic flows, and shallow intrusive rocks	B-16, B-17
Ta3	Late Miocene to Middle Miocene	ANDESITE AND RELATED ROCKS OF INTERMEDIATE COMPOSITION	Younger andesite and intermediate flows and breccias	B-16, B-17, DVTA
Tba	Early Miocene to Early Pliocene	ANDESITE AND BASALT FLOWS	Poorly dated unnamed basaltic and andesitic rocks. Mostly in about 17 to about 6 million year (m.y.) age range. In Humboldt County, locally includes rocks as old as 21 m.y. May include rocks younger than 6 m.y. in places	B-16, B-17, B-20, DVTA
Tb	Late Miocene to Middle Miocene	BASALT FLOWS	Basalt flows and flow breccias. Dark gray to black, aphyric to sparsely porphyritic rocks.	DVTA

Table 3.1-2: Geologic Units Within the Region of Influence (continued)

Unit	Geologic Age	Name	Description	Affected Environment
Ts3	Late Eocene to Late Miocene	TUFFACEOUS SEDIMENTARY ROCKS	Tuffaceous and other young Tertiary sedimentary rocks. Most of these rocks are sedimentary with a strong volcanic component; a few are tuffaceous with a strong sedimentary component.	B-16, B-17, DVTA
Tt2	Early Oligocene to Early Miocene	WELDED AND NONWELDED SILICIC ASH-FLOW TUFFS	Intermediate silicic ash flow tuff; locally includes thin units of air-fall tuff and sedimentary rock	B-17, B-20, DVTA
Tr2	Early Oligocene to Early Miocene	RHYOLITIC FLOWS AND SHALLOW INTRUSIVE ROCKS	Intermediate rhyolitic flows and shallow intrusive rocks	DVTA
Ta2	Early Oligocene to Early Miocene	ANDESITE AND RELATED ROCKS OF INTERMEDIATE COMPOSITION	Andesite flows and breccias and other related rocks of intermediate composition such as dacite, rhyodacite, quartz latite, and biotite-hornblende porphyries	B-17
Ta1	Late Eocene to Middle Eocene	ANDESITE AND RELATED ROCKS OF INTERMEDIATE COMPOSITION	Older andesite and intermediate flows and breccias; includes andesite or dacite flows, flow breccias, and hypabyssal rocks in Lander County; andesitic to latitic flows, pyroclastic rocks, and phenoandesitic and phenolatitic flows in Elko County; and other undifferentiated volcanic rocks in other counties.	DVTA
TJgr	Jurassic to Miocene	GRANITIC ROCKS, CENTRAL AND EASTERN NEVADA	Mostly quartz monzonite and granodiorite. Inconclusively dated or not dated radiometrically.	B-17, DVTA
Tgr	Paleocene to Late Miocene	GRANITIC ROCKS	Mostly quartz monzonite and granodiorite	DVTA
Kgr	Cretaceous	GRANITIC ROCKS	Mostly quartz monzonite and granodiorite	B-17
KJd	Jurassic to Cretaceous	DIORITE	Mostly diorite and quartz diorite	B-17

Table 3.1-2: Geologic Units Within the Region of Influence (continued)

Unit	Geologic Age	Name	Description	Affected Environment
Jgr	Jurassic	GRANITIC ROCKS	Mostly quartz monzonite and granodiorite	B-17
JTRsv	Late Triassic to Early Cretaceous	SHALE, SANDSTONE, VOLCANOGENIC CLASTIC ROCKS, ANDESITE, RHYOLITE, AND LOCALLY THICK CARBONATE UNITS	Undivided sequence locally containing recognizable equivalents of the Luning and Dunlap Formations	B-17, DVTA
Jd	Early Jurassic to Middle Jurassic	DUNLAP FORMATION	(Lower and Middle Jurassic)–Conglomerate, sandstone, greenstone, felsite, and tuff. Locally contemporaneous with folding and thrusting. Mineral County and adjacent parts of Esmeralda and Nye Counties	B-17
Jgb	Early Jurassic to Middle Jurassic	GABB region of influence C COMPLEX	A large complex of gabbroic rocks forms a series of related intrusions in the northern parts of the Stillwater Range and Clan Alpine Mountains of Churchill County. The complex contains highly differentiated facies near the periphery of the body and more homogeneous gabbro in the interior. Layered rocks near the margins include olivine gabbro, hornblende gabbro, and anorthosite. The homogeneous rocks consist largely of feldspathic hornblende gabbro and analcite gabbro. The complex is interpreted to be part of a continental Jurassic volcanic arc that is the northern continuation of a Jurassic continental margin arc that extended from the Sonora Desert region in the south to northern California in the north (Crafford, 2007). Biotites from several places in the gabbro have been dated by K/Ar and range from 140 to 170 Ma. Includes gabbro, basalt, and synorogenic quartz sandstone (Boyer Ranch Formation). Churchill and Pershing Counties	B-20

Table 3.1-2: Geologic Units Within the Region of Influence (continued)

Unit	Geologic Age	Name	Description	Affected Environment
JTRs	Late Triassic to Early Jurassic	HUMBOLDT ASSEMBLAGE – SHALE, SILTSTONE, SANDSTONE, AND MINOR CARBONATE	Rocks of the Grass Valley, Osobb, and Dun Glen Formations, and their unnamed overlying rocks elsewhere known as the Winnemucca Formation, exposed in Pershing, Churchill, Lander, and Humboldt Counties, characterize this unit. These rocks are depositional on top of the Star Peak Group carbonate and detrital rocks (TRc). Crossbedding, lode casts, and other depositional features indicate uniform northwest-trending current directions. The lithology and depositional characteristics of these rocks suggest shallow marine conditions on and around a westerly prograding delta (Crafford, 2007). Fossils from these rocks range in age from Late Triassic (Norian) to Early Jurassic (Toarcian) (Crafford, 2007).	B-17, B-20, DVTA
TRc	Triassic	HUMBOLDT ASSEMBLAGE – LIMESTONE, DOLOMITE, SHALE, SANDSTONE, AND CONGLOMERATE	Limestone, minor amounts of dolomite, shale, and sandstone; locally thick conglomerate units Includes Tobin, Dixie Valley, Favret, Augusta Mountain, and Cane Spring Formations and Star Peak Group in central Nevada and Grantsville and Luning Formations in west-central Nevada Unit consists of the Star Peak Group which lies depositionally on the volcanic and volcaniclastic rocks of the Koipato Group (TRkv). Map unit includes rocks mapped as Cane Spring, Natchez Pass, Prida, Augusta Mountain, Congress Canyon, Fossil Hill, Favret, Dixie Valley, and Tobin Formations, including Smelser Pass, Panther Canyon, and Home Station Members of the Augusta Mountain Formation. Basaltic flows and volcanic breccias (TRvm) are present in the Humboldt and northern Stillwater Ranges within the Smelser Pass Member of the Augusta Mountain Formation. The Star Peak Group includes carbonate platform deposits and grades westward into slope and basin paleogeographic environments.	DVTA

Table 3.1-2: Geologic Units Within the Region of Influence (continued)

Unit	Geologic Age	Name	Description	Affected Environment
TRc (cont.)	Triassic	HUMBOLDT ASSEMBLAGE – LIMESTONE, DOLOMITE, SHALE, SANDSTONE, AND CONGLOMERATE	Complex stratigraphic patterns of carbonate and terrigenous rocks in the lower part of the group result from localized relative uplift. Widespread diagenetic secondary dolomitization of calcareous rocks complicates the stratigraphic patterns (Crafford, 2007). There is a major unconformity within the Star Peak Group underneath the Panther Canyon Member, which is late Ladinian (late Middle Triassic) in age. The Panther Canyon Member rests in places directly on the carbonated rocks of either the Koipato Group (TRkv) or the Golconda terrane (GC), and elsewhere on varying thicknesses of secondary dolomite that replaces Star Peak Group carbonate rocks. The Star Peak Group crops out in Churchill, Humboldt, Lander, and mostly Pershing Counties. Abundant fossil data from the Star Peak Group indicates this unit is latest Early (Spathian) to middle Late (Carnian) Triassic in age (Crafford, 2007).	DVTA
Jpu	Permian to Jurassic (?)	VOLCANOGENIC SEDIMENTARY ROCKS, TUFF, ANDESITIC AND FELSITIC FLOWS, AND CARBONATE ROCKS	Age uncertain. Mineral, Esmeralda, and Northwest Nye Counties	B-17

Sources: (Stewart & Carlson, 1978; U.S. Geological Survey, 2016)

3.1.2.1.3 Caves and Karst

During the terminal Pleistocene, c. 16,000 years before present, the Carson desert was submerged beneath pluvial Lake Lahontan. The water level of Lake Lahontan rose to an elevation of ca. 1,330–1,335 m by about 13,500–13,000 before present, and lake margins spread as far north as the Nevada/Idaho border and south to Walker Lake (U.S. Department of the Navy, 2007). Shortly after, the lake started to desiccate. By the late Holocene/Pre-Archaic period 6900 before present, the Carson Desert was still covered by water to some unknown extent and depth. Sometime during this series of filling and draining events, caves and overhangs were developed in the landforms at the west end of the Stillwater Range. With the Federal Cave Resources Protection Act, Section 3(1) of 1988, Congress declared that significant caves on federal lands are an invaluable and irreplaceable part of the Nation's natural heritage and recognized that significant caves may be threatened due to improper use, recreational demand, urban spread, and lack of protection. The Act defines a cave as any naturally occurring void, cavity, recess, or system of interconnected passages occurring beneath the surface of the Earth or within a cliff or ledge that is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. A karst is an area of irregular limestone or carbonate in which erosion has produced fissures, sinkholes, underground streams, and caverns.

The geologic setting of the planning area consists of granitic and metamorphic rocks that are overlain by volcanic and sedimentary rocks, so there is little opportunity for the formation of large or extensive cave systems. The majority of the caves in the planning area consist of undercut rock shelters and shallow cavities in basalt or rhyolite rock that were formed by wave action from ancient Lake Lahontan (U.S. Department of the Navy, 2007). The wave action at various lake levels provided a mechanism to carve shoreline terraces and caves into the surrounding topography. No significant karst features have been identified in the planning area due to the lack of significant deposits of limestone that are required for the formation of karst-type caves or fissures (Bureau of Land Management, 2014).

There are several named and unnamed caves in the proposed FRTC withdrawal areas. Caves with cultural significance exist but have not been identified or mapped in a single database, or the caves are proprietary in nature and the locations are documented only in cultural files as a means to protect the resource. The Salt Cave site, located in the proposed B-16 withdrawal area, provides recreational caving opportunities, such as exploration or spelunking. There are actually two large caves at the site, located about 25 m apart. Pictographs or rock art are painted on tufa rock in both caves, and the roof above areas large enough for sleeping has been blackened by smoke, indicating both historic and recent use (Desert Explorer, 2009). There are no other known or identified caves that provide recreational opportunities in the proposed withdrawal areas. In observance of the Federal Cave Resources Protection Act, federal lands are managed in a manner which, to the extent practical, protects and maintains significant caves and cave resources (43 Code of Federal Regulations Part 37.2). The type and degree of protection will be determined through the resource management planning process with full public participation (Bureau of Land Management, 2014).

3.1.2.1.4 Soils

Soil is a natural material at the surface of the earth composed of solids, liquids, and gases layered in distinct horizons that are a direct result of weathering of underlying rock. Traditionally, soils were classified with respect to the characteristics that affect plant growth (moisture retention capacity, drainage, depth, and organic matter content). Since soils are located at the earth's surface, their

engineering characteristics, such as stability on slopes, compaction, and shrink/swell potential, are also important.

In general, due to limited precipitation and organic matter in desert areas such as the region of influence, soil development is weak compared to areas with more precipitation and humidity. Soils within the region of influence (Natural Resources Conservation Service, 2017a) are further summarized in Sections 3.1.2.2 (Bravo-16) through 3.1.2.5 (Dixie Valley Training Area).

Soil erosion occurs when material is removed from surface soil. Soil erosion potential varies within the region of influence. Water and wind erosion can occur very slowly or very quickly depending on a variety of factors. Factors that affect water erosion include the force of the water, the ability of the soil to hold together, the surface cover, the slope length, and the slope gradient. Meanwhile, factors that affect wind erosion include the soil texture, the content of organic matter, the surface cover, the soil moisture, as well as wind velocity and direction among other factors (Natural Resources Conservation Service, 2004). While erosion is a natural process, human activities can increase erosion processes. An erosion hazard is the probability that damage may occur from site preparation and the aftermath of activities like cutting, fires, and overgrazing.

3.1.2.1.5 Farmland

The soils in the region of influence typically have high salinity and sodicity, which restrict plant growth and are not conducive to agriculture. Soils are considered sodic if their sodium adsorption ratio is greater than 10 and their pH is (generally) greater than 9.0 or 9.5 (Natural Resources Conservation Service, 2017a; U.S. Department of the Navy, 2015).

Salinity: The amount of soluble salts in soil.

Sodicity: The amount of sodium relative to other salts on the soil exchange complex.

Sodium Adsorption Ratio: The amount of sodium relative to calcium and magnesium in saturated soil paste.

None of the soils found within the region of influence are associated with prime or unique farmland. The southwest portion of the affected environment for B-16 and the southeast portion of the affected environment for B-17 include areas that the NRCS has identified as being farmland of statewide importance (Natural Resources Conservation Service, 2017a). Farmland of statewide importance is land other than prime farmland that would meet specific criteria based on climate and the physical and chemical compositions of soil for high yields of crop as defined by the state in which the land is situated. Nevada defines farmland of statewide importance as all farmland with full or partial irrigation water supply that is used for the production of food, feed, fiber, forage, and oilseed crops (Natural Resources Conservation Service, 2017a). Sections 3.1.2.2 (Bravo-16) through 3.1.2.5 (Dixie Valley Training Area) further describe these lands within the region of influence.

3.1.2.1.6 Seismicity and Seismic Hazards

In most of Nevada, mountain ranges (commonly about 10 miles wide and rarely longer than 80 miles), are separated by valleys. Generally, this pattern repeats over and over from east to west across the state. The geologic structure that controls this topography is dominated by faults. Nearly every mountain range is bounded on at least one side by a fault that has been active, with large earthquakes, during the last 1.6 million years. As discussed above, for the last several million years, these faults have been the mechanism for the basins to have been down-dropped relative to the mountains (Price, 2003). Faults in and near the region of influence are summarized in Supporting Study: Faults and Fault Zones In the Withdrawal Area (available at https://frtcmodernization.com).

As a result of the ongoing crustal extension in the Basin and Range Province, Nevada is a seismically active area; this seismic activity contributes to the location of mineral enrichment zones as well as to compartmentalization for geothermal potential. Favorable structural settings for geothermal systems generally correspond to fault interaction areas, which are critically stressed regions characterized by numerous small-to-moderate earthquakes (Faulds et al., 2017).

Thousands of microearthquakes occur in Nevada every year, and occasionally larger mountain-building earthquakes occur (Shake Out, 2018). Richter magnitude 3 and 4 earthquakes are fairly common in the region but rarely cause major damage. In a six-month period in 1954, a total six earthquakes occurred in the Fallon area, all of which were above a Richter magnitude of 6.1 (Shake Out, 2018). Some of these events caused considerable damage to structures and infrastructure in the town of Fallon. Notably, two earthquakes of Richter magnitude 6.6 and 7.1 occurred four minutes apart in the Dixie Valley-Fairview Peak area in 1954. The first event ruptured the ground for 40 miles. The second event ruptured the ground for an additional 29 miles on the western side of the Dixie Valley. Because the area was sparsely settled, damage to structures was mostly limited to cracked chimneys. Water lines were broken in the communities of Lovelock, Mina, and Gabbs.

3.1.2.1.7 Paleontological Resources

Fossils are the remains, traces, or imprints of ancient organisms preserved in or on the earth's crust that provide information about the history of life on earth. Paleontological resources do not include any materials associated with archeological resources, which consist of material remains of past human life or activities that are over 100 years old, as defined in Section 3(1) of the Archeological Resources Protection Act of 1979, as amended (16 U.S.C. 470bb[1]).

