TABLE OF CONTENTS

TABLES

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3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Chapter 3 describes the affected environment of the WTP Project Area. Resources and resource uses described in this chapter include the key resources or land uses in the WTP Project Area, as well as the substantive issues of concern brought forward during internal and public scoping. Affected environment information within this chapter is intended to set up a baseline for comparison of the direct, indirect, and cumulative impacts of each of the alternatives. All figures and maps not found within the text of this chapter are located in **Appendix A**.

The DEIS, which was released in February of 2008, contained an evaluation of conformance with the terms, conditions, and decisions of the Price River MFP (BLM 1984a) and the Diamond Mountain RMP (BLM 1994b). As described in the **Executive Summary** and **Section 1.5**, these documents were, at the time, the existing and approved plans for the WTP Project Area. However, land use plan revisions for both Price and Vernal were ongoing at the time the and have since been completed and approved. While the FEIS has been modified to discuss conformance with the Price and Vernal Approved RMPs, it should be noted that information from the Diamond Mountain RMP and Price River MFP (which were used to describe the affected environment in this chapter) have not been modified to reflect decisions made in the Approved RMPs. For example, this chapter and the subsequent analyses in Chapter 4.0 include an assessment of the impacts of development on a number of special designations that were not carried forward for in the Approved RMPs or have been slightly modified in the Approved RMPs (e.g., the potential Desolation Canyon ACEC was not carried forward for management in the Approved Price RMP). The BLM determined that updating or removing certain components of the affected environment information, even if it has changed, is unnecessary because the analysis contained within this FEIS is based on a more conservative baseline than the decisions included in Approved RMPs. In addition, discussion of the affected environment as contained in this EIS directly responds to issues and concerns brought forward by the public and cooperating agencies during public scoping the public comment period for the DEIS.

Similarly, as more than two years have passed since the publication of the DEIS, some of the reference data cited within the FEIS is not the most current data available. However, the data used serves as quality and accurate information for establishing a baseline condition reflecting the general conditions, trends, and resources for the areas of analysis. The established baseline provides a set point in time from which a comprehensive analysis can be based on throughout the document. Some updates have been made to reflect key events that have occurred since publication of the DEIS. For example, the information on greater sage-grouse has been updated to reflect the species' new status as a Candidate for listing under the Endangered Species Act. Similarly, the cultural resource section has been updated to reflect the revised Area of Potential Effect (APE) that was developed during the WTP PA, as well as to reflect the additional information collected in the expanded Class I literature review for the revised APE. However, for this EIS, the publication of the NOI largely represents the "starting point" for the collection of baseline data for the affected environment. Thus, the affected environment for this FEIS remains largely as it was published in the 2008 DEIS.

3.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.2.1 Geology

3.2.1.1 Physiography and Topography

The WTP Project Area is located above and to the northeast of the Roan Cliffs, a northwest-trending, south-facing sinuous escarpment that defines the southern limits of the Uinta Basin. The Uinta Basin is a bowl-shaped structural and sedimentary basin that trends roughly east-west and encompasses about 10,890 square miles of Utah, Colorado, and Wyoming. The Uinta Basin was the site of ancient Lake Uinta and Lake Flagstaff that covered a large part of eastern Utah and northwestern Colorado between 50 and 65 million years ago. Between 15,000 and 20,000 feet of fluvial and lacustrine deposits accumulated in the Uinta Basin during this period. The basin is bounded on the north by the Uinta Mountains and on the east by the Douglas Creek Arch with portions of the Wasatch Range and the Roan Cliffs comprising its western and southern boundaries. The highest point in the Uinta Basin region is Kings Peak in the Uinta Mountains with an elevation of 13,528 feet. The lowest point is about 4,200 feet in elevation where the Green River exits the basin near the south end of Desolation Canyon.

The WTP Project Area lies on the West Tavaputs Plateau within the Tavaputs Plateau Topographic District of the Uinta Basin (Clark 1957). The Tavaputs Plateau District consists of a series of broad, discontinuous plateaus underlain largely by sandstones. Both flowing streams and dry washes are deeply incised in canyons that may be more than 1,000 feet deep in these plateaus.

The West Tavaputs Plateau is a rugged, high-elevation plateau that is dissected by a series of steep, V-shaped stream canyons. Slopes in these canyons mostly range from 40 to 50 percent, with both steeper and gentler slopes occurring. Locally, slopes can be nearly vertical in areas of the canyons where the stream has undercut the side slopes. The area has over 4,400 feet of relief, with the lowest point being approximately 4,500 feet along the Green River in Desolation Canyon, and the highest point being over 9,000 feet near the southwest corner of the WTP Project Area. The major topographic features of the WTP Project Area include steep-walled V-shaped canyons, narrow, irregular ridges, and elongated mesas. Rock is exposed throughout the canyons as massive rock walls, ledges, pinnacles, and buttresses.

3.2.1.2 Stratigraphy

The Uinta Basin is a structural basin that has been partially filled with sediments. **Figure 3.2-1** presents the geologic map for the WTP Project Area and vicinity. **Table 3.2-2** presents the general stratigraphic column for the WTP Project Area. Rock formations in the area range in age from Quaternary to Triassic. Howells et al. (1987) provide a detailed description of the geologic history of the Uinta Basin.

Rocks exposed at the surface in the WTP Project Area consist of approximately 2,500 feet of the Eocene Green River Formation, the Eocene and Paleocene Colton Formation, and Quaternary alluvium and colluvium (Hintze 1988; Hintze et al. 2000; Weiss et al. 1990). The Green River Formation covers the majority of the WTP Project Area and is the largest lacustrine deposit in the world. Because of multiple facies changes, and intertonguing and gradational boundaries with the underlying Colton Formation and the overlying Uinta Formation, different nomenclature has been used to subdivide the Green River Formation by different geologists in the area. The units in the WTP Project Area have been previously described as the Middle and Upper Members of the Green River Formation (Weiss et al. 1990). The Upper Member is correlative with the Evacuation Creek Member and the upper part of the Parachute Creek Member as defined by Dane (1955). Weiss et al. (1990) selected the base of the Mahogany ledge, a prominent marker bed composed of multiple oil shale intervals and marlstone, as the base of the Upper Member. The Middle Member correlates to the lower portion of the Parachute Creek Member and the Douglas Creek Member (Cashion 1967).

The Middle Member of the Green River Formation is composed of sandstone, siltstone, shale, and limestone. Sandstone beds are composed predominantly of fine- to medium-grained quartz grains and may be cross-bedded. These beds form prominent gray and brown-colored ledges. Siltstones are gray to tan and form tan or reddish-brown ledges and steep slopes. The shale layers are gray, tan, and green and weather to green or gray slopes. Limestones present in this unit are thin-bedded to massive and are usually gray, but weather to distinctive orange-brown ledges. This member forms much of the rugged topography present in the canyons on the west side of the WTP Project Area and is characterized by numerous cliffs and ledges dissected by gullies.

The upper portion of the Middle Member, which is correlative to the Parachute Creek Member described in other areas, is composed of interbedded gray and brown marlstone, sandstone, siltstone, oil shale, and tuff. These strata are mostly thin, even-bedded, and continuous. The top of the Middle Member is marked by the base of the Mahogany ledge, a zone of multiple oil shale beds that ranges in thickness from about 15 feet to 150 feet in this area (Weiss et al. 1990). The Mahogany Bed, the most notable oil shale interval, varies from about 2.5 feet to about 6 feet thick within this interval.

The Upper Member of the Green River Formation consists of light-gray to light-brown thinly bedded marlstone, limestone, siltstone, sandstone, and some shale that alternate irregularly. The Upper Member also comprises many thin layers of oil shale and some tuff layers. A prominent sandstone layer called the Horse Bench Sandstone forms a conspicuous marker interval within this member. This resistant unit is uniformly 30-40 feet thick and forms the flat tops of the mesas in the WTP Project Area. This sandstone is composed of gray and brown very fine- to medium-grained quartz, with thin to massive bedding, and commonly is cross-bedded and contains ripple marks.

The Eocene and Paleocene Colton Formation is exposed on the east side of the WTP Project Area in the steep-walled side canyons of the Green River. This formation consists of dark reddish-brown to green beds of mudstone and shaly siltstone interlayered with thin, fine- to medium-grained quartz sandstone beds. The Colton Formation represents fluvial deposits in northwest-flowing stream channels on a deltaic and alluvial plain adjacent to ancient Lake Flagstaff. This formation is generally correlative to the Wasatch Formation exposed east of Desolation Canyon.

Deeper rock formations present beneath the WTP Project Area that have produced oil and gas in other portions of the Uinta Basin include the Colton Formation, the Cretaceous Mesaverde Group, Mancos Shale, Dakota Sandstone, and Cedar Mountain

Formation, and the Jurassic Morrison Formation, Entrada Sandstone, and Navajo Sandstone.

Quaternary alluvium and colluvium occurs in the bottom of Nine Mile Canyon and portions of the major side canyons, as shown on **Figure 3.2-1**. This alluvium covers about 2,572 acres of the WTP Project Area. The alluvial deposits along Nine Mile Creek and the side canyons consist of unsorted deposits of light- to dark-grayish brown silt, sand, and clay, with some interbedded gravel. Alluvium is also present in isolated patches that occur on the tops of the mesas in the Horse Bench and Flat Top Mesa areas (McGregor 1980). At the mouths of the major canyons, alluvial fan and debris flow deposits are present. Large debris flow deposits are present at the mouths of most of the side canyons that enter Nine Mile Canyon from the north. These features are up to 500 feet across, were deposited by high-energy surface runoff events, and consist of sandstone boulders, cobbles, and pebbles in a matrix of poorly sorted sand and silt. These events occasionally cover Nine Mile Canyon Road with debris that must be removed.

Slope failure deposits are also locally present and comprise rock fall deposits, rock avalanche deposits, talus slopes, and debris fans. One landslide deposit has been mapped in the WTP Project Area, in a side canyon that is tributary to Jack Creek Canyon in Section 18, T13S:R16E (Harty 1991; McGregor 1980). An additional area with landslide deposits is located at the southwest corner of the WTP Project Area, as shown on **Figure 3.2-1**.

Table 3.2-2 General Stratigraphic Column for the WTP Project Area

Age	Geologic Unit	Approximate Thickness (feet)	Lithology
Quaternary	Surficial Deposits	Up to 200	Unconsolidated surface deposits of alluvial sand and gravels, colluvial debris including landslide and pediment deposits, and eolian sands.
Tertiary	Green River Formation	Up to 6,000	Massive thin bedded lacustrine shale and freshwater limestone. Minor lenses and beds of sandstone and conglomerate; gray to greenish-gray shale, and white to tan limestone. Contains deposits of tar sand and oil shale.
	Colton Formation	660 – 2,770	Limestone containing irregularly interbedded shale, siltstone, sandstone, and conglomerate. Alluvial, lacustrine, and deltaic origin.
	Flagstaff Limestone	200 – 300	Reddish-brown to grayish-brown lacustrine mudstone with interbedded calcareous siltstone, sandstone, limestone, and conglomerate, and limestone with minor carbonaceous shale.
Cretaceous	Mesaverde Group – Price River Formation	0 – 1,200	Light gray to grayish/reddish brown fluvial sandstone with conglomerate and mudstone.
	Mesaverde Group – Castlegate Sandstone	130 – 500	Light to dark gray fluvial quartz sandstone and conglomerate. Commonly forms cliffs and steep slopes.

Table 3.2-2 General Stratigraphic Column for the WTP Project Area

Age	Geologic Unit	Approximate Thickness (feet)	Lithology
	Mesaverde Group – Blackhawk Formation	400 – 1,500	Dominantly light brown to light gray deltaic quartz sandstone with interbedded shale and shaly siltstone, calcareous shale, and coal. Generally forms steep slopes. Most important coal-bearing formation in Utah.
	Mesaverde Group – Star Point Sandstone	0 – 300	Light brown to brown marine quartz sandstone with interbedded shale and shaly siltstone.
	Mancos Shale	2,300 – 6,100	Light to dark gray, bluish-gray, and light brown marine shale and shaly siltstone with some fine-grained sandstone. Generally erodes to flat lowlands.
	Dakota Sandstone	0 – 30	Tan to light brown cross-bedded marine and deltaic quartz with thin, discontinuous carbonaceous seams.
	Cedar Mountain Formation	160 – 750	Purple to gray mudstone and gray cross-bedded fluvial sandstone.
Jurassic	Morrison Formation	350 – 400	Multi-colored claystone, mudstone, sandstone, conglomerate, and limestone. Contains uranium and dinosaur fossils.
	Summerville Formation	120 – 250	Reddish-brown shaly siltstone and sandstone with thin interbeds of gypsum. Tidal flat deposit.
	Curtis Formation	75 – 250	Light greenish-gray to light brown glauconitic quartz marine with some siltstone and conglomerate. Forms ledges that act as resistant caps.
	Entrada Sandstone	200 – 300	Orangish-brown to reddish-brown massive eolian sandstone.
	Carmel Formation	560 – 650	Reddish-brown shaly siltstone with gypsum and sandstone interbeds (upper unit), and pale green to brownish-gray calcareous sandstone.
	Page Sandstone	50 – 70	
	Navajo Sandstone	400 – 1,000	Light reddish-brown to light gray, massive cross-bedded, eolian sandstone. Stands as steep cliffs.

Source: Hintze (1988); Schlotthauer et al. (1981)

3.2.1.3 Structure

Deposition of the Mesaverde Group marked the end of a long period of marine transgressions across the area. The modern structural characteristics of the Uinta Basin developed during the early Eocene Laramide Orogeny, a time of mountain building in the western United States (Clark 1957). Formation and subsidence of the basin occurred simultaneously with the uplift of adjacent highlands, including the Uinta Mountains and the Wasatch Range to the north, the San Rafael Swell to the southwest, the Douglas Creek Arch to the east, the Sierra Madre uplift in northwestern Colorado and southern Wyoming, the Park, Sawatch, and White River uplifts in Colorado, and a reactivated Uncompahgre Uplift in Utah and Colorado. During the Paleocene and Eocene, the Uinta Basin was occupied by a series of lakes that began to form after the region emerged from the sea in the late Cretaceous. Erosion of the highlands surrounding the basin has filled it with about 20,000 feet of sediment since retreat of the Cretaceous sea.

The structural axis of the basin occurs as the Uinta Basin Syncline and generally trends west-northwest and plunges gently to the northwest. The WTP Project Area lies to the south of the structural axis near the southwest boundary of the basin. Bedrock exposed at the surface on the West Tavaputs Plateau generally dips about one to three degrees to the northeast toward the central portion of the Uinta Basin. A series of normal faults is present near the southern edge of the WTP Project Area. These faults trend to the west-northwest and surface exposures of these faults are up to 10 miles long. These faults form a series of grabens (downdropped valleys bounded by faults) that extend from Desolation Canyon across the WTP Project Area and trend north 70 degrees west. These faults and grabens, and two similar series of faults exposed to the north and south of the WTP Project Area, are related to the ancient Uncompahgre Uplift that extends beneath the area (Weiss et al. 1990).

Strata underlying the southern portion of the basin (and the WTP Project Area) have been gently folded at depth in association with the buried ancient Uncompahgre Uplift. This subtle folding of the rocks at depth has served to localize accumulations of natural gas in the rock formations of the area. Three such folds, identified by Weiss et al. (1990) as the Stone Cabin, Peter's Point, and Nine Mile Anticlines, are present beneath the WTP Project Area and were the targets for previous drilling activities in the existing Stone Cabin, Peter's Point, and Nine Mile Canyon gas fields. Gas has been produced from the Colton and Green River Formations at depths of about 2,800 feet to 4,300 feet below ground surface (bgs) in these units (Weiss et al. 1990). The Peter's Point Anticline has also been called the Jack Canyon Anticline (BLM 1990).

3.2.2 Mineral Resources

3.2.2.1 Petroleum

Oil and Gas

Within the Uinta Basin, most of the historic energy production is from the Tertiary Wasatch and Green River formations (the Uinta Tertiary Oil and Gas Play) and Cretaceous Mesaverde Group (the upper Cretaceous Conventional Play) (BLM 2002a). The reservoir rocks in the Wasatch Formation consist of lake margin fluvial and alluvial plain sediments deposited by Eocene Lake Uinta. This formation contains many buried stream channels that trend in a north-northwest direction and contain significant accumulations of natural gas. Reservoir rocks in the Green River Formation are typically lenticular sandstone beds. The reservoir rocks of the Mesaverde Group are deltaic sandstone deposits. Gas production problems are possible within the Mesaverde Group and Wasatch Formation due to the tight and thoroughly cemented sandstone beds that reduce the porosity and permeability of the reservoir (BLM 2003a).

Deeper formations which contain oil and gas accumulations in the southern Uinta Basin include the Cretaceous Dakota Sandstone, Cedar Mountain Formation, Mancos Shale, the Jurassic Morrison, Entrada, and Wingate formations, and the Permian White Rim Sandstone, among other formations (BLM 1990; Keighin and Hibpshman 1975; White River Resources Corporation 2004).

Within the WTP Project Area are five existing conventional oil and gas fields: the Dry Creek, Stone Cabin, Prickly Pear, Nine Mile Canyon, and Peter's Point units (BLM 2002a). Production from the Peter's Point Unit is from the base of the Green River

Formation and from units in the Colton Formation and began in 1976 (BLM 1990). The wells are located along the Peter's Point (or Jack Canyon) Anticline (an upward doming or flexing of the rocks) which provides closure of strata in the Green River and Colton formations. This area was formerly designated as the Jack Canyon Known Geologic Structure.

Beneath the WTP Project Area, the Dakota Sandstone formation is considered to have very promising potential as a gas-producer (BLM 1990). The Dakota Sandstone consists of nearly pure quartz beach sands that thicken toward the south and have excellent reservoir characteristics. Migration of oil and gas along the subsurface fault zones associated with the Uncompahgre Uplift may have resulted in accumulation of petroleum resources in stratigraphic traps.

Oil Shale

Oil shale is a compact, sedimentary rock containing large quantities of organic matter that yields oil when distilled (BLM 2003a). Kerogen, organic matter that can be converted to oil, occurs within marlstones of the Parachute Creek Member of the Green River Formation, which is present in the WTP Project Area. The Mahogany (or R-7) Oil Shale Zone (also called the Mahogany Bed) is the richest oil shale unit of the Green River Formation, and the most likely to be developed at some point in the future. The Mahogany Zone varies in thickness throughout the Uinta Basin, and generally thickens toward the east (Cashion 1967). Within the WTP Project Area, oil shale exists as many thin beds in the Upper Member and a few thin beds in the Middle Member of the Green River Formation (BLM 2002a; Weiss et al. 1990). These beds are separated by thin beds of marlstone and siltstone. The total thickness of the oil shale beds is reported to be about 2.5 feet to 6 feet thick. The potential for development is considered to be low, based on the thin nature of the deposit and its low kerogen content compared to other deposits located elsewhere in the Uinta Basin (BLM 1990; BLM 2002a).

In 1981, Congress designated certain areas within the Uinta Basin known to contain deposits of oil shale as Known Oil Shale Leasing Areas (KOSLA) pursuant to the Combined Hydrocarbon Leasing Act of 1981. These areas have a minimum oil shale yield of 25 gallons per ton, a minimum Mahogany Zone thickness of 25 feet, and a maximum depth of 3,000 feet below the ground surface. None of the KOSLAs are located west of the Green River in the WTP Project Area.

Tar Sands

Deposits of tar sands are located along the margins of the Uinta Basin (Blackett 1996; BLM 1984b, BLM 2002a, BLM 2005a). These tar sand deposits contain heavy hydrocarbon residues such as bitumen (a general name for various solid and semi-solid hydrocarbons that are fusible and soluble in carbon bisulfide), tar, and degraded oils that have lost their volatile components. The bitumen fills the pore spaces in coarse sandstones or forms cement in loose, unconsolidated sands (Pruitt 1961). These deposits are considered to be economic when they generally contain about 8-10 percent bitumen by weight (Weiss et al. 1990). The deposits are mined in some areas of the Uinta Basin for use as paving materials and other products.

Certain tar sand deposits in the Uinta Basin have been designated as seven Special Tar Sand Areas (STSAs) by Congress pursuant to the Combined Hydrocarbon Leasing Act of 1981. The Sunnyside STSA covers about 157,445 acres, mostly to the south of the WTP Project Area. This STSA is considered to have the largest, best-exposed oil-impregnated sand deposits in the southwestern Uinta Basin (BLM 1990). A small portion of this STSA is located in the south portion of the WTP Project Area in T13S:R14E, T13S:R15E, and T13S:R16E (Ritzma 1979). About 2,000 acres of this STSA are located within the Jack Canyon WSA and about 1,640 acres are located in the Desolation Canyon WSA. The deposits here may contain up to 10 million barrels of recoverable oil, or about 0.3 percent of the estimated resources for the entire STSA. Because of the depth to the tar sands (over 1,000 feet), the potential for production from these areas is considered to be low (BLM 1990; BLM 2002a).

A large deposit of tar sands, contained within the Sunnyside STSA, is present to the southwest of the WTP Project Area and is referred to as the Sunnyside Deposit (BLM 2002a; Weiss et al. 1990). The deposit represents the eastern portion of a former giant oil deposit that has been breached by erosion, with the western half of the field destroyed. The deposit is hosted in beds of the Colton and Green River formations with individual impregnated sandstone layers up to 330 feet thick. It is estimated that this deposit contains between 190 and 320 million tons of bitumen (Weiss et al. 1990). This deposit was mined for over 60 years, until production stopped in 1956 (BLM 1990), and produced about 335,000 tons of bitumen.

Smaller deposits of tar sands are reported to exist within the WTP Project Area, including the Argyle Canyon, Minnie Maud, Nine Mile Canyon, and Cottonwood-Jacks Canyon deposits (BLM 2002a; Ritzma 1979). The Nine Mile Canyon deposit is located along the north side of Nine Mile Creek in T11S:R14E to R17E, and the Cottonwood-Jacks Canyon deposit is located in the Cottonwood and Jack Canyon area in T11S and T12S:R15E to R17E. These deposits are contained within the Middle and Upper Members of the Green River Formation and in the upper portion of the Colton Formation (BLM 2002a; Ritzma 1979; Weiss et al. 1990). These deposits have never been mined.

3.2.2.2 Coal

Coal is present at the surface to the south, southwest, and west of the WTP Project Area in the Cretaceous Blackhawk Formation of the Mesaverde Group (BLM 2002a; Pruitt 1961; Weiss et al. 1990). The Blackhawk Formation consists of marine sandstone beds that thin toward the east and grade into the Mancos Shale. These marine sandstones are separated by coal-bearing shale and siltstone beds. These coal beds have been extensively mined in the Sunnyside area, southwest of the WTP Project Area along the Book Cliffs, in the Helper-Hiawatha area to the west of the WTP Project Area, and in the Huntington-Castle Dale area to the south. The coals from these areas are high-volatile bituminous coals with sulfur contents ranging from 1 to 3 percent. The coal-bearing portion of the Blackhawk Formation is about 700 feet thick in this area (BLM 2002a). Coal deposits likely occur beneath the WTP Project Area at depths of about 6,000 feet bgs. The great depth to this coal precludes its use as a recoverable resource.

3.2.2.3 Other Mineral Resources

Other mineral resources within the Uinta Basin include deposits of sand and gravel, building stone, phosphate rock, uranium, base metals, and gypsum.

Extensive sand and gravel deposits are present to the south of the WTP Project Area as a mantle of unconsolidated to well-cemented water-deposited detritus that forms pediments along the Book Cliffs. This material constitutes a nearly inexhaustible supply of sand and gravel for the region. These deposits consist of poorly sorted mixtures of angular to subrounded clasts of sandstone, siltstone, and shale ranging in size from silt to boulders, and commonly exceed 100 feet in thickness (BLM 2002a; Weiss et al. 1990). Recent alluvial deposits along streams in the area also contain quality sand and gravel; however, they have not been mined because they are in generally inaccessible locations (BLM 2002a).

The Uinta Basin produces some stone derived from the Green River Formation that is used as decorative building materials. Suitable stone is found in sandstone beds of the Upper and Middle Members of the Green River Formation. The stones cover the ground in some areas of the southern Uinta Basin where it is collected. None of the currently mined areas are located within the WTP Project Area (BLM 1984a). Some limestone is mined from the North Horn, Flagstaff, Colton, and Green River formations south of the WTP Project Area for use as crushed stone (BLM 2002a; Weiss et al. 1990).

Minor deposits of uranium, base metals, and gypsum also occur within the Uinta Basin (BLM 1984a) and in the San Rafael Swell area to the southwest of the WTP Project Area (BLM 2002a). Base metals and gypsum occur in small deposits near the Uinta Mountains to the north of the WTP Project Area. Some uranium exists within the carbonaceous units of the Mesaverde Group and Uinta Formation. There is currently little interest or development potential for any of these materials in the Uinta Basin (BLM 1984a).

3.2.3 Paleontology

3.2.3.1 Introduction

The Potential Fossil Yield Classification System, recently developed by the BLM (2007c), classifies geologic units based on the relative abundance of vertebrate fossils or scientifically important invertebrate and plant fossils and their sensitivity to adverse impacts. This classification is applied to a geologic formation, member, or other distinguishable unit. This new classification system recognizes that although significant fossil localities may occasionally occur in a geologic unit, a few widely spaced localities do not necessarily indicate a higher class. Instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment. The classification system is as follows:

- **Class 1 – Very Low** – Geologic units that are not likely to contain recognizable fossil remains, including unit consisting of volcanic or metamorphic rocks, or are PreCambrian in age or older.
- **Class 2 - Low** – Sedimentary geologic units that are not likely to contain vertebrate fossils or significant nonvertebrate fossils. Vertebrate or significant invertebrate or plant fossils are absent or very rare. These units include formations younger than 10,000 years before present, recent aeolian deposits, and sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration).

- **Class 3 – Moderate or Unknown** – Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units with unknown fossil potential. These units are often marine in origin with sporadic occurrences of vertebrate fossils, or units where vertebrate or significant nonvertebrate fossils are known to occur intermittently. This class is subdivided into **Class 3a – Moderate Potential**, and **Class 3b – Unknown Potential**.
- **Class 4 – High** – Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface-disturbing activities may adversely affect paleontological resources in many cases. This class is subdivided into **Class 4a** and **Class 4b**. **Class 4a** units are exposed with little or no soil or vegetative cover. Outcrop areas are extensive and exposed bedrock often covers areas larger than 2 acres**.** **Class 4b** units have a high potential but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to bedrock.
- **Class 5 – Very High** – Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils. Surface-disturbing activities may affect paleontological resources in many cases. This class is subdivided into **Class 5a** and **Class 5b**. **Class 5a** units are exposed with little or no soil or vegetative cover. Outcrop areas are extensive and exposed bedrock often covers areas larger than 2 acres**.** These units are frequently the focus of illegal collecting activities. **Class 5b** units have a very high potential but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to bedrock.

Geologic units with a classification of Class 4 or higher often require a field survey by a qualified paleontologist to assess local conditions. Mitigation may be necessary prior to and during surface-disturbing activities.

The Uinta Basin contains the most complete sequence of Upper Eocene rocks known in North America. Exploration of these deposits for vertebrate fossils began over 130 years ago and is still active today. The Green River Formation has received much attention with vertebrate, invertebrate, and plant fossils having been discovered throughout the formation (Bradley 1931; Grande 1984; MacGinitie 1969). Much of the WTP Project Area is underlain by exposed bedrock of the Green River Formation. Soils are generally less than 50 cm deep, and bedrock outcroppings are found throughout the WTP Project Area. However, the occurrence of fossils in the Green River Formation is sporadic and unpredictable. Therefore, this unit is classified as **Class 4a (High)** under the new classification system.

3.2.3.2 Paleontology of the WTP Project Area

Existing information concerning the distribution of known fossil localities on the West Tavaputs Plateau was complied by Hamblin (2006). This paleontological study was based on existing geological mapping and known paleontological resources of the Green River Formation (Middle to Upper Eocene) and Colton Formation (Paleocene and Lower Eocene), which are present in the WTP Project Area. Information was obtained from records at the Utah State Paleontologists Office of the Utah Geological Survey, the Field Offices in Vernal and Price, Utah, and other reports and publications.

Information obtained from the database at the Paleontology Office of the Utah Geological Survey and information from the Vernal and Price Field Offices, indicates there are eleven previously recorded fossil localities in or near (within 1½ miles) the WTP Project Area. All are in the Green River Formation. Fossils therein are listed as invertebrates, gastropods, ostracodes, gar scales, vertebrates, plant fossils, and trace fossils. A new locality has been reported in a large block of sandstone next to the Nine Mile Canyon Road that contains mammal tracks (Leschin 2007; Mayers 2007). Most of these fossil localities occur along roads on the north side of the WTP Project Area. However, the lack of known fossil localities within the WTP Project Area and vicinity is likely a reflection of accessibility and the lack of paleontological research in the area (Hamblin 2006). It can be expected that paleontological surveys conducted for oil/gas field development activity would lead to the discovery of many new fossil localities on the West Tavaputs Plateau. At present, the entire WTP Project Area may be thought of as having a potential for paleontological resources. Paleontological monitoring at recently constructed well pads turned up vertebrate tracks, insect larva, and plant compressions (Sandau 2006).

Paleontology of the Colton Formation

The database at the Paleontology Office of the Utah Geological Survey did not show any previously recorded fossil sites in the Colton Formation within the WTP Project Area. On an unpublished list of Paleontologically Sensitive Formations in Utah by Madsen (1979), the Colton Formation is listed as 25th with no listings under invertebrates, plants, or trace fossils. This list was based on published literature at the time and may have changed in the past 25 years. Fossils do not seem to be plentiful in the Colton Formation, but a fair variety of fossils are mentioned in the literature. Many of the invertebrate fossils are associated with intertonguing beds of the Flagstaff Formation below and the Green River Formation above the Colton Formation (Smith 1986). The Colton Formation is classified as a “Class 3” formation under the new BLM classification system.

The following is a list of known fossils in the Colton Formation compiled from LaRocque (1960), Swain (1964), Jacobs (1969), Fouch et al. (1976), Zawiskie et al. (1982), and Smith (1986):

- Plants
  - Algae
  - Plant fragments and impressions
  - Root marks
- Invertebrates
  - Ostracodes
  - Bivalves
  - Gastropods
  - Trace fossils
- Vertebrates
  - Fish
  - Turtles
  - Crocodiles
  - Birds

Paleontology of the Green River Formation

The Green River Formation, a "Class 4a" formation, is one of the most important fossil-bearing formations in Utah. Fossils present within the Green River Formation include invertebrates, gastropods, ostracodes, gar scales, vertebrates, plant fossils, and trace fossils. On the list of Paleontologically Sensitive Formations, the Green River Formation is listed 3rd for fossil vertebrates, 21st for invertebrates, 5th for fossil plants, and 1st for trace fossils. This clearly reflects the paleontological importance of the Green River Formation.

Grande (1984) gives good coverage of the general paleontology of the Green River Formation, particularly fish. MacGinitie (1969) discusses the Green River flora. Bradley (1931) talks about microfossils contained in the oil shale zones within the Green River Formation, and Swain (1964) discusses ostracodes. The following is a generalized list of known fossils from the Green River Formation from Miller and Webb (1980) and Grande (1984):

Plants
- Bacteria
- Fungi
- Mold
- Ferns
- Moss
- Algae
- Conifer
- Angiosperms (flowering plants)
- Petrified wood

Invertebrates
- Protozoans
- Nematoda
- Annelida
- Porifera - sponge spicules
- Bivalves
- Gastropods
- Ostracodes
- Spiders
- Insects (extremely abundant and varied)
- Ichnites (fossil tracks and burrows)

Vertebrates
- Fish
- Amphibians
- Turtles
- Lizards
- Snakes
- Crocodiles
- Birds
- Mammals
  - *Marsupials*
  - *Primates*
  - *Insectivores*
  - *Condylarths (extinct group)*
  - *Titanotheres (extinct group)*

Rodents
Bats
Ichnites (fossil tracks and burrows)
Perrisodactyls (mammals with an odd number of toes)

Paleontology of Other Exposed Sediments

If Pleistocene-age sediments are part of the valley bottom alluvium, there would be a slight possibility that Pleistocene fossils could be encountered there. However, this potential is fairly low. Pleistocene sediments are classed as “Class 2.” Other, more recent sediments would also be classified as “Class 2.” It may be very difficult to determine the actual age of valley bottom sediments without discovery of fossils and further research.

3.3 CLIMATE AND AIR QUALITY

Regional air quality is influenced by a combination of factors including climate, meteorology, the magnitude and spatial distribution of local and regional air pollution sources, and the chemical properties of emitted pollutants. Within the lower atmosphere, regional and local scale air masses interact with regional topography to influence atmospheric dispersion and transport of pollutants. The following sections summarize the climatic conditions and existing air quality within the WTP Project Area and surrounding region.

3.3.1 Climate

The WTP Project Area is located on the West Tavaputs Plateau in the southern foothills of the Uinta Basin; a semiarid mid-continental climate regime typified by dry windy conditions and limited precipitation. The Uinta Basin is bordered by the Wasatch Range to the west, which extends north and south through the middle of the State, and the High Uinta Mountains to the north, which extend east and west through the northeast portion of the State. Elevation of the WTP Project Area ranges from 4,500 feet above mean sea-level (famsl) in the eastern portion to over 9,000 famsl in the western portion.

3.3.1.1 Temperature and Precipitation

The closest climate measurements to the WTP Project Area were recorded at Nutters Ranch, Utah (1963-1986). The Nutters Ranch station is located in the northwest portion of the WTP Project Area at an elevation of 5,790 famsl (WRCC 2005). **Table 3.3-1** summarizes the mean temperature range, mean total precipitation, and mean total snowfall by month.

Prevailing synoptic-scale westerly air masses originating from the Pacific Ocean are typically interrupted by the western mountain ranges before reaching the Uinta Basin. As a result, the lower elevations of the Uinta Basin receive relatively slight amounts of precipitation. The higher elevations of the area generally receive more favorable amounts of precipitation. The annual mean precipitation at Nutters Ranch is 11.6 inches, and ranges from a minimum of 6.4 inches recorded in 1974, to a maximum of 24.8 inches recorded in 1965. On average, February is the driest month with a monthly mean precipitation of 0.5 inches, and August is the wettest month with a monthly mean precipitation of 1.4 inches. The annual average snowfall is 45.6 inches. December, January, February, and March are the snowiest months. A maximum annual snowfall of 102 inches was recorded in 1965.

The surrounding area has an annual mean temperature of 46 degrees F. However, abundant sunshine and rapid nighttime cooling result in a wide daily range in temperature. Wide seasonal temperature variations typical of a mid-continental climate regime are also common. Average winter temperatures range from 9 degrees F to 38 degrees F, while average summer temperatures range from 50 degrees F to 85 degrees F. Recorded daily extreme temperatures are minus 25 degrees F in 1971 and 100 degrees F in 1976.

Table 3.3-1 Temperature, Precipitation, and Snowfall at Nutters Ranch, Utah (1963-1986)

Season	Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
Spring	March	22.4 – 51.6	1.2	6.1
	April	29.8 – 61.4	1.0	4.1
	May	38.5 – 71.9	1.1	0.6
	Total Spring Average	*30.3 – 61.6*	*3.3*	*10.8*
Summer	June	46.4 – 81.3	0.9	0.0
	July	53.6 – 87.7	1.2	0.0
	August	51.3 – 85.4	1.4	0.0
	Total Summer Average	*50.4 – 84.8*	*3.4*	*0.0*
Fall	September	42.2 – 77.1	1.1	0.5
	October	31.2 – 65.3	1.2	1.3
	November	20.1 – 49.4	0.7	5.4
	Total Fall Average	*31.2 – 63.9*	*3.0*	*7.2*
Winter	December	9.2 – 36.6	0.9	12.4
	January	6.4 – 35.3	0.6	6.1
	February	11.5 – 42.0	0.5	9.0
	Total Winter Average	*9.0 – 38.0*	*1.9*	*27.6*
Total Annual Average		***30.2 – 62.1***	***11.6***	***45.6***

Source: WRCC (2005). Data collected at Nutters Ranch, Utah from 1963 to 1986.

3.3.1.2 Winds and Atmospheric Stability

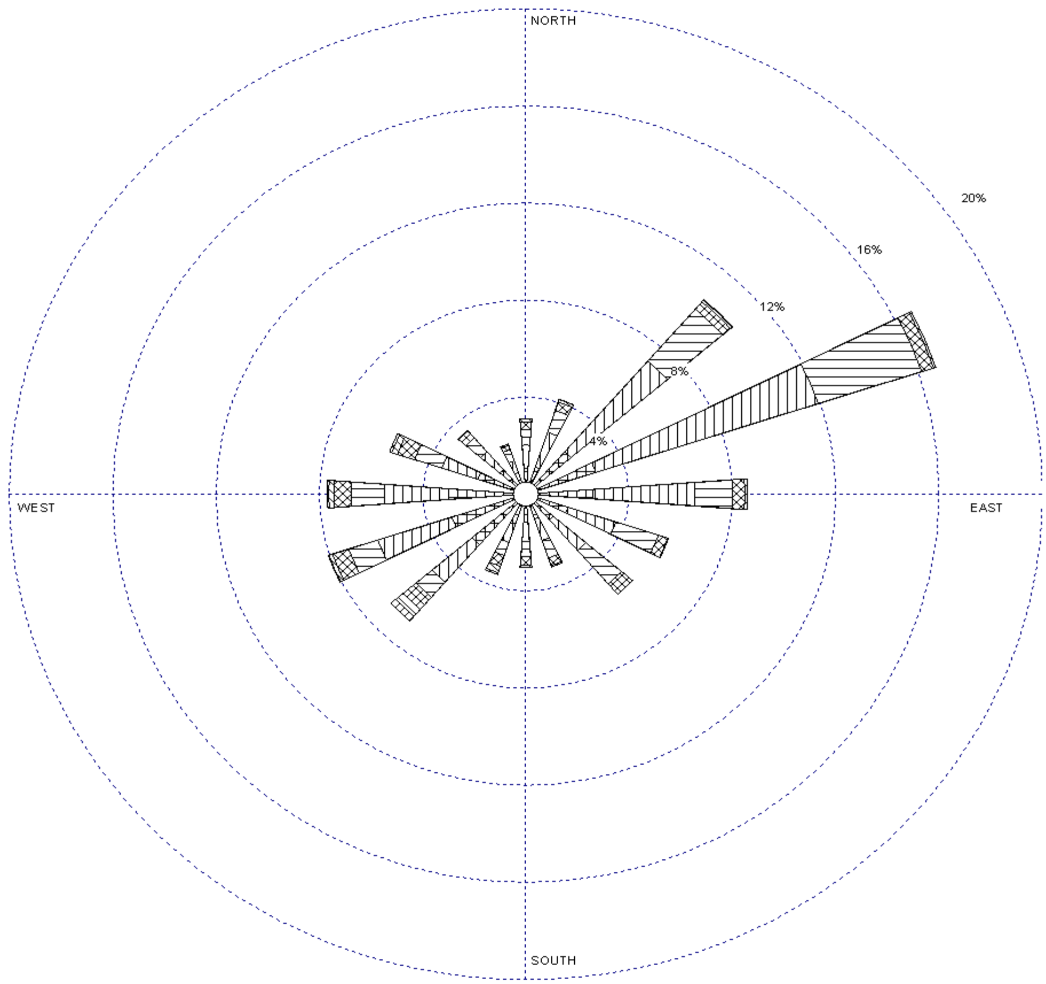
The transportation and dilution of air pollutants are primarily a function of wind speed and direction. Winds dictate the direction in which pollutants are transported. As wind speed increases, the dispersion of emitted pollutants also increases, thereby reducing pollutant concentrations.

Wind data within the WTP Project Area have not been directly measured. Local terrain effects will influence the wind profiles specific to the WTP Project Area. However, representative wind speed and direction data for the area are available at the Bonanza Deseret Power Plant for the years 1985, 1986, 1987, and 1992 (UDEQ-DAQ 1998). **Figure 3.3-1** presents a wind rose depicting wind speed and direction for all four years of data. Note that the data represent the direction from which the wind is blowing (Wind Direction Origin). For example, winds blowing from the north would transport pollutants to the south. As shown, winds originate predominately from the east-northeast 16.7 percent of the time. The average measured wind speed is 6.8 miles per hour.

Figure 3.3-1 Wind Rose for Bonanza, Utah

WIND ROSE PLOT

Bonanza, Utah



Wind Speed (m/s)

- > 11.06
- 8.49 - 11.06
- 5.40 - 8.49
- 3.34 - 5.40
- 1.80 - 3.34
- 0.51 - 1.80

DISPLAY
Wind Speed

AVG. WIND SPEED
3.02 m/s

ORIENTATION
Direction (blowing from)

DATE
8/7/2003

UNIT
m/s

CALM WINDS
2.00%

PLOT YEAR-DATE-TIME
1985 1986 1987 1992
Jan 1 - Dec 31
Midnight - 11 PM

COMPANY NAME
Buys and Associates

COMMENTS

WRPLOT View 3.5 by Lakes Environmental Software - www.lakes-environmental.com

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The degree of stability in the atmosphere is also important to the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Temperature inversions can result in very stable conditions with virtually no vertical air motion and light winds, thereby restricting dispersion. Conversely, during convective conditions, upward and downward movement in the atmosphere prevails along with stronger winds, and the vertical mixing of pollutants in the atmosphere is enhanced.

The potential for atmospheric dispersion is relatively high for the WTP Project Area due to the frequency of strong winds. However, calm periods and nighttime cooling may enhance air stability, thereby inhibiting air pollutant transport and dilution.

The region can experience frequent temperature inversions in winter when cold stable air masses settle into the valleys and snow cover and shorter days inhibit ground-level warming. Temperature inversions are less common during the summer months when daytime ground-level heating rapidly leads to inversion break-up and increased vertical mixing. The higher locations of the WTP Project Area generally will remain warmer at night and less prone to the temperature inversions common to the valleys and drainages.

Atmospheric stability can be categorized by stability classes “A” through “F”, with “A” representing a high degree of atmospheric turbulence, and “F” representing a high degree of atmospheric stability. A “D” stability represents a neutral atmosphere. **Table 3.3-2** presents the frequency distribution of the atmospheric stability classes for the region. As illustrated, slightly stable (Class E) atmospheric conditions occurs the majority of the time (31.6 percent), followed by neutral conditions (27.1 percent) and moderately stable conditions (16.3 percent).

Table 3.3-2 Atmospheric Stability Class Frequency of Occurrence

Stability Class	Frequency of Occurrence (in percent)
A – Strongly Convective	9.9
B – Moderately Convective	6.5
C – Slightly Convective	8.5
D – Neutral	27.1
E – Slightly Stable	31.6
F – Moderately Stable	16.3
Total	100

Source: UDEQ-DAQ (1998). Meteorological data collected near Bonanza, Utah at the Deseret Generating and Transmission power plant for the years 1985, 1986, 1987, and 1992.

3.3.2 Air Quality

3.3.2.1 Existing Sources of Air Pollution

The Uinta Basin has seen recent oil and gas development on Tribal, Federal, State and private lands. Fugitive dust is the most prominent air pollutant in the region and in the WTP Project Area and is intermittent depending on winds and dust-causing activities. In addition to the Uinta Basin, other geographic areas of industrial and vehicular emissions in the region include the Wasatch Front to the west, the Green River area to the south, and the Castle Valley area to the southwest.

Existing point and area sources of air pollution within the WTP Project Area and surrounding region include the following:

- Exhaust emissions, primarily CO, NO_x, $PM_{2.5}$, and formaldehyde, from existing natural gas fired compressor engines used in production of natural gas;
- Natural gas dehydrator still-vent emissions of VOCs, BTEX and *n*-hexane;
- Gasoline and diesel-fueled vehicle tailpipe emissions of VOCs, NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$;
- Oxides of sulfur (SO_x) , NO_x, and fugitive dust emissions from coal-fired power plants and coal mining and processing;
- Fugitive dust (in the form of PM_{10} and $PM_{2.5}$) from vehicle traffic on unpaved roads, wind erosion in areas of soil disturbance, and road sanding during winter months; and
- Long-range transport of pollutants from distant sources contributing to regional haze.

3.3.2.2 Regulatory Environment

Criteria Pollutants

National Ambient Air Quality Standards (NAAQS) have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which standards have been set include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), CO, ozone (O_3) and particulate matter less than 10 microns in diameter (PM_{10}) or 2.5 microns in diameter ($PM_{2.5}$). Existing air quality in the region is acceptable based on EPA's NAAQS. The surrounding area is designated as an attainment area, meaning that the concentration of criteria pollutants in the ambient air is less than the NAAQS. Site-specific air quality monitoring data are not available for the WTP Project Area; however, estimated background criteria pollutant concentrations for the Uinta Basin (see **Table 3.3-3**) were provided by the Utah Department of Environmental Quality Division of Air Quality.

EPA has established a new 1-hour NO_2 NAAQS at the level of 100 parts per billion (ppb) (188 $\mu g/m^3$) effective April 12, 2010. In addition to establishing an averaging time and level, EPA also is setting a new "form" for the standard. The form is the air quality statistic used to determine if an area meets the standard. The form for the 1-hour NO_2 standard is the 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations. The annual standard for NO_2 remains unchanged.

Ozone

Ground-level ozone (O_3) is a secondary pollutant that is formed by a chemical reaction between NO_X and VOCs in the presence of heat and sunlight. Motor vehicle exhaust and industrial emissions, gasoline vapors, some tree species emissions, and chemical solvents are some of the major sources of NO_x and VOC that help to form ozone.

Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. As a result, it is generally known as a summertime air pollutant. Ozone can be transported great distances and therefore contributes to air pollution issues on a regional scale. Primary health effects from O_3 exposure range from breathing difficulty to permanent lung damage. Ground-level ozone also contributes to plant and ecosystem damage.

In 2008, the BLM participated in the Uinta Basin Air Quality Study technical analysis of the potential air quality and air quality related value impacts that may result from oil and gas industry activity and other emission sources within the Uinta Basin. This analysis, known as the UBAQS, was finalized in 2009. The analysis calculated that air quality in the Basin is expected to remain in compliance with the NAAQS for criteria pollutants out to 2012 (IPAMS, UBAQS 2009).

On January 6, 2010, EPA proposed to strengthen the national ambient air quality standards (NAAQS) for ground-level ozone. EPA is proposing to establish the 8-hour “primary” ozone standard to a level within the range of 0.060-0.070 parts per million (ppm).

EPA is also proposing to establish a distinct cumulative, seasonal “secondary” ozone standard, and is proposing to set the level of the secondary ozone standard within the range of 7-15 ppm-hours. The proposed secondary ozone standard would be a cumulative, seasonal standard expressed as an annual index of the sum of weighted ozone hourly concentrations, cumulated over 12 hours per day (8 am to 8 pm) during the consecutive 3-month period within the O_3 season with the maximum index value. EPA intends to issue the final ozone standards by August 31, 2010.

Particulate Matter (PM_{10} and $PM_{2.5}$)

Airborne particulate matter consists of tiny coarse-mode (PM_{10}) or fine-mode ($PM_{2.5}$) particles or aerosols combined with dust, dirt, smoke, and liquid droplets. $PM_{2.5}$ is derived primarily from the incomplete combustion of fuel sources and secondarily formed aerosols, whereas PM_{10} is primarily from crushing, grinding, or abrasion of surfaces. Sources of PM include industrial processes, power plants, mobile sources, construction activities, and fires. With regard to mobile sources, more PM is emitted into the atmosphere from the use of diesel fuel than the use of gasoline.

PM causes a wide variety of health and environmental impacts. Many scientific studies have linked breathing PM to significant health problems, including aggravated asthma, increased respiratory symptoms, such as coughing, and difficult or painful breathing, chronic bronchitis, decreased lung function, and premature death. PM is the major cause of reduced visibility and can stain and damage stone and other materials, including culturally significant objects, such as monuments and statues.

UDAQ began monitoring $PM_{2.5}$ in Vernal in December 2006. During the 2006-07 winter season $PM_{2.5}$ levels exceeded the new $PM_{2.5}$ health standard that became effective in December 2006. The $PM_{2.5}$ levels in Vernal were similar to other areas in northern Utah that experience wintertime inversions. The State of Utah is in the process of identifying areas that are experiencing high $PM_{2.5}$ levels and identifying potential strategies to improve wintertime air quality in those areas.

Potential PM Control Measures

The sources of elevated $PM_{2.5}$ concentrations during winter inversions in the Uinta Basin haven't been identified as of yet. Based on experiences and studies in other areas of the Rocky Mountain west and the emission inventory in the Uinta Basin, potential sources and controls can however be tentatively identified. In Utah elevated $PM_{2.5}$ concentrations along the Wasatch Front are associated with secondarily formed particles from sulfates, nitrates, and organic chemicals from a wide variety of sources (UDAQ, 2006). In the Cache Valley of northern Utah approximately half of ambient $PM_{2.5}$ during elevated concentrations are composed of ammonium nitrate, most likely from agricultural operations, with the rest from combustion, primarily mobile sources and woodstoves (Martin, 2006). For comparison, $PM_{2.5}$ in most rural areas in the western United States is typically dominated by total carbonaceous mass and crustal materials from combustion activities and fugitive dust respectively (EPA, 2009).

As the Uinta Basin is neither a major metropolitan area as found on the Wasatch Front, nor has significant agricultural activities as found in Cache Valley, the most likely causes of elevated $PM_{2.5}$ are probably those common to other areas of the western US (combustion and dust) plus nitrates and organics from oil and gas activities in the Basin. Typical combustion controls include burning restrictions such as open burning and woodstove bans during poor air quality, and improvements in combustion devices such as woodstove change-out programs. Mobil combustion controls include diesel engine retrofitting (school bus retrofits for example), clean fuels (low sulfur diesel), and vehicle miles travelled reduction programs. Oil and gas industry precursor controls include nitrogen oxide engine controls such as catalytic reduction, ignition retard, and newer low emission diesel engines (Tier II or better). Though volatile organic compound (VOC) control measures are usually not required in $PM_{2.5}$ nonattainment areas unless it is demonstrated that their presence contributes significantly to $PM_{2.5}$ concentrations, their dual application in reducing ozone precursor gases suggest it may be prudent to include VOC controls in the overall emission control package. Examples of oil and gas VOC controls include flaring, green completions, vapor recovery, dehydrator and pneumatic controls, and fugitive leak detection.

Under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act (CAA), incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of the State not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for Class I and II areas are presented in **Table 3.3-3**. **Figure 3.3-4** presents a regional map indicating the location of the WTP Project Area and surrounding areas of special concern. The closest Class I areas are Arches National Park (65 miles south) and Canyonlands National Park (85 miles south).

UDAQ began monitoring $PM_{2.5}$ in Vernal in December 2006. During the 2006-07 winter season $PM_{2.5}$ levels exceeded the new $PM_{2.5}$ health standard that became effective in December 2006. The $PM_{2.5}$ levels in Vernal were similar to other areas in northern Utah that experience wintertime inversions. The State of Utah is in the process of identifying areas that are experiencing high $PM_{2.5}$ levels and identifying potential strategies to improve wintertime air quality in those areas.

Table 3.3-3 Ambient Criteria Pollutant Concentrations in the Uinta Basin					
Pollutant	**Averaging Period(s)**	**Uinta Basin Background Concentration[a] (μg/m³)**	**NAAQS (μg/m³)**	**PSD Class I Increment (μg/m³)**	**PSD Class II Increment (μg/m³)**
SO_2	Annual 24-hour 3-hour	5 10 20	80 365 1,300	2 5 25	20 91 512
NO_2 NO_2[d]	Annual 1-hour	17 NA	100 188	2.5 NA	25 NA
PM_{10}	24-hour	63	150	8	30
$PM_{2.5}$	Annual 24-hour	11 15/52[b]	15 35	None None	None None
CO CO	8-hour 1-hour	1,111 1,111	10,000 40,000	None None	None None
O_3[c]	8-hour	105	147	None	None

[a] Source: Utah Division of Environmental Quality - Division of Air Quality (UDAQ).

[b] The state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. The $PM_{2.5}$ concentrations given in this table represent 98th percentile values from limited $PM_{2.5}$ monitoring conducted in Vernal and Uintah/Duchesne Counties in 2007. The smaller figure is representative of average summer concentrations, while the larger value is representative of winter inversion conditions, based on this monitoring.

[c] The 147 μg/m³ value in the table is equivalent to 0.075 ppm.

[d] The NAAQS (effective 4/12/10) for 1-hour NO_2 is based on a three-year average of the 98th percentile of the yearly maximum of 1-hour daily maximums. 188 μg/m³ is equivalent to 100 ppm

NA = not available, values have not been established

Hazardous Air Pollutants

Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified 187 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde, benzene, toluene, ethylbenzene, isomers of xylene (BTEX) compounds, and normal-hexane (n-hexane).

The CAA requires the EPA to regulate emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." As required under the CAA, EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. Under Section 112(d) of the CAA, the EPA is required to develop regulations establishing national emission standards for hazardous air pollutants (NESHAP) for all industries that emit one or more of the pollutants in major source quantities. These standards are established to reflect the maximum degree of reduction in HAP emissions through application of maximum achievable control technology (MACT). Source categories for which MACT standards have been implemented include oil and natural gas production and natural gas transmission and storage.

There are no applicable Federal or State of Utah ambient air quality standards for assessing potential HAP impacts to human health. Therefore, reference concentrations

(RfC) for chronic inhalation exposure and Reference Exposure Levels (REL) for acute inhalation exposures are applied as significance criteria. **Table 3.3-4** provides the RfCs and RELs. RfCs represent an estimate of the continuous (i.e., annual average) inhalation exposure rate to the human population (including sensitive subgroups such as children and the elderly) without an appreciable risk of harmful effects. The REL is the acute (i.e., one-hour average) concentration at or below which no adverse health effects are expected. Both the RfC and REL guideline values are for non-cancer effects.

Table 3.3-4 HAP Reference Exposure Levels and Reference Concentrations

Hazardous Air Pollutant (HAP)	Reference Exposure Level [REL One-hr Average] ($\mu g/m^3$)	Reference Concentration [a] [RfC Annual Average] ($\mu g/m^3$)
Benzene	1,300 [b]	30
Toluene	37,000 [b]	400
Ethylbenzene	350,000 [c]	1,000
Xylenes	22,000 [b]	100
n-Hexane	390,000 [c]	200
Formaldehyde	94 [b]	9.8

[a] EPA Air Toxics Database, Table 1 (EPA 2002a)
[b] EPA Air Toxics Database, Table 2 (EPA 2002a)
[c] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2002a) since no REL is available

The State of Utah has adopted Toxic Screening Levels (TSLs) which are applied during the air permitting process to assist in the evaluation of HAPs released into the atmosphere (UDEQ-DAQ 2000). The TSLs are derived from Threshold Limit Values (TLVs) published in the American Conference of Governmental Industrial Hygienists (ACGIH) – "Threshold Limit Values for Chemical Substances and Physical Agents" (ACGIH 2003). These levels are not standards that must be met, but screening thresholds which if exceeded, would suggest that additional information is needed to evaluate potential health and environmental impacts. **Table 3.3-5** lists the corresponding TSLs for each applicable HAP.

Diesel emissions have the potential to cause adverse health effects. The EPA has recognized that diesel exhaust has the potential to cause long-term (chronic) respiratory damage and short-term (acute) irritation (eye, throat, bronchial) and respiratory symptoms. Evidence also suggests that diesel exhaust is a likely human carcinogen with potential to cause lung cancer from long-term inhalation exposure. However, the carcinogenic effect of diesel exhaust on humans has not been definitively proven due to a lack of conclusive exposure data (EPA 2002b).

Table 3.3-5 Utah Toxic Screening Levels (TSLs)

Pollutant and Averaging Time	Toxic Screening Levels [b] ($\mu g/m^3$)
Formaldehyde (one-hour)	37
Benzene [a] (24-hour)	53
Toluene (24-hour)	6,280
Ethylbenzene (one-hour)	54,274
Ethylbenzene (24-hour)	14,473

Table 3.3-5 Utah Toxic Screening Levels (TSLs)	
Pollutant and Averaging Time	**Toxic Screening Levels [b] (μg/m^3)**
Xylene (one-hour)	65,129
Xylene (24-hour)	14,473
n-Hexane (24-hour)	5,875

[a] Although there exists an acute TLV for benzene, the State of Utah does not apply a comparison to an acute TSL since the chronic TSL is more stringent.
[b] Source: UDEQ–DAQ (2000)

Diesel exhaust is a complex mixture of organic and inorganic compounds distributed among the gaseous and particulate phases. Therefore, measuring the concentration and composition of diesel exhaust can be extremely difficult. No single constituent of diesel exhaust serves as a unique marker of exposure; however, the levels of fine particles (the majority being $PM_{2.5}$) or elemental carbon (both of which are much higher in diesel emissions than in other combustion products) can be used as surrogate indices of diesel exhaust particulate matter (DPM) (EPA 2002b). A DPM RfC of 5 μg/m^3 (EPA 2003a), extrapolated from animal studies, is considered to be the best current marker for chronic non-cancer respiratory effects of diesel exhaust on humans.

Greenhouse Gases

Several compounds in the earth's atmosphere act as greenhouse gases, which trap outgoing longwave radiation emitted from the earth's surface, resulting in a warming of the atmosphere. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor, CO_2, methane (CH_4), N_2O, and O_3. Certain human activities, however, add to the levels of most of these naturally occurring gases. While not currently regulated, CO_2 and CH_4 are two greenhouse gases that are emitted as a by-product of industrial activities, including oil and gas development and production. The global warming potential (GWP) of a greenhouse gas is the ratio of measured contribution to global warming from the emission of one unit of mass of a greenhouse gas to the measured contribution to global warming of one unit of mass of carbon dioxide calculated over a specified time interval. This is how CO_2 equivalents are calculated.

Annually, approximately 6×10^{15} grams (approximately 1.1 billion tons) of CO_2 equivalents per year is released into the atmosphere as CO_2 from fossil fuel combustion (oil, natural gas, and coal). As part of the natural carbon cycle, much of the carbon released into the atmosphere (from natural and human activity sources) is recaptured through exchange with the oceans and uptake by plant photosynthesis, resulting in a steady-state condition. However, evidence indicates increasing CO_2 concentrations may be linked to global warming through the greenhouse effect. From the beginning of the industrial age, the atmospheric content of CO_2 has increased from about 280 parts per million (ppm) to about 360 ppm recently (EPA 2005). In addition to fossil fuel burning, changes in land use patterns such as destruction of land vegetation also accounts for a portion of the net increase in atmospheric CO_2 concentrations (Schlesinger 1991).

Fluxes of methane gas are minor when compared to the global carbon budget. Globally, the atmospheric methane concentration is about 1.8 ppm, while methane emissions caused by human activity amount to about 0.5×10^{15} grams (approximately 0.55 billion tons) of CO_2 equivalents per year. However, methane's contribution to global warming is significant because it is estimated to be more than 20 times as effective in trapping heat in the atmosphere as CO_2 (EPA 2005). Human activities that generate methane include decomposition of organic matter in landfills, biomass burning, rice cultivation, animal waste, and the production, transmission, and distribution of natural gas and petroleum. Natural sources of methane include wetlands, cattle, oceans, and termites. Methane is removed from the atmosphere by reactions with hydroxyl radical (-OH) as well as through consumption by soil microbes (Schlesinger 1991).

Since 1751, roughly 315 billion tons of carbon have been released to the atmosphere from the consumption of fossil fuels and cement production. Half of these emissions have occurred since the mid 1970s. The 2004 global fossil-fuel CO_2 emission estimate, 7,910 million metric tons of carbon, represents an all-time high and a 5.4 percent increase from 2003.

Globally, liquid and solid fuels accounted for 77.5 percent of the emissions from fossil-fuel burning in 2004. Combustion of gas fuels (e.g., natural gas) accounted for 18.1 percent (1,434 million metric tons of carbon) of the total emissions from fossil fuels in 2004 and reflects a gradually increasing global utilization of natural gas. Emissions from cement production (298 million metric tons of carbon in 2004) have more than doubled since the mid 1970s and now represent 3.8 percent of global CO_2 releases from fossil-fuel burning and cement production. Gas flaring, which accounted for roughly 2 percent of global emissions during the 1970s, now accounts for less than 1 percent of global fossil-fuel releases.

Figure 3.3-2 shows the trend in global and USA total CO_2 emissions from 2000 to 2004. Worldwide GHG emissions have steadily risen from approximately 27.2 billion tons per year in 2000 to 30.7 billion metric tons per year in 2004, an increase of 12.7 percent. Although data are not readily available, it is reasonable to expect international GHG emissions have continued to increase beyond 2004 levels because of economic development, especially in China and India. (EPA 2008a [430-R-08-005]).

Figure 3.3-3 shows the trend in global total CO_2 emissions from 1990 to 2006, the latest year that data are readily available. Although data are not readily available, it is reasonable to expect international GHG emissions have continued to increase beyond 2006 levels because of global economic development. EPA data indicate that USA emissions have been relatively constant beyond 2004 levels (EPA 2008a [430-R-08-005]).

3.3.2.3 Air Quality Related Values

Areas of special concern, including some Federally-mandated Class I areas and Class II wilderness areas and national parks, are monitored for Air Quality Related Value (AQRV) impacts. These AQRVs include terrestrial and aquatic deposition and visibility impairment.

Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area in a period of time (kilograms per hectare per year [kg/ha/yr]). Air pollutants are deposited by wet deposition (i.e., precipitation) and by dry deposition (i.e., gravitational settling of particles and adherence of gaseous pollutants to particles). Total deposition refers to the sum of airborne material transferred to the earth's surface by both wet and dry deposition.

Total terrestrial deposition levels of concern (LOC) have been estimated for several Class I areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total terrestrial deposition LOC include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total deposition LOC for Bridger include a "red line" set at 10 kg/ha/yr for nitrogen and 20 kg/ha/yr for sulfur, and a "green line" set at 3 to 5 kg/ha/yr for nitrogen and 5 kg/ha/yr for sulfur.

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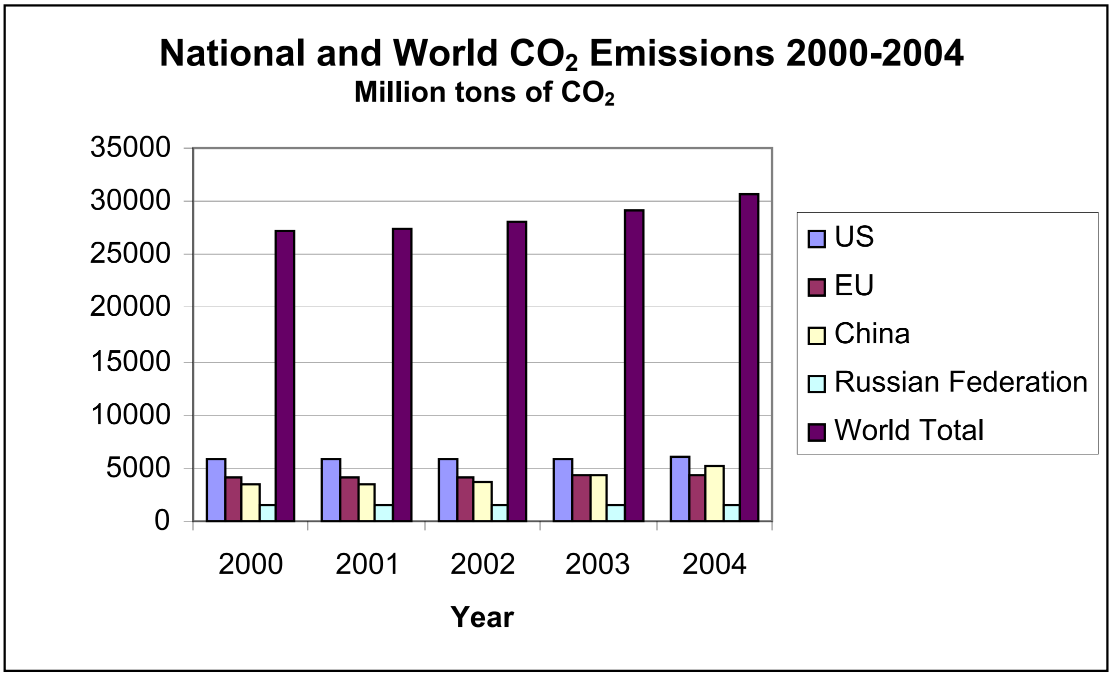
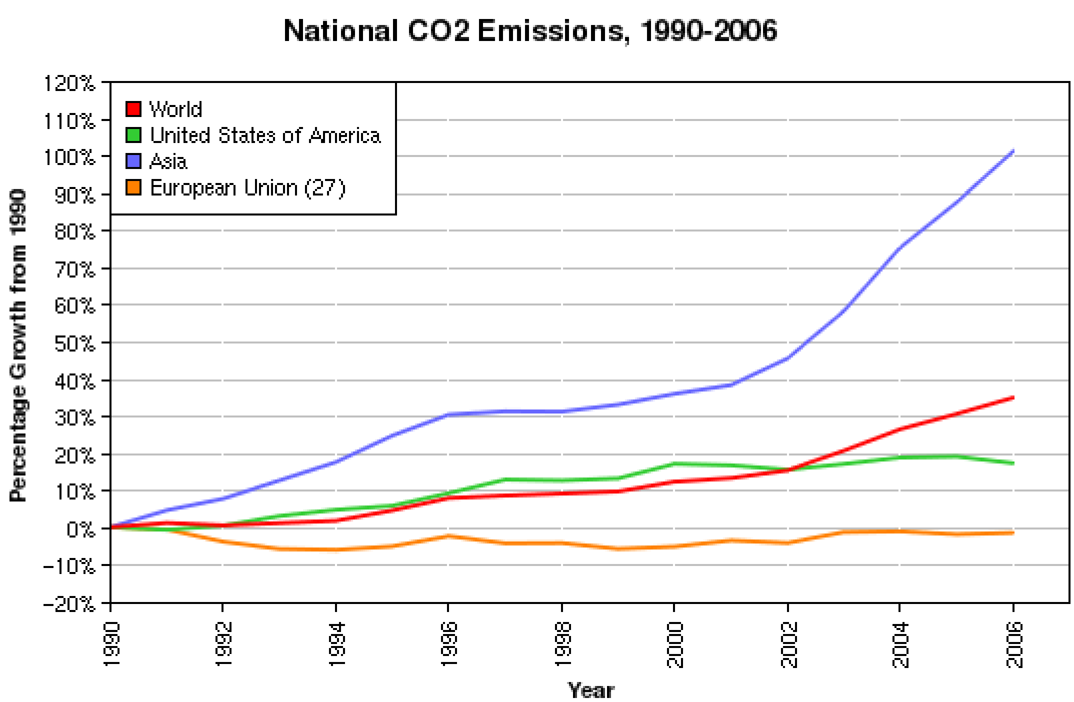
Figure 3.3-2 Global and USA Annual CO_2 Emission Trends



Source: Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008) http://cait.wri.org/ linked from http://www.epa.gov/climatechange/emissions/globalghg.html.

Figure 3.3-3 National CO_2 Emission Trends



Source: Climate Analysis Indicators Tool (CAIT), http://cait.wri.org/cait.php?page=graphcoun

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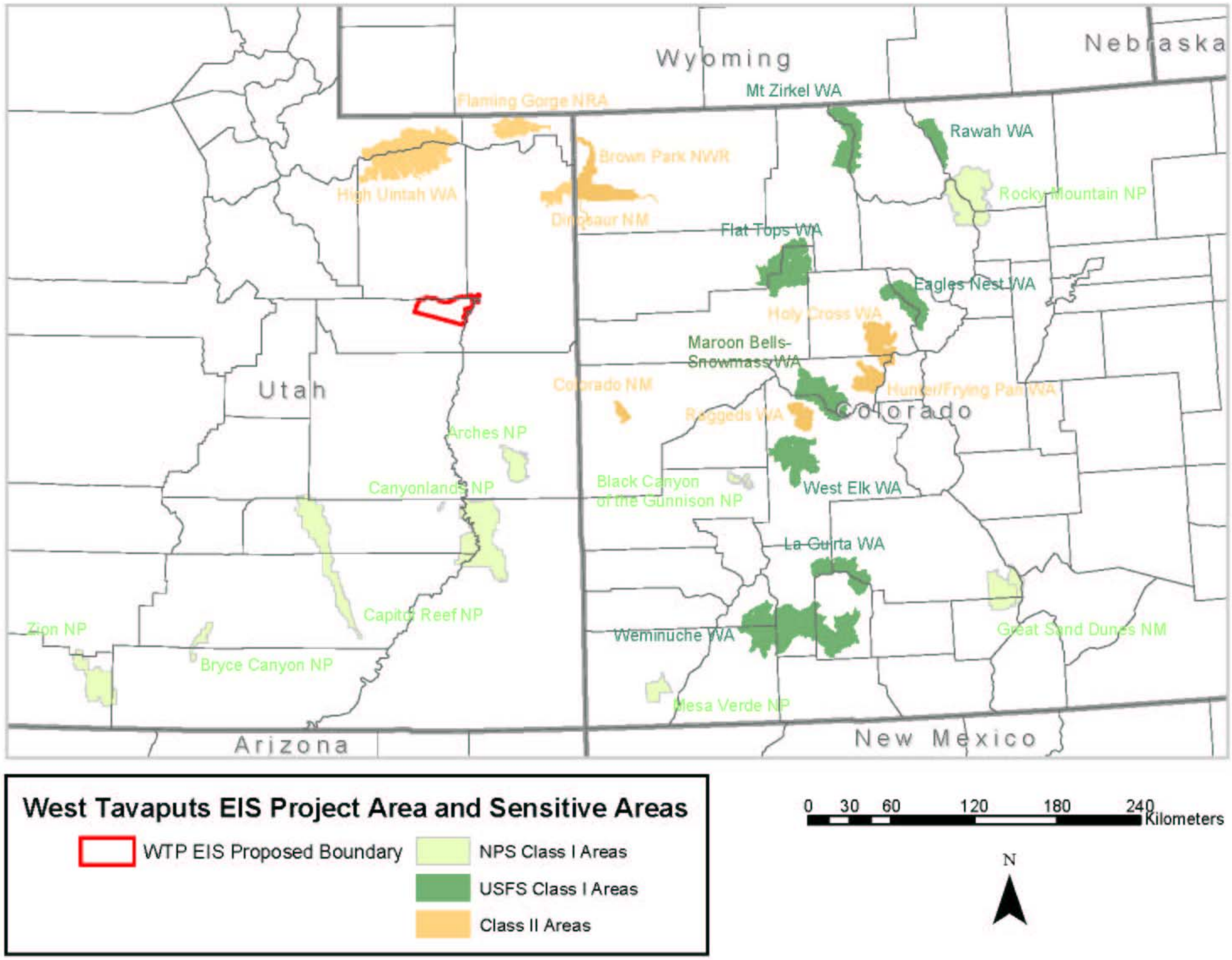
Figure 3.3-4 WTP Project Area with Surrounding Prevention of Significant Deterioration Class I and Class II Areas



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The nearest wet and dry deposition measurements collected at a Class I area are available from Canyonlands National Park, located approximately 80 miles south of the WTP Project Area. Wet deposition data for the Canyonlands station are available through the National Atmospheric Deposition Program (NADP) for the period 1997 through 2004. The NADP assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). Similarly, the Clean Air Status and Trends Network (CASTNet) measures the dry deposition rates of nitrogen and sulfur compounds. Data from the Canyonlands CASTNet station are available from 1995 through 2002.

Tables 3.3-6 and 3.3-7 summarize the annual average wet and dry components of total nitrogen and sulfur deposition at Canyonlands. Note that wet and dry deposition data are available from 1995 through 2007.

Table 3.3-6 Nitrogen Deposition at Canyonlands, Utah

Chemical Species	Dry Deposition[1] (kg N ha^{-1} yr^{-1})	Wet Deposition[2] (kg N ha^{-1} yr^{-1})	Total Deposition (kg N ha^{-1} yr^{-1})
Ammonium (NH_4^+)	0.11	0.43	0.54
Nitrate (NO_3^-)	0.03	0.56	0.59
Nitric acid (HNO_3)	0.85	-	0.85
TOTAL	0.99	0.99	1.98

kg = kilograms
N = Nitrogen
ha = hectare
yr = year

Table 3.3-7 Sulfur Deposition at Canyonlands, Utah

Chemical Species	Dry Deposition[1] (kg S ha^{-1} yr^{-1})	Wet Deposition[2] (kg S ha^{-1} yr^{-1})	Total Deposition (kg S ha^{-1} yr^{-1})
Sulfate (SO_4^{2-})	0.11	0.50	0.61
Sulfur dioxide (SO_2)	0.14	-	0.14
TOTAL	0.25	0.50	0.75

kg = kilograms
S = Sulfur
ha = hectare
yr = year

[1] Source: Dry deposition collected at Canyonlands CASTNet site (CAN407) from 1995-2007.
[2] Source: Wet deposition data collected at Canyonlands NADP site (UT09) from 1997-2007.
Deposition data represent the annual average over each respective time period.

The average annual pH of precipitation measured at Canyonlands from 1997 through 2004 was 5.2, and ranged from 5.0 to 5.7 over the period. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH; therefore the average pH of precipitation at Canyonlands is at the acidic end of the range.

Acid Neutralization Capacity

Aquatic bodies such as lakes and streams are important resources in most Class I areas. Acid deposition resulting from industrial emissions of sulfur and nitrogen based compounds can have a toxic effect on the plants and animals of an aquatic ecosystem. Lakes and streams differ in their inherent sensitivity to inputs of acidifying compounds from the atmosphere. For pristine watersheds, the acid neutralization capacity (ANC) is a good indicator of the sensitivity and buffering capacity of the water body to acid deposition. The ANC for fresh surface waters can be characterized by the combined concentrations of select base positive ions (i.e., calcium, magnesium, potassium, and sodium), expressed in microequivalents per liter (µeq/l) [as in amount of base available to neutralize an equal amount of acid]. The lower the ANC, the more sensitive the water body to acidifying compounds and their toxic effects. **Table 3.3-8** summarizes the existing ANC for selected lakes of special concern.

Table 3.3-8 Potential Acid Neutralizing Capacity Changes at Sensitive Lakes

Location	Sensitive Lake	Background ANC (µeq/l)*
Flat Tops Wilderness Area	Ned Wilson	38.0
Flat Tops Wilderness Area	Upper Ned Wilson	12.6
High Uintah Wilderness Area	Dean	57.3
High Uintah Wilderness Area	Pine Island	95.6
Maroon Bells Wilderness Area	Moon	51.5
Raggeds Wilderness Area	Deep Creek #1	44.3
West Elk Wilderness Area	S. Golden	111.0

*Source: Sorkin 2006.

Visibility

Visibility is usually characterized by two parameters, visual range (VR) and the light-extinction coefficient (b_{ext}). The visual range parameter represents the greatest distance that a large dark object can be seen, while the light extinction coefficient represents the attenuation of light per unit distance due to scattering and absorption by gases and particulate matter in the atmosphere. Under typical conditions, the visual range and b_{ext} parameters are inversely related to each other. Good visibility conditions are represented by long visual ranges and low b_{ext} values, while poor visibility conditions are represented by short visual ranges and high b_{ext} values. The dimensions of visual range are length, and the parameter is usually expressed in kilometers (km). The units of b_{ext} are 1/length (inverse length) and the coefficient is typically expressed as “inverse kilometers” (km^{-1}), or “inverse megameters” (Mm^{-1}), the reciprocal of one million meters.

Visibility related background data collected as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program are available for Canyonlands National Park, Weminuche Wilderness, and White River National Forest (Aspen, Colorado monitoring site). Long-term (10 years or greater) data are available for Weminuche Wilderness and Canyonlands National Park; however, the available data for White River National Forest are limited to four years.

Figures 3.3-5 and **3.3-6** present long-term visibility conditions (as reconstructed from aerosol measurements) for the 20 percent cleanest, 20 percent haziest, and mid-range 40 percent to 60 percent days at Canyonlands National Park and Weminuche Wilderness (IMPROVE 2004). Both annual average and 5-year rolling average visibility data are presented. The annual average data illustrate the variability in visibility conditions that results from forest fires or other short-term factors. The 5-year data represent long-term average conditions analogous to the natural visibility conditions tracked under the regional haze program.

Seasonal visibility conditions can be reconstructed utilizing quarterly particle concentrations measured at the IMPROVE monitoring sites in conjunction with monthly relative humidity factors. **Tables 3.3-9** through **3.3-11** summarize the seasonal visibility conditions at Canyonlands National Park (1988-2004), Weminuche Wilderness (1988-2004), and White River National Forest (2001-2004).

Figure 3.3-7 presents the Standard Visual Range for each of the IMPROVE monitoring areas. As shown, visibility is very good at all three areas with a Standard Visual Range of 193 to 324 km (120 to 201 miles). White River National Forest (Aspen, Colorado monitoring site) exhibits the best visibility. Seasonal visibility conditions are typically the clearest during the fall and winter months (October through March) when particulate concentrations are at a minimum, while hazier conditions predominate during the spring and summer months (April through September) when particulates are at a maximum.

Table 3.3-9 Canyonlands National Park Reconstructed Visibility Conditions (20 Percent Cleanest)

Month	Relative Humidity Factor [1] f(Rh) (unitless)	Dry Hygroscopic Extinction [2] (1/Mm)	Dry Non-Hygroscopic Extinction [2] (1/Mm)	Reconstructed Extinction (bext) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.6	1.524	2.775	16.737	5.2	234
Feb	2.3	1.524	2.775	16.310	4.9	240
Mar	1.7	1.524	2.775	15.396	4.3	254
Apr	1.6	2.298	4.724	18.332	6.1	213
May	1.5	2.298	4.724	18.102	5.9	216
Jun	1.2	2.298	4.724	17.528	5.6	223
Jul	1.3	2.825	5.866	19.538	6.7	200
Aug	1.5	2.825	5.866	19.962	6.9	196
Sep	1.6	2.825	5.866	20.244	7.1	193
Oct	1.6	1.716	3.766	16.528	5.0	237
Nov	2.0	1.716	3.766	17.163	5.4	228
Dec	2.3	1.716	3.766	17.678	5.7	221

Monitoring Period: 1988-2004

1 Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003.

2 Quarterly particle extinction data provided by Scott Copeland, USFS, Washakie Ranger District, Lander, WY. December 2005.

Table 3.3-10 Weminuche Wilderness Reconstructed Visibility Conditions (20 Percent Cleanest)

Month	Relative Humidity Factor [1] f(Rh) (unitless)	Dry Hygroscopic Extinction [2] (1/Mm)	Dry Non-Hygroscopic Extinction [2] (1/Mm)	Reconstructed Extinction (bext) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.4	0.968	2.835	15.139	4.1	258
Feb	2.2	0.968	2.835	14.975	4.0	261
Mar	1.9	0.968	2.835	14.626	3.8	267
Apr	1.7	1.753	4.442	17.386	5.5	225
May	1.7	1.753	4.442	17.334	5.5	226
Jun	1.5	1.753	4.442	17.001	5.3	230
Jul	1.6	2.115	6.079	19.526	6.7	200
Aug	2.0	2.115	6.079	20.245	7.1	193
Sep	1.9	2.115	6.079	20.139	7.0	194
Oct	1.7	0.808	3.283	14.666	3.8	267
Nov	2.1	0.808	3.283	14.997	4.1	261
Dec	2.3	0.808	3.283	15.127	4.1	258

Monitoring Period: 1988-2004

[1] *Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003.*

[2] Quarterly particle extinction data provided by Scott Copeland, USFS, Washakie Ranger District, Lander, WY. December 2005.

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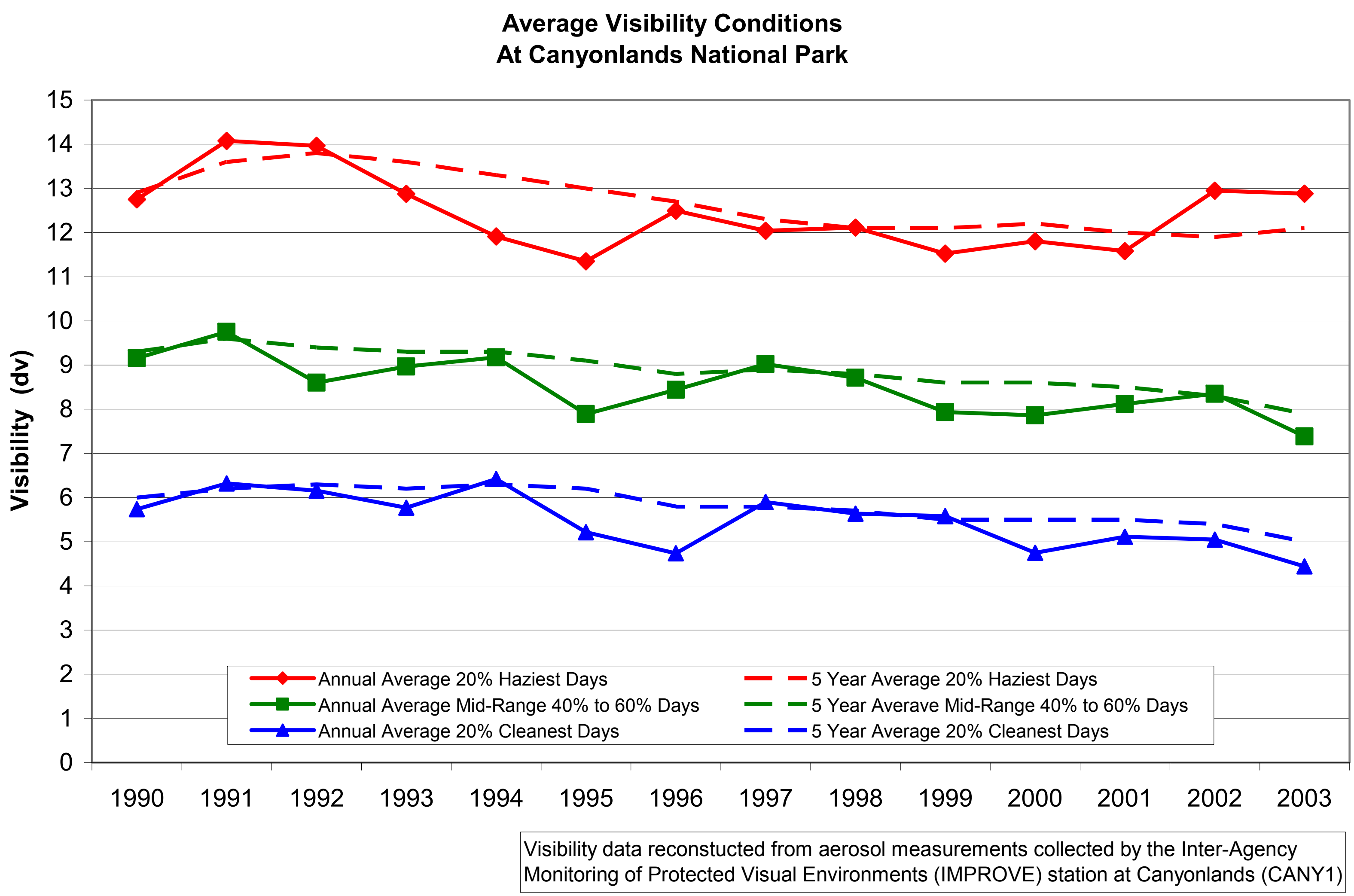

Figure 3.3-5 Visibility Conditions at Canyonlands National Park, Utah

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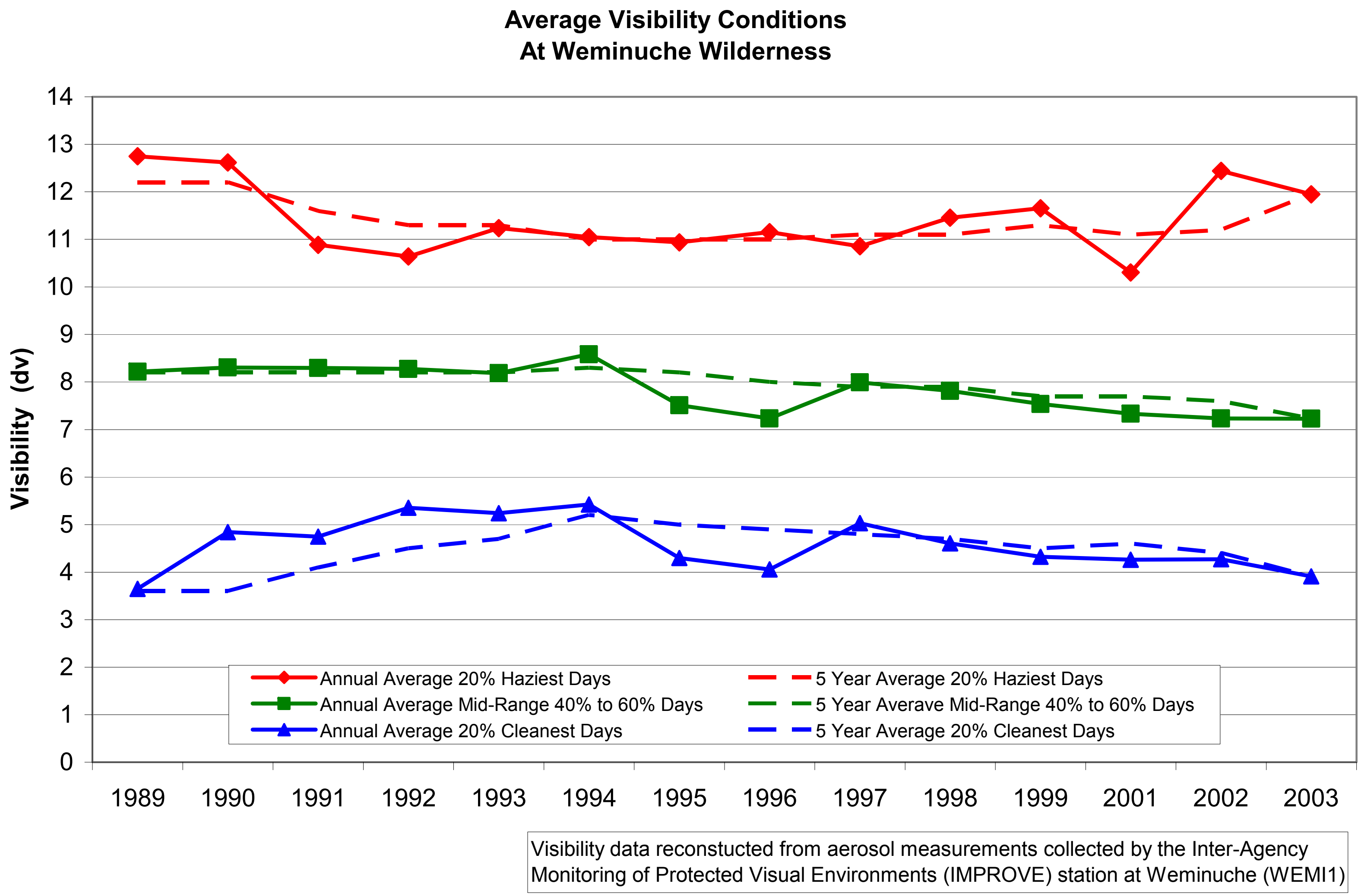

Figure 3.3-6 Visibility Conditions at Weminuche Wilderness, Colorado

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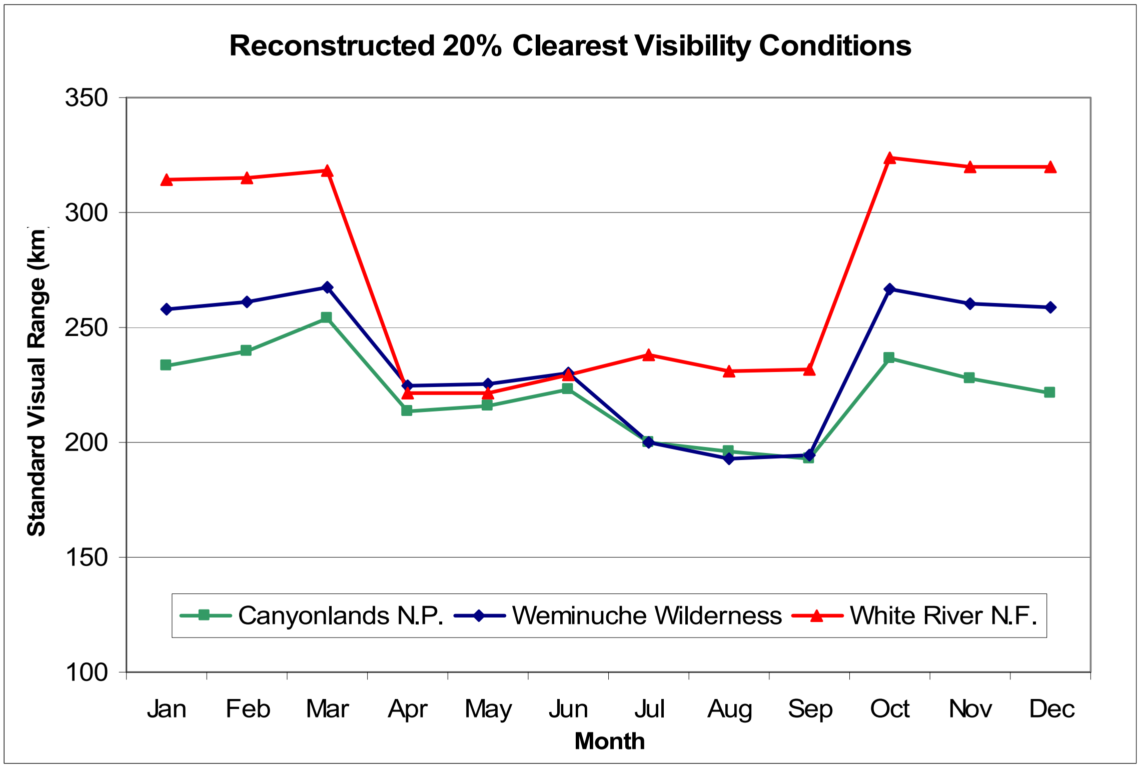

Figure 3.3-7 Reconstructed 20 Percent Clearest Seasonal Visibility Condition

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Table 3.3-11 White River National Forest Reconstructed Visibility Conditions (20 Percent Cleanest)						
Month	Relative Humidity Factor [1] f(Rh) (unitless)	Dry Hygroscopic Extinction [2] (1/Mm)	Dry Non-Hygroscopic Extinction [2] (1/Mm)	Reconstructed Extinction (bext) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.2	0.669	0.985	12.438	2.2	314
Feb	2.1	0.669	0.985	12.417	2.2	315
Mar	2.0	0.669	0.985	12.290	2.1	318
Apr	2.0	1.842	3.901	17.641	5.7	222
May	2.1	1.842	3.901	17.678	5.7	221
Jun	1.7	1.842	3.901	17.070	5.3	229
Jul	1.9	1.736	3.201	16.429	5.0	238
Aug	2.2	1.736	3.201	16.950	5.3	231
Sep	2.1	1.736	3.201	16.880	5.2	232
Oct	1.8	0.537	1.098	12.075	1.9	324
Nov	2.1	0.537	1.098	12.220	2.0	320
Dec	2.1	0.537	1.098	12.214	2.0	320

Monitoring Period: 2001-2004

[1] *Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003.*

[2] Quarterly particle extinction data provided by Scott Copeland, USFS, Washakie Ranger District, Lander, WY. December 2005.

3.4 SOILS

3.4.1 WTP Project Area Soil Types

The development of soils is governed by many factors, including climatic conditions (the amount and timing of precipitation, temperature, and wind), the parent material that the soil is derived from, topographic position (slope, elevation, and aspect), and vegetation type and cover. Soils in the WTP Project Area are developed on hillsides, ridges, the tops of the mesas, canyon sides, escarpments, alluvial fans, and canyon floors. These soils have been developed from residuum and colluvium derived from sandstone, siltstone, and shale bedrock, and alluvium in the canyon bottoms derived from mixed sedimentary rocks. Large portions of the WTP Project Area, especially along canyon rims, are covered by bare exposures of rock outcrop, principally sandstone of the Green River Formation.

A soil survey of Carbon County was conducted for the U.S. Geological Survey (USGS) Soil Conservation Service by Jensen and Borchert (1988). There are 37 soil units that can be identified in the WTP Project Area. The smallest unit constitutes only 8 acres of the WTP Project Area while the largest unit comprises 25,897 acres. Most of these soil units are composed of a complex of two or more soil types that are found in close association with each other.

Figure 3.4-1 illustrates soil types within the WTP Project Area. **Table 3.4-1** provides information for each soil unit, including the acreage of each soil unit in the WTP Project Area, soil texture, landforms on which the soil is found, the parent material from which the soil was derived, the slopes on which the soil exists, the depth and drainage classes for the soil, runoff speed, reclamation source material rating, and water erosion potential. A description of each soil map unit, the general locations where each soil exists, and the dominant vegetation on each soil unit, is provided below.

3.4.1.1 Badland-Rubbleland-Rock Outcrop Complex (Map Unit 3)

This soil association occurs on mountain slopes and hillsides on slopes ranging from 50 to 80 percent. The complex consists of Badland (60 percent), Rubbleland (15 percent) and Rock outcrop (15 percent). The unit is virtually free of vegetation. Runoff is very rapid and the erosion potential is severe. Within the WTP Project Area, this association can be found scattered throughout the Horse Bench area and in Nine Mile Canyon near Gate Canyon.

3.4.1.2 Beje Complex (Map Unit 5)

This soil complex is found on mountain ridge tops on slopes ranging from 8 to 40 percent. The unit is 45 percent Beje very gravelly fine sandy loam, 35 percent Beje fine sandy loam, and 20 percent other soils. Soil in this complex is generally shallow (10 to 20 inches) and the dominant plant communities include grasses and shrubs. Among the important plants are black sagebrush, bluegrass, Salina wild rye, birch leaf mountain mahogany, and serviceberry. Shallow soil depth and low precipitation make it difficult to revegetate disturbed areas. Runoff is medium and the erosion potential is moderate. The soil is primarily found along Dry Canyon and Mount Bartles Road.

3.4.1.3 Beje-Trag Complex (Map Unit 7)

This soil association occurs on gentle slopes and plateaus on slopes ranging from 3 to 30 percent. The unit is 55 percent Beje, 20 percent Trag, and 25 percent other soils. Similar to the previous complex, grasses (60 percent) and shrubs (30 percent) constitute the primary vegetation. This unit is used as rangeland and wildlife habitat. Unlike the shallow Beje soil, the Trag soil is deep (approximately 60 inches) and therefore suitable for seeding. The potential for water erosion is moderate. The complex can be found in the southwestern corner of the WTP Project Area near Sheep Canyon and along the Mount Bartles Road.

3.4.1.4 Cabba Family, 20-40 Percent Slopes (Map Unit 10)

This soil association can be found on benches and canyon sides and is particularly prevalent near Jack Creek in the Jack Canyon WSA. In general, the association occurs on steep slopes covered by a canopy of Utah juniper and pinyon with an understory of shrubs. The potential for water erosion is moderate. The reclamation potential is poor because of shallow soil depths and low precipitation.

3.4.1.5 Cabba Family, 40-70 Percent Slopes (Map Unit 11)

This soil complex constitutes a minor portion of the WTP Project Area (914 acres) and can be found in Harmon Canyon. The soil is developed on steep mountain slopes with southern aspects. The primary vegetation includes a canopy primarily comprised of pinyon and juniper (30 percent) with an understory of grasses and shrubs that are equally distributed. Runoff is rapid and the water erosion potential is very high.

3.4.1.6 Cabba Family- Badland- Rock Outcrop Complex (Map Unit 12)

There are only 41 acres of this soil complex located within the WTP Project Area. The soil complex is located on the south slopes of Nine Mile Canyon near Gate Canyon. Slopes range from 40-60 percent and the vegetation cover is similar to other Cabba family soil complexes (Map Units 10, 11, 12, and 13). The reclamation potential is poor because of shallow soil depths and high water erosion potential.

3.4.1.7 Cabba Family- Guben- Rock Outcrop Complex (Map Unit 13)

This soil association is one of the three primary soil associations found throughout the WTP Project Area and can be found in nearly every canyon. This unit is 50 percent Cabba, 20 percent Guben, 15 percent Rock outcrop, and 15 percent other soils. In general, slopes range from 40 to 75 percent. The Cabba family soil, found on canyon sides between ledges of rock outcrop, is a shallow soil susceptible to rapid runoff and erosion. The primary vegetation includes pinyon, juniper, Salina wildrye and Mormon-tea. The Guben soil, which occurs on toe slopes, is deep and contains Douglas fir in addition to the juniper and pinyon. The unit is not conducive to grazing or wood harvesting because of the steep slopes.

3.4.1.8 Casmos- Rock Outcrop Complex, 2-25 Percent Slopes (Map Unit 14)

This minor soil complex (1,083 acres within WTP Project Area) can be found on the summit and pediment slopes in the northeastern corner of the WTP Project Area between Desolation and Nine Mile Canyons. The unit is 65 percent Casmos, 10 percent rock outcrop, and 25 percent other soils. The existing plant community on the Casmos soil consists of 30 percent grasses, 10 percent forbs, and 60 percent shrubs. The water erosion potential is moderate. The suitability for revegetation is poor because of shallow soil depths.

3.4.1.9 Casmos-Rock Outcrop Complex, 40-70 Percent Slopes (Map Unit 15)

This soil association is the primary association on the canyon sides of Horse Bench. The unit is 65 percent Casmos, 20 percent rock outcrop, and 15 percent other soils. The vegetative community consists of shadscale, galleta, yellowbrush, eriogonum, and Salina wildrye. The suitability for revegetation is very poor because of the steep slopes and low precipitation. The potential for water erosion is moderate.

3.4.1.10 Croydon Loam, 8-30 Percent Slopes (Map Unit 21)

The Croydon loam occurs on foot slopes near the southwestern border of the WTP Project Area and can be found along Dry Creek Road. Vegetation includes aspen with an understory of grasses. The potential for water erosion is slight.

3.4.1.11 Doney Family, 3-15 Percent Slopes (Map Unit 25)

This moderately deep soil is found near the Stone Cabin Gas Field and Dry Creek. Among the important plants that grow on this soil type are basin big sagebrush, western wheatgrass, Indian ricegrass, and needle-and-thread. The potential for water erosion is moderate. The unit is suitable for rangeland and wildlife habitat.

3.4.1.12 Doney Family, 50-70 Percent Slopes (Map Unit 26)

One-hundred and sixty acres of this soil can be found near the southwest corner of the WTP Project Area near Mount Bartles Road. Steep slopes make the soil susceptible to rapid runoff and erosion. The primary plant communities are 60 percent grasses, 15 percent forbs, and 25 percent shrubs.

3.4.1.13 Green River- Juva Variant Complex (Map Unit 41)

This complex is found on floodplains, alluvial fans, and stream terraces along the Green River. The unit is 45 percent Green River silt loam and 30 percent Juva variant fine sandy loam. The present vegetation includes tamarisk, willows, saltgrass, sedges, and cottonwood on the floodplains; and shadscale, pricklypear, galleta, greasewood, and rabbitbrush on the alluvial fan surfaces. The water erosion potential is moderate.

3.4.1.14 Grobutte- Cabba Families Association (Map Unit 43)

This unit is 40 percent Grobutte and 35 percent Cabba. The association generally can be found on mountain slopes ranging from 25 to 70 percent, and is most common near Harmon Canyon. The primary vegetation includes Douglas-fir, Rocky Mountain juniper, Utah juniper, and mountain mahogany, with an understory of black sagebrush, Salina wildrye, and needle-and-thread. Runoff occurs rapidly, and, therefore, the water erosion potential is high.

3.4.1.15 Guben- Rock Outcrop Complex (Map Unit 47)

This complex is a minor complex that can be found near the southwest corner of the WTP Project Area in Sheep Canyon and along the Mount Bartles Road. The unit generally occurs on steep mountain slopes ranging from 50 to 80 percent. The primary vegetation includes Rocky Mountain Douglas Fir and pinyon. The potential for water erosion is slight.

3.4.1.16 Haverdad Loam, 1-8 Percent Slopes (Map Unit 48)

Haverdad loam is a very deep soil that occurs on alluvial fans located in Nine Mile Canyon. The vegetation includes Wyoming big sagebrush, blue grama, winterfat, and bottlebrush squirreltail. Only 62 acres of this soil type are found within the WTP Project Area. The reclamation potential is poor because of the high alkaline conditions in the soil.

3.4.1.17 Haverdad Loam, Moist, 1-5 Percent Slopes (Map Unit 50)

Small areas of this soil are located on alluvial fans and valley floors throughout the WTP Project Area. The most common occurrences are in Dry, Cottonwood, Prickly Pear, and Harmon canyons. The water erosion potential is moderate. The primary vegetation includes Wyoming big sagebrush, blue grama, winterfat, and bottlebrush squirreltail. The vegetation community on this soil provides excellent wildlife habitat.

3.4.1.18 Hernandez Family, 3-8 Percent Slopes (Map Unit 52)

Fourteen acres of this soil can be found near Cottonwood Canyon on fan terraces. The soil is moderately deep and the primary vegetation includes Wyoming big sagebrush, yellowbrush, galleta, Indian ricegrass, and blue grama. The hazard of water erosion is moderate and the reclamation potential is fair.

3.4.1.19 Midfork Family- Comodore Complex (Map Unit 62)

This soil complex can be found on mountain slopes ranging from 50 to 70 percent. The unit is 50 percent Midfork family and 20 percent Comodore bouldery loam. The soil is very deep (approximately 60 inches) and supports a thick overstory of Douglas fir (90 percent). The complex is located west of Mount Bartles Road near the southwestern border of the WTP Project Area. The reclamation potential is poor because of the steep slopes and high water erosion potential.

3.4.1.20 Pathead Extremely Bouldery Fine Sandy Loam, 40-70 Percent Slopes (Map Unit 71)

This moderately deep soil can be found on steep mountain slopes and canyon sides along the Dry Creek and Mount Bartles Roads near the southern border of the WTP Project Area. The present vegetation is mainly curlleaf, mountain mahogany, pinyon, juniper, Salina wildrye, and serviceberry. Runoff is rapid and erosion potential is high.

3.4.1.21 Perma Family- Datino Complex (Map Unit 76)

This soil unit is found on mountain slopes (60 to 80 percent) and canyon sides near Dry Creek and Stone Cabin Creek in the southwestern portion of the WTP Project Area. The soils in this complex are deep (60 inches and more). The present vegetation includes Douglas fir, birchleaf mountain mahogany, serviceberry, Wasatch penstemon, and mountain big sagebrush, snowberry, pinegrass, and Salina wildrye. Steep slopes make the potential for water erosion high, and the reclamation potential is poor.

3.4.1.22 Podo Gravelly, Sandy Loam, 1-8 Percent Slopes (Map Unit 82)

This shallow, well-drained soil can be found on benches and mesa tops throughout the WTP Project Area. The primary areas are along the Cottonwood Ridge Road, on Flat Iron Mesa and on Prickly Pear Mesa. The present vegetation is mainly pinyon, Utah juniper, black sagebrush, Mormon-tea, and birchleaf mountain mahogany. The unit is used as rangeland, woodland, and wildlife habitat. The soils are very shallow making it difficult to revegetate. Runoff occurs slowly and the water erosion potential is slight.

3.4.1.23 Podo- Cabba Family Complex (Map Unit 83)

The Podo-Cabba complex is the most common soil complex within the WTP Project Area (25,897 acres). The complex can be found on side slopes, benches, and canyon rims on slopes ranging from 3 to 30 percent. The complex is comprised of 50 percent Podo, 30 percent Cabba, and 20 percent other soils. The present vegetation is mainly pinyon, juniper, Mormon-tea, black sagebrush, and shadscale. The unit can be used for wildlife habitat, rangeland, and woodland. Runoff is medium and erosion potential is moderate.

3.4.1.24 Podo-Rock Outcrop Complex (Map Unit 84)

This soil complex is found on mountain slopes of 50 to 70 percent. Slopes are generally south-facing at lower elevations and north-facing at higher elevations. The primary areas are located along Dry Creek and Stone Cabin Creek near the southern boundary of the WTP Project Area. The unit is 50 percent Podo and 30 percent rock outcrop. The vegetation on the Podo soils includes pinyon, Utah juniper, and Douglas-fir. Areas of rock outcrop are found on nearly vertical ledges and cliffs. Runoff is rapid, and the water erosion potential is high.

3.4.1.25 Rabbitex- Pathead Complex (Map Unit 87)

This soil complex covers areas near the top of Harmon Canyon, along the Mount Bartles Road, and along Stone Cabin Creek on slopes ranging from 25 to 50 percent. The complex is comprised of Rabbitex (35 percent), Pathead (35 percent), and other soils (30 percent). Soils in the complex are deep to moderately deep and the primary vegetation includes Salina wildrye, western wheatgrass, birchleaf mountain mahogany, muttongrass, larkspur, black sagebrush, and rabbitbrush. Runoff is rapid and the erosion potential is high.

3.4.1.26 Riverwash (Map Unit 94)

Riverwash consists of materials deposited along streambeds. The soil supports little if any vegetation. Approximately 8 acres of Riverwash can be found in the northeastern portion of the WTP Project Area along the Green River.

3.4.1.27 Rock Outcrop (Map Unit 95)

Rock outcrops exist through the WTP Project Area. However the rock outcrop soil type is mainly found along the Green River in Desolation Canyon. Rock outcrop consists of exposures of sandstone bedrock on very steep escarpments and ridges. The areas are generally barren.

3.4.1.28 Rottulee Family- Trag Complex (Map Unit 97)

These soils can be found on mountain slopes and the sides of Sheep Canyon in the southwestern corner of the WTP Project Area. Slopes are 30 to 60 percent and the soils are moderately deep. The complex is 60 percent Rottulee, 20 percent Trag, and 20 percent other soils. Runoff is rapid; however, water the hazard of water erosion is only moderate.

3.4.1.29 Senchert Loam, 3-15 Percent (Map Unit 100)

This soil can be found on plateaus and ridges near Stone Cabin Canyon and Sheep Canyon near the southern border of the WTP Project Area. The present vegetation includes aspen and snowberry. The erosion potential is moderate.

3.4.1.30 Senchert-Toze Family Complex (Map Unit 103)

This soil complex can be found on north, east, and west aspects on slopes of 15 to 35 percent in the vicinity of Mount Bartles. The present vegetation is mainly aspen, white fir, and Douglas-fir. The area is used for recreation, wildlife habitat, rangeland, and woodland. The erosion potential is moderate.

3.4.1.31 Shupert- Winetti (Map Unit 107)

This complex is located in narrow valley and canyon floors on slopes of 1 to 8 percent. The common vegetation includes basin big sagebrush, rabbitbrush, cheatgrass, needle-and-thread, and dropseed. Runoff is slow making this soil subject to flooding during intense storms. Channeling and deposition are common along stream banks. This complex can be found in Nine Mile Canyon, Dry Canyon, Cottonwood Canyon, Prickly Pear Canyon, and along Stone Cabin Creek.

3.4.1.32 Travessilla- Rock Outcrop Complex (Map Unit 120)

Small areas of the Travessilla- Rock outcrop complex are scattered throughout the Horse Bench area. The unit is predominantly Travessilla fine sandy loam (70 percent). The soil is shallow (10 to 20 inches) and the primary vegetation includes pinyon, juniper, and an understory of shrubs. The erosion potential is moderate.

3.4.1.33 Travessilla-Rock Outcrop- Gerst Complex (Map Unit 121)

This complex is the second most common soil in the WTP Project Area (21,693 acres). The soil is found on the canyon sides of Desolation, Jack, Cottonwood, Dry, and Prickly Pear canyons. The unit is 40 percent Travessilla (40 to 70 percent slopes), 30 percent rock outcrop, and 20 percent Gerst very channery loam (50 to 70 percent slopes). Travessilla is a shallow soil that can be found on north and west slopes at higher elevations. The vegetation is primarily pinyon, juniper, Douglas-fir, Salina wildrye and birchleaf mountain mahogany. Runoff is rapid and erosion potential is high. The Gerst soil is also a shallow soil; however, it primarily is found on south and west slopes. The vegetation includes juniper, pinyon, Salina wildrye, and Mormon-tea. Similar to Travessilla, runoff is rapid and the water erosion potential is high.

3.4.1.34 Travessilla-Travessilla Family- Rock Outcrop Complex (Map Unit 122)

This complex can be found on steep canyon sides (50 to 80 percent) in Nine Mile, Dry, Cottonwood, and Rock House canyons. The complex consists of Travessilla fine sandy loam (35 percent), Travessilla family channery sandy loam (20 percent), rock outcrop (15 percent), and other soils (30 percent). The Travessilla soil is generally on the canyon rims, the Travessilla family soil is located in the canyon bottoms, and the rock outcrop is on vertical cliffs. In general the soils within the complex are shallow and susceptible to rapid runoff and high erosion. The plant community is predominantly shrubs.

3.4.1.35 Travessilla Family, 1-8 Percent (Map Unit 123)

The Travessilla family soil is found on Horse Bench. The present vegetation is mainly black sagebrush, galleta, Indian ricegrass, yellowbrush, and fourwing saltbush. The soil is shallow (8 to 15 inches) and the potential for water erosion is high. It is difficult to revegetate large areas because of the shallow soils.

3.4.1.36 Uintah-Toze Families Complex (Map Unit 125)

Only 17 acres of the Uintah-Toze families' complex are located in the WTP Project Area. The complex is 35 percent Uintah, 30 percent Toze, and 30 percent other soils. The complex can be found on mountain sides on slopes ranging from 30 to 75 percent. The moderately deep soils support a vegetative community that includes Engelmann spruce and subalpine fir. The water erosion potential is high.

3.4.1.37 Winetti Variant Cobbly Fine Sandy Loam, 0-8 Percent Slopes (Map Unit 126)

This deep soil (60 inches or more) can be found on alluvial fans along the Green River in the WTP Project Area. The present vegetation includes greasewood, cheatgrass, big sagebrush, and alkali sacaton. This soil is subject to flooding during prolonged or intense storms. The hazard of water erosion is slight.

3.4.2 Erosion and Reclamation Potential

For evaluation of potential environmental impacts to soils, the key attributes are their erosion potential and ease of reclamation after soil disturbance. Erosion potential can vary widely among soil units within a given area, and is dependent on the particle size distribution of the soil, the slopes on which it is found, and the amount and type of vegetative cover. Reclamation potential is dependent on the soil structure, pH conditions, and soil salinity. Excessive salinity (salt content), acidity, or alkalinity can inhibit the growth of desirable vegetation. Soil mapping conducted by the U.S. Department of Agriculture (USDA) typically provides information about each soil type within a mapped area which can be used to evaluate the erosion potential and reclamation potential of each soil unit. Erosion hazards may become a critical issue when protective vegetation is removed during activities such as access road and well pad construction. Water erosion potential was rated for all soil types in the WTP Project Area by Jensen and Borchert (1988). Erosion potentials are not estimated for rock outcrops.

Most of the soil types are considered to have moderate erosion potential. Erosion potential is considered to be slight for the Croydon, Green River, Juva variant, Guben, Podo (1-8 percent), Winetti, and Winetti variant soils. These soils are mainly located on foot slopes, floodplains, alluvial fans, and mesa tops on slopes less than 8 percent. Erosion potential is high to severe for the Badland, Cabba (40-70 percent), Guben (40-75 percent), Grobutte, Midfork, Comodore, Perma, Datino, Podo (50-70 percent), Pathead, Rabbitex, Trag, Travessila (30-80 percent), Gerst, and Uinta soils. Soils with high to severe erosion potential are located on steep mountain slopes, canyon sides, toe slopes, and canyon rims. The USDA has provided reclamation material source ratings for most of the soils in the proposed WTP Project Area on the Web Soil Survey. Most of the soils in the WTP Project Area are rated poor for reclamation potential based on the attributes of the primary soil type. The poor ratings are generally due to the shallow depth to bedrock, low organic matter content, high stone content, and high to severe water erosion potential. The Croydon, Haverdad, Hernandez, Midfork, Senchert, and Toze soils are rated fair for reclamation source material.

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
3	Badland-Rubbleland-Rock outcrop complex	1,085	Badland	60	---	Mountain slopes and hillsides	Shale	50 to 80	Shallow	---	Rapid	---	Severe
			Rubbleland	15	---		Stones and boulders		---	---	Rapid	---	---
			Rock Outcrop	10	Sandstone, siltstone, and shale bedrock		---		--	---	Rapid	---	---
5	Beje complex	5,657	Beje	100	Fine sandy loam, gravely clay loam	Mountain ridge tops	Residuum derived from sandstone and shale	8 to 40	Shallow	Well drained	Medium	Poor	Moderate
7	Beje-Trag complex	905	Beje	55	Loam, clay loam, sandy clay loam	Gently sloping plateaus	Residuum derived from calcareous sandstone	3 to 15	Shallow	Well drained	Medium	Poor	Moderate
			Trag	20	Clay loam		Alluvium derived from sandstone and shale	3 to 30	Very deep	Well drained	Medium	---	Moderate
10	Cabba Family 20-40% slopes	4,917	Cabba	100	Bouldery loam, clay loam, loam	Benches and canyon sides	Residuum and colluvium derived from shale and siltstone	20 to 40	Shallow	Well drained	Medium	Poor	Moderate
11	Cabba Family 40-70% slopes	904	Cabba	100	Fine sandy loam, gravelly loam	Mountain slopes	Colluvium derived from sandstone and shale	40 to 70	Shallow	Well drained	Rapid	Poor	Very high
12	Cabba Family-Badland-Rock outcrop complex	41	Cabba	40	Channery clay loam, clay loam, loam	South-facing canyon sides	Residuum and colluvium derived from shale	40 to 60	Shallow	Well drained	Rapid	Poor	High
			Badland	20	---		Shale	---	Shallow	---	Rapid	---	Severe
			Rock Outcrop	20	Sandstone and shale bedrock	Steep escarp-ments and ledges	---	---	---	---	Rapid	---	---

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
13	Cabba Family-Guben-Rock outcrop complex	19,516	Cabba	50	Bouldery loam, clay loam, loam	Canyon sides between ledges of rock outcrop	Residuum and colluvium derived from sandstone and shale	40 to 70	Shallow	Well drained	Rapid	Poor	High
			Guben	20	Bouldery loam, stony loam	Toe slopes	Colluvium derived from sandstone and shale	40 to 75	Very deep	Well drained	Rapid	Poor	High
			Rock Outcrop	15	Sandstone and shale bedrock	Canyon rims, ledges, and very steep side slopes	---	---	---	---	Rapid	---	---
14	Casmos-Rock outcrop complex 2-25 percent slopes	1083	Casmos	65	Channery loam, clay loam	Shoulder, side slopes, and summits	Residuum and colluvium derived from sandstone and shale	2 to 25	Shallow	Well drained	Medium	Poor	Moderate
			Rock Outcrop	10	---	Shoulders and side slopes	---	---	---	---	Rapid	---	---
15	Casmos-Rock outcrop complex 40-70 percent slopes	8,307	Casmos	65	Channery loam, clay loam	Below escarp-ments	Residuum and colluvium derived from sandstone and shale	40 to 70	Shallow	Well drained	Medium	Poor	Moderate
			Rock Outcrop	20	---	Terrace escarp-ments	---	---	---	---	Rapid	---	---
21	Croydon loam, 8-30 percent slopes	440	Croydon	95	Loam, clay loam	Foot slopes	Alluvium derived from sandstone and shale	8 to 30	Deep	Well drained	Slow	Fair	Slight

Table 3.4-1 Soil Characteristics of the WTP Project Area

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25	Doney family, 3-15 percent slopes	2,145	Doney	85	Silt loam, clay loam, loam	Benches and foots slopes	Residuum derived from sandstone, siltstone, and shale	3 to 15	Mod. deep	Well drained	Medium	Poor	Moderate
26	Doney family, 50-70 percent slopes	160	Doney	85	Stony loam, loam	Mountain slopes	Residuum and colluvium derived from shale and siltstone	50 to 70	Mod. deep	Well drained	Rapid	Poor	Moderate
41	Green River-Juva variant complex	1,124	Green River	45	Silt loam, fine sandy loam	Flood-plains	Alluvium from mixed sed. rock	0 to 2	Very deep	Mod. Well drained	Slow	Poor	Slight
			Juva Variant	30	Fine sandy loam, loam	Alluvial fans and stream terraces	Alluvium from mixed sed. rock	1 to 5	Very deep	Well drained	Slow	---	Slight
43	Grobutte-Cabba families association	5,750	Grobutte	40	Gravelly loam, cobbly loam, stony sandy loam	South and west mountain slopes	Colluvium derived from sandstone, siltstone, and shale	25 to 40	Very deep	Well drained	Medium	Poor	High
			Cabba	35	Gravelly loam, clay loam	North and east mountain slopes	Residuum and colluvium derived from sandstone and shale	40 to 70	Mod. deep	Well drained	Rapid	Poor	High
47	Guben-Rock outcrop complex	277	Guben	55	Bouldery fine loam, stony loam	Mountain slopes	Colluvium derived from sandstone and shale	50 to 80	Very deep	Well drained	Moderat e	Poor	Slight
			Rock Outcrop	20	Sandstone and shale bedrock	ledges	---	---	---	---	Rapid	---	---
48	Haverdad loam, 1-8 percent slopes	62	Haverdad	90	Loam, clay loam, fine sandy loam	Fan terraces, alluvial fans, and valley floors	Alluvium derived from sandstone and shale	0 to 3	Very deep	Well drained	Slow	Fair	Moderate

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
50	Haverdad loam, moist, 1-5 percent slopes	2,488	Haverdad	90	Loam, fine sandy loam	Alluvial fans and valley floors	Alluvium derived from sandstone and shale	1 to 5	Very deep	Well drained	Slow	Fair	Moderate
52	Hernandez family, 3-8 percent slopes	14	Hernandez	80	Loam	Fan terraces	Alluvium derived from sandstone and shale	3 to 8	Very deep	Well drained	Slow	Fair	Moderate
62	Midfork family-Comodore complex	553	Midfork	50	Bouldery loam, very channery loam	Mountain slopes	Colluvium derived from sandstone and shale	50 to 70	Very deep	Well drained	Rapid	Fair	High
			Comodore	20	Bouldery loam, very stony loam	Mountain slopes	Colluvium derived from sandstone, siltstone, and shale	50 to 70	Shallow	Well drained	Rapid	---	High
71	Pathead extremely bouldery fine sandy loam, 40-70 percent slopes	1,035	Pathead	75	Extremely bouldery fine sandy loam, very stony fine sandy loam	Mountain slopes and canyon sides	Colluvium derived from sandstone and shale	40 to 70	Mod. deep	Well drained	Rapid	Poor	Moderate
76	Perma family-Datino complex	762	Perma	40	Very stony loam, cobbly sandy loam	Mountain slopes and canyon sides	Colluvium derived from sandstone and shale	60 to 80	Very deep	Well drained	Rapid	Poor	High
			Datino	35	Extremely stony fine sandy loam, very stony loam	Mountain slopes and canyon sides	Colluvium derived from sandstone and shale	60 to 80	Very deep	Well drained	Rapid	Poor	High
82	Podo gravelly sandy loam, 1-8 percent slopes	7,101	Podo	80	Gravelly sandy loam, loam, gravelly loam	Benches and mesa tops	Residuum derived from sandstone	1 to 8	Shallow	Well drained	Slow	Poor	Slight
83	Podo-Cabba family complex	25,897	Podo	50	Gravelly sandy loam, loam, gravelly loam	Benches, canyon rims, and side slopes	Residuum and colluvium derived from sandstone	8 to 30	Shallow	Well drained	Medium	Poor	Moderate

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Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
			Cabba	30	Gravelly loam	Benches, canyon rims, and side slopes	Residuum and colluvium derived from sandstone and shale	3 to 30	Shallow	Well drained	Medium	Poor	Moderate
84	Podo-Rock outcrop complex	1,302	Podo	50	Gravelly sandy loam, loam, gravelly loam	Mountain slopes	Residuum and colluvium derived from sandstone and shale	50 to 70	Shallow	Well drained	Rapid	Poor	High
			Rock Outcrop	30	Sandstone bedrock	Mountain slopes	---	---	---	---	Rapid	---	---
87	Rabbitex-Pathead complex	2,037	Pathead	35	Gravelly loam, very cobbly loam	Mountain slopes	Residuum and colluvium derived from sandstone and shale	25 to 50	Deep	Well drained	Rapid	Poor	High
			Rabbitex	35	Loam, channery loam, gravelly loam	Mountain slopes	Alluvium and colluvium derived from sandstone and shale	25 to 50	Deep	Well drained	Rapid	---	High
94	Riverwash	8	Riverwash	100	Sandy loam, gravelly course sand to loam	Stream-beds or riverbeds	---	---	---	---	---	---	---
95	Rock outcrop	1,334	Rock Outcrop	100	Sandstone, siltstone, and shale bedrock	Steep escarp-ments and ridges	---	---	---	---	Rapid	---	---
97	Rottulee family-Trag complex	152	Rottulee	60	Loam, clay loam, gravelly silty clay loam, gravelly silt loam	Mountain slopes and canyon sides	Residuum and colluvium derived from sandstone and shale	30 to 60	Mod. deep	Well drained	Rapid	Poor	Moderate

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
			Trag	20	Stony loam, clay loam	Mountain slopes and canyon sides	Colluvium derived from sandstone and shale	30 to 60	Very deep	Well drained	Rapid	---	High
100	Senchert loam, 3-15 percent slopes	164	Senchert	85	Loam, clay loam	Plateaus and ridges	Residuum and alluvium derived from sandstone and shale	3 to 15	Mod. deep	Well drained	Slow	Fair	Moderate
103	Senchert-Toze family complex	600	Senchert	50	Loam, clay loam, silty clay	North, east, and west aspects of mountain slopes, plane areas	Residuum and colluvium derived from sandstone and shale	15 to 30	Mod. deep	Well drained	Slow	Fair	Moderate
			Toze	30	Loam, cobbly silt loam, gravelly silt loam, gravelly fine sandy loam	North, east, and west aspects of mountain slopes, Concave areas	Colluvium derived from sandstone, siltstone, and shale	15 to 35	Very deep	Well drained	Medium	Fair	Moderate
107	Shupert-Winetti complex	1,954	Shupert	40	Gravelly loam, clay loam	Narrow valley and canyon floors	Alluvium derived from sandstone and shale	1 to 8	Very deep	Well drained	Slow	Poor	Moderate
			Winetti	35	Bouldery sandy loam, loam, very bouldery loam, very gravelly sandy loam	Narrow valleys and canyon floors	Alluvium derived from sandstone and shale	1 to 8	Very deep	Well drained	Slow	Poor	Slight
120	Travessilla-Rock outcrop complex	248	Travessilla	70	Fine sandy loam	Benches and mesas	Residuum derived from sandstone and shale	3 to 20	Shallow	Well drained	Medium	Poor	Moderate
			Rock Outcrop	15	Sandstone bedrock	Benches and mesas	---	---	---	---	Rapid	---	---

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
121	Travessilla-Rock outcrop-Gerst complex	21,693	Travessilla	40	Extremely bouldery loam, loam, very fine sandy loam	North and west canyon sides at higher elevations	Residuum and colluvium derived from sandstone and shale	40 to 70	Shallow	Well drained	Rapid	Poor	High
			Rock Outcrop	30	Sandstone and siltstone bedrock	Canyon rims and ledges	---	---	---	---	Rapid	---	---
			Gerst	20	Channery loam, channery clay loam	South and west aspects at lower elevations	Residuum derived from shale	50 to 70	Shallow	Well drained	Rapid	Poor	High
122	Travessilla-Travessilla family-Rock outcrop complex	6,808	Travessilla	35	Fine sandy loam	Canyon rims	Residuum derived from sandstone and shale	50 to 80	Shallow	Well drained	Rapid	Poor	High
			Travessilla family	20	Channery sandy loam, sandy loam	Canyon bottoms	Residuum derived from sandstone and shale	30 to 50	Shallow	Well drained	Rapid	Poor	High
			Rock Outcrop	15	Sandstone bedrock	Vertical cliffs	---	---	---	---	Rapid	---	---
123	Travessilla family, 1-8 percent slopes	1,993	Travessilla	100	Channery sandy loam, sandy loam	benches	Residuum derived from sandstone	1 to 8	Shallow	Well drained	Medium	Poor	High
125	Uintah-Toze families complex	17	Uinta	35	Loam, stony sandy loam, stony clay loam	Mountain slopes	Colluvium derived from sandstone and siltstone	40 to 70	Deep	Well drained	Rapid	Poor	High
			Toze	35	Fine sandy loam, cobbly silt loam, gravelly silt loam	Mountain slopes	Colluvium derived from sandstone, siltstone, and shale	35 to 70	Very deep	Well drained	Rapid	---	Moderate

Table 3.4-1 Soil Characteristics of the WTP Project Area

Map Unit	Soil Complex Name	Acreage in Project Area	Soil Unit Name	% of Complex	Soil Texture	Land-forms	Parent Material	Slope (%)	Depth Class	Drainage Class	Runoff	Reclaim Source Material Rating	Water Erosion Potential
126	Winetti variant cobbly fine sandy loam, 0-8 percent slopes	685	Winetti Variant	85	Cobbly fine sandy loam, fine sandy loam, sand, sandy loam, extremely gravelly sand	Alluvial fans	Alluvium derived from mixed sedimentary rock	0 to 8	Very deep	Well drained	Very slow	Poor	Slight

% percent

3.4.3 Existing Soil Disturbances

Soils in the WTP Project Area have been disturbed by previous oil and gas development and exploration, grazing, and recreational activities. Based on existing disturbance numbers contained in **Appendix C** it is anticipated that there is a total of about 458 acres of existing disturbance from oil and gas activities within the WTP Project Area. The amount of disturbance associated with other uses is not included in this estimate.

3.4.4 Biological Soil Crusts

Biological soil crusts are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials. Many names have been applied to these soil crusts, including cryptogamic, cryptobiotic, microphytic, and microbiotic soils (Belnap et al. 2001). These biological soil crusts are composed of cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria that exist together in symbiotic relationships. These soil crusts are common in the Colorado Plateau region, as well as other desert and semi-desert regions throughout the world. On the Colorado Plateau, these soil crusts often occupy areas where harsh environmental conditions (shallow soils, loose rocks, common freezing conditions, and low moisture) have limited the growth of vascular plants (Belnap et al. 2001). These soil crusts have important ecological roles in desert areas, including fixing carbon and nitrogen for other plants, reducing surface albedo (and thus raising soil temperatures), increasing water infiltration rates, and stabilizing fragile soils by reducing water and wind erosion (Belnap et al. 2001).

It is estimated that soil crusts occur in approximately 30 percent of the WTP Project Area (BLM 2004c). The richness of crust cover is primarily influenced by soil stability. Stability is determined by slope, soil texture, moisture, depth, and chemistry. A high biological crust cover can be found in areas where the primary vegetation includes Wyoming big Sagebrush, basin big sagebrush, mountain big sagebrush, and black sagebrush. Threats to biological soil crust include livestock grazing, human foot traffic, motorized vehicles, drought, invasive species, and fire. A loss of biological crust can substantially increase runoff and the hazard of water and wind erosion.

The natural recovery rates of biological crusts are dependent on many factors, including the type, severity, and extent of soil disturbance, climatic conditions, substrate conditions, and the nature of the vascular plant communities (Belnap et al. 2001). The recovery rates also vary for different components of biological crusts. For example, in an examination of existing studies of recovery rates for biological crusts on the Colorado Plateau, Belnap et al. (2001) reported that cyanobacterial cover was predicted to recover in 45 to 110 years, whereas the actual recovery time on assessed plots ranged from 14 to 34 years. Thus, for cyanobacteria, estimates of recovery time based on linear extrapolations overestimated recovery time. In contrast, *Collema* recovery after three years was estimated to be 85 years and decreased only to 50 years after 14 years of observation. *Collema* recovery rates were initially estimated at 487 years at a second site, with the estimated recoveries being revised to between 40 and 766 years after 11 years. Therefore, the original estimates were both over and under the actual rates observed, depending on the individual site characteristics. Sites with more shade and less sandy soils were quicker to recover than the original estimates predicted, whereas those with more sandy soils and exposure were less able to recover than originally predicted.

3.5 WATER RESOURCES

3.5.1 Surface Water

The WTP Project Area is primarily drained by two streams: Nine Mile Creek and Jack Creek. Both of these creeks flow to the east and join the Green River south of Ouray, Utah. Nine Mile Creek is a free-flowing perennial stream for much of its length. Jack Creek is largely intermittent but contains perennial flow in the upper reaches where it is supplied by perennial springs. The Green River flows to the south through Desolation Canyon. The Green River is a major river in the western United States. It originates in Wyoming along the Continental Divide and joins the Colorado River 110 miles south of Green River, Utah. The flow in the Green River is partially controlled by the Flaming Gorge Dam. Major tributaries to the Green River include the Duchesne River, the Yampa River, and the White River. The White River drains the eastern portion of the basin, including those portions of the basin within Colorado. Within the Uinta Basin, the State of Utah has classified five drainages as hydrological sub-units: the Upper Green, the Green, the Ashley-Brush, the Duchesne/Strawberry, and the White River (UDWR 2001). The WTP Project Area lies within the Green River sub-unit.

The WTP Project Area is drained by ten watersheds, as shown on **Figure 3.5-1**. These watersheds include Sheep Canyon, Gate Canyon, Dry Creek, Prickly Pear Canyon, Devils Canyon, Cottonwood Canyon, Jack Creek, Butts Canyon, Desolation Canyon, and Cedar Ridge.

Figure 3.5-2 shows the surface water features in the vicinity of the WTP Project Area. The majority of the WTP Project Area is drained by Nine Mile Creek and its tributaries. Major tributaries that flow to the north into Nine Mile Creek in the WTP Project Area are Stone Cabin Creek, Harmon Canyon, Prickly Pear Canyon, Dry Canyon, and Cottonwood Canyon. These streams, and ephemeral tributaries to these streams, drain the western and northern portions of the WTP Project Area. The lower reaches of these tributary drainages have formed deeply incised canyons. Other major tributaries to Nine Mile Creek include Minnie Maud Creek and Argyle Creek, which join Nine Mile Creek from the northwest near the western boundary of the WTP Project Area, and a series of ephemeral drainages that flow to the south into Nine Mile Creek along the north boundary of the WTP Project Area, including Trail Canyon, Gate Canyon, and Daddy's Canyon. Horse Bench is primarily drained to Nine Mile Creek by Pinnacle Canyon, South Franks Canyon, and ephemeral tributaries to these creeks, and to the Green River by Cedar Ridge Canyon and ephemeral tributaries to Jack Creek. Jack Creek flows from its headwaters south of the WTP Project Area through the southeastern portion of the WTP Project Area to the Green River. The Peter's Point area and much of both WSAs are drained by Jack Creek and its tributaries.

There are no natural lakes or ponds in the WTP Project Area. However, there are a number of small stock watering impoundments located on top of the mesas.

3.5.1.1 Surface Water Flow

Streams within the WTP Project Area can be classified as ephemeral, intermittent, or perennial. Ephemeral streams are those streams that flow only in direct response to a rainfall or runoff event and often have periods of no flow. The amount and timing of flow in ephemeral streams is dependent on the quantity and timing of precipitation, the watershed size, evaporation and transpiration rates, and the permeability of the surface material. Intermittent streams receive some groundwater inflows in addition to direct surface runoff and contain flow at least part of the year in some portion of the stream. Some streams within the WTP Project Area may also be classified as “interrupted”, because water in them flows for some distance underground before resurfacing further down the drainage. Perennial streams are streams that flow all year.

Stream flows in the major canyons within the WTP Project Area are both perennial and intermittent and dependent on seasonal storms and snowmelt runoff. The majority of the runoff is during the spring and early summer and is generated by melting of the winter snow pack. During the late summer, thunderstorms may produce severe floods. In the ephemeral drainages, the channels are dry for most of the year and a single storm may account for a large percentage of the total runoff.

There is one historic USGS gauging station on Nine Mile Creek, located at Nutters Ranch (USGS 09309000). This station is described as being on Minnie Maud Creek in the USGS database. One other USGS surface water gauging station (USGS 09308500) is located on Minnie Maud Creek, which flows into Nine Mile Creek from the northwest, just west of the WTP Project Area. This station is located about 3.5 miles west of Nine Mile Creek. The station on Minnie Maud Creek was monitored for discharge between August 1950 and September 1989, and the station on Nine Mile Creek was monitored for discharge between July 1947 and September 1955. In addition to the USGS gauging stations, flow was estimated in conjunction with water quality sampling at four Utah STORET monitoring stations located on Nine Mile Creek, one station on Argyle Creek near the confluence with Nine Mile Creek, two stations on Minnie Maud Creek upstream from the WTP Project Area boundary, one station on Jack Creek near the confluence with the Green River, and two stations in Cottonwood Canyon.

Two USGS gauging stations are located on the Green River, one upstream of Nine Mile Creek at Ouray, Utah and one downstream of the WTP Project Area at Green River, Utah.

Table 3.5-1 presents summary flow data for the four USGS stations where historic stream flow measurements are available. Mean monthly stream flow over the period of record for USGS gauging station 09308500 on Minnie Maud Creek is relatively steady between August and March, ranging from 0.80 to 4.06 cubic feet per second (cfs). Stream flow begins increasing in March due to contributions from snowmelt and increases dramatically during the spring, reaching a high of 27.9 cfs during May. Fifty percent of all daily flows in at this location were less than 1.6 cfs, and 90 percent of all flows were less than 13 cfs for the period of record. Zero flow was recorded approximately 4 percent of the time at this location.

Mean monthly stream flows in Nine Mile Creek near Nutters Ranch follow a similar pattern, ranging from 6.95 cfs to 13.4 cfs during the late summer through early spring, and increasing to a high of 82.6 cfs during May. Fifty percent of all daily flows at USGS gauging station 09309000 on Nine Mile Creek were less than 8.2 cfs, and 90 percent of all flows were less than 36 cfs for the period of record. Zero flow was recorded approximately 1 percent of the time. **Figure 3.5-3** shows the hydrograph for USGS station 09309000 on Nine Mile Creek at Nutters Ranch. The sharp peaks on the graph represent high flow events that are many times the baseflow for this stream, illustrating the highly variable flow conditions in Nine Mile Creek.

Table 3.5-1 Stream Flow Data for USGS Gauging Stations

USGS Gauging Station Name and Number	Range of Monthly Mean Discharge (cfs)	Peak Daily Discharge (cfs)	Mean Annual Discharge (cfs)	Period of Record
Minnie Maud Creek near Myton, Utah 09308500	0.80 (January) to 27.9 (May)	215 (May 6, 1952)	6.11	August 1950 – September 1989
Minnie Maud Creek (Nine Mile Creek) at Nutters Ranch 09309000	6.95 (January) to 82.6 (May)	580 (May 6, 1952)	22.39	July 1947 – September 1955
Green River near Ouray, Utah 09307000	1,925 (January) to 17,000 (June)	14,100 (June 11, 1952)	5,614	October 1947 – September 1966
Green River at Green River, Utah 09315000	2,301 (January) to 18,620 (June)	66,700 (June 27, 1917)	6,132	October 1894 – September 2006

Source: USGS (2007)

In addition to the data collected at the USGS stations, flow has been estimated for Nine Mile Creek at four Utah STORET stations. Flow was estimated at Utah STORET station 4933330, located below the confluence with Cottonwood Canyon, on 22 occasions between September 1992 and July 2005. Estimated flow in Nine Mile Creek at this location ranged from 0 to 280 cfs, with an average flow of 53.5 cfs. Flow was present on all but one occasion. Flow was also estimated at Utah STORET station 4933288, located below the confluence with Dry Canyon, as 5 cfs in January, 2006 and 25 cfs in November 2007. Single estimates of flow were also made at Utah STORET station 4933345, below the campground on Minnie Maud Creek, as 4 cfs on October 3, 2007, and at Utah STORET station 4933335, on Nine Mile Creek above the confluence with Cottonwood Canyon, as 16.7 cfs on October 4, 2007. Flow at the mouth of Nine Mile Creek was estimated 16 times between May 1977 and July 1992, and ranged from 0 cfs (on two occasions in 1990 and 1992) and 600 cfs, and averaged about 50 cfs.

The total runoff from Nine Mile Creek has been estimated to be about 14,800 acre-feet (Price and Miller 1975). The creek likely loses flow downstream because of consumption of water by phreatophytes (salt cedar, salt grass, and greasewood) that grow along the channel (Price and Miller 1975).

Flow was also estimated on 20 occasions during the period June 1995 to July 2005 at the mouth of Jack Creek at Utah STORET station 4933250. Estimated flow in Jack Creek ranged from 0 to 40 cfs over this period, and averaged 7.6 cfs. No flow was reported half of the time. Other streams in the area contain flow for part of the year. Streams in Dry Canyon, Harmon Canyon, Cottonwood Canyon, and Prickly Pear Canyon have long stretches of channel that exhibit intermittent seasonal flows that are fed by discharge from the alluvial groundwater aquifer and springs. Surface flows are typical in the upper reaches of Cottonwood and Dry Canyons for all or most of the year, and in the lower reaches of these canyons where the streams join Nine Mile Creek. Flows in the lower reaches of all these canyons are connected to subsurface flow within the alluvium underlying the channels.

Mean monthly stream flows on the Green River at Ouray range from 1,925 cfs to 17,000 cfs, and peak in June and July. Fifty percent of all flows in the Green River are less than 2,760 cfs and 90 percent are less than 14,100 cfs at this location. Mean monthly stream flows further downstream at Green River range from a low of 2,301 cfs to a high of 18,620 cfs. Flows range from 2,301 cfs to 7,213 cfs during the late summer through May, and increase to their maximum during June and July. Fifty percent of flows are less than 3,420 cfs and 90 percent are less than 15,000 cfs. **Figure 3.5-4** provides the hydrograph for the Green River at Green River, Utah for the period January 1994 to September 2004. Flow patterns in the Green River are more consistent than those in Nine Mile Creek, and show the classic pattern of a rising limb, peak, and falling limb for each water year. The consistent nature of the flows reflects the large drainage area of 44,850 square miles for the river.

3.5.1.2 Surface Water Quality

Water quality refers to biological, chemical, and physical characteristics of a water sample. The sample results may then be compared to a standard defined for protection of drinking water, aquatic organisms, and other water uses. Important indicators of water quality include temperature, electrical conductivity or specific conductance (a measure of the ability of water to conduct electric current), and pH (a measure of the hydrogen ion activity). A pH less than 7 indicates the water is acidic and a pH greater than 7 indicates alkaline water. Chemical water quality is determined by the concentrations of various chemical constituents in the water, including metals, ionic constituents such as chloride, sulfate, and bicarbonate, and total dissolved solids (TDS). Hardness (a measure of the amount of calcium and magnesium) is also an important indicator and is reported as milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$). Hardness determines the soap-consuming capacity of water as well as the tendency to leave a mineralized crust on plumbing fixtures. In addition, some of the numeric water quality standards for trace metals are dependent on the hardness of the water. For a more thorough discussion of water quality, see Fetter (1980).

The EPA has established primary and secondary drinking water standards (EPA 2003b) for approximately 90 water contaminants as required by the Safe Drinking Water Act, as amended in 1996, and Clean Water Act (CWA) of 1987, as amended. These regulations specify maximum contaminant levels (MCLs) and secondary standards for specific contaminants. The MCLs are health-based. Although these MCLs legally apply only to public drinking water supplies, they are also useful as general indicators of water quality. The secondary standards are for constituents that cause cosmetic effects (such as skin or tooth discoloration) or esthetic effects (such as taste, odor, or color) in drinking water. The CWA delegated the administration of these standards to cooperating States and Tribes, so long as the State standards are at least as stringent as the Federal standards. Most States, including Utah, now have primacy for the administration of the CWA and have also adopted State water-quality standards (UDEQ 2000), including numeric standards protective of aquatic biota.

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Figure 3.5-3 Hydrograph for Nine Mile Creek at Nutters Ranch

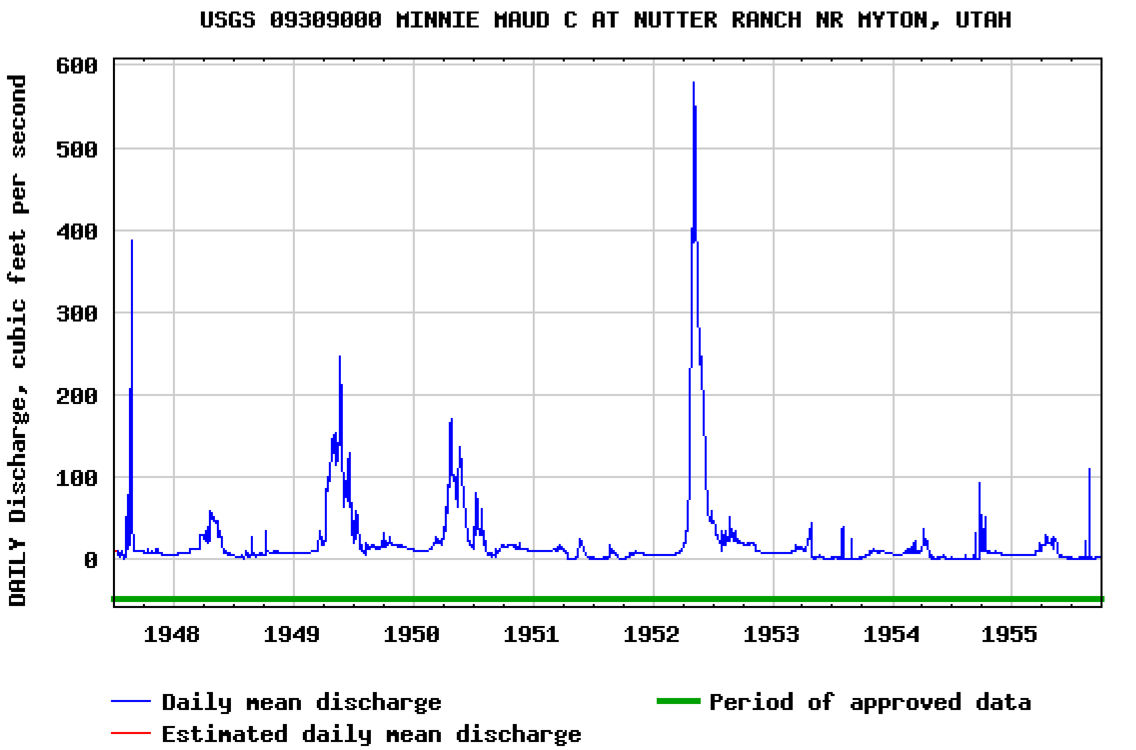
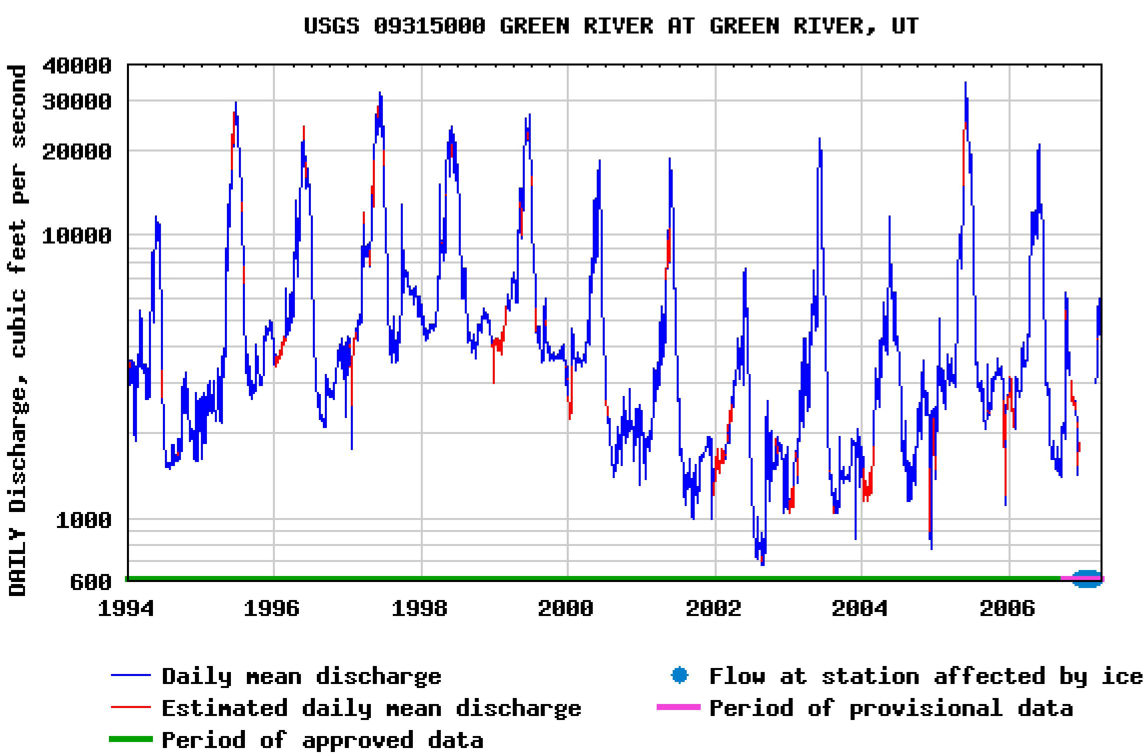


Figure 3.5-4 Hydrograph for the Green River at Green River, Utah



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Salinity and Sodium Hazards

Excessive salinity and sodium content is a special water quality concern in portions of the Uinta Basin and in other areas. Sodium is part of the total salinity portion of water quality and may be a contributor to crop failure. The sodium hazard of irrigation water is estimated by the sodium adsorption ratio (SAR), which is the proportion of sodium to calcium plus magnesium in the water. SAR is calculated using the formula:

$$SAR = Na^{+} / [(Ca^{+2} + Mg^{+2})/2]^{1/2}$$

(all ions reported in milliequivalents)

Waters with SARs in the range 0 to 6 can generally be used on all soils with little risk of sodium buildup. When SAR's range from 6 to 9, chances for soil permeability problems increase (Hergert and Knudsen 1997). Water with a SAR greater than nine should not be used for irrigation, even if the total salt content is relatively low. Continued use of water having a high SAR leads to a breakdown in the physical structure of the soil. The sodium replaces calcium and magnesium adsorbed on the soil clays and causes dispersion of soil particles. This dispersion results in breakdown of soil aggregates and causes the soil to become hard and compact when dry and increasingly impervious to water penetration.

Salinity and sodium hazard classes developed by the USDA-George E. Brown, Jr., Salinity Laboratory (1954) are presented in **Tables 3.5-2** and **3.5-3**.

Table 3.5-2 Salinity Hazard Classes

Salinity Hazard Class	Specific conductance (µS/cm at 25° C)	Characteristics
Low	0-250	Low salinity water can be used for irrigation on most soil with minimal likelihood that soil salinity will develop.
Medium	251-750	Medium salinity water can be used for irrigation if a moderate amount of drainage occurs.
High	751 – 2,250	High salinity water is not suitable for use on soil with restricted drainage. Even with adequate drainage, special management for salinity control may be required.
Very High	> 2,250	Very high salinity water is not suitable for irrigation under normal conditions

Source: USDA-George E. Brown, Jr. Salinity Laboratory (1954)

Table 3.5-3 Sodium Hazard Classes

Sodium Hazard Class	SAR (at SC = 2,250)	Characteristics
Low	0 to 4	Low sodium water can be used for irrigation on most soil with minimal danger of harmful levels of exchangeable sodium.
Medium	4 to 9	Medium sodium water will present an appreciable sodium hazard in fine textured

Table 3.5-3 Sodium Hazard Classes		
Sodium Hazard Class	**SAR (at SC = 2,250)**	**Characteristics**
		soil having high cation exchange capacity.
High	9 to 14	High sodium water may produce harmful levels of exchangeable sodium in most soils.
Very High	More than 14	Very high sodium water is generally unsatisfactory for irrigation purposes.

Source: USDA-George E. Brown, Jr. Salinity Laboratory (1954)

WTP Project Area Surface Water Quality

The water quality characteristics of surface waters in the vicinity of the WTP Project Area reflect the chemical nature of precipitation and the geologic strata over which the water flows. The following section describes the chemical quality of these waters, based on data collected by the USGS at three of the four gauging stations located near the WTP Project Area, and a series of State of Utah water quality monitoring stations located on Nine Mile Creek, Minnie Maud Creek, Argyle Creek, and Jack Creek, as well as in Cottonwood Canyon. The USGS and STORET databases are not consistent in their references to Minnie Maud Creek and Nine Mile Creek. USGS gauging station 09309000 is listed as being on Minnie Maud Creek, but is actually located on Nine Mile Creek near the confluence with Gate Canyon. In addition, Utah STORET station 4933345 is listed as being on Nine Mile Creek, but is located above the confluence with Argyle Creek. For this EIS, locations above the confluence with Argyle Creek are considered to be on Minnie Maud Creek and those stations below the confluence with Argyle Creek are considered to be on Nine Mile Creek.

Table 3.5-4 provides a listing of the water quality monitoring stations and their periods of record. **Figure 3.5-2** shows the locations of these stations. In addition, data for two USGS stations located on the Green River, both upstream and downstream from the mouth of Nine Mile Creek, are also presented. There are no water quality data available for USGS station 09309000 on Nine Mile Creek.

Table 3.5-4 USGS and Utah STORET Water Quality Monitoring Stations		
USGS or Utah Station Name and Number	**Location**	**Period of Record**
Minnie Maud Creek near Myton, Utah USGS 09308500	Minnie Maud Creek below campground	October 1971 – September 1989
Minnie Maud Creek, Utah STORET 4933420	Above Cow Canyon	May 2006 – August 2007
Nine Mile Creek (Minnie Maud Creek), Utah STORET 4933345	Minnie Maud Creek below campground	October 3, 2007
Argyle Creek, Utah STORET 4933380	Above the confluence with Nine Mile Creek	May 2005 – October 2006
Cottonwood Canyon, Utah STORET 4933290	On tributary to Cottonwood Canyon	September 1991 – May 1992; August 1998
Cottonwood Canyon, Utah STORET 4933280	Main stem of Cottonwood Canyon	March 1990 – September 1991; May 2006 – August 2007

Table 3.5-4 USGS and Utah STORET Water Quality Monitoring Stations		
USGS or Utah Station Name and Number	**Location**	**Period of Record**
Jack Creek, Utah STORET 4933250	At mouth	June 1995 – June 2005
Nine Mile Creek, Utah STORET 4933330	Below South Franks Canyon	September 1992 – September 2005
Nine Mile Creek, Utah STORET 4933288	Below Dry Canyon	November 2005 – September 2007
Nine Mile Creek, Utah STORET 4933335	Above Cottonwood Canyon	October 4, 2007
Nine Mile Creek, Utah STORET 4933310	At mouth	May 1977 – September 1998
Green River, USGS 09307000	Ouray, Utah	Dec 1950 – Sept 1951; Oct 1958 – Sept 1966
Green River, USGS 09315000	Green River, Utah	August 1928 – Sept 2006

Minnie Maud Creek

Tables 3.5-5, 3.5-6, and 3.5-7 provide summaries of the available water quality data for Minnie Maud Creek above the confluence with Nine Mile Creek. These analyses are representative of surface water quality upstream of the WTP Project Area.

Table 3.5-5 provides a summary of water quality analyses for samples collected from Minnie Maud Creek at USGS gauging station 09308500. For this station, temperature and specific conductance were measured in conjunction with discharge measurements from October 1971 to September 1989. One water quality sample was collected in October 1971. Based on this one sample, waters in Minnie Maud Creek are described as sodium-calcium-magnesium bicarbonate type waters with very high hardness (320 mg/L as $CaCO_3$). The waters are alkaline with a pH of 8.30 units. Specific conductance ranges from 480 to 6,200 uS/cm with an average of 835 uS/cm. Values for all parameters reported for the one sample are less than the associated water quality standards.

Table 3.5-5 Summary of Water Quality Analyses for Minnie Maud Creek, USGS Gauging Station 09308500					
Parameters	**Standards**		**Summary Statistics**		
	Drinking Water	**Aquatic Biota[3]**	**No. of Samples**	**Range**	**Mean**
General Water Quality Indicators					
Temperature (°C)			110	0 – 25.5	9.16
Specific Conductance (uS/cm)			114	480 – 6,200	835
pH (standard units)	6.5-8.5[2]	6.5-9.0	1	8.30	8.30
Total Hardness (mg/L)			1	320	320
Ionic Constituents					
Calcium (mg/L)			1	56	56
Magnesium (mg/L)			1	44	44
Sodium (mg/L)			1	61	61
Potassium (mg/L)			1	1.8	1.8
Chloride (mg/L)	250[2]		1	7.8	7.8

Table 3.5-5 Summary of Water Quality Analyses for Minnie Maud Creek, USGS Gauging Station 09308500					
Parameters	**Standards**		**Summary Statistics**		
	Drinking Water	**Aquatic Biota[3]**	**No. of Samples**	**Range**	**Mean**
Bicarbonate (mg/L)			1	350	350
Orthophosphate (mg/L)			1	0.03	0.03
Trace Metals					
Boron (ug/L)			1	100	100
Iron (ug/L)	300[1]	1,000	1	0.3	0.3
Manganese (ug/L)	50[2]		1	10	10

All samples are dissolved (filtered) unless otherwise noted
Average values calculated using one-half the detection limit for non-detect values
[1]Federal Drinking Quality Standards Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Quality Secondary Standards
Source: USGS (2007)

Table 3.5-6 provides a summary of water quality analyses for samples recently collected from Minnie Maud Creek at Utah STORET station 4933420, located above the confluence with Cow Canyon and the historic USGS gauging station. For the STORET stations, the database reports all non-detect values simply as "Non-detect". Calculation of any central tendency (mean or median) using non-detect values requires that the instrument detection limit is known for each parameter and individual analysis. Non-detect values cannot simply be assumed to be zero. Therefore, for the STORET stations, a mean was calculated only for parameters with less than 20 percent of the available values reported as non-detect.

Results from this station confirm that waters in Minnie Maud Creek are described as sodium-calcium-magnesium bicarbonate type waters with very high hardness (428 mg/L as $CaCO_3$). The waters are alkaline with average pH of 8.35 units. Specific conductance ranges from 713 to 1,104 uS/cm with an average of 946 uS/cm. These values are in the medium to high salinity classes and indicate that the waters are generally not suitable for irrigation. However, water from the creek is currently used for irrigation to some degree. The mean concentrations of TDS, TSS, nitrate and nitrite, and total phosphorus exceed the associated water quality standards. Measurements of TDS exceeded the secondary drinking water standard of 500 mg/L for 10 of 12 samples, and TSS exceeded the aquatic biota standard for 3 of 11 samples. Cadmium, copper, lead, pH, nitrate plus nitrite, sulfate, manganese, and zinc exceeded the standards for one or more samples each.

Table 3.5-6 Summary of Water Quality Analyses for Minnie Maud Creek, STORET Site 4933420						
Parameters	**Standards**		**Summary Statistics**			
	Drinking Water[1]	**Aquatic Biota[3]**	**No. of Samples**	**No. of Detects**	**Range**	**Mean**
General Water Quality Parameters						
Total Alkalinity (mg/L)			12	12	254 – 372	325
Temperature (°C)			4	4	3.61 – 19.7	10.9
Specific Conductance (uS/cm)			16	16	713 - 1104	946
pH (standard units)	6.5-8.5[2]	6.5-9.0	16	16	8.00 – **8.60**	8.35
Dissolved Oxygen		6.5 min	4	4	7.51 – 11.66	9.9
Turbidity (NTU)			16	16	1.13 – 1080	95.3
Dissolved Hardness (mg/L)			17	17	327 – 522	428

Table 3.5-6 Summary of Water Quality Analyses for Minnie Maud Creek, STORET Site 4933420						
Parameters	**Standards**		**Summary Statistics**			
	Drinking Water[1]	**Aquatic Biota[3]**	**No. of Samples**	**No. of Detects**	**Range**	**Mean**
Total Dissolved Solids (mg/L)	500[2]	1,200	12	12	350 - **736**	**577**
Total Suspended Solids (mg/L)		90	11	11	4 - **970**	**122**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	17	1	0.07	NC
Bicarbonate (mg/L)			12	12	310 – 440	383
Calcium (mg/L)			17	17	61.3 – 113	78.3
Carbonate (mg/L)			12	12	0 – 18	6.92
Chloride (mg/L)	250[2]		12	3	10.4 – 10.8	NC
Magnesium (mg/L)			17	17	42.3 – 71.5	57.0
Nitrate + Nitrite, total (mg/L)	10[1]	4	15	4	0.12 – **5.16**	NC
Phosphorus, total (mg/L)		0.05	7	6	0.022 – **0.32**	**0.094**
Potassium (mg/L)			17	17	1.47 – 3.87	2.48
Sodium (mg/L)			17	17	49.6 – 91.2	70.4
Sulfate (mg/L)	250[2]		12	12	125 – **280**	206
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	6	2	60.9 – 90.8	NC
Arsenic (ug/L)	10[1]	150	6	6	1.66 – 2.8	2.13
Barium (ug/L)	2000[1]	1000	6	1	110	NC
Boron (ug/L)			5	5	106 – 191	137
Cadmium (ug/L)	5[1]	1.1[5]	6	1	**1.67**	NC
Chromium (ug/L)	100[1]	74	6	2	5.59 – 6.26	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	6	2	3.15 – **41.6**	NC
Iron (ug/L)	300[2]	1,000	6	3	48.4 – 84.1	NC
Lead (ug/L)	15[1]	3.2[5]	6	2	1 – **6.4**	NC
Manganese (ug/L)	50[2]		6	6	19.3 – **84.3**	NC
Mercury (ug/L)		0.012	6	0	ND	NC
Nickel (ug/L)		52	5	0	ND	NC
Selenium (ug/L)	50[1]	5	6	6	1.08 – 1.95	1.34
Silver (ug/L)	100[2]	4.1[5]	6	0	ND	NC
Zinc (ug/L)	5000[2]	120	6	1	**1040**	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Table 3.5-7 provides the results for one sample collected from Minnie Maud Creek below the campground on October 3, 2007. This station is described as being on Nine Mile Creek in the EPA STORET database, and is located at the same site as USGS gauging station 09308500.

The results from this sample are consistent with those from station 4933420 on Minnie Maud Creek. TDS was 596 mg/L, close to the average TDS recorded at station

4933420. TSS was recorded at 52 mg/L, below the aquatic biota standard. All other parameters were below the associated water quality standards, except for pH at 8.51 units.

Table 3.5-7 Water Quality Analyses for Minnie Maud Creek, STORET Site 4933345, October 3, 2007

	Drinking Water Standards[1]	Aquatic Biota Standards[3]	Result
General Water Quality Parameters			
Total Alkalinity (mg/L)			317
Temperature (°C)			15.6
Specific Conductance (uS/cm)			941
pH (standard units)	6.5-8.5[2]	6.5-9.0	**8.51**
Turbidity (NTU)			10.7
Dissolved Oxygen (mg/L)		6.5 min	7.55
Dissolved Hardness (mg/L)			406
Total Dissolved Solids (mg/L)	500[2]	1,200	**596**
Total Suspended Solids (mg/L)		90	52
Ionic Constituents			
Ammonia (mg/L)		0.11 – 0.49[4]	ND
Bicarbonate (mg/L)			368
Calcium (mg/L)			70.2
Carbonate (mg/L)			9
Chloride (mg/L)	250[2]		ND
Magnesium (mg/L)			56
Nitrate + Nitrite, total (mg/L)	10[1]	4	ND
Phosphorus, total (mg/L)		0.05	ND
Potassium (mg/L)			3.33
Sodium (mg/L)			71.5
Sulfate (mg/L)	250[2]		229
Trace Metals			
Aluminum (ug/L)	50-200[2]	750	10.4
Arsenic (ug/L)	10[1]	150	1.93
Barium (ug/L)	2000[1]	1000	103
Boron (ug/L)			110
Cadmium (ug/L)	5[1]	1.1[5]	ND
Chromium (ug/L)	100[1]	74	4.75
Copper (ug/L)	1300[1], 1000[2]	12[5]	1.28
Iron (ug/L)	300[2]	1,000	ND
Lead (ug/L)	15[1]	3.2[5]	ND
Manganese (ug/L)	50[2]		30.2
Mercury (ug/L)		0.012	ND
Nickel (ug/L)		52	ND
Selenium (ug/L)	50[1]	5	1.50
Silver (ug/L)	100[2]	4.1[5]	ND
Zinc (ug/L)	5000[2]	120	ND

ND = Not Detected
All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[6]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Argyle Creek

Table 3.5-8 provides a summary of water quality data recently collected by the BLM from Argyle Creek above the confluence with Nine Mile Creek. These analyses are representative of surface water quality upstream of the WTP Project Area.