Paleontological resources are known to occur near the proposed FRTC Withdrawal Area near B-17. A near resource is the Stewart Valley area of critical environmental concern, which was officially designated in the Bureau of Land Management (BLM) Walker Resource Management Plan (Bureau of Land Management, 2001). The plan included 1,420 acres of mineral entry withdrawal (expired in 2010) for the most sensitive portion of the 16,000-acre ACEC (Bureau of Land Management, 2014). The Stewart Valley Area is to the southwest of the proposed FRTC withdrawal area.

Resources farther from urban or developed areas are relatively stabilized and are not, in large measure, adversely affected by human activity. However, all areas of fossil-bearing sediments are trending toward increased recreational use, and protection of paleontological resources is subject to the limits to the availability of resource staff and law enforcement monitoring (Bureau of Land Management, 2014).

Based on current management practices, improved access to BLM-administered lands, and increased urbanization, there is the potential for paleontological resources to be illegally removed or damaged in the future due to increases in recreational and commercial usage, and limited law enforcement presence (Bureau of Land Management, 2014).

3.1.2.2 Bravo-16

Bravo-16 is located approximately 7 miles southwest of Fallon, Nevada, along the eastern margin of the northwest trending Dead Camel Mountains, west of U.S. Route 95. Figure 3.1-5 and Figure 3.1-6 show the topography and geology within the affected environment.

The Dead Camel Mountains make up much of the proposed B-16 expansion area. Elevations within this area range from approximately 3,900 feet above Mean Sea Level (MSL) to approximately 5,000 feet above MSL at Red Mountain in the north (Figure 3.1-5).

These mountains are primarily underlain by Miocene volcanic rocks (e.g., andesite, basalt, and ash-flow tuff) (Figure 3.1-6). Mostly playa and alluvial sedimentary rock occurs in the lower lying areas. Salt Cave is located in the proposed B-16 withdrawal area and provides recreational caving opportunities, such as exploration or spelunking. No other significant cave and karst resources are known to exist in the B-16 withdrawal area.

Playa: Undrained basin underlain by stratified clay, silt, or sand as well as soluble salts.

Alluvium: A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material that was deposited in recent geologic time (e.g., Quaternary).

Soils on the summits of hills and plateaus, and the adjoining areas are typically thin rocky soils derived from volcanic rocks. These soils consist primarily of extremely stony to very cobbly, very fine to fine sandy loams. Local areas are devoid of soil accumulations due to areas of badland topography and exposures of hard bedrock. The soils near the base of the slopes consist of reworked alluvium, lakebed, and dune sand deposits (Natural Resources Conservation Service, 2017a; U.S. Department of the Navy, 2015).

The western slope of the Dead Camel Mountains is largely composed of sand, including stratified coarse and fine sand, and cobbly sandy loams. Potential runoff for these areas tends to be very high, and salinity is very slightly saline to slightly saline with high sodicity. This area gently slopes into Churchill Valley. Characteristic of basins within the region, playa and alluvial deposits underlie this valley. Soils have formed lake terraces (Biddleman associations) and hills, ridges, dunes, and drainage ways (Theon very gravelly sandy loam, 8–30 percent) adjacent to the valley (Figure 3.1-6). These areas are largely well drained with moderate to very high runoff potential.

Soil is permeable when air and water can move easily through it.

Soil acidity is measured by pH on a scale between 1 (acidic) and 14 (alkaline) with 7 being neutral.

Shrink-swell potential is the extent that the soil will expand when wet, which is often influenced by the amount of certain clay materials.

There is no prime or unique farmland within the proposed B-16 withdrawal. The NRCS's Web Soil Survey identified land within the southwestern portion of the proposed boundary as farmland of statewide importance (Natural Resources Conservation Service, 2017a). Although human activity is evident within this area (numerous dirt roads and a powerline), the land is managed by the BLM, and satellite imagery did not display any indication that this area is currently being cultivated as cropland, but there are active grazing allotments on this land (refer to Section 3.4, Livestock Grazing). Water resources on the land are managed by the Bureau of Reclamation in coordination with the BLM.

There are two fault zones in the B-16 region of influence: an unnamed fault zone west of Carson Lake and an unnamed fault zone in Dead Camel Mountains (U.S. Geological Survey, 1999). The unnamed fault zone west of Carson lake is a group of short, discontinuous faults in southwestern Lahontan Valley. This fault zone is located within the B-16 region of influence. For additional information on the faults described below, see Supporting Study: Faults and Fault Zones In the Withdrawal Area (available at https://frtcmodernization.com).

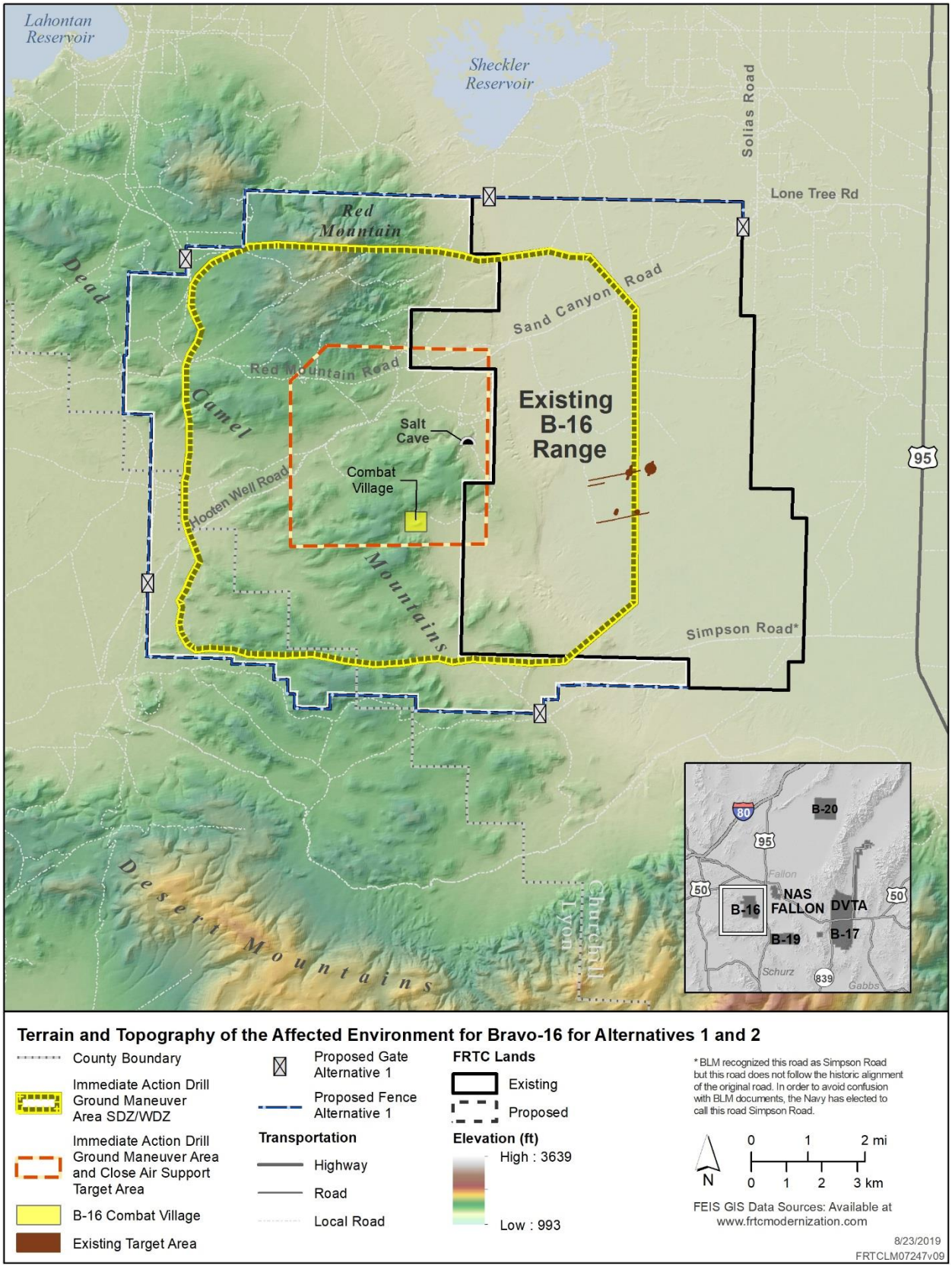

Figure 3.1-5: Terrain and Topography of the Affected Environment for Bravo-16 for Alternatives 1 and 2

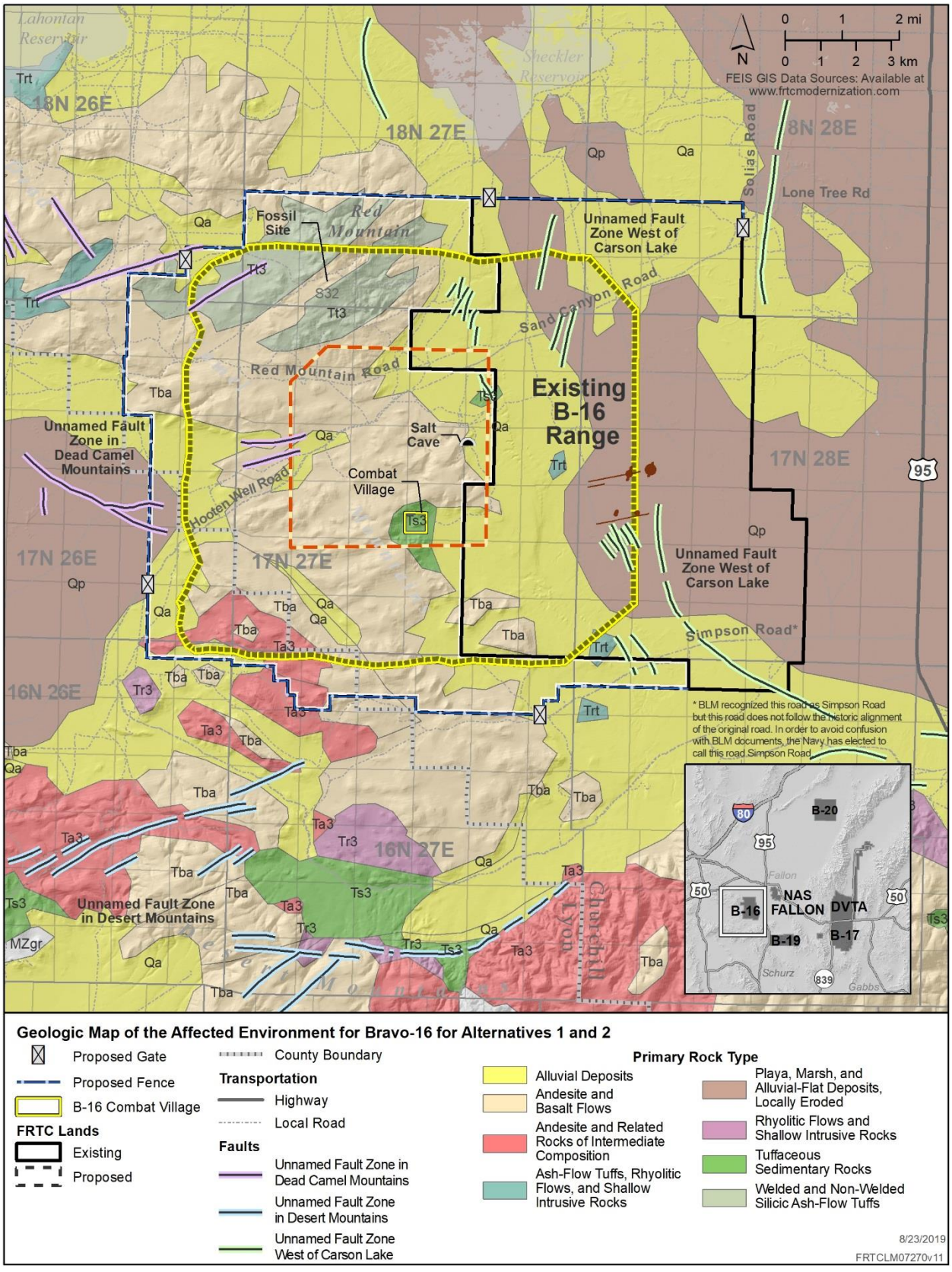

Figure 3.1-6: Geologic Map of the Affected Environment for Bravo-16 for Alternatives 1 and 2

There are no historical earthquakes associated with this fault zone. As seen on both Figures 3.1-6 and 3.3-6 (geothermal potential), there may be spatial correlation between the unnamed fault zone west of Carson Lake along the western range front and geothermal favorability (Faulds et al., 2017). This correlation may indicate a preferential pathway for super-heated water, which could be used for geothermal energy production.

The unnamed fault zone in the Dead Camel Mountains is a short, distributed zone in the western Dead Camel Mountains. This fault zone is located in the western B-16 region of influence. There are no historical earthquakes associated with this fault zone.

A fossil site is located in the northwestern portion of the proposed expansion area in the Dead Camel Mountains (T18N, R27E, Section 32; see Figure 3.1-6) that contain plant leaf, seed, and cone impressions (Firby et al., 1981).

3.1.2.3 Bravo-17

The B-17 Withdrawal is located southeast of Fallon, Nevada. The affected environment for B-17 is bounded to the north by U.S. Route 50, and extends east beyond State Route 361 and west beyond State Route 839. Figure 3.1-7 and Figure 3.1-8 show the topography and geology within the affected environment.

At over 8,000 feet above MSL, Fairview Peak is the tallest peak in the area (northeast corner of the withdrawal). Other mountainous or hilly areas include the Monte Cristo Mountains (roughly 6,500 feet above MSL) located in the central portion, the Sinkavatas Hills west of the Monte Cristo, and the Sand Springs Range (roughly 7,000 feet above MSL) in the northwest corner. As seen on the geologic map, the mountainous areas are relatively complex with many rock types. These areas are largely underlain by hard intrusive igneous rocks such as older (Jurassic to Cretaceous) granite and younger (Eocene to Miocene) mafic (dark) to intermediate color intrusive rocks. The mountainous areas also contain hard extrusive volcanic rocks such Oligocene to Miocene andesite, basalt, and ash flow tuffs. The lower elevation areas are mostly composed of soft unconsolidated alluvium and playa rocks. Occasional outcrops of shale, mudstone, siltstone, sandstone, and carbonate rocks (Triassic to Jurassic) also occur in the withdrawal area.

Significant cave and karst resources are not known to exist in the B-17 withdrawal area.

Soils in mountainous and adjoining areas (including the Monte Cristo and Sand Springs Mountains) are typically thin, poorly developed rocky soils derived from the igneous rocks (Figure 3.1-8) (e.g., Downeyville-Stewval-Blacktop and Budihol-Chill-Rock Outcrop associations). These soils consist primarily of sandy loams with gravel or cobbles. The eastern slope of Fairview Peak is primarily composed of alluvium with gravelly and sandy loam with very high runoff and very low capacity to transmit water (Pineval-Rebel association). Local areas are devoid of soil accumulation due to exposures of hard bedrock. The soils near the base of the slopes consist of reworked alluvium, lakebed, and dune sand deposits (e.g., Genegraf-Rednik-Trocken association). These soils have low salinity and low to moderate sodicity, are moderately to strongly alkaline, have a low to moderate shrink-swell potential, and have a slight erosion hazard. Soils in the middle of the basins often are composed of alluvial, stratified lacustrine, and lake terrace deposits (e.g., Appian-Juva-Bango association). These soils are slightly saline and sodic, moderately to very strongly alkaline, very deep, and well-drained. There are also playa deposits in the northwest and southwest corners of the region of influence. The playa soils are fine-grained, poorly drained, saline deposits that do not support vegetation (Natural Resources Conservation Service, 2017a; U.S. Department of the Navy, 2015).