Waters in Argyle Creek are also described as sodium-calcium-magnesium bicarbonate type waters with very high hardness (414 mg/L as $CaCO_3$). The waters are alkaline with average pH of 8.36 units. Specific conductance ranges from 945 to 1,169 uS/cm with an average of 1,030 uS/cm. These values are similar to those recorded in Minnie Maud Creek and are in the medium to high salinity classes, which indicates that the waters are generally not suitable for irrigation. However, water from the creek is currently used for irrigation to some degree. The mean concentrations of TDS, TSS, and arsenic exceed the associated water quality standards. Measurements of TDS exceeded the secondary drinking water standard for all four samples, and TSS exceeded the aquatic biota standard for two of four samples. Arsenic ranges from 10.2 ug/L to 27.3 ug/L for the three samples collected. Total phosphorus exceeded the aquatic biota standard for two of nine samples.

Table 3.5-8 Summary of Water Quality Analyses for Argyle Creek, STORET Site 4933380

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			4	4	403 – 423	414
Temperature (°C)			3	3	4.54 – 18.6	12.7
Specific Conductance (uS/cm)			7	7	945 – 1169	1030
pH (standard units)	6.5-8.5[2]	6.5-9.0	7	7	8.38 – 8.50	8.36
Dissolved Oxygen		6.5 min	3	3	8.83 – 12.41	10.2
Turbidity (NTU)			7	7	9.75 – 149	59.8
Dissolved Hardness (mg/L)			9	9	343 – 466	414
Total Dissolved Solids (mg/L)	500[2]	1,200	4	4	**618 – 656**	**633**
Total Suspended Solids (mg/L)		90	4	4	50 – **179**	**104**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	9	3	0.05 – 0.09	NC
Bicarbonate (mg/L)			4	4	480 – 500	493
Calcium (mg/L)			9	9	54.9 – 71.9	63.1
Chloride (mg/L)	250[2]		4	0	ND	NC
Magnesium (mg/L)			9	9	50 – 69.7	62.5
Nitrate + Nitrite, total (mg/L)	10[1]	4	7	3	0.19 – 0.25	NC
Phosphorus, total (mg/L)		0.05	9	3	0.02 – **0.075**	NC
Potassium (mg/L)			9	9	3.05 – 4.39	3.50
Sodium (mg/L)			9	9	84.5 – 109	97.6
Sulfate (mg/L)	250[2]		4	4	153 – 189	172
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	3	0	ND	NC
Arsenic (ug/L)	10[1]	150	3	3	10.2 – **27.3**	**19.9**

Table 3.5-8 Summary of Water Quality Analyses for Argyle Creek, STORET Site 4933380

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Barium (ug/L)	2000[1]	1000	3	1	100	NC
Boron (ug/L)			2	2	688 – 856	772
Cadmium (ug/L)	5[1]	1.1[5]	3	0	ND	NC
Chromium (ug/L)	100[1]	74	3	1	6.49	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	3	0	ND	NC
Iron (ug/L)	300[2]	1,000	3	2	20.3 – 20.7	NC
Lead (ug/L)	15[1]	3.2[5]	3	0	ND	NC
Manganese (ug/L)	50[2]		3	3	13.8 – 15.3	14.5
Mercury (ug/L)		0.012	3	0	ND	NC
Nickel (ug/L)		52	2	0	ND	NC
Selenium (ug/L)	50[1]	5	3	2	1.14 – 1.58	NC
Silver (ug/L)	100[2]	4.1[5]	3	0	ND	NC
Zinc (ug/L)	5000[2]	120	3	0	ND	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Cottonwood Canyon

Tables 3.5-9 and **3.5-10** provide summaries of the available water quality data for Cottonwood Canyon.

Table 3.5-9 provides a summary of the results for three samples collected from a tributary to Cottonwood Canyon in 1991, 1992, and 1998. This station is described as being in Dry Canyon by the STORET database. Based on these samples, waters in this tributary are described as calcium bicarbonate type waters with high hardness (247 mg/L as $CaCO_3$). The waters are alkaline with average pH of 8.11 units. Specific conductance ranges from 488 to 637 uS/cm with an average of 584 uS/cm. These values are substantially lower than those recorded in Nine Mile Creek and are in the medium salinity class, which indicates that the waters are suitable for irrigation purposes. The mean concentration of TDS is also lower than in Nine Mile Creek and all TDS measurements were below the secondary drinking water standard. Measurements of TSS were not performed. Dissolved oxygen was below the minimum standard for the one measurement reported. All trace metals, except barium, were reported as not detected.

Table 3.5-9 Summary of Water Quality Analyses for Cottonwood Creek Tributary, STORET Site 4933290

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			3	3	240 – 282	262
Temperature (°C)			2	2	10 – 11	10.5

Table 3.5-9 Summary of Water Quality Analyses for Cottonwood Creek Tributary, STORET Site 4933290

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Specific Conductance (uS/cm)			4	4	488 – 637	584
pH (standard units)	6.5-8.5[2]	6.5-9.0	5	5	7.10 **– 8.60**	8.11
Dissolved Oxygen		6.5 min	1	1	**5.7**	**5.7**
Turbidity (NTU)			3	3	0.46 – 1.01	0.82
Total Hardness (mg/L)			3	3	208 – 281	247
Total Dissolved Solids (mg/L)	500[2]	1,200	3	3	304 – 392	345
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	3	0	ND	NC
Bicarbonate (mg/L)			3	3	293 – 344	320
Calcium (mg/L)			3	3	37 – 52.4	47.1
Chloride (mg/L)	250[2]		3	2	4 – 9.9	NC
Magnesium (mg/L)			3	3	28 – 36.5	31.5
Nitrate + Nitrite, total (mg/L)	10[1]	4	1	0	ND	NC
Phosphorus, total (mg/L)		0.05	3	1	0.013	NC
Potassium (mg/L)			3	1	4.8	NC
Sodium (mg/L)			3	3	26 – 39	30.3
Sulfate (mg/L)	250[2]		3	3	36 – 69.7	51.1
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	1	0	ND	NC
Arsenic (ug/L)	10[1]	150	2	0	ND	NC
Barium (ug/L)	2000[1]	1000	2	2	47 – 58	52.5
Cadmium (ug/L)	5[1]	1.1[5]	2	0	ND	NC
Chromium (ug/L)	100[1]	74	2	0	ND	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	2	0	ND	NC
Iron (ug/L)	300[2]	1,000	2	0	ND	NC
Lead (ug/L)	15[1]	3.2[5]	2	0	ND	NC
Manganese (ug/L)	50[2]		2	0	ND	NC
Mercury (ug/L)		0.012	2	0	ND	NC
Selenium (ug/L)	50[1]	5	2	0	ND	NC
Silver (ug/L)	100[2]	4.1[5]	2	0	ND	NC
Zinc (ug/L)	5000[2]	120	2	0	ND	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = Not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Table 3.5-10 provides a summary of the results for samples collected from the main stem of Cottonwood Canyon in 1990, 1991, and 2006-2007. These samples define the baseline water quality for this drainage.

Waters in the main stem of Cottonwood Canyon are described as calcium-magnesium bicarbonate type waters with high hardness (285 mg/L as $CaCO_3$). The waters are alkaline with average pH of 8.20 units. Specific conductance ranges from 530 to 886 uS/cm with an average of 634 uS/cm. These values are in the medium to high salinity classes and are substantially lower than those in Nine Mile Creek. The mean concentration of TDS of 369 mg/L is lower than in Nine Mile Creek and all but one of the TDS measurements were below the secondary drinking water standard. TSS ranged from zero to 508 mg/L, but only 1 sample out of 10 exceeded the aquatic biota standard.

Table 3.5-10 Summary of Water Quality Analyses for Cottonwood Canyon, STORET Site 4933280

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			10	10	264 – 341	298
Temperature (°C)			2	2	2.68 – 10.7	6.7
Specific Conductance (uS/cm)			10	10	530 – 886	634
pH (standard units)	6.5-8.5[2]	6.5-9.0	10	10	**6.09 – 8.81**	8.20
Dissolved Oxygen		6.5 min	1	1	11.04	11.04
Turbidity (NTU)			10	10	0.53 – 557	82.5
Dissolved Hardness (mg/L)			10	10	248 – 337	285
Total Dissolved Solids (mg/L)	500[2]	1,200	9	9	312 – **566**	369
Total Suspended Solids (mg/L)		90	10	7	0 – **508**	NC
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	10	0	ND	NC
Bicarbonate (mg/L)			10	10	280 – 416	351
Calcium (mg/L)			9	9	31.6 – 64.4	53.5
Chloride (mg/L)	250[2]		10	2	12 – 121	NC
Magnesium (mg/L)			9	9	34.6 – 46	44.5
Nitrate + Nitrite, total (mg/L)	10[1]	4	9	1	0.12	NC
Phosphorus, total (mg/L)		0.05	9	0	ND	NC
Potassium (mg/L)			9	8	1.01 – 2.5	1.45
Sodium (mg/L)			9	9	27.6 – 69	36.1
Sulfate (mg/L)	250[2]		9	9	32.4 – 120	50.9
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	3	0	ND	NC
Arsenic (ug/L)	10[1]	150	3	3	8.62 – 9.37	8.97
Barium (ug/L)	2000[1]	1000	3	1	101	NC
Boron (ug/L)			3	3	142 – 191	165
Cadmium (ug/L)	5[1]	1.1[5]	3	0	ND	NC
Chromium (ug/L)	100[1]	74	3	0	ND	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	3	0	ND	NC
Iron (ug/L)	300[2]	1,000	3	0	ND	NC
Lead (ug/L)	15[1]	3.2[5]	3	0	ND	NC

Table 3.5-10 Summary of Water Quality Analyses for Cottonwood Canyon, STORET Site 4933280						
Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Manganese (ug/L)	50[2]		3	1	5.24	NC
Mercury (ug/L)		0.012	3	0	ND	NC
Nickel (ug/L)		52	3	0	ND	NC
Selenium (ug/L)	50[1]	5	3	1	1.02	NC
Silver (ug/L)	100[2]	4.1[5]	3	0	ND	NC
Zinc (ug/L)	5000[2]	120	3	0	ND	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = Not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Jack Creek

Table 3.5-11 provides a summary of water quality analyses for samples collected near the mouth of Jack Creek at Utah STORET station 4933250. Waters in Jack Creek are described as calcium bicarbonate type waters with high hardness (233 mg/L as $CaCO_3$). The waters are alkaline with pH of 7.60 – 8.90 units and an average pH of 8.34. Specific conductance ranges from 176 to 600 uS/cm with an average of 442 uS/cm. These values are in the low to medium salinity classes. TDS ranges from 254 mg/L to 354 mg/L with an average of 306 mg/L. The values of specific conductance and TDS are substantially lower than those in Nine Mile Creek. The concentrations of ammonia and total phosphorus exceed the aquatic biota standards. Aluminum, copper, lead, iron, manganese, and zinc also exceed the associated water quality standards for one or more samples. The maximum values for aluminum and iron were reported for days with very high suspended solids concentrations. Therefore, these high values are not considered to be representative of the actual dissolved aluminum and iron concentrations in Jack Creek.

Table 3.5-11 Summary of Water Quality Analyses for Jack Creek, STORET Site 4933250						
Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			10	10	90 – 264	208
Temperature (°C)			11	11	11.5 – 31.2	18.9
Specific Conductance (uS/cm)			13	13	176 – 600	438
pH (standard units)	6.5-8.5[2]	6.5-9.0	19	19	7.60 – **8.90**	8.34
Dissolved Oxygen		6.5 min	8	8	**5.08** – 10.2	7.80
Turbidity (NTU)			13	13	0.29 – 7,164	1,240

Table 3.5-11 Summary of Water Quality Analyses for Jack Creek, STORET Site 4933250

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Total Hardness (mg/L)			4	4	207 – 267	239
Total Dissolved Solids (mg/L)	500[2]	1,200	10	10	254 – 354	306
Total Suspended Solids (mg/L)		90	8	8	**176 – 6,600**	**2,660**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	7	3	0.1 – **0.73**	NC
Bicarbonate (mg/L)			10	10	109 – 322	252
Calcium (mg/L)			12	12	22.4 – 67.3	46.7
Carbonate (mg/L)			10	10	0 – 7	0.7
Chloride (mg/L)	250[2]		10	6	3 – 13.2	NC
Magnesium (mg/L)			12	12	11.3 – 42.6	28.8
Nitrate + Nitrite, total (mg/L)	10[1]	4	6	6	0.11 – 3.78	1.02
Phosphorus, total (mg/L)		0.05	11	7	**0.097 – 1.45**	NC
Potassium (mg/L)			12	12	1.11 – 6.35	2.29
Sodium (mg/L)			12	12	5.06 – 31.5	17.3
Sulfate (mg/L)	250[2]		10	8	22 – 56.3	31.7
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	10	6	40.6 – **2,030**	NC
Arsenic (ug/L)	10[1]	150	10	10	6.7 – 9.1	7.60
Barium (ug/L)	2000[1]	1000	10	10	74.4 – 150	110
Cadmium (ug/L)	5[1]	1.1[5]	10	0	ND	NC
Chromium (ug/L)	100[1]	74	10	2	5.3 – 5.7	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	10	2	**15 – 16.6**	NC
Iron (ug/L)	300[2]	1,000	10	7	21.3 – **3,580**	NC
Lead (ug/L)	15[1]	3.2[5]	10	2	3.1 – **4.3**	NC
Manganese (ug/L)	50[2]		10	7	5.47 – **99.5**	NC
Mercury (ug/L)		0.012	10	0	ND	NC
Selenium (ug/L)	50[1]	5	10	3	1.1 – 1.3	NC
Silver (ug/L)	100[2]	4.1[5]	10	0	ND	NC
Zinc (ug/L)	5000[2]	120	10	2	38 – **173**	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = Not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Nine Mile Creek

Tables 3.5-12 through **3.5-15** provide summaries of the results for samples collected from Nine Mile Creek. These samples define the baseline water quality for Nine Mile Creek within the WTP Project Area. Samples have been collected sporadically between 1977 and the current date in Nine Mile Creek from four STORET locations.

Table 3.5-12 provides a summary of water quality analyses for samples recently collected from Nine Mile Creek below the confluence with Dry Creek at Utah STORET station 4933288.

The pH of the waters at this location ranges from 7.80 – 8.68 units, and averages 8.36. Specific conductance ranges from 891 to 1,111 uS/cm with an average of 1,010 uS/cm. These values are similar to those for Minnie Maud Creek and Argyle Creek, which provide much of the flow in Nine Mile Creek, and are in the high salinity class, which indicate that the waters are generally not suitable for irrigation, especially on fine-grained soils. However, water from Nine Mile Creek is currently used for this purpose to some degree. TDS ranges from 544 mg/L to 686 mg/L with an average of 616 mg/L. All TDS values are above the secondary drinking water standard. TSS ranges from 18.4 mg/L to an extreme 180,500 mg/L measured on September 8, 2007. However, all other TSS values were below 368 mg/L for this station. Ammonia, pH, nitrate plus nitrite, total phosphorus, aluminum, arsenic, copper, lead, manganese, and zinc exceed the associated water quality standards for one or more samples.

Table 3.5-12 Summary of Water Quality Analyses for Nine Mile Creek, STORET Site 4933288

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			11	11	298 – 435	373
Temperature (°C)			2	2	2.81 – 5.06	3.94
Specific Conductance (uS/cm)			13	13	891 – 1,111	1,010
pH (standard units)	6.5-8.5[2]	6.5-9.0	13	13	7.80 – **8.68**	8.36
Dissolved Oxygen		6.5 min	2	2	11.2 – 13.5	12.3
Turbidity (NTU)			13	13	5.7 – 5,958	527
Dissolved Hardness (mg/L)			17	17	285 – 464	393
Total Dissolved Solids (mg/L)	500[2]	1,200	11	11	**544 - 686**	**616**
Total Suspended Solids (mg/L)		90	11	11	18.4 – **180,500**	**16,500**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	17	3	0.05 – **0.12**	NC
Bicarbonate (mg/L)			11	11	358 – 487	435
Calcium (mg/L)			17	17	60.5 – 72.2	60.5
Carbonate (mg/L)			11	11	0 – 22	9.73
Chloride (mg/L)	250[2]		11	3	10 – 19.9	NC
Magnesium (mg/L)			17	17	31.7 – 69	58.9
Nitrate + Nitrite, total (mg/L)	10[1]	4	17	7	0.15 – **12.1**	NC
Phosphorus, total (mg/L)		0.05	17	11	0.02 – **0.41**	NC
Potassium (mg/L)			17	17	1.99 – 5.06	2.69
Sodium (mg/L)			17	17	46.1 – 101	84.7
Sulfate (mg/L)	250[2]		11	11	141 – 236	191

Table 3.5-12 Summary of Water Quality Analyses for Nine Mile Creek, STORET Site 4933288

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	6	3	28.1 – **143**	NC
Arsenic (ug/L)	10[1]	150	6	6	3.32 – **11.3**	5.75
Barium (ug/L)	2000[1]	1000	6	1	118	NC
Boron (ug/L)			6	6	277 – 467	339
Cadmium (ug/L)	5[1]	1.1[5]	6	0	ND	NC
Chromium (ug/L)	100[1]	74	6	1	6.56	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	6	2	4.18 – **306**	NC
Iron (ug/L)	300[2]	1,000	6	5	27.4 – 199	70.0
Lead (ug/L)	15[1]	3.2[5]	6	2	0.75 – **82.9**	NC
Manganese (ug/L)	50[2]		6	6	9.31 – **58**	19.9
Mercury (ug/L)		0.012	6	0	ND	NC
Nickel (ug/L)		52	6	0	ND	NC
Selenium (ug/L)	50[1]	5	6	5	1.05 – 1.34	1.20
Silver (ug/L)	100[2]	4.1[5]	6	0	ND	NC
Zinc (ug/L)	5000[2]	120	6	2	12 – **2,140**	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Table 3.5-13 provides the results for one sample collected from Nine Mile Creek above the confluence with Cottonwood Creek on October 4, 2007.

The results from this sample are consistent with those from other Nine Mile Creek stations. TDS was 624 mg/L, close to the average TDS recorded for the Nine Mile Creek station below Dry Creek Canyon. TSS was recorded at 78.8 mg/L, below the aquatic biota standard. All other parameters were below the associated water quality standards, except for pH at 8.60 units.

Table 3.5-13 Water Quality Analyses for Nine Mile Creek, STORET Site 4933335, October 4, 2007

	Drinking Water Standards[1]	Aquatic Biota Standards[3]	Result
General Water Quality Parameters			
Total Alkalinity (mg/L)			385
Temperature (°C)			8.2
Specific Conductance (uS/cm)			991
pH (standard units)	6.5-8.5[2]	6.5-9.0	**8.60**

Table 3.5-13 Water Quality Analyses for Nine Mile Creek, STORET Site 4933335, October 4, 2007			
	Drinking Water Standards[1]	Aquatic Biota Standards[3]	Result
Turbidity (NTU)			27.6
Dissolved Oxygen (mg/L)		6.5 min	10.08
Dissolved Hardness (mg/L)			392
Total Dissolved Solids (mg/L)	500[2]	1,200	**624**
Total Suspended Solids (mg/L)		90	78.8
Ionic Constituents			
Ammonia (mg/L)		0.11 – 0.49[4]	ND
Bicarbonate (mg/L)			433
Calcium (mg/L)			60
Carbonate (mg/L)			18
Chloride (mg/L)	250[2]		ND
Magnesium (mg/L)			58.8
Nitrate + Nitrite, total (mg/L)	10[1]	4	ND
Phosphorus, total (mg/L)		0.05	0.03
Potassium (mg/L)			2.75
Sodium (mg/L)			87.1
Sulfate (mg/L)	250[2]		206
Trace Metals			
Aluminum (ug/L)	50-200[2]	750	37.3
Arsenic (ug/L)	10[1]	150	5.36
Barium (ug/L)	2000[1]	1000	ND
Boron (ug/L)			309
Cadmium (ug/L)	5[1]	1.1[5]	ND
Chromium (ug/L)	100[1]	74	6.02
Copper (ug/L)	1300[1], 1000[2]	12[5]	1.42
Iron (ug/L)	300[2]	1,000	60.6
Lead (ug/L)	15[1]	3.2[5]	0.23
Manganese (ug/L)	50[2]		24.6
Mercury (ug/L)		0.012	ND
Nickel (ug/L)		52	ND
Selenium (ug/L)	50[1]	5	1.08
Silver (ug/L)	100[2]	4.1[5]	ND
Zinc (ug/L)	5000[2]	120	ND

ND = Not Detected
All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Table 3.5-14 provides a summary of water quality analyses for samples collected from Nine Mile Creek at Utah STORET station 4933330. Waters in Nine Mile Creek are described as sodium bicarbonate type waters with moderate to very high hardness (average 328 mg/L as $CaCO_3$). The waters are alkaline with pH of 7.60 – 8.90 units and an average pH of 8.41. Specific conductance ranges from 334 to 1,370 uS/cm with an average of 946 uS/cm. TDS ranges from 466 mg/L to 888 mg/L with an average of 638 mg/L, above the secondary drinking water standard. TSS ranges from 5.2 mg/L to 16,730 mg/L with an average of 1,355 mg/L. Eleven of the 24 measurements of TSS are above the aquatic biota standard. The maximum values of ammonia, pH, total phosphorus, and sulfate exceed the aquatic biota standards. Aluminum, arsenic, iron, and manganese also exceed the associated water quality standards for one or more samples. A review of the water quality data shows that the maximum values for aluminum and iron were reported for days with very high suspended solids concentrations. Therefore, these high values are not considered to be representative of the actual dissolved aluminum and iron concentrations in Nine Mile Creek. If these values are discarded, the maximum aluminum concentration over the period of record was 443 ug/L (micrograms per liter) and the maximum iron concentration was 780 ug/L.

Table 3.5-14 Summary of Water Quality Analyses for Nine Mile Creek, STORET Site 4933330

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			25	25	103 – 474	349
Temperature (°C)			20	20	12 – 28	20.3
Specific Conductance (uS/cm)			23	23	771 – 1,230	968
pH (standard units)	6.5-8.5[2]	6.5-9.0	42	42	7.60 – **8.90**	8.41
Dissolved Oxygen		6.5 min	10	10	**6.2** – 11.2	8.14
Turbidity (NTU)			26	26	1 – 3,015	350
Dissolved Hardness (mg/L)			15	15	296 – 428	363
Total Dissolved Solids (mg/L)	500[2]	1,200	25	25	466 – **888**	**638**
Total Suspended Solids (mg/L)		90	24	24	5.2 – **16,730**	**1,355**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	16	6	0.05 – **0.263**	NC
Bicarbonate (mg/L)			25	25	126 – 578	418
Calcium (mg/L)			26	26	25.6 – 60.6	42.3
Carbonate (mg/L)			26	26	0 – 34	3.16
Chloride (mg/L)	250[2]		25	20	5 – 27	12.4
Magnesium (mg/L)			26	26	14 – 77.3	59.0
Nitrate + Nitrite, total (mg/L)	10[1]	4	17	4	0.06 – 0.32	NC
Phosphorus, total (mg/L)		0.05	24	21	0.01 – **0.74**	0.20
Potassium (mg/L)			26	26	1.8 – 10.3	3.21
Sodium (mg/L)			26	26	31 – 190	101
Sulfate (mg/L)	250[2]		25	25	69.7 – **316**	201
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	20	11	33 – **3,600**	NC
Arsenic (ug/L)	10[1]	150	22	19	5 – **14.8**	8.77
Barium (ug/L)	2000[1]	1000	22	17	34.1 – 200	NC
Cadmium (ug/L)	5[1]	1.1[5]	22	0	ND	NC

Table 3.5-14 Summary of Water Quality Analyses for Nine Mile Creek, STORET Site 4933330

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Chromium (ug/L)	100[1]	74	22	9	6.1 – 9.4	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	22	0	ND	NC
Iron (ug/L)	300[2]	1,000	22	15	22 – **5,000**	NC
Lead (ug/L)	15[1]	3.2[5]	22	0	ND	NC
Manganese (ug/L)	50[2]		22	7	5.6 – **240**	NC
Mercury (ug/L)		0.012	22	0	ND	NC
Selenium (ug/L)	50[1]	5	22	6	1.0 – 1.66	NC
Silver (ug/L)	100[2]	4.1[5]	22	0	ND	NC
Zinc (ug/L)	5000[2]	120	22	1	27	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

Table 3.5-15 provides a summary of water quality analyses for samples collected from Nine Mile Creek at the confluence with the Green River at Utah STORET station 4933310 during the period May 1977 to September 1998.

The pH of the waters at this location ranges from 6.70 – 8.90 units, and averages 8.25. Specific conductance ranges from 600 to 2,100 uS/cm with an average of 1,030 uS/cm. TDS ranges from 403 mg/L to 948 mg/L with an average of 676 mg/L. TSS ranges from 5 mg/L to 9,640 mg/L and averages 1,330, well above the aquatic biota standard. Thirteen of the 21 TSS samples were above the standard at this location. The average concentration of arsenic slightly exceeds the primary drinking water standard. Ammonia, pH, total phosphorus, sulfate, aluminum, cadmium, copper, iron, lead, manganese, and silver also exceed the associated water quality standards for one or more samples. Iron exceeded the secondary drinking water standard 7 times and the primary drinking water standard twice out of 12 samples.

Table 3.5-15 Summary of Water Quality Analyses for Nine Mile Creek at Mouth, STORET Site 4933310

Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
General Water Quality Parameters						
Total Alkalinity (mg/L)			29	29	183 – 477	345
Temperature (°C)			22	22	4.5 – 28	16.9
Specific Conductance (uS/cm)			52	52	600 – 2,100	1,030
pH (standard units)	6.5-8.5[2]	6.5-9.0	42	42	6.70 – **8.90**	8.25
Dissolved Oxygen		6.5 min	17	17	**5.5** – 12.6	8.6
Turbidity (NTU)			25	25	1.8 – 3,789	322

Table 3.5-15 Summary of Water Quality Analyses for Nine Mile Creek at Mouth, STORET Site 4933310						
Parameters	Standards		Summary Statistics			
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	No. of Detects	Range	Mean
Total Hardness (mg/L)			29	29	208 – 440	354
Total Dissolved Solids (mg/L)	500[2]	1,200	29	29	403 - **948**	**676**
Total Suspended Solids (mg/L)		90	21	21	5 – **9,640**	**1,330**
Ionic Constituents						
Ammonia (mg/L)		0.11 – 0.49[4]	22	6	0.096 – **0.71**	NC
Bicarbonate (mg/L)			29	29	224 – 542	416
Calcium (mg/L)			29	29	27 – 92	45.1
Carbonate (mg/L)			22	22	0 – 26	4.23
Chloride (mg/L)	250[2]		29	29	4 – 26	13.3
Fluoride (mg/L)	4[1], 2[2]	1.4-2.4[4]	11	11	0.54 – 1.4	0.82
Magnesium (mg/L)			29	29	21 – 78	58.7
Nitrate + Nitrite, total (mg/L)	10[1]	4	7	2	0.017 – 1.55	NC
Phosphorus, total (mg/L)		0.05	20	16	0.014 – **1.55**	**0.28**
Potassium (mg/L)			30	30	2.0 – 5.0	3.06
Silica (mg/L)			10	10	10 – 24	19.9
Sodium (mg/L)			29	29	38 – 180	109
Sulfate (mg/L)	250[2]		29	29	78 - **355**	218
Trace Metals						
Aluminum (ug/L)	50-200[2]	750	8	6	**180 – 2,100**	NC
Arsenic (ug/L)	10[1]	150	13	13	5 – **31**	**10.6**
Barium (ug/L)	2000[1]	1000	13	10	50 – 150	NC
Boron (ug/L)			10	10	200 – 1,350	712
Cadmium (ug/L)	5[1]	1.1[5]	13	1	**5**	NC
Chromium (ug/L)	100[1]	74	13	3	6.5 – 10	NC
Copper (ug/L)	1300[1], 1000[2]	12[5]	13	3	5 – **26**	NC
Iron (ug/L)	300[2]	1,000	12	7	10 – **3,540**	NC
Lead (ug/L)	15[1]	3.2[5]	12	1	**20**	NC
Manganese (ug/L)	50[2]		13	8	5 – **120**	NC
Mercury (ug/L)		0.012	9	0	ND	NC
Nickel (ug/L)		52	4	1	25	NC
Selenium (ug/L)	50[1]	5	13	7	0.5 – 2.0	NC
Silver (ug/L)	100[2]	4.1[5]	13	1	**5**	NC
Zinc (ug/L)	5000[2]	120	13	4	5 – 46	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
ND = not detected
NC = Mean not calculated – more than 20% of values reported as not detected
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: EPA (2006)

In summary, waters in Nine Mile Creek have high hardness, with the averages at the four stations ranging from 354 mg/L to 392 mg/L. Specific conductance is fairly constant, with average values ranging from 991 uS/cm to 1,030 uS/cm for the four stations. The average TDS increases in a downstream direction from 616 mg/L below Dry Canyon to 676 mg/L at the mouth. The average TDS is above the Federal secondary standard of 500 mg/L at all stations. Alkalinity decreases from 373 mg/L below Dry Canyon to 345 mg/L at the mouth. The concentrations of ammonia, total phosphorus, sulfate, and arsenic generally increase in a downstream direction. The maximum recorded concentrations of ammonia increase from 0.12 mg/L below Dry Canyon to 0.71 mg/L at the mouth, and the maximum concentrations of total phosphorus increase from 0.41 mg/L to 1.55 mg/L. Sulfate increases from 191 mg/L below Dry Canyon to 218 mg/L at the mouth. The average arsenic concentration increases from 5.75 ug/L below Dry Canyon to 10.6 ug/L at the mouth. This latter value is above the Federal MCL for arsenic of 10 ug/L.

Green River

Tables 3.5-16 and 3.5-17 provide summaries of the results for samples collected by the USGS from the Green River. These samples provide the baseline water quality for the Green River, both upstream and downstream from the confluence of Nine Mile Creek and the confluence with Jack Creek.

Table 3.5-16 provides a summary of water quality analyses for samples collected from the Green River near Ouray from December 1950 to September 1951 and from October 1958 to September 1966. Waters in the Green River are described as calcium-sodium bicarbonate-sulfate type waters with moderate to very high hardness (110 – 640 mg/L as $CaCO_3$). TDS is variable and ranges from 168 mg/L to 1,380 mg/L, and averages 525 mg/L. The waters are generally alkaline with pH ranging from 7.30 to 8.60 units, with an average of 7.91. Sulfate exceeded to secondary maximum contaminant level (SMCL) of 250 mg/L for 45 of 164 samples (27.4 percent). Values for all other parameters reported are less than the associated water quality standards, except for nitrate and iron. Nitrate exceeded the aquatic water standard of 4 mg/L for three samples out of 59, and iron exceeded the SMCL of 300 ug/L for one of 34 samples. Specific conductance ranges from 323 to 1,890 uS/cm with an average of 789 uS/cm. These values fall within the moderate to high salinity classes. The SAR of the waters ranges from 0.7 to 5 and averages 1.90. These are considered to be safe values for SAR. TSS concentrations are quite variable, ranging from 87 mg/L to 52,300 mg/L, with an average of 4,900 mg/L. These high values are reflective of the high sediment loading to the Green River from sources in the Uinta Basin, Wyoming, and Colorado.

Table 3.5-16 Summary of Water Quality Analyses for the Green River at Ouray, USGS Gauging Station 09307000

Parameters	Standards		Summary Statistics		
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	Range	Mean
General Water Quality Indicators					
Temperature (°C)			182	0.6 – 28.3	16.7
Specific Conductance (uS/cm)			177	323 – 1,890	789
pH (standard units)	6.5-8.5[2]	6.5-9.0	167	7.60 – **8.60**	7.91
Total Hardness (mg/L)			167	110 – 640	267
Sodium Adsorption Ratio			156	0.7 – 5	1.90
Total Dissolved Solids (mg/L)	500[2]	1,200	174	168 – **1,380**	**525**
Total Suspended Solids (mg/L)		90	194	87 – **52,300**	**4,900**
Ionic Constituents					
Calcium (mg/L)			107	34 – 191	73.2

Table 3.5-16 Summary of Water Quality Analyses for the Green River at Ouray, USGS Gauging Station 09307000					
Parameters	**Standards**		**Summary Statistics**		
	Drinking Water[1]	**Aquatic Biota[3]**	**No. of Samples**	**Range**	**Mean**
Magnesium (mg/L)			107	8.3 – 66	25.2
Sodium (mg/L)			157	19 – 250	73.5
Potassium (mg/L)			58	1.5 – 6.4	2.93
Chloride (mg/L)	250[2]		167	7.5 – 197	37.3
Sulfate (mg/L)	250[2]		164	50 – **621**	204
Fluoride (mg/L)	4[1], 2[2]	1.2 - 2.4[4]	57	0.2 – 0.8	0.39
Bicarbonate (mg/L)			168	112 – 320	195
Nitrate, total (mg/L)	10[1]	4	59	0.3 – **4.3**	1.66
Silica (mg/L)			78	7.3 – 21	12.3
Trace Metals					
Boron (ug/L)			58	50 – 300	143
Iron, total (ug/L)	300[2]	1,000	42	<0.1 – **330**	29.3

All samples are dissolved (filtered) unless otherwise noted
Average values calculated using one-half the detection limit for non-detect values
Bolded values exceed standards
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code)
[4]Value is dependant on temperature and pH
Source: USGS (2007)

Table 3.5-17 provides a summary of water quality analyses for samples collected from the Green River at Green River. Water quality samples have been collected continuously since August 1928 at this location. Waters in the Green River at the lower station are described as calcium-sodium bicarbonate-sulfate type waters with moderate to very high hardness (an average of 308 mg/L). TDS is variable and ranges from 196 mg/L to 3,440 mg/L, and averages 598 mg/L. The waters are generally alkaline with pH averaging 7.95 units. The mean value for sulfate slightly exceeds the SMCL of 250 mg/L. Maximum values of ammonia, arsenic, fluoride, copper, manganese, and selenium exceed the aquatic biota water standards. Specific conductance ranges from 61 to 3,240 uS/cm with an average of 862 uS/cm. These values fall within the low to very high salinity classes. The SAR of the waters ranges from 1 to 4 and averages 1.98. These are considered to be safe values for SAR. TSS concentrations are quite variable, ranging from 17 mg/L to 67,300 mg/L, with an average of 2,800 mg/L. These values are likely more representative of current sediment loading to the Green River than those recorded earlier at the upstream station at Ouray.

Table 3.5-17 Summary of Water Quality Analyses for Green River at Green River, USGS Gauging Station 09315000					
Parameters	**Standards**		**Summary Statistics**		
	Drinking Water	**Aquatic Biota[3]**	**No. of Samples**	**Range**	**Mean**
General Water Quality Indicators					
Temperature (°C)			867	0 – 32.5	14.6
Specific Conductance (uS/cm)			1,457	61 – 3,240	862
Dissolved Oxygen (mg/L)		Min. 6.5	279	**4** – 13.8	9.0
pH (standard units)	6.5-8.5[2]	6.5-9.0	960	**2.50 – 8.70**	7.95
Sodium-Adsorption Ratio (SAR)			1,086	1 – 4	1.98
Total Hardness (mg/L)			1,204	110 – 1,900	308
Total Dissolved Solids (mg/L)	500[2]	1,200	1,198	196 – **3,440**	**598**

Table 3.5-17 Summary of Water Quality Analyses for Green River at Green River, USGS Gauging Station 09315000					
Parameters	**Standards**		**Summary Statistics**		
	Drinking Water	**Aquatic Biota**[3]	**No. of Samples**	**Range**	**Mean**
Total Suspended Solids (mg/L)		90	725	17 – **67,300**	**2,800**
Ionic Constituents					
Calcium (mg/L)			1,306	27 – 507	70.5
Magnesium (mg/L)			1,304	8.5 – 150	29.7
Sodium (mg/L)			1,186	13 – 301	81.3
Potassium (mg/L)			895	<0.1 – 15	3.5
Chloride (mg/L)	250[2]		1,291	0.4 – 226	33.9
Sulfate (mg/L)	250[2]		1,289	48 – **2,000**	**251**
Fluoride (mg/L)	4[1], 2[2]	1.2 - 2.4[4]	473	<0.1 – **1.8**	0.32
Bicarbonate (mg/L)			1,136	107 – 382	210
Nitrite & Nitrate (mg/L)	10[1]	4	232	0.01 – 2.7	0.27
Ammonia (mg/L)		0.11 – 2.49[4]	169	<0.01 – **0.18**	0.029
Silica (mg/L)			1,180	1.8 – 53	10.2
Orthophosphate (mg/L)			48	0.01 – 0.37	0.06
Trace Metals					
Aluminum (ug/L)	50-200[2]	750	86	0.5 – 30	8.4
Arsenic (Ug/L)	10[1]	4	111	<1 – **5**	1.72
Barium (ug/L)	2,000[1]	1,000	106	6 – 440	96.9
Boron (ug/L)			607	10 – 600	127
Copper (ug/L)	1,300[1] 1,000[2]	12	65	<1 **– 20**	3.24
Iron (ug/L)	300[1]	1,000	132	1.5 – 190	16.1
Manganese (ug/L)	50[2]		104	<1 – **130**	5.43
Selenium (ug/L)	50[1]	5	145	0.5 – **8**	1.54
Strontium (ug/L)			97	283 – 5,300	704
Zinc (ug/L)	5,000[2]		102	<1 – 370	29.6

All samples are dissolved (filtered) unless otherwise noted
Average values calculated using one-half the detection limit for non-detect values
Bolded values exceed standards
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code)
[4]Value is dependant on temperature and pH
Source: USGS (2007)

Utah 303(d) List of Impaired Waters

Section 303(d) of the CWA outlines a water protection program that is intended to clean up waters that remain polluted even after the application of technology-based limitations. A State's 303(d) list is updated every 2 years and identifies water bodies where water quality standards are violated by one or more pollutants, causing impairment to a beneficial use. Once an assessment unit (AU) is identified as water quality limited, the State is to determine the source of the water quality problem and allocate responsibility for controlling the pollution. This analysis is called a Total Maximum Daily Load (TMDL) analysis. The TMDL determines the amount of a specific pollutant that an AU can receive without exceeding water quality standards or impairing a beneficial use (UDEQ 2006). The program requires the States to:

- Identify waters that are and will remain in violation of State water quality standards after the application of technology-based controls;

- Prioritize these waters, taking into account the severity of their pollution; and
- Develop TMDLs that will allow polluted water bodies to meet water quality standards, accounting for seasonal variations and a margin of safety.

Nine Mile Creek has been listed since 1998 for temperature (EPA 2007). The elevated temperatures are likely the result of the natural canopy of cottonwood trees being removed along much of the stream at some point in the past and open field irrigation that exposes large quantities of creek water to solar radiation. Because of the elevated temperature, the creek is considered to not be supporting the beneficial use classification 3A for cold-water game fish.

3.5.1.3 Stream Classification

The Utah Water Quality Board (UWQB) classifies Utah surface water resources according to quality and degree of protection (UWQB 2000). All streams and water bodies in Utah are assigned to one or more of five classes. Nine Mile Creek and its tributaries are classified as Class 2B and 3A. Class 2B streams are protected for secondary contact recreation such as boating, wading, or similar uses. Class 3A streams are protected for cold water species of game fish and other cold water aquatic life. According to the UWQB, the classification of Jack Creek is 2B, 3A, and 4. Class 4 streams are protected for agricultural purposes.

3.5.1.4 Surface Water Rights and Use

Water in Nine Mile Creek and the major side canyons within the WTP Project Area are used for livestock watering, wildlife, dispersed recreation, and industrial uses. The major industrial user is the petroleum industry. **Table 3.5-18** provides a listing of the water rights for surface water diversions in the WTP Project Area. Most of the surface water diversions are located on Nine Mile Creek. One surface water diversion point was identified in Sheep Creek and one in Dry Creek. Three diversion points are located within the Desolation Canyon WSA on unnamed tributaries to the Green River.

Table 3.5-18 Existing Surface Water Diversion Rights

Water Right Number	Location	Appropriated Amount	Owner
90-14	S1670 W1060 N4 18 12S 16E	2.89 cfs	BBC
90-20	S340 E920 N4 03 12S 14E	1.14 cfs	BBC
90-272	S340 E920 N4 03 12S 14E	0.13 cfs	BBC
90-273	S340 E920 N4 03 12S 14E	0.10 cfs	BBC
90-274	S340 E920 N4 03 12S 14E	0.02 cfs	BBC
90-275	S340 E920 N4 03 12S 14E	0.05 cfs	BBC
90-276	S340 E920 N4 03 12S 14E	0.01 cfs	BBC
90-277	S340 E920 N4 03 12S 14E	0.08 cfs	BBC
90-278	S340 E920 N4 03 12S 14E	0.12 cfs	BBC
90-279	S340 E920 N4 03 12S 14E	0.50 cfs	BBC

Table 3.5-18 Existing Surface Water Diversion Rights			
Water Right Number	**Location**	**Appropriated Amount**	**Owner**
90-30	N75 W1790 E4 33 11S 18E	5.0 cfs	Hunt Oil Company
90-28	N75 W1790 E4 33 11S 18E	1.3 cfs	Hunt Oil Company
90-87	S340 W1710 NE03 12S 14E	0.08 cfs	Michael M. Carlson
90-42	S340 W1710 NE03 12S 14E	0.40 cfs	Michael M. Carlson
90-43	S340 W1710 NE03 12S 14E	0.40 cfs	Michael M. Carlson
90-70	S340 W1710 NE03 12S 14E	0.15 cfs	Michael M. Carlson
90-74	S340 W1710 NE03 12S 14E	0.10 cfs	Michael M. Carlson
90-75	S340 W1710 NE03 12S 14E	0.10 cfs	Michael M. Carlson
90-78	S340 W1710 NE03 12S 14E	0.10 cfs	Michael M. Carlson
90-79	S340 W1710 NE03 12S 14E	0.10 cfs	Michael M. Carlson
90-82	S340 W1710 NE03 12S 14E	0.45 cfs	Michael M. Carlson
90-83	S340 W1710 NE03 12S 14E	0.45 cfs	Michael M. Carlson
90-86	S340 W1710 NE03 12S 14E	0.08 cfs	Michael M. Carlson
90-231	S1280 E560 N4 03 12S 14E	0.022 cfs	Michael M. Carlson
90-286	N940 E750 S4 08 12S 16E	0.50 cfs	Nyles and Virginia Reinfeld
90-271	N940 E750 S4 08 12S 16E	0.10 cfs	Nyles and Virginia Reinfeld
90-280	N940 E750 S4 08 12S 16E	0.13 cfs	Nyles and Virginia Reinfeld
90-281	N940 E750 S4 08 12S 16E	0.02 cfs	Nyles and Virginia Reinfeld
90-282	N940 E750 S4 08 12S 16E	0.05 cfs	Nyles and Virginia Reinfeld
90-283	N940 E750 S4 08 12S 16E	0.01 cfs	Nyles and Virginia Reinfeld
90-284	N940 E750 S4 08 12S 16E	0.08 cfs	Nyles and Virginia Reinfeld
90-285	N940 E750 S4 08 12S 16E	0.12 cfs	Nyles and Virginia Reinfeld
90-300	S440 W1640 N4 08 12S 14E	0.50 cfs	Michael M. Carlson
90-347	N440 E1610 W4 01 12S 16E	10.7 cfs	Carlyle and Florence Pace
90-381	S580 W840 NE 10 12S 16E	10.7 cfs	Carlyle and Florence Pace
90-640	S1320 W1515 E4 36 11S 14E	0.43 cfs	Hunt Oil Company
90-642	S1320 W1515 E4 36 11S 14E	0.43 cfs	Hunt Oil Company
90-644	S1320 W1515 E4 36 11S 14E	0.27 cfs	Hunt Oil Company
90-646	S1320 W1515 E4 36 11S 14E	0.05 cfs	Hunt Oil Company
90-648	S1320 W1515 E4 36 11S 14E	0.17 cfs	Hunt Oil Company
90-643	N980 W350 SE 32 11S 15E	0.48 cfs	Hunt Oil Company
90-645	N980 W350 SE 32 11S 15E	0.27 cfs	Hunt Oil Company

Table 3.5-18 Existing Surface Water Diversion Rights

Water Right Number	Location	Appropriated Amount	Owner
90-649	N980 W350 SE 32 11S 15E	0.17 cfs	Hunt Oil Company
90-683	S1020 W90 E4 32 11S 15E	0.10 cfs	Hunt Oil Company
90-1499	S1270 W800 N4 04 12S 14E	0.10 cfs	Michael M. Carlson
90-1511	0 E500 SW 15 13S 17E	12.0 cfs	Juanita M. Bodell
90-1525	0 W1500 SE 27 12S 17E	33.0 cfs	Great Western Pipeline Corp.
90-1527	N4488 E1574 SW 29 13S 17E	33.0 cfs	John H. Morgan
90-1837	N472 W1175 SE 33 11S 15E	3.5 acre-feet	Nelco Contractors, Inc.
90-1096	S660 W1980 31 11S 15E	21.45 acre-feet	SITLA
90-1475	S660 E660 W4 32 11S 17E	11.2 acre-feet	SITLA
90-1476	S660 W660 E4 32 11S 17E	11.2 acre-feet	SITLA
90-1478	S660 W660 E4 32 11S 18E	11.2 acre-feet	SITLA
90-1422	N660 W660 S4 2 12S 15E	300 stock units	SITLA
90-1237	N660 E660 W4 21 12S 15E	Not given	SITLA
90-1424	N660 E660 S4 32 12S 15E	11.2 acre-feet	SITLA
90-1425	N660 E660 S4 32 T12S 15E	11.2 acre-feet	SITLA
90-1426	N660 W660 S4 36 12S 15E	400 stock units	SITLA
90-1486	S660 E660 N4 36 12S 15E	0.9 acre-feet	SITLA
90-1429	S660 E660 W4 32 12S 16E	400 stock units	SITLA
90-629	S660 E660 W4 16 13S 16E	4.2 acre-feet	SITLA
90-630	N660 W660 SE 16 13S 16E	4.2 acre-feet	SITLA
90-1631	N660 E660 W4 36 13S 16E	40 stock units	SITLA

3.5.1.5 Floodplains

Floodplains within the WTP Project Area are located along Nine Mile Creek, the Green River, and the lower reaches of Dry, Harmon, Jack, and Cottonwood Canyons. These floodplains are generally located on benches above the current channel in these streams. These benches were formed by deposition of sediment carried by runoff from the mesa tops and canyon walls during storm and snowmelt events. These floodplains support riparian vegetation, and along Nine Mile Creek, some irrigated agriculture. Floodplains along the lower portions of Dry Canyon and Cottonwood Canyon are 200-500 feet across and represent a low-gradient depositional environment. The distribution of floodplains in the WTP Project Area is generally coincident with the mapped areas of Quaternary alluvium shown on **Figure 3.2-1**.

3.5.2 Groundwater

3.5.2.1 Nature, Yield, and Extent of Aquifers

Regional Aquifers

Groundwater in the southern Uinta Basin is contained in a complex system of shallow unconsolidated, perched, and deep confined aquifers. Three main aquifers are present in the southern Uinta Basin. The principal aquifers include unconsolidated alluvial deposits along the major drainages and two zones within the Green River Formation (Holmes and Kimball 1987; Hood and Fields 1978; Schlotthauer et al. 1981). Deeper water-bearing zones are also present in many geologic units, including the Navajo Sandstone, the Entrada Formation, the Morrison Formation, and the Mesaverde Formation (Freethey and Cordy 1991). These deeper zones are generally too deep to be currently considered as useable aquifers, but constitute a large water resource for the future. The alluvial aquifers are usually unconfined; whereas, the consolidated aquifers are generally unconfined near outcrops and confined down dip. The primary permeability of these aquifers is generally low; however, fractures, bedding planes, and faults may produce relatively high secondary permeability (Schlotthauer et al. 1981).

The alluvial aquifers are recharged by direct precipitation, infiltration of streamflow, and leakage from consolidated-rock aquifers. Most of these aquifers consist of silt and clay, with minor amounts of sand and gravel. These aquifers exist along the major drainages of Hill, Willow, Nine Mile, Bitter, and Evacuation Creeks, and the White and Green Rivers. Other minor drainages, including Coyote Wash and Cottonwood Wash, also contain saturated alluvium. The thickness of alluvium in the major drainages ranges from about 15 feet to over 120 feet. The thickest alluvium is present along Hill, Willow, and Bitter Creeks. The average thickness of alluvium along the Green and White Rivers is about 30 feet. The hydraulic conductivity of these deposits ranges from about one to 25 feet/day. Recharge to the alluvial aquifers in the southern Uinta Basin has been estimated to be about 32,000 acre-feet per year. Water from these aquifers is discharge by springs, evapotranspiration, wells, and subsurface flow into consolidated aquifers. In many of the streams of the area, evapotranspiration consumes most of the water in the stream channel. The amount of water in storage in these aquifers is estimated to be about 675,000 acre-feet, with about 190,000-200,000 acre-feet recoverable (Price and Miller 1975; Holmes and Kimball 1987).

The Green River Formation is often considered an aquiclude and prevents downward movement of groundwater; however, two zones within the formation are considered to be regional aquifers. The Bird's-Nest Aquifer, which may be present beneath the WTP Project Area, lies between the upper part of the Parachute Creek Member and the Mahogany Zone. This aquifer has been identified to the northeast of the WTP Project Area and outcrops along the White River and Evacuation Creek. This aquifer is characterized by nodules of nahcolite (a sodium bicarbonate evaporite) set in marlstone overlain by thin, brittle, shale beds and the Horse Bench Sandstone. The aquifer is generally 90 to 205 feet thick, with an average thickness of about 115 feet. The hydraulic conductivity of the aquifer is enhanced by the dissolution of the nahcolite and fracturing. Transmissivity of the aquifer is quite variable, ranging from about 1 to 15,000 feet squared per day (VTN Colorado Inc. 1977). The maximum potential yield to individual wells was estimated to be about 5,000 gallons per minute (gpm). This zone generally produces water with TDS between 3,000 and 10,000 mg/L, but some water from the zone is unusable (TDS more than 10,000 mg/L). The Bird's-Nest Aquifer contains an estimated 1.9 million acre-feet of water in storage (Holmes and Kimball 1987).

The Douglas Creek Aquifer underlies much of the southern Uinta Basin and consists of beds of sandstone and limestone of the Douglas Creek Member (Middle Member) of the Green River Formation and some intertonguing sandstone beds of the Wasatch and Colton formations (Holmes and Kimball 1987; Howells et al. 1987). This aquifer crops out in Desolation Canyon along the east boundary of the WTP Project Area. The aquifer is generally about 500 feet thick. Aquifer tests conducted in the Douglas Creek aquifer show that transmissivity ranges from about 16 to 170 feet squared per day, and the storage coefficient ranges from about 7×10^{-4} to 2.5×10^{-4}. The TDS of this water is generally between 3,000 and 10,000 mg/L. The Douglas Creek aquifer contains an estimated 16 million acre-feet in storage (Holmes and Kimball 1987).

Recharge to the aquifers in the Green River Formation is by precipitation that falls on the East and West Tavaputs Plateaus in the southern portion of the Uinta Basin, infiltration from streams that cross the outcrop area, and leakage from the underlying Wasatch/Colton formations. Use of groundwater from the Green River Formation is limited to livestock watering and industrial uses because of its poor quality in terms of total dissolved solids and hardness.

WTP Project Area Aquifers

Water-bearing zones may be present in nearly all geologic formations beneath the WTP Project Area, but the main aquifers are the alluvium along Nine Mile Creek and the lower portions of Dry and Cottonwood Canyons, and porous and fractured zones within the Green River Formation that correlate with the Bird's-Nest Aquifer. In addition, water may also be present in small, isolated and perched water-bearing zones in the Upper Member of the Green River Formation, and in small areas of alluvium present on the tops of the mesas.

Groundwater in the consolidated regional aquifers beneath the WTP Project Area moves to the east toward the Green River and to the north toward Nine Mile Creek. Locally, water in perched aquifers moves toward the closest drainage. The rate of groundwater movement is slow. This slow movement allows for long periods of contact between the water and the rocks, and contributes to the high levels of dissolved solids common in the groundwater of the area.

The unconsolidated materials present along Nine Mile Creek and the lower portions of the major side canyons, especially Dry and Cottonwood Canyons, form the principal aquifer in the area. Unconsolidated deposits of alluvium and gravel on mesa tops and ridges may also locally produce some groundwater. The alluvium along Nine Mile Creek is saturated for the entire length through the WTP Project Area. There are seven existing water wells located along Nine Mile Creek within the WTP Project Area, as shown on **Figure 3.5-2**. Well logs are available for five of these wells. Three wells are located between Argyle Creek and Gate Canyon. Well logs for two of these wells report that the alluvium here consists of silt between 0 and 8 feet depth, clay with boulders between 5 and 20 feet, sandy clay from 20 to 30 feet, and gravelly sand from 30 feet to 41 feet or 43 feet. Clay was encountered at depths of 41 feet and 43 feet in the two borings. The water level was about 25 feet below ground surface during drilling for both wells. Drill-stem testing provided a yield estimate of about 0.011 cubic feet per second (4.9 gpm) for both wells.

A well log is available for the well completed in the alluvium at the confluence of Cottonwood Canyon and Nine Mile Creek. The alluvium at this location consists of clay with gravel, cobbles, and boulders to a depth of 44 feet, sand and gravel from 44 feet to 79 feet, and gravel from 79 feet to 88 feet. This well produced about 0.031 cfs (13.9 gpm) with 70 feet of drawdown in a 1-hour bailer test. A well log is also available for one well located on Nine Mile Creek downgradient from the confluence with Cottonwood Canyon. This well was completed at a depth of 100 to 120 feet. It is not clear from the log whether this well is completed in alluvium or fractured bedrock below the alluvium. The water level was reported to be 103 feet bgs during drilling, and surface casing was set in this well to a depth of 18 feet. Drill-stem testing showed a yield of about 0.022 cfs (9.8 gpm) for this well. One additional well was drilled 2,000 feet further downstream from this well. A water rights number could not be identified for this well. The log shows that the alluvium here consists of sand with pieces of shale to a depth of 40 feet, and clay and gravel from 40 feet to 60 feet. Bedrock was encountered at about 70 feet. The water level was recorded at 46 feet during drilling, and the well produced about 0.022 cfs (9.8 gpm). The log indicates that drilling was stopped because the water turned black, possibly indicating that this well perforated a zone of tar sands within the Green River Formation.

The well log for well 90-1542 shows that this well was completed to a depth of 280 feet in the Green River Formation. The well was perforated in three zones: 60 feet to 100 feet; 160 feet to 200 feet, and 240 feet to 280 feet. The water level was reported to be 18 feet bgs during drilling. A pump test conducted in this well showed that the formation is capable of producing 0.267 cfs (120 gpm).

Deeper water-bearing zones beneath the WTP Project Area include sandstone layers in the Colton Formation and Mesaverde Group. These zones usually produce poor quality water with TDS greater than 10,000 mg/L (Schlotthauer et al. 1981).

Recharge to the groundwater aquifers is principally from precipitation that falls on the West Tavaputs Plateau. Most recharge occurs during the spring during snowmelt. Little recharge occurs during short duration, high intensity thunderstorms during the summer (Hood 1976). These thunderstorms may produce flooding in the ephemeral drainages common in the area. These channels are dry for most of the year and the flood discharges represent the majority of the total annual flow in these drainages. Relatively small quantities of recharge results from infiltration of flow from the Green River into bedrock units.

Groundwater in shallow deposits generally flows toward and discharges into streams and the major rivers. Discharge from the consolidated bedrock aquifers is from springs and seeps to the surface, from seepage into streambeds, by upward leakage into the overlying formations, and by downward leakage into underlying formations (BLM 2003a).

3.5.2.2 Springs

Numerous springs are present in the WTP Project Area, as shown on **Figure 3.5-2**. These springs are generally located in areas where a relatively permeable sandstone layer overlies a less-permeable siltstone of mudstone and outcrops into a canyon, where the bedrock is sufficiently fractured to allow for percolation of water from the surface, or from alluvium along canyon bottoms. A spring survey was conducted in August 2008 to verify mapped spring locations, search for new springs in portions of the WTP Project Area, evaluate beneficial uses of these springs (e.g., use by wildlife and livestock), and select springs for inclusion in the long-term monitoring program (**Appendix Q**) that would apply to Alternatives C and E. A total of 15 springs within the proposed development areas were evaluated during the survey. Six of the 15 springs had sufficient flow to measure the discharge and record basic water quality parameters (pH, temperature, and conductivity). Flow volumes at the six springs where flow measurements were taken ranged from 0.15 gallons per minute (gpm) to 0.98 gpm. Indian Spring, located near the head of Jack Creek, had the lowest conductivity at 204 uS/cm. Conductivity in Jack Creek ranges from 176 – 600 uS/cm with an average value of 438 uS/cm, reflecting the contribution from spring flows to this creek. Conductivity ranged from 786 uS/cm to 1,603 uS/cm at the remaining five springs where field parameters were measured, with an average conductivity of 1,209 uS/cm. These values are similar to those recorded in Nine Mile Creek at the Utah STORET water quality monitoring stations. Temperature ranged from 12.3º C to 20.5º C, with the lowest temperature recorded at Unnamed spring 7, located near the bottom of Harmon Canyon. This lower temperature is reflective of the source of this spring from alluvium within Harmon Canyon. The pH of the spring waters ranged from 7.68 to 8.68 with an average of 8.28, similar to values recorded in Nine Mile Creek. These values are within the acceptable pH range for aquatic biota of 6.5 to 9.0 units. The lowest pH was recorded at Indian Spring.

Spring boxes, consisting of a metal stock tank, were present at two springs (Unnamed 1 and Unnamed 8). Evidence of livestock use was noted at three springs (Unnamed 1, Unnamed 7, and Unnamed 8), and evidence of wildlife use (deer and elk footprints) were noted at six springs (Unnamed 1, Unnamed 7, Unnamed 8, Unnamed 12, Unnamed 13, and Unnamed 14). Riparian vegetation was noted at all but one spring (Unnamed 8). The vegetation included buttercup, gooseberry, willow, ribes, rose, tamarisk, box elder, rosebush, cottonwood, current, juncus, and saltgrass.

Numerous additional springs are located within the high country watersheds (areas above 7,000 feet) to the south of the WTP Project Area boundary, as shown on **Figure 3.5-2**.

3.5.2.3 Groundwater Quality

Groundwater in the southern Uinta Basin ranges in chemical quality from relatively good to briny. Fresh to slightly saline water can be found in the shallow aquifers. Water quality in the alluvial aquifers along Nine Mile Creek and the major side canyons is likely consistent with the quality of surface water in the creek.

Water quality in the Green River Formation ranges from fresh to briny across the Uinta Basin. Fresher water is contained in the formation near recharge areas such as along the Roan Cliffs south of the WTP Project Area (Feltis 1968; Price and Miller 1975). Dissolved solids in water wells completed in the Green River Formation elsewhere in the southern Uinta Basin range from 327 mg/L to over 100,000 mg/L (Price and Miller 1975). The concentration of dissolved solids generally increases with depth in the formation. The freshest waters are from high-altitude springs that discharge from the formation. The high salinity in parts of the formation is caused by dissolution of evaporate minerals including halite, nahcolite, gypsum, and anhydrite, especially in the Upper Member (also informally called the saline facies).

Groundwater quality information is available for two wells located along Nine Mile Creek. These two samples (BLM samples 6092 and 6235) were collected in July and September 2006. **Table 3.5-19** provides the sample results. TDS and arsenic are above the primary water quality standards for sample 6235.

Table 3.5-19 Water Quality for Alluvial Aquifer Wells Along Nine Mile Creek

	Drinking Water	Aquatic Biota[3]	Sample 6092 July 6, 2006	Sample 6235 Sept 6, 2006
Temperature (°C)			9.2	14.1
Specific Conductance (uS/cm)			548	988
pH (standard units)	6.5-8.5[2]	6.5-8.5	8.03	7.93
Sodium-adsorption ratio			0.1	1.8
Total Hardness (mg/L)			252.5	401.1
Total Dissolved Solids (mg/L)	500[2]	1,200	260	**596**
Bicarbonate (mg/L)			312.2	476.5
Calcium (mg/L)			59.1	66.5
Chloride (mg/L)	250[2]		4.86	8.72
Magnesium (mg/L)			25.4	57.0
Nitrate (mg/L)	10[1]	4	ND	0.57
Potassium (mg/L)			0.54	2.02
Sodium (mg/L)			4.4	80.9
Sulfate (mg/L)	250[2]		7.77	134.6
Aluminum (mg/L)	0.050-0.2[2]	0.75	ND	ND
Arsenic (mg/L)	0.001[1]	0.150	ND	**0.019**
Barium (mg/L)	2[1]	1	0.125	0.04
Cadmium (mg/L)	0.005[1]	1.1[4]	ND	ND
Chromium (mg/L)	0.1[1]	0.074	ND	ND
Copper (mg/L)	1.3[1], 1[2]	12[4]	0.015	0.003
Iron (mg/L)	0.3[2]	1	ND	ND
Lead (mg/L)	0.015[1]	3.2[4]	ND	ND
Manganese (mg/L)	0.050[2]		0.0016	0.0024
Selenium (mg/L)	0.050[1]	0.005	ND	ND
Zinc (mg/L)	5[2]	0.120	0.216	0.0058

Bolded values exceed standards
[1]Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Water Secondary Standard
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code)
[4]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: unpublished BLM data

3.5.2.4 Groundwater Rights and Use

Groundwater in the WTP Project Area is used for livestock watering and industrial uses. **Table 3.5-20** provides a listing of the existing groundwater rights in the WTP Project Area. Most of these wells are completed in the alluvium along Nine Mile Creek.

Table 3.5-20 Existing Groundwater Diversion Water Rights

Water Right Number	Location	Appropriated Amount	Owner
90-29	N450 E779 S4 32 11S 15E	0.012 cfs	Hunt Oil Company
90-1840	N1191 W3294 SE 13 12S 14E	4.73 acre-feet	BBC
90-1528	N1191 W3294 SE 13 12S 14E	0.00 cfs	Price Field Office
90-1835	N1191 W3294 SE 13 12S 14E	4.73 acre-feet	BBC
90-1531	N900 E1300 W4 35 11S 14E	0.011 cfs	George and Gloria Fasselin
90-1531	N850 W225 E4 35 11S 14E	0.011 cfs	George and Gloria Fasselin
90-1542	S800 W2300 NE 32 12S 16E	0.015 cfs	Utah School and Institutional Trust Lands Adm.
90-1841	S800 W2300 NE 20 12S 16E	20.0 acre-feet	Utah School and Institutional Trust Lands Adm.
90-1809	N1300 W1550 SE 36 11S 16E	2.33 acre-feet	Zoila Calder
90-1812	N1970 W380 S4 09 12S 16E	0.45 acre-feet	Sekani LLC
90-1843	N500 E1000 SW 07 12S 16E	4.73 acre-feet	BBC
90-1542	S800 W2300 NE 32 12S 16E	0.015 cfs	SITLA
0490001M00	S480 W2500 NE 16 12S 15E	0.00 cfs	Utah School and Institutional Trust Lands Adm.
0490001M00	S1830 E2100 NW 36 12S 15E	0.00 cfs	Utah School and Institutional Trust Lands Adm.
0490001M00	S2000 W590 NE 32 12S 16E	0.00 cfs	Utah School and Institutional Trust Lands Adm.

3.6 LAND USE AND STATUS

3.6.1 Land Ownership

The WTP Project Area is comprised of approximately 137,930 acres within Carbon County, Duchesne County, and Uintah County, Utah. The WTP Project Area includes a mix of Federal public lands administered by both the Price and Vernal Field Offices, State of Utah lands administered by the SITLA, and various privately owned properties. **Table 3.6-1** provides a breakdown of land ownership in the WTP Project Area. Surface ownership is illustrated in **Figure 3.6**.

Table 3.6-1 Land Ownership (by County) within the WTP Project Area[1]

Land Ownership[2]	Carbon County (% of WTP Project Area)	Duchesne County (% of WTP Project Area)	Uintah County (% of WTP Project Area)	Total Project Area (% of WTP Project Area)
BLM	115,517 (83.7%)	1,989 (1.4%)	2,700 (2.0%)	120,206 (87.2%)
State	8,641 (6.3%)	563 (0.4%)	1,206 (0.9%)	10,410 (7.6%)
Private	5,827 (4.3%)	1,387 (1.0%)	33 (0.0%)	7,292 (5.3%)

Table 3.6-1 Land Ownership (by County) within the WTP Project Area[1]				
Land Ownership[2]	**Carbon County (% of WTP Project Area)**	**Duchesne County (% of WTP Project Area)**	**Uintah County (% of WTP Project Area)**	**Total Project Area (% of WTP Project Area)**
Total	**130,030 (94.3%)**	**3,939 (2.9%)**	**3,939 (2.9%)**	**137,931**

[1]Minor discrepancies due to GIS project boundary calculations and rounding.
[2]Carbon County lands are managed by the Price Field Office; whereas, lands in Duchesne and Uintah County are the Vernal Field Office.
% = percent

3.6.2 Public Lands

Within the WTP Project Area, there are approximately 130,616 acres of land that are owned by the Federal government or the State of Utah. Government ownership accounts for approximately 95 percent of the total surface area. Within the WTP Project Area, Federal lands, and to a lesser extent, State lands are managed for multiple uses. Concurrent land uses within the WTP Project Area include mineral development, use of rangeland under permitted grazing allotments, and recreation (e.g., OHV use, hunting, hiking, biking, camping, and cultural/heritage tourism). Each of these land uses are discussed within various portions of this section.

3.6.3 Private Lands

Within the WTP Project Area there are approximately 7,292 acres of private land. Private ownership comprises 5 percent of the WTP Project Area. The majority of private lands are located in Nine Mile Canyon, which forms the northern border of the WTP Project Area. Private lands in the WTP Project Area are used for residential, commercial, and agricultural purposes. Historically private lands within the WTP Project Area have depended on use of the surrounding Federal lands for livestock grazing. A number of ranches have houses, barns, and historical structures. Within Nine Mile Canyon there are also a small number of irrigated agricultural lands.

Nine Mile Ranch is a private developed campground/bed and breakfast facility that is located in Nine Mile Canyon approximately 5 miles from Wellington, Utah. While the Ranch continues to operate as a livestock operation, it also provides services for individual and group visitors to Nine Mile Canyon that are interested in guided tours of the Native American artifacts, as well as mountain biking, hiking, horseback riding, and winter activities. Additional recreational on private land includes hunting and fishing, wildlife viewing, and access to Native American artifacts located in Nine Mile Canyon.

Although the majority of the private lands continue to be used for agricultural purposes, mineral development has occurred in concurrence with other land uses on a small number of privately owned lands in the WTP Project Area.

3.6.4 Existing Mineral Development

Development has been going on in the WTP Project Area since the 1950s. This EIS is preceded by three recent oil and gas projects including the Stone Cabin 3-D Seismic Survey Project EA (UT-070-2003-15) and approved by the BLM on April 2, 2004; the

West Tavaputs Plateau Drilling Program EA (UT-070-2004-28) and approved by the BLM on July 29, 2004; and the Burris 1-10 Well and Right of Way EA, approved by the BLM in 1999 (UT-066-97-55).

At the time the NOI was published for this project, there were 71 existing natural gas wells, with their attendant service roads and facilities, within the WTP Project Area. Of the 71 wells, 37 wells were capable of production and 34 were temporarily abandoned or plugged and abandoned.

As discussed in **Section 1.1**, since the NOI was published on August 26, 2005 some development activities have been occurring in the WTP Project Area that was previously approved under the West Tavaputs Plateau Drilling Program EA (UT-070-2004-28) and through application of the categorical exclusions provided by Section 390 of the Energy Policy Act of 2005. In addition, three EAs were prepared to evaluate limited interim drilling activities within the WTP Project Area, which were provided for through subsequent decisions. However, despite these actions subsequent to the NOI, the baseline existing development used for this analysis is that existing at the time of the NOI, which provides for a more conservative evaluation of the potential impacts from full field development.

In addition to oil and gas resources, the WTP Project Area also contains deposits of oil shale, tar sands, and coal. The WTP Project Area contains a small portion of the Sunnyside STSA; however, the Energy Policy Act of 2005 made these areas available for conventional oil and gas leasing.

A review of the BLM's LR2000 database (BLM 2007b) revealed no existing or pending mining claims and/or leases for resources other than oil and gas within the WTP Project Area.

3.6.5 Split Estate

Within the WTP Project Area, subsurface ownership closely parallels surface ownership on leased lands, meaning that the individual or entity who owns the surface right to the land generally owns the rights to the minerals beneath the surface. However, in limited cases, lands within the WTP Project Area contain separate surface and subsurface ownership, meaning one individual or entity may own the surface rights to the land, while another may own the rights to the minerals beneath the surface. This form of ownership is known as "split estate."

In split estate situations mineral rights take precedence over rights associated with the property. **Table 3.6-2** provides a breakdown of split-estate issues within the WTP Project Area.

Table 3.6-2 Split Estate within the WTP Project Area

	Leased Surface (acres)	Mineral Ownership (acres)	Split-Estate (acres)
BLM	59,903	60,345	442
Private	5,194	4,870	-322

Table 3.6-2 Split Estate within the WTP Project Area			
	Leased Surface (acres)	**Mineral Ownership (acres)**	**Split-Estate (acres)**
State	8,421	8,303	-118
Total	**73,519**	**73,519**	**442**

3.6.6 Rights of Way

Operators are required to submit a ROW application to using or construct a road, pipeline, or ancillary facility located on BLM-administered lands outside of the lease or unit on which the proposed project is to be conducted. Several existing and permitted ROWs are found across BLM-administered lands within the WTP Project Area. **Table 3.6-3** lists pending and authorized ROWs granted by the BLM in the WTP Project Area.

Table 3.6-3 Existing and Authorized ROWs				
Permittee	**Case Type**	**Township and Range[1]**	**Section(s)**	**Acreage[1]**
Duchesne County	Road	11S;15E	4,8,9,17	118.5
Duchesne County	Road	11S;15E	33	1.73
Duchesne County	Road	11S;15E	3,4,10,11,12	56.18
		11S;16E	4,5,7,8	
Duchesne County	Road	11S;15E	15,17,22,23,24	77.58
		11S;16E	15,19,20,21,22,23,24	
		11S;17E	19,20,21,22,23,27	
EOG Resources	Road	11S;15E	03,04	12.36
Falcon Creek Resources	Road	11S;17E	8	0.58
Duchesne County	Road	11S;17E	4,5,8,9,14,15	127.27
BLM	Road	11S;18E	27,33,34	369.6
EEX Corp.	Road	12S;14E	3,10	4.85
BBC	Road	12S;14E	3	3.24
BLM	Road	12S;15E	33,34,35	186
		12S;16E	8,9,21,28,29,30,31	
		13S;15E	1,3,4,9,10,11,14,15, 17,20,30	
BBC	Road	12S;16E	8,9,21,28,29,31	70.18
		13S;16E	3,4,5,6,7,8,17,18,20,2 2,23,27,28,29,33	
		13S;17E	18	
Great Western Onshore	Road	12S;16E	8,9,21,28,29,31	50.37
		13S;15E	12,13,14,23,26,27, 33,34	
		13S;16E	6,7	

Table 3.6-3 Existing and Authorized ROWs				
Permittee	**Case Type**	**Township and Range[1]**	**Section(s)**	**Acreage[1]**
BLM	Road	12S;16E	23,24,26,27,31,33, 34,35,36	369.6
		12S;17E	1,9,10,11,12,17,18, 19,20	
		12S;18E	4,5,6	
		13S;15E	12,13,14,23,27,33,34	
		13S;16E	1,3,4,5,6,7,8,9,10,11,12	
GNC Energy	Road	13S;13E	13,14,15,24	4.24
		13S;14E	19	
BLM	Road	13S;15E	35	1
		13S;16E	7,8,13,17,18,19,20,22, 23,24,27,28,29,30,31, 33	
		13S;17E	7,18,19,20,21	
BBC	O&G pipeline	11S;15E	33	91.06
		12S;15E	3,10,11,12	
		12S;16E	7,8,9,10,15,22,27,33,34,35	
		13S;16E	1	
		13S;17E	6	
Emery Telcom	Telephone	11S;15E	31	9.02
		12S;13E	11,12,14,15,18	
		12S;14E	5,6,7	
BBC	O&G pipeline	11S;15E	33	17.72
		12S;14E	11,12	
		12S;15E	5,6,7	
BBC	O&G pipeline/ facility	11S;15E	33	1.45
Gasco Energy	O&G pipeline	11S;15E	12,22,23	6.61
Questar	O&G pipeline	11S;15E	12,13,14,23,26,27, 33,34	224.39
		11S;16E	4,5,7,8	
		12S;13E	11,12,14,15,18,19	
		12S;14E	3,4,7	
		12S;15E	5,6	
EOG Resources	O&G pipeline	11S;16E	4	12.12
EOG Resources	O&G pipeline	11S;17E	4	0.97

Table 3.6-3 Existing and Authorized ROWs

Permittee	Case Type	Township and Range[1]	Section(s)	Acreage[1]
BLM	ROW-other	11S;18E	20	31.01
Slickrock Air Guides Redtail Aviation Fluckey, Trent	ROW-other	11S;18E	29,30	3.39
BBC	O&G pipeline	12S;14E 12S;15E	12,13 18,19,20,21,22	12.4
Bracken, Joseph Lee, Edwin	Irrigation	12S;15E 12S;16E	2,3,11,12 7,8,9,10	151.25
Bracken, Joseph Lee, Edwin	Irrigation	12S;15E 12S;16E	3,10,11,12 1,3,7,8,9,10	1
BBC	O&G pipeline	12S;15E 12S;16E	24,25,26,27,28,33 18,19	65.29
BBC	Temporary use permit	12S;15E	23,35	3.31
Carbon County	Comm. site	12S;15E	15	2.11
BBC	Temporary use permit	12S;16E 13S;16E 13S;17E	9,15,22,27,33,34,35,36 1 6	29.79
BBC	O&G pipeline	12S;16E	33	2.54
Pinnacle Towers	Comm. site	13S;14E	33	0.23
BLM	Comm. site	13S;14E	33	0.015
Pacificorp	Power Trans.	13S;14E	33	0.082
Pacificorp	Power Trans.	13S;14E	33	.97
Quest Corp.	Telephone	13S;14E	33	0.11
University of Utah	Other	13S;14E	29	0.34

[1]The WTP Project Area does not incorporate the entirety of every township and range listed in **Table 3.6-3**.
Source: BLM (2007b)

3.7 RANGELAND MANAGEMENT AND WILD HORSES

3.7.1 Rangeland Resources

3.7.1.1 Introduction

BLM-administered lands in the WTP Project Area are open for grazing according to the approved RMP. There are several BLM administered allotments within the WTP project area; individual allotments are grazed under term permits which provide for seasons of use and grazing systems consistent with the Rangeland Health Standards and Guidelines.

The BLM grazing allotments are assigned a management category based on evaluations for resource potential and conflicts. **Table 3.7-1** provides a description of the three management categories: Maintain, Improve, and Custodial. These categories set the priorities for funding allocation, manpower for planning purposes and achieving management objectives, and monitoring plans. Based on priorities, the allotment monitoring plans sets the frequencies for completing monitoring studies. Baseline and annual monitoring has been and is conducted to ensure compliance with the BLM grazing policy and to respond to concerns addressing changes in vegetation conditions and achievement of land use planning objectives (BLM 2004b).

Table 3.7-1 BLM Grazing Allotment Management Categories

Management Category	Criteria
Maintain (M)	Resource production potential is moderate to high, and present production is near potential No serious resource-use conflicts exist Opportunities may exist for positive economic return from public investment
Improve (I)	Resource production potential is moderate to high, present production is set at low to moderate levels Serious resource-use conflicts are present Opportunities may exist for positive economic return from public investment
Custodial (C)	Resource production potential is low, and present production is at low to moderate levels Limited resource-use conflicts are present Opportunities for positive economic return from public investment do not exist

Source: Appendix G of the San Rafael Resource Assessment, BLM (1989)

3.7.1.2 Carrying Capacity

The carrying capacity of an allotment is defined in terms of Animal Unit Months (AUMs). An AUM is defined as the amount of forage required to feed one 1,000 pound animal for one month (the equivalent of one cow and calf, one horse, or five sheep). AUMs, or forage availability, of a given allotment can be correlated to a variety of factors such as vegetative communities present, precipitation, and rangeland condition. Carrying capacity can be derived from the number of acres needed for one AUM and can be derived from nutritional demand or actual utilization estimates relative to available forage based on proper forage use. It can also be obtained from a benchmark analysis of range condition. Within the WTP Project Area, available AUMs within an allotment generally fluctuate from 0 to 100 percent annually due to precipitation (Tweddell 2006). AUMs may also fluctuate depending on the intensity of grazing (i.e., closure of allotments versus full use of allotments).

3.7.1.3 Facilities and Livestock Management

Grazing allotments within the WTP Project Area contain various range improvements which are used to control animal movement, improve forage, and provide water to livestock. Range improvements include fences, cattle guards, chaining of pinyon-juniper (e.g., on Prickly Pear Bench), water tanks, developed springs and wells, and reservoirs. There are numerous springs, seeps, and reservoirs associated with the grazing allotments in the WTP Project Area, both developed and natural that receive use by livestock, wild horses, and wildlife

Livestock operators use the existing road network, within and surrounding the WTP Project Area, to move cattle to and from the allotments, as well as to access the allotments to check on their livestock, fix fences, inspect water facilities, distribute salt, and conduct other maintenance activities.

3.7.1.4 Allotments in WTP Project Area

As **Figure 3.7-1** illustrates, portions of seven BLM grazing allotments are found within the WTP Project Area boundary: Dry Canyon, Green River, Stone Cabin, Rock Creek, Sheep Canyon, Blind Canyon, and Max Canyon. Under all alternatives, development is proposed within three of these seven allotments: Green River, Stone Cabin, and Dry Canyon. Parleys Canyon grazing allotment is located northwest, but outside of, the WTP Project Area (also illustrated in **Figure 3.7-1**). Under Alternative C, development is proposed in the Parleys Canyon grazing allotment to accommodate construction of the Trail Canyon alternative access route. **Table 3.7-2** summarizes the following information for the four affected grazing allotments: management category, acreage within the WTP Project Area, number of active Federal AUMs within the WTP Project Area, season of use, livestock grazed, and the percent of land within the WTP Project Area boundary that is comprised of public land.

Table 3.7-2 Grazing Allotment Information for the BLM Lands within the WTP Project Area

Allotment	Management Category	Grazing Allotments on the BLM Lands within the WTP Project Area (Acres)[1]	Active Federal AUMs within the WTP Project Area	Season of Use	Livestock	% Public Land
Dry Canyon	Improve	1,963	640	6/01-10/15	Cattle	79%
Green River	Improve	30,013	2,011	2/01-5/31	Cattle	90%
Parleys Canyon[2]	Improve	N/A	N/A	3/01-4/25	Cattle	100%
Stone Cabin	Improve	8,386	1,625	5/01-9/30	Cattle & Horses	90%

[1]It is important to note that GIS-based calculations do not take into consideration those BLM lands with a slope greater than 20 percent.
[2]The Parleys Canyon grazing allotment is located to the northwest, and outside of, the WTP Project Area. The entire allotment includes 14,608 acres of public land and 356 active Federal AUMs. Cited acreage within the Parleys Canyon grazing allotment does not exclude lands with slopes greater than 20 percent.

3.7.2 Wild Horses

3.7.2.1 Introduction

The Range Creek HMA encompasses approximately 73,627 acres of land within the Price Field Office. The general boundary is described as: Dry Canyon and the northern portion of Cottonwood Ridge on the north; Bruin Point on the west; Bishop Ridge and Flat Canyon on the south; and the broken ledges of the Green River on the east. The HMA contained wild horse historical use areas as of 1971, when Congress passed the Wild Horse and Burro Act. The WTP Project Area encompasses approximately 38,316 acres (or approximately 50 percent) of the Range Creek HMA. Herd management areas are illustrated in **Figure 3.7-2**.

The 1994 Range Creek Herd Management Area Plan (HMAP) and Decision Record (EA# UT-066-94-10) serves to manage the wild horse population inhabiting the Range Creek HMA in accordance with the Title 43 Code of Federal Regulations (Part 4700) and Washington Office Instruction Memorandum No. 83-289. The wild horse population is managed as a component of public lands in a manner that maintains or improves the rangeland ecosystem and promotes a natural ecological balance with all other users and resources. The Range Creek HMA adheres to the multiple use policy specified in the Wild Free-Roaming Horse and Burro Act of 1971 (P.L. 92-195) and the Federal Land Policy and Management Act of 1976 (P.L. 94-579), while maintaining the free-roaming behavior of wild horses within the HMA.

3.7.2.2 Range Creek HMA Wild Horse History

The HMAP established the appropriate management levels (AMLs) for the Range Creek HMA, as well as management objectives and directives for the future management of the HMA, which include expansion beyond establishing “thriving natural ecological balance” to achieving and maintaining a viable, vigorous, and stable population. The current AML is set at 100 head, with management goals of a population of no less than 75 and no more than 125 horses. The Range Creek HMA Wild Horse Gather Plan of 2002 (EA# UT-070-2002-29) determined that the adjudication of 1,200 AUMs to wild horses within the HMA was appropriate. Studies completed during research for the EA indicated that the genetic viability of the herd within the HMA was a concern to the Price Field Office.

Horses have been part of the range environment in the Range Creek area at least since contemporary livestock use began. The origin of the wild horse herd is believed to come from ranch horses once owned by the Preston Nutter Ranch. Branded horses were allowed to roam free in a semi-wild state and were periodically captured to obtain working stock and brand the young horses. The original herd was last gathered by the ranchers for branding in the early 1930s.

The Range Creek HMA Wild Horse Gather Plan/Decision Record (BLM 2002d) implemented management actions that would selectively sort individual horses as well as added program objectives to the Range Creek 1994 HMAP that included: reducing reproductive rates to levels that accommodate a 4-year gather schedule; reestablishment of a “natural” age class structure; reestablishment of a “normal” gender ration of 50/50, males to females; reestablishment or maintenance of typical Range Creek herd characteristics; and maintenance of the genetic diversity of the Range Creek herd. Wild horses that are removed during gathers enter the BLM's Wild Horse Adoption Program or are moved to long-term holding facilities.

3.7.2.3 Affected Environment

Access to the Range Creek HMA is through Nine Mile and Cottonwood Canyon. It can also be reached by traveling through Water Canyon and over Bruin Point. According to early 2007 counts, 76 wild horses were observed within the Range Creek HMA (Tweddell 2007b). Assuming an average 20 percent annual increase in herd size, by fall 2007, the Range Creek herd would be roughly 91 wild horses, which is within the established AML for the Range Creek herd.

The HMA within the WTP Project Area is used throughout the year by the herd; however it is primarily used in the winter (BLM 2004b). Wild horse use is primarily on the open benches of the plateaus, where vegetation is comprised largely of sagebrush and grasslands. Limited use is made of areas with steep slopes and inadequate forage such as wooded pinyon-juniper. There are three horse use areas within the Range Creek HMA: Flat Iron, Cottonwood Ridge, and Cedar Ridge. The Flat Iron horses show a seasonal use pattern moving from the lower elevation winter ranges (approximately 7,000 feet) to higher elevation summer ranges (approximately 8,900 feet) in Twin Hollow south of the WTP Project Area. The Cedar Ridge horses may winter throughout this use area, migrating to Bishop Ridge summer ranges south of the WTP Project Area. The Cottonwood Ridge area, located between Flat Iron and Cedar Ridge, is intermittently occupied by wild horses. The limiting factor for year-round use is an adequate source of permanent water (Tweddell 2007c). Recent counts and reports show a band of horses using the Indian Swale area during the winter and spring; however, it is unclear as to whether they moved up Cottonwood Ridge or crossed Jack Creek to Bishop Ridge for the summer (Tweddell 2007c). Unmapped spring sources may support these horses (Tweddell 2007c).

The Range Creek HMA is fully contained within the Green River grazing allotment for livestock. Approximately 1,200 AUMs are allotted to the Range Creek herd. The WTP Project Area contains approximately 600 AUMs or 50 percent of the AUMs available to the Range Creek herd. The Green River allotment is managed to sustain elk, deer, bighorn sheep, cattle, and the wild horses. Forage competition between the wild horses, elk, deer, bighorn sheep, and cattle is not considered to be critical at this time. A Rangeland Health assessment was conducted on the HMA in June of 2000. The management on the HMA was found to be consistent with achieving and adhering to Utah Rangeland Health Standards and Guidelines.

Wild horse diets consist largely of grass and grass-like species (graminoids). Key forage grasses within the Range Creek HMA include Indian ricegrass (*Oryzopsis hymenoides*), needle-and-thread grass (*Stipa comata*), galleta (*Hilaria jamesii*), and sand dropseed (*Sporobolus cryptandrus*). Other forage species for the herd found within the HMA include winterfat (*Ceratoides lanata*), mountain mahogany (*Cercocarpus montanus*), and fourwing saltbush (*Atriplex canescens*).

There are numerous seeps and springs associated with the Range Creek HMA. Wild horse utilization levels on the HMA have been heavy near a few springs.

3.7.2.4 Habitat Fragmentation Modeling for Wild Horses

Based on public scoping comments and discussions during preparation of the EIS, it was determined that the impact analyses for wild horses would be strengthened by a formal habitat fragmentation analysis. In order to determine the extent of existing habitat fragmentation, preliminary fragmentation analyses were conducted based on existing surface disturbance in the WTP Project Area. The specific goals of the fragmentation modeling exercise for wild horse use areas were to:

- To determine/quantify the extent and spatial configuration of existing habitat fragmentation in wild horse use areas within the Range Creek HMA; and
- To determine/quantify patch size, edge effects, and connectivity to supplement existing surface disturbance analyses in the EIS.

Based on discussions with the BLM Resource Specialists, the following spatial buffers were placed around existing development features in order to model the extent of wild horse habitat fragmentation from existing surface disturbance:

- 200-meter buffer around all well pads; and
- 200-meter buffer from the centerline of all roads and pipelines.

Using GIS software, these spatial buffers were then clipped to wild horse use areas within the Range Creek HMA to determine/quantify the extent and spatial configuration of existing habitat fragmentation within the WTP Project Area[1].

Based on the modeling exercise, it appears that current wild horse use areas have been fragmented to varying degrees by existing development. Approximately 11,088 acres of the approximately 36,563 acres (or approximately 30.1 percent) of wild horse use areas within the WTP Project Area have been fragmented by existing surface disturbance and infrastructure. The extent of existing habitat fragmentation for each wild horse use area of the Range Creek HMA within the WTP Project Area is summarized below in **Table 3.7-3** and illustrated in **Figure 4** of **Appendix I**. Further discussion of the habitat fragmentation exercise may be found in **Appendix I**.

Table 3.7-3 Extent of Existing Habitat Fragmentation in Wild Horse Use Areas of the Range Creek HMA within the WTP Project Area

Wild Horse Use Areas within the Range Creek HMA	Existing Fragmentation/ Total Herd Use Area Lost (acres)	Percent of Herd Use Area	# of Patches	Average Patch Size (acres)	Smallest Patch (acres)	Largest Patch (acres)
Flat Iron/Twin Hollow	4,383	40.1	5	1,693	102	6,424
Cottonwood Ridge	5,090	34.7	9	1,064	208	2,618

[1] Baseline fragmentation analyses were conducted using data available at the time the NOI for this EIS was filed (August 2005). It should be recognized that since publication of the NOI, natural gas development within the WTP has continued under authorizations based on the previous NEPA analyses and provisions of the Energy Policy Act of 2005.

Table 3.7-3 Extent of Existing Habitat Fragmentation in Wild Horse Use Areas of the Range Creek HMA within the WTP Project Area						
Wild Horse Use Areas within the Range Creek HMA	**Existing Fragmentation/ Total Herd Use Area Lost (acres)**	**Percent of Herd Use Area**	**# of Patches**	**Average Patch Size (acres)**	**Smallest Patch (acres)**	**Largest Patch (acres)**
Cedar Ridge/Bishop	1,535	14.0	4	2,329	183	4,981

3.8 VEGETATION

3.8.1 WTP Project Area Vegetation

The distribution of vegetation types within the WTP Project Area can primarily be attributed to a combination of localized climate, soils, and topography. The WTP Project Area lies within a major land resource area (MLRA), as described by the USDA-Natural Resources Conservation Service (NRCS), known as the Central Desert Basin, Mountains, and Plateau area. This geographic region is located in the 6 to 9-inch precipitation zone. Saline and alkaline soils greatly influence plant growth. Altitude changes between valley floors and plateau tops affect vegetation distribution (BLM 2004b).

Utah Geographic Approach to Planning (GAP) data and land cover information provide a general illustration of land cover for the entire Price Field Office. Cover type categories are listed by principal species, which define the cover type. Cover type mapping is done on a landscape scale, identifying primary associated species that can occur as localized or substantial areas within the given cover type (Edwards et al. 1995). For the purposes of this EIS, vegetation types within the WTP Project Area are addressed based on Utah GAP data cover types and mapping.

The WTP Project Area ranges from approximately 4,500 to 9,000 feet in elevation and supports vegetation types ranging from lowland riparian to mountain fir. The pinyon-juniper vegetation type dominates the WTP Project Area, comprising approximately 50,909 acres, or roughly 40 percent of the WTP Project Area. **Figure 3.8** illustrates all Utah GAP vegetation cover types located within the WTP Project Area, and those vegetation communities (including pinyon-juniper, sagebrush, and pinyon) northwest of the WTP Project Area associated with the Trail Canyon alternative access route. In addition, **Table 3.8-1** indicates approximate acreages and percent coverage for all vegetation cover types identified within the WTP Project Area. A brief description of their respective associated vegetation and understory species follows in the paragraphs below.

Table 3.8-1 Utah GAP Vegetation Cover Types of the WTP Project Area		
Utah GAP Vegetation Cover Type[1]	**Number of Acres within the WTP Project Area**	**Percent of Cover Type within the WTP Project Area**
Aspen	<1	0.00
Dry Meadow	271	0.20

Table 3.8-1 Utah GAP Vegetation Cover Types of the WTP Project Area		
Utah GAP Vegetation Cover Type[1]	**Number of Acres within the WTP Project Area**	**Percent of Cover Type within the WTP Project**
Grassland	197	0.14
Juniper	16,567	12.02
Lowland Riparian	95	0.07
Mountain Fir	1,788	1.30
Pinyon	7,296	5.29
Pinyon-Juniper	50,909	36.94
Ponderosa Pine/Mountain Shrub	3,928	2.85
Sagebrush	22,950	16.65
Sagebrush/Perennial Grass	11,044	8.01
Salt Desert Scrub	22,130	16.06
Spruce-Fir	655	0.48
Total	**137,930**	**100.00**

[1]Utah GAP Vegetation Cover Type does not include acreage calculations for water features or wetland areas located within the WTP Project Area.

3.8.1.1 Aspen

The aspen cover type is a deciduous forest principally dominated by quaking aspen (*Populus tremuloides*). Primary associated conifer species include spruce (*Picea engelmannii* and *Picea pungens*), fir (A*bies lasiocarpa*, *Abies concolor*, and *Pseudotsuga menziesii*), and pine (*Pinus contorta* and *Pinus ponderosa*). Primary associated shrub species include snowberry (*Symphoricarpos* spp.) and serviceberry (*Amelanchier alnifolia*) (Edwards et al. 1995).

3.8.1.2 Dry Meadow (Herbaceous Dry Meadow, Including Mostly Forbs and Grasses)

Principal forb species in the dry meadow cover type include yarrow (*Achillea millefolium*), dandelion (*Taraxacum officinale*), Richardson's geranium (*Geranium richardsonii*), penstemon (*Penstemon* spp.), mulesears (*Wyethia amplexicaulis*), golden aster (*Chrysopis villosa*), arrowleaf balsamroot (*Balsamorhiza sagittata*), hawkbit (*Agoseris pumila*), larkspur (*Delphinium spp*.), and scarlet gilia (*Ipomopsis aggregate*). Principal grass species include wheatgrass (*Agropyron* spp.), needlegrass (*Stipa* spp.), timothy (*Phleum* spp.), bluegrass (*Poa* spp.), spike trisetum (*Trisetum spicatum*), and some sedges (*Carex* spp.). Primary associated shrub species include sagebrush (*Artemisia spp*.), rabbitbrush (*Chrysothamnus viscidiflorus*), cinquefoil (*Potentilla fruitcosa*), snowberry (*Symphoricarpos spp*.), and elderberry (*Sambucus cerulean*) (Edwards et al. 1995).

3.8.1.3 Grassland (Perennial and Annual Grasslands)

Principal perennial grass species in the grassland cover type include bluebunch wheatgrass (*Agropyron spicatum*), sandberg bluegrass (*Poa secunda*), crested wheatgrass (*Agropyron cristatum*), basin wildrye (*Elymus cinereus*), galleta (*Hilaria jamesii*), needlegrass (*Stipa comata*), sand dropseed (*Sporobolus cryptandrus*), blue gramma (*Bouteloua gracilis*), thurbers needlegrass (*Stipa thurberiana*), western wheatgrass (*Agropyron smithii*), squirreltail (*Sitanion hystrix*), and Indian ricegrass

(*Oryzopsis hymenoides*). Principal annual grass species include cheatgrass (*Bromus tectorum*), an invasive weed species. Primary associated shrub species include sagebrush (*Artemisia* spp.), shadscale (*Atriplex confertifolia*), and greasewood (*Sarcobatus vermiculatus*). Primary associated tree species include juniper (*Juniperus* spp.) (Edwards et al. 1995).

3.8.1.4 Juniper

The juniper cover type is a coniferous forest type principally dominated by juniper (*Juniperus scopulorum* and *Juniperus osteosperma*). Primary associated tree species include pinyon (*Pinus edulis*) and mountain mahogany (*Cercocarpus ledifolius*). Primary associated shrub species include sagebrush (*Artemisia* spp.) (Edwards et al. 1995).

3.8.1.5 Lowland Riparian (Riparian Areas Generally Lower Than 5500 Feet)

In lowland riparian areas, principal woody species include fremont cottonwood (*Populus fremontii*), salt cedar (*Tamarix ramosissima*), netleaf hackberry (*Celtis reticulate*), velvet ash (*Fraxinus velutina*), desert willow (*Chilopsis linearis*), sandbar willow (*Salix exigua*), and squawbush (*Rhus trilobata*) (Edwards et al. 1995).

3.8.1.6 Mountain Fir

The mountain fir is a coniferous forest principally dominated by combinations of white fir (*Abies concolor*) and Douglas fir (*Pseudotsuga menziesii*). Primary associated tree species include ponderosa pine (*Pinus ponderosa*), pinyon (*Pinus edulis*), spruce (*Picea engelmannii* and *Picea pungens*), and subalpine fir (*Abies lasiocarpa*) (Edwards et al. 1995).

3.8.1.7 Pinyon

The pinyon cover type is a coniferous forest type principally dominated by pinyon (*Pinus edulis*). Primary associated tree species include juniper (*Juniperus spp.*), ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), and Douglas fir (*Pseudotsuga menziesii*). Primary associated shrub species include oak (*Quercus gambelii*) and sagebrush (*Artemisia* spp.) (Edwards et al. 1995).

3.8.1.8 Pinyon-Juniper

The pinyon-juniper cover type is a coniferous forest type principally co-dominated by pinyon (*Pinus edulis*) and juniper (*Juniperus scopulorum* and *Juniperus osteosperma*). Primary associated tree species include mountain mahogany (*Cercocarpus ledifolius*). Primary associated shrub species include sagebrush (*Artemisia* spp.) (Edwards et al. 1995).

3.8.1.9 Ponderosa Pine/Mountain Shrub

The ponderosa pine/mountain shrub cover type is a coniferous forest type or woodland with ponderosa pine (*Pinus ponderosa*) as the dominant/associate or co-dominant species with mountain shrubs. Principal mountain shrub associate species include manzanita (*Arctostaphylos* spp.), bitterbrush (*Purshia tridentata*), oak (*Quercus gambelii*), snowberry (*Symphoricarpos* spp.), and curlleaf mountain mahogany

(*Cercocarpus ledifolius*). Primary associated tree species include juniper (*Juniperus* spp.), pinyon (*Pinus* spp.), white fir (*Abies concolor*), and Douglas fir (*Pseudotsuga menziesii*). Primary associated shrub species include sagebrush (*Artemesia* spp.) and rabbitbrush (*Chrysothamnus viscidiflorus*) (Edwards et al. 1995).

3.8.1.10 Sagebrush

The sagebrush cover type consists of shrubland principally dominated by big sagebrush (*Artemisia tridentata*), black sagebrush (*Artemisia nova*), low sagebrush (*Artemisia arbuscula*), or silver sagebrush (*Artemisia cana*). Primary associated tree species include juniper (*Juniperus* spp.), pinyon (*Pinus* spp.), mountain mahogany (*Cercocarpus ledifolius*), and ponderosa pine (*Pinus ponderosa*). Primary associated shrub species include rabbitbrush (*Chrysothamnus spp*.), snakeweed (*Gutierrezia sarothrae*), winterfat (*Ceratoides lanata*), shadscale (*Atriplex confertifolia*), and bitterbrush (*Purshia tridentata*) (Edwards et al. 1995).

3.8.1.11 Sagebrush/Perennial Grass

The sagebrush/perennial grass cover type occurs in areas where sagebrush shrubland and perennial grassland are co-dominant species. Principal shrub species include sagebrush (*Artemisia tridentata*, *Artemisia nova,* or *Artemisia cana*). Principal grass species include bluebunch wheatgrass (*Agropyron spicatum*), sandberg bluegrass (*Poa secunda*), crested wheatgrass (*Agropyron cristatum*), needlegrass (*Stipa comata*), sand dropseed (*Sporobolus cryptandrus*), blue grama (*Bouteloua gracilis*), thurbers needlegrass (*Stipa thurberiana*), western wheatgrass (*Agropyron smithii*), Indian ricegrass (*Achnatherum hymenoides*), and galleta (*Hilaria jamesii*). Associated principal shrub species include rabbitbrush (*Chrysothamnus* spp.), bitterbrush (*Purshia tridentata*), and oak (*Quercus spp*.). Associated principal annual grass species include cheatgrass (*Bromus tectorum*), an invasive weed species (Edwards et al. 1995).

3.8.1.12 Salt Desert Scrub

Salt desert scrub shrublands are principally dominated by shadscale (A*triplex confertifolia*), gray molly (*Kochia vestita*), mat-atriplex (*Atriplex corrugate*), castle valley clover (*Atriplex cuneata*), winterfat (*Ceratoides lanata*), budsage (*Artemesia spinescens*), fourwing saltbush (*Atriplex canescens*), mormon tea (*Ephedra* spp.), horsebrush (*Tetradymia canescens*), snakeweed (*Gutierrezia sarothrae*), and rabbitbrush (*Chrysothamnus* spp.). Primary associated shrub species include greasewood (*Sarcobatus vermiculatus*) and sagebrush (*Artemisia* spp.). Primary associated forb species include halogeten (*Halogeten glomeratus*), an invasive weed species (Edwards et al. 1995).

3.8.1.13 Spruce-Fir

The spruce-fir cover type is a coniferous forest type principally dominated by combinations of spruce (*Picea engelmannii* and *Picea pungens*) and sub-alpine fir (*Abies lasiocarpa*). Primary associated tree species include lodgepole (*Pinus contorta*), white fir (*Abies concolor*), Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), and bristlecone pine (*Pinus aristata*) (Edwards et al. 1995).

3.8.2 Riparian Areas

The BLM Manual 1737, Riparian-Wetland Area Management, defines riparian areas as a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands adjacent to, or contiguous with, perennially and intermittently flowing rivers and streams are typical riparian areas. Excluded are sites such as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil (BLM 1998).

Although riparian areas comprise less than 1 percent of the 22-million acres administered by the BLM in Utah, these unique areas are considered to be among the most important, productive, and diverse in the State. Healthy and productive riparian areas provide water, food, cover, and travel corridors for many aquatic and terrestrial wildlife species, some of which are obligate species to riparian areas and are not found in dryer, upland habitats. Native riparian plants and their root systems contribute to improved water quality and quantity by holding soils in place while filtering sediments, increasing groundwater recharge, and protecting stream banks. Riparian areas can also provide value to the general public for a wide variety of recreation activities and aesthetic attributes (BLM 2005b).

In recognition of the importance of riparian areas, the BLM developed the Riparian-Wetland Initiative for the 1990s. This initiative established national goals and objectives for maintaining riparian-wetland resources on public lands and included a strategy that focused management on entire watersheds. The Utah Riparian Management Policy is tiered to this national strategy (BLM 2005b). Its purpose is to provide specific guidance for management of Utah's riparian areas on BLM lands, while also supporting the BLM national directives. The objective of the Utah Riparian Management Policy is to establish an aggressive riparian management program that will identify, maintain, and/or improve riparian values to achieve a healthy and productive ecological condition for maximum long-term benefits, in order to provide watershed protection while still preserving quality riparian-dependent aquatic and terrestrial species habitats, and as appropriate, allow for reasonable resource uses (BLM 2005b).

The BLM utilizes the concept of Proper Functioning Condition (PFC) to delineate riparian habitat quality and to assist in guiding management actions. The following definitions are used when determining the PFC of a given riparian area (BLM 2004b):

- *Proper Functioning Condition* – The ability of the riparian area to dissipate energy, filter sediment, transfer nutrients, develop ponds, and channel characteristics that benefit wildlife populations and improve water retention and groundwater recharge, while improving stream bank stability and supporting greater biodiversity.
- *Functioning-At-Risk* – Riparian-wetland areas that are in functional condition but an existing soil, water, or vegetation attribute makes them susceptible to degradation. The following are categories of Functioning-at-Risk riparian areas:
    - *Upward Trend* – Those riparian areas in which changes in management strategies have shown an increase in riparian vegetative communities and improved bank stability.

- o *Stable Trend* – Those riparian areas that have not demonstrated significant upward or downward trends in vegetative communities and/or bank stability.
- o *Downward Trend* – Those riparian areas in which there has been a significant deterioration in riparian vegetative communities, a decrease in bank stability, and an increase in erosion of stream banks.

- *Non-Functioning* – Riparian areas where stream flow has been altered, the stream channel is degraded, vegetation is insufficient to naturally reseed the area, exotic plants (e.g., tamarisk [*Tamarix ramosissima*]) are present, and there is a lack of structural components such as woody debris.

The Utah Riparian Management Policy mandates that the BLM Field Offices maintain and/or improve riparian areas to PFC by incorporating riparian resource needs into RMPs and other land use planning documents (BLM 2005b). Riparian areas are considered properly functioning when adequate vegetation, land form, or large woody debris is present to:

- Dissipate stream energy associated with high water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve floodwater retention and groundwater recharge;
- Develop root masses that stabilize stream banks against cutting action;
- Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for native fish production, waterfowl breeding, and other uses; and
- Support great biodiversity (BLM 2005b).

Riparian functioning condition assessments have been completed by the BLM for several riparian areas within the Price Field Office, including many riparian areas identified in the WTP Project Area. **Table 3.8-2** shows the most recent PFC for each of the riparian areas located in the WTP Project Area.

Table 3.8-2 Riparian Functioning Condition Assessments of Riparian Areas Present within the WTP Project Area

Riparian Areas within the WTP Project Area	Assessment Completed	Proper Functioning Condition
Cottonwood Canyon	1994	Lower 1/3 is non-functioning with an improving trend.
		Middle 1/3 is functioning-at-risk with an improving trend.
		Upper 1/3 is functioning-at-risk with a declining trend.
Dry Canyon	1994	Lower 1/3 is non-functioning with an improving trend.
		Middle 1/3 is functioning-at-risk with a declining trend.
		Upper 1/3 is functioning-at-risk with an improving trend.
Green River	2001	Proper functioning condition.
Harmon Canyon	NA	Assessment has not been completed.
Jack Creek	1994	Lower 1/3 is non-functioning with an improving trend.

Table 3.8-2 Riparian Functioning Condition Assessments of Riparian Areas Present within the WTP Project Area		
Riparian Areas within the WTP Project Area	**Assessment Completed**	**Proper Functioning Condition**
		Middle 1/3 is properly functioning.
		Upper 1/3 (above Cedar Ridge Road) is functioning-at-risk with no apparent trend.
Nine Mile Creek	1994	From mouth to Pinnacle Canyon is functioning-at-risk with no apparent trend.
		From Pinnacle Canyon confluence to Dry Canyon confluence is Proper Functioning Condition with a downward trend.
		From Dry Canyon confluence to Water Canyon confluence is functioning-at-risk with an improving trend.
Stone Cabin Draw	1998	Functioning at-risk with an improving trend.

Source: Ivory (2007b) and Ivory (2008)

Two BLM management strategies deter surface-disturbing activities from occurring within riparian areas: the Price River MFP (BLM 1984a) and the Utah Riparian Management Policy (BLM 2005b). The Price River MFP states that NSO would be allowed within the 100-year floodplain or 330-feet on either side from the centerline, whichever is greater, along all intermittent and perennial streams. An exception to this stipulation can be authorized if there are no practical alternatives or impacts could be fully mitigated. Similarly, the Utah Riparian Management Policy states that no new surface-disturbing activities would be allowed within 100 meters of riparian areas unless it can be shown that either 1) there are no practical alternatives or, 2) all long-term impacts can be fully mitigated or, 3) the activity would benefit and enhance the riparian area. In addition to these BLM policies and management strategies, Executive Orders 11988 (Floodplain Management) and 11990 (Wetland Management) also protect riparian areas on Federal lands. These policies require that actions proposed within a riparian area be analyzed to 1) determine reasonable alternatives to the location and taking of the action within a riparian area, 2) mitigate any long-term impacts, to the extent possible, from actions implemented within riparian areas (no action should be an option if impacts cannot be mitigated), and 3) maintain riparian areas in public ownership (BLM 2005b).

According to Utah GAP data, there are approximately 95 acres of lowland riparian habitat within the WTP Project Area. However, given the scale of Utah GAP vegetation mapping (1:119,000), pockets of riparian habitat not identified by GAP data may exist. Riparian areas of primary importance and concern may include Dry Canyon, Jack Creek, and Nine Mile Creek, due to higher proposed development concentrations in these areas. Other important riparian areas could include perennial streams such as the Green River and Cottonwood Creek, and drainages such as Harmon Canyon and Stone Cabin Draw. Individual riparian stands may range from a few square feet to a few acres.

Within the WTP Project Area, riparian areas are found in locations (such as along creeks and streams) with visible vegetation or physical characteristics demonstrating the influence of permanent water. Principal woody riparian species found within the WTP Project Area include willow (*Salix* spp.), narrowleaf cottonwood (*Populus augustifolia*), thinleaf alder (*Alnus tenuifolia*), water birch (*Betula occidentalis*), black hawthorn

(*Crataegus douglasii*), Rocky Mountain maple (*Acer glabrum*), red-osier dogwood (*Cornus stolonifera*), and wild rose (*Rosa woodsii*).

3.8.3 Wetland Areas

Executive Order No. 11990 (42 F.R. 26961) outlines that agencies must minimize destruction, loss or degradation of wetlands, as well as preserve the natural function of wetland areas on Federal lands when carrying out responsibilities pertaining to water and other related land resource activities. In adherence with this management objective, the U.S. Army Corps of Engineers Wetland Delineation Manual refers to wetlands as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Environmental Laboratory 1987). Principal wetland species include cattail (*Typha latifolia*), bullrush (*Scirpus* spp.), and sedge (*Carex* spp.).

No surveys have been conducted by the BLM within the WTP Project Area to identify or delineate specific wetlands. However, wetland areas are usually located within riparian areas. Nine Mile Creek is known to contain active beaver dams that have created ponds and associated wetlands within the canyon (BLM 2004b). Other wetland areas may occur within the WTP Project Area in high meadows associated with springs and seeps, but are likely limited given the area's relative lack of surface water and annual precipitation.

3.8.4 Invasive and Noxious Plants

The Utah Noxious Weed Act (Section 4-17-2) defines a noxious weed as any plant that the Commissioner of Agriculture and Food determines to be especially injurious to public health, crops, livestock, land, or other property. The Utah Noxious Weed Act also vests the Commissioner of Agriculture and Food with authority to designate and publish a noxious weed list for the State of Utah (Section 4-17-3). As of March 1, 2007, the Utah Commissioner had identified 18 noxious weeds for the State of Utah; and Carbon County had identified one additional noxious weed (Utah Weed Control Association 2007). Other invasive weed species, such as cheatgrass (*Bromus tectorum*), may be of management concern but are not considered priorities for noxious weed work or funding, and therefore are not included on the noxious weed list.

A weed inventory completed by Carbon County in 2005 identified populations of noxious weed species within the WTP Project Area. Nearly all weed species found within the WTP Project Area were located along existing transportation corridors. Black henbane (*Hyoscyamus niger*), the most prevalent noxious weed species, was found largely in the western portion of the WTP Project Area along existing roads. **Table 3.8-3** lists the occurrence of known invasive and noxious weeds within the WTP Project Area, including those observed by the BLM or USFWS or identified and published by the Utah Commissioner of Agriculture and Food and Carbon County.

Table 3.8-3 Invasive and Noxious Plants Identified on Public Lands within the WTP Project Area

Common Name	Scientific Name	State of Utah Noxious Weed[1]	Carbon County Noxious Weed[2]	Occurrence in WTP Project Area[3]
Bindweed (Wild Morning-glory)	*Convolvulus* spp.	Yes		Yes, occurs along most roadsides.
Black Henbane	*Hyoscyamus niger*	N/A	N/A	Yes, occurs along Prickly Pear Canyon Road, Harmon Canyon Road, and along spur roads in the Stone Cabin Gas Field.
Broad-leaved Peppergrass (Tall Whitetop, Perennial Pepperweed)	*Lepidium latifolium*	Yes		Yes, is primarily confined to the Green River corridor.
Cheatgrass[4]	*Bromus tectorum*	N/A	N/A	Yes, occurs throughout the WTP Project Area.
Houndstongue	*Cynoglossum officinal*	N/A	N/A	Yes, occurs along most roadsides.
Leafy Spurge	*Euphorbia esula*	Yes		Yes, occurs along Nine Mile Canyon Road on private land near Water Canyon (Hunt Oil property).
Musk Thistle	*Carduus nutans*	Yes		Yes, occurs along Cottonwood Spur Road along Nine Mile travel corridor, in Dry Canyon and Stone Cabin Draw.
Russian Knapweed	*Centaruea repens*	Yes		Yes, occurs along Nine Mile Canyon, Mount Bartles Road, and Cottonwood Canyon Road.
Russian Olive	*Elaegnus angustifolia*		Yes	Potentially present along Nine Mile Creek.
Tamarisk (Salt Cedar)	*Tamarix ramosissima*	N/A	N/A	Yes, occurs along all listed drainages.
Whitetop	*Cardaria* spp.	Yes		Yes, occurs along Cottonwood Canyon Road.

[1]State of Utah Noxious Weed list officially designated and published for the State of Utah, as per the authority vested in the Commissioner of Agriculture and Food under Section 4-17-3 of the 2007 Utah Noxious Weed Act.
[2]Carbon County Noxious Weed list (BLM 2004b; Utah Weed Control Association 2007).
[3] Source: BLM (2007a).
[4]Although not listed as a noxious weed, cheatgrass is a very invasive species that is present throughout the WTP Project Area.
N/A = Not applicable

Federal, State, and local laws and regulations govern the Price Field Office invasive and noxious species program, which aims to prevent and control the spread of noxious weeds. The Price Field Office has an existing memorandum of understanding (MOU) with Carbon County for noxious weed control. As such, aggressive treatments are used on seven invasive and noxious species within the Price Field Office: black henbane, Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), purple loosestrife (*Lythrum salicarion*), Russian knapweed (*Acroptilon repends*), Scotch thistle (*Onopordum acanthium*), and whitetop (*Cardaria* spp.) (BLM 2004b).

3.9 WILDLIFE AND FISHERIES

The WTP Project Area supports a diversity of wildlife and wildlife habitats, including approximately 137,930 acres of wildlife habitat ranging in elevation from 4,500 to 9,000 feet. Vegetation within the WTP Project Area is dominated by pinyon-juniper communities along the benches and plateaus with big sagebrush and rubber rabbitbrush as the associated shrub species. For a more detailed description of the habitat types found in the WTP Project Area, refer to **Section 3.8** (Vegetation). Current land uses affecting wildlife populations and wildlife habitats include mineral resource extraction, livestock grazing, wildlife habitat improvement projects, hunting, dispersed recreation, and cultural/heritage tourism.

3.9.1 General Wildlife

Mammals typically found within the WTP Project Area and surrounding region include cottontail rabbits (*Sylvilagus* spp.), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), black bear (*Ursus americanus*), mountain lion (*Puma concolor*), and various species of rodents and bats. Typical birds common to the WTP Project Area include black-billed magpie (*Pica pica*), canyon wren (*Catherpes mexicanus*), common raven (*Corvus corax*), waterfowl, several species of sparrow, and numerous other species. Reptiles and amphibians with the potential to occur in the WTP Project Area include wandering garter snake (*Thamnophis elegans vagrans),* Great Basin gopher snake (*Pituophis catenifer*), Great Basin spadefoot (*Spea intermontana*), western whiptail (*Cnemidophorus tigris*), sagebrush lizard (*Sceloporus graciosus*), and shorthorned lizard (*Phrynosoma hernandesi*).

Although all of these species are important members of wildland ecosystems and communities, most are common and have widespread distributions within the region. Consequently, the relationship of these species to the Proposed Action and alternatives is not discussed with the same depth as species that are threatened, endangered, candidate, sensitive, of special economic interest, or are otherwise of high public interest or unique value.

3.9.2 Big Game Species

Three resident big game species are known to occur within the WTP Project Area: mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus nelsoni*), and Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*).

For big game species, the UDWR has identified various types of seasonal ranges (e.g., spring/fall, summer, winter, and yearlong). The BLM utilizes these seasonal habitat type definitions for management decisions and habitat designations. Types of seasonal ranges are then ranked according to their relative biological value using the following definitions:

- ***Crucial Value***: Habitat on which the local population of a wildlife species depends for survival because there are no alternative ranges or habitats available. Crucial value habitat is essential to the life history requirements of a wildlife species. Degradation or unavailability of crucial habitat will lead to significant declines in carrying capacity and/or numbers of wildlife species in question (UDWR 2007).

- ***Substantial Value***: Habitat that is used by a wildlife species but is not crucial for population survival. Degradation or unavailability of substantial value habitat will not lead to significant declines in carrying capacity and/or numbers of the wildlife species in question (UDWR 2007).

Mule Deer

Mule deer are common throughout Utah and occur in habitats ranging from open deserts to high mountains to urban areas (UDWR 2007). Mule deer habitat is characterized by shrublands composed of thick brush or trees interspersed with small openings on rough, broken terrain (Fitzgerald et al. 1994; UDWR 2003a). Areas of thick shrubs or trees provide protection from heat, cold, and wind, while open areas are used for forage (Wilson and Ruff 1999; UDWR 2003a). Mule deer do best in habitats composed of young and emerging plants and diets, which in the Price Field Office generally consist primarily of Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) (BLM 2004b; UDWR 2003a).

In the Price Field Office, mule deer are migratory and move seasonally from summer to winter ranges (BLM 2004b). Summer range is generally found in high elevational ranges in aspen, conifer, and mountain browse communities (BLM 2004b; Fitzgerald et al. 1994). During the winter, mule deer migrate to lower elevational ranges, generally to areas occupied by sagebrush and pinyon-juniper vegetation (BLM 2004b; Wilson and Ruff 1999). Mule deer often exhibit a high degree of fidelity to specific winter range areas (BLM 2004b).

In Utah, breeding periods peak in mid-November, with spring fawning occurring primarily in mountain browse areas between late May and mid-June (BLM 2004b; ODFW 2003; UDWR 2003a; UDWR 2007). Fawning habitat generally includes area of low shrubs with adequate water, cover, and succulent vegetation (Olson 1992). Riparian habitats provide quality fawning conditions for improved growth rates and survival during the first year of life (Olson 1992).

The Nine Mile mule deer herd management unit is comprised of two subunits: Range Creek and Anthro. The WTP Project Area occurs within the Range Creek subunit. Mule deer population levels have decreased State-wide since 2000, and population levels in the Range Creek subunit have increased only marginally since the severe declines of the 1980s and early 1990s (BLM 2004b; UDWR 2003a). The declines of the 1980s and 1990s were attributed primarily to severe drought conditions, which substantially reduced animal condition, fawn production, and survival (BLM 2004b). In 2004, the UDWR reduced the population objective of wintering mule deer on the Range Creek subunit from 6,000 to 5,800 mule deer. This reduction occurred primarily to account for the loss of habitat due to oil and gas development, but also to account for habitat loss associated with sagebrush mortality, pinyon-juniper encroachment, road improvements, and urban expansion (Crompton 2008). The UDWR currently manages the Range Creek subunit to maintain a herd composition of 15 to 20 bucks per 100 does (UDWR 2006). Population levels in the Range Creek subunit were estimated to be approximately 2,800 mule deer in 2006, and increased to 2,950 mule deer in 2007, which is 49 percent below the current population objective (Crompton 2008). Current and recent mule deer population trends for the Range Creek subunit are illustrated below in **Figure 3.9-1**.

Mule deer populations within the WTP Project Area are still at low levels due to many years of consecutive drought. Summer range habitat condition has been identified as a factor currently limiting mule deer population growth (UDWR 2007). However, winter range habitats in the Range Creek subunit are considered to be in good condition (BLM 2004b).

Mule deer utilize nearly all of the WTP Project Area as crucial and substantial wintering grounds; however, some crucial summer, crucial spring/fall, and crucial year-long mule deer habitats have been identified along the WTP Project Area boundaries. UDWR-identified mule deer habitats within the WTP Project Area are summarized below in **Table 3.9-1** and illustrated in **Figure 3.9-2** (see **Appendix A**).

The Anthro subunit is located north of Nine Mile Canyon Road and east of Argyle Canyon. It is adjacent to, but outside of, the WTP Project Area. Discussion of this subunit has been included in the EIS because under Alternative C, BBC and other operators would be required to construct a new route through Trail Canyon. This alternative access route, as illustrated in **Figure 2.4-1** (see **Appendix A**), would be constructed in UDWR-identified crucial value, spring/fall habitat and in UDWR-identified substantial value, winter habitat for mule deer. According to the UDWR mule deer herd management plan, the Anthro subunit is managed toward a winter population size of 2,500 mule deer. Similar to the Range Creek subunit, the Anthro subunit is currently below its proposed population objective. Population estimates from 2005 suggested a winter population of 1,500 mule deer, which is 40 percent below the population objective.

Table 3.9-1 Mule Deer Habitat Acreage and Values as Identified by UDWR

UDWR-identified Habitat Values	Total Acreage within the WTP Project Area	Percentage of Total WTP Project Area (approx. 137,930 total acres)
Year-long Habitat		
Crucial	3,779	2.7
Winter Habitat		
Crucial	73,600	53.4
Substantial	47,115	34.2
Additional Habitat Types		
Crucial spring/fall	4,804	3.5
Crucial summer	8,634	6.3

Elk

Elk are common in most mountainous regions of Utah, where they can be found in mountain meadows and forests during the summer and in foothills and grasslands during the winter (UDWR 2007). Elk are gregarious animals, with herds of more than 200 occurring in open habitats; however, group sizes are generally smaller in heavily forested habitats (Wilson and Ruff 1999). Elk are generalist feeders, and food sources include grasses, forbs, and shrubs with browse becoming a primary food source in the winter (Fitzgerald et al. 1994; UDWR 2005a).

Elk are migratory and move seasonally between summer and winter ranges. Migrating elk will generally follow melting snow pack uphill in the spring. Summer habitat is composed of aspen, conifer, and mountain shrub vegetation at higher elevational ranges (BLM 2004b; Fitzgerald et al. 1994). Fall migrations are triggered by weather and forage availability, causing elk to move to mid to lower-elevational areas during winter (BLM 2004b; Fitzgerald et al. 1994). Elk winter in areas of mountain browse, sagebrush, and pinyon-juniper vegetation types, where they congregate in large, mixed herds (BLM 2004b).

Elk usually breed during late September or early October with calving occurring in late spring (Wilson and Ruff 1999; UDWR 2007). Elk calving grounds are generally located in areas with plenty of cover, forage, and water availability (Fitzgerald et al. 1994).

The Nine Mile elk herd management unit is comprised of two subunits: Range Creek and Anthro. The WTP Project Area occurs within the Range Creek subunit. Elk were reintroduced into the Nine Mile Canyon area through a joint agreement between the BLM and UDWR in the early 1990s (BLM 2004b). In 2008, the UDWR increased the population objective of wintering elk on the Nine Mile elk herd unit by 600 elk (or 35 percent) from the 2001 herd management plan of 1,700 elk. This increase focused entirely on the portion of the Range Creek subunit south of Nine Mile Canyon, where the majority of elk habitat is on private lands. As a result of these changes, the breakdown of population objectives for the Range Creek subunit, effective beginning in winter 2008/2009, is 1,350 elk south of Nine Mile Canyon Road (within the WTP Project Area), and 250 elk north of Nine Mile Canyon Road and west of Argyle Canyon Road (outside of the WTP Project Area) (UDWR 2008).

Population assessments have been conducted for the Range Creek subunit. A 2005 aerial population assessment estimated the population of the Range Creek subunit at 2,000 elk. This subunit was last surveyed in 2006 when 1,826 elk were counted; this count was then used to project the 2007 wintering population at 2,000 elk (UDWR 2008). Current and recent elk population trends for the entire Range Creek subunit (both north and south of Nine Mile Canyon Road) are illustrated in **Figure 3.9-3**.

UDWR-identified elk habitats within the WTP Project Area are summarized below in **Table 3.9-2** and are illustrated in **Figure 3.9-4** (see **Appendix A**). Habitats on both summer and winter ranges within the WTP Project Area are considered to be in good condition and are not identified as a limiting factor to elk populations (BLM 2004b).

The Anthro subunit is located north of Nine Mile Canyon Road and east of Argyle Canyon. It is adjacent to, but outside of, the WTP Project Area. Discussion of this subunit has been included in the EIS because under Alternative C, BBC and other operators would be required to construct a new route through Trail Canyon. This alternative access route, as illustrated in **Figure 2.4-1** (see **Appendix A**), would be constructed in UDWR-identified substantial value, year-long habitat for elk. According to the UDWR elk herd management plan, the Anthro subunit is managed toward a winter population size of 700 elk. Similar to the Range Creek subunit, the Anthro subunit has increased over the past decade and is currently above its population objective. Population surveys, last conducted in January of 2007, suggested a winter population of 1,000 elk (UDWR 2008).

Table 3.9-2 Elk Habitat Acreage and Values as Identified by UDWR		
UDWR-identified Habitat Values	**Total Acreage within the WTP Project Area**	**Percentage of Total WTP Project Area (approx. 137,930 total acres)**
Winter Habitat		
Crucial	80,139	58.1
Substantial	24,545	17.8
Additional Habitat Types		
Crucial summer	10,120	7.3
Substantial Year-long	22,984	16.7

Rocky Mountain Bighorn Sheep

The Rocky Mountain bighorn sheep is native to Utah and prefers open habitat types with adjacent steep rocky areas for escape and safety (Wilson and Ruff 1999; UDWR 2000). Bighorn sheep are gregarious animals and are usually found in groups of five to eighty individuals (Fitzgerald et al. 1994; Wilson and Ruff 1999). The diet of bighorn sheep vary based on season and availability but consists mainly of grasses, forbs, and shrubs (UDWR 1999; UDWR 2007).

Unlike mule deer and elk, Rocky Mountain bighorn sheep in the Price Field Office do not migrate between seasonal ranges (BLM 2004b). However, some seasonal movement within their range does occur, such as ewes moving to reliable water sources during the lambing season (BLM 2004b). Breeding generally occurs in November and December with young born in May or June (Fitzgerald et al. 1994; UDWR 2007).

The WTP Project Area occurs within the Nine Mile herd management unit for bighorn sheep. Rocky Mountain bighorn sheep were extirpated from the Price Field Office by the early 1920s (BLM 2004b). However, the species was reestablished via reintroduction into the Nine Mile Canyon area through a cooperative agreement between the BLM and UDWR beginning in the 1990s (BLM 2004b). Additionally, bighorns have been documented using the lower reaches of Jack Canyon throughout the year, and especially during the lambing season. This area extends from as far north as Horse Bench and Nine Mile Creek, to as far south as Flat Canyon.

Aerial surveys of bighorn sheep populations in the Nine Mile herd unit are conducted on a bi-annual basis. The population in 2005 was estimated to be 293 bighorn sheep, which is close to the objective of 300 bighorn sheep in the Nine Mile, Range Creek Bighorn Sheep Management Plan (Crompton 2006). Like mule deer and elk, bighorn sheep are found throughout the WTP Project Area on a year-round basis. The most recent bighorn sheep habitat data from the UDWR identify approximately 69,339 acres of crucial value, year-long habitat and approximately 64,566 acres of substantial value, year-long habitat within the WTP Project Area (UDWR 2007). Current and recent bighorn sheep population levels are illustrated in **Figure 3.9-5**.

Figure 3.9-1 Mule Deer Population Estimates and Objectives for the Nine Mile, Range Creek Mule Deer Herd Subunit. (Crompton 2006; UDWR 2006)

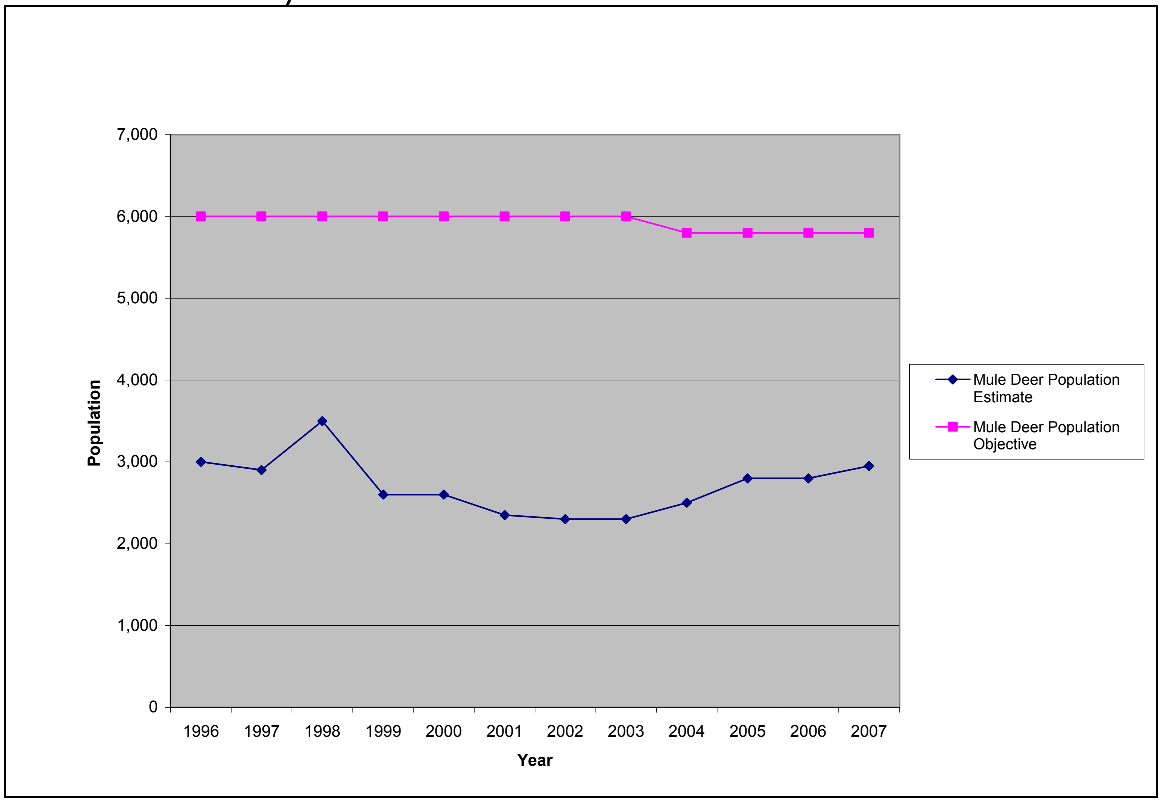

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Figure 3.9-3 Elk Population Estimates and Objective for the Nine Mile, Range Creek Elk Herd Subunit (Crompton 2006; UDWR 2008)

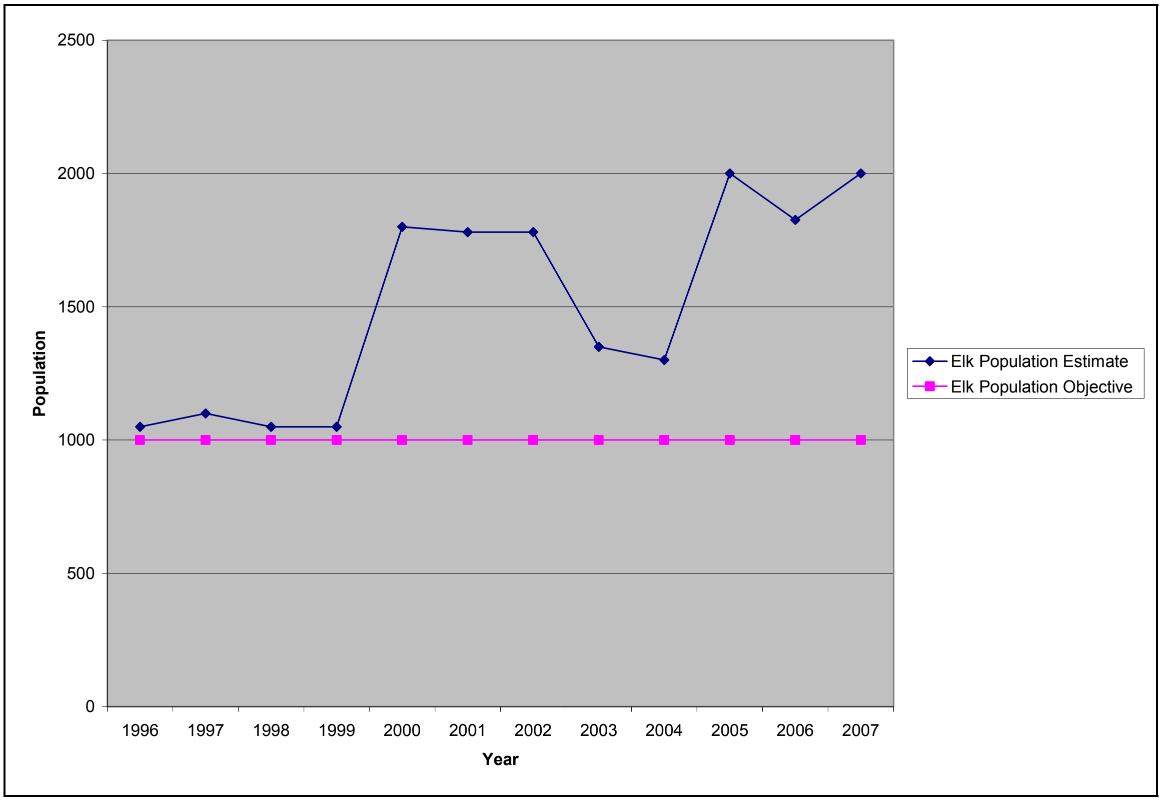

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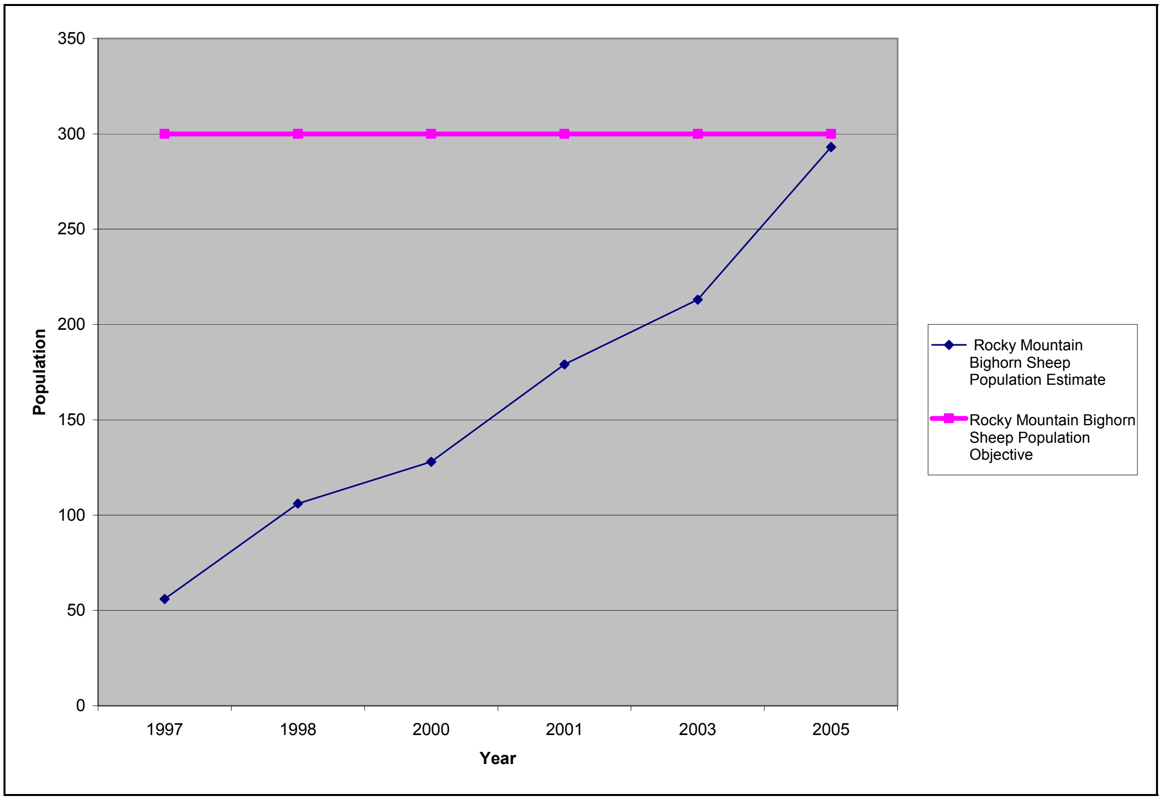
Figure 3.9-5 Rocky Mountain Bighorn Sheep Population Estimates and Objective for the Nine Mile, Range Creek Rocky Mountain Bighorn Sheep Herd Subunit (Crompton 2006)



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The UDWR has also identified habitats for bighorn sheep north of Nine Mile Canyon Road and east of Argyle Canyon. These habitats are adjacent to, but outside of, the WTP Project Area. Discussion of bighorn sheep habitats outside of the WTP Project Area has been included in the EIS because under Alternative C, BBC and other operators would be required to construct a new route through Trail Canyon. This alternative access route, as illustrated in **Figure 2.4-1** (see **Appendix A**), would be constructed in UDWR-identified crucial value, year-long habitat and substantial value, year-long habitat for bighorn sheep.

3.9.2.1 Habitat Fragmentation Modeling for Mule Deer and Elk

Based on public scoping comments and discussions during preparation of the EIS, it was determined that the impact analyses for mule deer and elk would be strengthened by a formal habitat fragmentation analysis. In order to determine the extent of existing habitat fragmentation, preliminary fragmentation analyses were conducted based on existing surface disturbance in the WTP Project Area (see **Appendix I**). The specific goals of the fragmentation modeling exercise for mule deer and elk were:

- To quantify the extent and spatial configuration of existing habitat fragmentation in crucial winter habitat for mule deer and crucial winter habitat for elk; and
- To quantify patch size, edge effects, and connectivity to supplement existing surface disturbance analyses in the EIS.

Based on information within existing literature (Wyoming Game and Fish Department [WGFD] 2007) regarding typical displacement or avoidance distances of wildlife from areas of disturbance, and discussions with the Price Field Office Resource Specialists, the following spatial buffers were placed around existing development features in order to model the extent of habitat fragmentation from existing surface disturbance.

- Mule Deer
  - 200-meter buffer around all well pads; and
  - 200-meter buffer from the centerline of all roads and pipelines.
- Elk
  - 1.2-mile buffer around all well pads; and
  - 0.5-mile buffer from the centerline of all roads and pipelines.

Using GIS software, these spatial buffers were then clipped to crucial winter habitats for mule deer and elk to determine/quantify the extent and spatial configuration of existing habitat fragmentation within the WTP Project Area.

Based on the modeling exercise, it appears that existing mule deer and elk crucial winter range habitats have been fragmented to varying degrees by existing development.

Based on the modeling analysis, approximately 17,345 acres of the 73,600 acres (23.6 percent) of crucial mule deer winter range within the WTP Project Area have been fragmented by existing surface disturbance and infrastructure. The extent of existing habitat fragmentation in mule deer crucial winter habitat within the WTP Project Area is summarized below in **Table 3.9-3a**.

The modeling analysis also indicated that crucial elk winter range within the WTP Project Area has been fragmented. As illustrated in **Table 3.9-3b**, approximately 54,046 acres of the 80,139 acres (67.4 percent) of crucial elk winter range within the WTP Project Area have been fragmented by existing surface disturbance and infrastructure.

Table 3.9-3a Extent of Existing Habitat Fragmentation in Mule Deer Crucial Winter Habitat within the WTP Project Area

Existing Fragmentation within Crucial Winter Habitat (acres)	Percent of Crucial Winter Habitat
17,345	23.6

Table 3.9-3b Extent of Existing Habitat Fragmentation in Elk Crucial Winter Habitat within the WTP Project Area

Existing Fragmentation within Crucial Winter Habitat (acres)	Percent of Crucial Winter Habitat
54,046	67.4

3.9.3 Birds

Many species of birds are known to occur, or have the potential to occur, within the WTP Project Area. For the purpose of analysis, these are separated into three groupings: raptors, upland game birds, and migratory birds. These three respective groups are discussed in detail below.

3.9.3.1 Raptors

Some of the more common or visible birds within the WTP Project Area include raptors, or birds of prey. The WTP Project Area contains diverse breeding and foraging habitats for raptors: cool desert shrub communities, rocky outcrops, cliff faces, riparian zones, mixed conifer forests, and lower elevation shrublands. **Table 3.9-4** identifies those raptor species with the potential to occur within the WTP Project Area, and a description of their typical nesting habitats.

Table 3.9-4 Raptor Species with the Potential to Occur in the WTP Project Area[1]

Common Name	Scientific Name	Nesting Habitats
American Kestrel	*Falco sparverius*	Holes in trees, cliffs
Bald Eagle[2]	*Haliaeetus leucocephalus*	Tall trees near bodies of water where fish and waterfowl prey are available
Burrowing Owl[2]	*Athene cunicularia*	Mammal burrows, generally prairie dog towns
Cooper's Hawk	*Accipiter cooperii*	Woodland areas and riparian zones
Ferruginous Hawk[2]	*Buteo regalis*	Ground, pinyon-juniper woodlands, balanced pinnacles
Golden Eagle[2]	*Aquila chrysaetos*	Cliff ledges and rocky outcrops
Great-horned Owl	*Bubo virginianus*	Abandoned stick nests of other large birds

Table 3.9-4 Raptor Species with the Potential to Occur in the WTP Project Area[1]		
Common Name	**Scientific Name**	**Nesting Habitats**
Long-eared Owl	*Asio otus*	Coniferous and deciduous forests, and shrublands
Mexican spotted owl[2]	*Strix occidentalis lucida*	Trees, trunk cavities, or cliffs
Northern Goshawk[2]	*Accipiter gentilis*	Mature mixed conifer or aspen forests
Northern Harrier	*Circus cyaneus*	Ground, often with thick vegetation
Peregrine Falcon[2]	*Falco peregrinus*	Cliff ledges
Prairie Falcon	*Falco mexicanus*	Cliff ledges
Red-tailed Hawk	*Buteo jamaicensis*	Cliff ledges, rocky outcrops, aspen, pinyon-juniper woodlands
Saw-whet Owl	*Aegolius acadicus*	Dead tree cavities, squirrel nests, hollows in trees, rocky caves
Short-eared Owl	*Asio flammeus*	Small depression on ground near open habitats
Sharp-shinned Hawk	*Accipiter striatus*	Coniferous forests
Swainson's Hawk[2]	*Buteo swainsonii*	Solitary trees or bushes, often in junipers
Turkey Vulture	*Cathartes aura*	Caves, crevices in cliffs, or tree thickets

[1]All of the raptor species listed in **Table 3.9-4** are migratory birds and as such, these species and their nests are protected from take or disturbance under the MBTA (16 USC, 703 et seq.). However, based on public comments received during the scoping period regarding potential impacts to raptor from the WTP project, raptors are discussed in their own section rather than being grouped under the migratory bird species discussion in **Section 3.9.3.3**.
[2]The bald eagle, burrowing owl, ferruginous hawk, golden eagle, Mexican spotted owl, peregrine falcon, and Swainson's hawk, are considered to be special status wildlife species and are discussed in more detail in **Section 3.10**.

3.9.3.2 Upland Game Birds

Four species of upland game birds have the potential to occur in the WTP Project Area: greater sage-grouse (*Centrocercus urophasianus*), chukar (*Alectoris chukar*), blue grouse (*Dendragapus obscurus)*, and ruffed grouse (*Bonasa umbellus)*.

Greater Sage-grouse

The greater sage-grouse is listed as a Candidate for listing under the ESA. Based on its status, the sage-grouse is addressed in **Section 3.10**.

Chukar

The chukar was first introduced in Utah in the 1950s and is now widely distributed throughout the State (UDWR 2003b; UDWR 2007). Chukars prefer steep, rocky, semi-arid slopes, which are generally used as a means to escape potential predators (UDWR 2003b; UDWR 2007). Associated vegetative community types include rabbitbrush, sagebrush, and cheatgrass just below the juniper tree belt (UDWR 2007). The chukar diet consists of primarily of assorted grasses (UDWR 2003b).

Chukars are a ground-nesting species and nesting typically occurs in late April or May (UDWR 2007). Water sources may be used extensively in late summer, and chukars will move to lower elevation south-facing slopes during the winter months (UDWR 2003b; UDWR 2007). In the Price Field Office, chukar habitats occur along the river corridors and steep, talus slopes. According to UDWR habitat data, there are approximately 43,639 acres of crucial winter chukar habitat, and approximately 1,011 acres of crucial year-long chukar habitat in the WTP Project Area.

Blue Grouse

Blue grouse (also known as dusky grouse) are native to Utah. They are found in most mountainous areas of the State and are known to occur in the Price Field Office (BLM 2004b; UDWR 2007). Preferred habitat is found in open stands of conifer habitat or in aspen stands with a brush understory (UDWR 2007). Winters are spent at high elevations in dense fir trees until the spring when blue grouse move to lower meadow, brush, or open timber stands for mating (UDWR 2007). Blue grouse are primarily ground dwellers. They feed on a variety of plants and insects during the summer and pine needles during the winter (Kingery 1998). Mating occurs from mid April to May, and nesting periods generally last from May through June (Kingery 1998; UDWR 2007). According to UDWR habitat data, there are approximately 36,245 acres of crucial, year-long blue grouse habitat in the WTP Project Area.

Ruffed Grouse

The ruffed grouse, a native species of Utah, is found in brushy woodland areas adjacent to streams and springs (UDWR 2007). Desirable habitat is composed of thickets of alder, willow, aspen, maples, and other deciduous shrubs and trees interspersed with conifers (UDWR 2007). The diet of the ruffed grouse consists of fruits, green vegetation, seeds, insects, and may include the buds of deciduous trees during the winter (UDWR 2007). The UDWR does not identify any portion of the WTP Project Area as containing ruffed grouse habitat.

3.9.3.3 Migratory Birds

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C., 703 et seq.) was implemented for the protection of migratory birds. The MBTA makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products. In addition to the MBTA, Executive Order 13186 sets forth the responsibilities of Federal agencies to further implement the provisions of the MBTA by integrating bird conservation principles and practices into agency activities and by ensuring that Federal actions evaluate the effects of actions and agency plans on migratory birds.

This section addresses migratory birds that may inhabit the WTP Project Area, including those species classified as Priority Species by Utah Partners In Fight (UPIF). Numerous migratory bird species occupy the WTP Project Area. Special status migratory bird species are addressed in **Section 3.10**.

The WTP Project Area is located within the Colorado Plateau ecoregion as defined by UPIF. This region covers southern and eastern Utah, totaling approximately 38 percent (12,252 square miles) of the State (Parrish et al. 2002). The WTP Project Area provides varied habitats for migratory birds including: steep canyon walls, spruce and mountain-fir forests, pinyon-juniper, aspen, sagebrush, ponderosa pine/mountain shrub, grassland, lowland riparian, and salt desert scrub.

Table 3.9-5 identifies potential migratory bird species that may occur in associated habitats within the WTP Project Area. Species denoted with an asterisk (*) have been identified as Priority Species by UPIF.

Table 3.9-5 Migratory Bird Species and Associated Habitats Potentially Occurring within the WTP Project Area

Common Name	Scientific Name
Pinyon-Juniper	
Ash-throated Flycatcher	*Myiarchus cinerascens*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-throated Gray Warbler	*Dendroica nigrescens*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Bushtit	*Psaltriparus minimus*
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Gray Flycatcher	*Empidonax wrightii*
Gray Vireo*	*Vireo vicinior*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Juniper Titmouse	*Baeolophus ridgwayi*
Sagebrush	
Brewer’s Sparrow*	*Spizella breweri*
Sage Sparrow*	*Amphispiza belli*
Sage Thrasher	*Oreoscoptes montanus*
Desert Shrub	
Black-throated Sparrow	*Amphispiza bilineata*
Loggerhead Shrike	*Lanius ludovicianus*
Northern Mockingbird	*Mimus polyglottos*
Say’s Phoebe	*Sayornis saya*
Vesper Sparrow	*Pooecetes gramineus*
Western Meadowlark	*Sturnella neglecta*
Mixed Conifer	
Brown Creeper	*Certhia americana*
Clark’s Nutcracker	*Nucifraga Columbiana*
Evening Grosbeak	*Coccothraustes vespertinus*
Gray Jay	*Perisoreus Canadensis*
Mountain Chickadee	*Poecile gambeli*
Plumbeous Vireo	*Vireo plumbeus*
Yellow-rumped Warbler	*Dendroica coronata*
Sub-alpine Conifer	
Cordilleran Flycatcher	*Empidonax occidentalis*
Dark-eyed Junco	*Junco hyemalis*
Golden-crowned Kinglet	*Regulus satrapa*
Hammond’s Flycatcher	*Empidonax hammondii*
Hermit Thrush	*Catharus guttatus*
Olive-sided Flycatcher	*Contopus cooperi*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Carduelis pinus*
Ruby-crowned Kinglet	*Regulus calendula*
Three-toed Woodpecker*	*Picoides tridactylus*
Townsend’s Solitaire	*Myadestes townsendi*

Table 3.9-5 Migratory Bird Species and Associated Habitats Potentially Occurring within the WTP Project Area	
Common Name	**Scientific Name**
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Riparian	
Bank Swallow	*Riparia riparia*
Black Phoebe	*Sayornis nigricans*
Blue Grosbeak	*Guiraca caerulea*
Broad-tailed Hummingbird*	*Selasphorus platycercus*
Cassin's Kingbird	*Tyrannus vociferans*
Cliff Swallow	*Petrochelidon pyrrhonota*
Lark Sparrow	*Chondestes grammacus*
Macgillivray's Warbler	*Oporornis tolmiei*
Western Kingbird	*Tyrannus verticalis*
Yellow-billed Cuckoo*	*Coccyzus americanus*
Canyons and Cliffs	
Canyon Wren	*Catherpes mexicanus*
Common Raven	*Corvus corax*
White-throated Swift	*Aeronautes saxatalis*

Source: Parrish et al. (2002)

3.9.4 Fisheries

The WTP Project Area is located directly west of the Green River. The majority of perennial drainages in the WTP Project Area flow north to Nine Mile Creek, which flows directly to the Green River. Tributaries of the Green River support cool water fisheries in their upper reaches at higher elevations and a warm water species assemblage in their lower reaches at lower elevations (BLM 2004b). Areas with limited or constrained riparian areas typically exhibit relatively warm water temperatures, less stream stability, and increased numbers of non-native fish (BLM 2004b).

The WTP Project Area has several known and potential cold water fisheries. These fisheries could potentially support rainbow trout (*Oncorhynchus mykiss*), Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), or brown trout (*Salmo trutta*). Known and potential cold water fisheries include Nine Mile Creek, Jack Canyon Creek, and Dry Canyon Creek (BLM 2004b). Portions of the Green River and Nine Mile Creek have been identified as warm water fisheries by the Price Field Office (BLM 2004b). Representative cold and warm water fish species occupying habitats within, or directly downstream of, the WTP Project Area are identified in **Table 3.9-6**.

Table 3.9-6 Fish Species Potentially Occurring Within, or Directly Downstream of, the WTP Project Area			
Common Name	**Scientific Name**	**Origin**	**Status**
Black Bullhead	*Ameiurus mel*	Exotic Game	None
Bluehead Sucker	*Catostomus discobolus*	Native Nongame	Sensitive Species
Bonytail Chub	*Gila elegans*	Native Nongame	Federally Endangered
Brown Trout	*Salmo trutta*	Exotic Game	None
Channel Catfish	*Ictalurus punctatus*	Exotic Game	None

Table 3.9-6 Fish Species Potentially Occurring Within, or Directly Downstream of, the WTP Project Area			
Common Name	**Scientific Name**	**Origin**	**Status**
Colorado Pikeminnow	*Ptychocheilus lucius*	Native Nongame	Endangered Species
Colorado River Cutthroat	*Oncorhynchus clarki pleuriticus*	Native Game	Sensitive Species
Common Carp	*Cyprinus carpio*	Exotic Nongame	None
Fathead Minnow	*Pimephales promelas*	Exotic Nongame	None
Flannelmouth Sucker	*Catostomus latipinnis*	Native Nongame	Sensitive Species
Green Sunfish	*Lepomis cyanellus*	Exotic Game	None
Humpback Chub	*Gila cypha*	Native Nongame	Federally Endangered
Mottled Sculpin	*Cottus bairdi*	Native Nongame	None
Mountain Sucker	*Catostomus platyrhynchus*	Native Nongame	None
Rainbow Trout	*Oncorhynchus mykiss*	Exotic Game	None
Razorback Sucker	*Xyrauchen texanus*	Native Nongame	Federally Endangered
Red Shiner	*Cyprinella lutrensis*	Exotic Nongame	None
Redside Shiner	*Richardsonius balteatus*	Exotic Nongame	None
Roundtail Chub	*Gila robusta*	Native Nongame	Sensitive Species
Sand Shiner	*Notropis stramineus*	Exotic Nongame	None
Speckled Dace	*Rhinichthys osculus*	Native Nongame	None
Utah Chub	*Gila atraria*	Exotic Nongame	None
Yellowstone Cutthroat Trout	*Oncorhynchus clarki bouvieri*	Exotic Game	None

Source: Draft Aquatic Management Plan, Price River Drainage, 2001–2010, Louis N. Berg, Regional Aquatic Program Manager, Utah Division of Wildlife Resources, Salt Lake City, UT, February 2001. 3-28 (BLM 2004b)

Special status fish species potentially occurring in, or directly downstream of, the WTP Project Area are discussed in **Section 3.10**.

Almost all waters in the WTP Project Area are managed by UDWR as wild fisheries, and as such these fisheries are maintained by natural recruitment rather than stocking. Many sports fish are considered game species that are found within the planning area. They include rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus mel*), and green sunfish (*Lepomis cyanellus*). Other exotic fish species have been introduced illegally as bait fish. These species include the Utah chub (*Gila atraria*), fathead minnow (*Pimephales promelas*), red shiner (*Cyprinella lutrensis*), redside shiner (*Richardsonius balteatus*), sand shiner (*Notropis stramineus*), and common carp (*Cyprinus carpio*) (BLM 2004b).

Several ephemeral washes also occur in the WTP Project Area, but based on their ephemeral nature, they generally do not hold enough water to support fish populations.

3.10 THREATENED, ENDANGERED, BLM SENSITIVE, AND OTHERWISE SPECIAL STATUS SPECIES

3.10.1 Introduction

This section discusses species that have a Federal and/or BLM special-status designation. This includes:

- Species listed as threatened or endangered, proposed for listing as threatened or endangered, or considered a candidate for listing as threatened or endangered under the Endangered Species Act (ESA) of 1973, as amended;
- Species listed as sensitive by the Price Field Office; and
- Other special status species protected by the Bald and Golden Eagle Protection Act (BGEPA) and the Migratory Bird Treaty Act (MBTA).

Section 7(a) of the ESA requires Federal agencies to evaluate their actions with respect to any species that are proposed or listed as endangered or threatened, and their critical habitat, if any has been formally designated. Regulations implementing this interagency cooperation provision of the ESA are codified at 50 Federal Register (FR) 402. Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to "*adversely affect*" or "*jeopardize the continued existence*" of a Federally-listed species or result in the adverse modification or destruction of its critical habitat. If a Federal action "*is likely to adversely affect*" a Federally-listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the USFWS. Candidate species for listing under the ESA and the BLM sensitive species are also managed to prevent future listing as threatened or endangered.

Numerous Federally-listed, Federal candidate, BLM sensitive, and otherwise special status species have the potential to occur within the WTP Project Area. A brief description of each of these species is presented in the following sections.

3.10.2 Threatened, Endangered, and Candidate Species

3.10.2.1 Birds

Mexican Spotted Owl

The Mexican spotted owl (MSO, *Strix occidentalis lucida*) was listed as threatened under the ESA, effective April 15, 1993 (USFWS 1993). Critical habitat for the MSO was later designated in 2004, including 2.2 million acres in Utah (USFWS 2004a). In addition, a recovery plan for the MSO has been developed to outline the steps necessary to remove the MSO from Federal listing (USFWS 1995b).

MSO range extends from the southern Rocky Mountains in Colorado and the Colorado Plateau in southern Utah, southward through Arizona and New Mexico and discontinuously through the Sierra Madre Occidental and Oriental to the mountains at the southern end of the Mexican Plateau. The most northerly nesting occurrence in the southwestern U.S. was recorded on September 6, 1958, in the Book Cliffs of northeastern Utah, where there were two additional unconfirmed reports in 1992 (USFWS 1993).

In Utah, primary constituent elements of MSO habitat include one or more of the following: (1) presence of water (often providing cooler temperatures and higher humidity than the surrounding areas); (2) clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; (3) canyon walls containing crevices, ledges, or caves; and (4) high percent of ground litter and woody debris (USFWS 1995b, 2004a).

The range inhabited by the MSO has been divided into 11 geographic areas referred to as “Recovery Units” (RU), six of which are located within the U.S. Within the Utah portion of the Colorado Plateau Recovery Unit (CPRU), MSO are only known to nest in steep-walled canyon complexes, while in other RUs, MSO breeding occurs primarily in mature mixed-conifer forests. These canyons frequently contain small clumps or stringers of ponderosa pine, Douglas-fir, white fir, and pinyon-juniper. Canyons within the CPRU are typically surrounded by terrain that does not appear to support breeding MSOs. In southern Utah, MSOs occupy arid, rocky canyon habitat within desert scrub vegetation communities (BLM 2002b; Willey and Van Ripper 2000). Rinkevich (1991) found that the majority of sites occupied by MSO in canyons are hot, dry environments with little or no vegetative cover. The lack of vegetative cover in the canyons is made up by the structural complexity of the canyons with high vertical walls, spires, junctions, cliffs, ledges, and caves. This structural diversity provides cliffs for escape cover, shaded roost sites, and availability of suitable prey (BLM 2002b; Willey and Van Ripper 2007). The diet of the MSO includes a variety of mammals, birds, reptiles and insects, with mammals consisting of the bulk of the diet throughout the owl’s range (Ganey 1992; Ganey et al. 1988; USFWS 1993).

Habitat models were developed by Willey and Spotskey in 1997 and 2000 in an attempt to determine potential MSO habitat within the State of Utah. The 1997 model analyzes vegetation information from the Utah GAP analysis, slope curvature, and elevation to make habitat assessments. Based on these features, the model allows the user to identify potential suitable habitat for the MSO. The 2000 model was developed for detailed analysis of habitat features to support the design of field surveys or to designate important habitats for protection. Approximately 63,930 acres of potential MSO habitat exists within the WTP Project Area according to the 1997 and 2000 models. Based on these models, the BLM engaged SWCA Environmental Consultants (SWCA) to conduct MSO habitat evaluations (i.e., ground-truthing) of the modeled habitats. These habitat evaluations were conducted in the summer of 2004 in portions of Nine Mile Canyon, along the northern edge of the WTP Project Area. SWCA’s habitat evaluations classified stretches of the canyon as “good” and “fair” MSO habitat. The largest areas of good habitat were located near the confluence of Sheep Canyon, Gate Canyon, and the northeastern edge of the WTP Project Area in Uintah County, Utah (SWCA 2005).

In addition to the habitat evaluation and mapping completed by SWCA, numerous MSO surveys have been completed in the WTP Project Area according to USFWS survey guidelines. MSO surveys within the WTP Project Area were first completed in Dry Canyon in 2001 by EIS Consultants, Inc (EIS Consultants). No MSO were seen or heard during these inventories (EIS 2001). Cottonwood, Harmon, Jack, and Nine Mile Canyons, as well as Prickly Pear Creek were surveyed for MSO in 2003. No MSOs were identified or heard during these surveys (EIS 2003a-e). Surveys completed in 2004 documented a potential sighting (i.e., an unconfirmed auditory response from an

MSO) of a single MSO in the Lower Jack Canyon near the Green River (EIS 2004). In 2006, EIS Consultants completed MSO surveys in Dry, Jack, Nine Mile, and Prickly Pear Canyons. No MSO were seen or heard during these surveys (EIS 2006a-e). Most recently, EIS Consultants completed MSO surveys in Cottonwood, Dry, Harmon, Nine Mile, Prickly Pear Canyons, as well as in the Peter's Point area during the 2007 breeding and nesting season. No MSO were seen or heard during these surveys (EIS 2006d, 2007a-e). As outlined in Chapter 2 (**Tables 2.2-6** and **2.6-8**), BBC would continue to conduct MSO surveys within the WTP Project Area in accordance with USFWS survey guidelines prior to any surface-disturbing activities within "fair" or "good" MSO habitats or 0.5-mile buffer around these habitats.

The Diamond Mountain planning area, which is located in the Vernal Field Office directly north of and adjacent to the WTP Project Area, has been identified as containing suitable MSO habitat according to the aforementioned 1997 and 2000 Willey and Spotskey models. These modeled MSO habitats were further evaluated by computer models or ground-truthed by SWCA between 2003 and 2005. Discussion of suitable MSO habitat in the Diamond Mountain planning area has been included in the EIS because under Alternative C, BBC and other operators would be required to construct a new route through Trail Canyon. This alternative access route, as illustrated in **Figure 2.4-1**, would be constructed in and within 0.5 miles of several ground-truthed areas of "good" and "fair" habitats identified in SWCA's habitat evaluations (SWCA 2005). Similar to other MSO habitats within the WTP Project Area, and as outlined in Chapter 2 (**Table 2.6-8**), BBC and other operators would continue to conduct MSO surveys in accordance with USFWS survey guidelines prior to any surface-disturbing activities within "fair" or "good" MSO habitats or 0.5-mile buffer around these habitats.