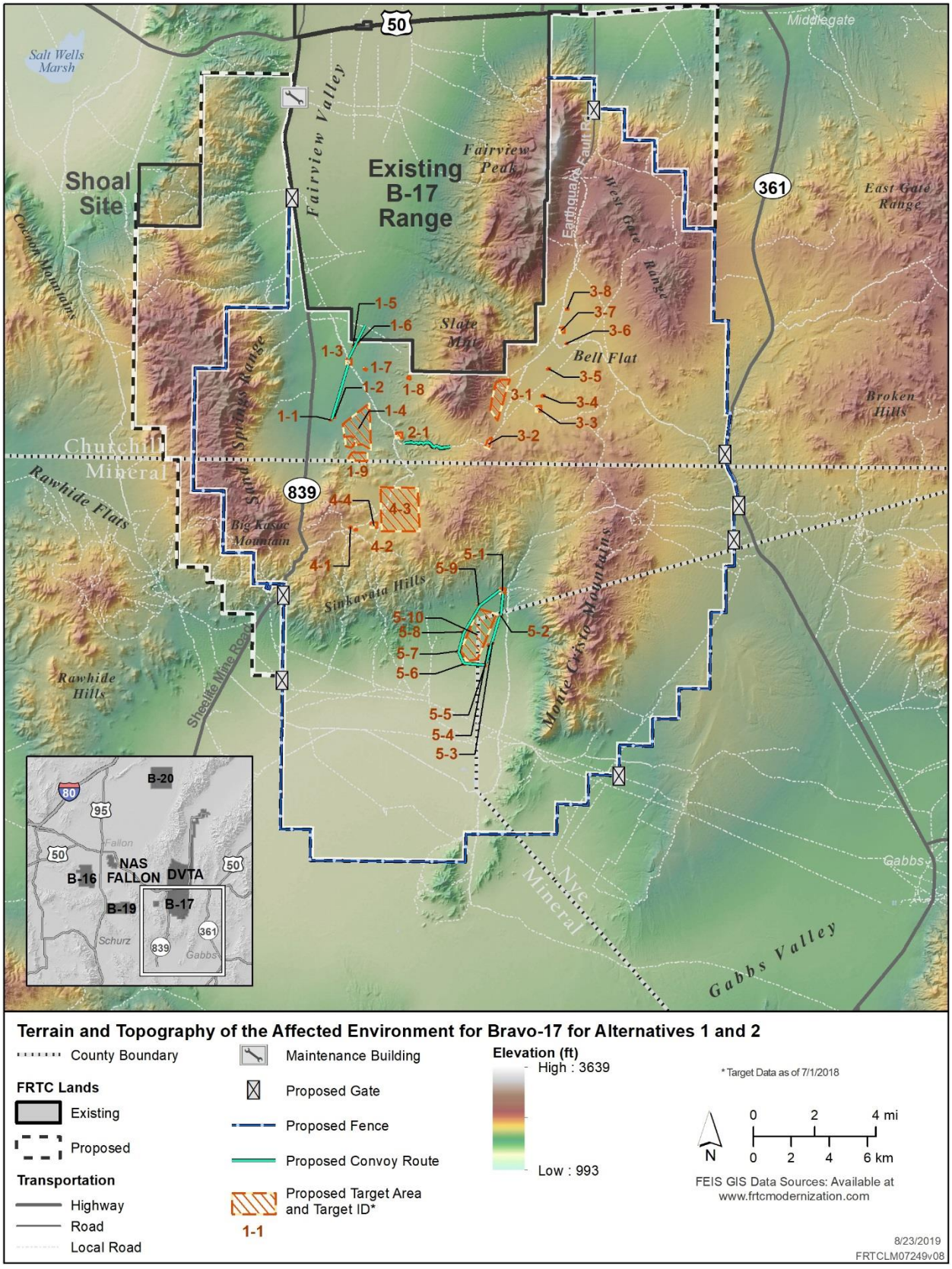

Figure 3.1-7: Terrain and Topography of the Affected Environment for Bravo-17 for Alternatives 1 and 2

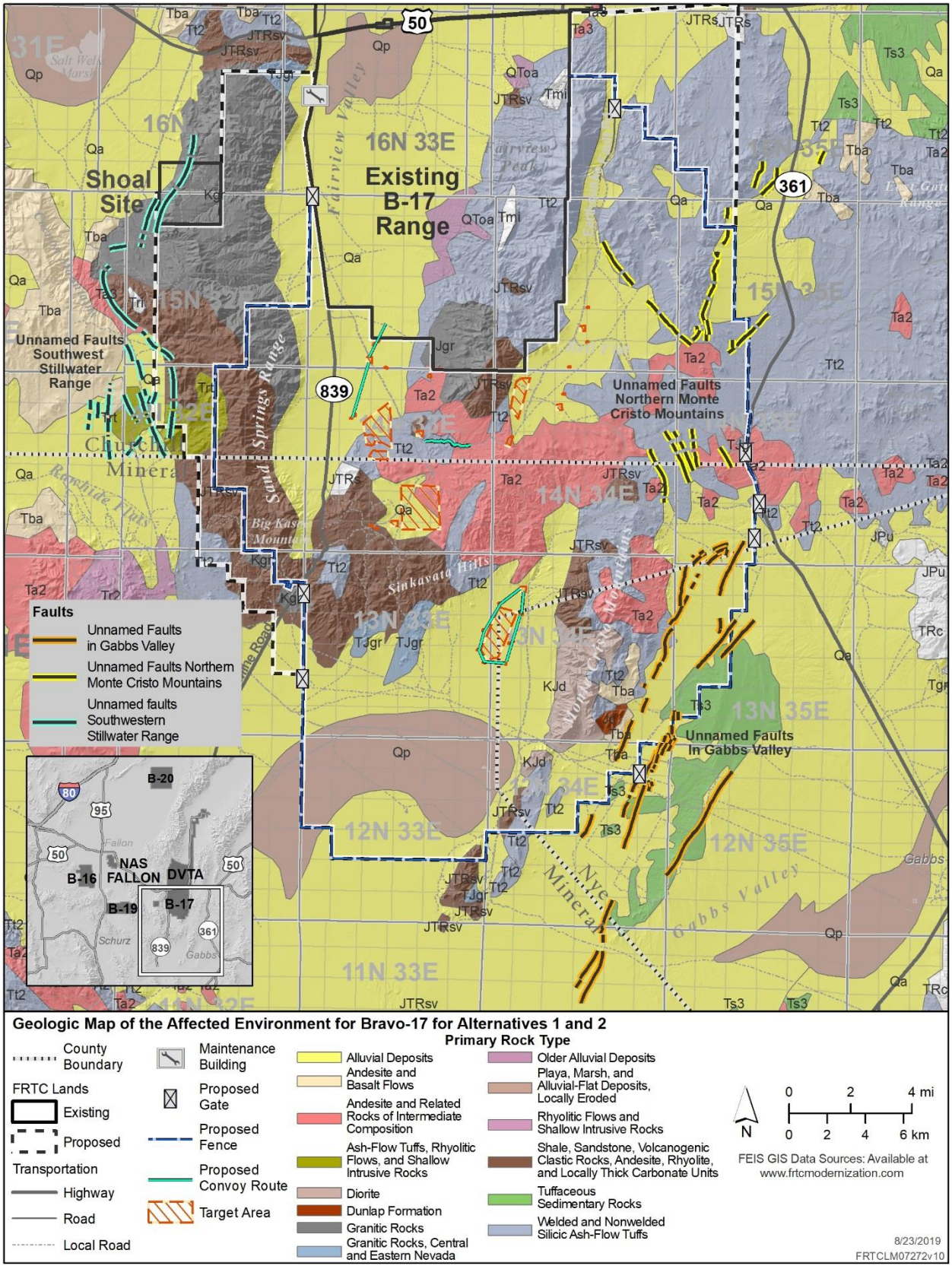

Figure 3.1-8: Geologic Map of the Affected Environment for Bravo-17 for Alternatives 1 and 2

There is no prime or unique farmland within the affected environment for B-17. The NRCS Web Soil Survey identified land within Gabbs Valley as farmlands of statewide importance (Eastgate gravelly sandy loam, 0–4 percent slopes; Eastgate-Cirac Association) (Natural Resources Conservation Service, 2017a). This includes land at the foot of the southern slope of Cobble Cuesta, which follows Gabbs Wash (Eastgate gravelly sandy loam, 0–4 percent slopes); however, there does not appear to be any active cropland on this land. Satellite imagery does show central pivot irrigation near the Finger Rock Wash (Eastgate-Cirac association), evidencing cultivation efforts on this farmland.

There are six faults or fault zones in the B-17 region of influence: Western Fairview Peak fault, Sand Springs Range fault, Hot Springs fault zone, Fairview fault zone, unnamed faults in northern Monte Cristo Mountains, and unnamed faults in Gabbs Valley (U.S. Geological Survey, 2018). All of these faults and fault zones appear to correlate (spatially) at least to some extent with geothermal favorability and mineral enrichment (see Figure 3.1-7 and Figure 3.1-8). For additional information on the faults described below, see Supporting Study: Faults and Fault Zones In the Withdrawal Area (available at https://frtcmodernization.com).

The Western Fairview Peak fault is part of a discontinuous zone that primarily has faults in eastern Fairview Valley, southern Dixie Valley, and the southern Fairview Peak range. The Western Fairview Peak Fault Zone runs primarily through the center of the northern half of the B-17 region of influence. This fault may be related to the Louderback Mountains fault and Dixie Valley fault, but unlike these faults, did not rupture in 1954. There are no historic earthquakes associated with the Western Fairview Peak fault.

The Sand Springs Range fault is a nearly continuous, moderately long zone primarily along the east of the Sand Springs Range. A portion of this fault is found within the western B-17 region of influence. There are no historic earthquakes associated with this fault.

The Hot Springs fault zone is a moderately short and nearly continuous zone bounding the entire west front of the Monte Cristo Mountains and east front of Black Hills. This fault zone is found within the southern B-17 region of influence. The Hot Springs fault zone was part of the historic Fairview Peak earthquake of 1954, which ruptured most of the short faults north of the border between Mineral and Nye counties.

The Fairview fault zone is a well-defined, historical, and normal-right oblique fault zone along the east side of Fairview Peak range and Slate Mountain, east and west sides of Chalk Mountain, and in Stingaree Valley and Bell Flat. This fault zone is found within the center of the B-17 region of influence. The Fairview fault zone was part of the historic Fairview Peak earthquake of 1954, which produced a complex pattern of surface ruptures along the entire length of the fault. Virtually all faults in the zone are clearly marked by 1954 scarps, and many have distinct free faces that represent as much as approximately 2.9 meters of right-lateral and 3.8 meters of vertical separation. Several paleoseismic studies have been conducted on the Fairview fault zone.

The unnamed faults north of Monte Cristo Mountains are anastomosing with the left-stepping down-to-the-west faults along the southwest base of the Cedar Mountains. These faults are found within the northeastern B-17 region of influence. There are no historic earthquakes associated with these faults; however, the faults have minor short surface ruptures from the 1932 Cedar Mountain earthquake.

The unnamed faults in Gabbs Valley are a group of generally short and discontinuous faults along the northwest sides of the Pilot Mountains and on the West side of Table Mountain. A portion of these

faults are within the southern half of the B-17 region of influence. There are no historic earthquakes associated with these faults.

3.1.2.4 Bravo-20

The B-20 withdrawal is located within the Carson Sink, between the Stillwater and the West Humboldt mountain ranges. The Carson Sink is one of the major basins associated with the former widespread Pleistocene Lake Lahontan. In more recent times, the Carson Sink was the location of the terminus for the Carson River and the Humboldt River. Currently, canals from the Truckee-Carson Irrigation District drain into the basin; during heavy snow/rain years (on average every five years), temporary flooding and partial filling occurs (refer to Section 3.9, Water Resources). Figure 3.1-9 and Figure 3.1-10 show the topography and geology within the affected environment.

With an elevation of approximately 3,876 feet, the Carson Sink basin is primarily flat with the exception of Lone Rock, which is a 140-foot-tall basalt outcrop in the center of B-20 (U.S. Department of the Navy, 2008). Geologic units within the basin inside of the withdrawal footprint are largely composed of Quaternary playa/marsh deposits. These deposits typically consist of very poorly drained clay, silt, and fine-to-coarse grained sand that generally do not support developed soil profiles. Quaternary alluvial deposits consisting of beach and sand dunes are found at the basin margins. Extrusive volcanic rocks including Oligocene to Miocene ash-flow tuff, and Miocene to Pliocene andesite and basalt flows are located in the extreme northwest corner of the withdrawal area at the base of the West Humboldt Mountain Range. Also located in this vicinity are Triassic-to-Jurassic shale, mudstone, siltstone, sandstone, and carbonate rock.

The majority of the soils in the B-20 region of influence consists of playas. As mentioned above, soils on the playa are very poorly developed to nonexistent. Soils in the vicinity of Lone Rock are primarily derived from alluvial and dune deposits. Alluvial-derived soils consist primarily of fine sand and silty clay (Isolde-Parran-Appian Association). These soils are deep and well drained, and available water capacity is moderate. These soils have low to high salinity and sodicity, are strongly to very strongly alkaline, have moderately slow to moderately rapid permeability, and have very slow surface runoff. Potential for sheet and rill erosion is also slight (Natural Resources Conservation Service, 2017a).

In addition to the silty clay playa deposits, the Western Humboldt range borders the northwestern B-20 region of influence. Soils along the base of slopes are very deep, well drained, very strongly alkaline soils that formed in alluvium from mixed rocks (Trocken-Ragtown association). Soils on the summits are very shallow and shallow, well drained, moderately alkaline soils that formed in residuum and colluvium derived from volcanic rocks (Theon-Singatse-Rock outcrop association) (Natural Resources Conservation Service, 2017a).

There is no prime or unique farmland or farmland of statewide or local importance in the proposed B-20 boundary (Natural Resources Conservation Service, 2017a). No significant cave or karst resources are known to exist in the B-20 withdrawal area.

There are two fault zones in the B-20 region of influence: the Rainbow Mountain fault zone and the Eastern Carson Sink fault zone. Both of these fault zones may correlate (spatially) with both geothermal favorability and mineral enrichment (Figure 3.1-9 and Figure 3.1-10). For additional information on the faults described below, see Supporting Study: Faults and Fault Zones In the Withdrawal Area (available at https://frtcmodernization.com).

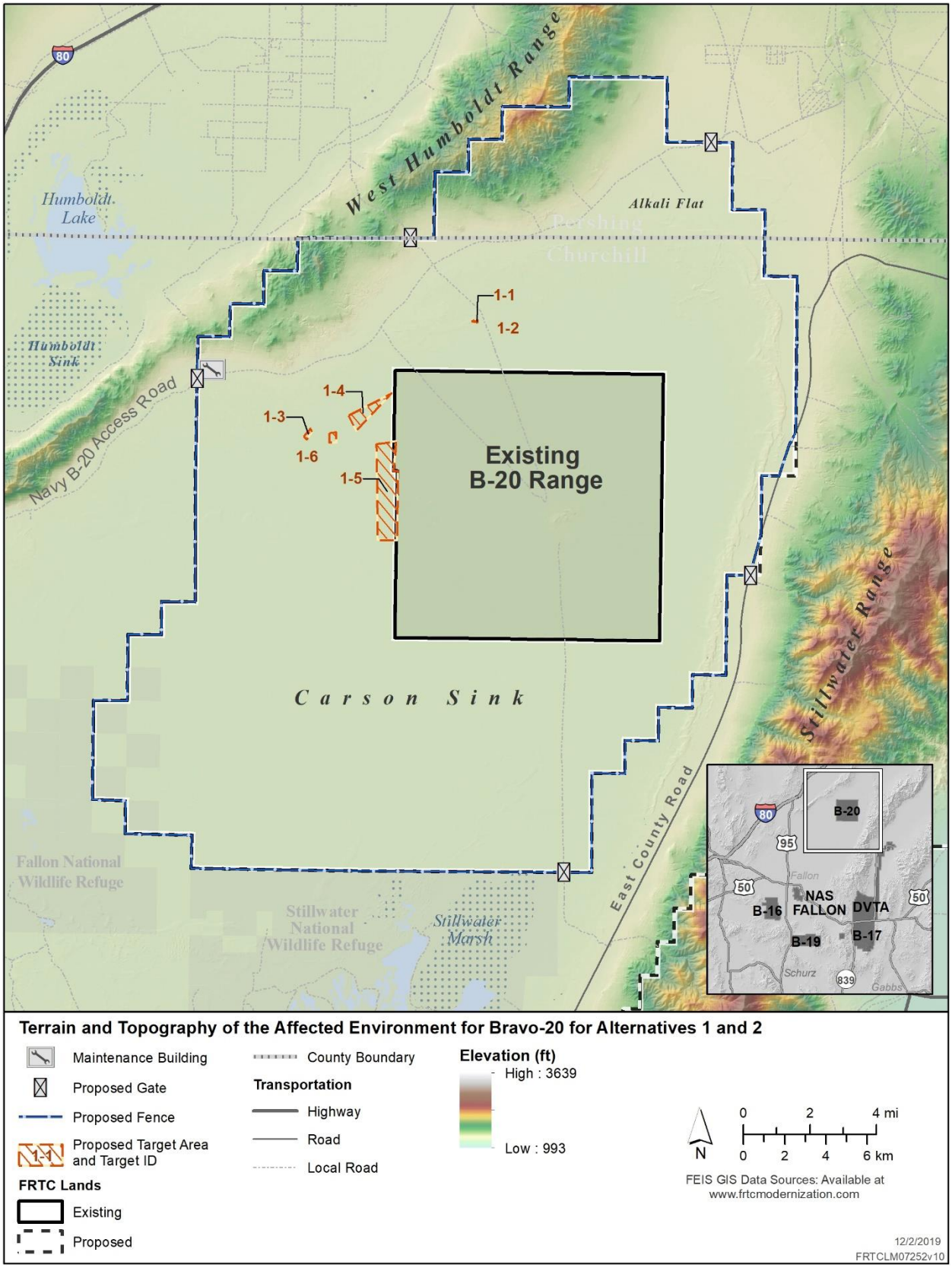

Figure 3.1-9: Terrain and Topography of the Affected Environment for Bravo-20 for Alternatives 1 and 2

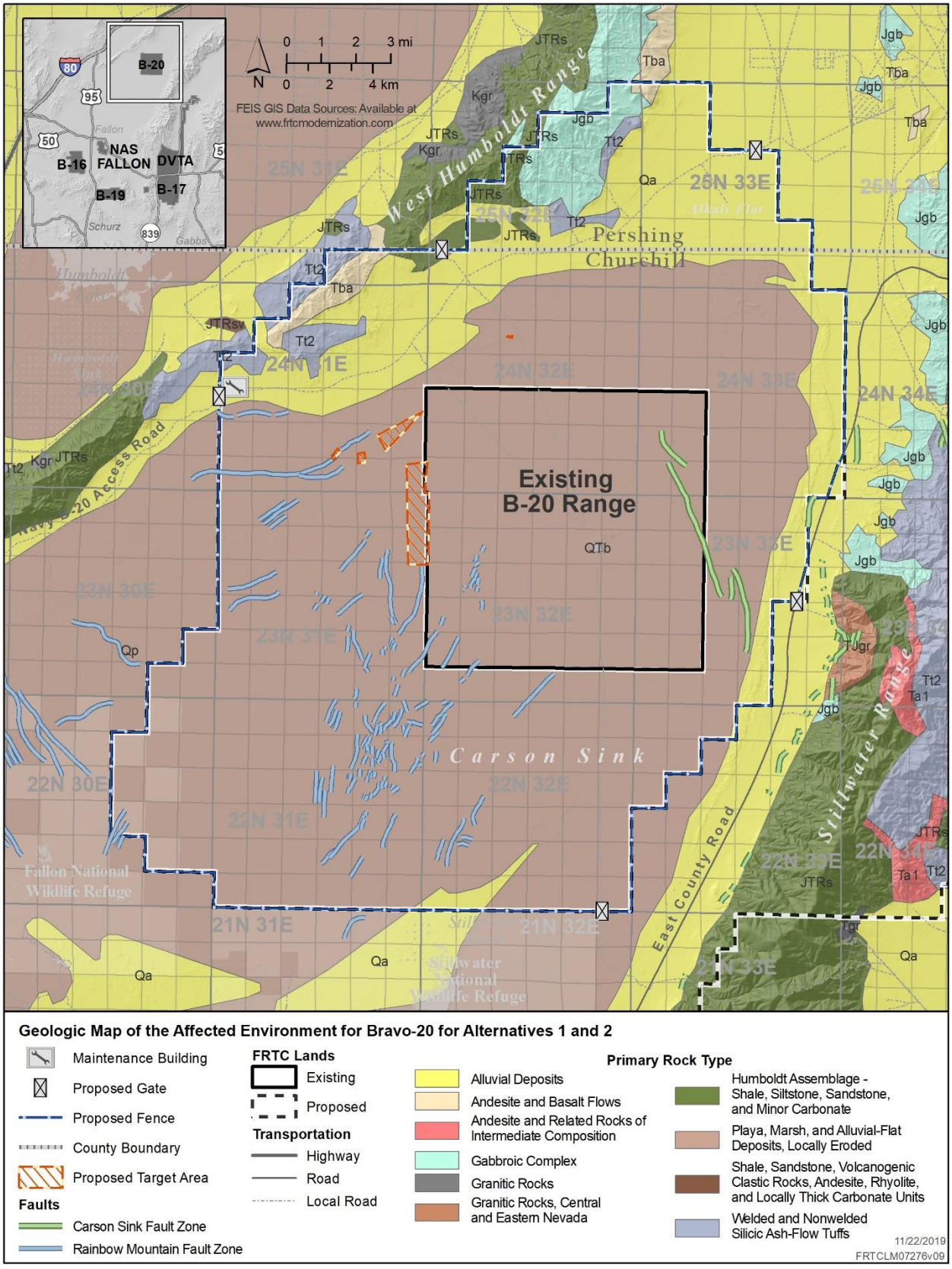

Figure 3.1-10: Geologic Map of the Affected Environment for Bravo-20 for Alternatives 1 and 2

The Rainbow Mountain fault zone is long and widely distributed; has numerous faults that occur throughout much of the Carson Sink, along the eastern margin of the Salt Wells Basin; and bounds both sides of Stillwater Point. A portion of this fault zone is found within the southern and western B-20 region of influence. The Rainbow Mountain fault zone was part of the historic Rainbow Mountain earthquake of 1954 and the Stillwater earthquake of 1954, which caused many breaks and scarps to the floor of this zone.

The Eastern Carson Sink fault zone generally separates the extremely broad and deep Carson Sink from the prominent west front of the Stillwater Range and consists of short faults. A portion of this fault zone is found within the eastern B-20 region of influence. There are no historic earthquakes associated with this fault zone.

3.1.2.5 Dixie Valley Training Area

The DVTA is within the Dixie Valley, which is north of U.S. Route 50 and B-17. Figure 3.1-11 and Figure 3.1-12 show the topography and geology within the affected environment. The DVTA is proposed to extend east into the Louderback and Clan Alpine Mountains, west into the Stillwater Mountains and south into the Sand Springs Mountains (west of the Dixie Valley) and near Fairview Peak (east of the valley).

The elevation of the Dixie Valley floor ranges from about 3,400 feet above MSL near the north end of the proposed withdrawal area to about 4,200 feet above MSL near the southern end of the proposed withdrawal area. The Dixie Valley is a typical basin feature surrounded on both sides by mountain ranges. The Valley is underlain by Quaternary alluvium, consisting of unconsolidated sand and silt, with coarser-grained alluvial fan, colluvium, and talus deposits found on slopes nearer the mountain ranges that define the valley. Playa deposits are present near the northern end of the region of influence. The Louderback (roughly 4,800 feet above MSL) and the westernmost Clan Alpine Mountains (roughly 7,000 feet above MSL) are located on the east side of the Dixie Valley. These mountain ranges are primarily underlain by Oligocene to Miocene extrusive volcanic welded and nonwelded ash-flow tuffs. Other similarly aged extrusive and intrusive volcanic rocks such as andesite and rhyolite are located on the eastern flank of the Dixie Valley. In addition, Triassic limestone, dolomite, shale, and sandstone are found in isolated instances. The Stillwater Range is located on the west side of the valley and is a very steep and rugged mountain range that separates the Dixie Valley from the Carson Sink. The portion of the Stillwater Range that is within the region of influence is largely composed of Oligocene to Miocene volcanic ash-flow tuffs, Eocene to Miocene tuffaceous sedimentary rock, and Cretaceous granite. The mountains also include areas with Jurassic shale, mudstone, siltstone, sandstone, and carbonate rock with sparse volcanic rock. Chalk Mountain is in the southeastern portion of the Dixie Valley. This mountain is composed of granitic rocks and limestone with minor amounts of dolomite, shale, and sandstone, and locally thick conglomerate units.

Soils at the lower elevations of Dixie Valley exhibit typical characteristics found in internally drained valleys of the Basin and Range Province. These soils have a high pH and are high in soluble salts because runoff is slow on the broad, nearly level valley floor. Soils at the base of a mountain also are alluvial in origin. These soils, which are generally gravelly, occupy the fan remnant and inset fan landforms. Predominant soil associations include Hawsley loamy sand, Rednik-Trocken-Bluewing Association, and the Genegraf-Rednik-Trocken Association. Soils in the northern portion of the existing DVTA consist primarily of sodic sands, deep sodic fans, and playa deposits. Soils in this northern area of the Dixie Valley are composed of sandy loams and fine sands (Bango-Playas-Chuckle Association) and silty loam, loamy sand, sandy loam, and silty clay loam (Slaw-Juva-Wholan Association).

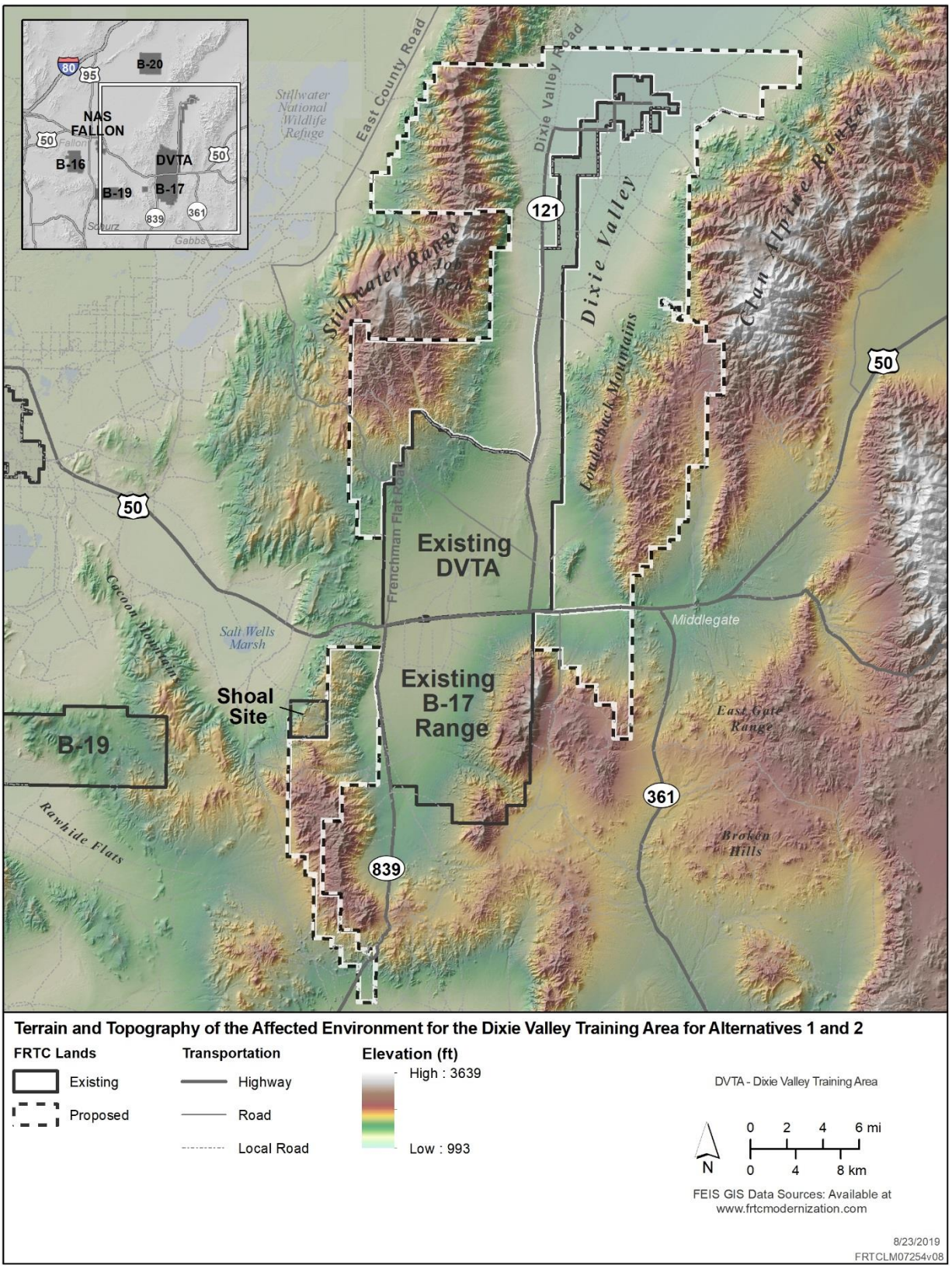

Figure 3.1-11: Terrain and Topography of the Affected Environment for the Dixie Valley Training Area for Alternatives 1 and 2

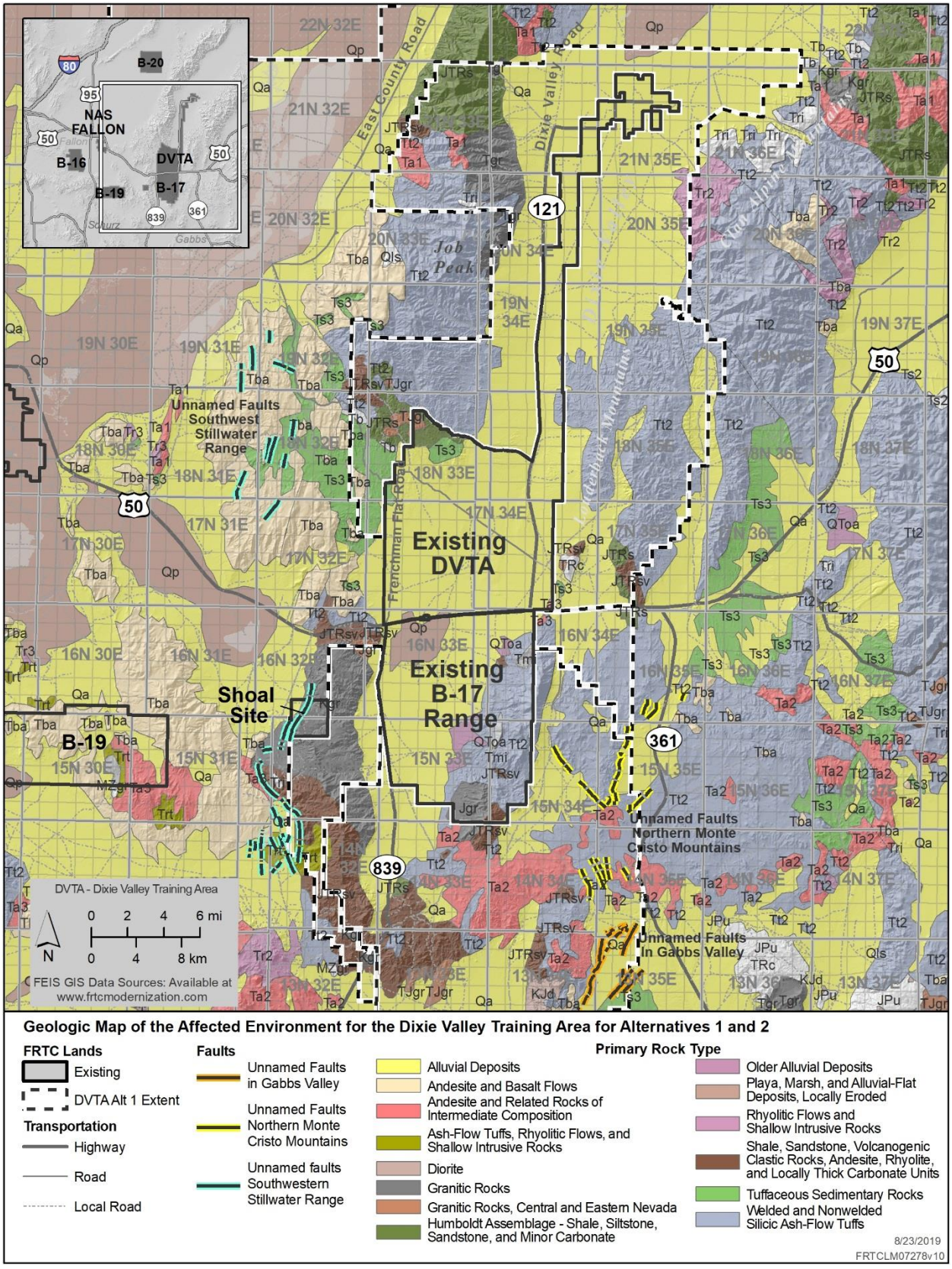

Figure 3.1-12: Geologic Map of the Affected Environment for Dixie Valley Training Area for Alternatives 1 and 2

The western slope of the Louderback and Clan Alpine Mountain ranges are primarily composed of gravelly colluvium or residuum weathered by volcanic rocks and ridges (Theon-Singatse-Rock Outcrop Association), which has a very high runoff potential, very low permeability, and a relatively shallow depth to bedrock. The southern portion of Chalk Mountain soil is primarily very stony and very cobbly loam with very high runoff (Theriot-Findout-Rock outcrop association). Soils in the Stillwater Range typically have very low to low permeability, a very high runoff rate, and severe erosion hazards (e.g., Old Camp-Bombadil-Loomer association) (Natural Resources Conservation Service, 2017a).