USFWS-designated critical habitat for the MSO occurs on the eastern portion of the Tavaputs Plateau, in the canyons near the Green River. Although MSO have not been officially documented as occurring within the WTP Project Area, approximately 36,117 acres of USFWS-designated critical habitat fall within the WTP Project Area (see **Figure 3.10-1**). There is no USFWS-designated critical habitat for MSO on lands administered by the Vernal Field Office.

Southwestern Willow Flycatcher

The southwestern willow flycatcher (*Empidonax traillii extimus*) (SWWF) was listed as an endangered species by the USFWS in 1993 (60 FR 10693-10715) (USFWS 1995). Relatively rare in Utah, the SWWF breeds in different types of dense riparian habitats across a large elevational and geographic area. Although other willow flycatcher subspecies may breed in shrubby habitats away from water, the SWWF breeds in patchy to dense riparian habitats along streams or other wetlands, near or adjacent to surface water or underlain by saturated soil.

Typical nesting sites occur in dense stands of willows with a cottonwood gallery forest overstory. In Utah, however, although non-native riparian species may be interspersed with native willows in nesting habitats, nests rarely occur in dense stands of only these non-native species (Sogge et al. 1997; USFWS 2005).

The USFWS Recovery Plan for the SWWF divides the SWWF's breeding range into six RUs, which are subdivided further into Management Units (USFWS 2002a). RUs are defined based on large watershed and hydrologic units and standardized boundaries of river basin units within the U.S. The State of Utah falls within both the Lower Colorado and Upper Colorado RUs. Although the Price Field Office and the WTP Project Area fall north of these two RUs, the Green River could be used as a migration corridor, and SWWF could potentially use the area along the Green River as breeding habitat. According to the Stone Cabin 3-D Seismic Survey Project Environmental Assessment for the WTP drilling program, the SWWF has been documented in areas surrounding the WTP Project Area and could potentially occur within the WTP Project Area (BLM 2003b).

Western Yellow-billed Cuckoo

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (WYBC), a Federal candidate for listing under the ESA, is a riparian obligate bird that feeds in cottonwood groves and nests in willow thickets. Currently, the range of the cuckoo is limited to disjunctive fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho, southward into northwestern Mexico and westward into southern Nevada and California (UDWR 2007).

In Utah, the WYBC's breeding habitat generally consists of large tracts of low- and mid-elevation riparian habitat with dense shrubs and overstory forests, especially cottonwood-willow associations (Parrish et al. 2002). Nesting habitat is classified as dense lowland riparian areas characterized by a dense sub-canopy or shrub layer (e.g., regenerating canopy trees, willows, or other riparian shrubs) within 100 meters (333 feet) of water (UDWR 2007). Nest locations have been identified along the Green River near the WTP Project Area (Howe and Hanberg 2000; Parrish et al. 2002).

Potential breeding and nesting habitat occurs along the Green River, which forms the eastern boundary of the WTP Project Area.

Greater Sage-grouse

At the time the DEIS was published, the greater sage-grouse (*Centrocercus urophasianus*) was identified as a BLM sensitive species by the Price Field Office. Since then, on March 5, 2010, the USFWS announced the greater sage-grouse warrants the protection of the ESA, but is precluded by higher priority listing actions. As a result of this decision, the USFWS placed the greater sage-grouse on the candidate list for future action, meaning the species would not receive statutory protection under the ESA and individual states would continue to be responsible for managing the bird (USFWS 2010). However, the USFWS will review the status of the species annually to determine whether it warrants more immediate action. (USFWS 2010).

Immediately following issuance of the decision above, the BLM released Instruction Memorandum (IM) No. 2010-071 (BLM 2010). This IM supplements the BLM's 2004 National Strategy for sage-grouse and identifies those management actions necessary to sustain sage-grouse populations while also achieving the Department of the Interior's energy-related priorities. Under this IM, the BLM will require a combination of management actions (e.g., onsite modification and offsite mitigation) for energy development projects proposed in "priority habitat" for sage-grouse. Management actions may also include requirements to avoid priority sage-grouse habitat or require that development not exceed certain density thresholds. In general, it is important to note these management actions may be more protective than the stipulations or restrictions identified in a Field Office's current land use plan. In addition, priority habitat, which is the habitat of highest conservation value relative to maintaining suitable sage-grouse populations range-wide, has not yet been identified by the BLM using a consistent methodology. Priority habitat will be areas of high habitat quality supporting important sage-grouse populations, including those populations that are vulnerable to localized extirpation, but necessary to maintain range-wide connectivity and genetic diversity. Until these areas are identified, the BLM will identify priority habitat on an interim basis using a variety of plans and professional judgment.

Due to the sage-grouse's dependence on sagebrush habitats, the greater sage-grouse is considered a sagebrush obligate (Braun et al. 1976). Sagebrush habitats across the range of sage-grouse may vary considerably (Tisdale and Hironaka 1981; West and Young 2000), and the specific habitat components used by the species can vary due to biotic and abiotic factors. Large, woody species of sagebrush including big sagebrush, silver sagebrush, and threetip sagebrush (*A. tripartita*) are used by sage-grouse throughout the year in all seasonal habitats (Dalke et al. 1963; Griner 1939; Patterson 1952). Other species of sagebrush such as low sagebrush (*A. arbuscula*) and black sagebrush (*A. nova*) provide important seasonal habitat components during spring and winter (Dalke et al. 1963; Griner 1939; Patterson 1952). Summer habitats used by sage-grouse include riparian and upland meadows and sagebrush grasslands (Dalke et al. 1963; Griner 1939; Patterson 1952). Sage-grouse have also been documented using a variety of human-modified habitats, such as irrigated and non-irrigated croplands and pasturelands (Patterson 1952; Sime 1991).

According to the Utah GAP vegetation data, approximately 22,951 acres of sagebrush-dominated shrublands occur within the WTP Project Area. These areas primarily occur on higher elevation benches in the WTP Project Area. The WTP Project Area provides important wintering habitat for sage-grouse. Wintering sage-grouse tend to concentrate within the two "core winter use areas" illustrated on **Figure 3.10-2**. Of these, the core winter use area on Prickly Pear Mesa includes the area in and around the existing Interplanetary airstrip.

Leks are traditional courtship display and mating areas attended by sage-grouse in or adjacent to sagebrush-dominated nesting habitat (Patterson 1952; Wakkinen et al. 1992). Leks are generally established in relatively open areas with less herbaceous vegetation and shrub cover than surrounding areas (Dingman 1980; Klott and Lindzey 1990). Leks may consist of natural openings within sagebrush communities or openings created by human disturbances, including dry stream channels, edges of stock ponds, ridges, grassy meadows, burned areas, gravel pits, sheep bedding grounds, plowed fields, and roads (Connelly et al. 1981; Dalke et al. 1963; Hofmann 1991; Patterson 1952; Rogers 1964). One active lek location has been identified within the southwestern portion of the WTP Project Area (UDWR 2007).

According to Braun et. al. (1977), most hens nest within approximately 2 miles of a lek. Holloran et al. (2005) and Walker et al. (2007) respectively found that 52 percent and 74-80 percent of hens are known to nest within 2 and 4 miles of a lek respectively Sage-grouse nesting habitat is often a broad area within or adjacent to winter range or between winter and summer ranges (Fischer 1994; Klebenow 1969; Wakkinen 1990). Productive nesting habitat includes sagebrush with horizontal and vertical structural diversity (Connelly et al. 2000; Gregg 1991; Schroeder et al. 1999; Wakkinen 1990). The understory of productive nesting habitat typically includes native grasses and forbs that provide a food source of insects, concealment of the nest and hen, and herbaceous forage for pre-laying and nesting hens (Connelly et al. 2000; Gregg 1991; Schroeder et al. 1999). Sage-grouse nest locations have not been identified within the WTP Project Area; however, potential nesting habitat exists throughout the WTP Project Area in sagebrush-dominated shrublands near or adjacent to leks and/or wintering grounds.

Early brood-rearing habitat generally occurs relatively close to nest sites, but movements of individual broods may be highly variable (Connelly 1982; Gates 1983). Early brood-rearing habitats consist of relatively open stands of sagebrush when compared to optimum, denser nesting habitat (Martin 1970; Wallestad 1971). High plant species richness with abundant forbs and insects characterize brood areas (Apa 1998; Dunn and Braun 1986; Drut et al. 1994; Klott and Lindzey 1989). As herbaceous plants mature and dry, hens usually move their broods to more mesic sites (Bunnell 2000; Connelly and Markham 1983; Connelly et al. 1988; Fischer et al. 1996; Klebenow 1969). Insects, especially ants and beetles, are an important food component of early brood-rearing habitat (Drut et al. 1994; Fischer et al. 1996). UDWR has identified approximately 38,033 acres of crucial sage-grouse brooding habitat in the WTP Project Area (UDWR 2007). Much of this crucial sage-grouse brooding habitat coincides with the approximately 47,628 acres of crucial sage-grouse winter habitat identified by the UDWR in the WTP Project Area (UDWR 2007).

Based on public scoping comments and discussions during preparation of the EIS, it was determined that the impact analyses for greater sage-grouse would be strengthened by a formal habitat fragmentation analysis. In order to determine the extent of existing habitat fragmentation, preliminary fragmentation analyses were conducted based on existing surface disturbance in the WTP Project Area (see **Appendix I**). The specific goals of the fragmentation modeling exercise for sage-grouse were:

- To determine/quantify the extent and spatial configuration of existing habitat fragmentation in the sage-grouse core winter use areas; and
- To determine/quantify patch size, edge effects, and connectivity to supplement existing surface disturbance analyses in the EIS.

Based on information within existing literature (WGFD 2007) and discussions with the Price Field Office resource specialists, the following spatial buffers were placed around existing development features in order to model the extent of sage-grouse core winter use area fragmentation from existing surface disturbance:

- 2-mile buffer around all existing well pads; and
- 2-mile buffer from the centerline of all existing roads and pipelines.

These spatial buffers were then clipped to sage-grouse core winter use areas to determine/quantify the extent and spatial configuration of existing habitat fragmentation within the WTP Project Area.

Based on the fragmentation analysis, all sage-grouse core winter use areas within the WTP Project Area have been fragmented by existing development.

3.10.2.2 Fish

Bonytail

The bonytail chub (*Gila elegans*), commonly referred to as "bonytail," was listed as endangered on April 23, 1980 (45 FR 13374). Critical habitat for this species was later designated in 1993 (50 FR Par 17) (USFWS 1994).

The bonytail is adapted to mainstream rivers, where it has been observed in pools and eddies (Minckley 1973; Vanicek 1967). Today, the bonytail exists in very low numbers in its natural riverine habitat and within man-made reservoir habitat.

There are currently no self-sustaining populations of bonytail in the wild, and very few individuals have been caught throughout the Upper Colorado River Basin in Utah. Releases of hatchery-reared bonytail into the upper basin have resulted in low survival, with no evidence of reproduction or recruitment. Low population numbers impact the ability of this species to effectively reproduce (USFWS 2002b).

A total of 139 river miles in Utah has been designated as critical habitat for the bonytail. USFWS-designated critical habitat for the bonytail occurs in Desolation Canyon along the portion of the Green River, which forms the eastern boundary of the WTP Project Area.

Colorado Pikeminnow

The Colorado pikeminnow (*Ptychocheilus lucius*) (formerly known as the Colorado squawfish) was first listed as endangered on the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001). Full protection was afforded to this species under the ESA, upon its listing in the Federal Register on January 4, 1974 (32 FR 1175). Critical habitat for this species was designated in 1993 (50 FR Par 17) (USFWS 1994).

The Colorado pikeminnow is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation, and survival of young. The species spawns during the spring and summer over riffle areas with gravel or cobble substrate. Spawning typically occurs at water temperatures of 16°C or higher between late June and mid-August (USFWS 1990a; USFWS 2002c). Subadult Colorado pikeminnows move upstream as they mature (USFWS 1990a; USFWS 2002c).

Adult Colorado pikeminnow utilize a variety of riverine habitats including eddies, backwaters, shorelines, and others (Tyus et al. 1982). During winter, adult pikeminnows use backwaters, runs, pools, and eddies, but are most common in shallow ice-covered shoreline areas (Holden and Wick 1982). In spring and early summer, adult Colorado pikeminnow use shorelines and lowland areas inundated during typical spring flooding.

The Colorado pikeminnow is endemic to the Colorado River Basin where it is adapted to rivers with seasonally variable flow, high silt loads, and turbulence. Historically in Utah, the Colorado pikeminnow was found in the Colorado, Green, Duchesne, San Juan, White, and Dolores Rivers, and probably numerous smaller streams (Ellis 1914; Holden and Stalnaker 1975; USFWS 1990a). Natural populations of the Colorado pikeminnow are now restricted to the Upper Colorado River Basin in Wyoming, Colorado, Utah, and

New Mexico. The species is most abundant in the Green River below the confluence with the Yampa River; the White River from Taylor Draw Dam near Rangely, Colorado, downstream to the confluence with the Green River; and the mainstream of the Colorado River from Palisade, Colorado, to Lake Powell (USFWS 1990a). Natural reproduction of Colorado pikeminnow in Utah is currently known from the Green and San Juan Rivers.

A total of 726 river miles has been designated as critical habitat for the Colorado pikeminnow in Utah in portions of the Green, Colorado, White, and San Juan Rivers, and their respective 100-year floodplains. USFWS-designated critical habitat for the Colorado pikeminnow occurs along the portion of the Green River, which forms the eastern boundary of the WTP Project Area.

Humpback Chub

The humpback chub (*Gila cypha)* was listed as endangered on the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001). It was included in the U.S. List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR, No. 106) and was afforded full protection as endangered under the ESA, upon its listing in the Federal Register on January 4, 1974 (32 FR 1175). Critical habitat for this species was designated in 1994 (50 FR Part 17) (USFWS 1994).

The humpback chub is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Populations of adult humpback chub are found in boulder-strewn river canyons where they utilize a variety of habitats including pools, riffles, eddies, rocky runs, and travertine dams (Tyus and Karp 1990). Humpback chub reproduce primarily from May through July depending on location. The presence of juveniles in populations of humpback chub suggests successful reproduction in Utah (i.e., within Black Rocks, Westwater Canyon, Cataract Canyon, and Desolation/Gray Canyons in the Upper Colorado River Basin) (USFWS 2002e).

Collections of humpback chub in Desolation and Gray Canyons indicate the presence of low numbers of this species. Of the five self-sustaining populations of the humpback chub in the Upper Colorado River Basin in Utah, one of them occurs in Desolation/Gray Canyon on the Green River (USFWS 2002e). Each of these populations consists of a discrete reproducing group of fish, with independent stock-recruitment dynamics and is geographically separated from other populations (USFWS 2002e).

A total of 139 river miles in Utah has been designated as critical habitat for the humpback chub. USFWS-designated critical habitat for the humpback chub in Utah occurs in portions of the Green River and Colorado River. USFWS-designated critical habitat for the humpback chub occurs in Desolation Canyon along the portion of the Green River, which forms the eastern boundary of the WTP Project Area.

Razorback Sucker

The razorback sucker (*Xyrauchen texanus*) was listed as endangered under the ESA on March 21, 1994 (56 FR 54957). Critical habitat for this species was also designated in 1994 (50 FR Par 17) (USFWS 1994).

Adult razorback suckers occupy a variety of habitat types including impounded and riverine areas, eddies, backwaters, gravel pits, flooded bottoms, flooded mouths of tributary streams, slow runs, sandy riffles, and others (Minckley et al. 1991). They typically move into flooded areas in early spring and begin spawning migrations to specific locations as they become reproductively active; spawning occurs over rocky runs and gravel bars (Tyus and Karp 1990).

Razorback sucker populations have declined markedly in the last 50 years. The existing populations consist primarily of old fish believed to be nearing their maximum life expectancy (Minckley et al. 1991; USFWS 1998). It is presumed that the existing populations represent a 90-percent decline in the historic range and abundance of the species (USFWS 1998).

In the Upper Colorado River Basin in Utah, the razorback sucker is currently found in the Green River, upper Colorado River, and San Juan River sub-basins (USFWS 2002d). The fish are mostly aged adults with little or no recruitment, except in the middle Green River, where small numbers of juveniles and young adults indicate low recruitment levels.

A total of 688 river miles in Utah has been designated as critical habitat for the razorback sucker in Utah in portions of the Green, Colorado, Duchesne, White, and San Juan Rivers, and their respective 100-year floodplains. USFWS-designated critical habitat for the razorback sucker occurs along the portion of the Green River, which forms the eastern boundary of the WTP Project Area.

3.10.2.3 Plants

Through coordination between the USFWS and the Price Field Office, a list of four Federally-listed threatened and endangered plant species that may occur in Carbon and Duchesne Counties, Utah, was formulated. This list includes Barneby ridge-cress (*Lepidium barnebyanum*), shrubby reed-mustard (*Schoenocrambe suffrutescens*), Ute ladies'-tresses (*Spiranthes diluvialis*), and Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). An evaluation of available recent field records and surveys, as well as an analysis of potential habitat information, was conducted for these four species. The available data suggest that of the four species with the potential to occur in the WTP Project Area, only the Uinta Basin hookless cactus has been documented as occupying habitat within the WTP Project Area.

Natural history and population occurrence information for the threatened and endangered plant species were gathered from the online Utah Rare Plant Guide (Utah Native Plant Society 2007), as well as from information compiled by the Utah Division of Natural Resources (UDNR 2006). Potential or known occurrence for each of the Federally-listed plant species was identified by the Price Field Office (Ivory 2007a).

Table 3.10-1 summarizes habitat descriptions, current Federal-listing status, and potential or known occurrence within the WTP Project Area for each of the aforementioned plant species considered in this EIS.

Table 3.10-1 T&E Plant Species in Carbon and Duchesne Counties, Utah			
Common Name/ ***Scientific Name***	**Habitat Summary**	**Status**	**Occurrence within the WTP Project Area[1,2]**
Uinta Basin Hookless Cactus *Sclerocactus wetlandicus*	Gravelly hills and terraces on alluvial soils in cold shrub communities.	Threatened	Known; occupied habitat present
Barneby Ridge-cress *Lepidium barnebyanum*	White shale outcrops of the Uinta Formation in pinyon-juniper.	Endangered	Unlikely; no potential habitat
Shrubby Reed-mustard *Schoenocrambe suffrutescens*	Calcareous shale of the Green River Shale Formation in shadscale, pygmy sagebrush, mountain mahogany, juniper, and other mixed desert shrub communities.	Endangered	Unlikely; no potential habitat
Ute Ladies'-tresses *Spiranthes diluvialis*	Moist to very wet meadows, along streams, in abandoned stream meanders, and near springs, seeps, and lakeshores in sandy or loamy soils typically missed with gravel.	Threatened	Unlikely; no potential habitat

[1]*Potential habitat* is defined as areas which satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment (BLM 2007a; USFWS 2007).
[2]*Occupied habitat* is defined as areas currently or historically known to support the species; synonymous with "known habitat" (BLM 2007a; USFWS 2007).

Uinta Basin Hookless Cactus (Sclerocactus wetlandicus)

The Uinta Basin hookless cactus is found in Duchesne, Uintah, and northern Carbon Counties, Utah. The species occurs on gravelly hills and terraces on alluvial soils in cold shrub communities at elevations ranging between 4,700 and 6,000 feet. Flowering occurs from May to June.

A variety of insects (including bees, ants, flies, and beetles), which may be pollinators for the cactus, have been observed visiting cactus flowers (USFWS 1990b). Small bees of the *Halictidae* and *Anthophoridae* families were the most frequent visitors (NatureServe 2008). However, the effective pollination vectors are not specifically known (USFWS 1990b). Ants and gravity appear to be the primary seed dispersal mechanisms for this species (NatureServe 2008).

There are two known populations of the Uinta Basin hookless cactus within the northeastern portion of the WTP Project Area, as well as additional potential habitat for the species.

Barneby Ridge-cress (Lepidium barnebyanum)

Areas suspected to contain potential habitat for Barneby ridge-cress include white shale outcrops on the Uinta Formation within pinyon-juniper communities (mainly on ridge crests) at elevations ranging between 6,200 and 6,500 feet. Flowering occurs from May to June. The WTP Project Area does not contain potential habitat for this species and therefore, the Proposed Action and alternatives would have "***no effect***" on the species. As such, the Barneby ridge-cress is not further analyzed in this EIS.

Shrubby Reed-mustard (Schoenocrambe suffrutescens)

Areas suspected to contain potential habitat for shrubby reed-mustard include calcareous shale of the Green River Shale Formation in shadscale, pygmy sagebrush, mountain mahogany, juniper, and other mixed desert shrub communities at elevations ranging between 5,400 and 6,000 feet. Flowering occurs from May to mid-August. The WTP Project Area does not contain potential habitat for the shrubby reed-mustard and therefore, the Proposed Action and alternatives would have "***no effect***" on the species. As such, the shrubby reed-mustard is not further analyzed in this EIS.

Ute Ladies'-tresses (Spiranthes diluvialis)

Ute ladies'-tresses occur in Daggett, Duchesne, Garfield, Salt Lake, Tooele, Uintah, Utah, Wayne, Wasatch, and Weber Counties, Utah. A member of the orchid family, this species is a perennial forb and flowering occurs from late July through August. Ute ladies'-tresses occurs in moist to very wet meadows, along streams, in abandoned stream meanders, and near springs, seeps, and lakeshores. The species grows in sandy or loamy soils that are typically mixed with gravels. In Utah, the species' occurrence ranges in elevation from 4,300 to 7,000 feet. The WTP Project Area does not contain potential habitat for this species and therefore, the Proposed Action and alternatives would have "***no effect***" on the species. As such, the Ute ladies'-tresses is not further analyzed in this EIS.

3.10.3 BLM Sensitive and Other Special Status Species

3.10.3.1 Mammals

Northern River Otter

The northern river otter (*Lontra canadensis*) is a BLM sensitive species that occurs in small populations along creeks and rivers throughout Utah (UDWR 2007). River otters occupy relatively high-quality aquatic habitats ranging from fast flowing cool, streams to slow or non-flowing wetland areas (Fitzgerald et al. 1994). Additional habitat characteristics include year-round open water, densely wooded riparian cover along the banks, and abundant prey. Generally, otters do not build their own dens, but utilize old beaver lodges, logjams, tree root cavities, or bank dens excavated by beavers or muskrats (Wilson and Ruff 1999).

Starting in 1989, UDWR began implementing an otter reintroduction effort along the Green River in eastern Utah. From 1989 to 1992, the UDWR released 67 otters along the Green River, including 10 otters into Sand Wash located north of the WTP Project Area (UDWR 2005b). Although the population of otters in Utah is unknown and no population estimates exist, based on the increased number of sightings, it is believed that populations are increasing in eastern Utah.

Townsend's Big-eared Bat

Townsend's big-eared bat (*Corynorhinus townsendii*) is identified as a BLM sensitive species by the Price Field Office. The species occurs State-wide in Utah at elevations below 9,000 feet (UDWR 2007). Habitats utilized by Townsend's big-eared bat include: desert shrub, pinyon–juniper, pinyon–juniper–sagebrush, mountain brush, mixed forest, and ponderosa pine forest. The primary habitat components in Utah include caves, mines, and buildings, which are used for multiple purposes such as day roosts, maternity roosts, and winter hibernation (Oliver 2000).

Because required roost conditions vary seasonally and individuals typically do not move long distances between roost sites, the highest population densities generally occur in areas with complexes of mines or caves offering diverse roost habitat conditions (Bosworth 2003). Habitat for this species occurs in the steep, rocky canyons and forested areas that are found throughout the WTP Project Area.

Western Red Bat

The western red bat (*Lasiurus blossevillii*) is identified as a BLM sensitive species by the Price Field Office. The western red bat is one of the most rarely encountered species of bats in the State. The few documented occurrences of the western red bat are in north-central, central, and southwestern Utah, with the majority of records in Washington County, Utah (Bosworth 2003; Oliver 2000). Scattered occurrences of this species are also known in Carbon, Utah, and Cache Counties, Utah (Bosworth 2003).

Western red bats are normally found near water, often in wooded areas. Some individuals may hibernate during cold times of the year, but most members of the species migrate south to warmer climates for the winter. The species is nocturnal; daytime roosting usually occurs in trees and foraging takes place near riparian areas (UDWR 2007). Habitat for this species occurs in riparian areas found throughout the WTP Project Area.

Spotted Bat

The spotted bat (*Euderma maculatum*) is identified as a BLM sensitive species by the Price Field Office. This species occurs in all surrounding states, therefore it is thought to be distributed throughout the state of Utah. However, there are no records of this species from the northern and western portions of the state (Bosworth 2003). The spotted bat is thought to be rare in Utah, however, because of the tendency of this species to forage high above the ground and thus not to be readily captured in mist nets, it may be more common in the sate than records suggest (Bosworth 2003, Oliver 2000). Crevices in cliff walls in deep, narrow, rocky canyons are the primary roosting sites for this species. Spotted bats may be found foraging in a variety of habitats, including open sagebrush steppe, desert scrub, and montane meadow habitat. Foraging can occur at considerable distances from roosting habitat (Oliver 2000, UDWR 2007). Habitat for this species occurs in the steep, rocky canyons, and open areas that are found throughout the WTP Project Area.

3.10.3.2 Birds

Blue Grosbeak

The blue grosbeak (*Passerina caerulea*) is identified as a BLM sensitive species by the Price Field Office. This bird is typically found in habitats with scattered trees, riparian woodlands, scrub, or woodland edges (UDWR 2007). Blue grosbeaks have also been documented utilizing invasive stands of tamarisk (Kingery 1998). In Utah, breeding occurs in the southern portion of the State (UDWR 2007). Although nesting occurs nearby or within open areas, nests are primarily found in localized areas of dense vegetation (Kingery 1998). Nests are located anywhere from ground level to 15 feet above the ground (UDWR 2007). Habitat for the blue grosbeak exists throughout the WTP Project Area.

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is identified as a BLM sensitive species by the Price Field Office. Burrowing owls are summer residents on the plains over much of Utah and usually arrive on breeding grounds from late March to mid-April (Johnsgard 1988). The species is associated with dry, open habitat with short vegetation containing an abundance of burrows (Haug and Oliphant 1990; Thomsen 1971; Wedgwood 1978). In Utah, white-tailed prairie dog burrows are the most prevalent site for burrowing owl nest sites. In addition to prairie dog burrows, burrowing owls may nest in unoccupied, abandoned badger (*Taxidea taxus*) or ground squirrel (*Spermophilus* spp.) burrows (Desmond and Savidge 1996). Surveys for prairie dog colonies and burrowing owls have been conducted by the UDWR in the WTP Project Area, but no burrowing owl nests or prairie dog burrows have been documented (UDWR 2007). Although these surveys did not identify active or inactive nests, the burrowing owl has the potential to occur within the WTP Project Area because badger and ground squirrel burrows occur there and may provide potential nesting sites for the species.

Common Yellowthroat

The common yellowthroat (*Geothylypis trichas*) is identified as a BLM sensitive species by the Price Field Office. Preferred habitat includes cattail marshes, riparian areas, brushy pastures, and old agricultural fields (Kingery 1998; UDWR 2007). Breeding begins in late spring and nests are often built in cattails, shrubs, or small trees (Kingery 1998; UDWR 2007). The diet of the common yellowthroat consists primarily of insects and spiders (UDWR 2007). Habitat for the common yellowthroat exists in the WTP Project Area in riparian or marshy areas along numerous creeks and drainages.

Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is identified as a BLM sensitive species by the Price Field Office. The ferruginous hawk is a common species in western, northeastern, and southeastern Utah. Nesting generally starts in March or April depending on latitude, and throughout their range ferruginous hawks have been found nesting on a wide variety of substrates (Evans 1982). Nest substrates include trees and shrubs, cliffs, utility structures, and ground outcrops. Ferruginous hawks commonly nest in grasslands, agricultural lands, sagebrush/saltbush/greasewood shrublands, and on the periphery of pinyon-juniper forests. The latter usually occurs at an interface between pinyon-juniper and shrub-steppe habitats and especially in outlier trees from main woodlots (Parrish et al. 2002). Because of a strong preference for elevated nest sites, cliffs, buttes, and creek banks are usually present in occupied nesting habitats (Olendorff 1993). Primary prey species include small mammals, and in eastern Utah prairie dogs are taken in large numbers.

Although ferruginous hawk nests have not been documented within the WTP Project Area during raptor nest inventories (UDWR 2007), potential nesting and foraging habitat exists within the WTP Project Area.

Bald Eagle

On June 28, 2007, the U.S. Secretary of the Interior announced the removal of the bald eagle from the list of threatened and endangered species. Even though the bald eagle has been removed from protection under the ESA, it is still protected under the MBTA and BGEPA. These Acts continue protection of the bald eagle by preventing "take" resulting from human activities.

The bald eagle builds large nests, which are often reused year after year (USFWS 1983). Nests are generally built in large trees within riparian habitat along rivers, lakes, and coasts, and rarely occur further than two miles from water. Nests are also built on cliffs or on the ground, if no other suitable nesting habitat is available. The nesting season of the bald eagle varies by region. In the Great Plains and western mountain region, breeding generally occurs from January through March. During the winter months, bald eagles communally roost in cottonwoods and other large trees along rivers, and forage in upland habitats for carrion and small mammals.

Fish are the predominate prey of bald eagles and therefore, the bald eagle is closely associated with aquatic ecosystems throughout most of its range. Many other types of prey are also taken, including waterfowl and small mammals, depending on location, time of year, and population cycles of the prey species. Carrion, especially in wintering areas, are also taken when available (USFWS 1995a).

Although bald eagle breeding pairs were extremely rare in Utah in the past, the number of occupied breeding territories in Utah continues to increase. To date, there are nine known bald eagle breeding pairs in the State of Utah (72 FR 37346). In addition to breeding bald eagles, Utah provides wintering habitat for a large population of bald eagles, which occupy the State between October and April each year. It is estimated that approximately 1,243 bald eagles winter in Utah each year.

Although no bald eagle nests have been identified in the WTP Project Area, winter roosting sites have been identified in Desolation Canyon along the Green River, which forms the eastern boundary of the WTP Project Area. In addition to winter roosting sites, it is likely that bald eagles could utilize the entire WTP Project Area as foraging habitat throughout the winter months.

Golden Eagle

The golden eagle (*Aquila chrysaetos*) is not identified as a BLM sensitive species by the Price Field Office. The species is, however, protected under the BGEPA based upon the similarity of the juvenile bald eagle's physical appearance to that of the adult golden eagle. Populations in the northern parts of the breeding range migrate south for winter, but populations in Utah are generally year-round residents. Throughout the summer, golden eagles are found in mountainous areas, canyons, shrublands, and grasslands. During the winter, they inhabit shrub-steppe vegetation, as well as wetlands, river systems, and estuaries. Prey species mainly include small mammals, especially rabbits, marmots, and ground squirrels; however, golden eagles also prey on insects, snakes, birds, juvenile ungulates, and carrion.

Golden eagle nests are constructed on cliffs or in large trees. Pairs are monogamous and often use the same nest in consecutive years. Eggs are laid from late February to early March in Utah (UDWR 2007). Nesting and foraging habitat is found throughout the WTP Project Area in steep-walled canyons and pinyon-juniper habitat. Currently, there are 30 known golden eagle nests within the WTP Project Area, and the entire WTP Project Area provides potential foraging habitat (UDWR 2007).

Northern Goshawk

The northern goshawk (*Accipiter gentiles*) is identified as a BLM sensitive species by the Price Field Office. This species occurs as a permanent resident throughout Utah, but is not considered common (UDWR 2007). Graham et al. (1999) found that the majority of nests identified in Utah occurred in mid-elevation (6,000 ft) to high-elevation (10,000 ft) locations. Although all forests in Utah were found to be suitable as goshawk habitat for some portion of their life cycle, the greatest proportion of identified nests were observed in mixed lodgepole pine and quaking aspen forests (Graham et al. 1999; USFS 1999a). Goshawk diets consist of small to medium birds and mammals, from robins and chipmunks to grouse and hares.

Goshawks will typically nest in mature to old forests with relatively large trees, high canopy closure, sparse ground cover, and open understories (Graham et al. 1999; UDWR 2007). Nests are occupied by both male and female goshawks from early March through mid September. Goshawks generally choose nest trees near the bottom of steep slopes, flat benches in steep country, and fluvial pans on small stream junctions (Kingery 1998). Nests are generally re-used and mating pairs will typically have more than one nest site within their territory (Kingery 1998). Although no known goshawk nests have been identified with the WTP Project Area, suitable nesting and foraging habitat exists throughout the WTP Project Area in forested areas containing ponderosa pine, mountain fir, or spruce fir.

Peregrine Falcon

The peregrine falcon (*Falco peregrinus*) is identified as a BLM sensitive species by the Price Field Office. Peregrines are often found in open habitat near a water source with available cliff faces or inaccessible ledges for nesting. Peregrine falcon nests, referred to as eyries, are usually located on a small scrape on a ledge of a cliff face, or on man-made structures. A suitable cliff face or structure is typically between 23 meters to 610 meters (75 to 2,000 feet) tall and within 0.4 km (0.25 miles) to 0.8 km (0.50 miles) of riparian habitat. Peregrines may occasionally use abandoned nests of eagles, hawks, or ravens. A pair of peregrines may favor a particular cliff and return each year to breed, and alternating nest sites along an escarpment are common (ODOT 2002).

Foraging habitat primarily includes wetlands, but also includes sagebrush-steppe, desert scrub, and grasslands. The species is generally absent from high-elevation montane areas (Bosworth 2003).

UDWR data have identified two peregrine falcon nests within the WTP Project Area (UDWR 2007). Additionally, potential nesting and foraging habitat are also found throughout the WTP Project Area within steep canyons and associated riparian areas. The Jack Canyon WSA portion of the WTP Project Area has been identified as spring and fall migration habitat for the peregrine falcon, and it may be used throughout the winter (BLM 1990).

Swainson's Hawk

The Swainson's hawk (*Buteo swainsoni*) is identified as a BLM sensitive species by the Price Field Office. In Utah, this bird is found Statewide, primarily at mid-elevations in the western and northern parts of the State, in shrub and grassland habitats (UDWR 2007). The Swainson's hawk typically inhabits sites in arid grassland, desert, and agricultural areas with scattered trees and shrubs (Kingery 1998). Nests are typically constructed in solitary trees or bushes, and are most commonly found in junipers. Breeding generally occurs between mid-May and mid-June, and nests are often used for several years (Kingery 1998; UDWR 2007)

No Swainson's hawk nests have been identified within the WTP Project Area; however, the Swainson's hawk may nest and forage in the pinyon-juniper and desert shrub habitats found throughout much of the WTP Project Area.

3.10.3.3 Fish

Bluehead Sucker

The bluehead sucker (*Catostomus discobolus*) is identified as a BLM sensitive species by the Price Field Office. Bluehead suckers occur in small to large streams, rivers, and tributaries in the Upper and Lower Colorado River Basin, and in the Weber and Bear River drainages in the Bonneville Basin. Large adult bluehead may inhabit stream environments as deep as 2 to 3 meters (approximately 7 to 10 feet), although they most commonly feed in riffles and swift runs. Life expectancy is typically 6 to 8 years. Spawning occurs in spring and early summer at lower elevations and mid- to late summer in higher, colder waters on gravel beds in shallow water (UDWR 2007).

Bluehead suckers historically occurred in the Colorado River Basin above the mouth of the Grand Canyon in mainstream and tributary habitats. In Utah, bluehead suckers continue to be found in mainstream rivers and tributary streams above the Glen Canyon Dam to headwater reaches of the Green and Colorado Rivers. Populations currently occur in the mainstream Green River from the Colorado River confluence upstream to Lodore, Colorado, and in the White River from the Green River confluence upstream to Meeker, Colorado. In the Upper Colorado River Basin (Utah, Wyoming, Colorado, and New Mexico), bluehead suckers currently occupy approximately 45 percent of their historical habitat. Recent declines of the species have occurred in the White River below Taylor Draw Dam, and in the upper Green River (UDWR 2007). Potential habitat for bluehead suckers occurs in the portion of the Green River, which forms the eastern boundary of the WTP Project Area. Two bluehead suckers have been documented in this portion of the Green River.

Colorado River Cutthroat Trout

The Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) (CRCT) is identified as a BLM sensitive species by the Price Field Office. In June 2007, the USFWS published notice of a 12-month finding for the petition to list the CRCT as threatened or endangered under the ESA. In this ruling, the USFWS determined that listing the species was not warranted (72 FR 32589).

Populations of CRCT have been declining for decades, primarily attributed to the widespread introductions of non-native salmonids (CRCT Coordination Team 2006). CRCT have hybridized with introduced salmonids, limiting naturally occurring genetically pure populations to high-elevation headwater streams in Utah (CRCT Coordination Team 2006; UDWR 2007). Since 1999, the UDWR has raised CRCT in hatcheries and released them into lakes in the Uinta Mountains, in the northeastern part of Utah (UDWR 2007).

A range-wide status assessment in Utah, Wyoming, and Colorado performed by Hirsch et al. (2005) found CRCT currently occupy about 3,022 miles of habitat, or approximately 14 percent of historically occupied areas.

Preferred habitat of CRCT is composed of cool, clear water of high-elevation streams and lakes (UDWR 2007). Spawning generally begins in late spring or early summer, generally over gravel substrates with good water circulation. Diets primarily consist of macroinvertebrates and plankton; however, adults will also prey on smaller fish (UDWR 2007).

The WTP Project Area contains numerous cold water streams that provide potential habitat for the CRCT. Additionally, 12 miles of currently occupied habitat has been identified in Desolation Canyon along the Green River, which forms the eastern boundary of the WTP Project Area.

Flannelmouth Sucker

The flannelmouth sucker (*Catostomus latipinnis*) is identified as a BLM sensitive species by the Price Field Office. Flannelmouth suckers typically inhabit deep water habitats of large rivers, but are also found in small streams and occasionally in lakes.

Extant flannelmouth sucker populations can be found from the Green River at the Colorado River confluence upstream to Flaming Gorge Reservoir, and the White River from the Green River confluence to Kenny Reservoir, Colorado. Recent investigations of historical accounts, museum specimens, and comparison with recent observations indicate that flannelmouth suckers occupy approximately 50 percent of their historic range in the Upper Colorado River Basin (Utah, Wyoming, Colorado, and New Mexico). Populations have declined since the 1960s due to impoundment of the mainstream Green River in Wyoming and Utah (Flaming Gorge Reservoir) and the Colorado River in Glen Canyon, Utah (Lake Powell) (UDWR 2007). Potential habitat for the flannelmouth sucker occurs in the portion of the Green River, which forms the eastern boundary of the

WTP Project Area, and at least one flannelmouth sucker has been documented in this portion of the Green River.

Roundtail Chub

The roundtail chub (*Gila robusta*) is identified as a BLM sensitive species by the Price Field Office. This species is a large member of the minnow family found most often in major rivers and smaller tributary streams. Although movement patterns are poorly understood, the roundtail chub has been described as sedentary and mobile, depending on life stage and habitat conditions.

Extant roundtail chub populations occur in the Green River from the Colorado River confluence upstream to Echo Park, and in the White River from the Green River confluence upstream to near Meeker, Colorado. The roundtail chub now occupies approximately 45 percent of its historical range in the Colorado River Basin. In the Upper Colorado River Basin (New Mexico, Utah, Colorado and Wyoming), it has been extirpated from approximately 45 percent of its historical range, including the Price River and portions of the San Juan, Gunnison, and Green Rivers. Data on smaller tributary systems are largely unavailable, and population abundance estimates are available only for short, isolated river reaches (UDWR 2007). Potential habitat for the roundtail chub occurs in the portion of the Green River, which forms the eastern boundary of the WTP Project Area, and at least one roundtail chub has been documented in this portion of the Green River.

3.10.3.4 Amphibians

Western Toad

The western toad (*Bufo boreas*) is identified as a BLM sensitive species in the Price Field Office. The species inhabits much of the western U.S. and occurs throughout most of Utah (UDWR 2007). The western toad occurs in the montane areas of central and northern Utah where it is found in association with permanent water bodies in a variety of habitats, including riparian, mountain shrub, mixed conifer, and aspen-conifer assemblages. Breeding sites are in small pools, beaver ponds, reservoirs, and backwaters, and in side channels of creeks and rivers (Bosworth 2003).

Although western toads have not been identified in the WTP Project Area, potential habitat occurs throughout the WTP Project Area.

3.10.3.5 Reptiles

Smith's Southwestern Black-headed Snake

Smith's southwestern black-headed snake (*Tantilla hobartsmith*) is identified as a BLM sensitive species by the Price Field Office. The Smith's southwestern black-headed snake is known to occur in the Colorado Plateau region of southern and eastern Utah (Bosworth 2003). The species is secretive and abundance is unknown, and furthermore, the species is seldom documented in the State (Bosworth 2003; UDWR 2007). Habitat for the species is found in open areas of grassland and woodland habitats, often near stream corridors (UDWR 2007). Potential habitat for this species exists throughout the WTP Project Area.

Smooth Green Snake

The smooth green snake (*Opheodrys vernalis*) is identified as a BLM sensitive species by the Price Field Office. No studies specifically address population trends for the smooth green snake anywhere in its range; however, the smooth green snake is believed to be less abundant than in the past. This species' habitat is characterized by moist sites with thick grassy, herbaceous, and shrubby vegetation, especially wet meadows. In particular, in northeastern Utah, the smooth green snake is found in wetlands within aspen stands (Redder et al. 2006). Potential habitat for this species exists throughout the WTP Project Area.

Utah Milk Snake

The Utah milk snake (*Lampropeltis triangulum taylori*) is identified as a BLM sensitive species by the Price Field Office. The species occurs in the eastern and central portions of the State and is thought to be uncommon in Utah (UDWR 2007). Milk snakes occur in a wide variety of habitats including: shrubby hillsides, canyons, and open stands of ponderosa pine in the foothills, pinyon-juniper woodlands, and arid river valleys (Hammerson 1999). Habitat for this species exists throughout the WTP Project Area.

3.10.3.6 Plants

The State of Utah does not have a sensitive plant list; however, the BLM Utah State Office lists four BLM sensitive species that either occur or may potentially occur in Carbon County, Utah. This list includes Book Cliffs blazing star (*Mentzelia multicaulis labrina*), Creutzfeldt-flower (*Cryptantha creutzfeldtii*), Graham's beardtongue (*Penstemon grahamii*), and Utah phacelia (*Phacelia utahensis*). An evaluation of recent field records and surveys, as well as an analysis of potential habitat information, was conducted for these four species. Based on the available data, only the Graham's beardtongue was documented as occupying habitat within the WTP Project Area boundary. **Table 3.10-2** summarizes habitat descriptions and potential or known occurrence within the WTP Project Area for each of the aforementioned sensitive plant species considered in this EIS. Natural history and population occurrence information for the Utah BLM sensitive species were gathered from the online Utah Rare Plant Guide (Utah Native Plant Society 2007). Potential or known occurrence for each of the BLM sensitive species was identified by the Price Field Office (Ivory 2007a).

Table 3.10-2 The BLM Sensitive Plants in Carbon County, Utah

Common Name/*Scientific Name*	Occurrence in the WTP Project Area[1,2]
Graham's Beardtongue (*Penstemon grahamii*)	Likely; occupied habitat present
Book Cliffs Blazing Star (*Mentzelia multicaulis labrina*)	Likely; potential habitat present
Creutzfeldt-Flower (*Cryptantha creutzfeldtii*)	Likely; potential habitat present
Utah Phacelia (*Phacelia utahensis*)	Unlikely; potential habitat present

[1]*Potential habitat* is defined as areas which satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment (BLM 2007a; USFWS 2007).
[2]*Occupied habitat* is defined as areas currently or historically known to support the species; synonymous with "known habitat." (BLM 2007a; USFWS 2007).

Graham's Beardtongue (Penstemon grahamii)

Areas suspected to contain potential habitat for Graham's beardtongue consist of sparsely vegetated desert shrub and pinyon-juniper communities on shaley talus knolls at elevations ranging between 4,600 and 6,700 feet. Flowering occurs from May to mid-June.

Pollinators of the Graham's beardtongue include several species of bees (*Anthophora lesquerellae, Osmia sanrafaelae, Lasioglossum sisymbrii, Dialictus* sp., *Bombus huntii*) and a wasp (*Pseudomasaris vespoides*). The wasp, which is an extreme specialist of penstemon flowers, is likely the most consistent pollinator of the Graham's beardtongue (USFWS 2006c). Due to the scarcity of its flowers, the Graham's beardtongue alone may not be able to support a viable population of the wasp. The wasp pollinator most likely relies on more abundant, concurrently blooming, penstemon species to support the wasp population (USFWS 2006d)

There is one known occurrence of Graham's beardtongue within the WTP Project Area boundary, as well as additional potential habitat for the species.

Book Cliffs Blazing Star (Mentzelia multicaulis labrina)

Areas suspected to contain potential habitat for the Book Cliffs blazing star include sagebrush, rabbitbrush, and pinyon-juniper communities on Mancos Shale and Price River Formations at about 6,200-feet in elevation. This species blooms from July through September. Habitat is present for the blazing star in Carbon County, Utah, and potential habitat occurs within the WTP Project Area.

Creutzfeldt-Flower (Cryptantha creutzfeldtii)

Areas suspected to contain potential habitat for the Creutzfeldt-flower include shadscale and mat *Atriplex* communities on the Mancos Shale Formation ranging between 5,250 and 6,000 feet in elevation. This species blooms from late April through June. Habitat is present for the Creutzfeldt-flower in Carbon County, Utah, and potential habitat occurs within the WTP Project Area.

Utah Phacelia (Phacelia utahensis)

Areas suspected to contain potential habitat for Utah phacelia are limited to the salt desert shrub community on Arapien Shale Formations ranging between 5,500 to 5,700-feet in elevation. This species blooms from April through June. There are no known populations of the Utah phacelia in Carbon County, Utah.

3.11 RECREATION

3.11.1 Introduction

Numerous opportunities for recreation exist within and in close proximity to the WTP Project Area. Recreational activities take place in developed facilities, as well as in the large undeveloped parts of the WTP Project Area and provide for a wide array of visitor experiences. Recreational opportunities include dispersed camping, hiking, horseback riding, OHV use, scenic overlooks, hunting, fishing, boating, canyoneering, scientific and cultural resource study, wildlife viewing, and wild lands enjoyment. Key attractions in the area include portions of the Desolation Canyon and Jack Canyon WSAs, Nine Mile Canyon and the cultural resources contained therein, and the Green River through Desolation Canyon.

The majority of the lands within the WTP Project Area fall under the jurisdiction of the Price Field Office. Remaining portions of the WTP Project Area are under the jurisdiction of the Vernal Field Office, the SITLA, and private landowners. The discussion of recreational resources and management thereof will concentrate on BLM-administered lands.

As previously discussed in **Section 3.1**, the 2008 DEIS was written and published when the Price River MFP and Diamond Mountain RMP were the existing and approved plans for the WTP Project Area. However, land use plan revisions for both Price and Vernal have since been completed and approved. While this FEIS has been modified to discuss conformance with the Price and Vernal Approved RMPs, the document still includes discussion of recreational management decisions that have undergone modifications within the Approved RMPs. For example, within the Approved Price RMP, all areas that were open to OHV use are now limited to designated roads and trails. The analysis has not been changed in this FEIS because the BLM received numerous public comments regarding potential effects to OHV use under the Proposed Action and alternatives (see **Section 6.3**). To modify the analysis at this time in the process would essentially preclude the BLM from responding to those public concerns.

3.11.2 Recreation Management

The primary goal of recreation management on public lands is the protection of natural resources while providing a diversity of unique opportunities and experiences for the recreating public (BLM 1997). The management of recreation is generally guided by the *Utah Standards for Public Land Health and Guidelines for Recreation Management* (BLM 1997). In addition to these standards, the BLM has established a Recreation Opportunity Spectrum (ROS) framework to classify recreational resources and opportunities on public lands. Further, the BLM has designated Recreation Management Areas (RMAs) to guide the management of those experiences and opportunities.

3.11.2.1 Recreation Opportunity Spectrum

The ROS is the BLM's framework to inventory, plan and manage recreational opportunities on public lands. The ROS classifies BLM-administered lands into six classes, based on three principal components: the environmental setting, the possible activities, and the experiences that can be achieved.

For the WTP Project Area, ROS classes were identified under the Diamond Mountain RMP for the Vernal Field Office portion of the WTP Project Area. The Price River MFP does not address ROS classification. ROS inventory for the Price Field Office portion of the WTP Project Area was developed subsequent to the Price River MFP (**Figure 3.11-1**).

Lands within the WTP Project Area fall within four of the six ROS classes. Definitions of the four relevant classes and their management prescriptions are as follows:

Primitive

The primitive (P) classification is applied to areas that are essentially unmodified natural environments of about 5,000 acres or more, lying at least 3 miles from the nearest point of motor vehicle access. Within primitive areas, there is little evidence of others and the visitor experience in these areas provides an opportunity for solitude and isolation from human civilization. Primitive areas are managed to be essentially free from evidence of humans and on site controls. Motor vehicle use within these areas is not permitted.

Semi-Primitive Nonmotorized

The semi-primitive nonmotorized (SPNM) setting consists of about 2,500 acres lying at least 0.5 miles from the nearest point of motor vehicle access. These areas are predominantly natural or natural-appearing environments wherein motorized recreation use is not permitted. The experience provides for minimal contact with others and isolation from human civilization. These areas are managed to be largely free from the evidence of humans and on site controls (such as signage).

Semi-Primitive Motorized

The semi-primitive motorized (SPM) setting consists of about 2,500 acres within 0.5 miles of primitive roads and two-track vehicle trails. These areas are managed to provide a natural-appearing environment. Evidence of humans and management control are present but subtle. Motorized recreation is permitted, yet the experience still provides for isolation from human civilization since the concentration of users should be low.

Roaded Natural

Roaded natural (RN) settings consist of areas near improved and maintained roads. While these areas are mostly natural in appearance, moderate evidence of the sights and sounds of humans can be expected. The experience provides for a sense of security due to the moderate number of visitors and developments present. RN areas are managed to provide a natural appearing environment with moderate evidence of humans. Placements of ROW, utility corridors, management facilities, and other surface-disturbing activities would be favored in roaded natural areas over semi-primitive nonmotorized and semi-primitive motorized areas.

Generally, RN classifications are found along the Nine Mile Canyon. Semi primitive motorized classifications are located along Dry Canyon and some of the other roads along the plateau. SPNM and P classifications are concentrated in the WSAs, in lands adjacent to the WSAs (e.g., those lands identified as having wilderness characteristics), and on the plateaus above Nine Mile Canyon. Acreages of land within each classification are listed in **Table 3.11-1**.

Table 3.11-1 Acreage of Lands under each ROS Class within the WTP Project Area	
ROS Class	**Acreage within the WTP Project Area**
Roaded Natural	3,921
Semi-Primitive Motorized	64,737
Semi-Primitive Non-Motorized	18,122
Primitive	28,746
Unclassified	4,680

It should be noted that ROS classifications within the Price Field Office are currently used as an inventory of recreational opportunities rather than being used as a management framework for those opportunities.

3.11.2.2 Recreation Management Areas

RMAs are the primary means by which the BLM manages recreational use of public lands. All public lands managed by the BLM fall within either a SRMA or within an Extensive Recreation Management Area (ERMA). These designations are described below.

Special Recreation Management Areas

SRMAs are defined as areas that require a recreation investment, where more intensive recreation management is needed, and where recreation is a principal management objective (BLM 2004c). Portions of two SRMAs, Nine Mile Canyon and Desolation Canyon, fall within the WTP Project Area. These areas are managed as SRMAs in recognition of the high levels of recreation activity and the unique nature of the resources found within their boundaries.

Nine Mile Canyon

Nine Mile Canyon has often been described as the "longest outdoor art gallery in the world" and is internationally recognized for its substantial concentration of prehistoric archaeological sites and renowned rock art panels. There are also a number of historic features in the area, dating from the 1880s, which have regional significance. Nine Mile Canyon itself has been classified as a BLM Backcountry Byway and a State of Utah Scenic Byway. In addition, the Canyon and surrounding area is a proposed archeological district to be listed on the National Register of Historic Places (NRHP). For more information about the prehistoric history and historic settlement of the area see **Section 3.12** (Cultural Resources). The unique cultural resources, scenic value, and recreational draw of the Nine Mile Canyon prompted the BLM to create the Nine Mile Canyon SRCMA in 1995.

The SCRMA occupies about 23,464 acres of the WTP Project Area encompassing the 78-mile Nine Mile Canyon Backcountry Byway and its viewshed, the potential Nine Mile Canyon Archeological district, and the Nine Mile Canyon ACEC. The Backcountry Byway includes Soldier Creek Road; Nine Mile Canyon Road to the junction of Cottonwood Canyon; 1 mile up Cottonwood Canyon from Nine Mile; and the road through Gate Canyon/Wells Draw and Myton Bench (**Figure 3.11-2**). The SRCMA was established primarily to protect the wide range of historical and archeological resources in the canyons. Other objectives identified in the *BLM Recreation and Cultural Area Management Plan: Nine Mile Canyon Special Recreation and Cultural Management Area* (BLM 1995a) are to protect, preserve, and enhance the natural character, inspirational value, and scenic quality of the area while optimizing recreation and interpretive opportunities (signage). Included in the objectives of the management plan is the provision of a safe recreational environment. Management of the SRCMA is challenging given the mixture of private, Federal, State, and Tribal land ownership in the area. In addition, the SRCMA is situated in three counties (Duchesne, Uintah, and Carbon) and falls under the jurisdiction of two different Field Offices (Price and Vernal).

Desolation Canyon

The Desolation Canyon SRMA is located along the eastern boundary of the WTP Project Area and is managed under the Desolation and Gray Canyons of the Green River, River Management Plan (BLM 1979). The SRMA is generally defined as the visual corridor limited to what can be seen or heard from the river. The area is surrounded by over 1 million acres of uninhabited lands and receives high levels of primitive recreation use from early spring to late fall. River use in Desolation Canyon is available by special recreation permit (SRP) only; river permits are limited for resource protection. Six private and commercial river launches of up to 25 people per launch are permitted every day of the high-use season (May 15 to August 15). Two launches per day are permitted the remainder of the year. Total user day capacity for the area is 35,000 user days per season. Approximately 14,720 acres of the Desolation Canyon SRMA fall within the WTP Project Area.

International, regional and local visitors to the Desolation Canyon SRMA have expectations for primitive, wild landscape, solitude, quiet, and tranquility. Desolation and Gray Canyons of the Green River provide a week long, high quality wilderness experience as well as a cultural and heritage experience with a wealth of prehistoric and historic resources.

Given the potential for wilderness designation of Desolation Canyon and its status as a National Historic Landmark (see **Section 3.17**, Special Designations), specific management objectives have been established for the canyon. The primary goals are to maintain the natural character of the canyon environment (in both Desolation and Gray Canyons) and to provide for the equitable distribution of available user days to a broad spectrum of the public. Specific management actions have been established for the portion of the river from Sand Wash to Nefertiti Rapid to provide a continuing opportunity for a quality wilderness type experience in this area and to protect the scientific value of the cultural resources while also allowing for their enjoyment. One of the provisions, Management Action #5, is to suspend oil and gas exploration for lands lying within the management plan corridor (i.e., within sight or sound of the river).

Extensive Recreation Management Area

With the exception of the SRMAs described above, the WTP Project Area is managed as an ERMA and recreation activities are subject to few restrictions. Recreation is managed at the opportunity level, rather than for specific experiences and activities. The Price Field Office ERMA is managed according to the prescriptions of the Price River

MFP and the San Rafael RMP. The Vernal Field Office ERMA is managed according to the prescriptions of the Diamond Mountain RMP.

3.11.3 Recreational Opportunities

As stated previously, there are a variety of recreational activities allowed and pursued within the WTP Project Area, primarily of a dispersed nature. The BLM manages for the opportunities and experiences provided by the following uses:

- Recreational OHV use;
- Cultural/heritage tourism;
- Primitive/unconfined recreation;
- River recreation; and
- Hunting, fishing, and wildlife watching .

While most recreational activities take place on the largely undeveloped areas of the WTP Project Area, there is, at present, one developed recreational facilities in the WTP Project Area. The Daddy Canyon facility, near the mouth of Dry Canyon on Nine Mile Canyon Road, consists of a trailhead, toilets, and a parking area.

Visitor experiences from activities such as OHV use, backcountry camping, mountain biking, rock climbing, river running, and hiking are dependent on a low density of other visitors and are subjective values that vary greatly by individual. A detailed listing of experiences that the BLM manages for, such as enjoying nature, physical exercise, and solitude, can be found in *Appendix A*, *Experience and Benefit Checklist* of the *Unified Strategy to Implement "BLM's Priorities for Recreation and Visitor Services" Workplan*.

3.11.3.1 Recreational Off Highway Vehicle Use

The BLM developed the 2001 *National Management Strategy for Motorized Off-Highway Vehicle Use on Public Lands* (Strategy) to assist field managers in the implementation of on-the-ground solutions for OHV recreation and access issues, to protect public land resources, and to make more executive use of existing staff and funding. This Strategy is an effort to manage motorized OHV activities in full compliance with Executive Orders 11644 (1972) and 11989 (1978), 43 CFR 8340, which, among other management prescriptions, require the BLM to assign designations to areas and trails. The designations, which are incorporated in the BLM's 8340 Manual, are defined as follows:

> **Open:** The BLM designates areas as "open" for intensive OHV use where there are no compelling resource protection needs, user conflicts, or public safety issues to warrant limiting cross-country travel.
>
> **Limited:** The agency designates areas as "limited" where it must restrict OHV use in order to meet specific resource management objectives. These limitations may include: restricting the number or types of vehicles; limiting the time or season of use; permitted or licensed use only; limiting use to existing roads and trails; and limiting use to designated roads and trails. The BLM may place other limitations on use, as necessary to

protect resources, particularly in areas that motorized OHV enthusiasts use intensely or where they participate in competitive events.

Closed: The BLM designates areas as "closed" if closure to all vehicular use is necessary to protect resources, ensure visitor safety, or reduce use conflicts.

OHV designations established within the WTP Project Area are illustrated in **Figure 3.11-3**. The Jack Canyon and Desolation Canyon WSAs are designated as limited to existing roads and trails; however, as there are no roads and trails within the WSAs the areas are effectively closed to OHV use. Limited OHV use is allowed along Nine Mile and Cottonwood Canyons. The remainder of the area is open to OHV use. No OHV designations have been established for the portion of the WTP Project Area under the jurisdiction of the Vernal Field Office, north of the Duchesne/Carbon County line.

3.11.3.2 Cultural/Heritage Tourism

Visitation to the WTP Project Area is predominantly comprised of tourists and recreational users who travel the Nine Mile Canyon Backcountry Byway and branch canyon roads to view and experience the cultural and historical assets of the area. As discussed in the SRMA section, Nine Mile Canyon and the surrounding area are managed for specific recreation experiences and activities. These include driving for pleasure, viewing cultural sites in their natural landscape context, heritage tourism, and wildlife viewing. The gravel road through Nine Mile Canyon, known as County Road (CR) 53 or Nine Mile Canyon Road, is also a designated Backcountry Byway. Nine Mile Canyon is promoted heavily by regional travel councils and has received much publicity both locally and at a national level. As a result, the area draws a substantial number of recreationists each year.

Intensive visitation inventories for the Nine Mile Canyon and branch side canyon areas have not been conducted since 1995. At that time, the average daily count of vehicles passing over traffic counters in the area was 100 per day. During Easter weekend, April 1993, 600 people were observed recreating in the canyon. Visitation occurs year-round, with peaks on the weekends from the spring through the fall. Vehicle touring, bicycling, camping and guided tours are the most popular recreational activities. Given the increased media attention focused on the area, numbers have likely increased exponentially since that time. To date, Nine Mile Canyon generates more requests for information from the Castle Country Regional Information Center and the Carbon County Travel Bureau than any other attraction in the region.

Reports from visitors have revealed a less-than-satisfying experience in many cases. The primary reasons cited include unmet expectations for facilities, especially interpretive information in the canyon, and the excessive dust and poor road conditions that are often encountered. In addition, tourists in the canyons often exit their vehicles to view the rock art that is in close proximity to the road. This creates a safety hazard when combined with both industrial and other recreational traffic on the roads. Use conflicts also arise due to the complex land ownership and large areas of privately owned lands along the Nine Mile Canyon Backcountry Byway.

Empirical observations by frequent users of Nine Mile Canyon (e.g., Nine Mile Canyon Coalition) indicate that recreational use of the area for cultural and heritage tourism has experienced steady decline since a surge in oil and gas development began in the WTP Project Area in 2004. These observations are supported by anecdotal information provided by the Castle Country Regional Information Center in Price, that during the past two years visitor interest and inquiries about visiting the Canyon have declined significantly.

3.11.3.3 Primitive/Unconfined Recreation

The largely undeveloped areas of the WTP Project Area provide abundant opportunity for primitive and unconfined recreational experiences, especially within the Jack Canyon and Desolation Canyon WSA. Most primitive recreation activities are allowed on lands under wilderness review. These include hiking and camping, backpacking, fishing and hunting, boating, and horseback riding. Travel by OHV in WSAs is prohibited.

As discussed in **Section 3.17** (Special Designations), the presence of pipelines, roads, wells and other human imprints have altered the wilderness characteristics in parts of the WTP Project Area. The existing imprints, however, and their individual and cumulative impact on the natural character of most of the lands in the area, are minor. The largely undeveloped lands are of sufficient size to allow access to outstanding opportunities for solitude and unconfined recreation.

3.11.3.4 River Recreation

Float boating, rafting, river running, and kayaking are important recreation activities on the Green River through Desolation Canyon along the eastern boundary of the WTP Project Area. A trip through Desolation and Gray Canyons along the Green River, consecutive canyons within the plateau, is a premier, wilderness recreation experience. The 84-mile trip from sand Wash to Swasey's Beach is world renown. There is also ample opportunity for land-based activity from the river, such as hiking in the more than 60 side canyons. The BLM receives over 6,000 applications per year for the 450 available trip permits issued to self-outfitted users. Eighteen commercial outfitters market trips through these canyons both nationally and internationally. For more information on the Desolation Canyon SRMA and NHL, see **Section 3.17** (Special Designations).

3.11.3.5 Hunting, Fishing, and Wildlife Watching

Licensed hunting is a key seasonal recreational activity that takes place on most of the Federal and State lands within the WTP Project Area. With the exception of the developed recreational sites and the proposed Nine Mile Canyon National Historic District, the lands within the WTP Project Area are open in the fall and early winter for big game hunting. The area is particularly appealing to deer and elk hunters given that the hunting experience in the area is high quality and primitive. The area has produced a number of trophy and State record book animals.

Until about 15 years ago, the West Tavaputs Plateau and surrounding area was considered to be one of the foremost deer hunting areas in the United States. However, deer populations have been reduced over the last 20 years, and are currently at below 50 percent of desired numbers. On the other hand, elk populations are approximately double the desired management numbers and UDWR has recently increased cow elk hunting permits in an attempt to manage this herd and decrease the population to range carrying capacity. Hunting throughout the area has resulted in numerous cross-country roads (two-tracks) and hunter camps.

The WTP Project Area falls within the Nine Mine, Range Creek Unit for elk, mule deer, pronghorn, bighorn sheep, black bear, and cougar hunting. Portions of this unit are largely comprised of private property and require written permission from the landowners to access properties before applying for the hunt. Hunting seasons are different for each species and weapon type (e.g., archery, muzzleloader, any weapon); however, big game seasons generally begin in the early fall and end in the early winter. Black bear, unlike other species, can also be hunted during the springtime. It is important to note that the WTP Project Area constitutes only a fraction of the Hunting Unit. **Table 3.11-2** provides details on all permitted hunting activities within the WTP Project Area.

Table 3.11-2 Permitted Hunting Activity within the WTP Project Area

Hunt #	Species	Hunt Name	2008 Season Dates	Permits Available		Permit Fee (Dollars)	
				Resident	Non-Resident	Resident	Non-Resident
965	Once-in-a-lifetime Species: Rocky Mountain bighorn	Nine Mile/ Range Creek	11/1-11/30	6*	0*	508	1,513
835	Limited Entry: Pronghorn (any weapon)	Nine Mile/ Range Creek	9/13-9/23	9*	0*	50	288
385	Limited Entry Bull Elk (Muzzleloader)	Nine Mile/ Range Creek South	9/24-10/2	NI	NI	280	NA
345	Limited Entry Bull Elk (Any Weapon, late)	Nine Mile/ Range Creek South	9/13-9/23	5*	0*	280	NA
344	Limited Entry Bull Elk (Any Weapon, early)	Nine Mile/ Range Creek South	11/8-11/14	2*	0*	280	NA
310	Limited Entry Bull Elk (Archery)	Nine Mile/ Range Creek South	8/16-9/12	2*	0*	280	NA
998	General Buck Deer Hunt (Muzzloader)	Southeastern	8/16-9/12	11,700*	1300*	35	263
988	General Buck Deer Hunt (Any Weapon)	Southeastern	10/18-10/22			35	263
564	Antlerless Elk	Nine Mile/ Range Creek	10/4-10/26	90	10	45	213
565	Antlerless Elk	Nine Mile/ Range Creek	11/15-1/11/09	585	65	45	213
007	Limited Entry: Spring Black Bear	Nine Mile, Anthro-Range Creek	4/12-5/31	14	2	93	318
107	Limited Entry: Fall Black Bear	Nine Mile, Anthro-Range Creek	8/23-9/30 11/1-11/23	11	1	93	318

*2006 permit data.
NA- Not applicable
NI- No information available

Fishing is not a popular recreational activity in the WTP Project Area. Fishing is not allowed in Nine Mile Creek, and the lower Green River through Desolation Canyon is not a popular fishing destination.

3.12 CULTURAL RESOURCES

3.12.1 Introduction

Cultural resources are defined as any evidence of past human activities. They include structures such as historic or prehistoric buildings, bridges, homesteads, canals, roads, or shipwrecks. They also include such things as art, stone tools, food remains, ceramics, glass items, tin cans, documents, and many other items that show how people lived, thought, and felt about the world around them (Stettler and Seddon 2005). Cultural resources also include places that are significant to a particular group's history and traditions. These places are often called Traditional Cultural Properties (TCPs). These types of properties can be archaeological sites, such as prehistoric campsites, rock art, burials, rock shelters, lithic scatters, and village sites. They can also be non-archaeological site types such as lakes and springs, land features, and traditional gathering or collection areas (16 U.S.C. 470, Section 101[d][6][a]).

The data presented within this section are a synopsis of a Class I literature review (Whitfield et al. 2006 as amended by Patterson 2010) for the WTP APE conducted by Montgomery Archaeological Consultants, Inc. (MOAC).

Most of the WTP APE, approximately 149,579 acres, coincides with lands administered by the Price Field Office. Remaining portions fall under the SITLA and private ownership. Archival record searches were conducted in October, November, and December of 2005 at the Price and Vernal Field Offices by Meg Thornton and Roger Stash, and at the State Historic Preservation Office in Salt Lake City by Marty Thomas. An additional records search was conducted by Jody Patterson in the spring of 2010 to include updates of the entire APE.

This study was conducted by MOAC under U.S.D.I. (FLPMA) Permit No. 05-UT-60122 in compliance with Federal and State legislation including the Antiquities Act of 1906, the National Historic Preservation Act (NHPA) of 1966 (as amended), the NEPA of 1969, the Archaeological and Historic Preservation Act of 1974, the Archaeological Resources Protection Act of 1979, and the American Indian Religious Freedom Act of 1978.

The NHPA sets forth national policy and procedures regarding "historic properties"—that is, regions, sites, buildings, structures, and objects included in or eligible for the NRHP. Section 106 of the NHPA requires Federal agencies to consider the effects of their undertakings on such properties, following regulations issued by the Advisory Council on Historic Preservation (ACHP) (36 CFR 800).

Criteria for evaluating the significance of resources for listing on the NRHP are outlined in 36 CFR 800.10, "National Register Criteria." The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and,

a) That are associated with events that have made a significant contribution to the broad patterns of our history;

b) That are associated with the lives of persons significant in our past;

c) That embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; and

d) That have yielded, or may be likely to yield, information important in prehistory or history.

In consultation with the SHPO, the BLM had originally identified multiple APEs for the project including 1) all BLM and SITLA lands within the Project Area; 2) the Nine Mile Canyon and Gate Canyon Roads (i.e., 150 feet on either side of the roads); and 3) the canyon bottoms, for effects to the setting. However, during development of the WTP PA, and in consultation with the SHPO, ACHP, Indian Tribes, and other consulting parties, the BLM determined that the APE should be revised and expanded to include additional areas outside of the WTP Project Area where there are known cultural resources that could be impacted by industrial traffic. As a result, the revised APE, shown on **Figure 3.12.4**, has been expanded to include the north rim of Nine Mile Canyon; Gate Canyon from the east to west rim; and Nine Mile Canyon from Sheep Canyon (project boundary) west to its junction with Minnie Maud Creek. A complete description of the revised APE boundary can be found in **Appendix T** - WTP Programmatic Agreement.

3.12.2 Cultural Overview

The Northern Colorado Plateau Archaic stage spans from 7000 Before Christ (B.C.) to Anno Domini (A.D.) 400, and is characterized by the adaptation to essentially modern environments. Subsistence practices were more intensive involving hunting and gathering of a large variety of plant, animal, and insect resources. Milling stones increased in frequency, and projectile points became smaller and more variable. Matson (1991) has divided the Archaic stage into four temporal periods, called the Early, Middle, Late, and Terminal periods. No Early or Middle Archaic radiocarbon dates have been reported from cultural contexts in Nine Mile Canyon. Overall, the presence of Archaic hunters and gatherers in the study area appears to have been extremely sporadic, although some rock art styles have been attributed to these groups. Possibly Late Archaic or Basketmaker II presence is represented at Rasmussen Cave in Nine Mile Canyon. Gunnerson (1969) reported a skeleton from the bottom of a refuse heap by the Claflin-Emerson Expedition. The remains were located in direct association with moccasins and buckskin leggings as well as an atlatl, complete with its foreshafts and attached flint points. According to Gunnerson (1969), the artifacts interred with the individual closely resemble what could be expected in a Basketmaker II burial except for the hide moccasins and leggings. Spangler (1995) points out that an actual migration of Basketmaker II peoples into the Tavaputs Plateau and Uinta Basin region is not supported by existing data, although it is possible that small migratory groups of people with Basketmaker-like traits may have occupied sites like Rasmussen Cave.

Rock art styles commonly attributed to Colorado Plateau Archaic peoples include the Barrier Canyon Style which has been ascribed a temporal span of circa 1000 B.C. to A.D. 500 by Cole (1990). The temporal placement of this rock art style is based primarily on a relative chronological ordering approach, since there is a general lack of absolute dates corresponding to Barrier Canyon depictions. The few available dates are mainly from the cultural deposits in association with the rock art element or panel. For instance, in the Needles District (southeastern Utah) cultural remains associated with a Barrier Canyon Style panel yielded a date of 3340 +/- 110 before present (B.P.) (Tipps and Hewitt 1989). Nearer to the study area, Loendorf (1986) proposes that a Barrier Canyon Style figure from Rochester Creek dates between 165 B.C. and A.D. 210, based on a radiocarbon date processed from stratified deposits at this site. The validity of the cultural identification of this rock art style has also been debated by researchers on the basis of cross-cultural comparison of specific stylistic elements. Manning (1990) has hypothesized that the Barrier Canyon Style anthropomorphic tradition may date from A.D. 1300 to 1600 based on the fox pelt pendant motif displayed on a number of anthropomorphs in Utah. The terminal date for the Barrier Canyon Style is proposed by Schaafsma (1986) at about A.D. 100; based mainly on the portrayal of only the head and torso of anthropomorphs, leaving out the arms and legs. Spangler (1995) considers the Barrier Canyon Style to be an indigenous development of Late Archaic peoples of the northern Colorado Plateau that did not spread significantly beyond the southern escarpment of the Book Cliffs, based on the paucity of this rock art style on Tavaputs Plateau and in the Uinta Basin.

The Barrier Canyon Style includes both rock paintings and pecked petroglyphs (usually solid), although the former medium is more common. The most well-known and dominant motif attributed to the Barrier Canyon Style is the elongated immobile anthropomorphic form, which has been described as “mummy like” (Schaafsma 1971). Anthropomorphic figures range in height from a few centimeters to more than two meters, often appearing in rows of two or more, either crowded together, or in separate groupings. Characteristic of this style are anthropomorphs with broad shoulders and long tapered bodies, ranging from rectangular to triangular, with shoulders often appearing hunched (Cole 1990). Heads may be small and rounded or bulging at the eyes, rectangular, abstracted into a line or lines, and with a two-horned headdress. Life-sized figures are often represented with vertical, or zigzag forms (serpents), and are frequently associated with small birds, sheep, deer, unidentified quadrupeds, and therianthropes (combined animal and human forms). Sometimes quadrupeds are rendered with small heads and disproportionate large bodies that are rectangular or ovate. Rock art researchers and enthusiasts have indicated that Barrier Canyon Style anthropomorphs evoke a supernatural appearance, hence the term “ghost death images” (Schaafsma 1971) or “spirit figures” (Kelen and Sucec 1996). Along the same speculative lines, Cole (1990) points out thematic compositions and imagery of Barrier Canyon Style panels which may represent ceremonial events in some cases involving anthropomorphs, plants, and snakes. Although these interpretations cannot be substantiated (i.e., ethnographic analogs or oral traditions), they do emphasize the distinctiveness of this probable Archaic cultural tradition. Compared to the post-Archaic assigned rock art styles, only a few Barrier Canyon rock art panels have been documented in Nine Mile Canyon. These include the large polychrome painted anthropomorphs in nearby Sheep Canyon (Matheny and Matheny 1990); a large anthropomorphic figure with small appendages from lower Nine Mile Canyon (Hurst and Louthan 1979), and several red pictograph anthropomorphs (42Dc612 and 42Dc717) also found in lower Nine Mile Canyon (Spangler 1993).

On the Northern Colorado Plateau, the Formative stage (A.D. 700 to A.D. 1250) is characterized by a reliance on domesticated plants (most notably corn), substantial habitation structures often organized into hamlets or villages, production of pottery, and the use of the bow and arrow. Traditionally, the WTP Project Area has been classified within the occupation zone of the San Rafael Fremont variant, a cultural taxonomy defined by Marwitt (1970). More recently, a cultural homogeneity among Formative peoples of the Book Cliffs, East Tavaputs and West Tavaputs Plateaus (Nine Mile Canyon) region has been recognized (Spangler 1993; Spangler 1995). According to Spangler (1993), the Formative inhabitants of this region were specifically adapted to a marginal canyon environment where subsistence activities were concentrated in selective canyon drainages with permanent water, arable land, and pinyon-juniper resources. Based on numerous archaeological projects completed by the University of Utah, Brigham Young University, and the Nine Mile Canyon Survey Project, Fremont sites in Nine Mile Canyon have been categorized as complex sites (small villages), circular structures (semi-subterranean pithouses), slab-lined cists, wall alignments, granaries, hearths, and rock art panels. Investigations in Argyle and Sheep Canyons indicate a settlement pattern of structural sites (complex and circular slab rooms) located in close proximity to each other on both the north and south sides of the canyons (Matheny and Matheny 1990).

Spangler (1995) has defined two Fremont settlement patterns in Nine Mile Canyon that are chronometrically documented. One consisted of semi-subterranean pithouses of dry-laid masonry construction situated on stream terraces 10 to 30 meters above the floodplains that afford easy access to arable lands. Dated sites in this category include 42Cb770 (Franks Place), a pithouse village with an outdoor work area. The site yielded an adolescent burial in a slab-lined cist situated within a dry-laid stone masonry semi-subterranean dwelling with a calibrated date of A.D. 1166. A second settlement pattern is the masonry surface architecture located on somewhat inaccessible rock outcrops 100 meters or more above the floodplain offering economically inefficient access to permanent water and arable lands (Spangler 1995). Near the WTP Project Area, several multiple-structure sites have been documented on high ridge tops with commanding views of Argyle and Nine Mile Canyon, and are interpreted as possible ceremonial sites since the access to water is hundreds of vertical feet below (Matheny and Matheny 1990). Sky House, excavated by Gillin (1938), is also in this category, although interpreted as a defensive site situated 365 feet above the valley floor, it consists of a burned adobe/masonry structure containing a female burial wrapped in a rabbit skin blanket along with clay figurines. The dendrochronological assessment of construction beams from Sky House resulted in a tight cluster between A.D. 1086 and 1090. Another well-represented site type in Nine Mile Canyon is storage facilities (e.g., granaries and slab-lined cists). Fremont granaries in Nine Mile Canyon are either dry-laid or wet-laid masonry enclosures located in shallow rock shelters or overhangs that provide protection from inclement weather. The construction of large storage structures in Nine Mile Canyon may denote the production of food surpluses. The Nine Mile Canyon storage strategy appears to have been dominated by remote storage and/or caching of harvested resources by a more mobile population that did not require expedient access to stored resources (Spangler 1995). Horticultural implements and maize remains have been found in several of the granaries in the Dry Canyon area (Matheny et al. 1991). Dates processed from wooden digging implements recovered at storage facility sites in Nine Mile Canyon include A.D. 973, A.D. 978, and A.D. 1025.

The Tavaputs Plateau temporal sequence obtained from Nine Mile Canyon, Willow Creek, and Hill Creek appears to reflect a narrow Fremont fluorescence in the region between A.D. 1000 and 1200. Late Fremont occupation of Nine Mile Canyon is represented by a complex sandstone and adobe storage site (42Dc655) dated A.D. 1255; and by a slab/masonry surface structure, which yielded a radiocarbon date of A.D. 1295 (Spangler 1995). According to traditional interpretations, environmental stress is the proposed cause for the abandonment of the area by Formative stage peoples. Lindsay (1986) proposes that climatic change in the form of reduced summer rainfall and possibly a shortened growing season (i.e., environmental stress) triggered the abandonment of the Colorado Plateau, specifying the variability of abnegation over time and space. Jennings and Norbeck (1955) applied the Nine Mile Canyon dendrochronology to interpret a period of drought from about A.D. 1270 to 1295 that closely corresponded to a more severe drought in the Anasazi area.

Fremont style rock art includes well-made petroglyphs, rock paintings (monochrome and polychrome), and combination petroglyph-rock paintings that feature heroic and supernatural anthropomorphs, often near life size. The rock art of Nine Mile Canyon falls within the geographic area for the Northern San Rafael Fremont Style which, according to Schaafsma (1971), shares stylistic similarities with the Barrier Canyon Style on the northern Colorado Plateau. In general, San Rafael Fremont rock art displays a greater number of more active, realistic figures in association with a variety of animals and geometric abstract images. The location of Fremont rock art is often high on cliff walls and in locations that are difficult to access. The high settings emphasize the heroic and ceremonial nature of the subject matter (Cole 1990). A distinctive feature of Fremont rock art is the organization of subject matter that is frequently visible at sites. Some panels have strong narrative qualities, particularly those with hunting and fertility themes. This characteristic is illustrated in many of the Nine Mile Canyon panels where individual elements as well as groups of anthropomorphs and quadrupeds are tightly clustered and superimposed on discrete cliff areas, boulders, and rock faces (Schaafsma 1971). Several researchers have noted that rock art panels in Nine Mile Canyon are poorly executed and crowded, with anthropomorphs in the lower portion of the canyon constituting 41 percent of all motifs (Spangler 1993).