There is no prime or unique farmland or farmland of statewide or local importance in the proposed DVTA boundary (Natural Resources Conservation Service, 2017). The south-central portion of the Dixie Valley was an irrigated agriculture settlement area prior to the Navy's ownership of the land. During the 1980s, the Navy purchased these irrigators' lands and acquired the associated water rights. The Navy maintains the water rights on 29 wells in this area. The water is used by wildlife and to maintain wildlife habitat. Livestock on the BLM- and Bureau of Reclamation-administered grazing allotments also use the water from some of the wells.

There are 13 faults or fault zones in the DVTA region of influence: Sand Springs Range fault, Western Fairview Peak fault, unnamed faults northern Monte Cristo Mountains, Fairview fault zone, Eastern Carson Sink fault zone, Dixie Valley fault zone, Eastern Dixie Valley fault zone, unnamed fault in eastern Dixie Valley, Middlegate fault zone, West Gate fault, Gold King fault, Louderback Mountains fault, and Western Sand Springs Range fault. The Sand Springs Range fault, Western Fairview Peak fault, unnamed faults northern Monte Cristo Mountains, and Fairview fault zone are also within the B-17 region of influence. The Eastern Carson Sink fault zone is also within the B-20 region of influence. All of these faults and fault zones appear to show, at least to some extent, spatial correlation with geothermal favorability and mineral enrichment (refer to Section 3.3.2.2, Mineral and Energy Resource Potential Per Range). For additional information on the faults described below, see Supporting Study: Faults and Fault Zones In the Withdrawal Area (available at https://frtcmodernization.com).

The Dixie Valley fault zone is a long, continuous, and well-defined to spectacularly expressed fault zone that bounds the east side of the Stillwater Range. A portion of this fault zone runs through the center of the DVTA region of influence. The Dixie Valley fault zone was part of the Dixie Valley earthquake of 1954, which produced spectacular surface ruptures up to 2.8 meters high along the southern part of the fault zone. Several paleoseismic studies have been conducted on the Fairview fault zone.

The Eastern Dixie Valley fault zone consists of two groups of faults along the western flanks of the Augusta and Clan Alpine Mountains. A small portion of this fault is within the northeast corner of the DVTA region of influence. There are no historic earthquakes associated with this fault zone.

The unnamed fault in eastern Dixie Valley is a distributed group of short faults bounding the east of Clan Alpine Mountains and north end of Louderback Mountains. This fault is located within the eastern DVTA region of influence. This fault was part of the historic Fairview Peak earthquake of 1954 and the Dixie Valley earthquake of 1954, which caused the southwestern piedmont fault to have as much as 0.2 meters of vertical displacement.

The Middlegate fault zone is a relatively narrow and continuous fault along the Clan Alpine Mountains. A portion of this fault is found within the eastern edge of the DVTA region of influence. There are no historic earthquakes associated with this fault zone.

The West Gate fault is a range-front fault that is nearly continuous along the west side of the Clan Alpine Mountains. This fault is found within the eastern DVTA region of influence. The West Gate fault was part

of the Fairview Peak earthquake of 1954, which produced scarps that represent as much as 1.1 meters and 0.5 meters of vertical separation along the southern and northern rupture zones.

The Gold King fault is a short, continuous fault within the Louderback Mountains. This fault is located within the center of the DVTA region of influence. The Gold King fault was part of the historic Wonder earthquake of 1903, Fairview Peak earthquake of 1954, and the Dixie Valley earthquake of 1954, which produced several ruptures. This is one of only a few examples of a fault that has ruptured more than once during the historical period on a worldwide basis.

The Louderback Mountains fault is a short, continuous zone along the southeast side of southern Dixie Valley and locally along the southwest sides of the Louderback Mountains. This fault is located within the center of the DVTA region of influence. The Louderback Mountains fault was part of the historic Fairview Peak earthquake of 1954 and the Dixie Valley earthquake of 1954, which produced well-defined scarps; the ruptures extended the entire length of the fault.

The Western Sand Springs Range fault is a relatively short zone with range-front faults discontinuously bounding the west of Sand Springs Range and on the north side of Black Eagle hill. This fault is found on the western edge of the DVTA region of influence. There are no historic earthquakes associated with this fault.

3.1.3 Environmental Consequences

Geological resources are analyzed in terms of drainage, erosion, prime farmland, land subsidence, and seismic activity. The analysis of topography and soils focuses on the area of soils that would be disturbed, the potential for erosion of soils from construction areas, and the potential for eroded soils to become pollutants in downstream surface water during storm events. The analysis also examines potential impacts related to seismic events. Best Management Practices are identified to minimize soil impacts and prevent or control pollutant releases into storm water.

Factors considered in determining whether an impact would be significant include the potential for substantial changes in the rocks and soil that would preclude established land uses or would adversely affect sensitive environmental resources. Normal military and nonmilitary activities do not increase exposure to seismic hazards or to other geologic hazards (including landslides, subsidence, settlement, or volcanic eruption), so this section does not further address those topics. In addition, because range flight events would be conducted in airspace above FRTC and would not affect geology or soils outside the proposed boundaries of the bombing ranges and training areas, these operations are not addressed further in this section.

A total combined score on Form AD-1006, *Farmland Conversion Impact Rating*, of between 200 and 260 points out of 260 points would be considered a significant conversion of farmland (Federal Aviation Administration, 2015). Factors used to determine this score include, but are not limited to, the total acres to be irreversibly converted (directly and indirectly), whether the land is prime or unique farmland or farmland of statewide or local importance, whether the land is nonurban, the distance to urban areas, the percent of the land being farmed, and whether there have been other on-farm investments.

The BLM considers vertebrate fossils, as a group, to be scientifically significant. Meanwhile, invertebrate and plant fossils may be determined to be significant on a case-by-case basis. The destruction of such a resource or paleontological site would be considered a factor for significance for the EIS.

3.1.3.1 No Action Alternative

For geologic resources, future land uses that could occur if the FRTC is not renewed under the No Action Alternative may include range closure activities or restricted land use of areas previously disturbed by military operations and recreational use; utility corridor construction; livestock grazing, or mining, geothermal, solar, or wind energy resource development. Cessation of military surface uses would eliminate future soil disturbance at weapons impact areas, reducing the susceptibility of disturbed soils to further erosion, and potentially allowing soils to recover to their natural state unless disturbed by recreation or other public activities. Release of the FRTC lands to another Department of Defense agency, the BLM, or others would likely open unrestricted lands to public use or mineral resource development.

In general, due to limited precipitation in high desert areas such as the region of influence, weathering rates are slow, causing soil development to be weak and have unique (to arid environments) horizons as compared to areas with more precipitation and humidity. Recovery of desert soils can take decades or perhaps a century or more to return to the undisturbed state. Depending on the activity, recovery of desert soil may be less likely in areas that would experience repeated disturbance. Limited recovery of soil stability and ground or vegetative cover may be all that could be expected once surface disturbance occurs; however, physical and chemical weathering, which are two primary causes of soil development, never stops. Nevertheless, in many areas, the native soils and soil stability were weak to begin with.

In the immediate target areas, military ordnance landing on soft ground disturbs the surface. Disturbance is greater where high explosives are authorized and less where only practice munitions can be used. In areas where soil is poorly developed and bedrock is shallow, the disturbance is often less than softer areas. The area of disturbance is predictably very consistent from target area to target area. The disturbance pattern has the shape of an ellipse with the long axis always in line with the run-in line (run-in lines are nearly always fixed). This is because pilot accuracy is typically much better from perpendicular to the run-in line than short of or past the target (in line with the run-in line). In accordance with Navy policy, the target areas are actively managed in the Range Sustainment Program by regularly removing used ordnance and maintaining the landscape to ensure long-term sustainability.

Following closure of the range, cleanup activities may temporarily increase soil erosion to a very limited extent during ordnance clearance, however, range closure activities would be conducted in compliance with all applicable laws and regulations, and would involve implementation of best management practices control measures to eliminate or minimize soil erosion.

Depending on the future land uses allowed if the FRTC is not renewed, impacts on geologic resources could be significant. While future allowable uses are undefined at this time, a few examples of potential activities can help to understand the potential effects. Recreational use, particularly off-road activities, would likely increase the overall susceptibility of soils to erosion or runoff. Off-road travel would also locally increase naturally occurring wind and water erosion by altering soil structure and destroying physical or biological soil crusts, desert pavement, or vegetated surfaces, potentially resulting in increased fugitive dust and sediment loads or sedimentation in the ephemeral drainages. Off-road travel would compact soils along frequently used roads or trails and increase storm water runoff during precipitation events. Off-road travel, along with the loss of native vegetative cover in disturbed soil areas, would increase the chance of invasive, non-native plant species introduction, colonization, and naturalization. However, any future uses would be subject to all applicable Federal, state, and local laws, regulations, and ordinances, which may permanently or temporarily minimize impacts on soils.

Geologic resources in the region of influence would likely be significantly impacted by mineral and geothermal energy exploration and development. Development would have a larger impact on geological resources, such as soil, than exploration because of the following construction and building projects: surface or underground workings, heap leach pads, geothermal power plant facilities, wells and brine ponds, solar panel fields, wind turbines, paved roads, rail spurs, or electrical transmission lines. This construction would also likely increase the area of soils susceptible to wind and water erosion. However, erosion and runoff control measures would likely be implemented during mining to reduce sediment transport and minimize water quality effects. Open-pit mining also would have the potential to generate waste rock or tailing volumes, which would be stored on adjacent land and may potentially oxidize to produce acid rock drainage. Withdrawal and injection of geothermal fluids into the subsurface create the possibility of locally increasing seismic activity (Kim et al., 2018). Therefore, in light of such uncertainties, implementation of the No Action Alternative could impact geological resources within the region of influence.

3.1.3.2 Alternative 1: Modernization of the Fallon Range Training Complex

Under Alternative 1, the Navy proposes renewal by Congress of the current public land withdrawal at the FRTC. Under Alternative 1, the Navy would also request additional lands for withdrawal and propose to acquire additional non-federal land to be reserved for military use.

The Weapons Danger Zones (WDZs) for all ranges would be within the range boundaries and the probability of munitions landing beyond the range boundaries would be very low (i.e., 99.99 percent containment). Therefore, potential impacts associated with inadvertent off-range release of munitions are not addressed in further detail in this section. Policies and procedures would continue to remain in place on the FRTC that prevent off-range release of munitions or ordnance and respond in the unlikely event of a future off-range release of munitions or ordnance.

Based on current management practices, improved access to land, and increased urbanization, there is the potential for paleontological resources to be illegally removed or damaged in the future due to increases in recreational and commercial usage, and limited law enforcement presence (Bureau of Land Management, 2014). This would be improved with any resources that are on proposed withdrawn lands, as they would be fenced and protected.

As the public becomes more aware of cave locations, the incidents of vandalism from graffiti and target shooting can increase. Visitation can negatively impact the biological and cultural importance of a cave from the introduction and spread of invasive weeds and organisms, soil compaction, the disturbance of artifacts, and the spread of certain diseases (Bureau of Land Management, 2014). Cave resources are typically impacted by the public until management decisions are developed to adequately protect the resources. However, any caves or karsts that are located on the open withdrawn ranges would be fenced and protected, while any located on the bombing portions of the withdrawal would also have limited access because they would be located in fenced and restricted areas with limited access.

3.1.3.2.1 Bravo-16

Land Acquisition and Withdrawal

Alternative 1 would expand B-16 to approximately 59,560 acres, which would be an increase of approximately 32,201 acres from existing conditions (Table 2-1).

Training Activities

Unit-level training would not increase but would expand to include the entire proposed B-16 range. Unit-level training includes Air-to-Surface Ordnance Delivery, Combat Search and Rescue training, and Naval Special Warfare training. Expansion would allow concurrent training operations with Naval Special Warfare tactical ground mobility training activities in the proposed western expansion area and air operations (helicopter and fixed wing) in the eastern portion of the existing B-16 range using existing targets. Approximately 21,600 acres of B-16 would be set aside for an Immediate Action Drill Ground Maneuver Area and Close Air Support Target Area (approximately 36 percent of B-16) (Figure 3.1-5 and Table 3.1-3).

Disturbances of previously intact desert soils from vehicle and foot traffic would lead to the disruption of desert crust, pavement, or varnish that may be present (all of which assist in the stabilization of the soil). As a result, there would be an increased potential for soil erosion, compaction, and displacement, which would be considered a permanent disruption due to the long recovery time required for desert soils.

Training would involve vehicle use on the existing road network, which primarily consists of primitive dirt roads and gravel roads. During the tactical ground mobility training, off-road use of vehicles would occur in the expanded B-16. Continued vehicle uses on dirt roads would result in soil disturbance and compaction in previously disturbed areas. Similarly, the presence of personnel for training activities, including insertion/extraction, tactical ground mobility, and ground maneuver tactics, could compact soils and expose them to erosion. If areas are used frequently, damage to plants could become permanent as plants are repeatedly trampled and soils become compacted, preventing recovery of plants, potentially making soils more susceptible to future erosion.

Alternative 1 would not relocate existing target or strafe areas. There would continue to be limited physical disturbance to soils within target areas from military munition strikes, and targets would be moved around within target areas. The existing B-16 target areas are on alkali flats. Only practice/inert ordnance with spotting charge is allowed on this range. Range scrap would be removed at regular intervals based on the *Fallon Operational Range Clearance Plan* (U.S. Department of the Navy, 2013), which would be updated following the implementation of any selected alternative to include the additional withdraw areas.

Public Accessibility

Under Alternative 1, the Navy would not allow the public to access the expanded B-16 for any purpose other than for ceremonial or cultural site visits and management activities, which are currently occurring within the proposed withdrawal area. Areas that were previously used for livestock grazing, mineral exploration and development, or recreation (e.g., off-highway vehicle racing) would no longer be used for these purposes. This could reduce the amount of soil erosion, compaction, and displacement that is currently occurring on these lands; however, any beneficial impact on geological resources would be largely offset by the proposed construction and ground-training activities proposed on B-16.

The Salt Cave site, located in the proposed B-16 withdrawal area, would no longer be accessible for general recreational purposes. Restricting access to the Salt Cave site would impact those who are interested in visiting the caves and viewing the pictographs. However, restricting access would potentially have some beneficial impact on the pictographs located on several of the cave walls, which are unprotected and susceptible to unintended damage by visitors to the caves. Limiting unsupervised access by recreational visitors would reduce the potential for damage to the pictographs. However, it is

unclear if the pictographs have been damaged by visitors to the caves in the past. Additional information on pictographs at the Salt Cave site and a discussion of Tribal access to the site is found in Section 3.11 (Cultural Resources). Even though the Salt Cave site would be within the B-16 area, the Navy's first priority is to avoid areas of cultural and historical significance. Data on the location of significant sites based on recent surveys has been incorporated into the Naval Air Station Fallon Integrated Comprehensive Range Complex Management Plan so that those sites can be managed appropriately and avoided when target sites are officially located in the proposed B-16 withdrawal area.

Table 3.1-3: Alternatives 1 and 2: Soils Within New Target Areas on Bravo-16

Target Name	Acreage	Geologic Unit	Soil Association	Erosion Hazard
B16 Target Area 1	7,378.8	Qa Tba Ts3 Tt3	Bango-Hawsley association	Slight
			Biddleman association	Moderate
			Biddleman-Mazuma-Weena association	Moderate
			Hawsley-Gamgee association	Moderate
			Isolde-Pirouette-Hawsley association	Moderate
				Severe
				Slight
			Pirouette-Osobb-Celeton association	Slight
			Pirouette-Osobb-Rock outcrop association	Moderate
			Pirouette-Singatse-Hawsley association	Severe
			Singatse-Rock outcrop association	Moderate
B16 Target Area 2	2,296.1	Qa Tba Ts3 Tt3	Biddleman association	Moderate
			Biddleman-Mazuma-Weena association	Moderate
			Hawsley-Gamgee association	Moderate
			Isolde-Pirouette-Hawsley association	Moderate
			Pirouette-Osobb-Celeton association	Slight
			Pirouette-Osobb-Rock outcrop association	Moderate
B16 Target Area 3	11,924.9	Qa Tba Ts3	Appian loamy sand	Slight
			Badland-Mazuma complex, 2–30 percent slopes	Unknown
				Very Severe
			Bango-Hawsley association	Slight
			Bango-Hawsley association	Unknown
			Biddleman association	Moderate
				Slight
			Biddleman-Mazuma-Weena association	Moderate
				Unknown
			Hawsley-Gamgee association	Moderate
			Hawsley-Piroutte-Isolde association	Unknown
			Isolde-Pirouette-Hawsley association	Moderate
				Slight
			Malpais complex	Moderate
			Pirouette-Osobb-Celeton association	Slight
			Pirouette-Singatse-Hawsley association	Severe
			Pirouette-Theon-Weena association	Unknown
			Theon very gravelly sandy loam, 8–30 percent slopes	Slight
			Trocken very gravelly sandy loam, 2–15 percent slopes	Moderate

Sources: (Natural Resources Conservation Service, 2017a, 2017b; U.S. Geological Survey, 2016)
See Table 3.1-2 for geologic unit information

The fossil site located in the northwestern portion of the proposed expansion area (T18N, R27E, Section 32; see Figure 3.1-6) is known to contain plant leaf, seed, and cone impressions (Firby et al., 1981), and has not been determined to be scientifically significant.

Construction

It is anticipated that construction activities within the proposed B-16 boundary would directly disturb an estimated 161 acres during construction (i.e., less than 1 percent of the range; Table 3.1-4). Proposed construction activities would directly disturb geological resources on B-16 by excavating, grading, grubbing, compacting, and clearing soil and vegetation in construction areas during the construction phase. Geotechnical and topographic surveys would be prepared for all construction areas prior to any potential activity implementing Alternative 1.

Table 3.1-4: All Action Alternatives: Estimated Construction Impact Acreages for Bravo-16

Modernization	Construction Area (acres)	Permanent Impact Area (acres)	Temporary Impact Area (acres)
Combat Village	85	85	0
Perimeter Fence/Gates	77	8	69
TOTAL[1]	161	92	69

[1] Acres may not add up due to rounding

The full recovery of desert soils, like those found on B-16, is very slow, and recovery would be slower in areas that would experience repeated disturbance. Recovery of soil stability and ground or vegetative cover would start to occur once surface disturbance stops.

Although there are several ephemeral washes, no perennial streams or waterbodies are in the proposed boundary of B-16. During wet years, water may pond seasonally in low areas within the range. Unmitigated construction activities could disturb soils, increasing the potential for wind and water erosion and sedimentation to enter these washes. The vegetation and terrain of the area influence erosion. If vegetation, soil crusts, or desert pavement are damaged or destroyed by surface use and not provided adequate recovery periods, wind and water erosion would cause the bare ground to expand, impacting vegetation and soil productivity beyond the initial disturbance area.

A stormwater pollution prevention plan (SWPPP) would be prepared for proposed construction activities on B-16 when such activities would disturb one or more acres or be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015). In accordance with Nevada's Stormwater Construction General Permit, all project-related SWPPP(s) would include erosion and sediment control measures (e.g., wattles, silt fences) and best management practices that would minimize or avoid direct and indirect impacts on soil, vegetation, and surface waters (Nevada Division of Environmental Protection, 2015). SWPPP(s) would remain in effect until the construction sites have stabilized.

Personnel would stay within established corridors in order to minimize disturbance areas to the maximum extent practicable during construction activities. All personnel would follow posted speed limits. The maximum speed limit on FRTC bombing ranges is 35 miles per hour unless otherwise posted. This requirement minimizes fugitive dust, decreases the spread of invasive plant species, and reduces the potential to disturb or compact soil off road or outside target areas during construction activities.

As described in Section 3.1.2 (Affected Environment), the FRTC is located near numerous young faults. According to the USGS Fault and Fold Database (U.S. Geological Survey, 1999), the Combat Village would be located over tuffaceous sedimentary rock within an unnamed fault zone west of Carson Lake. To reduce the potential for seismic effects on proposed facilities, the Navy would perform geotechnical surveys and construct all buildings and towers in accordance with standard seismic design measures as identified in the Uniform Building Code.

Farmland Protection Policy Act

The NRCS's Web Soil Survey identified approximately 1,630 acres within the southwestern portion of the proposed B-16 boundary as farmland of statewide importance (see Perazzo gravelly loam, 2–8 percent slopes; Patna sand, 0–4 percent slopes; Pizene-Orizaba complex; Yerington gravelly sandy loam, 2–4 percent slopes; and Yerington loamy fine sand, 2–4 percent slopes on Figure 3.1-6) (Natural Resources Conservation Service, 2017a). Based on satellite imagery, it does not appear that these areas are currently being cultivated as cropland. The BLM's records show that these lands are occasionally used for livestock grazing (refer to Section 3.4, Livestock Grazing). Alternative 1 would include ground mobility exercises on these lands but would not involve any major construction or other irreversible conversion (directly or indirectly) of this land to non-agricultural use. In addition, target areas would not overlap these lands and there would not be an area of concentrated ammunition on B-16. Therefore, the Navy has determined that expanding B-16 under Alternative 1 would not irreversibly convert prime or unique farmland or farmland of statewide or local importance.

3.1.3.2.2 Bravo-17

Land Acquisition and Withdrawal

Alternative 1 would expand B-17 to approximately 232,799 acres, which would be an increase of approximately 178,013 acres from existing conditions (Table 2-1).

Training Activities

B-17 would continue to be the most heavily used bombing range at the FRTC. Alternative 1 would not increase the use of B-17, and training activities would be uniformly or proportionately redistributed over the range. Live and inert munitions would continue to be used at this range.

Alternative 1 includes the creation of 39 new target areas within the proposed B-17 boundary (Figure 3.1-7).

Table 3.1-5 provides additional information regarding the type of target area and the soils within these target areas. It is estimated that Alternative 1 would set aside approximately 2,939 acres for new target areas within the proposed B-17 expansion area.

Most nonexplosive practice and explosive munitions would impact the ground and thus physically disturb surficial soils in designated target areas. High velocity explosives would be capable of shattering rock and displacing soil to a limited extent. The long-term effect from military munitions strikes would result in an increased potential for soil erosion and displacement within and in the immediate vicinity of the target areas. Compared to baseline conditions, without management there would be an increased potential for sediments or contaminants to migrate from the new target areas, specifically in areas with higher runoff rates. It is Navy policy to actively manage the landscape at target areas to ensure sustainable use.

Table 3.1-5: Alternatives 1 and 2: Soils Within New Target Areas on Bravo-17

Target Name	Acreage	Geologic Unit	Soil Association	Erosion Hazard
1-1	2.4	Qa	Defler-Trocken association	Moderate
1-2	2.2	Qa	Defler-Trocken association	Moderate
1-3	20.7	Qa	Rednik-Trocken-Genegraf association	Slight
1-4	582.9	Qa Tt2	Bluewing-Hawsley association	Slight
			Defler-Trocken association	Moderate
			Downeyville-Blacktop-Rock outcrop association	Moderate
			Downeyville-Gabbvally association	Severe
			Rednik-Trocken-Genegraf association	Severe
				Slight
			Terlco-Annaw-Izo association	Moderate
			Unsel-Annnaw-Izo association	Severe
1-5	2.1	Qa	Rednik-Trocken-Genegraf association	Slight
1-6	2.2	Qa	Rednik-Trocken-Genegraf association	Slight
1-7	2.6	Qa	Rednik-Trocken-Genegraf association	Slight
1-8	6.21	Ta2 Tt2	Bimmer-Chill association	Moderate
			Downeyville-Blacktop-Rock outcrop association	Moderate
1-9	97.6	Ta2 Tt2	Downeyville-Gabbvally association	Severe
			Unsel-Annnaw-Izo association	Moderate
2-1	23.1	JTRsv Tt2	Downeyville-Blacktop-Rock outcrop association	Moderate
			Trocken-Bluewing association	Severe
3-1	277.2	Qa	Defler-Pineval association	Severe
			Old Camp-Theon-Rock outcrop association	Severe
			Unsel-Pineval-Defler association	Slight
3-2	27.6	Qa Ta2	Downeyville-Blacktop-Rock outcrop association	Moderate
			Downeyville-Gabbvally association	Severe
3-3	21.5	Qa	Unsel-Pineval-Defler association	Slight
3-4	3.0	Qa Tt2	Rebel-Wholan-Pineval association	Severe
			Unsel-Pineval-Defler association	Slight
3-5	2.4	Qa	Rebel-Wholan-Pineval association	Severe
3-6	2	Qa	Rebel-Wholan-Pineval association	Severe
3-7	20.3	Qa	Rebel-Wholan-Pineval association	Severe
3-8	2.4	Qa	Defler-Pineval association	Severe
			Rebel-Wholan-Pineval association	Severe
4-1	2.3	JTRsv	Downeyville, moist-Downeyville-Gabbvally association	Moderate
			Rednik-Trocken-Bluewing association	Moderate
4-2	2.2	JTRsv	Rednik-Trocken-Bluewing association	Moderate

Table 3.1-5: Alternatives 1 and 2: Soils Within New Target Areas on Bravo-17 (continued)

Target Name	Acreage	Geologic Unit	Soil Association	Erosion Hazard
4-3	1,114.4	Qa Ta2	Downeyville, moist-Downeyville-Gabbvally association	Moderate
			Rednik-Trocken-Bluewing association	Moderate
			Terlco-Annaw-Izo association	Moderate
4-4	24.1	Qa	Rednik-Trocken-Bluewing association	Moderate
5-1	20.9	Qa	Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
5-2	2.6	Qa	Isolde-Hawsley association	Moderate
5-3	2.6	Qa	Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
5-4	2.9	Qa	Isolde-Hawsley association	Moderate
5-5	2.8	Qa	Luning-Hawsley-Bluewing association	Moderate
5-6	2.4	Qa	Oricto-Gynelle-Izo association	Severe
5-7	2.2	Qa	Oricto-Gynelle-Izo association	Severe
5-8	2.7	Qa	Oricto-Gynelle-Izo association	Severe
5-9	2.9	Qa	Luning-Hawsley-Bluewing association	Moderate
			Oricto-Gynelle-Izo association	Severe
5-10	655.1	Qa	Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
			Oricto-Gynelle-Izo association	Severe

Sources: (Natural Resources Conservation Service, 2017a, 2017b; U.S. Geological Survey, 2016)
See Table 3.1-2 for geologic unit information

Public Accessibility

Under Alternative 1, the Navy would not allow the public to access the expanded B-17 range for any purpose other than for ceremonial or cultural site visits and management, which are currently occurring within the requested withdrawal and proposed acquisition area. Areas previously used for livestock grazing, mineral exploration and development, or recreation would no longer be used for these purposes. This could reduce the amount of soil erosion, compaction, and displacement that is currently occurring within this area; however, any potential beneficial impact on geological resources within the proposed boundary of B-17 would be largely offset by the proposed construction and training activities on B-17.

Construction

Construction within the proposed B-17 boundary would directly disturb an estimated 217 acres (i.e., less than 1 percent of the range; Table 3.1-6). Construction would directly disturb geological resources by excavating, grading, grubbing, compacting, and clearing soil and vegetation during the construction phase. Geotechnical and topographic surveys would be prepared for construction areas prior to any potential activity implementing Alternative 1.

The proposed B-17 is largely composed of alkaline desert soils. There are numerous ephemeral washes within the proposed B-17 boundary. Water drains from these washes and pools in the northern (LaBou Flat) and southern portions of the proposed B-17 boundary (Gabbs Valley). A SWPPP would be prepared for proposed construction activities on B-17 when such activities would disturb 1 or more acres or be part of a common plan that disturbs 1 or more acres (Nevada Division of Environmental Protection, 2015).

Table 3.1-6: Alternatives 1 and 2: Estimated Construction Impact Acreages for Bravo-17

Modernization	Construction Area (acres)	Permanent Impact Area (acres)	Temporary Impact Area (acres)
Administrative Building	10	3	8
Towers	10	10	0
Electronic Warfare Site	5	5	0
Perimeter Fence/Gates	181	19	163
TOTAL[1]	206	36	182

[1] Acres may not add up due to rounding

In addition, as with B-16, construction personnel would be required to remain within established corridors and follow posted speed limits when traveling to or from construction sites.

There are several named and unnamed Quaternary fault zones within the proposed boundary of B-17, including the Fairview Fault Zone, the Sand Springs Fault Zone, and the Hot Springs Fault Zone. The proposed administrative building and well site would be located on a previously disturbed area on the existing B-17 range, along State Route 839 (16N 33E Section 31 and 32). Quaternary alluvial deposits underlie this area. The Sand Springs Fault Zone is east of the construction area.

The Navy would construct two communication/sensor towers on B-17. The location of these towers is not currently known and would be placed following the implementation of any selected alternative. To reduce the potential for seismic effects on proposed facilities, the Navy would prepare geotechnical investigations for these structures and all buildings and towers would be constructed in accordance with standard seismic design measures as identified in the Uniform Building Code.

Road and Infrastructure Improvements to Support Alternative 1

State Route 839

Alternative 1 includes three notional options for potentially relocating State Route 839. All three of these options include closing portions of the existing State Route 839 to public travel and improving existing roads from dirt roads to paved roads. The Navy is working with the Nevada Department of Transportation, the BLM, Churchill County, and other stakeholders to identify a suitable location outside of B-17's WDZ for relocating State Route 839.

Table 3.1-7 compares the anticipated impact on geological resources from each notional option for relocating State Route 839. It is assumed that staging and laydown areas would be located within the potential construction area for State Route 839. A follow-on, site-specific National Environmental Policy Act (NEPA) document would be required to analyze the impacts of any feasible relocation of State Route 839, which would include analyzing potential impacts on geological resources. Best Management Practices would be implemented in accordance with SWPPPs to prevent any soil loss or indirect impacts during construction activities (Nevada Department of Transportation, 2006).

Paiute Pipeline

Alternative 1 includes the potential relocation of the Paiute Pipeline outside the B-17 WDZ. Constructing a new pipeline and removing the existing pipeline would result in impacts on geological resources, including direct physical disturbance (e.g., excavating, grading, grubbing, and soil compaction) and could lead to soil contamination resulting from accidental spills of petroleum, oil, or lubricants. It is assumed that staging and laydown areas would be located within the potential construction area for the pipeline.

It is estimated that relocating the pipeline could disturb up to 219 acres. A follow-on, site-specific NEPA analysis would be required to analyze the impacts of any feasible relocation of the Paiute Pipeline, which would include analyzing potential impacts on geological resources. These activities, including the separate NEPA analysis, would be completed by the appropriate local, state, or federal agencies.

Table 3.1-7: Alternatives 1 and 2: Estimated Potential Construction Impact Acreages for Three Notional Relocation Options for State Route 839

Modernization	Potential Construction Area (acres)	Potential Permanent Impact Area (acres)	Potential Temporary Impact Area (acres)
Notional Relocation Corridor Option 1	137	137	0
Notional Relocation Corridor Option 2	117	117	0
Notional Relocation Corridor Option 3	179	179	0

Farmland Protection Policy Act

There are no known prime or unique farmland or farmland of statewide or local importance within the proposed B-17 boundary for this alternative (Natural Resources Conservation Service, 2017a). Although this land is being used as grazing land, it does not appear that the land is currently being cultivated as farmland, and this land would not be considered prime or unique farmland or farmland of statewide or local importance.