Fremont style anthropomorphs in the Tavaputs Plateau are frequently depicted in horizontal rows in a manner similar to that of Archaic and Anasazi rock art styles. Cole (1990) points out that anthropomorphs exhibiting characteristics of both Fremont and Barrier Canyon Style rock art occur in Nine Mile. Some of these images have detailed facial features, headdresses, masklike faces, clothing, and elaborate body decorations. Others have relatively simple solid-pecked and painted figures. Fremont style anthropomorphic heads are rectangular, helmet-shaped, and rounded, and frequently sit directly on the shoulders. Side hair bobs are frequently exhibited at northeastern Utah and western Colorado sites (Cole 1990). Headdresses include fringed sticks, horns, antlers, ears, antennae, rectangular tablitas, feathers, and elevated cap-like devices. A common Fremont style anthropomorph depicted on panels in Nine Mile Canyon is solidly pecked and characteristically horned, sometimes adorned with a fringed horn headdress resembling elk antlers (Castleton 1984; Schaafsma 1980). Feet and hands are often enlarged, and arms and hands may hang down or be raised. Other elements of the Northern San Rafael Fremont Style include scalps, masks, and heads; concentric circles, spirals, lines, and other geometric designs; quadrupeds such as bighorn sheep, pronghorn, deer or elk, bison, and canines; scorpion and centipede-like images and other possible insects; lizards, snakes, shield-like images, owls, wading birds, footprints, paw prints, and ungulate tracks (Cole 1990; Schaafsma 1971).

A variety of themes have been identified at rock art sites with Northern San Rafael Fremont Style depictions in the region including ideology, fertility, hunting, and warfare (Spangler 1995). It should be conveyed that in many cases the extrapolation of rock art subject matter is based on broad cross-cultural comparisons, out-of-context symbolism, or sometimes pure conjecture. The significance of identifying rock art themes and compositions is the delineation of the functional differences of intrasite and intersite rock art localities as well as distinguishing indigenous cultural traditions. The non-empirical idea that some Fremont style rock art motifs may depict events in the supernatural or mythological realm has been postulated by some researchers (Cole 1990; Gunnerson 1969; Kelen and Succec 1996; Schaafsma 1986). In particular, Cole (1990) has inferred shamanistic and mythological imagery in Fremont style rock art as represented by masked and "supernatural" anthropomorphs, in addition to bird-like representations. Schaafsma (1986) also states "the ceremonial attire of the anthropomorphs, especially their horned and other types of ornate headdress, suggests that these are figures of supernatural power." In Nine Mile Canyon, a notable anthropomorphic figure with fringed headdress and bird-feet hands has been interpreted as a transformational or "shaman" personage (Kelen and Sucec 1996). Another panel in Nine Mile Canyon displaying the upper torso of a human-like form attached to a sheep's lower body with wide antler-like appendages is purported to represent the supernatural transformations of a shaman (Matheny et al. 1991). Fertility is alluded to at various sites in the area that feature birthing scenes, copulation, and vulva symbolism (Cole 1990).

Hunting themes appear to be the most common Fremont style rock art representation in the Tavaputs Plateau; consisting of intentionally grouped and thematically related elements (Spangler 1993). One of the more elaborate panels of this organizational trait is the "Great Hunt" petroglyph site in middle Nine Mile Canyon that appears to be related to shamanistic activities to bring hunting success as depicted by anthropomorphs with headdresses (or horns); some shown holding bows and arrows (Cole 1990). Ferris (1989) believes that some or all of the hunters and shield figures may not have been part of the original composition, but added later. The data recovered from the multi-year Nine Mile Canyon Project indicate that the native bighorn sheep was the most frequently depicted animal in Nine Mile Canyon petroglyph panels, and may have had high value as a subsistence item (Matheny and Matheny 1990). Also, when weapons were depicted, they were associated with sheep, except one case in which deer were the subject matter (Matheny and Matheny 1990). Hunting weapons rendered on panels in Nine Mile Canyon include bows and arrows, shields, and the atlatls.

Warfare is implied on rock art panels that depict shield-bearing figures holding spears, bows and arrows, and possibly scalps or heads. Rock art panels in Nine Mile Canyon near the mouth of Dry Canyon exhibit shield figures engaged in combat (Gillin 1938). In northeastern Utah, warfare is implied by the "headhunters" motif known on many Classic Vernal Style rock art panels which shows straps or handles at the top of the head, and sometimes hair bobs and necks (Kelen and Sucec 1996; Spangler 1995). According to Cole (1989, 1990), the "headhunter" icon portrayed on panels in the Uinta Basin shares affinities with similarly interpreted panels in the San Juan Basketmaker area. Although stylistically different, these motifs exhibit straps or handles at the top of the heads, hair bobs, and necks, which are similar to Basketmaker examples (Cole 1990). Also suggestive of warfare are the shield-bearing anthropomorphs which are present in Nine

Mile Canyon. Keyser (1975) considers the shield motif characteristic of Northwest Plains rock art that originated among the Great Basin Fremont and diffused into the Plains with the arrival of Shoshonean peoples. He indicates the motif corresponds with the distribution of Intermountain pottery, steatite (soapstone) vessels, and tubular smoking pipes, all considered diagnostic of Shoshonean peoples. Furthermore, Keyser (1975) suggests that the Shoshonean peoples may have borrowed the shield-bearing motif from Fremont peoples as an elaboration of their own rock art style featuring circular designs.

Cole (1990) has defined a late Fremont rock art style bearing less angular figures, nose representations, and stick-figure bowmen with simple quadrupeds, as well as the unusual arrows that she states may be related to cultural events taking place prior to the demise of the Fremont culture by A.D. 1500. According to Spangler (1995), many motifs Cole considers characteristic of the late Fremont are also found in abundance in Nine Mile Canyon. In particular, the stick-figure bowman and simplified quadruped are common, although all are petroglyphs. The paucity of radiocarbon dates directly or indirectly associated with Nine Mile Canyon rock art makes any temporal interpretations speculative at this time.

Following the Fremont abandonment of the area, a largely nomadic hunting and gathering life way resumed. This occupation is attributed to the Numic-speaking peoples; a diverse group that was present throughout much of Utah upon the arrival of Europeans in the 18th century. The Protohistoric stage is characterized by an increased use of higher elevations and general cessation of cultigen production and use. Archaeological records indicate Numic expansion into the Colorado Plateau appears between A.D. 1200 and 1400, although the origins of this linguistic group are not well established. Reed (1994) proposes that the Numic speakers appeared in eastern Utah and western Colorado beginning around A.D. 1100, based on the distribution of chronometric dates associated with brown ware ceramics. A correlation of 108 radiocarbon determinations from Numic contexts for this area suggest that post-Formative populations may have peaked during the 1300s or 1400s, with a likely decline between A.D. 1650 and 1750 (Reed 1994). The apparent decline during this period observed in the radiocarbon determinations may be attributed to sampling error or may reflect actual population decline due to epidemics (Reed 1988). The archaeological evidence of the Numic-speaking peoples consists primarily of lithic scatters, low density ceramic scatters, and the occasional wickiup. Most of the artifact scatters are in open air settings, although a small number are in rockshelters.

The cultural history of the Eastern Ute, comprising those bands living east of the Green River, has been divided into three phases (Reed 1988). The Canalla Phase (A.D. 1100-1650) refers to the time period between the appearance of the well-dated Uncompahgre Brown Ware ceramics and the adoption of an equestrian life way (Reed 1988). Diagnostic artifacts include Uncompahgre Brown Ware ceramics, Desert Side-Notched and Cottonwood Triangular arrow points, and Shoshonean knives. The pedestrian hunters and gatherers probably lived in wickiups. Near the end of the phase, some groups may have obtained occasional trade items from Spanish settlements in New Mexico. The Antero phase (A.D. 1650-1881) represents a shift to a fully equestrian lifestyle and integration of Euro-American trade goods into Ute material culture. The use of the horse permitted hunting of bison on the plains and led to an increase in raiding for economic gain. While gathering persisted, some groups attempted horticulture in the

19th century. Euro-American trade goods became increasingly important, apparently supplanting many traditional artifact types. Tepees, as well as wickiups, were inhabited.

An occupation by Protohistoric hunter-gatherers on the Tavaputs Plateau is indicated by the recovery of several temporally diagnostic artifacts and post-Fremont style rock art. Late prehistoric radiocarbon dates in the study area are derived from isolated artifacts. The most notable dated archaeological find in Nine Mile Canyon is a burden basket recovered from a cliff ledge in the South Franks tributary of the canyon. A sample from the perishable item returned an accelerator mass spectrometry (AMS) date of 395 +/- 70 years B.P. (A.D. 1475 calibrated), which placed it into the Canalla Phase (Spangler 1995). The basket was found in close association with a juniper bark filled slab-lined cist located in a small alcove. The bark from the feature indicated a date of 250 +/- 60 years B.P. (A.D. 1625 calibrated) (Spangler 1995). A third radiocarbon date of 310 +/- 60 years B.P. (A.D. 1638 calibrated) was obtained from a buffalo robe cache found by local collectors in Nine Mile Canyon. Items in this cache included two monochrome painted buffalo robes with antler flaking tines, arrow points, a shaft-straightener, a leather pouch containing powdered red pigment, balls of white and red clay, as well as a white buckskin bag with yellow-dyed porcupine quills and dewclaws strung on a stick (Spangler 1995). More recently, limited testing at the First Canyon site (42Cb1279) uncovered a single component Numic (Ute) occupation dating to mid A.D. 1600 (Montgomery and Montgomery 1999). This is the single example in the area of a dated occupation within a controlled stratigraphic context. The occupation was localized along the cliff base, with extensive rock art panels representing Archaic Barrier Canyon Style, Fremont Northern San Rafael Style, and Early Historic Ute Style. The shallow cultural horizon contained evidence of deflated hearths, a large amount of lithic artifacts including three Desert Tri-Notched projectile points, and floral and faunal remains.

Rock art corresponding to the Numic peoples on the northern Colorado Plateau has been divided into at least three different styles: Early Historic Ute Style, Late Historic Ute Style, and Ute Representational Style (Buckles 1971; Cole 1989; Cole 1990). Early Historic Ute Style is ascribed a temporal range of A.D. 1600 to 1830 for eastern Utah and western Colorado (Buckles 1971; Cole 1989; Cole 1990). This rock art style is dated from the time the Ute began to use the horse, approximately A.D. 1640 (Smith 1974), until 1830 when contact between Utes and Euro-Americans became routine due to the establishment of trading posts in western Colorado. Petroglyphs of this style are solidly pecked, stipple-pecked, and incised, and are located in a wide variety of settings, from the alpine zone to cliff faces along canyon bottoms. This rock art style has been observed in the White River, Douglas Creek, Hill Creek, and Nine Mile Canyon drainages where it is sometimes found in association with other rock art styles (e.g., Barrier Canyon Style, Fremont Style). Subject matter of this style includes equestrian and pedestrian anthropomorphs, some with shield motifs. Keyser (1975) views mounted shield figures as unrelated to the classic shield bearing warrior motif, since they differ significantly in form and distribution. Stylistically, the body forms of Early Historic Ute Style anthropomorphs range from rounded to rectangular, and arms are depicted out to the side and less often hanging down (Cole 1990). On the Tavaputs Plateau, human representations are often composed of highly abstract lines with minimal attention to detail (Spangler 1995). Males are sometimes depicted by phallic symbolism engaged in such activities as hunting and warfare. Females are less obviously illustrated, although vulva forms are exhibited at some sites. Other motifs include abstract images, horses, elk, deer, bighorn sheep, bison, birds, bows and arrows, shields, lances, bear-paw prints (stylized tripartite images), and cloven-hoof tracks. Some subjects may represent supernatural beings or people in ceremonial dress (e.g., shamans were known to have conducted curing and other ceremonies among the Ute) (Cole 1990). Many panels have the appearance of being added to by different artists. At some panels on the Tavaputs Plateau, stick-like and triangular-bodied anthropomorphs exhibit headdresses, shields, and weaponry. Horses and game animals are frequently realistic in form, with emphasis on movement. Antlers, humps, and horns are also emphasized in depictions. Bison have a fluorescence in this art style, probably because the possession of the horse allowed the Ute groups of the area the opportunity to annually migrate to the plains where these animals appeared in abundance. According to Buckles (1971) the earliest examples of Ute rock art in western Colorado (e.g., ceremonial style) lack bison depictions. Thematic groupings include group aggression (e.g., battle or raid scenes), individual prestige (indicated by power symbolism and details of dress and material goods), buffalo, and other hunting scenes. While panel groupings appear to have biographic content, truly narrative story lines like those of the Plains Biographic Style are not obvious.

Late Historic Ute Style rock art (A.D. 1830 to 1880) continues to show affinities to earlier art forms, but there is also influence from Euro-American art traditions that emphasize controlled composition, realism, and naturalism in life forms (Cole 1990). Abstraction and simplicity of form depicted in earlier forms is generally lacking from this later style. Also, rock art panels are frequently crowded, and some elements appear to have been fitted into spaces between other imagery. Subject matter of the Late Ute Style is similar to the earlier, but with some additional subjects. Representations include anthropomorphs, decorated shields, shield-figures, horses and equestrians, tepees, trees, and animal tracks. Sometimes anthropomorph and zoomorph figures convey motion, realistic physical attributes, and detail of clothing, tack, decoration, and life-styles (Cole 1990). In Nine Mile Canyon, Hurst and Louthan (1979) have defined early Ute rock art as “Sub-style A” characterized by lightly scratched or pecked renditions of horses, tepees, owls, and deer hunting scenes. Buckles (1971) notes similarities between late Ute art and contemporaneous art of Plains Indians, and suggests that Plains culture influenced the Ute to express individualistic subjects. A few examples of narrative art with story lines occur, but compositions are much less complex and structured than Plains Biographic Style art (Cole 1990). According to Spangler (1995), the Late Historic Ute Style is more prevalent in the Uncompahgre Plateau region, whereas the earlier Ute style is particularly common in the East Tavaputs Plateau. These rock art depictions commonly occur near panels of Fremont and Barrier Canyon Style rock art, as well as near examples of earlier Ute style art. Despite contact with Euro-American culture, Ute rock art retains its aboriginal character. Significance was placed on the horse and related materials, such as trailing headdresses, shields, and decorated bridles, but Ute rock art rarely indicates a concern with Euro-American lifestyles or belief systems (Cole 1990).

Ute Representational Style (A.D. 1880 to 1950) is mainly based on examples from Ute Mountain Tribal Park. However, some good examples have been reported from the East Tavaputs Plateau region (Spangler 1995). This style includes detailed pictographs and petroglyphs executed with metal tools employing techniques such as pecking, abrasion, scratching, and incising. Themes of Ute Representational Style include traditional dress and ceremonies, possibly the Bear Dance; horses as symbols of value, prestige, and beauty; cowboy culture; and personal recognition (Cole 1990). This Ute rock art style features humans and equestrians, but horses are also important individual subjects. In contrast to the horses, humans are stiff and stylized in appearance, comparable to the earlier Ute rock art styles. Humans, some with detailed facial features, are frequently near life-size and are shown full-face, in profile, and from the rear (Spangler 1995). Traditional clothing, such as breast plates and feather headdresses, are depicted. Cowboy attire is shown in great detail and includes articles described above as well as spurs. Hats and boots are depicted as individual items. Euro-American influence is further indicated by the depiction of cattle, buildings, trains, and flags.

In addition to rock art panels, other sites of importance within the WTP Project Area may include brush driveline and corral sites, as well as Culturally Modified Trees (CMTs), which have recently been more thoroughly documented to the northwest within the South Unit of the Ashley National Forest (DeVed and Loosle 2001; Loosle 2007). Brush driveline and corral sites often consist of a combination of sagebrush and/or pinyon-juniper branches and limbs intertwined together to form walls. The walls were placed between living trees, incorporating living branches into the matrix of the wall to strengthen it. The walls of the driveline were intended to lead animals (e.g., horses, deer, antelope, sheep) into a circular or semi-circular enclosed corral. These driveline and corral sites often resembled an open keyhole configuration. Several of these sites have been recorded on National Forest and Ute Tribal lands north of Nine Mile Canyon. It is believed that these sites are associated with Protohistoric and historic Ute occupation of the area (Loosle 2007). CMT sites have also been documented to the northwest within Sowers and Timber Canyons of the South Unit of the Ashley National Forest (Loosle 2007). CMTs are trees that have been altered by native people as part of their traditional use of the forest, or by non-native peoples during their use or occupation of forested areas. Trees have been altered for a variety of reasons. Among native populations, the process has been documented as a subsistence practice (e.g., consumption of peeled bark, tree sap as sweetener), for medicinal purposes, or for practical purposes (e.g., sap as moccasin waterproofer, glue) (DeVed and Loosle 2001; Martorano 1989; Loosle 2007). The full extent of these site types within the WTP Project Area is currently unknown; however the Uintah and Ouray Ute Indian Tribe identified CMTs at a multi-component camp site within the WTP Project Area. Additional information about this site can be found in **Section 3.12.4**.

The Tavaputs Plateau and Nine Mile Canyon are unique to Utah in that the areas were never subjected to the massive homesteading and agricultural activities that usually resulted in permanent settlements (Spangler 1995). The earliest Euro-American presence in the canyon is unknown, but likely consisted of fur trappers and later prospectors. Schaafsma (1971) reports an inscription in Nine Mile Canyon reading, “J.F. 1818.” However, an earlier photo recently found shows this inscription as reading, “1918" (Miller 2004), indicating vandals had altered the date to read earlier. An 1860s inscription left by a Salt Lake City prospector named “Grosbeck” is representative of later exploration (Spangler 1995). The area was largely ignored, except by hardy cattle ranchers, because of the scarcity of permanent water and suitable agricultural land.

Permanent Euro-American presence was most likely established in the area after the creation of a freight road that linked the Denver and Rio Grande railheads in Price to settlements in the Uinta Basin in 1886 (Geary 1981). This road construction coincided with the building of Fort Duchesne on the Uintah Frontier. As the main road into the Uinta Basin, the Nine Mile Canyon Road played an important part in the early development of Eastern Utah. Originally constructed by the Buffalo Soldiers of the all-black 9th U.S. Cavalry and members of the 6th Infantry from Fort Douglas in 1886, the road followed an existing trail previously used by Native Americans and fur trappers. It linked Fort Duchesne with the nearest railhead and telegraph line. The road immediately became heavily traveled. The stagecoach, mail service, and freight shipments all used this route. When gilsonite mining became an important industry in the Uinta Basin in 1889, it was also hauled over the Nine Mile Canyon Road to Price and the railways for shipment throughout the country. Traveling the road from Fort Duchesne to Price took six days, and freighters traveled it with tandem wagons weighing four to six tons pulled by four- to six-horse teams. Besides government freight, Utes used the road to haul provisions, and communities in Ashley Valley used the route for transportation (Watt 1997). In 1905, when the Uintah and Ouray Ute Indian Reservation opened the area to white settlement, nearly 15,000 homesteaders traveled the road (Duchesne County Chamber of Commerce 1993). Nine Mile Canyon Road was considered “all season” because of its generally low passes and relatively easy traveling. The new Indian Canyon road to Duchesne was constructed in 1915, and significantly lowered the use of the Nine Mile Canyon Road. However, the Nine Mile Canyon Road was still being used minimally as late as the 1920s.

The earliest Euro-American individuals associated with Nine Mile Canyon were a trapper by the name of Grosbeck and John Wesley Powell. George Whitmore and the brothers Shedrach and Alfred Lunt established ranches in the area beginning in 1878. This date is derived from an 1878 General Land Office map that shows the location of the Alfred and Shedrach Lunt ranch at the mouth of Gate Canyon. The same ranch was later owned by William Brock. It became a stop for the first stagecoaches, and offered a campground for travelers. Soldiers from Fort Duchesne in the Uinta Basin were brought down to man a telegraph relay station built there by the military (Spangler 1995). When Brock had to flee the area for killing a man, Pete Francis bought the ranch and opened a saloon and hotel. In 1902, the ranch was acquired by Preston Nutter after Francis died in a saloon brawl. The dominant economic mainstay in Nine Mile Canyon was always cattle ranching, and Preston Nutter was at the forefront of the business. He used the old William Brock ranch as headquarters for his cattle enterprise, which comprised approximately 25,000 head. Nutter ranged cattle on hundreds of acres through ownership or lease from Nine Mile Canyon to the Arizona Strip on the Grand Canyon’s North Rim (Duchesne County Chamber of Commerce 1993). Preston Nutter weathered several depressions in the cattle industry, becoming a consultant to Washington politicians on grazing issues, and somewhat of a celebrity. The Nutter Ranch remains a major historical landmark.

The settlement pattern in the area was very different from most Utah Mormon town sites; there was no definitive town site in the canyon. Instead, the site was a long linear settlement along waterways and parcels of property. However, the Nine Mile settlement had all of the qualities of a town, including schools, a constable and justice of the peace, as well as a detailed genealogy. Smith Wells and Harper are two communities that are often described as Nine Mile’s largest communities. However, they each only consisted of one family. Both Smith Wells and Harper were associated with freighting activities. In 1891, Owen Smith capitalized on the freighters’ need for water along the Nine Mile Canyon Road. A 37-mile stretch of the road between Fort Duchesne and the canyon posed a problem for freighters who had to haul barrels of water as cargo in their wagons. Smith established a 180-foot deep water well that serviced as many as 500 head of cattle in one stop. This “oasis” employed a complex system of gears and buckets designed by Smith, and became known as “Smith’s Wells” (Spangler 1995). Harper, originally the Frank Alger ranch, began with the establishment of a small post office and precinct center. In 1905, the post office name was changed to Harper, which in a 1910 census, listed 130 residents. Some of the log buildings are still standing. An early resident of Harper, Mildred Miles Dillman, compiled the 1948 *Early History of Duchesne County*, which names some of the early residents of the canyon (Spangler 1995). However, the temporal sequence of ranching in the canyon is difficult to decipher, and the location of most of the ranches is unknown.

3.12.3 Ethnographic Overview

This ethnographic overview consists of a literature review for the WTP Project Area and adjacent areas. Published and unpublished sources, as well as archival materials, and previous cultural resources reports were examined to determine both general contextual information (e.g., subsistence, land use patterns, religious beliefs), and more specific data linking cultural history and practice with locations within the WTP Project Area. This overview has been undertaken with basic ideas of cultural affiliation, Traditional Cultural Properties (TCPs), and sacred sites as outlined by Parker and King (1998), and Deloria and Stoffle (1998) were also examined. Other State entities have variously expressed cultural connections to the general area encompassing the West Tavaputs Plateau (Ferguson 2001; Molenaar 2004a; Molenaar 2004b). The *existing* ethnographic literature is most supportive of the four State groups (and variants) that are the focus of this review. They are the Ute, the Southern Paiute, the Hopi, and the Navajo.

3.12.3.1 The Ute

Today, the Ute people, the *Nuche*, live on four reservations: the Uintah and Ouray Reservation in Utah, east of Roosevelt; White Mesa, south of Blanding, Utah; and the Ute Mountain Ute and Southern Ute reservations in southwestern Colorado. They are considered by linguists to be part of a larger Numic speaking people, including Shoshones and Southern Paiute. The *Nuche* were aboriginal hunters and gatherers. The contemporary and historic oral traditions of the *Nuche* relate them to the land and other parts of nature, as the story of *Sinauf* illustrates (Duncan 2000). *Sinauf* was a god, half man, and half wolf, who journeyed from the south going northwards to the ancestral lands of the *Nuche*. *Nuche* creation and migration stories, significant religious ceremonies (such as the Bear Dance and, later in their history, the Sun Dance), and many of the spiritual powers of the medicine man, *Poowagudt,* were derived from natural living things. *Nuche* believed the landscape to be infused with sacredness. As the Northern Ute writer and spiritual leader, Duncan (2000) says, “These stories became the basis of Ute history and culture and defined the relationship of Ute Indians with all living elements, both spiritually and physically.” The landscapes occupied by the *Nuche*, according to belief, are infused with sacredness, a source of *Poowagudt'*s spiritual powers.

Janetski (1994) and others (Sutton 1993) maintain that the Ute and other Numic speakers arrived in Utah around A.D. 1300, prior to European contact. Little was known about the Ute people before approximately A.D. 1640-50. Some lines of evidence, including oral traditions, suggest that they migrated here from western coastal regions. While known contacts with Ute (or Numic speaking peoples) begin sometime around 1540 with Coronado’s expedition (Spangler 1995), more intensive and extensive documentation of the Ute in the historic record does not occur until approximately 1640. Spangler (1995) and Ferguson (2001) have summarized in detail the existing ethnographic and ethnohistoric data on early Ute habitation of the Uinta Basin, specifically the West Tavaputs Plateau.

Utilizing A.D. 1640 as a baseline date, Ute aboriginal lands once covered large parts of Northern Colorado, Utah, and New Mexico. Ethnographers and ethnohistorians have identified the Ute territory as comprising over 200,000 square miles, ranging from Abiquiu, New Mexico north to Colorado Springs, extending into the Braggs, Wyoming area; and to the west and south to Fillmore, Utah (Conetah 1982; Duncan 2000). Glimpses of this pre-horse lifestyle from Escalante's 1770s descriptions suggest that the Ute located around Utah Lake lived a semi-sedentary hunting and gathering life in small family groupings. They were dwelling in wickiups and using dogs as pack animals to transport their material items (Pettit 1990; Warner 1995). They seasonally migrated from deserts to valleys during colder seasons, and to the mountains for hunting and gathering during spring and summer (Conetah 1982; Janetski 1994).

Ute groups living in and around the southern Colorado and Northern New Mexico region appear to be the first to have adopted the horse, while other Ute groups to the north and west did not adopt the horse until the late 17th or early 18th century (Conetah 1982; Forbes 1959). Some Numic speakers, including bands or small groupings of Ute, eventually began hunting buffalo and engaged in other Plains-like cultural practices. Still other Numic groups continued their pre-contact hunting and gathering lifestyle, which centered primarily on small game hunting and seed collecting.

Early accounts by trappers and traders indicate that the Ute in the Uinta Basin-Tavaputs Plateau area had adopted the horse by at least 1825 (Spangler 1995). The adoption of the horse had a profound influence on the life ways of the Ute (Conetah 1982; Forbes 1959). Employment of the horse by some bands greatly increased their mobility, changing their seasonal subsistence rounds, and expanding their territorial range (Pettit 1990). Ethnohistoric and ethnographic sources suggest Utes (or Numic speakers) were clearly in the WTP Project Area as early as the mid 16th century, and perhaps earlier. Clear evidence places the Sherberetch Ute band and possibly the Uinta-ats and San Pitch in the WTP Project Area by the beginning of the 19th century (Conetah 1982; Duncan 2000; McKay 1980; Newton 2001).

Ute social organization, reflective of these subsistence patterns, has been a subject of intense research over the last 80 years. The nature of the Ute band structure, nomenclature, and geographical distribution reflected the diverse and often harsh habitats they occupied and the adaptive strategies they employed to subsist. They refer to themselves as *Nuche,* the Ute, but band naming and identification appears to have varied chronologically and spatially (Conetah 1982). Steward (1997) and others (Callaway et al. 1986) have noted that band naming varied depending on habitat – either geographical location or food resource. The ethnographic literature identifies at least 13 bands of Ute (historically), and dozens of spelling and interpretive variations (Callaway et al. 1986; Conetah 1982; Steward 1997). The apparently fluid nature of Ute band membership, and the fission and fusing of bands to create new bands, is a highly adaptive mode of social organization, allowing the *Nuche* to roam over a vast territory (Steward 1997).

Due to the acceleration and intensification of contact with Euro-Americans between 1825 and the early decades of the 20th century, Ute culture would once again be transformed. During this period almost every succeeding generation of Utes would experience massive culture change to their life ways, including settlement patterns and subsistence patterns. Beginning in the early decades of the 19th century, the fur trade brought trappers and explorers into the Uinta Basin and into direct and continuous contact with the Utes via trading routes, such as the Old Spanish Trail (Firmage 1996). Coupled with the newly acquired equestrian life ways, Spangler (1995) notes that trading and tribute became a mainstay in Ute economic life. As Alley (1982) notes, the fur trade and other Euro-American cultural patterns “laid the groundwork for the later dispossession of the Utes and Paiutes by white settlers and the United States government.”

Mormon colonial expansion, beginning in the 1850s, set in motion a series of conflicts and wars with the Utes and other native peoples in Utah. For example, south of the Tavaputs Plateau, the Elk Mountain (Moab area) Mormon mission, established in the mid-1850s, triggered conflict with Ute peoples in southeastern Utah, such as the Black Hawk War, and a variety of other encounters between Utes, Navajos, Paiutes, and Mormon pioneers (Peterson 1998). To the west and southwest, Utes living near Utah Lake, and possibly Paiutes in valleys west of the Wasatch Mountains, lost their lands through a series of conflicts with Mormon settlers (Duncan 2000). Many Ute groups had been forcibly concentrated in the Uinta Basin by the beginning of the reservation period or the early 1860s.

Between 1846 and 1882, Euro-American expansion into the Great Basin gained momentum and was intensified by Mormons settling Utah and miners flooding into Ute territory in western Colorado, following the discovery of gold, silver, and coal. The result was a maze of [government and private] decrees with Ute bands from Central Utah (Corn Creek, Tintic) and Eastern Utah to New Mexico, and North and South Colorado…In less than 45 years (1861-1905), the U.S. government would create, terminate, and then eviscerate Ute reservations from northern and southern Colorado and Northeastern Utah (Fritz 2004).

By the beginning of the 20th century, the Utes had been placed on four reservations, scattered throughout Utah and Colorado, and forced to adopt farming, livestock ranging, and wage labor as a means of subsistence. Utes from the Uintah and Ouray Reservation roamed with herds of sheep, cattle, and horses throughout the Tavaputs Plateau area, including the Willow Creek and Hillcreek areas immediately adjacent to the WTP Project Area (Fritz 2004).

Observations and Conclusions

Early (pre-1850s) ethnographic/ethnohistoric evidence with detailed accounts and exact geographic/topographic locations for Utes within the WTP Project Area are limited. Facing repeated and rapid cultural change, Ute culture evolved a band structure that occupied and maintained a diverse range of landscapes and local adaptations with fluid identities. More sensitive and diachronic ethnographic models capable of recognizing and explicating rapidly shifting (temporally and spatially) localized ethnic unit identities or ethnogenesis are needed.

Recent rock art studies in Nine Mile Canyon suggest Numic and/or specifically Ute authorship. For instance, Spangler writes, “[u]nequivocal evidence of Ute/Numic occupations was minimal. Four sites exhibited evidence of Numic hunters on horseback, although a much greater number of sites executed in a similar style are probably attributed to Numic occupation of the canyon” (Spangler 2004). Matheny et al. (2004) provides a thorough overview of hunting and winter economy depicted in the rock art of Nine Mile Canyon. Hurst and Louthan (1979) write,

> There is no real evidence that the canyon was occupied or utilized by the Shoshonean speakers known to have inhabited Eastern Utah following the demise of the Fremont… It is the opinion of the authors, however, that one of these groups, probably the Utes, utilized this canyon during historic times and that some of the rock art described in this report can be attributed to these people.

Finally, oral traditions suggest early Ute were in the environs adjacent to the WTP Project Area. It should be noted that the WTP Project Area is adjacent to, and may be a natural topographic route, for the movement of people across the landscapes north and south near the Green River, and east and west near the Book Cliffs and the Old Spanish Trail (Spangler 1995). Clear evidence places the Sherberetch Ute band and possibly the Uinta-ats and San Pitch bands in the WTP Project Area by the beginning of the 19th century (Conetah 1982; Duncan 2000; Newton 1999; Newton 2001). Late 19th and early 20th century Ute ranchers and herders are documented to have grazed and lived in the WTP Project Area.

Sources

The University of Utah library special collections and the American West Center are excellent depositories of Ute ethnographic and ethnohistoric materials. They, along with the Utah Division of State History, were consulted for this study. Excellent Ute histories have been prepared by Jorgensen (1964); Pettit (1990); Simmons (2000); Smith (1974); Tyler (1951); Thompson (1972); the Uintah and Ouray Tribe (1977a, b, c, d, and e); and the Ute Mountain Ute Tribe (1985). The most widely attributed works on Ute religion and general ethnology are by Jorgensen (1972) and Lowie (1924). Pre-19th century primary documentation on the Ute in Utah, specifically in the WTP Project Area, is sparse and limited to a few journal accounts, the best of which are the Dominquez-Escalante journals and a few references by Spaniards (Sanchez 1997; Warner 1995). The University of Utah Marriott library and other sources in the archives of the American West Center at the University of Utah also contain important Ute documents. All have been consulted for this study. More documentation relating to the early 19th century trader/trapper period (Spangler 1995), and the later Mormon period, is available in Mormon Church archives. Records relating to various Ute litigation, including records from the Indian Land Claims Commission on file at the University of Utah Marriott library and archives of the American West Center at the University of Utah, also contain important Ute documents (Thompson 2002; Thompson 2004). All have been consulted for this study.

3.12.3.2 Southern Paiutes

The Southern Paiutes' sacred belief that most centrally connects them to a physical landscape is *Puha. Puha* is believed to be an energy that is infused in all physical elements of the universe. It also forms the basis for how individuals and groups connect to the land in general, and to specific topographic locations (Liljeblad 1986; Miller 1983; Stoffle et al. 2004).

Oral traditions and migration narratives suggest that the Southern Paiute migrated eastward from near the Pacific Ocean (Ferguson 2001; Spangler 1995; Tyler 1951). Like the Ute, the Southern Paiutes are considered to be part of the Southern branch of the Uto-Aztecan linguistic family. Early ethnographic and ethnohistoric evidence places

Southern Paiutes in a broad territory from Southern Nevada and Utah and extending into Northern Arizona (Kelly and Fowler 1986). Spanish explorers, including Escalante, Dominguez, and Garces in the late 18th century, documented the first known contact between Southern Paiutes and Euro-Americans. According to Euler (1973), these early chronicles suggest Southern Paiutes displayed little impact of Euro-American influence despite nearly 250 years since the Spanish first arrived in the Southwest. Today, the Southern Paiutes are situated on reservations in Utah, Nevada, and Northern Arizona (Knack 2001).

Ethnographic and oral traditions portray near-starvation conditions for most Southern Paiutes throughout most of their history (Kelly and Fowler 1986). Oral traditions further suggest that Paiutes brought corn with them from their place of origin and practiced horticulture while surviving through periods of intense drought. The broad geographical region and diverse ecologies occupied by Southern Paiutes influenced the subsistence activities and diet from approximately A.D. 1000 through the mid-19th century. Southern Paiutes were organized in bands and variously subsisted on hunting for small game such as rabbits and larger game such as deer, and foraging for pine nuts, berries, seeds, and insects. Archaeological evidence suggests Southern Paiutes may have utilized a number of cultigens in pre-contact times (Fowler and Fowler 1981). Until the reservation period and the intensification of contacts with Euro-Americans in the mid-19th century, Southern Paiutes were semi-sedentary hunters, gathers, and horticulturalists (Fowler and Fowler 1981; Holt 1992).

Ethnohistoric and ethnographic studies of Southern Paiutes since contact and well into the 20th century portray a people trapped in a snare of dependency and economic deprivation (Bunte and Franklin 1987; Euler 1973; Holt 1987; Knack 2001). Yet, they maintained a sense of identity. Knack (2001) writes,

> Southern Paiutes' primary strategy throughout this dynamic period of change was flexibility, molding themselves to changing circumstances. Their hunting and gathering past had been adapted to an environment that had spotty resources, unpredictable from season to season. Their culture was under specified, without fixed structures to hem them in or preempt otherwise viable alternatives…Their life demanded that they be able to adapt and shift as each new situation demanded…This flexibility has served the Paiutes well over the last century and a half.

Knack's conclusions might be a beginning point for serious reexamination of Southern Paiute ethnohistoric research, including their apparent close relationship with certain Utes and Navajos in Central and Southern Utah and Northern Arizona.

Given Knack's description of the Southern Paiute's adaptive strategy, the diversity of social structure reported by ethnographers is not surprising. For instance, some ethnographers have identified at least 16 different bands (and a host of smaller subgroups) of Southern Paiutes (Ferguson 2001). The Southern Paiute affiliated writer, Martineau (1992), published a list of 29 bands and their territories. Interestingly and unlike most ethnographies, his list of bands included *Suhyh'vawdutseng,* Squawbush Water People, and noted their territory as extending from Monticello, Utah northward to the Book Cliffs.

Stoffle and colleagues investigated Southern Paiute cultural connections to Quitchupah Creek (Stoffle et al. 2004). Utilizing a cultural landscape model, and lines of evidence from previous Paiute research in Nevada, they determined significant Southern Paiute cultural connections between a variety of archaeological sites in the Quitchupah Creek canyon (including rock art sites with ceremonial functions, and camp sites) and *Puha*.

Observations and Conclusions

Early (pre-1980s) ethnographic literature of the Southern Paiutes suffers from a diversity of theoretical orientations and methodologies, making comparative coherency difficult. However, it seems clear that Southern Paiutes have maintained a sense of cultural identity from contact to the present day. Likewise, they have occupied a diverse range of landscapes and environments throughout the Great Basin and Colorado Plateau.

While no exact ethnographic references to the WTP Project Area were identified, two interesting studies are suggestive of Southern Paiutes presence: Martineau's (1992) reference to a Paiute Band adjacent and to the south of the WTP Project Area, and Stoffle et al.'s (2004) examination of Quitchupah Creek.

Sources

The works of Blyth-Whiting (1950); Dutton (1976); Fowler (1970); Franklin and Bunte (1990); Horr (1974); Kelly (1934, 1939, 1964, 1976); Manners (1974); Mitsuru-Hattori (1975); Steward (1974, 1997); Stewart (1966); and Wheat (1967) were reviewed for this study. Additionally, the Indian Land Claims Commission offers a wealth of ethnographic data, and the University of Utah special collections (including the Doris Duke oral history collections), and the files at the American West Center, contain useful archival materials. All were consulted as a part of this overview.

3.12.3.3 The Navajo Nation

Four sacred mountains bound the traditional homeland of the Navajo-Dine: *Sis Naajinii* (Blanca Peak near Alamosa, Colorado), *Tsoo Dzil* (Mount Taylor in New Mexico), *Dook'o'osliid* (San Francisco Peaks in Arizona), and *Dibe Ntsaa* (La Plata Mountains near Durango, Colorado) (Benally et al. 1982; Gill 1979). These sacred mountains, to which some add Navajo Mountain in Utah, and the sacred landscapes they encompass, are not the only lands the Navajo consider to contain sacred places. Today, the Navajo occupy the largest reservation in the United States, covering large parts of northeastern Arizona, northwestern New Mexico, and southeastern Utah.

Oral traditions, recounting movements through mythic time and worlds, place the Navajo in regions further north and east of their sacred mountains, a place the Navajo refer to as *Dinetah* (Kelley and Francis 1994). *Dinetah* is the place of emergence for the Navajo, the center of their sacred geography and history (McPherson 1992). There are numerous accounts of emergence and creation, yet all describe a journey upwards from other worlds into the physical world of today's Navajoland (Brugge et al. 1967; Gill 1979). These physical landscapes are recognized as sacred, full of powerful stories that communicate knowledge and wisdom to the Navajo (McPherson 1992; McPherson 2000).

The Navajo are Athabaskan speakers, and linguistic evidence suggests their language is closely related to State groups in Northwestern Canada and the interior of Alaska (Dobyns and Euler 1977). Numerous theories have been offered to trace the migration route(s) of the Athabaskan-speaking ancestors of the Navajo. These theories include an intermountain route through Eastern Utah and Western Colorado, a central Colorado route, an Eastern Colorado route, and a High Plains route through Kansas (Bailey and Bailey 1986). The chronological date for the arrival of Navajo into the Southwest is in question (Towner 1996). Dates for their arrival range from A.D. 800 to sometime after A.D. 1500. Today, most researchers agree that Athabaskan speakers arrived in the Southwest centuries before the Spanish (Towner 1996).

Ethnographically, the evidence seems clear that Athabaskan speakers, including groups known today as the Navajo and Apache, were occupying large parts of Arizona, New Mexico, southeastern Utah, and southwestern Colorado by the late 16th and early 17th centuries. Traditional Navajo lands at this point in time clearly included canyon tributaries of the San Juan River, the Los Pinos River, and the Animas River. Throughout much of the 16th and 17th century, the ancestral Navajo were practicing a mixed economy of hunting, gathering, and farming (Kelley 1986).

Most ethnographic evidence indicates that the Navajo did not emerge as a distinct cultural or political group as we know them today until the 18th century. At that time, the Navajo began developing a mixed pastoral and agricultural economy. The acquisition of the horse and sheep, and the addition of farming by some localized groups of Navajos, emerged as characteristics of the Navajo life way well into the 20th century (Bailey and Bailey 1986).

Observations and Conclusions

Tracing the origins of the Navajo archaeologically is a problematic and difficult task. As a recent collection of works on the archaeological origins of the Navajo underscores (Towner 1996), it is very difficult to attribute Navajo ethnic identity to material culture (this of course applies in general to the Great Basin), and even more so given the sometimes ambiguous and sparse cultural remains of the highly mobile hunting and gathering practiced by early Athabaskans (Bailey and Bailey 1986).

Identifying early historic Navajo cultural remains is further complicated by the rapidly evolving nature of Navajo ethnicity in the first centuries after contact with Europeans. Nevertheless, evidence does place the Navajo peoples in southern Utah, particularly along the San Juan River, as early as the late 18th and early 19th century. Further, it shows that some Navajo people were in alliance with Ute and Paiute peoples in the general vicinity of the Moab area in the middle and late 19th century (Maryboy and Begay 2000; NAU and SWCA 1996; Peterson 1998).

Navajo view their traditional use area (indicated above), as encompassing their ancestral homeland – *Dinetah* – as well as the sacred mountains between the San Francisco Peaks in Arizona to Mt. Taylor in New Mexico, extending northerly to the Colorado La Plata mountains and Blanca Peak and extending to Navajo Mountain in Utah (Van Valkenburgh and Begay 1938). These Navajo sacred landscapes continue to provide a powerful voice and essential knowledge, as well as a source of wisdom, for the Navajo peoples. Aboriginal uses are claimed well beyond the sacred mountains. With respect to this study, Navajo have reportedly engaged in agriculture and other subsistence activities in the 19th century as far north as Moab, Utah. Navajo, Ute, and Paiute are clearly documented in the area from the middle of the 19th century to the present. Navajo engage in wage labor and agricultural jobs throughout the 20th century in Grand County (Firmage 1996; McPherson 1995; Schwarz 2001) and Watt (1997) does note that Navajos were in the area of Price engaged in wage labor in the earlier part of the 1940s. This study has not identified any specific pre-20th century (wage labor) ethnographic references to Navajos in the WTP Project Area.

Sources

A massive literature exists on the Navajo. A sampling of classically important ethnographic studies include Kluckhohn and Leighton (1946); Shepardson and Hammond (1970); and Underhill (1956). A few significant historical and popular literature sources include Bailey and Bailey (1986); Dobyns and Euler (1977); Iverson (1976); Maryboy and Begay (2000); O'Neil (1973); Schwarz (2001); and Young (1978). The literature on Navajo symbolism and religion is particularly rich and prolific. Some of the most important works are Aberle (1982); Luckert (1977); and Reichard (1982). The Navajo Nation has published many important works as well. Some of these include Correll (1976) and Roessel (1983). Essential ethnographic documentation on the Navajo includes Indian Land Claims materials, a massive collection of materials gathered for several litigations, including the Navajo-Hopi land disputes. Important archives exist containing these and other materials at the University of Utah, Arizona State University, Museum of Northern Arizona, Edge of the Cedars Museum, and other facilities in Arizona, Utah, Colorado, and New Mexico. These sources were utilized for this overview when available.

3.12.3.4 The Hopi Tribe

The Hopi Tribe is located in Northeastern Arizona. Hopi are considered by ethnographers to be Puebloan peoples, meaning they live in distinct villages located on three separate mesas (topographically these mesas are the south edge of a large land formation), plus the villages of Upper and Lower Moencopi near Tuba City, Arizona. Historically, they practiced dry land agriculture (Dozier 1966; Nagata 1970; Titiev 1944). The land composing the Hopi reservation of today is a fraction of their sacred and ancestral homeland termed *Tutsqua.* *Tutsqua* extends throughout a large part of Northern Arizona and into Southern Utah, and to the Hopi is a less encompassing landscape than the ancestral Hopi area (Malotki 2000). While the 12 villages of today are located on the Hopi Reservation, they symbolize, according to Hopi belief, a broader sacred relationship to the land of *Tutsqua*. Villages, in essence, "are linked with an extensive network of ancestral sites, each of which holds the markings and stories of Hopi Clan's rock art (particularly important), ancestral burials, shrines, medicinal gathering places, ancient farming lands, and the habitat of animals for which many Hopi clans are named" (Hopi Tribe Website 2002; Kennard 1979). The Hopi maintain strong and close ties to these sites, holding them in the highest reverence even though many, if not most, are located outside the modern reservation. Just as Hopi villages form a continuous link with sacred sites throughout *Tutsqua*, these links also form a historic, living, and unbroken continuum of cultural and religious belief and practice for the Hopi (Eggan 1994).

The Hopi are bound to the land of *Tutsqua* by a long history and powerful spiritual covenant with Massau, the world's guardian (Stephen 1936). This covenant requires

Hopi to be stewards of the land. Violation of this covenant of stewardship, by taking away land or by desecrating sacred sites, will destroy the Hopi. The bonds to the land of Tutsqua are all-powerful to the Hopi. It is the place of origin, known to Hopi as emergence into the Fourth World. It is also a place occupied by the living katsina spirits, and where the Hopi must meet their religious obligations (Adams 1982; Courtlander 1971; Dockstader 1979; James 1944). The Hopi term their direct ancestors *Hisatsinom*, known by archaeologists as basketmakers. Archaeological evidence indicates that Hisatsinom continuously occupied large parts of the American Southwest beginning in A.D. 1.

Hopi organize family, political, and religious practices by clans. A village always has many different clans living within it (Connelly 1979; Eggan 1950; Eggan 1983). Clans are units of related individuals who have a common ancestor. Each clan has unique oral traditions and migration narratives. Clans also act as guardians of rituals, sacred knowledge, and sacred objects. They organize ceremonies and pass this knowledge from one generation to the next. Clans provide a living and active link to ancestral and sacred places throughout *Tutsqua* (as mentioned above, these include burials, rock art, shrines, and places to gather medicines). Some clans arrived before others on the mesas and in the Hopi villages (Eggan 1967). Some of the earliest arriving clans came from the north and east. Hopi clan migration narratives are pivotal to Hopi traditional knowledge and history, and have been known and widely discussed for decades by ethnographers and archaeologists. Hopi clan migrations describe in *Hopi* terms the amalgamation process, ritually, sequentially, and temporally, of what is known today as the Hopi Tribe (Clemmer 1986; Clemmer 1995).

Observations and Conclusions

The migration narratives of several Hopi Clans, for example the Spider, Rattlesnake, Flute, Squash, and Deer clans, indicate a northern geographic connection (Ellis 1961) including the Uinta Basin and presumably the West Tavaputs Plateau area. Ferguson (2001) has provided a thorough synopsis and discussion of the ethnographic and archaeological literature on northern-focused Hopi clan migration narratives. Ethnographers, linguists, and archaeologists have debated the historic value and/or the specifics of Hopi Clan narrations, and the possible Hopi ancestral connections to prehistoric cultures such as the Fremont, and other cultural traditions such as the Shoshone (via ritual analogs) (Bradfield 1995; Eggan 1980). Suffice to say the accumulation of these various lines of evidence make any conclusion other than the presence of ancestral Hopi in the study area without anthropological merit. The recent innovative methods by some archaeologists (Clark 1994; Duff 1998; Duff 2002) studying ancient migrations, and specifically relevant to Hopi, the work of Bernardini (2005) and Lyons (2003), may offer valuable models for future research on Great Basin archaeology and ethnography.

Finally, Ferguson (2001) notes that “Hopi value petroglyphs as a source of information regarding clan migrations.” Ferguson goes on to provide an interesting and valuable discussion of possible rock art sites and ancestral Hopi in the Uinta Basin. He draws no direct conclusions but strongly suggests similarities between rock art sites in the Vernal area and certain Hopi clans with known northern connections (Ferguson 2001). Similarly, recent rock art studies, specifically Spangler (1993), and Matheny et al. (2004) draw no conclusions but carefully consider the possibility of ancestral Hopi petroglyphs in Nine Mile Canyon.

Sources

There is a large body of historic, archaeological, and ethnographic literature on the Hopi Tribe. This brief overview has drawn generally and extensively from many well-known works including Adams (1982, 1991); Clemmer (1986, 1995); Connelly (1979); Courlander (1971); Dockstader (1979); Dozier (1966); Ferguson (2001); Eggan (1950, 1967); Hack (1942); James (1944); Nagata (1970); Stephen (1936); and Titiev (1944). Research has also relied on recent ethnographic overviews of the Uinta Basin and adjacent areas including the West Tavaputs Plateau by Ferguson (2001) and Spangler (1995). Additionally, archival materials housed at the University of Utah special collections in the Marriott Library were examined. Specifically researched items were the archives for the 1934 Hopi-Navajo Land Dispute case and the Indian Land Claims Commission files. At the request of the Hopi Tribe, an ethnographic overview is being completed by the BLM and funded by the project proponent.

3.12.4 Traditional Cultural Properties

Federal law mandates that Federal agencies must consult with Tribes concerning the identification of cultural values and practices that may be affected by Federal actions. When the NHPA was amended in 1992, Section 101(d)(6)(a) was added stating that "properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization may be determined to be eligible for inclusion in the National Register." Consultation efforts with Tribes under the auspices of NHPA seek to identify and evaluate these types of historic properties that contain traditional religious and cultural importance to their communities.

In 1990, the National Park Service commissioned a publication to assist Federal agencies in evaluating these types of historic properties for inclusion in the National Register. *National Register Bulletin: Guidelines for Evaluating and Documenting Traditional Cultural Properties* describes these types of properties as "Traditional Cultural Properties or TCPs," terms that are commonly used to categorize these historic properties.

By definition, a TCP is "one that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that are (a) rooted in that community's history, and are (b) important in maintaining the continuing cultural identity of the community" (Parker and King 1998). TCP types can be, but are not limited to, ceremonial sites, habitation sites, traditional origin locations, resource collection areas for subsistence or ceremonial use (includes mineral, plant, and water sources), burial sites, trails, and ethnohistorical locations. To qualify for nomination to the NRHP, a TCP must be more than 50 years old, must be a place with definable boundaries, must retain integrity (condition, relationship to culture group), and must meet certain criteria as outlined in National Register Bulletin 15 (National Park Service 1990). Consultation with tribes should be conducted by Federal agencies when identification, evaluation, and management of TCPs are being considered. Criteria used to evaluate historic properties consider the following:

(1) Ensure that the entity under consideration is a property
(2) Consider the property's integrity
    (a) Integrity of Relationship

    (b) Integrity of Condition
(3) Evaluate the property with reference to the National Register Criteria
    (a) Association with events that have made a significant contribution to the broad patterns of our history
    (b) Association with the lives of persons significant in our past
    (c) Embodiment of the distinctive characteristics of a type, period, or method of construction or that is representative of the work of a master, or possesses high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction
    (d) History or yielding, or potential to yield, information important in prehistory or history (Parker and King 1998)
(4) Determine whether any of the National Register Criteria Considerations (36 CFR 60.4) make the property ineligible

One TCP, a prehistoric temporary camp site with culturally modified tree (CMT) scars, was identified by the Uintah and Ouray Ute Indian Tribe during consultation. The Ute representative, Clifford Duncan, identified three of five scarred Ponderosa trees at site 42Cb1909 (prehistoric temporary camp site), as being culturally modified by Ute ancestors. This site is eligible to the NRHP and has an existing road cutting through a portion of the site. As mitigation for a previous project, BBC has avoided the site by re-routing oil and gas traffic around the site. The Ute Tribe did not request additional mitigation at the site, but questioned why the original road that bisects the site remained open.

During the course of consultation between October 2005 and release of the WTP DEIS (February 2008) the Hopi Tribe identified culturally significant sites of interest within the APE; however, they did not make a formal TCP claim for Nine Mile Canyon. In a letter to the BLM dated March 12, 2007, (regarding an unrelated project on Price Field Office lands) the Hopi Tribe identified Nine Mile Canyon as a TCP. In addition, during the public comment period for the WTP DEIS, the Hopi CPO provided a comment letter (April 30, 2008), wherein they again claimed Nine Mile Canyon as a TCP. The claim was based on oral history related to creation and migration stories and based on the interpretations of clan symbol markings identified on Nine Mile Canyon rock markings during consultation field trips. In response to the Nine Mile Canyon TCP claim for the WTP project, the BLM held multiple meetings with the Hopi CPO. During the initial meetings, the Hopi CPO indicated that the legal description of the proposed National Register Boundary for the NMCAD could potentially be used in the documentation effort of the TCP claim, or until the Hopi CPO could determine a boundary for their claim. However, at a later meeting (November 20, 2008) held at the Hopi CPO, the Hopi Tribe determined that due to protections afforded to Nine Mile Canyon through designation of the Nine Mile Canyon ACEC in the Price Field Office Approved ROD (BLM 2008b), and in lieu of the ongoing discussion regarding the multiple properties nomination to the NRHP (see Section 3.12.8 below), they would not pursue the TCP claim at this time. The Hopi's potential TCP has not been evaluated because it was placed in abeyance. The Tribe reserves the right to renew the claim in the future. Additional information regarding this TCP claim is discussed in Tribal Consultation Summary Report contained in **Section 6.2.1** of the EIS.

3.12.5 Class I Inventory

Along a research-management continuum, most projects conducted in the WTP Project Area fall at either end, with very few falling in the middle. Those projects challenging the research portion of the continuum include mostly the early studies in the vicinity aimed at defining the area's cultural chronology, land use, and site distribution. Those at the opposite end reflect the more recent compliance and management projects that revolve around locating and documenting cultural resources in an area where disturbance may occur due to various impacts from controlled burns, road construction, increased visitation, or oil and gas development. A few projects fall between these two extremes and typically consist of problem-oriented investigations of areas or archaeological sites requiring mitigation due to one or more of the impacts already noted. **Appendix O** present the projects identified in the WTP Project Area that contained cultural resources.

The early history of research in the vicinity of the WTP Project Area is well documented and critiqued (Spangler 1993; Spangler 1995; Spangler and Spangler 2003). Though some early work at the end of the 19th century occurred (Montgomery 1894), it was not until the 1930s that published data began to appear in scholarly journals and other, more popular venues. The early research focused both on the rock art (Beckwith 1931; Beckwith 1934; Beckwith 1935; Reagan 1933) and other themes common to archaeology of the day, such as cultural chronology and classification (Gillin 1938; Morss 1931; Reagan 1931; Reagan 1932; Reagan 1933), site distribution (Gunnerson 1957), and supplementary studies like dendrochronology (Ferguson 1949; Schulman 1948). After the initial investigations in the vicinity, a shift in research orientation occurred and numerous cultural resource surveys were conducted from the 1970s through the early 1990s (Hurst and Louthan 1979; Miller and Matheny 1990; Matheny and Matheny 1990; Matheny et al. 1991; Matheny et al. 1992). These projects, in contrast to modern cultural resource management (CRM) projects, were concerned with identifying and protecting the cultural resources of Nine Mile Canyon from an aesthetic and scientific viewpoint. Federal and State laws concerning the protection of archaeological resources did not drive these inventories, though in some instances they occurred in tandem with law-driven cultural resource compliance.

Compliance-driven projects in the WTP Project Area date as early as the 1970s, though most of the projects have occurred in the last 15 years (**Appendix O**). While the majority of the projects are related to oil and gas exploration and production, several are related to controlled burns, visitor facilities development, and other undertakings.

Although there are limited archaeological data for the 137,930 acre WTP Project Area as a whole, the majority of the proposed development would occur in areas that have received considerable scrutiny as a result of past oil and gas exploration and production activities (i.e., within the Prickly Pear and Peter's Point Federal Oil and Gas Units). Taken collectively, these surveys have resulted in a fairly systematic examination of the WTP Project Area and provide sufficient data for identifying culturally sensitive areas. As shown in **Figure 3.12-1**, the previous inventories can be construed as representative of large portions of the WTP Project Area.

3.12.6 Horse Bench Preliminary Assessment

Given the limited archaeological survey data in the Horse Bench portion of the WTP Project Area and the amount of proposed development being considered within the range of alternatives, the BLM and SHPO recommended that a brief assessment be made of the area to determine if the cultural resources differed in type or density relative to other portions of the WTP Project Area. BBC agreed to the proposal and contracted MOAC to conduct the assessment. At a meeting between the BLM, SHPO, and MOAC (November 02, 2006), several methods for conducting the assessment were proposed and discussed. Given the size of the Horse Bench area, the number of proposed wells, and the environmental gradations in vegetation and topography, a preliminary assessment method was chosen. The preliminary assessment consisted of a very general surface reconnaissance of the entire Horse Bench area where wells and other facilities are proposed. Utilizing the data in the Class I literature review (Whitfield et al. 2006) specific areas deemed to have a high potential for containing both prehistoric and historic cultural resources were identified. The four previously identified sites in the Horse Bench area were revisited during the assessment. The method has limitations and benefits. The primary limitation of the investigation is that the data are not amenable to quantitative analysis. The benefits of the method are that it allowed for the examination of multiple environmental settings and the identification of a wide variety of site types.

The preliminary assessment (Patterson 2007a) resulted in the relocation of four previously recorded sites and the identification of thirteen additional cultural resources. As a whole, the site types identified in the Horse Bench area include a prehistoric habitation, prehistoric artifact scatters (n=2), historic brush and stone fences (n=3), a historic cabin (Rock House), cairns (n=2), historic artifact scatters (n=2), a camp (n=1), and isolated prehistoric tools (n=2). Based on empirical observations, the location of cultural resources identified, and the environmental characteristics of the Horse Bench area, it appears that sites are more common on the western portion of the bench where the topography and vegetation cover is similar to the adjacent areas of Sage Brush Flat and Peter’s Point. Fewer sites occur on the eastern half of Horse Bench where there is a distinct change in topography and treeless vegetation communities. With the exception of two sites, the types of sites on Horse Bench are similar to those in adjacent areas. Two sites, located on the eastern side of the bench, are apparently unique in the upland portions of the WTP Project Area. One site, 42Cb732, consists of at least two stone structures, possibly collapsed towers, located on an inaccessible mesa. The second site, 05-458-HB2, is a corral incorporating a natural, cliff-lined finger ridge and a rock rail fence.

Based on the qualitative results of the preliminary assessment, it is expected that the number and types of sites in the Horse Bench area will be similar to those in adjacent areas. There is likely a partial correlation between vegetation and site density. It is also expected that more intensive survey will result in the identification of additional sites in the area.

3.12.7 Summary of Cultural Sites

The Class I data review (Whitfield et al. 2006; as amended by Patterson 2010) revealed numerous cultural resource inventories have identified over 1,100 sites in the WTP APE (**Appendix O**). Many of the cultural resources identified occur in Nine Mile Canyon and its major tributaries. However, with the increased exploration for and extraction of natural gas in the region, archaeological resources are being regularly identified in the upland areas away from the major canyons. While the number of inventories is large, and the number of sites identified even larger, very few scientific investigations have occurred in the region (see Spangler 1995; Spangler and Spangler 2003 for a history of archaeological work in Nine Mile Canyon). Science-based studies, as opposed to CRM inventories, have included limited archaeological testing, testing for site eligibility, and various types of mitigation efforts. While small in scale, such studies typically occur in conjunction with a host of research questions or hypotheses that archaeologists hope to answer or test.

While most of these science-based studies are important in their own right and contribute to a greater understanding of the area's prehistory, they have thus far done little to elucidate site distribution. Similarly, CRM inventories inform minimally as to underlying settlement systems responsible for the site distribution observed during such projects. Exceptions to this include Spangler's (1993) MA thesis entitled "Site Distribution and Settlement Patterns in Lower Nine Mile Canyon" and Leick's (2007) recently completed site distribution study on the upper elevation area of the South Unit of the Ashley National Forest northwest of Nine Mile Canyon.

Spangler (1993) posits that Fremont-affiliated peoples inhabited Lower Nine Mile Canyon only sporadically and for short periods of time. When present, the inhabitants concentrated their use in areas with overlapping availability of water, arable land, and pinyon-juniper stands. While Spangler's work is exceptional and unique in the area, it has several shortcomings. Though covering an area larger than most studies, the site distribution is limited to the canyon and does not consider the other nearby, upland sites or available resources, thereby circumscribing a more complete picture of the region's settlement patterns. Also, despite acknowledging the tenuous assessment of cultural affiliation for numerous sites in his WTP Project Area, Spangler proceeds under the assumption that Lower Nine Mile settlement patterns solely reflect Fremont, or at least Formative, occupation (Spangler 1993). Despite its limitations, Spangler's study does provide some evidence that site distribution is correlated with environmental variables; namely proximity to arable land, water, and timber. While these three resources likely varied in importance to prehistoric and historic peoples that utilized the region, the patterns identified by Spangler present a basis for further examining site distribution in relation to the character and distribution of natural resources in the West Tavaputs region.

Leick's (2007) recent research establishes a site distribution pattern of Paleoindian, Archaic, Fremont, and Ute/Shoshone sites within the South Unit of the Ashley National Forest based on location, elevation, surrounding vegetation, and distance from sources of water. Leick's findings suggest that 1) Paleoindian sites are most likely found on higher elevations such as ridge tops and sagebrush steppes; 2) Archaic sites are generally found on ridge tops in both pinyon-juniper woodlands and sagebrush steppes; 3) Fremont and Ute/Shoshone sites are most frequently found on lower elevation ridge tops in pinyon-juniper woodlands; and 4) no correlation was noted between site locations and springs.

3.12.7.1 Methodology

The data described and utilized here come from the Class I literature review conducted by MOAC (Whitfield et al. 2006, as amended by Patterson 2010). Information from site forms and associated project reports were correlated into the West Tavaputs Plateau Cultural Resource Database (WTPCRD), which serves as the archaeological site/cultural resource dataset utilized in this EIS. Though containing a wealth of information and data, the database has limitation; primarily in the form of missing or insufficient data and correspondence issues.

Site forms and reports vary greatly in their quality and quantity. Site forms used by archaeologists prior to the adoption of the Intermountain Antiquities Computer System (IMACS) in the early 1980s provide little pertinent information beyond a general location and a brief description. Compared with modern IMACS forms, early records tend to confuse more than enlighten. Spatial data for these sites are often further limited because the standard scales of the USGS topographic maps of that time were 1:48000, which commonly resulted in misplotted sites, transposition errors, and vague coordinate designations. Limited data collection and mapping errors have resulted in nearly half of the data deficiencies in the WTPCRD. Other reasons for the missing data include lost, misplaced, or backlogged site forms and reports that could not be located during the literature inventory. Though attempts were made to cross-reference missing data between all the record-holding agencies during the file search, some data could not be located. Such discrepancies account for less than a quarter of the missing data.

Site Typology

Archaeological sites identified during the Class I inventory fall into a qualitative typology based on several criteria. These criteria include the types and frequencies of artifacts present, the number and types of features present, the topographical setting of the site, and previous archaeological studies of similar sites. Sites are also grossly classified as either prehistoric or historic. In multiple instances, a site reflects both a prehistoric and historic component. Prehistoric sites consist of rock art, artifact scatters, temporary camps, rock shelters, habitations, granaries, and miscellaneous. Historic site types include inscriptions, artifact scatters, temporary camps, habitations, ranching land-use sites, and miscellaneous.

Prehistoric *rock art sites* consist of petroglyphs and pictographs. Petroglyphs include those elements of rock art that are etched, carved, or pecked onto a rock surface, and pictographs are painted with organic or mineral pigments. Rock art ranges from individual elements to complexes containing numerous panels. In almost all cases, rock art sites are recommended as eligible for inclusion in the NRHP because they fulfill criteria C and D.

Prehistoric *artifact scatters* consist of open sites containing lithic and ceramic debris scattered across the surface. Because of site exposure to the elements, organic artifacts rarely occur on the surface within the WTP Project Area. Artifact scatters do not contain any indications of features such as hearths, grinding slicks, or architecture. Unlike some of the other site types defined below, there is no function presumed for artifact scatters. Eligibility of scatter sites is determined based on the number and types of artifacts present, the potential for subsurface remains, and evidence that spatial patterning occurs.

Prehistoric *temporary camps* are those sites that include an artifact scatter, as discussed above, and the presence of ephemeral features such as hearths. The presence of short-lived features indicates that those who created the feature spent some time and energy constructing it and that some limited period of time was spent at the location. The presence and types of artifacts present reflect various activities that occurred at the site. Though not explored here, it is possible that some of these sites were re-occupied after their initial use. In most cases, these sites contain the potential for additional research and are recommended as eligible.

Prehistoric *rock shelters* are those sites that include artifacts, ephemeral features, or both, that occur in a natural rock alcove. Alcoves typically occur as natural recesses in cliff faces, though they can occur near isolated boulders at the base of talus slopes. Rock shelters typically do not contain architecture, but may include features such as hearths, cists, and ambiguous rock alignments. In most cases, these sites contain the potential for additional research and are recommended as eligible

Prehistoric *habitation* sites consist of those sites containing architectural features as well as artifacts and ephemeral features. Again, the assumption is that large quantities of time and energy were spent to construct walls, pit houses, and granaries. The likelihood that such features were constructed for short-term use is low. Habitations can occur in numerous settings including open air and in alcoves. The basis for differentiating between rock shelters and habitations in alcoves focuses on the type and extent of the features present. In most cases, these sites contain the potential for additional research and are recommended as eligible.

Prehistoric s*torage sites* consist of one or more architectural features located in alcoves, along narrow cliff benches, or under boulders with the presumed function of foodstuff storage or caching. Sites classified as storage can include granaries, cists, and caches. Sites with granaries and other features are generally classified as habitation sites. In most cases, these sites contain the potential for additional research and are recommended as eligible. The prehistoric *miscellaneous site* category consists of sites that do not fit into the above defined types.

Historic *inscription sites* include sites with historic inscriptions, (as indicated by dates) and the use of English (or some other written language) characters that are inscribed, etched, or carved onto a rock surface. These sites also include inscriptions that are painted on rock surfaces with axle grease or some similar substance. More often than not, historic inscriptions consist of a name or set of initials with a date etched into stone. Unless these sites meet Criteria A or B they are usually not considered eligible. If the site is, however, associated with a prehistoric rock art site, it is grouped under the eligibility of the prehistoric component.

Historic *artifact scatters* consist of sites containing a scatter of historic artifacts (e.g., cans, glass, ceramics) and no features. Like its prehistoric counterpart, no function is presumed for these sites. Eligibility of these types of sites is recommended based on the number and types of artifacts present, the potential for subsurface remains, and evidence that spatial patterning occurs. In most instances, these sites are not evaluated as eligible.

Historic *temporary camps*, generally referred to as cowboy camps, typically include an artifact scatter associated with ephemeral features such as campfire rings, tent platforms, or wood chip piles. The presence of transient features indicates that those who created the feature spent some time and energy constructing it. It is assumed that because of this, some short period of time was spent at the location. The presence and types of artifacts reflect various activities that occurred at the site. Though not explored here, it is possible that some of these sites were reoccupied after their initial use. In most cases, these sites contain little potential for additional research and are not recommended as eligible.

Historic *habitations* include cabins and homesteads. They typically contain some form of domicile (or the remains thereof), outbuildings, planted vegetation, and landscape features such as corrals and fences. In some cases, historic habitation sites are also associated with agricultural fields. In most cases, these sites contain the potential for additional research and are recommended as eligible. They may also contain distinctive elements or may be associated with people or events that are historically significant.Historic *ranching land-use sites* include brush fences, isolated corrals, and lambing pens. Eligibility recommendations for these sites are based on the type and method of construction, age, uniqueness, and condition. The historic *miscellaneous site* category consists of sites that do not fit into the above-defined types.

Site Distribution and Patterning

Although over 1,100 prehistoric and historic archaeological sites were identified during the literature review, describing their distribution and apparent patterning is complicated by inconsistent survey coverage and, in many instances, the nature of the archaeological record itself. The intensity of archaeological inventories conducted across the WTP Project Area varies significantly.

Figure 3.12-1 shows cultural resource surveys that have been conducted in the WTP APE. As is evident, the major canyons (i.e., Nine Mile Canyon, Dry Canyon, and Cottonwood Canyon) have received the most attention ranging from amateur survey and documentation, to institutionally-based surveys, to cultural resource inventories. The area between Dry and Cottonwood canyons has received considerable attention due primarily to natural gas exploration and production. Stone Cabin, Peter's Point, and Prickly Pear Gas Fields are commonly surveyed, but the sizes of the projects are generally small and consist of only 20 or 30 acres resulting in inventories ranging from low-moderate to moderate. The area with low-moderate to high survey intensities accounts for approximately 46 percent of the WTP Project Area, leaving 54 percent of the 140,000 acres mostly unexamined by archaeologists. As this area is relatively unknown archaeologically, interpretations of site density and patterning become extremely tenuous when attempting to extrapolate from the known (in this case those areas with sufficient archaeological coverage) to the unknown.

Also problematic is the very high number of archaeological sites that could not be assigned a temporal or cultural affiliation beyond prehistoric. **Table 3.12-1** provides a cross-tabulation of site types and, cultural affiliation within the WTP APE. Of the 1,105 cases retained for examination and analysis, 611 are classified as "Unknown Prehistoric." This lack of affiliation makes the distribution of sites with known affiliations suspect, as surely numerous unclassified sites actually fall under one of the temporal/cultural periods examined below.

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Table 3.12-1 Cross Tabulation of Site Types and Cultural Affiliation and Number of Components

Number of Components			Cultural Affiliation									Total
			Paleo-Indian	Archaic	Fremont	Numic	Unknown Prehistoric	Ute	European American	Unknown	Multi-component	
Single Component	Site Type	Rock Art/Inscription	0	1	82	1	304	6	32	0	0	426
		Rock Art/Inscription & Other	0	0	18		13	0	0	0	0	31
		Rock Shelter	0	0	13	2	44	0	0	0	0	59
		Rock Shelter/Rock Art	0	0	11	0	19	0	0	0	0	30
		Artifact/Trash Scatter	1	32	11	11	96	0	12	0	0	163
		Habitation	0	0	48	0	33	0	15	0	0	96
		Habitation & Rock Art	0	0	6	0	6	0	0	0	0	12
		Storage	0	0	23	0	35	0	0	0	0	58
		Ranch Land Use	0	0	0	0	0	0	36	0	0	36
		Temporary Camp	0	3	2	2	19	0	4	0	0	30
		Misc.	0	0	2	1	41	0	26	3	0	73
		Unknown	0	0	0	0	0	0	1	5	0	6
TOTAL			**1**	**36**	**216**	**17**	**610**	**6**	**126**	**8**	**0**	**1020**
Prehistoric-Prehistoric Multiple component	Site Type	Rock Art-Inscription	0	0	0	0	0	0	0	0	7	7
		Artifact Scatter	0	0	0	0	0	0	0	0	6	6
		Habitation	0	0	0	0	0	0	0	0	1	1
		Habitation & Rock Art	0	0	0	0	0	0	0	0	2	2
		Storage & Other	0	0	0	0	0	0	0	3	3	3
		Rockshelter & Rock Art	0	0	0	0	0	0	0	0	1	1
		Temporary Camp	0	0	0	0	0	0	0	0	3	3
		Misc.	0	0	0	0	0	0	0	0	2	2
TOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**25**	**25**
c-Historic Multiple Compone	Site Type	Artifact Scatter	0	0	0	0	0	0	0	0	5	5
		Rock Art/Inscription & Other	0	0	0	0	0	0	0	0	47	47
		Habitation and Other	0	0	0	0	0	0	0	0	2	2

Table 3.12-1 Cross Tabulation of Site Types and Cultural Affiliation and Number of Components

Number of Components			Cultural Affiliation									Total
		Rockshelter & Other	0	0	0	0	0	0	0	0	2	2
		Misc.	0	0	0	0	0	0	0	0	4	4
TOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**60**	**60**

Archaic

Archaic sites are uncommon in the WTP Project Area (**Table 3.12-1**). Of the 36 archaic sites, 32 represent artifact scatters, three represent temporary camps, and one is a rock art panel. A nearest neighbor analysis demonstrates that the Archaic sites are moderately clustered (r=0.69; z=-2.38; n=16). The clustering of Archaic sites is concentrated east of Dry Canyon. There are no significant correlations between Archaic site locations and various environmental and physiographic variables such as elevation, slope, aspect, proximity to water, or soil type. However, it is evident that Archaic populations focused their attention on the upland environments rather than the riverine environments.

The small sample of sites identified as Archaic suggests that while these populations utilized areas within the WTP APE, they did not do so intensively. Even given the high number of temporally ambiguous sites, and that the Archaic period spans some 7,000 to 8,000 years, one would expect higher site densities if the region were regularly utilized either as part of a seasonal or generational round of the highly mobile hunter-gatherers. Based on the available data, the Archaic site density in the WTP APE is 0.15 sites/mile^2.

Fremont

Fremont sites are extremely common in the WTP APE (**Table 3.12-1**). Not only are Fremont affiliated sites common, they show a wide range of land use and function. As opposed to the known Archaic sites in the WTP APE, Fremont affiliated sites are mostly associated with dependable water sources and the canyons the water flows through. Site densities are highest in Nine Mile Canyon with moderate-high densities in Dry and Cottonwood Canyons, particularly near their confluences with Nine Mile Canyon. A concentration of Fremont sites also occurs in the middle stretch of Jack's Creek. As a group, Fremont sites show few significant correlations with topographic and environmental variables in relation to site location and most of these correlations are weak. Fremont sites tend to be close to dependable water (x=208.2 +/- 414.1 m), located in canyons (r=-0.217, p=0.007), adjacent to canyon walls (e.g., cliffs, ledges, talus slopes, and alcoves) (r=0.320; p=0.0001), and at elevations below 5,500 feet (r=0.176; p=0.31). Habitation sites tend to be clustered across the WTP APE with one cluster west of Dry Canyon, another cluster between Dry and Cottonwood canyons, two large clusters between Cottonwood Canyon and the Green River, and the one in Jack's Canyon. There appears to be little use of upland areas away from the canyons. The few sites found in the upland areas are seemingly ephemeral. A large cluster of dispersed storage sites nearly bisects the WTP APE and rock shelter sites appear to cluster in and around Dry Canyon. Most of the Fremont habitation sites are associated with rock art. It is very probable that many of the rock art sites with no known affiliation are related to Fremont use of the area. The average site density for Fremont affiliated sites is 0.92 sites/mi^2.

Numic-Ute

Like Archaic sites, definitive Numic and Ute sites are relatively uncommon and show no evidence of clustering. Despite the apparent randomness, the patterning of site types shows a greater dichotomy than in any of the other affiliations examined here. Without exception, all the Numic-affiliated sites in the canyons are rock art. Rock shelters, temporary camps, and artifact scatters occur in upland settings. The rarity of Numic sites in the uplands, even in areas with adequate survey coverage, is somewhat perplexing and must certainly reflect the lack of diagnostic artifacts with which affiliation assessments can be made. As expected, the low occurrence of Numic sites and their wide distribution lack any correlations with environmental or physiographic variables. Given the known number and distribution of Numic- and Ute-affiliated sites in the WTP APE, the average site density is 0.54 sites/mi^2.

European American

The representative Euro-American sites in the WTP APE display a striking contrast to any of the prehistoric or patterns. In this instance, there is no apparent preference for either upland or canyon use, rather, both settings have been fully incorporated into the historic land use system. Habitation sites occur in both settings; however, habitation sites in the canyons reflect homesteads composed of houses, outbuildings, and associated agricultural fields, while those in the upland setting are typically individual dwellings with no associated features or fields. Habitations in the canyon bottoms, which are restricted to Nine Mile Canyon, are evenly spaced along its length. The majority of the upland portion of the WTP APE was geared clearly towards ranching activities, as corrals, brush fences, and cairns dominate the historic period sites. The number of sites categorized as miscellaneous are more numerous during this temporal period than any of the others. These sites include stone piles or rock concentrations, cairns, and trails. Cairns and cattle trails are generally associated. Again, there is little correlation between the types of historic sites and topographic and environmental variables. The average site density of historic sites in the WTP APE is 0.54 sites/mi^2.

Unknown Prehistoric

By far, the largest grouping is of prehistoric sites for which cultural or temporal affiliation could not be determined. This is often the result of the lack of diagnostic artifacts, such as temporally sensitive projectile points or ceramic shards with well-established temporal and distribution ranges. There is a distinct dichotomous pattern between the canyon and upland settings. Artifact scatters dominate the upland setting with temporary camps and rock shelters regularly scattered throughout. Rock art, habitations, and storage sites are relegated mostly to areas adjacent to or in the canyons. The site density for prehistoric sites with an undetermined cultural or temporal affiliation is 2.61 sites/mi^2.

3.12.8 Nine Mile Canyon National Register Multiple Property Listing

In the 1970's BLM archaeologists initiated the preparation of a National Register nomination for Nine Mile Canyon with the local archaeological club taking over in the 1980's. Efforts were continued from approximately 2000 to 2007 by the BLM. In 2007, a contractor prepared a National Register nomination form as directed by the NMCC with financial assistance from the NTHP. The BLM aided by providing maps and archival photographs of the sites.

This nomination was presented as a historic district that included 830 prehistoric sites with the majority located on BLM lands in Carbon, Uintah, and Duchesne Counties.

After some initial review, the Utah SHPO suggested using the multiple property submission (MPS) format. The BLM agreed to this approach. The National Park

Service (NPS) was consulted and also supported this approach. The MPS allows for flexibility for future discoveries, which can be easily included.

Since that time, the BLM has prepared cover documentation in support of a MPS for Nine Mile Canyon. The MPS is divided into three contexts, including prehistoric rock art, West Tavaputs adaptation, and historic period.

Using these MPS contexts, 63 sites (19 prehistoric rock art sites, 40 West Tavaputs Adaptation sites, and four historic period sites) in Nine Mile Canyon, were listed on the National Register of Historic Places on November 30, 2009.

Under the WTP PA, the BLM has committed to prepare and submit 100 recorded individual sites on BLM lands annually over the next five years. The MPS submission does not negate Nine Mile Canyon's future listing as a District.

3.13 SOCIOECONOMIC RESOURCES

As more than two years have passed since the publication of the DEIS, some of the socioeconomic reference data cited within this Section of the FEIS is not the most current data available. However, the data used provides information for establishing a baseline condition reflecting the general economic trends for the areas of analysis. The established baseline provides a set point in time from which a comprehensive analysis can be based on throughout the document. For this EIS, the publication of the NOI largely represents the “starting point” for the collection of socioeconomic data. It is also important to note that trend data is published at different times depending on the data source. For example, a primary source for trend data is the U.S Census Bureau’s decennial census, which is taken every 10 years to collect information about people and housing. In another example, like the national economy, as the financial crisis intensified, Utah’s economy contracted during 2009. Employment, which increased slightly during 2008, declined 4.9% in 2009. Further, the unemployment rate almost doubled, from 3.4% in 2008 to 6.5% in 2009. The housing collapse combined with business caution about building new plants, resulted in construction employment declining 22.6%, after a decline of 12.5% in 2008. Utah’s economy is expected to gradually strengthen during 2010. Employment is forecast to decline 1.8% for the year as a whole, but subdued job increases should begin by the second quarter. Housing permits are forecast to remain near historic lows throughout 2010. Though economic activity will be on the uptick, slack hiring will drive a slight increase in the unemployment rate from 6.5% in 2009 to 6.8% in 2010 (Utah Governor’s Office of Planning and Budget 2010 Economic Report to the Governor).

Thus, the affected environment for socioeconomic data for this FEIS remains largely as it was published in the 2008 DEIS.

3.13.1 Study Area for Socioeconomics

The study area for socioeconomics includes Carbon, Duchesne and Uintah Counties and the main cities in each county. This study area was defined to encompass effects to the economy, population, housing, facilities and services, and fiscal conditions at a local level.

The counties in the study area share common boundaries and are linked by a transportation network that integrates local resources. The principal communities of the study area include Price, Helper and Wellington in Carbon County, which are closest to the WTP Project Area. They also include the city of Duchesne, the county seat of Duchesne County, Roosevelt (Duchesne County) and Vernal (Uintah County), which house firms and a labor force that serve the oil and gas industry of the Uinta Basin.