Relocating the Paiute Pipeline could include affecting farmland of statewide importance south of B-17 (i.e., Slaw silt loam, 0–2 percent slopes), which is actively cultivated. However, design plans could avoid this area. As described above, the location of the pipeline and State Route 839 have not been defined and subsequent environmental analyses would be required to consider impacts on prime or unique farmland or farmland of statewide or local importance. For this analysis, it is assumed that the pipeline route would avoid prime or unique farmland or farmland of statewide or local importance.

3.1.3.2.3 Bravo-20

Land Withdrawal and Acquisition

Alternative 1 would expand B-20 to approximately 221,334 acres, which would be an increase of approximately 180,329 acres from existing conditions (Table 2-1).

Training Activities

B-20 would continue to be used for air-to-ground delivery of high-explosive munitions. Alternative 1 would not increase the use of B-20, and training activities would be uniformly or proportionately redistributed over this range. Alternative 1 would create six new target areas (Figure 3.1-9). These target areas and their underlying geology are described in Table 3.1-8. Approximately 1,408 acres would be used as target areas for B-20 (less than 1 percent of B-20).

High explosives would be capable of shattering rock and displacing soil on B-20. However, these target areas are on flat playa marsh lands (dry lake) with quaternary alluvial flat deposits. Playas have a low depth to water table and flood frequently. Erosion would also be limited within target areas. Some off-highway vehicle use would be anticipated, particularly near the target areas, which could physically disturb soils and lead to the spread of invasive plant species within the proposed boundary of the range.

Public Accessibility

Under Alternative 1, the Navy would not allow the public to access the expanded B-20 for any purpose other than for ceremonial or cultural site visits and management, which are currently occurring within the requested withdrawal and proposed acquisition area. Land previously used for livestock grazing, mineral exploration and development, or recreation would no longer be used for these purposes. This could reduce the amount of soil erosion, compaction, and displacement that is currently occurring; however, any beneficial impact on geological resources would be largely offset by the proposed construction and training activities on B-20.

Construction

Construction within the proposed boundary of B-20 would directly disturb an estimated 227 acres (i.e., less than 1 percent of the range; Table 3.1-9). These activities would directly disturb geological resources by excavating, grading, grubbing, compacting, and clearing soil and vegetation during the construction phase. Geotechnical and topographic surveys would be prepared for construction areas prior to any potential activity implementing Alternative 1.

Construction within the proposed B-20 boundary would largely be located in the Carson Sink, which is underlain by Quaternary alluvial playas. These alkali flats are composed of silty clay and are strongly saline with poor drainage (Natural Resources Conservation Service, 2017a). A SWPPP would be prepared for proposed construction on B-20 when such activities would disturb one or more acres or be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015).

The Rainbow Mountain, Eastern Carson Sink, and Western Humboldt Range fault zones are within the proposed B-20 boundary. To reduce the potential for seismic effects on proposed facilities, the proposed target maintenance buildings would be constructed in accordance with applicable standard seismic design measures as identified in the Uniform Building Code.

Table 3.1-8: All Action Alternatives: Geologic Units and Soils Within New Target Areas on Bravo-20

Target Name	Acreage	Geologic Unit	Soil Association	Erosion Hazard
1-1	1.3	Qp	Playas	Very Severe
1-2	1.3	Qp	Playas	Very Severe
1-3	21.5	Qp	Playas	Very Severe
1-4	239.6	Qp	Playas	Very Severe
1-5	1106.8	Qp	Playas	Very Severe
1-6	37.7	Qp	Playas	Very Severe

Sources: (Natural Resources Conservation Service, 2017a, 2017b; U.S. Geological Survey, 2016)
See Table 3.1-2 for geologic unit information

Table 3.1-9: All Action Alternatives: Estimated Construction Impact Acreages for Bravo-20

Modernization	Construction Area (acres)	Permanent Impact Area (acres)	Temporary Impact Area (acres)
Target Maintenance Building	10	3	8
Perimeter Fence/Gates	217	22	195
TOTAL[1]	227	24	203

[1] Acres may not add up due to rounding

Farmland Protection Policy Act

B-20 would not overlap any prime or unique farmland or farmland of statewide or local importance under Alternative 1.

3.1.3.2.4 Dixie Valley Training Area

Land Withdrawal and Acquisition

Alternative 1 would expand the DVTA to approximately 370,903 acres, which would be an increase of approximately 293,343 acres from existing conditions (Table 2-1).

Training Activities

Convoy Training and Combat Search and Rescue Training would occur within the proposed DVTA boundaries. Ground-disturbing activities would have long-term impacts on soils, which would consist of increased potential for soil erosion, compaction, and displacement during training events. Personnel and visitors would be encouraged to stay on established trails and within existing, previously disturbed areas when practicable. Although training would have the potential to impact soil, training activities on the DVTA would not include using explosives, ordnance, or live-fire ammunition.

Public Accessibility

Unlike the Bravo ranges, the public would largely be allowed to continue accessing and using the proposed DVTA. Impacts on geological resources would be comparable to existing conditions. However, Under Alternative 1, the public would no longer be allowed to explore and develop minerals resources within the DVTA (including geothermal exploration and development), which could potentially reduce soil and ground disturbance, resulting in a beneficial impact on geological resources.

Construction

Construction within the proposed boundary of the DVTA would directly disturb an estimated 15 acres for the construction of three electronic warfare sites (i.e., far less than 1 percent of the DVTA; Table 3.1-10; also refer to figures in Chapter 2, Description of Proposed Action and Alternatives). All staging and laydown areas for these sites would be located within the proposed construction area. These activities would directly disturb geological resources by excavating, grading, grubbing, compacting, and clearing soil and vegetation during the construction phase. Geotechnical and topographic surveys would be prepared for construction areas prior to any potential activity implementing Alternative 1. A SWPPP would be prepared for proposed construction activities when such activities would disturb one or more acres or be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015).

Farmland Protection Policy Act

The proposed DVTA would not overlap any prime or unique farmland or farmland of state or local importance under Alternative 1.

Table 3.1-10: All Action Alternatives: Construction Impact Acreages for the Dixie Valley Training Area

Modernization	Construction Area (acres)	Permanent Impact Area (acres)	Temporary Impact Area (acres)
Electronic Warfare Site	5	5	0
Electronic Warfare Site	5	5	0
Electronic Warfare Site	5	5	0
TOTAL[1]	15	15	0

[1] Acres may not add up due to rounding

3.1.3.2.5 Fallon Range Training Complex Special Use Airspace

Changes to the FRTC special use airspace would not impact geological resources.

3.1.3.2.6 Summary of Effects and Conclusions

Implementation of Alternative 1 would not significantly impact geological resources.

Approximately 4,241 acres would be used as new target areas on B-17 and B-20. It is estimated that proposed construction activities would directly disturb approximately 700 acres. SWPPP(s) would be prepared to minimize and avoid indirectly impacting soils, vegetation, and surface waters when construction activities would disturb one or more acres or would be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015). The NRCS identified farmland of statewide importance within the proposed boundary of B-16. Only limited construction (i.e., perimeter fence construction) would occur on these lands. This alternative would not irreversibly convert any prime or unique farmland or farmland of statewide or local importance to non-agricultural use. Therefore, implementation of this alternative would not result in significant impacts on geological resources.

3.1.3.3 Alternative 2: Modernization of the Fallon Range Training Complex and Managed Access

Alternative 2 is similar to Alternative 1. The differences between Alternative 1 and Alternative 2 are the allowable public activities on B-16, B-17, B-20, and the DVTA (Table 2-5). The requested withdrawal and proposed acquisition areas, construction areas, target areas, and special use airspace would be the same as Alternative 1. Approximately 4,241 acres would be used as new target areas within the FRTC. In addition, proposed construction activities would directly disturb approximately 700 acres.

Opening the bombing ranges to special events (races) could potentially lead to impacts on geological resources because these activities directly disturb soil, increase erosion, and may lead to the spread of invasive vegetation species. Hunters could also potentially create trails and spread invasive vegetation species within B-17. However, these activities are largely currently occurring in these areas. In addition, as described in Section 3.1.3.1 (No Action Alternative), allowing for the exploration and development of leasable and salable minerals within the DVTA could substantially impact surface and subsurface geological resources. De-designating wilderness study areas and opening these areas to leasable and salable exploration could result in substantial impacts on geological resources (refer to Section 3.3, Mining and Mineral Resources). Special events and mineral resource development would be subject to site-specific review and approvals following implementation of this alternative.

The Navy would create a program to oversee the approval process of land use activities within the FRTC, which would review the environmental impacts of any proposed public use of FRTC lands. When combined with military activities, it is more likely that this alternative would have a greater impact on soil, particularly when the length of time necessary for the desert soils to recover or stabilize is considered, than Alternative 1.

Implementation of this alternative would not convert any prime or unique farmland. There is no prime or unique farmland or farmland of statewide or local importance within the proposed B-17, B-20, or DVTA expansion areas. The NRCS Web Soil Survey identified farmland of statewide importance within the proposed boundary of B-16 (Natural Resources Conservation Service, 2017a). Only limited construction (i.e., perimeter fence construction) would occur in these areas. In addition, it is assumed that the potential relocation of the Paiute Pipeline and State Route 839 would be placed to avoid prime or unique farmland of statewide or local importance. Therefore, although impacts on geological resources would be greater under this alternative compared to Alternative 1, implementation of this alternative would not result in significant impacts on geological resources.

3.1.3.4 Alternative 3: Bravo-17 Shift and Managed Access (Preferred Alternative)

Alternative 3 is similar to Alternative 2. The main difference between Alternative 2 and Alternative 3 is that under Alternative 3, B-17 would be located farther to the south and east and rotated slightly counter-clockwise, and would also be somewhat larger. Unlike Alternative 1 or 2, the Navy would not withdraw land south of U.S. Route 50 as DVTA. Rather, the Navy proposes that Congress categorizes this area as a Special Land Management Overlay. This Special Land Management Overlay would define two areas (one east and one west of the B-17 range) as Military Electromagnetic Spectrum Special Use Zones. These two areas, which are public lands under the jurisdiction of BLM, would not be withdrawn by the Navy and would not directly be used for land-based military training or managed by the Navy. Alternative 3 would implement the same managed access program as Alternative 2. The major construction differences between Alternative 3 and Alternative 1 are that Alternative 3 would not involve the potential relocation of State Route 839 but would potentially relocate State Route 361. Alternative 3 would also have a different laydown for new target areas on B-17 than Alternatives 1 and 2.

3.1.3.4.1 Bravo-16

Under Alternative 3, the B-16 range would expand to the west by approximately 31,875 acres (see Figure 2-15), increasing the total area to approximately 59,234 acres. Unlike Alternative 1 and Alternative 2, the lands south of Simpson Road (and Simpson Road itself) would not be withdrawn. Additionally, currently withdrawn lands south of Simpson Road would be relinquished by the Navy back to the BLM or Bureau of Reclamation. In addition, access restrictions, construction activities, and training activities on B-16 would be the same as Alternative 2. Therefore, implementation of Alternative 3 would result in the similar impacts on geological resources as Alternative 2 within B-16.

3.1.3.4.2 Bravo-17

Land Withdrawal and Acquisition

Alternative 3 would expand B-17 to approximately 265,588acres, which would be an increase of approximately 212,016 acres from existing conditions (Table 2-7).

Training Activities

B-17 would continue to be the most heavily used bombing range of the FRTC under Alternative 3. Alternative 3 would not increase the use of B-17; training activities would be uniformly or proportionately redistributed over the range. Live and inert munitions would continue to be used on B-17 under this alternative (Figure 3.1-13).

Unlike Alternatives 1 and 2, Alternative 3 would create three larger target areas (small targets would be placed within the target areas) on either side of the Monte Cristo Mountains. Table 3.1-11 provides additional information regarding the type of target area and the location and soils within these target areas. Under this alternative, approximately 4,440 acres would be set aside for new target areas within the proposed B-17 expansion area.

Since existing target areas would be used less than currently utilized because of the additional new targets, any geological impact from using these target areas would continue to be localized and would not be anticipated to alter the ecological function of the area as described in U.S. Department of the Navy (2015). High velocity explosives would be capable of shattering rock and displacing soil.

The long-term effect from military munitions strikes would result in an increased potential for soil erosion and displacement within and in the immediate vicinity of the target areas. Compared to baseline conditions, if unmanaged, there would be an increased potential for sediments or contaminants to migrate from the new target areas, specifically in areas with high runoff rates. Loose soil and sediment could then be carried downhill and settle in basins, valleys, and other topographic depressions during rain events; however, this would not represent a substantial threat to an off-range area that poses unacceptable risk to human health or the environment.

Areas with the potential for erosion would be actively managed by the Navy's range sustainment program to prevent runoff or changes to the natural landscape.

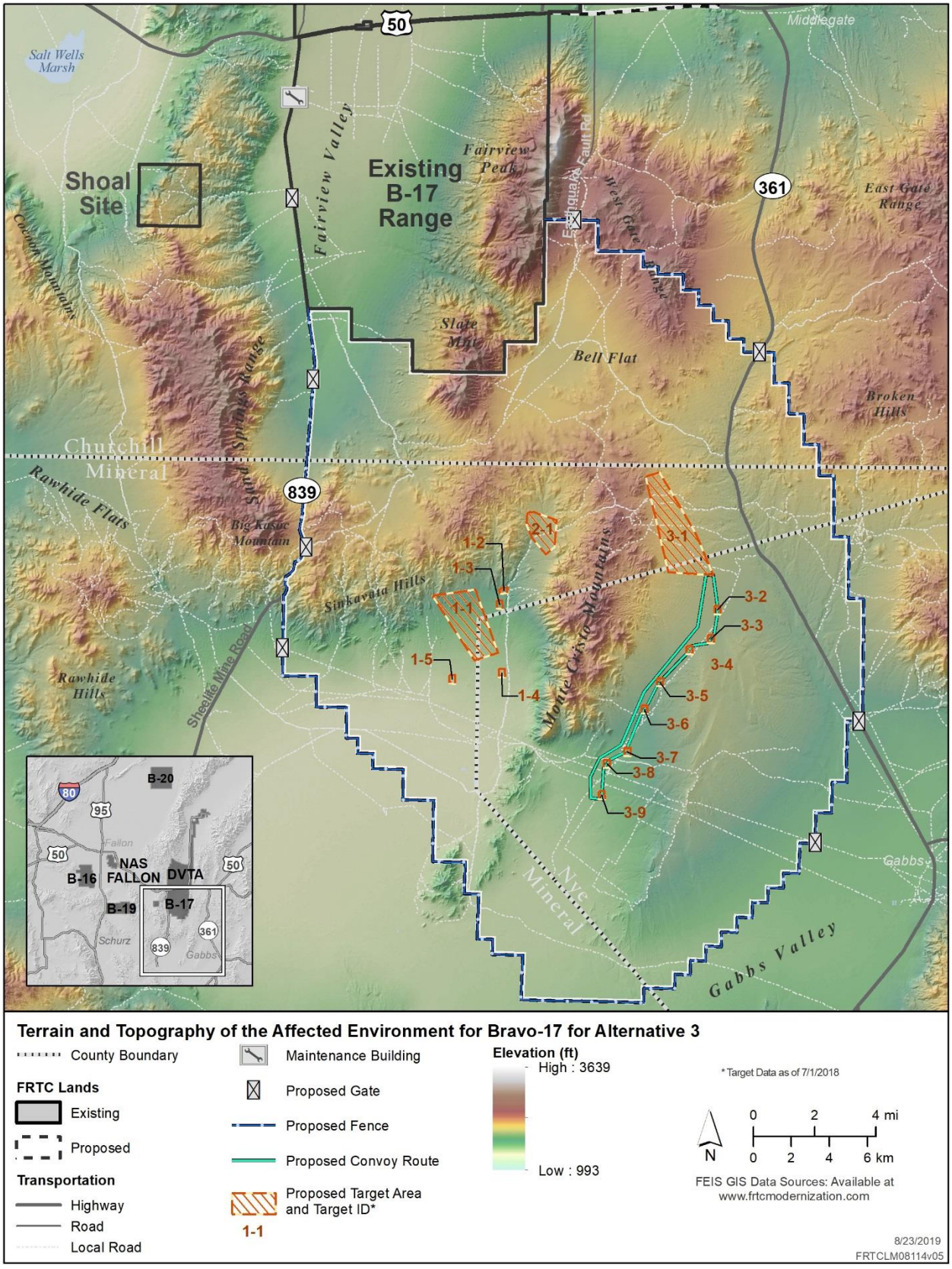

Figure 3.1-13: Terrain and Topography of the Affected Environment for Bravo-17 for Alternative 3