3.13.2 Local Population

In 2005, Carbon County had a population of 19,338, Duchesne County had a population of 15,237, and Uintah County had a population of 26,883 (**Table 3.13-1**). Carbon County's population has declined at a steady rate since the 2000 Census. The average annual rate of population decline, calculated on the basis of the first official estimate after the Census, has been 1.1 percent per year from 2000 to 2005. For the same period, Duchesne County's population grew at the average annual rate of 1.1 percent per year, and Uintah County's population grew at the rate of 1.2 percent per year.

Table 3.13-1 Population Trends by County

	Carbon County	Duchesne County	Uintah County	State of Utah, in millions
2000 Census	20,422	14,371	25,224	2.23
2000	20,396	14,397	25,297	2.25
2001	19,858	14,646	26,049	2.31
2002	19,858	14,856	25,984	2.36
2003	19,558	14,698	26,019	2.41
2004	19,385	14,933	26,224	2.47
2005	19,338	15,237	26,883	2.55
2000-2005 Difference	(1,058)	840	1,586	0.30
2000-2005 Percentage Difference	-5.2	5.8	6.3	1.3
2000-2005 AARC (Percent)	-1.1	1.1	1.2	2.5
2004-2005 Difference	(47)	304	659	0.078
2004-2005 Percentage Difference	-0.2	2.0	2.5	3.2

Notes: 2000 Census counts are April 1. Estimates are July 1. AARC-Average Annual Rate of Change.
Source: U.S. Census Bureau (2000a), GOPB (2005a).

As **Table 3.13-1** shows, the average annual growth rate from 2004 to 2005 in Duchesne and Uintah Counties was above the 2000 to 2005 rate. Likewise, the declining population growth rate slowed in Carbon County from 2004 to 2005 when compared to the Average Annual Rate of Change (AARC) from 2000 to 2005. In all counties, growth rates were lower than the State average. In Carbon County, the rate of population decline slowed to 0.2 percent from 2004 to 2005, compared to -1.1 percent per year since 2000. From 2004 to 2005, Duchesne County grew 2.0 percent, up from an average annual rate of 1.1 percent since 2000, and Uintah County grew 2.5 percent, up from 1.2 percent per year since 2000. The State of Utah as a whole grew 3.2 percent per year from 2004 to 2005.

Population in Carbon County is concentrated in the valleys and transportation corridors located in the southeastern part of the County. **Table 3.13-2** shows that the population declined in all Carbon County communities from 2000 to 2004. The rate of population decline in the city of Price was lower than in all other cities and the unincorporated county.

Table 3.13-2 Trend in Municipal Population Compared to the County as a Whole

	2000	2001	2002	2003	2004	2003-04 Percentage Difference	2000-04 AARC (Percent)
Carbon County	20,396	19,858	19,858	19,558	19,385	-0.9	-1.3
Helper City	2,013	1,929	1,932	1,929	1,909	-1.0	-1.3
Price City	8,412	8,268	8,276	8,300	8,197	-1.2	-0.6
Wellington City	1,657	1,592	1,597	1,597	1,582	-0.9	-1.2
Other municipalities	1,814	1,735	1,734	1,726	1,703	-1.3	-1.6
Balance of County	6,500	6,334	6,319	6,006	5,994	-0.2	-2.0
Duchesne County	14,397	14,646	14,856	14,698	14,933	1.6	0.9
Duchesne City	1,413	1,425	1,443	1,448	1,454	0.4	0.7
Roosevelt City	4,293	4,316	4,407	4,413	4,437	0.5	0.8
Other municipalities	866	872	886	882	881	-0.1	0.4
Balance of County	7,825	8,033	8,120	7,955	8,161	2.6	1.1
Uintah County	25,297	26,049	25,984	26,019	26,224	0.8	0.9
Vernal City	7,702	7,746	7,859	7,852	7,939	1.1	0.8
Other municipalities	1,872	1,920	1,969	2,008	2,042	1.7	2.2
Balance of County	15,723	16,383	16,156	16,159	16,243	0.5	0.8

Notes: Estimates for municipalities are only available through 2004. Estimates are as of July 1. AARC-Average Annual Rate of Change.
Source: GOPB (2005a); U.S. Census Bureau (2004).

In Duchesne and Uintah Counties, population is concentrated along U.S. Highway 40. As **Table 3.13-2** shows, from 2000 to 2004, population growth in Duchesne County was greater in the unincorporated parts of the County than in the larger cities of Roosevelt and Duchesne. The growth rate in the city of Vernal from 2000 to 2004 was similar when compared to all other municipalities in Uintah County and the unincorporated county.

The data in **Table 3.13-2** also show that the municipal share of population in Carbon County was 69.1 percent in 2004, a slight decrease from 69.3 percent in 2003. Likewise, in Duchesne County, the municipal share was 45.3 percent in 2004, slightly down from 45.6 percent in 2003. In Uintah County, unlike the other two counties, the municipal share of population slightly increased from 37.9 percent in 2003 to 38.1 percent in 2004.

Counties in the study area are racially and ethnically undiversified. As shown in **Table 3.13-3**, the largest share of the 2004 population was white in all three counties. The percentage of white persons in Carbon County was higher than in Utah as a whole. However, compared to the State, the share of the population that was white was lower in Duchesne County and markedly lower in Uintah County where American Indian persons comprise 9.1 percent of the population.

Table 3.13-3. Shares of Total County Population by Race and Hispanic Origin, 2004 (Percent)

	White	Black/ African American	American Indian	Asian	Pacific Islander	Two or More Races	Hispanic Origin
State of Utah	93.8	1.0	1.3	1.9	0.7	1.3	10.6
Carbon County	97.6	0.3	1.2	0.5	0.0	0.4	10.8
Duchesne County	92.6	0.2	5.2	0.4	0.0	1.7	4.3
Uintah County	89.3	0.2	9.1	0.3	0.1	1.0	3.7

Notes: American Indian also includes other native races of North America. Pacific Islander is predominantly Native Hawaiian. Persons of Hispanic Origin may be of any race or combination of races.
Source: GOPB (2006a).

The proportion of persons of Hispanic origin (of any race) was 10.8 percent in Carbon County in 2004; this was similar to the proportion of Hispanic persons in Utah as a whole (10.6 percent). The proportion of Hispanic persons was considerably lower in both Duchesne County (4.3 percent) and in Uintah County (3.7 percent) when compared to Utah as a whole.

Table 3.13-4 presents recent trends in the components of population change. Natural increase (the net effect of births and deaths) remains a positive contributor to population change in Carbon, Duchesne, and Uintah Counties. Compared to the other two counties, the impact of natural increase was lower in Carbon County from 2000 to 2005, where it ranged from 0.4 percent to 0.7 percent of the base population annually. In Duchesne and Uintah Counties, natural increase ranged from 1.1 percent to 1.4 percent of the base population annually in the same period.

Table 3.13-4 Components of County Population Change, 2000 to 2005

	Year	Natural Increase	Net Migration	Net Change
Carbon County	2000	128	-232	-104
	2001	112	-650	-538
	2002	113	-113	0
	2003	82	-382	-300
	2004	130	-303	-173
	2005	106	-153	-47
	Total	**671**	**-1,833**	**-1,162**
Duchesne County	2000	177	-73	104

Table 3.13-4 Components of County Population Change, 2000 to 2005				
	Year	**Natural Increase**	**Net Migration**	**Net Change**
	2001	181	68	249
	2002	167	43	210
	2003	195	-353	-158
	2004	160	75	235
	2005	195	109	304
	Total	**1,075**	**-131**	**944**
Uintah County	2000	274	19	293
	2001	312	440	752
	2002	315	-380	-65
	2003	332	-297	35
	2004	306	-101	205
	2005	355	304	659
	Total	**1,894**	**-15**	**1,879**

Source: GOPB (2005a).

Since 2000, high net out-migration has dominated population change in Carbon County and has caused the overall decline in the County's population. The net outflow has ranged from 0.6 percent to 3.2 percent of the base population in each year through 2005. The cumulative effect has been a 7.8 percent loss of population since 2000 because of migration, compared to a 2.7 percent gain because of natural increase.

As **Table 3.13-4** (above) also shows, the cumulative effect of net migration in Duchesne and Uintah Counties has been small from 2000 to 2005 because annual gains and losses have generally offset each other as net migration varies from year to year. Since 2000, annual net migration in Duchesne County has been as low as -2.4 percent of the base population and as high as +0.7 percent. In Uintah County, the range in annual net migration has been from -1.5 to +1.7 percent. Since 2000, natural increase has been the predominant reason for the cumulative effect on population, adding 7.5 percent to the base year population in Duchesne and Uintah Counties from 2000 to 2005.

3.13.3 Local Economy and Labor Force

As **Table 3.13-5** shows, total employment has grown in Carbon, Duchesne, and Uintah Counties since 1970 but at rates below the State average. The main source of jobs continues to be non-farm wage and salary employment. This category grew at an average annual rate of 2.2 percent from 1970 to 2000 in Carbon County, 3.5 percent in Duchesne County, 3.3 percent in Uintah County, compared to 3.6 percent for Utah as a whole.

Table 3.13-5 also indicates that employment in Carbon, Duchesne, and Uintah Counties is based in the non-farm sectors even though total farm employment has grown since 1970 in Uintah County and less so in Carbon and Duchesne Counties. In all three counties, new farm proprietorships (i.e., owned by an individual) are the reason for farm employment growth: they have more than offset the decline in wage and salary farm jobs. In some regions, growth in farm proprietorships represents the breakup of commercial agricultural enterprises into smaller, often part-time, farms.

In addition, **Table 3.13-5** shows that sole proprietors themselves hold roughly 2 of every 10 jobs in the socioeconomics study area. In 2000, non-farm proprietors comprised 19.7 percent of total employment in Carbon County, up from 14.4 percent in 1990, and 22.4 percent in Duchesne County, up from 20.3 percent in 1990. Non-farm proprietors were 20.3 percent of total employment in Uintah County in 2000 and 19.4 percent in 1990. Non-farm proprietors were 17.1 percent of total employment in the State of Utah as a whole in 2000.

Table 3.13-6 shows that as the number of jobs has grown between 2001 and 2004, the kind of employment opportunities found in the socioeconomics study area has shifted. Mining employment (which traditionally includes the oil and gas industry) now has a larger share of total employment in Carbon and Uintah Counties. In Duchesne County, the employment sector showing the largest growth is local government.

Table 3.13-5 Total Employment, 1970 to 2000

Carbon County	**1970**	**1980**	**1990**	**2000**	**AARC 1970-00**	**AARC 1990-00**
Total full and part-time employment	5,823	10,175	9,608	11,722	2.4%	2.0%
Wage and salary employment	4,925	8,822	8,027	9,188	2.1%	1.4%
Farm wage and salary	105	32	36	24	-4.8%	-4.0%
Non-farm wage and salary	4,820	8,790	7,991	9,164	2.2%	1.4%
Proprietors employment	898	1,353	1,581	2,534	3.5%	4.8%
Farm proprietors	138	201	195	227	1.7%	1.5%
Non-farm proprietors	760	1,152	1,386	2,307	3.8%	5.2%
Farm employment – total	243	233	231	251	0.1%	0.8%
Non-farm employment – total	5,580	9,942	9,377	11,471	2.4%	2.0%
Duchesne County	**1970**	**1980**	**1990**	**2000**	**AARC 1970-00**	**AARC 1990-00**
Total full and part-time employment	3,088	6,084	6,016	7,766	3.1%	2.6%
Wage and salary employment	1,955	4,382	4,061	5,133	3.3%	2.4%
Farm wage and salary	153	209	180	102	-1.3%	-5.5%
Duchesne County	**1970**	**1980**	**1990**	**2000**	**AARC 1970-00**	**AARC 1990-00**
Non-farm wage and salary	1,802	4,173	3,881	5,031	3.5%	2.6%
Proprietors employment	1,133	1,702	1,955	2,633	2.9%	3.0%
Farm proprietors	684	648	733	890	0.9%	2.0%
Non-farm proprietors	449	1,054	1,222	1,743	4.6%	3.6%
Farm employment – total	837	857	913	992	0.6%	0.8%

Table 3.13-5 Total Employment, 1970 to 2000						
Non-farm employment - total	2,251	5,227	5,103	6,774	3.7%	2.9%
Uintah County	**1970**	**1980**	**1990**	**2000**	**AARC 1970-00**	**AARC 1990-00**
Total full and part-time employment	5,121	9,123	10,057	13,667	3.3%	3.1%
Wage and salary employment	3,944	7,254	7,410	9,999	3.1%	3.0%
Farm wage and salary	189	133	119	101	-2.1%	-1.6%
Non-farm wage and salary	3,755	7,121	7,291	9,898	3.3%	3.1%
Proprietors employment	1,177	1,869	2,647	3,668	3.9%	3.3%
Farm proprietors	500	597	692	899	2.0%	2.7%
Non-farm proprietors	677	1,272	1,955	2,769	4.8%	3.5%
Farm employment – total	689	730	811	1,000	1.2%	2.1%
Non-farm employment - total	4,432	8,393	9,246	12,667	3.6%	3.2%
State of Utah, In Thousands	**1970**	**1980**	**1990**	**2000**	**AARC 1970-00**	**AARC 1990-00**
Total full and part-time employment	454.61	688.65	944.33	1,387.85	3.8%	3.9%
Wage and salary employment	392.89	584.37	778.16	1,134.76	3.6%	3.8%
Farm wage and salary	6.94	5.99	5.38	4.63	-1.3%	-1.5%
Non-farm wage and salary	385.95	578.37	772.78	1,130.13	3.6%	3.9%
Proprietors employment	61.72	104.28	166.17	253.09	4.8%	4.3%
Farm proprietors	13.88	13.67	13.77	15.75	0.4%	1.4%
Non-farm proprietors	47.84	90.62	152.40	237.34	5.5%	4.5%
Farm employment – total	20.83	19.66	19.15	20.38	-0.1%	0.6%
Non-farm employment - total	433.79	668.99	925.18	1,367.47	3.9%	4.0%

Notes: AARC – Average Annual Rate of Change
% = percent
Source: BEA (2006a)

Table 3.13-6 Distribution of Non-Farm Employment by Major Industry in 2001 and 2004								
	Carbon County		**Duchesne County**		**Uintah County**		**State of Utah**	
	2001	**2004**	**2001**	**2004**	**2001**	**2004**	**2001**	**2004**
Agricultural Services, Forestry, Fishing & Hunting	0.0%	0.0%	0.5%	0.6%	0.6%	0.7%	0.4%	0.4%
Mining	7.0%	8.3%	12.3%	9.9%	17.0%	19.1%	0.7%	0.6%
Utilities	1.5%	1.6%	0.8%	0.9%	1.4%	1.2%	0.4%	0.4%

Table 3.13-6 Distribution of Non-Farm Employment by Major Industry in 2001 and 2004

	Carbon County		Duchesne County		Uintah County		State of Utah	
	2001	2004	2001	2004	2001	2004	2001	2004
Construction	6.4%	3.4%	7.5%	7.6%	5.5%	5.6%	6.6%	6.6%
Manufacturing	4.3%	3.6%	2.4%	2.3%	1.8%	1.5%	11.3%	10.4%
Wholesale Trade	3.8%	4.6%	2.4%	2.2%	3.5%	3.9%	3.8%	3.7%
Retail Trade	14.1%	14.1%	13.7%	12.3%	13.6%	12.0%	12.1%	12.0%
Transportation and Warehousing (48 & 49)	3.2%	3.2%	6.3%	6.4%	3.6%	4.2%	3.9%	3.7%
Information	1.1%	1.3%	2.8%	3.3%	1.2%	1.1%	3.1%	2.7%
Finance and Insurance	1.9%	2.3%	1.7%	2.0%	1.2%	1.3%	4.4%	4.5%
Real Estate and Rental and Leasing	0.6%	0.7%	1.0%	0.7%	1.5%	2.3%	1.3%	1.4%
Professional Scientific & Technical Svc	2.7%	2.5%	1.0%	0.9%	2.2%	2.3%	4.6%	4.6%
Management of Companies and Enterprises	0.7%	0.7%	0.0%	0.0%	0.0%	0.0%	2.0%	1.9%
Admin., Support, Waste Mgmt, Remediation	4.5%	4.0%	1.1%	1.1%	2.2%	2.5%	5.9%	6.0%
Education Services (private)	0.4%	0.0%	0.6%	0.1%	0.6%	0.3%	2.4%	2.5%
Health Care and Social Assistance	8.7%	10.6%	7.8%	8.0%	6.4%	7.2%	7.6%	8.7%
Arts, Entertainment, and Recreation	0.6%	0.7%	0.2%	0.1%	1.1%	0.5%	1.5%	1.4%
Accommodation and Food Services	8.1%	8.1%	5.6%	7.2%	8.0%	7.9%	7.6%	7.8%
Other Services (except Public Admin.)	3.7%	4.2%	2.6%	2.8%	2.7%	3.0%	2.8%	3.0%
Local Government, including Public Education	16.4%	15.9%	26.0%	27.7%	20.2%	18.0%	9.0%	9.3%

Table 3.13-6 Distribution of Non-Farm Employment by Major Industry in 2001 and 2004

	Carbon County		Duchesne County		Uintah County		State of Utah	
	2001	2004	2001	2004	2001	2004	2001	2004
State Government, including Public Education	8.1%	8.0%	2.1%	2.1%	1.4%	1.3%	5.4%	5.5%
Federal Government, excluding military	1.9%	2.1%	1.7%	1.8%	4.2%	4.0%	1.8%	1.8%
Military	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%	1.3%
Total Non-Farm Payroll Employment	8,866	8,505	5147	5,400	9,940	10,974	1,087, 740	1,109, 170

Note: These data exclude farm wage and salary employment and farm and non-farm proprietors.
% percent
Source: BLS (2006)

Tourism and recreation contribute to Utah's economy as a whole. In northeastern Utah, which includes Carbon, Duchesne, and Uintah Counties, tourism is important but economic dependency on the tourism industry is in the mid range among Utah counties, according to the Utah Division of Travel Development (2004). Tourism employment constitutes from 10 to 19 percent of total employment in the three counties of the WTP Project Area, based on estimates (Utah Division of Travel Development 2004) of direct tourism employment in nine of the major industry groupings listed in **Table 3.13-6** and of the ripple effects of that employment. The recreation resources of the WTP Project Area are described in **Section 3.11**, Recreation. The resources that figure into the potentially affected socioeconomic environment of Carbon, Duchesne and Uintah Counties are discussed below in **Section 3.13.5.2**, Special Management Areas.

Three counties, Carbon, Emery, and Sevier, lead the coal industry in Utah. Coal production is a large part of Carbon County's economic base, paying relatively high wages and spinning off indirect employment in trade, services, construction, manufacturing and transportation (Perlich 2005; UDOWS 2007a). In Uintah County, the local economy has historically been dependent on the oil and gas industry (counted as part of mining employment), and Uintah County's relative specialization in oil and gas production has increased since the early 1990s (Perlich 2003). Mining's loss of share in Duchesne County reflects some diversification and gains by other sectors, such as information services, accommodations and food services.

Direct employment in coal mining has actually decreased over the past few decades in Carbon County, even as production has increased, with 20 percent fewer jobs in 2000 (7.4 percent of total employment) than in 1970 when mining was over 17 percent of total employment (DOC 2003). Recently, higher demand for energy worldwide has caused mining employment to grow again in Carbon County, as shown in **Table 3.13-6**. The industry expects continued growth, and the number of new coal mines or reopening mines increased in 2005. If future coal demand rises, as many believe, adequate supply would require production from mines currently in the planning and permitting stages (EIA 2006a). Employment in coal mining would rise unless new technology more than offsets higher demand by allowing the industry to produce more coal per employee. Employment in coal mining could also decrease if concerns with the environmental impacts coal usage affects the current boom (UDOWS 2007b).

On the natural gas side of the mining industry, wellhead natural gas prices are expected to remain relatively high through 2030 (EIA 2006b). This would sustain or increase current development and production activity since the oil and gas extraction industry tends to expand exploration and production and hire more workers during periods of high prices (BLS 2005).

Table 3.13-7 shows that the annual average unemployment rate in the socioeconomics study area dropped to a 6-year low in 2005, indicating a tightening labor market. At 3.9 percent, the unemployment rate in Uintah County was below the State average of 4.3 percent. Unemployment rates in Carbon and Duchesne Counties were only a little higher than the State average in 2005.

Table 3.13-7 Labor Force and Unemployment Rates, 2000 to 2005

Year	Labor Force			Unemployment Rate (Annual Average)			
	Carbon County	Duchesne County	Uintah County	Carbon County (percent)	Duchesne County (percent)	Uintah County (percent)	State of Utah (percent)
2000	9,105	5,679	11,112	5.6	4.9	4.2	2.9
2001	8,869	6,048	11,707	6.3	5.2	4.4	3.9
2002	9,466	6,470	12,465	7.0	6.7	5.9	6.1
2003	9,474	6,381	13,013	7.8	6.8	5.8	5.6
2004	9,029	7,113	13,964	6.3	5.7	5.1	4.3
2005	8,372	7,126	13,799	4.8	4.6	3.9	4.3

Source: Hanni (2006)

Information from a recent survey by the State of Utah indicates that there is unsatisfied labor demand in the socioeconomics study area. The job vacancy rate for the Uinta Basin was 5.2 percent, the highest of any region surveyed during the fourth quarter of 2005. On average, the survey found almost 900 job openings at an average advertised wage of $12.20 per hour. One-third of all vacancies in the region were in the construction and mining industries, and demand was highest for truck drivers, mining service unit operators, and roustabouts (i.e., temporary and/or unskilled laborers) (UDOWS 2005). This evidence of demand in excess of supply in local labor markets indicates that new hiring requirements would be likely to trigger recruitment from outside communities near the WTP Project Area.

Per capita income in Carbon, Duchesne and Uintah Counties has historically been below the Statewide average despite the higher earnings of coal mining jobs in Carbon County.

Recently, as **Table 3.13-8** suggests, per capita income in Carbon County has declined somewhat and risen in Duchesne and Uintah Counties, perhaps because of higher employment in the oil and natural gas industry. In Duchesne County, 2004 per capita income was 89.9 percent of the State average, up from about 83.4 percent in 2001. In Uintah County, 2004 per capita income was almost 82.8 percent of the State average, up from almost 75.7 percent in 2001. In Carbon County, 2004 per capita income eased to 90.6 percent of the State average, down from 91.7 percent in 2001.

Table 3.13-8 Per Capita Personal Income, 2001 and 2004

	Per Capita Income, 2001	Percent of State of Utah, 2001	Per Capita Income, 2004	Percent of State of Utah, 2004	Percent Change, 2001-04
Carbon County	$22,747	91.7	$24,425	90.6	7.4
Duchesne County	$20,702	83.4	$24,220	89.9	17.0
Uintah County	$18,770	75.7	$22,313	82.8	18.9
Utah	$24,809	100.0	$26,946	100.0	8.6

Note: 2001 data are actual data from U.S. Department of Commerce BEA, May 2005. 2004 data are estimates from Utah Department of Workforce Services, Workforce Information, November 2005.
Source: GOPB (2006b)

Mining jobs are large contributors to total and per capita income in Carbon, Duchesne, and Uintah Counties, as is demonstrated in **Table 3.13-9**. The mining industry recorded high average monthly wages in all three counties in 2004, second only to the utilities industry in Carbon and Uintah Counties. **Table 3.13-9** also shows that, based on 2004 data, “arts, entertainment and recreation” and “accommodations and food services” industries are among the three lowest-wage industries in the three counties.

Table 3.13-9 Private Non-Farm Average Monthly Wage by Major Industry in 2004

	Carbon County	Duchesne County	Uintah County
Agricultural Services, Forestry, Fishing & Hunting	-	$1,176	$1,342
Mining	$5,933	$4,065	$4,349
Utilities	$6,258	$2,356	$6,480
Construction	$2,729	$2,335	$2,051
Manufacturing	$2,775	$2,581	$1,754
Wholesale Trade	$3,563	$2,901	$3,271
Retail Trade	$1,455	$1,301	$1,558
Transportation and Warehousing (48 & 49)	$3,451	$3,342	$3,782
Information	$1,690	$2,327	$1,887
Finance and Insurance	$2,104	$2,059	$2,386
Real Estate and Rental and Leasing	$747	$1,561	$4,043

Table 3.13-9 Private Non-Farm Average Monthly Wage by Major Industry in 2004			
	Carbon County	**Duchesne County**	**Uintah County**
Professional Scientific & Technical Svc	$1,091	$3,011	$2,420
Management of Companies and Enterprises	$3,539	-	-
Admin., Support, Waste Mgmt, Remediation	$2,050	$1,952	$1,715
Education Services (private)	-	$161	$1,346
Health Care and Social Assistance	$1,923	$2,135	$1,663
Arts, Entertainment and Recreation	$1,024	$517	$797
Accommodations and Food Services	$680	$817	$657
Other Services (except Public Admin.)	$2,172	$1,801	$2,313

Note: Some values are missing because publication of employment and wage data from this source are withheld for any industry level when necessary to protect the identity of cooperating employers.
Source: BLS (2006)

Another dimension of the economy in Carbon, Duchesne, and Uintah Counties is the non-labor component of personal income. The data for 2004 shown in **Table 3.13-10** indicate that non-labor income is a large part of the economic base in the three counties. Two categories (1. dividends, interest, rent; and 2. personal transfer receipts), are 35 percent of personal income in Carbon County, 31 percent in Duchesne County, and 29 percent in Uintah County. For Utah as a whole, non-labor income is 26 percent of personal income. In Carbon, Duchesne, and Uintah Counties, non-labor income is associated with income maintenance and public assistance medical care benefits rather than with public retirement benefits or property income.

Table 3.13-10 Labor and Non-Labor Income in 2004				
	Total Personal Income	**Net Earnings by Place of Residence**	**Dividends, Interest and Rents**	**Current Personal Transfer Receipts**
Carbon County ($000)	$479,136	$311,112	$56,141	$111,883
As percent of total	100	65	12	23
Duchesne County ($000)	$352,579	$246,522	$40,587	$65,470
As percent of total	100	70	12	19
Uintah County ($000)	$575,237	$407,693	$70,828	$96,716
As percent of total	100	71	12	17
State of Utah, as percent of total	100	74	15	11

Source: BEA (2006a, 2006b)

People who commute to work also have an impact on personal income measured within a single county. In-commuters take income away from the county where jobs are located, and out-commuters bring income back to their home county. According to Census data in **Table 3.13-11**, Carbon County had 971 out-commuters and 1,385 in-commuters in 2000, Duchesne County had 1,115 out-commuters and 878 in-commuters, and Uintah County had 1,235 out-commuters and 936 in-commuters.

Table 3.13-11 Workforce-Commuting in Carbon, Duchesne, and Uintah Counties in 2000

	Carbon County	Duchesne County	Uintah County
Persons living in county/working outside (1)	971	1,115	1,235
Persons living outside/working in county (2)	1,385	878	936
Net commuting out-flow	(414)	237	299
Total employed labor force living in county (3)	9,105	5,679	11,112
Percent of resident workers out-commuting to jobs	10.7	15.5	11.1
Total industry jobs in county (4)	11,722	7,766	13,667
Percent of jobs in county held by in-commuters	11.8	11.3	6.8

Source: (1) U.S. Census Bureau (2003a), (2) U.S. Census Bureau (2003b), (3) UDOWS (2005), (4) BEA (2006a)

The actual impact of commuting on personal income depends heavily on the income levels of commuters; high incomes associated with commuting in one direction can offset larger numbers of commuters in the other direction whose incomes are lower. Detailed income data from 2003 show that the net effect of commuting was to add 0.1 percent to total personal income in Carbon County and to add 12.6 percent to personal income in Duchesne County. The effect in Uintah County was to subtract 3.7 percent from personal income in 2003 (BEA 2006a).

3.13.4 Uintah and Ouray Reservation and the Ute Indian Tribe

The Uintah and Ouray Indian Reservation includes land in Uintah, Duchesne, and Grand Counties. The Reservation's boundary encloses many different blocks of land under varied ownership; Tribal surface and mineral ownership covers approximately 1.2 million acres; which are not necessarily overlapping. Tribal jurisdictional boundaries include approximately 4 million acres (Ute Indian Tribe-BIA 2007).

Because of varied ownership and patterns of residency, the population within Reservation boundaries was only 14.5 percent American Indian in 2000, down from 15.4 percent in 1990 (**Table 3.13-12**). Total population within the jurisdictional Reservation was 19,182 in 2000, including 2,780 persons identifying themselves as American Indian and another race.

Table 3.13-12 Population and Housing Profile, Uintah and Ouray Reservation, Jurisdictional Boundary, 1990 and 2000

	1990 Census	2000 Census	AARC 1990-2000
Total Population, All Races	17,224	19,182	1.1%
American Indian Population (persons of one race)	2,650	2,780	0.5%
American Indian Population as Percent of Total Population	15.4%	14.5%	NA
Total Housing Units	7,545	8,700	1.4%
Occupied Housing Units	4,938	6,010	2.0%
Vacant Housing Units, Available for Sale or Rent	1,068	755	-3.4%
Vacant Housing Units Available for Sale or Rent as Percent of Total Housing Units	14.2%	8.7%	NA
Vacant Housing Units, Held Vacant for Other Uses	1,539	1,935	2.3%

Notes: 2000 Census data include population on off-reservation trust land. AARC-Annual Average Rate of Change.
NA = Not applicable.
% percent
Source: U.S. Census Bureau (1990, 2000b)

Table 3.13-12 (above) also shows that there were 8,700 housing units on the Reservation in 2000. That is 1,155 (11.4 percent) more than in 1990. Although the number of housing units grew faster than the total population from 1990 to 2000, there was even faster growth in the number of occupied units and the number of units held vacant for other uses. Consequently, the vacancy rate for housing available for sale or rent, as measured by the Census, fell to 8.7 percent in 2000, down 5.5 percentage points from 1990.

The Ute Indian Tribe has a membership of 3,157 persons. Tribal members reside both on and off the Reservation. Since the data used in **Table 3.13-12** do not include State affiliation, the membership count is not reconciled to the census of American Indians residing on the Reservation, who may or may not be members of the Ute Indian Tribe.

The government of the Ute Indian Tribe is headquartered in Fort Duchesne. The Tribe is economically active, and State enterprises include the supermarket; gas stations; bowling alley; feedlot; Uinta River Technologies (computer data capture and management); Ute Tribal Enterprises LLC (livestock); Ute Water Systems (water and sewer for several reservation communities); and Ute Energy (development of State energy resources) (Ute Indian Tribe Website 2006).

3.13.5 Specific Economic Sectors

Discussions of specific economic sectors are included because they are the subject of expressed public interest as evidenced by comments received during the scoping process. This section will consider three specific topics: grazing, recreation and special designation areas, and the oil and gas industry. Discussion of the first two topics will focus on the economic impact of resources in these sectors that are in or near the WTP Project Area. The third topic will discuss how local oil and gas resources fit into a regional and national context.

3.13.5.1 Grazing

Parts of seven grazing allotments are found within the WTP Project Area. However, oil and gas development is proposed within only three of the seven allotments. The potential value of the production in these allotments can be derived using Price Field Office averages for the gross value of production per AUM. The data and estimates are presented in **Table 3.13-13**.

Table 3.13-13 Potential Gross Value of Livestock Production from Grazing Allotments within the WTP Project Area

	Grazing Allotment		
	Stone Cabin	Dry Canyon	Green River
Active AUMs (1) within the WTP Project Area	1,625	640	2,011
As Percent of Total Active AUMs in the Allotment	100	100	28
Potential Gross Value of Production (cash receipts) (2), in 2001 dollars	$38,480	$15,155	$47,621

Notes: 1. AUM – Animal unit month. The amount of forage required to feed one 1,000 pound animal (the equivalent of one cow, one horse or five sheep) for one month. The carrying capacity of an allotment is derived from the number of acres needed to produce one AUM of available forage. AUM's produced by an allotment are variable due to changing conditions from year to year.
2. Gross value of production is estimated by assuming that all allotments are used to graze cattle or cattle and horses up to carrying capacity. The 5-year average estimate of the value of production of one AUM in the Price Field Office is $23.68 for cattle in 2001 dollars.
Source: Active AUMs – Tweddell (2007a); Estimated Value of Production per AUM – BLM (2003d).

Note that the estimates in **Table 3.13-13** are based on generalizations that simplify the actual productivity of parts of the grazing allotments found within the WTP Project Area. Circumstances that would affect the actual gross value of production include stocking rates, livestock prices, and forage availability. In addition, a particular allotment may have more than a proportional, marginal impact on permittee production. Disproportionate marginal impacts may occur if the permittee "depends" on the allotment and cannot find substitute forage at the same cost, in a feasible location, or in the proper seasonal sequence (Godfrey and Bagley 1994).

3.13.5.2 Recreation and Tourism

This section discusses how counties near the WTP Project Area may derive beneficial, regional economic impacts because of recreation and tourism related visitor expenditures within the WTP Project Area, which contains four special management areas: Nine Mile Canyon, the Jack Canyon WSA, the Desolation Canyon WSA, and the Green River through Desolation Canyon.

Nine Mile Canyon is a complex site with historical, cultural, recreational, scenic and biological values. Current special designations associated with the canyon and its environs include: ACEC, SRCMA, Utah State Scenic Byway, and the BLM Backcountry Byway.

Portions of two WSAs fall within the boundaries of the WTP Project Area; the Jack Canyon WSA and the Desolation Canyon WSA. Combined, the WSAs comprise approximately 32,149 acres (23 percent) of the WTP Project Area. Approximately 5,120 acres of the WSAs are under oil and gas leases held by BBC, which constitute valid existing rights. Unless otherwise restricted through land use planning, activities allowed in WSAs include hunting, fishing, camping, river rafting, wildlife viewing and hiking.

The Green River through Desolation Canyon provides a river running and primitive recreation experience that has national recognition. The current Desolation Canyon SRMA, which is defined as the corridor limited to what can be seen or heard from the river, is managed under a specific plan (BLM 1979) (see **Section 3.11**, Recreation). The BLM plan recognizes the potential wilderness designation of Desolation Canyon and the canyon's status as a National Historic Landmark (see **Section 3.17**, Special Designations). The primary management goals are to maintain the natural character of the canyon environment and to equitably distribute user days to a broad spectrum of the public. A portion of the river is managed to provide a wilderness experience, and the entire management plan corridor is under suspension of oil and gas exploration.

Beneficial economic impacts from visitor expenditures occur in the local economy where the people stop and stay while visiting an attraction. The routes that people take to access attractions determine where expenditures occur. Regional economic impacts from tourism in Nine Mile Canyon would likely occur in Carbon County. Economic impacts from visitation to the two WSAs would also likely occur in Carbon County. The economic impacts from rafting the Green River through Desolation Canyon would be dispersed through Carbon County, Uintah County and elsewhere in Utah.

Estimating the economic impact of visitor attractions requires a measure of visitation and a measure of local spending. Nine Mile Canyon generates the most requests for information from the Castle Country Regional Information Center and the Carbon County Travel Bureau. However, the only visitor data known for the attraction are a 1993 Easter weekend count of 600 visitors, and a traffic count of 100 vehicles per day in 1995. Visitors attracted by primitive recreation are difficult to count under most circumstances. Two methods used to estimate visitation to designated wilderness areas include counting signatures at trailhead registers or conducting a trailhead survey. Surveys can also capture visitor spending information. No methods of this kind are being used for the WSA in the WTP Project Area.

Usage of Desolation Canyon of the Green River is limited to a capacity of 35,000 user days per season. High season use from May 15 to August 15 is limited to six launches per day of up to 25 people per launch. The Institute for Outdoor Recreation and Tourism at Utah State University conducted a research project for select river segments on or adjacent to BLM-administered lands in Utah. The Green River in Desolation Canyon was one of the areas surveyed. The goals of the study, as pertinent to this analysis, include updating and collecting visitor use data and collecting economic expenditure data for river users. In 1998, the BLM estimated that 6,000 boaters floated the Green River in Desolation Canyon during one season. The average trip length for this 84-mile segment in Desolation Canyon was 6 days. The average cost incurred per person was $441.44. The average cost per person was further broken down by trip type (i.e., commercial or private boats). Boaters on commercial trips spent an average of $1,176.94 over the 6-day trip. Boaters on private trips spent an average of $196.15.

The study also gathered information on expenditures of Utah residents and non-residents. The per-person expenditure of non-residents was $464.86, while Utah residents only spent $100.97 during their trip through Desolation Canyon (Reiter and Blahna 2001)[2].

The BLM annually collects general estimates of recreation visitation from each Field Office. The Price Field Office reported that for all resources in Carbon and Emery Counties, there were a total of 641,300 recreation visitor days (RVD) in 2000, or 320,650 full visitor days (BLM 2004b). The BLM RVDs are based on 12-hour periods of visit, so one full day equals two RVD's. Camping, pedestrian activity, boating, driving for pleasure, nature viewing and study, and OHV use accounted for 86 percent of the visitor days reported by the Price Field Office in 2000.

The Utah Office of Tourism calculates very general spending estimates of visitors. A survey by Utah State University (USU) economists in 1994 arrived at visitor spending estimates for visitors to four designated wilderness areas in Utah (Keith and Fawson 1995). **Table 3.13-14** summarizes the general visitor spending estimates that can be assembled to encompass general leisure visitors in southern Utah, business visitors, and visitors to Utah's four wilderness areas for recreation.

Table 3.13-14 Spending Estimates for Visitors to Southern Utah and Visitors to Utah Wilderness Areas

	Expenditures Per Person Per Day (2006 dollars)
All Visitors to Southern Utah	$87
Visitors to Four Utah Wilderness Areas	$23-$32

Notes: Original data in 2001 dollars for Southern Utah Visitors and in 1994 dollars for Utah Wilderness Area visitors. Adjusted to 2006 dollars using GDP Inflation Index. Southern Utah Visitors are 74 percent leisure and 26 percent business. The four Utah wilderness areas are Box-Death Hollow (Garfield County), Dark Canyon and Grand Gulch (San Juan County) and Paria Canyon (Kane County). The four Utah wilderness areas surveyed are considered multi-day backpacking venues; therefore, the expenditures estimate may not be representative of day-use spending. Day-use spending can be higher because recreation day-use visitors may, for example, stay in motels, eat in restaurants, and purchase from local retailers. Also, the four Utah wilderness areas surveyed are a mix of designated wilderness and wilderness study areas; spending patterns may differ between visitors to designated wilderness and visitors to WSAs.
Source: Keith and Fawson (1995)

It should be noted that visitor expenditures create a beneficial economic impact in a county if the expenditures are from non-residents of the county. The USU survey found that more than 98 percent of visits to the Utah wilderness areas were from non-local residents (Keith and Fawson 1995).

Many public goods on public lands are not marketed. However, they are scarce and provide satisfaction, so they have an economic value even if no money changes hands. Special management areas are examples of this type of public land, and what they offer to visitors and to the general public are examples of public goods.

Valuation studies of recreation use are common nationally. More studies of this type are available for the intermountain area—including Utah—than for other regions of the U.S. (Rosenberger and Loomis 2001). **Table 3.13-15** presents average on site use values for selected recreation activities that resemble the public use of special management areas

[2] All figures have been inflated from 1999 dollars to 2006 dollars using the GDP Inflation Calculator based on the inflation rate during government fiscal years (http://cost.jsc.nasa.gov/inflateGDP.html.

near the WTP Project Area. These values represent the economic value received by users that is over and above what they received for their direct expenditures.

Table 3.13-15 Average Non-Market Use Value of Recreation on Public Land from Existing Studies of Activities in the Intermountain Area

	Value Per Person Per Activity Day (2006 dollars)
Biking	$69
Camping	$28
Float Boating	$47
General Recreation	$16
Hiking	$35
Picnicking	$28
Sightseeing	$14
Wilderness Recreation	$34
Wildlife Viewing	$38

Notes: Original data in 1996 dollars. Adjusted to 2006 dollars using GDP Inflation Index. All values rounded to the nearest dollar. Data are median values from existing studies. Intermountain Area is USDA Forest Service regions 1 – 4. General recreation is a composite of recreation opportunities at a site with a measure for the site, not a specific activity.
Source: Rosenberger and Loomis (2001)

One activity not explicitly discussed within the aforementioned studies is cultural and heritage tourism. However, a number of studies have documented the importance of historic sites as a recreational resource. For example, the 1977 National Travel Survey, conducted by the Bureau of Census found that 21 percent of all households engaged in non-local trips visited historical areas (Taylor et al. 1993).

Like other forms of recreation, cultural and heritage tourism on public lands can provide economic benefits for surrounding communities. A study conducted by Taylor et al. (1993), in northwestern Wyoming compared the regional economic impact of historical site visitors and other recreational visitors. The study concluded that historical site visitors bring more money into an area, generate more economic activity, increase household income, and contribute more to local government revenue than other recreational visitors. In total, historic site visitors generated about 20 percent more regional economic impact on a per-day basis.

Another activity not previously discussed is hunting. In the year 2000, a team of BLM researchers estimated the level of hunting, fishing, and wildlife watching associated with BLM lands and the expenditures generated by those activities in 12 western States. Using a very simplified model, it was determined that the number of people that hunt, fish, and watch wildlife on BLM lands was roughly equivalent to the amount of BLM land when compared to the total amount of land within any given state. In 2000, dollars it was calculated that hunting, fishing, and wildlife watching activities accounted for approximately $177 million in expenditures within Utah. Hunting alone accounted for approximately $53 million of that total (Romaniello et al. 2002).

In effort to enhance the accuracy of the analysis, big game hunting data from various stated departments (UDOW) were used to calculate BLM associated expenditures for each game management unit within the each State. The WTP Project Area falls within game management unit number 11, which was amongst the highest in terms of BLM associated expenditures. High expenditures within this area can be attributed to a number of variables, including the total number of hunters within the unit, and the fact that the amount of BLM land within the unit is proportionally higher than in many other game management units.

3.13.5.3 Valuation of Passive (Non-Use) Wilderness Benefits

Economists use non-market valuation studies to estimate the monetary value people give to public lands and the benefits they provide. Economists use data collected from the actions or survey responses of visitors, homebuyers, and the public to simulate market conditions and to elicit measures of value.

Non-market valuation studies view public lands in terms of their onsite use value and their off site, or “passive,” use value. In many studies conducted around the country, on site use values have been calculated for public goods like recreation, water quality, and air quality. Passive use values have been calculated for rare species and environments such as free flowing rivers and wilderness.

This section considers the potential for non-market, or “economic”, value that users and the general public may derive from areas with wilderness characteristics.

Economic valuation studies of the passive use benefits of wilderness are much less common than studies of use values. Passive use studies are personal surveys that are intended to measure the satisfaction gained from knowing wilderness is preserved, even if an individual does not visit or ever plan to visit the area. Passive use benefits for wilderness may be thought of as the satisfaction of knowing that the option exists to visit a wilderness, that a wilderness will be available for use in the future, and that a wilderness simply exists (Cordell et al. 2005). People who live where wilderness is rare, or even non-existent, may put a very high value on it while people who live close to wilderness areas (Utah) may put a lower value on it. The economic values estimated by these studies can be in hundreds of dollars per acre when the entire population of the United States is counted in the estimate (Loomis 2000).

One valuation study associated with Utah wilderness was conducted more than 15 years ago by surveying Utah residents. The economic value to Utah residents of preserving all designated wilderness areas in Utah—2.7 million acres at the time—was a total of $72 per household per year in 2006 dollars after adjusting for inflation (Pope and Jones 1990). A comparable national estimate of annual willingness to pay for passive use benefits from all designated wilderness is $75 per household per year in 2006 dollars. The national estimate combined information from eight studies published from 1984 to 1996 (the Utah study among them) with an average household response rate of 50 percent. The annual per household benefit of $75 applied to the relevant population (one-half of all households, or 54.5 million at the time of the analysis) yielded a value of $38.50 per acre in 2006 dollars for the entire United States’ designated-wilderness system (Cordell et al. 2005).

There are other benefits of wilderness besides on site recreation and passive use. These benefits include community jobs and income supported by the local spending of wilderness visitors; scientific research, education, and management; off site activities and amenities such as hunting of wilderness-supported game; scenic views and property values; biodiversity conservation); and ecological services like watershed protection and carbon storage (Cordell et al. 2005).

3.13.5.4 Regional and National Natural Gas Industry Trends

Comments received during the scoping process expressed concern for Utah's role and that of areas near the WTP Project Area in the national energy strategy. This section first reviews regional and national trends that relate to the area's natural gas industry outlook. A discussion follows of existing businesses related to oil and gas development with an emphasis on the businesses serving gas development.

Natural Gas Industry Trends

Interest in Utah natural gas has increased because of market conditions. This is reflected in the growing leasing interest expressed to the BLM Utah State Office over the past 5 years. Recently, leasing nominations have focused on parcels in the Price Field Office, as well as parcels in the Richfield, Fillmore, and Cedar City Field Offices. Although these areas have seen less development historically than the Uinta Basin, recent exploratory drilling and geophysical testing indicates that oil and gas reserves may exist in these areas. Newer technology has improved the outlook for extracting gas at deeper levels in more complex geology (BLM 2006b).

Utah is a net exporter of natural gas. Utah's natural gas exports are part of the total production from the Rocky Mountain region, which also includes Colorado and Wyoming. Major pipeline corridors connect the Rocky Mountains to the West and Midwest regions. In the West, the major consumers of natural gas production are California and Nevada. Natural gas from the Rocky Mountains also reaches Washington and Oregon (EIA 1998).

A forecast of domestic natural gas production is described in the most recent Energy Outlook published by the Energy Information Administration (EIA) of the Department of Energy (EIA 2006a). In the forecast, EIA predicts that the Rocky Mountain and Alaska regions would provide most of the increase in domestic natural gas production from 2004 to 2030. A related trend in the EIA forecast is that incremental production of onshore natural gas in the lower 48 States would come primarily from "unconventional" resources, including coalbed methane, tight sandstones ("tight gas"), and gas shales.

Because 60 percent of the projected growth in natural gas consumption is predicted to occur east of the Mississippi River, EIA anticipates new natural gas pipelines would be built from supply regions in the West to meet natural gas demand in the East, including a North Slope Alaska pipeline. EIA also anticipates construction of new pipeline capacity from the Rocky Mountains to deliver increasing Rocky Mountains production to Pacific Coast markets.

California's importance as a market for Rocky Mountain natural gas production is reflected in the State's own studies. A forecast and analysis of future supply commissioned for the California Energy Commission (Stevens et al. 1998) forecasts that as California gas production stagnates or declines, unconventional gas from the Rocky Mountains—particularly tight gas and coalbed natural gas—would become more important to natural gas supplies in California. The study identified the Uinta Basin in

Utah as a very important emerging source of coalbed natural gas and a significant producer of tight gas.

Oil and Gas Related Business

Analysis of data published by the Utah Department of Workforce Services indicates that there are 245 businesses in the WTP Project Area that are related to oil and gas development. **Table 3.13-16** presents these data for Carbon, Duchesne, and Uintah Counties. The analysis emphasizes businesses that are directly related to the natural gas industry; business categories specific to the gas industry were selected whenever available.

Table 3.13-16 Businesses Related to Oil and Gas Development in the Study Area in 2006

Business Sector (NAICS Code)	Carbon County	Duchesne County	Uintah County	Total for Study Area
Extraction of Crude Petroleum and Natural Gas (211111)	1	8	9	18
Extraction of Natural Gas Liquid (21112)	1	0	1	2
Drilling of Oil and Gas Wells (213111)	1	4	15	20
Support Activities for Oil and Gas Operations (213112)	7	42	114	163
Construction - Oil and Gas Pipelines and Related Facilities (237120)	0	2	8	10
Manufacturing - Oil and Gas Field Equipment (331132)	0	1	1	2
Wholesale - Industrial Equipment (423830) (1)	5	3	15	23
Transportation - Gas Pipelines (486210)	2	1	4	7
Total	17	61	167	245

Notes: 1. The sector includes sales of pipeline equipment.
Source: UDOWS (2006)

As **Table 3.13-16** shows, Duchesne, Uintah and to a lesser extent Carbon County host many businesses that serve the oil and gas development industry. Uintah County hosts 167 of the businesses. Duchesne County hosts 61 businesses and Carbon County hosts 17 businesses.

3.13.6 Community Facilities and Services

Housing markets and public facilities and services are described in terms of their ability to accommodate future growth. These attributes influence the commuting and relocation choices of workers.

Evaluating the community capacity to absorb growth can suggest public and private policies to manage change. The Natural Resources Impact Working Group was convened in March 2006 to review the impacts of natural resource extraction activity on communities and counties in rural Utah; to develop ways to educate local officials on how to more effectively address those impacts; and to make recommendations to the governor and the legislature. The working group is staffed by the Rural Development

Program of the Governor's Office of Economic Development (Rural Development Program). Members of the working group are currently assembling a 5-year budget of impacts (GOED-Utah Office of Rural Development-Natural Resources Impact Working Group 2006b).

3.13.6.1 Housing

Table 3.13-17 shows estimates of the total housing stock in Carbon, Duchesne, and Uintah Counties. The table indicates that in all three counties of the WTP Project Area, the conventional housing stock generally kept pace with permanent population growth from 2000 to 2004. For example, the number of housing units grew at an average of 0.6 percent per year in Carbon County, compared to population falling at 1.3 percent per year on average. Housing grew an average of 1.6 percent per year in Duchesne County, compared to population growth of 0.9 percent per year on average. While housing grew 1.2 percent per year in Uintah County, compared to population growth of 0.9 percent per year on average.

Table 3.13-17 Total Housing Units by County, 2000 to 2004

	Carbon County	Duchesne County	Uintah County
2000	8,769	7,028	9,071
2001	8,887	7,196	9,201
2002	8,929	7,277	9,310
2003	8,946	7,384	9,416
2004	8,967	7,489	9,512
2000-04 Chg	198	461	441
2000-04 Pct	2.3%	6.6%	4.9%
2000-04 AARC	0.6%	1.6%	1.2%
2003-04 Chg	21	105	96
2003-04 Pct	0.2%	1.4%	1.0%

Source: U.S. Census Bureau (2005)
% percent

Existing housing resources in Carbon, Duchesne and Uintah Counties are concentrated in the larger cities of Price, Roosevelt and Vernal. However, analysis of building permits indicates that new housing construction in the past 5 years has mainly occurred in unincorporated parts of the counties. As **Table 3.13-18** shows, unincorporated areas received 71 percent of permits issued in Carbon County from 2000 to 2005, 88 percent of permits issued in Duchesne County, and 78 percent of permits issued in Uintah County.

<table>
<tr><th colspan="5">Table 3.13-18 Cumulative Building Permits by Jurisdiction, 2000 to 2005</th></tr>
<tr><th rowspan="2"></th><th rowspan="2"></th><th colspan="3">Cumulative Permits Issued 2000 to 2005</th></tr>
<tr><th>Total</th><th>In Cities & Towns</th><th>Elsewhere in County</th></tr>
<tr><td rowspan="3">Carbon County</td><td>Number</td><td>449</td><td>129</td><td>320</td></tr>
<tr><td>Average per Year</td><td>75</td><td>22</td><td>53</td></tr>
<tr><td>Percent by Jurisdiction</td><td>100</td><td>29</td><td>71</td></tr>
<tr><td>Duchesne County</td><td>Number</td><td>944</td><td>117</td><td>827</td></tr>
</table>

Table 3.13-18 Cumulative Building Permits by Jurisdiction, 2000 to 2005				
		Cumulative Permits Issued 2000 to 2005		
		Total	In Cities & Towns	Elsewhere in County
	Average per Year	157	20	138
	Percent by Jurisdiction	100	12	88
Uintah County	Number	969	209	760
	Average per Year	162	35	127
	Percent by Jurisdiction	100	22	78

Source: University of Utah-David Eccles School of Business-BEBR (2006).

Housing inventoried in 2000 by the Census Bureau was predominantly single-family and that trend has continued in Carbon, Duchesne, and Uintah Counties. Mobile and manufactured housing is fairly common and increasing in frequency. Housing units in multi-family structures are the least common housing types in all three counties.

As **Table 3.13-19** shows, in 2000, detached single-family units were 78 percent of housing in Carbon County, 64 percent of housing in Duchesne County, and 73 percent of housing in Uintah County. In Carbon, Duchesne, and Uintah Counties, mobile and manufactured units represented 12 percent, 27 percent, and 15 percent of total housing units, respectively.

Table 3.13-19 County Housing Units by Type, 2000 (Percent)			
	Carbon County	Duchesne County	Uintah County
Single Family	78.4	63.5	73.2
Duplex	2.3	1.0	2.4
All Other Multi-Family	7.7	8.6	9.1
Mobile & Manufactured	11.6	26.9	15.3

Source: U.S. Census Bureau (2000c)

An examination of building permits issued from 2000 to 2005 indicates that single family units are 33 percent of the new units built in Carbon County since the 2000 Census, 53 percent of new units in Duchesne County, and 60 percent of new units in Uintah County. Mobile or manufactured units are almost 67 percent of the new units built in Carbon County since the Census, and 48 and 36 percent of new units in Duchesne and Uintah Counties, respectively (University of Utah-David Eccles School of Business-BEBR 2006).

Housing costs have risen a little but are still relatively low in Carbon County, as measured by activity in the entire area covered by the Carbon/Emery Board of Realtors. **Table 3.13-20** shows that 25 percent more houses were sold in 2005 than in 2004 in the Carbon/Emery area, but prices appreciated only about 2 percent. In 2005, the average sale price in the area was 46 percent of the Statewide average (excluding Park City), down from 47 percent of the Statewide average in 2004.

Table 3.13-20 Home Sales and Average Prices, 2004 to 2005				
		Number of Sales	Average Sales Price of Homes	Local Price as Percent of State Average
Carbon/Emery Area	2004	288	$88,862	47.1
	2005	359	$90,707	45.7
	Percent change 2004-05	24.7	2.1	-
Uinta Basin Area	2004	427	$115,144	61.0
	2005	541	$138,080	69.6
	Percent change 2004-05	26.7	19.9	-
Utah (minus Park City)	2004	N/A	$188,655	-
	2005	N/A	$198,282	-
	Percent change 2004-05	-	5.1	-

N/A – data not available.
Source: Utah Association of Realtors (2006a, 2006b)

Table 3.13-20 also shows that in the Uinta Basin Area, about 27 percent more houses were sold in 2005 than in 2004. Prices appreciated about 20 percent, pushing the average sale price in the Uinta Basin to almost 70 percent of the Statewide average, up from 61 percent of the Statewide average in 2004.

Current housing availability is moderate in Carbon County but negligible in Uintah and Duchesne Counties. A search of the Multiple Listing Service of the Utah Association of Realtors in April of 2006 found 163 units listed as either single-family, condominium, manufactured, or mobile housing in Carbon County and six units listed as multi-family housing (Utah Association of Realtors 2006a). A search of the MLS for the Uintah area in April of 2006 found no listings for housing (Utah Association of Realtors 2006b).

Natural gas development in Uintah, Duchesne, and Carbon Counties is supported by a workforce of permanent residents plus workers who live in the area on a temporary or rotational basis while maintaining a permanent home elsewhere. Temporary and rotational workers reside in motels, field camps, rental housing, and recreational vehicles (RV), which can be parked most conveniently at commercial campgrounds. Research in Wyoming indicates that apart from operator-provided field camps, motel rooms and RVs are most commonly used as temporary housing by natural gas workers (Jacquet 2007).

The tri-county study area has a large, existing stock of motel rooms and RV campgrounds. This includes approximately 900 motel rooms and 300 commercial RV spaces (some year-round and some seasonal) in the vicinity of Vernal (Uintah County) and Roosevelt and Duchesne city (Duchesne County) as well as approximately 600 motel rooms with some properties also operating campgrounds in the vicinity of Price, Wellington and Helper (Carbon County). The estimates are based on the properties listed on the travel and tourism websites for the communities in the study area (Castle Country 2007; Duchesne County Chamber of Commerce 2007; Vernal Area Convention Bureau 2007).

In the study area, motels and campgrounds also support the visitor accommodations and services sector. Growing industry use, corresponding to the rising level of drilling activity since 2002 (UDOGM 2007), has absorbed more motel room-nights, particularly in Uintah and Duchesne Counties. During the summer of 2007, the Vernal area was able to house all visitors by identifying available lodging at times of peak demand and arranging accommodations through regional "welcome centers" (Farmer 2007).

3.13.6.2 Water and Wastewater

The Price city water system is constrained by peaking capacity, according to a study completed in late 2005. New water supplies would be needed to accommodate future growth (Price Sun Advocate 2005c). Price also is planning wastewater system improvements (Wastewater Project Assistance Program 2002).

Two water and wastewater systems in Carbon County face revenue shortages because of declining or stagnant demand. They are the Price River Water Improvement District (Wellington, Carbonville, and unincorporated Carbon County) and East Carbon City (Price Sun Advocate 2005d; Price Sun Advocate 2006a).

The Ashley Valley Water Reclamation Facility (Uintah County) treats wastewater for an area that includes the Ashley Valley and the cities of Vernal and Maeser. The facility opened in 2001, and was built with $21.6 million in grants and loans to address selenium concentration. Additional water and sewer system improvements are listed as current or projected growth needs by the Ashley Valley Water and Sewer District ($19.2 million) and the City of Vernal ($11 million), which jointly manage the wastewater plant with the Maeser Water and Sewer District (GOED-Utah Office of Rural Development-Natural Resources Impact Working Group 2006a).

The Roosevelt municipal water system (Duchesne County), which also serves communities along the line from the water source near Neola, rations culinary water in the hot summer months. Completion of the $80 million Sand Wash Pipeline in 2008 will relieve the shortage by providing untreated water for irrigation. The Roosevelt wastewater system, at 50 percent of capacity, is nominally adequate for another 6,000 persons (Hancock 2007).

Duchesne City's water system has the capacity to handle build-out within the city limits. Water mains are being enlarged to serve large subdivisions outside the city with wholesale treated water. The city's wastewater lagoons are near capacity and will need to be dredged but will not be expanded because outlying subdivisions will rely on septic systems in the foreseeable future (Miller 2007).

3.13.6.3 Public Safety

Each county sheriff's office near the WTP Project Area employs from 40 to 60 personnel with about three quarters of the staff assigned either to patrol or to jail operations. The Carbon County Sheriff's Office has a staff of 42, including 18 certified officers and 14 correctional officers. The Uintah County Sheriff has a staff of 53, including 19 certified officers and 22 correctional officers. The Duchesne County Sheriff's Office has a staff of 56, including 16 road deputies and 26 correctional officers (Duchesne County 2006a).

The larger municipal police departments close to the WTP Project Area are in Price, Roosevelt and Vernal. The Price police department has 16 sworn officers and a civilian staff of three (Price Utah City Directory 2006). The Vernal police department has 16 sworn officers (Vernal City Online 2006). Roosevelt's department has 9 officers, 5 reserve officers, 1 animal control officer, and 2 administrative staff (Roosevelt Police Department 2006).

Carbon County has six municipal fire departments that cover areas outside of the BLM and Forest Service. The five largest municipalities in the County are also signatories to a mutual aid agreement (Price Sun Advocate 2005e).

In 2001, Duchesne County issued a long-term plan committed to achieving adequate fire coverage by 2011. Currently, the County has seven fire departments within its boundaries—four city departments and three county departments—with a total of 95 volunteer firefighters. The County funds the city departments for coverage outside their boundaries and has 1 full-time employee to coordinate fire service and emergency management (Duchesne County 2006b).

Uintah County has multiple volunteer fire departments for areas outside of the BLM, the Forest Service, and the Uintah and Ouray Reservation. The local fire departments in Uintah County are Vernal/Uintah County (27 volunteers), Naples (18 volunteers), Jensen (17 volunteers), Lapoint-Tridell (15 volunteers), and Avalon (Uintah County 2006).

3.13.6.4 Health Care

There are three hospitals near the WTP Project Area:

- Castleview Hospital in Price (Carbon County) serves Carbon and Emery Counties. The hospital is an accredited facility with 74 Medicare or Medicaid certified beds. Castleview is a short-term care facility with no beds available for long-term care (Hospital-Data.com 2006a);
- Ashley Valley Medical Center in Vernal (Uintah County) is an accredited facility with 39 certified beds. The hospital is a short-term facility but all beds are available for long-term care (Hospital-Data.com 2006b); and
- Uinta Basin Medical Center in Roosevelt (Duchesne County) is a non-accredited facility with 42 certified beds. The hospital is a short-term facility but all beds are available for long-term care (Hospital-Data.com 2006c).

The Uinta Basin Medical Center also operates clinics in Duchesne City, Altamont, and Tabiona, which are all in Duchesne County (Hyde 2006). Clinics of the TriCounty Health Department, which also serves Daggett County, provide screening and preventive services from locations in the cities of Vernal, Roosevelt, and Duchesne (TriCounty Health Department 2006).

3.13.6.5 Schools

Three school districts operate within Carbon, Duchesne, and Uintah Counties, and each district covers the whole respective county. For the three districts combined, there were a total of 12,921 student enrolled in 39 schools as of fall 2005, down from a total fall enrollment of 14,214 in 2000 (**Table 3.13-21).** From 2000 to 2005, the annual average rate of decline in fall enrollment was 3.7 percent in Carbon County and 1.5 percent in Uintah County. Duchesne County enrollment also declined at an average rate of 0.7 percent per year during the same period. However, from 2004 to 2005, enrollment in Duchesne County actually rose 2.5 percent.

Table 3.13-21 Profile of Carbon, Duchesne and Uintah County School Districts

	Carbon County School District	Duchesne County School District	Uintah County School District
Number of Schools			
Elementary & Middle	5	7	9
Junior & Senior High	4	5	2
Special & Alternative	3	3	1
Fall Enrollment			
2000	4,100	4,140	5,974
2003	3,622	3,900	5,607
2004	3,488	3,894	5,642
2005	3,389	3,993	5,539
AARC 2000-05	-3.7%	-0.7%	-1.5%
Percent Change 2004-05	-2.8%	2.5%	-1.8%
Staffing Rates in 2003-04 Ratio of Pupils Per:			
K-12 Classroom Teacher	20.9	19.2	22.7
Special Education Teacher	4.4	9.0	6.1
School Administrator	302	322	374

% percent
Source: Utah State Office of Education-Utah School Finance and Statistics Division (2004a, 2004b)

Pupil-teacher ratios of 20.9 in Carbon County, 19.2 in Duchesne County, and 22.7 in Uintah County for K-12 classrooms are below the State average of 24.9, indicating adequate staffing (Utah State Office of Education-Utah School Finance and Statistics Division 2004b).

The Carbon County School District closed East Carbon High School at the end of the 2004-05 school year because of shifting enrollments. The district plans to spend up to $3 million for an elementary school in East Carbon (Price Sun Advocate 2005a; Price Sun Advocate 2005b). Previous capacity changes included the addition of three elementary schools, a junior high school, and Carbon High School in Price in 2001 and 2002.

The Duchesne County School District completed a new building for Duchesne High School in fall of 2005 and launched construction of a new junior high school in Roosevelt. Funding for the project includes $4.7 million from the State of Utah's education Revolving Loan Fund, a $3 million no-interest loan from the Permanent Community Impact Fund (PCIF) jointly issued to the district and Duchesne County for the auditorium, and $7.6 million in locally undertaken lease revenue bonds (Duchesne County School District 2005).

The Uintah County School District completed a $10.0 million Vernal Junior High addition and remodel in 2004-05. The $7.3 million in financing was structured as a combination of locally issued lease revenue and general obligation bonds. The remainder was paid for from capital outlay reserves and current funds from school programs needing the improvements (Uintah County School District 2005).

High school students and adults have access to concurrent enrollment, advanced degrees and career and technical training at the Price campus of the College of Eastern Utah, an open-access community college (College of Eastern Utah 2006) at the Roosevelt campus of the Utah College of Applied Technology (UCAT), and the Uinta Basin Campus of Utah State University with facilities in Vernal and Roosevelt (Utah State University 2006). There were 1,735 persons in workforce training programs at UCAT during the 2004-05 school year (UCAT 2005).

3.13.6.6 Transportation

U.S. Highways 6, 40 and 191 are the principal transportation routes through Carbon, Duchesne, and Uintah Counties. The Utah Department of Transportation (UDOT) has three projects for these highways near the WTP Project Area in the current 5-year plan. These are widening and passing lanes on U.S. 6 in Carbon County from Soldier Summit to Helper in 2006 ($9.0 million), widening on U.S. 40 in Duchesne County from West Roosevelt to Ioka Junction in 2007 ($2.3 million) and widening on U.S. 40 in Uintah County from East Roosevelt to the Ballard east city limits in 2007 ($2.8 million) (UDOT 2005).

In Carbon, Duchesne and Uintah Counties, county government handles ongoing road maintenance and repair, and special service districts (SSD) undertake capital construction projects primarily financed by allocations of Federal mineral lease revenues. Other sources of local government assistance for road improvements are the Local Government Federal and State Aid Projects and the Class B and C Road Funds programs.

3.13.7 Public Expenditures and Revenues

Municipal expenditures from fiscal year 2001 to fiscal year 2005 in potentially affected cities are shown in **Table 3.13-22**. Total expenditures rose by 19.2 percent in Price, 29.5 percent in Wellington, 35.2 percent in Roosevelt, 73.5 percent in the City of Duchesne, and 7.7 percent in Vernal. On the other hand, total expenditures fell by 0.9 percent in Helper. Total expenditures moved in the same direction as population in all communities except Price and Wellington, where expenditures increased by relatively high percentages despite loss of population.

Table 3.13-22 Total Expenditures by City Government and Distribution by Function in Millions of Dollars (not inflation adjusted)

	Total Expenditures	Shares by Category							
		General Government	Public Safety	Highway & Public Improve-ments	Parks, Recreation & Public Property	Community & Economic Development	Inter-governmental Expenditures	Capital Outlay	Debt Service
Helper									
FY 2001	$1.30	18.8%	33.8%	15.1%	8.4%	1.1%	NA	22.7%	NA
FY 2005	$1.29	19.3%	36.5%	19.2%	12.7%	0.2%	NA	NA	12.1%
Price									
FY 2001	$5.54	19.2%	29.4%	32.8%	12.9%	NA	0.9%	1.9%	2.9%
FY 2005	$6.60	23.9%	27.0%	25.8%	12.9%	0.7%	0.9%	6.3%	2.5%
Wellington									
FY 2001	$0.62	25.5%	50.3%	10.4%	13.5%	0.3%	NA	NA	NA
FY 2005	$0.80	26.7%	44.6%	5.3%	3.8%	0.3%	NA	2.4%	17.0%
Duchesne									
FY 2001	$0.60	14.5%	23.1%	23.8%	25.1%	NA	NA	NA	13.5%
FY 2005	$1.07	11.9%	16.4%	16.4%	14.2%	NA	NA	37.5%	3.6%
Roosevelt									
FY 2001	$2.65	20.7%	33.2%	15.9%	23.8%	NA	NA	1.6%	4.8%
FY 2005	$3.58	14.7%	27.3%	10.3%	22.2%	NA	NA	21.5%	4.0%
Vernal									
FY 2001	$6.26	18.9%	24.2%	24.9%	2.6%	NA	6.4%	16.9%	6.2%
FY 2005	$6.75	22.6%	31.1%	19.7%	7.4%	NA	2.9%	9.6%	6.7%

% percent

Source: Helper Municipal Corporation (2001); Helper Municipal Corporation (2005); Price Municipal Corporation (2001); Price Municipal Corporation (2005); Wellington Municipal Corporation (2001); Wellington Municipal Corporation (2005); Duchesne City Corporation (2001); Duchesne City Corporation (2005); Roosevelt City Corporation (2001); Roosevelt City Corporation (2005); Vernal City Corporation (2001); Vernal City Corporation (2005)

Table 3.13-23 Total Expenditures by County Government and Distribution by Function, in Millions of Dollars (not inflation adjusted)

	Total Expenditures	Shares by Category									
		General Government	Public Safety	Public Health	Highway & Public Improvements	Parks, Recreation & Public Property	Community & Economic Development	Inter-governmental Expenditures	Capital Outlay	Debt Service	Misc.
Carbon County											
FY 2001	$19.05	18.6%	18.4%	14.1%	27.6%	6.5%	2.2%	3.3%	0.8%	3.9%	4.4%
FY 2004	$18.64	19.9%	24.2%	20.3%	18.0%	6.4%	4.0%	NA	7.0%	0.2%	NA
Duchesne County											
FY 2001	$14.59	12.6%	22.9%	1.4%	19.9%	2.1%	2.0%	NA	28.9%	9.1%	1.0%
FY 2004	$12.88	18.7%	34.7%	5.0%	12.2%	2.7%	5.4%	NA	14.9%	6.3%	NA
Uintah County											
FY 2001	$18.50	22.2%	18.3%	16.0%	23.3%	4.7%	3.2%	NA	9.3%	3.0%	NA
FY 2004	$19.77	27.0%	21.4%	19.8%	16.8%	7.3%	2.3%	NA	4.7%	0.6%	NA

Note: Data from county annual financial reports are the most recent posted by the Utah State Auditor's Office at time of publication.
% percent
Source: Carbon County (2001); Carbon County (2004); Duchesne County (2001); Duchesne County (2004); Uintah County (2001); Uintah County (2004)

Expenditures by major function by county government in Carbon, Duchesne, and Uintah Counties are shown in **Table 3.13-23**. The data show that total expenditures grew by 6.8 percent from fiscal year 2001 to fiscal year 2004 in Uintah County, but fell by 2.1 percent in Carbon County and by 11.7 percent in Duchesne County. During this period, population grew 4.0 percent in Uintah County, fell by 2.5 percent in Carbon County, and grew by 3.6 percent in Duchesne County.

Expenditures also grew in all three county school districts (see **Table 3.13-24**). From the 2001 school year to the 2005 school year, total expenditures grew by 13.1 percent in the Carbon County School District, by 35.0 percent in the Duchesne County School District, and by 19.0 percent in the Uintah County School District. Fall enrollments for the corresponding periods fell across each district by 14.9 percent in Carbon County, by 5.9 percent in Duchesne County, and by 5.6 percent in Uintah County.

Table 3.13-24 Total Expenditures by Public School Districts Distribution by Function, In Millions of Dollars, Not Inflation Adjusted

	Total Expenditures	Shares by Category				
		Instruction	Supporting Services	School Lunch/Other Non-Instructional	Capital Outlay/Facilities Acquisitions & Construction	Debt Service
Carbon County School District						
FY 2001	$26.14	54.8%	28.2%	9.0%	3.6%	NA
FY 2005	$29.56	51.1%	25.4%	4.4%	13.6%	NA
Duchesne County						
FY 2001	$24.85	54.1%	30.6%	4.8%	6.7%	NA
FY 2005	$33.55	46.4%	26.3%	3.6%	18.0%	NA
Uintah County						
FY 2001	$34.45	57.3%	30.0%	5.4%	6.3%	NA
FY 2005	$41.01	54.9%	26.8%	8.1%	9.2%	NA

% percent
Source: Carbon County School District (2001); Carbon County School District (2005); Duchesne County School District (2001); Duchesne County School District (2005); Uintah County School District (2001); Uintah County School District (2005)

Total revenues and the main sources of revenue are presented in **Tables 3.13-25**, **3.13-26** and **3.13-27** for the counties, cities, and schools of Carbon, Duchesne, and Uintah Counties. Taxes contribute large shares of total revenue to each of these levels of local government.

Table 3.13-25 Total Revenues of Counties and Distribution by Source, In Millions of Dollars, Not Inflation Adjusted

	Total Revenues	Shares by Source						
		Taxes	Licenses & Permits	Inter-govern-mental Revenues	Charges for Services	Fines & Forfeitures	Interest Income	Contri-butions & Transfers
Carbon County								
FY 2001	$20.35	30.1%	0.6%	50.7%	10.6%	1.9%	0.0%	0.1%
FY 2004	$19.93	36.2%	0.6%	44.5%	10.0%	1.5%	0.2%	1.5%
Duchesne County								

Table 3.13-25 Total Revenues of Counties and Distribution by Source, In Millions of Dollars, Not Inflation Adjusted

	Total Revenues	Shares by Source						
		Taxes	Licenses & Permits	Inter-govern-mental Revenues	Charges for Services	Fines & Forfeitures	Interest Income	Contri-butions & Transfers
FY 2001	$12.79	39.8%	0.7%	30.2%	25.0%	NA	3.4%	NA
FY 2004	$12.89	42.7%	1.1%	24.8%	27.8%	NA	1.4%	NA
Uintah County								
FY 2001	$22.16	32.8%	1.1%	49.0%	8.0%	1.5%	NA	NA
FY 2004	$21.30	44.9%	1.4%	38.1%	9.0%	1.6%	4.0%	NA

Note: Data from county annual financial reports are the most recent posted by the Utah State Auditor's Office at time of publication.
% percent
Source: Carbon County 2001; Carbon County 2004; Duchesne County 2001; Duchesne County 2004; Uintah County 2001; Uintah County 2004.

Table 3.13-26 Total Revenues of Cities and Distribution by Source, In Millions of Dollars, Not Inflation Adjusted

	Total Revenues	Shares by Source						
		Taxes	Licenses & Permits	Intergovernmental Revenues	Charges for Services	Fines & Forfeitures	Interest Income	Contri-butions & Transfers
Helper								
FY 2001	$0.82	46.1%	1.7%	13.6%	19.8%	13.3%	NA	NA
FY 2005	$1.01	45.8%	1.4%	22.9%	19.1%	7.8%	NA	0.2%
Price								
FY 2001	$4.80	72.5%	3.2%	11.1%	7.2%	2.3%	NA	0.0%
FY 2005	$5.30	74.2%	2.8%	12.4%	7.8%	1.5%	NA	0.1%
Wellington								
FY 2001	$0.66	59.6%	1.2%	11.1%	7.0%	19.9%	NA	NA
FY 2005	$0.82	63.4%	0.9%	16.7%	4.0%	13.9%	NA	NA
Duchesne								
FY 2001	$0.54	65.1%	3.2%	17.9%	12.1%	NA	NA	NA
FY 2005	$0.69	55.7%	2.5%	31.7%	7.6%	NA	0.9%	NA
Roosevelt								
FY 2001	$2.74	62.7%	3.6%	12.6%	13.3%	2.1%	NA	NA
FY 2005	$3.52	63.6%	3.5%	12.8%	12.2%	1.6%	1.2%	NA
Vernal								
FY 2001	$8.67	47.5%	1.3%	34.8%	7.4%	3.6%	2.2%	NA
FY 2005	$7.60	69.2%	2.2%	8.6%	11.3%	4.4%	1.6%	0.3%

% percent
Source: Helper Municipal Corporation (2001); Helper Municipal Corporation (2005); Price Municipal Corporation (2001); Price Municipal Corporation (2005); Wellington Municipal Corporation(2001); Wellington Municipal Corporation (2005); Duchesne Municipal Corporation (2001); Duchesne Municipal Corporation (2005); Roosevelt City Corporation (2001); Roosevelt City Corporation (2005); Vernal City Corporation (2001); Vernal City Corporation (2005)

Table 3.13-27 Total Revenues of Public Schools and Distribution by Source, In Millions of Dollars, Not Inflation Adjusted

	Total Revenues	Shares by Source			
		Property Taxes	Other Local Revenue	State Sources	Federal Sources
Carbon County School District					
FY 2001	$27.08	24.3%	7.2%	58.1%	10.4%
FY 2005	$29.95	40.1%	3.8%	45.8%	10.3%
Duchesne County School District					
FY 2001	$25.59	21.1%	2.0%	69.5%	7.3%
FY 2005	$29.05	21.6%	3.0%	61.7%	13.7%
Uintah County School District					
FY 2001	$34.75	20.7%	5.7%	62.8%	10.7%
FY 2005	$43.34	29.9%	4.7%	50.1%	15.3%

% percent
Source: Carbon County School District (2001); Carbon County School District (2005); Duchesne County School District (2001); Duchesne County School District (2005); Uintah County School District (2001); Uintah County School District (2005)

As the tables show, the more important sources of revenue for local, general purpose governments are the general property tax and the sales tax (cities especially). Property taxes are the only taxes levied by school districts. As **Table 3.13-27** shows, the share that property taxes contribute has increased to more than 40 percent in the Carbon County School District and to a little less than 30 percent in the Uintah County School District. The category of intergovernmental revenues is important to the counties, which receive transfers for public health services, and to the school districts, which receive State and Federal funds for general use and categorical programs.

Utah's "Truth in Taxation" law requires voter approval to raise more property tax revenue than was collected from the previous year's tax base, though local governments can collect revenue from new growth. The local tax burden can shift from one property class to another if the value of one or more large classes of property changes dramatically over time. This can occur in Carbon and Uintah Counties where natural resource property, whose value is sensitive to resource prices, is a large share of the tax base. School districts operate under a Statewide arrangement that transfers State general revenues to local districts to provide a "floor" under per pupil expenditures.

Table 3.13-28 shows the 2004 tax base, tax rate, and general obligation debt load of jurisdictions in Carbon, Duchesne, and Uintah Counties. General obligation debt requires repayment from general revenues. All of the governments are well below limits, if not free of, general obligation debt.

Table 3.13-28 Tax Base, Tax Rate and General Obligation Debt of Local Government, Fiscal Year 2004								
	2004 Total Taxable Value ($000,000) (1)	**2004 Total Centrally Assessed Taxable Value ($000,000) (1)**	**2004 Oil & Gas Taxable Value ($000,000) (2)**	**2004 Coal Taxable Value ($000,000) (2)**	**2004 Other Natural Resource Taxable Value ($000,000) (2)**	**2004 Tax Rate (3)**	**2004 General Obligation Debt Limit ($000,000) (4)**	**2004 General Obligation Debt ($000,000) (5)**
Carbon County Government	$1,688.8	$1,042.3	$658.5	$198.4	$1.0	0.2777%	$33.81	0.0
Carbon County School District	1,688.8	$1,042.3	658.5	198.4	1.0	0.6595%	67.6	15.7
Helper	46.7	NA	NA	NA	NA	0.2482%	1.9	0.0
Price	261.3	NA	NA	NA	NA	0.2710%	10.5	0.0
Wellington	43.6	NA	NA	NA	NA	0.2157%	1.7	0.0
Duchesne County	687.6	257.4	184.0	0.0	2.2	0.3800%	13.8	5.3
Duchesne County School District	687.6	257.4	184.0	0.0	2.2	0.8117%	27.5	6.5
Duchesne city	26.5	NA	NA	NA	NA	0.2866%	1.1	0.4
Roosevelt	110.6	NA	NA	NA	NA	0.4466%	4.4	0.0
Uintah County	1,860.2	1,081.7	600.9	0.0	56.7	0.2886%	37.2	0.0
Uintah County School District	1,860.2	1,081.7	600.9	0.0	56.7	0.6060%	74.4	0.0
Vernal	291.6	NA	NA	NA	NA	0.1110%	11.7	0.0

Note: Sum of land, buildings, personal property, and centrally assessed property. The taxable valuation for a county government and the corresponding county school district are exactly the same because the jurisdictional boundary and tax base are the same for each entity. Different tax rates (mill levies) account for the difference in revenues generated.
% percent
Source: 1.Utah State Tax Commission (2004a); 2. Utah State Tax Commission (2004b); 3. Utah State Tax Commission (2004c): Utah Taxpayers Association (2006); 4. Estimated by Lloyd Levy Consulting LLC as 2 percent of taxable value for counties and 4 percent of taxable value for other entities.; 5. Entity Financial Statements for Fiscal Year 2004.

Table 3.13-28 emphasizes the importance of natural resources and related facilities in the property tax base of the potentially affected counties. Oil and gas production are 39 percent of taxable value in Carbon County, 27 percent in Duchesne County, and 32 percent in Uintah County. Coal production is 12 percent of taxable value in Carbon County.

Total centrally assessed property, which comprises more than one-third to more than one-half of taxable value in Carbon, Duchesne, and Uintah Counties, also includes pipelines, railroads, electric utilities and telecommunications facilities that may be indirectly related to natural resource extraction. Data in **Table 3.13-28** show that total centrally assessed property was about 62 percent of taxable value in Carbon County in 2004, about 37 percent in Duchesne County, and about 58 percent in Uintah County. Personal property related to natural resource extraction is assessed locally.