Table 3.1-11: Alternative 3: Geologic Units and Soils Within New Target Areas on Bravo-17

Target Name	Acreage	Geologic Unit	Soil Association	Erosion Hazard
1-1	1,100.9		Downeyville, moist-Downeyville-Gabbvally association	Moderate
			Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
			Oricto-Gynelle-Izo association	Severe
1-2	29.9		Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
			Unsel-Annnaw-Izo association	Severe
1-3	32.6		Isolde-Hawsley association	Moderate
			Luning-Hawsley-Bluewing association	Moderate
1-4	34.0		Luning-Hawsley-Bluewing association	Moderate
1-5	33.8		Oricto-Gynelle-Izo association	Severe
2-1	582.3		Downeyville, moist-Downeyville-Gabbvally association	Moderate
			Downeyville-Blacktop association	Moderate
			Isolde-Hawsley association	Moderate
			Unsel-Annnaw-Izo association	Severe
3-1	2,151.9		Downeyville-Blacktop association	Severe
			Downeyville-Stewval-Blacktop association	Severe
			Goldyke-Blacktop-Koyen association	Severe
			Unsel-Annaw association	Moderate
			Unsel-Annaw association MLRA 29	Severe
			Unsel-Annnaw-Izo association	Severe
3-2	33.3		Unsel-Annnaw-Izo association	Severe
3-3	338		Unsel-Annnaw-Izo association	Severe
3-4	1.1		Luning-Izo association	Moderate
			Unsel-Annnaw-Izo association	Severe
3-5	0.7		Luning-Izo association	Moderate
			Unsel-Annnaw-Izo association	Severe
3-6	0.2		Luning-Izo association	Moderate
			Stumble loamy sand, 0–8 percent slopes	Moderate
3-7	33.9		Stumble loamy sand, 0–8 percent slopes	Moderate
3-8	34.2		Stumble loamy sand, 0–8 percent slopes	Moderate
3-9	32.6		Ricert-Luning association	Moderate

Sources: (Natural Resources Conservation Service, 2017a, 2017b; U.S. Geological Survey, 2016)
See Table 3.1-2 for geologic unit information

Public Accessibility

As with Alternative 2, under Alternative 3, the Navy would allow the public to access B-17 for special events (races) and hunting. Allowing special events (races) on B-17 could potentially lead to impacts on geological resources because these activities directly disturb soil, increase erosion, and may lead to the spread of invasive vegetation species. Hunters could also impact geological resources by potentially creating trails and spreading invasive vegetation. The Navy would create a program to oversee the approval process of these activities, which would review the environmental impacts of any proposed public use of B-17. Refer to Section 3.12 (Recreation) for a discussion on potential impacts due to special events (races) and hunting. Although the specific locations and details of these activities are uncertain, it

is assumed for purposes of analysis that these activities would be comparable to existing baseline conditions.

When combined with military activities, it is more likely that this alternative would have a greater impact on geological resources within B-17, particularly when the length of time necessary for desert soils to recover or stabilize is considered, than Alternative 1. Individual targets would be moved around within these target areas.

Construction

Under Alternative 3, construction related to expanding B-17 would include constructing an administrative building, communication towers, and electronic warfare sites; improving approximately 12 miles of road; installing approximately 18 miles of pipeline; and installing approximately 78 miles of perimeter fencing. It is anticipated that construction activities within the proposed B-17 boundary would directly disturb an estimated 215 acres (i.e., far less than 1 percent of the range; Table 3.1-12). These activities would directly disturb geological resources by excavating, grading, grubbing, compacting, and clearing soil and vegetation during the construction phase. Geotechnical and topographic surveys would be prepared for all construction sites prior to any potential activity implementing Alternative 3. These activities, including separate NEPA analyses, would be completed by the appropriate local, state, or federal agencies.

Table 3.1-12: Alternative 3: Estimated Construction Impact Acreages for Bravo-17

Modernization	Construction Area (acres)	Permanent Impact Area (acres)	Temporary Impact Area (acres)
Administrative Building	10	3	8
Towers	10	10	0
Electronic Warfare Site	5	5	0
Perimeter Fence/Gates	190	19	171
TOTAL[1]	215	37	179

[1] Acres may not add up due to rounding

A SWPPP would be prepared for proposed construction activities when such activities would disturb one or more acres or be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015).

B-17 is largely composed of alkaline desert soils. There are several washes within the proposed boundary of B-17 and water pools in the northern (LaBeau Flat) and southern portions of the range (Gabbs Valley). A SWPPP would be prepared for proposed construction activities on B-17 when such activities would disturb one or more acres or be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015). In addition, construction personnel would be required to remain within established corridors and follow posted speed limits when traveling to or from a construction site.

There are several named and unnamed Quaternary fault zones within the proposed boundary of B-17, including the Fairview Fault Zone in the east, the Sand Springs Fault Zone in the west, and the Hot Springs Fault Zone in the south. The proposed administrative building and well site would be located on

a previously disturbed area on the existing B-17 Range along State Route 839 (16N, 33E, Sections 31 and 32). Quaternary alluvial deposits underlie this area. Although the USGS Fault and Fold Database did not identify any active faults within this construction area, the Sand Springs Fault Zone is east of the construction area.

The Navy would construct two communication/sensor towers on B-17. The location of these towers is not currently known and would be placed following the implementation of any selected alternative. To reduce the potential for seismic effects on proposed facilities, the Navy would prepare geotechnical investigations for these structures and all buildings and towers would be constructed in accordance with standard seismic design measures as identified in the Uniform Building Code.

Road and Infrastructure Improvements to Support Alternative 3

State Route 361

Alternative 3 includes the potential relocation of approximately 12 miles of State Route 361. Unlike Alternative 1, which would improve existing dirt roads and paths to a two-lane paved road, this would include constructing a new paved road, which would potentially increase impervious surface and could potentially increase storm water runoff. The Navy would work with the Nevada Department of Transportation, the Bureau of Land Management, Churchill County, and other stakeholders to identify a suitable location outside B-17's WDZ for relocating State Route 361.

Paiute Pipeline

Alternative 1 includes the potential relocation of the Paiute Pipeline outside the B-17 WDZ. Constructing a new pipeline and removing the existing pipeline would result in impacts on geological resources, including direct physical disturbance (e.g., excavating, grading, grubbing, and soil compaction) and could lead to soil contamination resulting from accidental spills of petroleum, oil, or lubricants. It is assumed that staging and laydown areas would be located within the potential construction area for the pipeline. It is estimated that relocating the pipeline could disturb up to 219 acres. A follow-on, site-specific NEPA analysis would be required to analyze the impacts of any feasible relocation of the Paiute Pipeline, which would include analyzing potential impacts on geological resources. These activities, including the separate NEPA analysis, would be completed by the appropriate local, state, or federal agencies.

Table 3.1-7 and Table 3.1-13 show the anticipated potential impact on geological resources from one notional relocation corridor option (two routes are being considered within the notional relocation corridor). It is assumed that staging and laydown areas would be located within the potential construction areas for State Route 361. A follow-on, site-specific NEPA document would be required to analyze the impacts of any feasible relocation of State Route 361, which would include analyzing potential impacts on geological resources. Best Management Practices would be implemented in accordance with SWPPPs to prevent any soil loss or indirect impacts during construction activities (Nevada Department of Transportation, 2006).

Table 3.1-13: Alternative 3: Estimated Potential Construction Impact Acreages for State Route 361

Modernization	Potential Construction Area (acres)	Potential Permanent Impact Area (acres)	Potential Temporary Impact Area (acres)
Option 1	73	73	0

Paiute Pipeline

Alternative 3 includes the potential relocation of the Paiute Pipeline outside the B-17 WDZ. As described in Section 3.1.3.2.2 (Bravo-17), constructing a new pipeline and removing existing pipeline could result in impacts on geological resources, including direct physical disturbance (e.g., excavating, grading, grubbing, and soil compaction) as well as soil contamination resulting from accidental spills of petroleum, oil, or lubricants. It is assumed that staging and laydown areas would be located within the potential construction areas for the pipeline. It is estimated this could potentially disturb up to 146 acres. A follow-on, site-specific NEPA document would be required to analyze the impacts of any feasible relocation of the Paiute Pipeline, which would include analyzing potential impacts on geological resources. For this analysis, it is assumed that the pipeline route would avoid prime or unique farmland or farmland of statewide or local importance. These activities, including the separate NEPA analysis, would be completed by the appropriate local, state, or federal agencies.

Farmland Protection Policy Act

The NRCS Web Soil Survey did not identify any prime or unique farmland within the proposed boundary of B-17. The NRCS did identify an area within the southeastern portion of B-17 as farmland of statewide importance (Eastgate gravelly sandy loam, 0–4 percent slopes, and Stumble-Eastgate association) (Natural Resources Conservation Service, 2017a). This area is requested to be withdrawn as part of the WDZ. There are no target areas on these farmlands. The Navy would continue to clear the range in accordance with the FRTC's Operational Range Clearing Plan (U.S. Department of the Navy, 2004). Therefore, the Navy has determined that this alternative would not irreversibly convert this land to non-agricultural use.

The notional relocation of the Paiute Pipeline could include segments that are within farmland of statewide importance; however, these areas could be avoided. Follow-on, site-specific NEPA documents would analyze whether relocating State Route 361 and the Paiute Pipeline would convert prime or unique farmland or farmland of statewide or local importance. For purposes of this EIS, it is assumed that these farmlands would be avoided during the potential relocation of State Route 361 and the Paiute Pipeline. These activities, including the separate NEPA analysis, would be completed by the appropriate local, state, or federal agencies.

3.1.3.4.3 Bravo-20

The requested withdrawal and proposed acquisition area for B-20 would be the same as Alternatives 1 and 2. In addition, access restrictions, construction activities, and training activities within B-20 would be the same as Alternative 2. Therefore, implementation of Alternative 3 would result in the same impacts on geological resources as Alternative 2 within B-20.

3.1.3.4.4 Dixie Valley Training Area

The requested withdrawal and proposed acquisition area for the DVTA would differ slightly from Alternatives 1 and 2. The southeastern portion of the DVTA would be realigned to conform to the adjusted B-17 withdrawal area. The result would be a minor increase in acreage of the DVTA compared to Alternatives 1 and 2; however, this area is the same area that would be withdrawn under Alternatives 1 and 2 as B-17. Ground-disturbing activities that would occur on the DVTA from public and operational activities could impact a slightly larger area; however, these activities are anticipated to be commensurate with current baseline activities. Therefore, implementation of Alternative 3 would result in similar impacts on geological resources as Alternative 2.

3.1.3.4.5 Fallon Range Training Complex Special Use Airspace

Changes to the FRTC special use airspace would not impact geological resources.

3.1.3.4.6 Summary of Effects and Conclusions

Implementation of Alternative 3 would not significantly impact geological resources. Approximately 27,374 acres would be used as new target areas on B-17 and B-20. There is a greater concern that displaced soil and sediment from high explosive ordnance use on B-17 could be transported off range under this alternative compared to Alternatives 1 and 2 and baseline conditions. However, this would not represent a substantial threat to an off-range area that poses unacceptable risk to human health or the environment. It is estimated that proposed construction activities would directly disturb up to 956 acres. SWPPP(s) would be prepared to minimize and avoid indirectly impacting soils, vegetation, and surface waters when construction activities would disturb one or more acres or would be part of a common plan that disturbs one or more acres (Nevada Division of Environmental Protection, 2015). The NRCS identified farmland of statewide importance within the proposed boundaries of B-16 and B-17. Only limited construction (i.e., perimeter fence construction) would occur in these areas. This alternative would not irreversibly convert any prime or unique farmland or farmland of statewide importance to non-agricultural use. Therefore, although Alternative 3 would result in greater impacts on geological resources than Alternatives 1 or 2, implementation of this alternative would not result in significant impacts on geological resources.

3.1.3.5 Proposed Management Practices, Monitoring, and Mitigation

3.1.3.5.1 Proposed Management Practices

The following management practices are proposed for implementation on the FRTC to avoid and minimize potential impacts on geological resources under Alternatives 1, 2, and 3:

- Construction personnel would stay within established corridors.
- Construction personnel would follow posted speed limits. The maximum speed limit on FRTC bombing ranges is 35 miles per hour unless otherwise posted.
- The potential relocation of the Paiute Pipeline and State Route 839 (Alternatives 1 and 2) or of the Paiute Pipeline and State Route 361 (Alternative 3) would be placed to avoid prime or unique farmland or farmland of statewide or local importance to the maximum extent practicable.
- Pedestrian field surveys would be conducted by a qualified and BLM-permitted paleontologist prior to any surface grading or excavation in areas of high (Class 4), very high (Class 5), or unknown (Class U) fossil yield potential. A partial survey may be conducted by a BLM-permitted paleontologist in areas with moderate potential (Class 3) or in other areas potentially sensitive to fossil resources.
- If there were an unanticipated discovery of a potential paleontological resources, surface-disturbing activities would cease in the immediate area of the discovery until the significance of the discovery can be analyzed, notification to proceed is received, and the appropriate BLM office has been notified. The presence of any found paleontological resources are be managed according to the BLM Instruction Manual. Once the extent and potential significance of the paleontological resources on the site has been determined, appropriate mitigation measures for further site development may be developed.

3.1.3.5.2 Proposed Monitoring

The measures outlined in Navy, *Military Readiness Activities Fallon Range Training Complex Environmental Impact Statement* (U.S. Department of the Navy, 2015), such as range condition assessment five-year reviews would continue to be implemented.

3.1.3.5.3 Proposed Mitigation

The Navy does not have any new proposed mitigation measures for the reduction or minimization of impacts on geological resources as a result of the Proposed Action that are not already in place. However, under the Proposed Action, the Navy would acquire any valid existing mining claims within the proposed withdrawal at fair market value. Under all action alternatives the Navy would reduce impacts on geologic resources by following standard operating procedures.

3.1.3.6 Summary of Effects and Conclusions

Table 3.1-14 summarizes the effects of the alternatives on geological resources.

Table 3.1-14: Summary of Effects for Geological Resources

Stressor	Summary of Effects and National Environmental Policy Act Determinations
No Action Alternative	
Summary	• Existing land uses at FRTC would be returned to accessible public lands managed by the BLM for multiple uses following range closure activities, potentially making the land available for uses that could have significant impacts on geological resources (e.g., agricultural uses). • Areas that cannot be rendered safe for public access would remain unavailable for public access. • Any future uses would be subject to all applicable federal, state, and local laws, regulations, and ordinances that could have the effect of permanently or temporarily minimizing impacts on soils.
Impact Conclusion	The No Action Alternative could result in significant impacts on geological resources.
Alternative 1	
Summary	• New air-to-ground targets would be placed within an approximately 4,241-acre area at B-17 and B-20. • Construction activities would permanently impact up to an estimated 347 acres and temporarily impact approximately 700 acres. • Would not result in the conversion of prime or unique farmland or farmland of statewide or local importance.
Impact Conclusion	No significant impact on geological resources
Alternative 2	
Summary	• New air-to-ground targets would be placed within an approximately 4,241-acre area at B-17 and B-20. • Construction activities would permanently impact up to an estimated 347 acres and temporarily impact approximately 700 acres. • Would not result in the conversion of prime or unique farmland or farmland of statewide or local importance.
Impact Conclusion	No significant impact on geological resources
Alternative 3	
Summary	• New air-to-ground targets would be placed within an approximately 27,374-acre area at B-17 and B-20 • Construction activities would permanently impact up to an estimated 241 acres and temporarily impact approximately 715 acres • Would not result in the conversion of prime or unique farmland or farmland of statewide or local importance.
Impact Conclusion	No significant impact on geological resources

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