Sales taxes are paid by oil and gas operations when purchases of equipment, materials, or supplies are made in the local area. Examples of purchases that generate sales tax revenue include gravel, pipe, fuel, and other supplies purchased locally. Like property tax revenue, sales and use tax revenues are used by local cities and counties to fund a wide variety of important local services and community facilities.

In addition to property taxes and sales taxes derived from natural resource operations, Carbon, Duchesne, and Uintah Counties receive payments-in-lieu of taxes (PILT) from the Federal government for all public lands within the county.

In **Table 3.13-29** the trend in per capita expenditures and revenues for local governments in the tri-county study area indicates a potential difficulty for jurisdictions in keeping expenditures and revenues synchronized as population and service demands change. The indicator tracked in the table is whether growth in per capita expenditures was matched or exceeded by growth in per capita revenues from 2000 to 2004 (or 2005 depending on availability of an annual financial report at the time of the analysis) Governments where the data indicate that growth in per capita expenditures exceeded growth in per capita revenues are Carbon County School District, Price, Wellington, Duchesne County School District, Duchesne city, Roosevelt, Uintah County, and Vernal. The expenditures and revenues summarized in **Table 3.13-29** are assumed to reflect a jurisdiction's ongoing operating costs and revenues.

Table 3.13-29 presents the recent trend in per capita revenue and expenditures for the local governments in Carbon, Duchesne, and Uintah Counties. Per capita revenues in jurisdictions near the WTP Project Area have generally kept pace with expenditures and with inflation since 2001. Inflation has been 2.4 to 2.5 per year, as measured by the broad, national Consumer Price Index. Carbon County, with per capita expenditure growth of 0.4 percent, and Duchesne County, with per capita expenditure decline of almost 15 percent, are exceptions. In Vernal, per capita expenditures rose 4.7 percent for the period and per capita revenues fell almost 15 percent.

Table 3.13-29 Change in Per Capita Expenditures and Revenues of Local Government, In Dollars, Not Inflation Adjusted

	Per Capita					
	Total Expenditures	Revenues				
		Total	Property Taxes	Other Taxes	Inter-governmental Revenue	Other Revenue
Carbon County						
FY 2001	$933.81	$997.84	$220.34	$80.06	$506.32	$191.12
FY 2004	$937.73	$1,002.31	$243.64	$119.40	$445.68	$193.59
Percent Change	0.4%	0.4%	10.6%	49.1%	-12.0%	1.3%
Carbon County School District						
FY 2001	$6,374.88	$6,604.63	$1,604.63	$0.00	$4,521.46	$478.54
FY 2005	$8,473.34	$8,587.16	$3,442.95	$0.00	$4,815.65	$328.56
Percent Change	32.9%	30.0%	114.6%	NA	6.5%	-31.3%
Helper						
FY 2001	$640.49	$403.95	$30.62	$155.56	$54.81	$162.96
FY 2005	$673.13	$530.12	$69.67	$173.39	$121.53	$165.53
Percent Change	5.1%	31.2%	127.6%	11.5%	121.7%	1.6%
Price						
FY 2001	$659.60	$571.41	$72.01	$342.30	$63.68	$93.43
FY 2005	$805.66	$646.58	$92.35	$387.58	$80.03	$86.62
Percent Change	22.1%	13.2%	28.3%	13.2%	25.7%	-7.3%
Wellington						
FY 2001	$369.75	$395.56	$54.62	$181.27	$43.82	$115.85
FY 2005	$504.42	$519.60	$68.90	$260.43	$86.60	$103.67
Percent Change	36.4%	31.4%	26.1%	43.7%	97.6%	-10.5%
Duchesne County						
FY 2001	$1,013.41	$888.10	$167.95	$185.80	$268.11	$266.24
FY 2005	$863.79	$864.60	$168.53	$200.79	$214.61	$280.67
Percent Change	-14.8%	-2.6%	0.3%	8.1%	-20.0%	5.4%
Duchesne County School District						
FY 2001	$6,003.38	$6,180.92	$1,307.00	$0.00	$4,750.97	$122.95
FY 2005	$8,616.33	$7,461.22	$1,611.71	$0.00	$5,622.50	$227.02
Percent Change	43.5%	20.7%	23.3%	NA	18.3%	84.6%
Duchesne City						
FY 2001	$426.85	$380.68	$62.50	$185.37	$68.18	$64.63
FY 2005	$737.96	$472.49	$64.65	$198.76	$149.93	$59.15
Percent Change	72.9%	24.1%	3.4%	7.2%	119.9%	-8.5%
Roosevelt						

Table 3.13-29 Change in Per Capita Expenditures and Revenues of Local Government, In Dollars, Not Inflation Adjusted

	Per Capita					
	Total Expenditures	Revenues				
		Total	Property Taxes	Other Taxes	Inter-governmental Revenue	Other Revenue
FY 2001	$615.49	$638.06	$92.81	$307.28	$80.48	$157.48
FY 2005	$806.40	$793.33	$135.45	$368.94	$101.42	$187.51
Percent Change	31.0%	24.3%	45.9%	20.1%	26.0%	19.1%
Uintah County						
FY 2001	$731.43	$875.87	$205.87	$81.08	$429.14	$159.78
FY 2005	$751.18	$809.43	$196.76	$166.63	$308.14	$137.90
Percent Change	2.7%	-7.6%	-4.4%	105.5%	-28.2%	-13.7%
Uintah County School District						
FY 2001	$5,766.49	$5,817.21	$1,203.05	$0.00	$4,280.38	$333.78
FY 2005	$7,268.88	$7,681.85	$2,294.75	$0.00	$5,027.47	$359.62
Percent Change	26.1%	32.1%	90.7%	NA	17.5%	7.7%
Vernal						
FY 2001	$812.03	$1,123.67	$39.67	$493.52	$391.50	$198.99
FY 2005	$850.11	$956.67	$30.61	$631.82	$82.25	$211.99
Percent Change	4.7%	-14.9%	-22.8%	28.0%	-79.0%	6.5%

% percent

Note: Expenditure and revenue data from **Tables 3.13-22** through **3.13-27** were divided by population from **Table 3.13-2** to arrive at per capita amounts.

Schools in Utah have some protection from changing revenues that is not available to other local governments. The foundation program, or Utah Minimum School Program (MSP), supports districts that do not raise at least a minimum amount per "weighted pupil unit" (WPU), currently about $2,200. School corporations with declining enrollments are also held harmless for 1 year, meaning aid is held equal to the previous year, though the hold-harmless payments are offset in subsequent years.

In addition, the State of Utah supports capital funding in districts with weak tax bases. The Duchesne County School District qualified for $317,000 in capital-outlay equalization payments in fiscal year (FY) 2006 and $452,000 in FY 2005. Because of their tax bases, the Carbon and Uintah County School Districts have not qualified for capital outlay equalization payments recently (Utah State Office of Education-Utah School Finance and Statistics Division 2004c; Utah State Office of Education-Utah School Finance and Statistics Division 2005).

State government directly benefits from lease royalties and taxes that are specific to minerals production, while local governments benefit indirectly. In Utah, mineral lease revenues, which are 50 percent of the royalties and bonuses collected on Federal resources in the State, are distributed to State agencies and to local entities by appropriation or statutory formula. Utah's total mineral lease revenue was $92.0 million in FY 2005. Of those receipts, the State appropriated $41.9 million (46 percent) to the

PCIF and $33.5 million (37 percent) to the Department of Transportation for redistribution to counties and special service districts (GOED-Utah Office of Rural Development-Natural Resources Impact Working Group 2005b). Both appropriations generally benefit local areas producing mineral lease revenues and impacted by mineral extraction activities.

The PCIF provides loans and grants to State agencies, counties and other sub-divisions of the State (e.g., special districts) that may be socially or economically impacted by mineral resource development on Federal lands. **Table 3.13-30** compares the mineral lease revenues appropriated to the PCIF that were derived from activity in Carbon, Duchesne, and Uintah Counties to the funding returned to those counties in the form of grants and loans. By State and Federal statute, projects eligible for PCIF funding are used to provide public services, to construct and maintain public infrastructure, or to plan for facilities and services.

Table 3.13-30 Utah Permanent Community Impact Fund – Cumulative Mineral Lease Receipts to, and Grant or Loan Funding from, Carbon, Duchesne and Uintah Counties, Fiscal Years 2001 to 2005

	Carbon County	Duchesne County	Uintah County
Permanent Community Impact Fund Revenue from (millions):	$26.7	$4.0	$35.6
Permanent Community Impact Fund Allocation to (millions):	$24.9	$12.8	$25.2
Allocated As Grants (millions)	$13.0	$5.1	$8.9
Percent Grants	52	40	35
Allocated As Loans (millions)	$11.9	$7.7	$16.3
Percent Loans	48	60	65

Note: Revenues are derived from lease bonuses and production royalties of activities located in each county. Fund allocations were distributed to local governments and other State sub-divisions located in each county.
Source: GOED-Utah Office of Rural Development-Natural Resources Impact Working Group (2005a)

Distributions of mineral lease revenues to Carbon, Duchesne, and Uintah Counties have increased several fold since 2001, as shown in **Table 3.13-31**. Historically, these funds are used for transportation and recreation projects and, more recently, for other facilities and services authorized by State statute. Carbon County uses its funding for transportation and recreation (Carbon County Recreation and Transportation Special Service District 2004) and Duchesne County uses its funding solely for road work (Duchesne County Special Service District #2 2004). Uintah County has operated service districts for roads, recreation, and health care funded, at least in part, by mineral lease revenue distributions (Uintah Special Service District 2004). Uintah County recently formed three new service districts for animal control, fire suppression and economic development (Vernal Express 2006).

Table 3.13-31 Mineral Lease Distributions to Local Government from UDOT Appropriation, Carbon, Duchesne, and Uintah Counties, Fiscal Years 2001 to 2006, in millions

	Carbon County	Duchesne County	Uintah County
2001	$5.14	$0.79	$6.86
2002	$2.26	$0.72	$3.03
2003	$3.23	$0.68	$6.89

Table 3.13-31 Mineral Lease Distributions to Local Government from UDOT Appropriation, Carbon, Duchesne, and Uintah Counties, Fiscal Years 2001 to 2006, in millions			
	Carbon County	**Duchesne County**	**Uintah County**
2004	$5.42	$0.93	$11.77
2005	$7.05	$1.90	$16.70
2006	$10.15	$2.75	$27.50

Note: Distributions by county are allocated proportionate to the amount of mineral lease money generated by each county. Within counties, distributions are allocated to the county government or special service district as determined by the county legislative body. Revenues are derived from lease bonuses and production royalties of activities located in each county.
Source: UDOT (2007a)

Note that the distribution by county in **Table 3.13-31** was determined in proportion to the amount of mineral lease money generated in each county by production from Federal minerals. Duchesne County is a high oil producing county. However, a small portion of the County's oil fields produce from Federal minerals. The rest of production in Duchesne County is from private or Ute Tribal mineral rights.

The Utah severance tax is a tax on the value of production, minus allowed deductions, of 3 percent on the first $1.50 per mcf (thousand cubic feet) of gas and 5 percent on the amount over that. Severance tax collections go to the State of Utah general fund.

3.13.8 Population and Employment Projections

Table 3.13-32 and **Table 3.13-33** project the total population and the total employment in Carbon, Duchesne, and Uintah Counties under expected baseline conditions. The regional and State projections are included for comparison. A set of projections for cities is not published by the State of Utah's long-term projections program.

Table 3.13-32 Population Projections by County				
	Carbon County	**Duchesne County**	**Uintah County**	**State of Utah, in millions**
2005 Estimate	19,338	15,237	26,883	2.547
2010	19,023	15,897	27,071	2.833
2020	20,982	19,021	29,289	3.486
2030	23,188	21,497	30,641	4.086
2040	25,118	23,516	31,614	4.701
2005-40 AARC	0.7%	1.2%	0.5%	1.8%

Table 3.13-33 Employment Projections by County				
	Carbon County	**Duchesne County**	**Uintah County**	**State of Utah, in millions**
2005	10,959	7,888	14,071	1.48
2010	11,339	8,189	14,534	1.70
2020	12,744	9,333	15,394	2.08
2030	14,325	10,437	16,216	2.49

Table 3.13-33 Employment Projections by County				
	Carbon County	Duchesne County	Uintah County	State of Utah, in millions
2040	16,688	11,615	17,256	2.95
2005-40 AARC	1.2%	1.1%	0.6%	2.0%

The projected population growth rate is about the same as the employment growth rate in Duchesne and Uintah Counties. However, the average annual population growth rate is lower than the employment growth rate in Carbon County. One economic trend that would account for this difference is that an increasing share of jobs in Carbon County may be held by in-commuters. A demographic trend that would affect the ratio of population to employment is an aging population and an accompanying decline in children as a share of total population, which could occur in Carbon County.

3.13.9 Community Social Conditions

The following two sections discuss the relationship of the nearby counties and communities to the WTP Project Area, and affected community groups.

3.13.9.1 Counties and Communities

Carbon, Duchesne and Uintah Counties contain small towns that are separated from the major cities of Utah by 2 hours or more of highway travel. In each community near the WTP Project Area, schools, churches, local government, and local institutions are touchstones of a social structure based on relationships among neighbors, acquaintances and members of community groups and institutions. The communities of the region remain, as they have been historically, central places within large rural areas. The private lands that comprise the urban and rural zones are adjoined by large tracts of public land that hold valuable and strategic natural resources. The public lands and resources, which occupy 60 to 70 percent of the surface area in each county, are pivotal to the region's sense of place and plans for the future.

Carbon County has historically valued "a small town atmosphere" and "rural character" (Carbon County 2005a). A long history of agriculture, coal mining, and railroad transportation has given cultural and ethnic diversity to communities such as Price and Helper. The presence of the College of Eastern Utah since 1937 has also contributed to social and cultural diversity.

Management decisions by the BLM and other Federal land managers, which concern the use of and access to public lands and resources, are a principal concern because of their potential impact to the economy of the area. County officials recognized this explicitly in a 2004 amendment to the general plan that states, "While private property is the cornerstone of the county, it is important to note that public lands resource extraction such as coal mining and coal bed methane [natural gas] extraction is the mainstay of our employment and tax base" (Carbon County 2005b).

Concern for sustaining the economy is echoed at the local level. In a community survey conducted for the Price City General Plan (Price Municipal Corporation 2004), residents identified the following aspects as key to their quality of life: availability of recreation and outdoor adventure; strong educational resources; the fairgrounds and its special events;

the CEU Prehistoric Museum; good medical facilities; a low cost of living; and a safe atmosphere. However, the survey identified the most important “issue” as “the need for more job opportunities and expanded economic development.

As in Carbon County, community identity for most of the population in Uintah and Duchesne Counties is tied to use of the land and natural resources, and to an economic dependency on public lands. The public in both counties is keenly aware of this and sensitive to the fact that public lands management impacts their economic well being (Carbon County 2005b; Duchesne County 2005).

According to the Uintah County General Plan (Uintah County 2005), residents value the County’s rural character, quiet lifestyle, natural landscapes, and open spaces. The plan states that maintaining these values is one of the top priorities of county residents. The plan also states the belief that Uintah County depends on the use and development of natural resources for its economic well-being and defines county government’s role as strongly supporting “the rights of Uintah County residents and businesses to responsibly use and develop natural resources.” With respect to public lands management, the general plan states that county policy is to support “multiple-use,” responsible resource use and development, and improved public and private access to and across public lands.

In Duchesne County, the County General Plan (Duchesne County 2005) identifies oil and gas and agriculture as significant to the county’s economic well being. The public’s planning priorities, according to the document, are maintaining a rural character and lifestyle; county participation in public land management issues; natural resource development; economic development; private land use issues; and human services, particularly education.

According to the Duchesne County General Plan, oil and gas has become more important to the local economy since the 1980s, so it is “in the interest of the county citizens and government” to promote access to public land to develop this resource. The general plan also states that recreation and tourism are part of the county’s economy and tax base and should be encouraged for their stabilizing effect. The plan adds that development on public lands should consider impacts to existing and potential recreational activities and be sensitive to values like rural lifestyle, quality of life, and scenic environment. However, county officials may also assert that the economic benefits of resource development outweigh those of tourism (Hyde 2006).

Members of the Ute Indian Tribe also reside near the WTP Project Area. Over half of the Tribal membership chooses to live on the Uintah and Ouray Reservation (Ute Indian Tribe Website 2006), which occupies a large percentage of the land area in Uintah and Duchesne Counties. Sovereignty over the land and resources of the reservation reinforces the Tribe’s separate social and cultural identity.

A survey conducted in 2004 (Duchesne County 2005), indicated that Tribal members see social benefits from residency on the reservation. The three aspects of life on the reservation that surveyed Tribal members liked the most were: 1) closeness to family, a sense of community, neighbors, cultural/community/Episcopal activities; 2) natural resources, scenery, mountains, clean air and clean water, wildlife, lots of space; and 3) no taxes, tax exempt, lower cost of living. The issues for the Tribe that members ranked as most important were: 1) Tribal management, committee relations, and housing maintenance; 2) health services; and 3) resource development.

“Tribal/non-Tribal relations” were identified as an issue of moderate importance to members of the Ute Indian Tribe in the 1994 survey. Counties also acknowledge the importance of cooperation and mutual sensitivity in relations with the Tribe. The Uintah County General Plan states that “cooperation between the Tribe and the County is necessary to ... address many Uinta Basin social and economic concerns and issues” (Uintah County 2005). The Duchesne County General Plan states that “resource use or development on private, public, or Tribal lands should be sensitive to Tribal interests and the County's rural lifestyle, quality of life, and scenic environment” (Duchesne County 2005).

3.13.9.2 Affected Groups

Discussions of affected groups are included to structure the assessment of social impacts. The information available from public statements of priorities (i.e., the general plans of local government and the comments offered by individuals, groups, businesses and institutions during the public scoping period of the NEPA process) suggest that individuals and groups give a high priority to different values: 1) motorized access to public lands; 2) conservation of wildlife; 3) protection of areas with special designation; and 4) resource use for economic development.

It should be noted that these discussions generalize and simplify the actual values of group members. In addition, this format is not meant to imply that these groups are mutually exclusive or that members of each group do not share interests with other groups. Furthermore, people’s attitudes and interests may change over time for a variety of reasons.

Individuals and Groups Who Give High Priority to Motorized Access to Public Lands

This group, represented by an organization that gave input into the scoping process, includes motorized recreationists (such as trail motorcycle, four-wheel-drive and OHV enthusiasts); people with a business or professional need for motorized access; and businesses that supply vehicles and related goods and services. The group prefers to retain all motorized access and supports measures to promote safety, not access closure, wherever multiple-use might lead to traffic hazards. More recreation-oriented members of the group also want to protect visual quality and wildlife as part of their motorized trail use experience.

Individuals and Groups Who Give High Priority to Conservation of Wildlife

Individuals and groups giving a high priority to conservation of wildlife were also represented by an organization that contributed to the scoping process. Members of this group and their supporters focus on the potential for impacts to wildlife and wildlife habitat, as well as other natural resource values associated with natural wildlife habitat. The comments emphasize the concern that these values be studied for potential conflict with gas development and that mitigation be considered for the potential damage caused to the environment.

Individuals and Groups Who Give High Priority to Protection of Areas with Special Designation

A variety of individuals and organizations at the local, regional, and national level have shown interest in lands in or near the WTP Project Area that have special BLM land use designation. Many of the comments received during the public scoping process focused on the Jack Canyon and Desolation Canyon WSAs, on Nine Mile Canyon, which is in the currently designated ACEC of the same name, and on the Green River corridor, part of which is in the currently designated Lower Green River ACEC.

These individuals and groups indicate that the status of these areas is important because they value their naturalness; their uniqueness or increasing rarity; their benefits for recreation; their place in the environment; or their value as a source of knowledge. Specific concerns regarding Nine Mile Canyon focused on its archaeological, historical, cultural, recreation and landscape values.

Groups with an interest in special designation areas indicated that their members may support these ideas because they want to protect personal, professional, lifestyle, or political values. In addition, many comments focused on an interest in preserving these areas for the benefit of future generations.

Individuals and Groups Who Give High Priority to Economic Use of Resources

Many comments offered during public scoping expressed concern that resources on public land be made available for use to contribute to economic development and strategic benefits at the local, regional, and national level. Individuals and groups stating this concern did so because they live, work, or represent interests in communities that have benefited socio-economically from development of natural resources on public lands. Some groups offered these concerns because they represent industry, or they represent businesses that sell to industry.

These groups indicate that gas development provides high paying jobs, stimulates the local economy, supports public facilities and services, and has historically been part of the local social and economic structure. Many comments show support for what they see as the need to encourage development to promote local social and economic stability.

Some comments stated the belief that development can occur without destroying other resources and values, especially if there is mitigation. Concerns of this kind came from local government concerned over impacts to roads and public safety service providers.

3.13.10 Environmental Justice

Environmental justice is the principle defined by Executive Order 12898 (EO 12898) and implemented by agency directives that low-income, minority, and Tribal groups should not have to experience a disproportionate share of any negative effects resulting from a plan or project. The principle is violated when a government action results in a disproportionate adverse effect on low-income, minority or Tribal populations.

Table 3.13-34 shows the proportions of low-income, minority, and Tribal populations in selected communities in Carbon, Duchesne, and Uintah Counties. The table includes the main communities in each county near the WTP Project Area plus three communities on the Uintah and Ouray Reservation. Data for the State of Utah are shown for comparison. The reservation communities are Fort Duchesne, Randlett, and Whiterocks. These communities are Census Designated Places (CDP) and they are the only boundary-defined places within the jurisdiction of the Uintah and Ouray Reservation that were enumerated by the Census Bureau in 2000. Fort Duchesne is the headquarters location of the Ute Indian Tribe.

Table 3.13-34 Poverty and Minority Population Characteristics of Selected Communities in Carbon, Duchesne, and Uintah Counties, 2000

	Percent of Total Population in Poverty	Minority Race or Hispanic as Percent of Total Population	Percent American Indian
Carbon County	13.4	11.1	1.1
Helper	12.7	13.6	1.6
Price	15.0	11.1	1.4
Wellington	14.7	5.9	1.1
Duchesne County	16.8	8.8	5.4
Duchesne City	12.4	3.8	0.7
Roosevelt	22.1	11.7	8.1
Uintah County	14.5	12.6	9.4
Vernal	14.8	6.8	2.3
Uintah and Ouray Reservation	20.2	17.5	14.5
Fort Duchesne CDP	54.6	90.9	90.2
Randlett CDP	54.5	95.0	93.3
Whiterocks CDP	70.9	93.8	93.8
State of Utah	9.4	12.6	1.3

Note: CDP – Census Designated Place. Unincorporated communities with boundaries defined for purposes of enumeration during the decennial census. The minority race or Hispanic population is the total minority population comprising all persons of a minority racial identity plus persons of Hispanic-origin identity not already included because of race.
Source: U.S. Census Bureau (2000d)

The BLM standard for identifying a low-income population is the poverty level used by the Census Bureau. The standard for identifying minority populations is either: (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is “meaningfully greater” than the minority population percentage in the general population or other appropriate unit of geographic analysis. For environmental justice compliance, the relevant minority population is the total minority population comprising all persons of a minority racial identity plus persons of Hispanic-origin identity (CEQ 1997).

Table 3.13-34 indicates that populations with a poverty rate over 50 percent exist in the Fort Duchesne, Randlett and Whiterocks. Elsewhere in Carbon, Duchesne and Uintah

Counties, the poverty rate varies from 12.4 percent to 22.1 percent, compared to 9.4 percent in the State of Utah overall. **Table 3.13-34** also shows that Fort Duchesne, Randlett and Whiterocks are minority communities. The population of these places is more than 90 percent minority and more than 90 percent American Indian or other closely related racial identity. This is consistent with information provided by a 1994 survey of members of the Ute Indian Tribe that indicated that 64 percent of State members live in Whiterocks, 16 percent in Fort Duchesne, and 8 percent in Randlett, with the remainder in Lapoint, Ouray, and Indian Bench, the latter being communities not enumerated by the Census Bureau (Duchesne County 2005). Elsewhere in Carbon, Duchesne, and Uintah Counties the minority population percentage is not meaningfully higher than the State average, as shown in **Table 3.13-34.**

3.14 TRANSPORTATION

This section describes the existing transportation network surrounding and within the WTP Project Area. The analysis includes road descriptions, maintenance agreements, traffic conditions, and crash statistics, and is organized according to management/maintenance responsibility. Additional information on the existing transportation network can be found in **Appendix F** (*West Tavaputs Plateau Natural Gas Full Field Development Transportation Plan*).

Access to the WTP Project Area is provided by a network of Federal and State highways and county roads. Within the WTP Project Area, BLM, county, and operator-maintained roads provide access to leases, wells, and associated ancillary facilities (see **Figure 3.14**).

In general, county and BLM system roads to and within the WTP Project Area were not engineered to accommodate industrial traffic. Many upgrades have been made to these roads in recent years as a result of increased industrial activity in the area. However, steep gradients, erosion, drainage, encroachment upon streams, blind corners, and travel width still present environmental and engineering concern.

3.14.1 Federal and State Highways

Federal and State highways providing access to the WTP Project Area include SR/US 40/191 from Vernal/Roosevelt and SR/US 6/191 from Price/Wellington. Use of these transportation corridors is monitored by UDOT. **Table 3.14-1** and **Table 3.14-2** provide a summary of the average AADT and percentage of the AADT that is truck traffic on highways providing access to the WTP Project Area.

Table 3.14-1 AADT for Federal and State Highways Providing Access to the WTP Project Area

Road Name	Segment Name	Beginning Mile Point	Ending Mile Point	Segment Distance	1996 AADT	1998 AADT	2002 AADT	2003 AADT	2004 AADT
SR/US 40/191	Southwest including Myton	105.00	105.46	0.46	3,775	4,020	4,775	4,730	5,470
	South including Roosevelt	111.39	114.62	3.23	7,070	7,785	7,475	7,335	10,710
	East	87.23	96.63	9.40	2,910	3,345	4,905	4,860	4,985

Table 3.14-1 AADT for Federal and State Highways Providing Access to the WTP Project Area									
Road Name	**Segment Name**	**Beginning Mile Point**	**Ending Mile Point**	**Segment Distance**	**1996 AADT**	**1998 AADT**	**2002 AADT**	**2003 AADT**	**2004 AADT**
	including Duchesne								
SR/US 6/191	East including Wellington	238.36	244.78	6.42	8,890	9,690	9,935	9,636	9,565

Source: UDOT (1998, 2002, 2003a, 2004a)

Table 3.14-2 Truck Traffic on Federal and State Highways Providing Access to the WTP Project Area							
Highway	**Segment Name**	**1999[1] AADT**	**Percent Trucks**	**2003 AADT**	**Percent Trucks**	**2004 AADT**	**Percent Trucks**
SR/US 40/191	Southwest including Myton	4,180	16	4,730	25	5,470	17
	South including Roosevelt	7,310	9	7,335	27	10,710	36
	East including Duchesne	3,475	26	4,860	25	4,985	19
SR/US 6/191	East including Wellington	10,035	8	9,636	32	9,565	30

[1]No truck traffic information is available prior to 1999.
Source: UDOT (1999, 2003b, 2004b)

SR/US 40/191 is a two-lane all weather highway in Utah's primary highway system. The road provides access to the WTP Project Area from the population centers of Roosevelt, Duchesne, and Vernal, which would serve as the primary service centers for project-related activity. SR/US 40/191 extends from Denver in the east to Salt Lake City in the west. Between 1996 and 2004 traffic on segments of SR/US 40/191 located near the WTP Project Area showed substantial increase (approximately 45-70 percent). In general, the increase in truck traffic remained proportional to the overall increase in traffic, with SR/US 40/191, near the population center of Roosevelt being the exception. Truck traffic along this stretch of highway increased from 9 percent in 1999 to 36 percent in 2004. It should be noted that SR/US 40/191 is used extensively by gas field traffic.

Like SR/US 40/191, SR/US 6/191 is a two-lane all weather highway in Utah's primary highway system. SR/US 6/191 is the primary transportation route through Price, Utah. SR/US 6/191 extends north to Interstate 15 at Spanish Fork and south to Interstate 70 at Green River. From 1996 to 1998, SR/US 6/191 near Price experienced a moderate traffic increase (approximately 9 percent). From 1998 to 2004 traffic volumes remained relatively constant. Although the overall traffic volume along this stretch of highway remained constant, truck traffic showed a substantial increase, from 8 percent in 1999 to 30 percent in 2004.

Crash statistics for Utah highways are available through the State Department of Highway Safety. **Table 3.14-3** provides a summary of crash statistics for segments of State and Federal highways providing access to the WTP Project Area from 2002-2004.

Table 3.14-3	**Crash History on Utah Highways Providing Access to the WTP Project Area**							
Year	**Total Crashes**	**Truck Crashes**		**PDO[1] Crashes**	**Injury Crashes**		**Fatal Crashes**	
		Number	**Percent**		**Number**	**Percent**	**Number**	**Percent**
SR/US 6/191								
2002	**87**	13	15	69	18	21	1	1
2003	**49**	7	14	39	10	20	1	2
2004	**76**	5	7	61	15	20	0	0
SR/US 40/191								
2002	**146**	6	4	97	47	32	2	1
2003	**131**	7	5	75	52	40	4	3
2004	**155**	13	8	110	43	28	2	1

[1]PDO – Property Damage Only
Source: UDOT (2006)

From 2002 to 2004 an average of 70 crashes per year occurred on SR/US 6/191 on segments of road that provide service to the WTP Project Area. Approximately 80 percent of reported crashes were PDO, 20 percent resulted in minor to serious injury, and 1 percent resulted in fatalities. As shown in **Table 3.14-2**, truck traffic on SR/US 6/191 comprised approximately 30 percent of the total traffic. According to UDOT, approximately 12 percent of the crashes reported involved heavy trucks and one fatality was associated with truck traffic.

From 2002 to 2004 an average of 144 crashes per year occurred on SR/US 40/191 on segments of road that provide service to the WTP Project Area. Approximately 65 percent of reported crashes were PDO, 33 percent resulted in minor to serious injury, and 2 percent resulted in fatalities. As shown in **Table 3.14-2**, on SR/US 40-191 approximately 25 percent of the total traffic volume is heavy truck traffic. According to UDOT, approximately 6 percent of the crashes on segments of the road that provide service to the WTP Project Area involved heavy trucks, none of which resulted in a fatality (UDOT 2006).

3.14.2 County Roads

The WTP Project Area comprises sections of Duchesne, Carbon, and Uintah Counties. County roads, accessed from the Federal and State highways discussed above, would provide the primary access into the WTP Project Area. From SR/US 6/191, east of Wellington, project-related personnel would use Soldier Creek Road to access Nine Mile Canyon. From SR/US 40/191, west of Myton, Pariette Road would provide access to Wells Draw Road through Gate Canyon to Nine Mile Canyon. Soldier Creek Road, Pariette Road, and a portion of Wells Draw Road are Class 1-B paved roads, meaning they are maintained by the respective counties. Nine Mile Canyon Road and Wells Draw Road are Class 1-B gravel roads, meaning they are also maintained by the respective counties. **Table 3.14-4** provides a summary of county roads within the WTP Project Area.

Carbon County has identified the majority of the roads within the WTP Project Area (including many of the BLM system roads) as being part of its transportation system.

The County has fee title ownership of a portion of the Cold Springs Road, which is located in Sections 25, 34, 35, and 36, T13S:R14E as well as Sections 19 and 20, T13S:R15E. The County has also acquired permanent easements on State trust lands in Section 2 and 16, T13S:R15E; Sections 16 and 32, T12S:R16E; and Sections 2 and 32, T13S:R16E. These easements include portions of the Cottonwood Canyon Road, Cottonwood Spur Road, Twin Hollow Road, Cold Springs Road, and Cedar Ridge Road. In the past, Carbon County has performed maintenance on the majority of these roads.

Table 3.14-4 County Roads Providing Access to and within the WTP Project Area

County	Road Name	Mileage Within or used to access the WTP Project Area	Road Class	Road Surface	ROW Width (feet)
Carbon	Nine Mile Canyon	25.7	B	Gravel	66
	Soldier Creek Mine	12.8	B	Paved	66
Duchesne	Nine Mile Canyon	7.01	B	Gravel	66
	Wells Draw Road/ Gate Canyon	29.5	B	Gravel	47

As requested by the BLM, a traffic study was conducted for the WTP EIS between September 2005 and October 2006. Since this time, baseline traffic has likely increased in the WTP Project Area as a result of interim development actions, which have increased the number of producing wells. During the first phase of the study, traffic monitors were placed in Gate Canyon to monitor traffic originating in Vernal/Roosevelt, and in Nine Mile Canyon to monitor traffic originating in Price/Wellington. In addition, a counter was placed at the Cottonwood Bridge, to capture traffic accessing the West Tavaputs Plateau via Cottonwood Canyon. The counters recorded traffic 24 hours per day.

The Gate Canyon monitor was located approximately 2 miles north of the Gate Canyon/Nine Mile Canyon intersection on the Gate Canyon Road. The Soldier Creek Mine counter, on Nine Mile Road, was located where the pavement turns from paved to dirt road, near the Soldier Creek Mine. The Cottonwood Bridge counter was located on the Cottonwood Bridge near the junction with Nine Mile Canyon.

Table 3.14-5 summarizes monthly and average daily traffic (ADT). The study did not differentiate between vehicle type (e.g., car, pick-up, and semi) or vehicle association (e.g., oil and gas, agriculture, recreation).

Table 3.14-5 Traffic to and within the WTP Project Area

Location	Month	Recorded Number of Days	Number of Vehicles	ADT
Cottonwood Bridge	September	30	551	18
	October	31	640	21
	November	30	447	15
	December	30	393	15
	January	16	164	10
	April	30	692	23

Table 3.14-5 Traffic to and within the WTP Project Area				
Location	**Month**	**Recorded Number of Days**	**Number of Vehicles**	**ADT**
	May	31	1,010	33
	June	30	1,073	36
	July	23	559	24
	August	14	965	69
	September	30	623	21
	October	9	271	30
	Total/Average	**304**	**7,388**	**24**
Soldier Creek Mine- Traffic from Price/Wellington	September	30	698	23
	October	31	1,561	50
	April	16	541	34
	May	31	841	27
	June	30	266	9
	July	23	370	16
	September	30	660	22
	October	6	136	23
	Total/Average	**197**	**5,073**	**26**
Wells Draw (Gate Canyon)- Traffic from Vernal/Roosevelt	September	30	2,664	89
	October	31	2,034	66
	November	30	1,668	56
	December	13	746	57
	April	30	2,583	86
	May	15	1,348	92
	July	21	2,650	126
	August	31	1,597	52
	September	20	1,708	85
	October	5	628	125
	Total/Average	**226**	**17,626**	**78**

Source: EIS (2006f)

As shown in the **Table 3.14-5**, approximately 75 percent of all traffic to the WTP Project Area originates in Vernal/Roosevelt; approximately 25 percent originates in Price/Wellington.

Table 3.14-6 provides a breakdown of traffic during each hour at the recording stations. Approximately 80 percent of all travel within the WTP Project Area occurred during the hours of 6:00 AM to 6:00 PM. In general, traffic is distributed evenly throughout the day (no evidence of congestion during morning or evening hours/shift changes).

Table 3.14-6 Traffic within the WTP Project Area by Time of Day						
Time	Cottonwood Bridge		Gate Canyon		Soldier Creek Mine	
	Count	Percent	Count	Percent	Count	Percent
6:00-7:00 AM	201	3	830	5	132	3
7:00-8:00 AM	345	5	1,232	7	216	4
8:00-9:00 AM	432	6	1,440	8	369	7
9:00-10:00 AM	552	7	1,373	8	354	7
10:00-11:00 AM	541	7	1,239	7	327	6
11:00 AM-12:00 PM	658	9	1,100	6	367	7
12:00-1:00 PM	687	9	1,171	7	421	8
1:00-2:00 PM	712	10	1,141	6	408	8
2:00-3:00 PM	666	9	1,200	7	362	7
3:00-4:00 PM	599	8	1,222	7	380	8
4:00-5:00 PM	545	7	1,216	7	389	8
5:00-6:00 PM	374	5	987	6	262	8
6:00 PM- 6:00 AM	1,091	15	3,510	20	1,078	8
Total	**7,403**	**100**	**17,661**	**100**	**5,065**	**100**

Source: EIS (2006f)

During the second phase of the traffic study, an individual visually monitored traffic at the intersection of Gate and Nine Mile Canyons. Information collected by the visual monitor was used to extrapolate data regarding vehicle type and association. In an effort to provide a representative sample with sufficient confidence level, traffic was physically monitored for each day of the week for 2 weeks (not necessarily consecutive days of the week) during the summer and fall of 2006 (EIS 2007f).

During the observed dates, BBC had two drilling rigs and one completion rig operating in the WTP Project Area. In addition to personnel associated with normal drilling and completion activities, a BBC pipeline crew was working in the area as were additional personnel needed for startup operations on two compressors (Donato 2006a).

In general, data were collected between 6:00 AM and 6:00 PM, when traffic volumes are highest within the WTP Project Area. As feasible, the traffic monitor distinguished between vehicle type (e.g., cars, pick-ups, semis), and vehicle association (e.g., oil and gas, agriculture, recreation). **Table 3.14-7** summarizes the data collected by the visual monitor.

The following information regarding traffic within the WTP Project Area can be derived from data collected by the visual monitor, which was presented in **Table 3.14-7**.

Table 3.14-7 Traffic by Vehicle Type and Association

Week 1										
Traffic Type	**Vehicle Classification**	**Mon. 8/21/06**	**Tues. 10/10/06**	**Wed. 10/4/06**	**Thurs. 8/31/06**	**Fri. 8/4/06**	**Sat. 7/22/06**	**Sun. 10/1/06**	**Total Traffic**	**ADT**
O&G	Truck	121	76	95	31	89	37	44	**493**	**70**
	SUV	5	1	5	2	0	0	0	**13**	**2**
	Semi	66	26	79	22	51	17	51	**312**	**45**
Recreation/Other	Truck	11	4	17	4	15	25	42	**118**	**17**
	SUV	10	3	9	2	23	12	11	**70**	**10**
	Car	2	0	2	1	2	8	3	**18**	**3**
Agriculture	Truck	1	0	0	0	16	1	0	**18**	**3**
	Semi	0	4	0	0	0	0	0	**4**	**1**
	Total Vehicles	**216**	**115**	**207**	**62**	**196**	**103**	**151**	**1050**	**150**
	Percent Rec.	11	6	14	11	20	44	37	**20**	**20**
	Percent O&G	89	90	86	89	71	52	63	**78**	**78**
	Percent Semi	31	26	38	35	26	17	34	**30**	**30**
Week 2										
Traffic Type	**Vehicle Classification**	**Mon. 10/23/06**	**Tues. 11/14/06**	**Wed. 11/8/06**	**Thurs. 10/19/06**	**Fri. 10/13/06**	**Sat. 11/11/06**	**Sun. 10/15/06**	**Total Traffic**	**ADT**
O&G	Truck	108	49	51	86	72	22	40	**428**	**61**
	SUV	0	0	0	2	22	0	5	**29**	**5**
	Semi	34	35	49	45	11	19	51	**243**	**35**
Recreation/Other	Truck	24	2	7	16	72	9	14	**144**	**21**
	SUV	6	1	3	4	11	5	22	**52**	**7**
	Car	4	0	2	0	6	0	2	**14**	**2**
Agriculture	Truck	0	2	7	0	0	5	3	**17**	**2**
	Semi	0	0	0	0	10	0	0	**10**	**1**
	Total Vehicles	**177**	**90**	**119**	**155**	**203**	**60**	**142**	**946**	**135**
	Percent Rec.	19	3	10	13	44	24	27	**22**	**22**
	Percent O&G	80	93	84	86	52	68	68	**74**	**75**
	Percent Semi	19	39	41	29	10	31	36	**27**	**27**

- Oil and gas traffic constitutes approximately 75 percent of the total traffic within the WTP Project Area.
- Heavy Truck Traffic (primarily associated with oil and gas) accounts for approximately 30 percent of the total traffic within the WTP Project Area.
- During weekdays (excluding Friday), oil and gas traffic constitutes 80-90 percent of the total traffic within the WTP Project Area.
- Recreational traffic is substantially higher on the weekends (including Friday) (20-45 percent of total traffic on days observed).
- Oil and gas traffic remains relatively constant during each day of the week within the WTP Project Area.

Traffic data collected by the visual monitor show a higher volume of daily traffic within the WTP Project Area than was recorded by the traffic monitors. The higher ADT recorded by the visual monitor could indicate that not all vehicles leave the WTP Project Area every day, or that individual vehicles may travel back-and-forth along the same route multiple times once inside the WTP Project Area.

Crash statistics on Gate Canyon and Nine Mile Canyon Roads were obtained from the Duchesne County and Carbon County Sherriff's departments. Between January 1, 2000, and January 1, 2006 there were a total of three traffic accidents on these roads reported to Duchesne County Sheriff's Department (Flilingim 2006). During the same time period, 19 accidents were reported in Carbon County. In Carbon County, two accidents resulted in personal injury and the remaining 17 accidents resulted in PDO. No fatalities were reported (Stefanoff 2006).

During 2004 and 2005, BBC employees and/or contractors reported a total of 12 vehicular accidents within the WTP Project Area (Donato 2006b). Based upon these numbers, it is recognized that a high percentage of accidents are not recorded by Carbon or Duchesne County Sheriff Departments.

3.14.2.1 Nine Mile Canyon and Gate Canyon

From US 40/191 to US 6/191 Nine Mile Canyon/Gate Canyon has been designated as a BLM Backcountry Byway and as a Utah State Scenic Byway. Backcountry Byways are components of the National Scenic Byway system established by the DOT in 1991. The BLM Backcountry Byways are a system of low-standard roads that pass through areas with high archaeological, cultural, historic, natural, recreational, and scenic values. The Nine Mile Canyon Backcountry Byway is approximately 78 miles long. Approximately 25 miles are included in the WTP Project Area. For a detailed description of Backcountry Byways see **Section 3.17**, Special Designations.

The majority of non-construction related vehicle traffic in Nine Mile Canyon is associated with cultural and heritage tourism. Visitation to the area occurs year-round with peak visitation on the weekends from the spring through the fall.

Nine Mile Canyon Road

The existing road through Nine Mile Canyon is maintained by Carbon and Duchesne Counties. Surfacing, road width, and general condition along the road all vary tremendously.

Portions of the road that do not have adequate surface materials have been eroded into native material, which results in dust or mud when very dry or very wet. Vehicles traversing the area frequently have trouble maintaining control, traction, and vision because of problems associated with the road surface.

The travel corridor within Nine Mile Canyon is very narrow in sections (approximately 14 to 18 feet wide) and there are numerous blind curves. The width of the road is generally constrained by the incised channel of Nine Mile Creek, cliffs, boundary fences on private land, irrigation ditches, and cultural sites.

Finally, Nine Mile Canyon is the primary drainage in the WTP Project Area, meaning that numerous side canyon drainages intersect the road. Flash floods and debris flows across the road from side canyons may occur during inclement weather. Since the road runs along the base of steep slopes and/or cliffs, occasional rock falls have also occurred in the area.

Approximately 50 new signs were installed by Carbon County in Nine Mile Canyon in September 2006 as part of Federal aid project STP-9999(808), also known as the "Rural Run-Off Road Mitigation Program." In conjunction with signage improvements, the County has also been monitoring crashes in Nine Mile Canyon. The Carbon County Safety Coordinator, with the assistance of Carbon County GIS Department, are mapping all traffic accident sites to create a file showing hot spots that need special attention to reduce the number of crashes (Sacco 2007).

The Carbon County Commission is committed to improving the road surface in portions of Nine Mile Canyon. During 2007, roto-mill, which consists of recycled asphalt pavement, was hauled to the canyon and laid near Nine Mile Canyon Ranch, the Hammerschmidt place, Cottonwood Glen rest area, the Argyle Canyon Road intersection, and Big Sulfur Canyon. Roto-mill is laid by a grader, which places the material on the road at a predetermined width. The road is then chipped and sealed to prevent deterioration. Additional roto-mill will likely be acquired in the future (Sacco 2007).

Subsequent to the publication of the DEIS, the Nine Mile Canyon Road Cooperative Board was established. The Board is led by Carbon County, and includes the Duchesne County Commission, elected officials, and representatives of the State of Utah, BLM, industry, special interests, and civil engineers. The goal of the Board is to develop and recommend a long-term plan to improve and maintain Nine Mile Canyon Road. A Board-approved dust suppression plan, developed for BBC and other operators by contract engineers, has been included within the FEIS (see **Appendix R**). Prior to developing this plan, the engineers tested the effectiveness of alternative dust suppressants within the WTP Project Area. The results of these tests are also included within the document. Since the summer of 2008, BBC and Carbon County have been applying dust suppressants in Nine Mile Canyon between Harmon and Cottonwood Canyon as well as on segments of Cottonwood, Harmon, and Gate Canyons.

Based on concerns that use of magnesium chloride on canyon roads in the WTP Project Area could damage rock art (see **Appendix G**), both the proponent and Carbon County have agreed to discontinue use of this suppressant in Nine Mile Canyon between Harmon and Cottonwood Canyons (12 miles), in Harmon Canyon (1 mile), in Gate Canyon (1 mile) and in Cottonwood Canyon (8 miles). Magnesium chloride, which has proven to be an effective dust suppressant, may be used to contain dust on roads elsewhere within the WTP Project Area where there are no cultural sites with a rock art component.

Gate Canyon

The Wells Draw Road travels through Gate Canyon (and is often referred to as Gate Canyon Road). In general, the issues in Gate Canyon are similar to those just discussed for Nine Mile Canyon. Gate Canyon is one of the major tributaries intersecting Nine Mile Canyon. The road through the canyon parallels and frequently crosses the stream channel. Runoff from flash floods frequently damages the road at channel crossings. In addition, segments of Gate Canyon have steep gradients.

Wells Draw Road is located entirely within Duchesne County. County standards for roads include a 24-foot wide travel surface, 3-foot side ditches, a 6-inch road base, and appropriate drainage structures. As feasible, Duchesne County plans to bring the entire Wells Draw Road up to county standards. Planned improvements would be made in three phases that are expected to take approximately 3 years (Curtis 2007).

According to the County, the first phase of road improvements would target areas that are impacted by flooding and areas that contain unsafe turns. In an effort to mitigate the problems associated with flash flooding, the County will install concrete drainage dips at a number of channel crossings. BBC has informally agreed to assist with construction activities to realign sections of the Wells Draw Road where unsafe turns are located. The County and BBC are currently working on an informal agreement that would include a scope of work and a project schedule (Curtis 2007).

3.14.3 BLM System Roads

The majority of roads within the WTP Project Area are part of the BLM transportation system (see **Section 3.14.4.1**). These roads include operator maintained roads that service existing oil and gas development, and BLM maintained roads that are primarily used for recreation purposes.

The key BLM system roads providing access from Nine Mile Canyon to the West Tavaputs Plateau are Harmon Canyon Road and Cottonwood Canyon Road. Due to the rugged topography of the area and the design of the canyon roads, there are extensive drainage related problems. During wet periods, heavy vehicles cause extensive damage as they traverse saturated roads. Grading practices have done little to alleviate the drainage problems. During dry periods, roads with native surface materials create dust problems.

Table 3.14-8 provides a summary of each of the named BLM system roads within the WTP Project Area that could be used under the different development scenarios.

Following the table, there is a detailed description of the primary access roads, which includes existing use and environmental and engineering problems.

Table 3.14-8 The BLM Roads Providing Access to and within the WTP Project Area

Road Name	Total Mileage Within WTP Project Area	Road Surface
Cottonwood Canyon	12.9	Native
Cottonwood Spur	2.9	Native
Jack Ridge	3.7	Native
Dry Creek Canyon	20.4	Native
Cottonwood Ridge	10.3	Native
Jack Canyon	7.5	Native
Jack Creek	1.5	Native
Stone Cabin Gas Field	5.2	Native
Stone Cabin Canyon	3.9	Native
Cedar Ridge Gas Field	5.2	Native
Cedar Ridge Road	12.7	Native
Twin Hollow	2.8	Native
Prickly Pear Canyon	8.9	Native
Flat Iron Mesa	6.1	Native
Harmon Canyon	5.3	Native
Horse Bench	15.2	Native

3.14.3.1 Harmon Canyon Road

Harmon Canyon Road (BLM system road 6513) is located 4.2 miles west of the Gate Canyon and Nine Mile Canyon junction. This road serves as the primary access route to the western portion of the WTP Project Area including the Stone Cabin Gas Field. Considerable upgrades have been made to the road in the past to accommodate oil and gas development that has been ongoing since the 1950s. The majority of the upgrades have provided temporary solutions to drainage problems caused by a natural spring that crosses the road and the stream channel that parallels the road. In addition to drainage problems, portions of the canyon contain unstable geology. Because of the roads width, seasonal bottleneck problems occur on this route when drill rigs are moved in or out of the WTP Project Area. Bottleneck problems also frequently occur during periods of inclement weather.

3.14.3.2 Prickly Pear Canyon Road

Prickly Pear Road (BLM system road 6514) is located 3.1 miles east of the Gate Canyon and Nine Mile Canyon junction. Like Harmon Canyon, Prickly Pear Road provides access to the Stone Cabin Gas Field. Prickly Pear Road, which is visible from Nine Mile Canyon, is steeper and narrower than Harmon Canyon, but the road is still used by pick-ups to access the plateau. The road currently has excessive gradients, a narrow travel surface, and corners with limited turning radius.

3.14.3.3 Dry Canyon Road

Dry Canyon (BLM system road 6519) is located downstream of Prickly Pear Canyon and is approximately 4.8 miles from the Gate Canyon and Nine Mile Canyon junction. Dry Creek is the largest drainage in the WTP Project Area. In the lower portion of Dry Canyon, the road is in close proximity to, and at times encroaches upon Dry Creek. In the upper reaches of the canyon, the road narrows and crosses Dry Creek in several places. The road has been washed out numerous times by flash floods.

3.14.3.4 Cottonwood Canyon Road, Dugway to Flat Iron Mesa, Dugway to Peter's Point, and Cottonwood Spur

Cottonwood Canyon Road, located downstream of Dry Canyon Road, provides access to Flat Iron Mesa and Peter's Point and is currently used by drilling vehicles. The road is located 6.6 miles from the Gate Canyon and Nine Mile Canyon junction and is used by recreational vehicles to access the Hunt Panel (one of the most recognized rock art walls in the Nine Mile Canyon). Below the Hunt Panel, the road is narrow with blind corners. Above the Hunt Panel, the road is frequently flooded by Cottonwood Creek.
From the canyon bottom, Flat Iron Mesa is reached via a dugway (a road cut into a steep hillside), which has gradients of approximately 20 percent.

Peter's Point is reached via another dugway with similar gradients or via the Cottonwood Spur Road.

All roads that provide access from the canyon to the plateau have steep initial grades, narrow surfaces, and drainage issues. Seasonal bottleneck problems occur in Cottonwood Canyon, and in particular on the dugways to Flat Iron Mesa and Peter's Point, when drill rigs are moved in or out of the WTP Project Area. Because of the excessive gradients, heavy equipment is required to assist the haul trucks during rig mobilization. Bottleneck problems also frequently occur during periods of inclement weather.

Extensive modifications have been made in recent years to Cottonwood Canyon and the dugways including widening, drainage, and the creation of staging areas to accommodate industrial use.

3.14.3.5 Horse Bench Road

The Horse Bench Road (BLM system road 6552) begins 9.1 miles from the Gate Canyon and Nine Mile Canyon junction near the Peter's Point airstrip. The road was constructed by the BLM to provide access to the Naval Oil Shale Reserve #2. The jurisdiction of which was transferred from the Department of Energy (DOE) back to the BLM in 2001 through the Department of Defense Authorization Act. This infrequently traveled road is narrow (10-12 feet) along most sections and is precariously pitched and exposed on the hill slope. The Horse Bench Road has steep grades (approximately 18 percent in areas) and drainage problems. Portions of the Horse Bench Road are characterized by shallow and rocky soils. In its current condition, the road could properly be characterized as a primitive road that is only passable in a high clearance vehicle. The BLM issued itself a ROW (UTU-040133) for this road in 1978.

3.14.3.6 Jack Canyon Road

The Jack Canyon Road is accessed from Sage Brush Flat, which is located on Peter's Point Mesa. Portions of the road were constructed during 1976. The BLM issued itself a ROW (UTU-040133) for this road in 1978. The road was extended in 1981 to provide access to the Peter's Point 5-14 well, which is located in the Desolation Canyon WSA. The extended portion of the road is a BLM-authorized ROW issued prior to the establishment of the WSA. In the upper portions of the canyon, the road is located in a drainage that is steep, rocky, narrow, and prone to flooding. Once the drainage converges with Jack Creek, the road encroaches upon the stream in numerous places causing additional drainage problems. In its current condition the road is impassible by motorized vehicle.

3.14.3.7 Cedar Ridge Road

Cedar Ridge Road (BLM system road 6547) runs from the Cottonwood Ridge Road to the end of Cedar Ridge. For its entire length, the road forms the boundary of the Jack Canyon WSA. For approximately half of its length, the road also forms the boundary of the Desolation Canyon WSA. Cedar Ridge Road is approximately 12.7 miles long. As with other roads in the WTP Project Area, segments of Cedar Ridge have steep gradients, shallow soils, a narrow traveling surface, and drainage issues. In its current condition, Cedar Ridge is well maintained to the abandoned PP3 and 3A wells. Beyond the abandoned wells, the road is only passable in a high clearance vehicle and could properly be characterized as a primitive road. The BLM issued itself a ROW (UTU-040135) for this road in 1978.

3.14.3.8 Jack Ridge Road

The Jack Ridge forms the northern boundary of the Jack Canyon WSA. The road, which was likely constructed to provide access to exploratory oil and gas wells in the 1950s, receives very little use. The Jack Ridge road could appropriately be characterized as a primitive two-track road that no longer receives maintenance, and has been allowed to self-reclaim. The BLM issued itself a ROW (UTU-040133) for this road in 1978.

3.14.4 Rights of Way and Road Maintenance Responsibility

In 1980, Carbon County and the BLM entered into a MOU to clarify road construction and maintenance responsibilities on Federal lands, including those in WTP Project Area. Although the MOU expired in 1990, no new agreement has been negotiated by the respective parties. Thus, for the purposes of analysis, in this EIS, maintenance responsibilities are assumed to be consistent with those contained in the 1980 agreement. As previously discussed, it should be noted that Carbon County considers many of the roads that are being analyzed as the BLM system roads in this EIS as part of their transportation system.

It is the BLM policy to maintain BLM system roads that provide access for resource management purposes. Price Field Office personnel identify which roads require maintenance or improvement on a yearly basis.

The BLM's current policy states that ROW holders are responsible for maintaining any ROWs they are issued. Where multiple ROWs exist, ROW holders must coordinate maintenance responsibilities. **Table 3.14-9** provides a list of existing ROWs in the WTP Project Area.

<table>
<tr><th colspan="5">Table 3.14-9 Federal Rights of Way within the WTP Project Area</th></tr>
<tr><th>Permittee</th><th>Serial Number</th><th>Township and Range[1]</th><th>Sections</th><th>Acreage[1]</th></tr>
<tr><td>Duchesne County</td><td>UTU 081573</td><td>11S;15E</td><td>4,8,9,17</td><td>118.5</td></tr>
<tr><td>Duchesne County</td><td>UTU 08157309</td><td>11S;15E</td><td>33</td><td>1.73</td></tr>
<tr><td rowspan="2">Duchesne County</td><td rowspan="2">UTU 08157310</td><td>11S;15E</td><td>3,4,10,11,12</td><td rowspan="2">56.18</td></tr>
<tr><td>11S;16E</td><td>4,5,7,8</td></tr>
<tr><td rowspan="3">Duchesne County</td><td rowspan="3">UTU 08157311</td><td>11S;15E</td><td>15,17,22,23,24</td><td rowspan="3">77.58</td></tr>
<tr><td>11S;16E</td><td>15,19,20,21,22,23,24</td></tr>
<tr><td>11S;17E</td><td>19,20,21,22,23,27</td></tr>
<tr><td>EOG Resources</td><td>UTU 082250</td><td>11S;15E</td><td>03,04</td><td>12.36</td></tr>
<tr><td>Falcon Creek Resources</td><td>UTU 074594</td><td>11S;17E</td><td>8</td><td>0.58</td></tr>
<tr><td>Duchesne County</td><td>UTU 08157306</td><td>11S;17E</td><td>4,5,8,9,14,15</td><td>127.27</td></tr>
<tr><td>BLM</td><td>UTU 04133</td><td>11S;18E</td><td>27,33,34</td><td>369.6</td></tr>
<tr><td>EEX Corp.</td><td>UTU 047445</td><td>12S;14E</td><td>3,10</td><td>4.85</td></tr>
<tr><td>BBC</td><td>UTU 078823</td><td>12S;14E</td><td>3</td><td>3.24</td></tr>
<tr><td rowspan="3">BLM</td><td rowspan="3">UTU 040134</td><td>12S;15E</td><td>33,34,35</td><td rowspan="3">186</td></tr>
<tr><td>12S;16E</td><td>8,9,21,28,29,30,31</td></tr>
<tr><td>13S;15E</td><td>1,3,4,9,10,11,14,15,17,20,30</td></tr>
<tr><td rowspan="3">BBC</td><td rowspan="3">UTU 040096</td><td>12S;16E</td><td>8,9,21,28,29,31</td><td rowspan="3">70.18</td></tr>
<tr><td>13S;16E</td><td>3,4,5,6,7,8,17,18,20,22,23,27,28,29,33</td></tr>
<tr><td>13S;17E</td><td>18</td></tr>
<tr><td rowspan="3">Great Western Onshore</td><td rowspan="3">UTU 053786</td><td>12S;16E</td><td>8,9,21,28,29,31</td><td rowspan="3">50.37</td></tr>
<tr><td>13S;15E</td><td>12,13,14,23,26,27,33,34</td></tr>
<tr><td>13S;16E</td><td>6,7</td></tr>
<tr><td rowspan="5">BLM</td><td rowspan="5">UTU 040133</td><td>12S;16E</td><td>23,24,26,27,31,33,34,35,36</td><td rowspan="5">369.6</td></tr>
<tr><td>12S;17E</td><td>1,9,10,11,12,17,18,19,20</td></tr>
<tr><td>12S;18E</td><td>4,5,6</td></tr>
<tr><td>13S;15E</td><td>12,13,14,23,27,33,34</td></tr>
<tr><td>13S;16E</td><td>1,3,4,5,6,7,8,9,10,11,12</td></tr>
<tr><td rowspan="2">GNC Energy</td><td rowspan="2">UTU 054670</td><td>13S;13E</td><td>13,14,15,24</td><td rowspan="2">4.24</td></tr>
<tr><td>13S;14E</td><td>19</td></tr>
<tr><td rowspan="3">BLM</td><td rowspan="3">UTU 040135</td><td>13S;15E</td><td>35</td><td rowspan="3">1</td></tr>
<tr><td>13S;16E</td><td>7,8,13,17,18,19,20,22,23,24,27,28,29,30,31,33</td></tr>
<tr><td>13S;17E</td><td>7,18,19,20,21</td></tr>
</table>

[1]The WTP Project Area does not incorporate the entirety of every township and range listed in **Table 3.14-9**.
Source: BLM (2007b)

As shown in **Table 3.14-9**, Carbon County does not currently hold any ROWs within the WTP Project Area. However, under FLPMA, Title V ROW applications may be filed on BLM system roads by county governments. In the event a Title V ROW is granted to

Carbon County, stipulations would be attached to the ROW to ensure that roads would be maintained consistent with the specifications determined as part of a decision on the proposed development.

County roads within the WTP Project Area are classified as Class B or Class D roads. Class B roads (including approximately 25 miles in Nine Mile Canyon) are maintained by the Carbon and Duchesne Counties. Class D roads are not maintained by the county. Carbon County's Encroachment Ordinance and maintenance agreement with BBC requires maintenance to certain standards on routes that are used for oil and gas development to and within the WTP Project Area (Carbon County 2005a).

3.14.4.1 Revised Statute 2477

Revised Statute 2477 (R.S. 2477) was enacted as Section 8 of the Act of July 26, 1866, 43 U.S.C. § 932, and was repealed by Section 706(a) of FLPMA. R.S. 2477 provided: "The right of way for the construction of highways over public land, not reserved for public uses, is hereby granted." Although R.S. 2477 is no longer in effect, valid existing rights established under it prior to the October 21, 1976 enactment of FLPMA are preserved by Section 701(a) of FLPMA.

Carbon and Duchesne Counties may hold valid existing ROWs in the WTP Project Area pursuant to R.S. 2477. However, issues pertaining to R.S. 2477 are beyond the scope of this EIS, and it does not adjudicate, analyze, or otherwise determine the validity of any claimed ROW under R.S. 2477. Likewise, nothing in this EIS alters or extinguishes any valid R.S. 2477 ROW the counties may have, or their right to assert and protect R.S. 2477 rights, and to challenge in Federal court or other appropriate venue any restrictions that they believe are inconsistent with their rights.

3.14.5 Dust

Fugitive dust is an issue on many of the primary transportation corridors in the WTP Project Area. Dust, created by traffic, is most noticeable in Nine Mile Canyon and Gate Canyon, which are the primary access routes to the WTP Project Area. Baseline dust emissions in the region are discussed in detail in **Section 3.3**, Air Quality.

At the time the DEIS was published, the primary dust suppression techniques on the BLM roads within the WTP Project Area included the use of water. Based on an assumption of 10 trips with 4,200-gallon water trucks per day for 100 days per year, the average annual water use for dust suppression is currently 12.8 acre-feet/year. An additional 10 trips (with 4,200-gallon water trucks) is required when moving drilling rigs in and out of the WTP Project Area.

At current rates of development, an average of 36 wells is drilled per year resulting in an additional 6.4 acre-feet/year of water use. Therefore, the current annual water use for dust suppression is approximately 19.2 feet/year.

On county roads within the WTP Project Area (i.e., Nine Mile Canyon Road), magnesium chloride has occasionally been used in the past when drilling rigs are being moved, or when the traffic volumes are higher.

However, subsequent to the publication of the DEIS, the Nine Mile Canyon Road Cooperative Board was established. The Board is led by Carbon County, and includes the Duchesne County Commission, elected officials, and representatives of the State of Utah, BLM, industry, special interests, and civil engineers. The goal of the Board is to develop and recommend a long-term plan to improve and maintain Nine Mile Canyon Road. A Board-approved dust suppression plan, developed for BBC and other operators by contract engineers, has been included within the FEIS (see **Appendix R**). Prior to developing this plan, the engineers tested the effectiveness of alternative dust suppressants within the WTP Project Area. The results of these tests are also included within the document. Since the summer of 2008, BBC and Carbon County have been applying dust suppressants in Nine Mile Canyon between Harmon and Cottonwood Canyon as well as on segments of Cottonwood, Harmon, and Gate Canyons.

Based on concerns that use of magnesium chloride on canyon roads in the WTP Project Area could damage rock art (see **Appendix G**), both the proponent and Carbon County have agreed to discontinue use of this suppressant in Nine Mile Canyon between Harmon and Cottonwood Canyons (12 miles), in Harmon Canyon (1 mile), in Gate Canyon (1 mile) and in Cottonwood Canyon (8 miles). Magnesium chloride, which has proven to be an effective dust suppressant, may be used to contain dust on roads elsewhere within the WTP Project Area where there are no cultural sites with a rock art component.

3.15 HEALTH AND SAFETY

From the standpoint of human health and safety, the affected environment consists of rural development on private lands in Nine Mile Canyon, which are predominantly used for agriculture (cropland and grazing) as well as primarily undeveloped public lands, which are predominately used for wildlife habitat, recreation, grazing, and energy development. No communities or population centers are within the immediate vicinity of the WTP Project Area. As such, large public exposures to health and safety risks are currently limited.

3.15.1 Occupational Hazards

Health and safety concerns associated with natural gas development and production include occupational hazards resulting from construction, operation, and maintenance activities at natural gas well pads and associated facilities. Construction of well pads, pipelines, compressors, and other natural gas facilities involves the use of heavy equipment, drill rigs, welding equipment, power tools, and other machinery that inherently exposes workers to the risks of accident or injury.

3.15.2 Traffic Accidents

Trucks and other vehicle traffic using roads serving natural gas well fields create a risk of traffic accidents. As discussed in the *WTP Transportation Plan* (**Appendix F**), roads providing access to and within the WTP Project Area are predominately unpaved roads that were not constructed to accommodate industrial traffic. Few if any roads currently meet safety standards promulgated by the American Association of Safe Highways and Transportation Officials (AASHTO), UDOT, the BLM, or Carbon and Duchesne Counties.

Recent data regarding traffic and vehicles accidents in the WTP Project Area are presented in **Section 3.14**, Transportation.

3.15.3 Dust

Vehicle traffic on unpaved roads without sufficient road base is the source of dust generation in the WTP Project Area. Dust created by traffic is most noticeable in Nine Mile Canyon and Gate Canyon, which are the primary access routes to the WTP Project Area. During dry seasons, dust can limit visibility creating a potential safety hazard for drivers. Baseline dust emissions in the region are discussed in detail in **Section 3.3**, Air Quality.

3.15.4 Pipeline Hazards

Pipelines are the safest and most cost-effective means to transport natural gas; nonetheless, there are risks associated with pipelines, including leaks and ruptures. Oil and gas development has been ongoing in the WTP Project Area since the 1950s. At the time the NOI was filed for this EIS, there were approximately 71 natural gas wells (producing as well as plugged and abandoned) in the WTP Project Area. As such, there is already an extensive network of attendant pipelines (surface-laid and buried). In certain locations existing lines are located in close proximity to narrow road sections. Pipelines co-located with road are at greater risk of being damaged by heavy equipment.

3.15.5 Well Fires, Explosions, and Wildfires

Natural gas is combustible; fires or explosions at well locations, and to a lesser extent, pipeline ruptures, have been known to occur in the WTP Project Area as well as in other gas fields. In the event of a fire, set-backs exist which are designed as a buffer to prevent well fires from spreading. Nonetheless, there is a potential that well fires could spread to adjacent lands.

Wildfires are integral natural forces affecting public lands. While the majority of wildfires are caused by lightning or prescribed burns, wildfires can also be caused by human activity. Past fire suppression policies on public land did not take into account the long-term effects of suppressing wildfires. As such, Pinyon-juniper and sage brush have become dominant plant communities. These communities are more susceptible to wildfires.

The WTP Project Area is within the Bruin Point Fire Management Unit (FMU). The current policy is to contain all unplanned fires of 100 acres or less, approximately 90 percent of the time, under all burning conditions. In Nine Mile Canyon, wildfires are fought aggressively (BLM 2004b).

3.15.6 Risk of Accidental Spills

Various hazardous materials are used in the construction, operation, and maintenance of natural gas exploration and production projects, including diesel fuel and gasoline, various oils and lubricants, and cleaners. In addition, natural gas production can produce liquid hydrocarbons, or condensate, which may contain compounds deemed hazardous if spilled.

3.15.7 Hydrogen Sulfide

Hydrogen sulfide is a common by-product of natural gas production. Exposure to relatively small concentrations of hydrogen sulfide can result in death. Samples from existing wells within the WTP Project Area show that there is no hydrogen sulfide in the WTP Project Area.

3.16 VISUAL RESOURCES

3.16.1 Introduction

The visual resources of the WTP Project Area fall within a region of notable features including the Book Cliffs, Roan Cliffs, San Rafael Swell, Nine Mile Canyon, Desolation Canyon, Cleveland-Lloyd Dinosaur Quarry, and Price River Canyon.

The terrain varies dramatically throughout the region from river bottoms and flood plains at about 4,500 feet elevation to the high ridges of the Tavaputs Plateau at 9,000 feet. Numerous mesas, ridges, plateaus, canyons, and deep remote drainages intersect with the Green River. The area also contains a wide diversity of vegetation, ranging from riparian zones along the Green River and its tributaries, to pinyon-juniper woodlands; areas dominated by saltbush/sagebrush/shadscale plant communities; and high ridges and plateaus forested with aspen, spruce, and fir.

As previously discussed in **Section 3.1**, the 2008 DEIS was written and published when the Price River MFP and Diamond Mountain RMPs were the existing and approved plans for the WTP Project Area. However, land use plan revisions for both Price and Vernal have since been completed and approved. While this FEIS has been modified to discuss conformance with the Price and Vernal Approved RMPs, the VRM information in this FEIS has not been modified to include all decisions from the recently approved RMPs. Specifically, under the Approved RMP many of the VRM Class II areas within the WTP Project Area are now managed as VRM Class III. However, this section of the FEIS still includes information on the VRM Class II areas. This description of the affected environment and subsequent Chapter 4 analysis directly responds to issues and concerns about visual resources that were brought forward by the public during the public scoping period and the WTP DEIS comment period. Changing the visual resource analysis at this time would prevent the BLM from addressing public comments and concerns identified in the DEIS and scoping period.

3.16.2 General Visual Characteristics of the WTP Project Area

The majority of the descriptive information contained within this section is taken from the *Visual Resources Management and Analysis VRM Class II Areas – Technical Support Document prepared for the West Tavaputs Plateau Drilling Program Environmental Assessment* (Ellsworth and Associates 2004).

The characteristic forms within the WTP Project Area consist of a network of plateaus, ridges, and rugged canyons that divide the landscape. Bands of red rock cliffs extend along the majority of the ridges. These ridges extend downward from the plateaus, creating a layering effect that adds much visual variety and spatial definition to the WTP

Project Area. Cliffs are often broken up and of varying heights. Many boulders have cascaded down the ridges after breaking off the face, leaving the lower canyon walls peppered with scattered boulders of varying size.

Clumps of pinyon pines, junipers, and firs, intermixed with sagebrush and grasses are scattered on the upper ridges and plateaus. These plant groupings transition into sagebrush and grasses on the ridge faces that descend to the canyon floors. The canyon floors consist primarily of sagebrush, rabbitbrush, greasewood, and grasses with groupings of aspens, cottonwoods, willows, tamarisks, and associated riparian species along the various tributaries.

Given the rugged character of the terrain, many prominent lines occur repeatedly throughout the WTP Project Area, the most evident of which are the ridgelines, which form a strong silhouette against the sky. Diffuse edges where vegetative cover transitions from species to species, meandering drainages, roadways, pipelines, and fences, as well as edges where rock faces protrude from sloped areas covered with vegetation also add to the visual diversity. Many cliff faces have definitive structure evidenced through a pattern of horizontal and vertical lines created by cracks and fissures in the rock. Color of the cliff faces remains constant throughout the seasons with some variation occurring on less steeply sloped and vegetated faces.

Texture of the characteristic landscape includes rugged rock faces and exposed landforms that range from fine and medium, to coarse grain depending upon the age, makeup, and orientation of the face, as well as distance from the observer.

The viewing distances and sense of scale throughout the WTP Project Area are highly dependent upon the location of the viewer and range from longer unobstructed views from the ridge tops to limited abrupt views toward the canyon walls. Long views framed and bordered by canyon walls are the typical view associated with moving through the narrow canyon corridors. Widths of the canyons vary greatly, creating areas of various spatial proportions on the canyon floor. Some areas are narrow and constricted, with very focused and enframed views while other areas are more open with a broad view of expansive ridges.

Human influence is evidenced in the landscape as remnants of rock art and dwellings from early inhabitants, some agricultural fields in the canyon bottoms with associated residential dwellings, roads, fences, associated structures, and burned areas. There are also landscape disturbances from oil and gas development, including compressor stations, a network of pipelines and roads, and both producing and inactive wells.

The visual quality of the area is highly regarded by visitors to the area due to the high degree of scenic quality, the close distance to visual elements (especially the rock art), and heightened viewer sensitivity.

3.16.3 Visual Resource Management System

The BLM is directed to manage public lands in a manner that will protect the quality of the visual (scenic) values in accordance with Section 102(a)(8) of FLPMA. The BLM VRM system provides the BLM with a methodological approach to identify visual (scenic) values; establish objectives for managing those values through the RMP process; and provide timely input into proposed surface-disturbing projects to ensure that the assigned objectives are met or intrusions are sufficiently mitigated (**Table 3.16-1**). The BLM has applied the VRM system on the public lands under their management throughout the WTP Project Area, with the overall objective being to minimize impacts resulting from human activities. The VRM process considers the scenic quality of the landscape, the sensitivity of the viewer, and the distance from the viewer to the landscape. Based upon these characteristics, the BLM assigns a visual resources management class to the lands under their jurisdiction, the objectives are as follows:

Table 3.16-1 VRM Class Objectives

VRM Class	Objective
I	To preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.
II	To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
III	To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
IV	To provide for management activities that require major modification to the existing character of the landscape. The level of change to the characteristic landscape can be high.

Source: BLM (1986)

The existing VRM classifications for the Price Field Office are based on an inventory conducted subsequent to the publication of the Price River MFP. Changes in resource conditions include new facilities and increased visitation in viewing areas. The existing VRM classes for lands falling under the jurisdiction of the Vernal Field Office are based upon prescriptions outlined in the Diamond Mountain RMP. VRM classes within the WTP Project Area are illustrated in **Figure 3.16-1**. For a more detailed description of the Visual Resources Inventory and Management processes, see the (**Appendix L**) Results are presented for cumulative sources in combination with each inventoried alternative – *Visual Resources Technical Report*.

3.16.3.1 Visual Resources Management in the WTP Project Area

The WTP Project Area includes areas designated as VRM Class I-IV. Existing and proposed oil and gas development lie within each of these designations. **Table 3.16-2** presents a summary of the areas managed under each VRM Class.

Table 3.16-2 Acres of Land within Each VRM Class in the WTP Project Area

VRM Class	Acreage
Class I	36,367
Class II	71,362
Class III	29,764
Class IV	423

The area including the Nine Mile Canyon Backcountry byway, the lower portion of Harmon, Dry, and Cottonwood Canyons, and visible cliff faces from the byway are managed as VRM Class II. The area within the benches and upper portion of each of the side canyons are managed as VRM Class II or III. The WSAs in the WTP Project Area are managed as VRM Class I. Desolation Canyon NHL is also managed as VRM Class I (one mile on each side of the Green River from Nine Mile Canyon to Florence Creek). The area of Desolation Canyon NHL that overlaps with the Nine Mile Canyon Recreation and Cultural Resources Management Area (which is designated as VRM Class II) is managed as VRM Class I.

GIS-based viewshed analyses were run for each of the major corridors in the WTP Project Area and are displayed in **Figures 3.16-2** through **3.16-11**. The results of these analyses are discussed further in Chapter 4.

3.17 SPECIAL DESIGNATIONS

As previously discussed in **Section 3.1**, the 2008 DEIS was written and published when the Price River MFP and Diamond Mountain RMPs were the existing and approved plans for the WTP Project Area. However, land use plan revisions for both Price and Vernal have since been completed and approved. While this FEIS has been modified to discuss conformance with the Price and Vernal Approved RMPs, this EIS still includes analysis of areas the BLM considered managing as ACECs, WSRs, or natural areas that were not carried forward for management within the Approved RMPs. In addition, since the RMPs have been completed, the Green River went from an eligible to suitable WSR segment, and the Nine Mile ACEC went from a potential ACEC to a designated ACEC. An analysis of the aforementioned areas in DEIS has been retained in this FEIS for two reasons. First, inclusion of information on all potential ACECs, eligible WSRs and lands with wilderness charcteristics in this FEIS directly responds to issues and concerns brought forward during the public scoping period and DEIS comment period. Second, retaining an analysis of above mentioned areas helps provide the decision maker with the information necessary to compare and contrast the predicted effects of the Proposed Action and alternatives, and make a reasoned and informed decision regarding which alternative or combination of alternatives should be selected in the ROD.

The WTP Project Area contains many areas, which the BLM currently manages or is considering managing in the future for conservation purposes under its multiple-use mandate. These areas provide opportunities for scientific research, recreation, and a wide range of other uses. Within the WTP Project Area there is a NHL, potential WSRs, WSAs, existing and potential ACECs, and a scenic backway.

Also identified within the WTP Project Area are non-WSA lands with wilderness characteristics. Although these areas are discussed in detail in this section, they differ from other areas of special designation in that the identification of lands with wilderness characteristics is strictly administrative. Therefore, identification of lands with wilderness characteristics does not by itself, change the allowed uses of public lands.

It should be noted that within this document, the terms *non-WSA lands with wilderness characteristics*, *wilderness characteristics areas*, and *wilderness inventory areas (WIAs)* are used interchangeably. The term WIA is used within the document in its historical context to delineate a specific inventory boundary.

3.17.1 Areas of Critical Environmental Concern

An ACEC is defined in FLPMA, Public Law 94-579, Section 103(a) as an area within the public lands where special management is required to protect and prevent irreparable damage to important historic, cultural and scenic values; fish, wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. ACECs differ from other special designations, such as WSAs, in that designation by itself does not automatically prohibit or restrict other uses in the area. The management of ACECs is focused on the resource or natural hazard of concern and varies considerably from area to area. In addition, ACECs are protected by the provisions of 43 CFR 3809.1-4(b)(3), which requires an approved plan of operations for all activities under the mining laws except for casual use.

To be considered for designation as an ACEC, an area must meet the requirements of relevance and importance as described in the Code of Federal Regulations (43 CFR 1610.7.2). The definitions for relevance and importance are as follows:

Relevance: An area is considered relevant if it contains one or more of the following:

1. A significant historic, cultural, or scenic value (for example rare or sensitive archaeological resources and religious or cultural resources important to Native Americans).
2. A fish or wildlife resource (for example habitat for endangered, sensitive, or threatened species, or habitat essential for maintaining species diversity).
3. A natural process or system (for example endangered, sensitive, or threatened plant species; rare, endemic, or relict plants or plant communities; rare geologic features).
4. A natural hazard (for example areas of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action may meet the relevance criteria if it is determined through the RMP process that it has become part of the natural process.

Importance: The value, resource, system, process, or hazard described above must have substantial significance to satisfy the importance criteria. This generally means it is characterized by one or more of the following:

1. Has more than locally significant qualities which give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.
2. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
3. Has been recognized as warranting protection in order to satisfy national priority concerns or to carry out the mandates of the FLPMA.
4. Has qualities that warrant highlighting in order to satisfy public or management concerns about safety and public welfare.
5. Poses a significant threat to human life and safety or to property.

Portions of two ACECs, managed by the Vernal Field Office, fall within or in close proximity to the WTP Project Area: the Nine Mile Canyon ACEC and the Lower Green River ACEC (see **Figure 3.17-1**). Summaries of the two ACECs follow. Details regarding management of these areas can be found in the Diamond Mountain RMP.

Nine Mile Canyon ACEC (57,583 acres)

The Nine Mile Canyon ACEC, managed by the Vernal Field Office, was established to protect and enhance the cultural values and special status plant species of the canyon while enhancing its scenic and wildlife resource values (BLM 1994b). The southern boundary of the ACEC coincides with the Duchesne/Carbon County line and the ACEC extends north encompassing the majority of Nine Mile Canyon. Approximately 7,109 acres of the ACEC fall within the WTP Project Area.

Lower Green River ACEC (9,425 acres)

The Lower Green River ACEC is located to the immediate northeast of the WTP Project Area. The ACEC was established to protect and enhance the delicate riparian community adjacent to the Green River for special status fish, bird, and plant species while maintaining the Wild and Scenic qualities of the river segment.

In addition to the two existing ACECs, external nominations for additional ACECs were received as part of the scoping process for the Draft Price and Vernal RMPs (BLM 2004b; BLM 2005a). Three of the nominated ACECs, which meet the relevance and important criteria, fall within the WTP Project Area: the Nine Mile Canyon ACEC, the Desolation Canyon ACEC, and the Four Mile Wash ACEC. The following descriptions are summarized from Appendix 26 of the Draft Price RMP and Appendix G of the Draft Vernal RMP:

Potential Nine Mile Canyon ACEC (125,798 acres)

The potential Nine Mile Canyon ACEC possesses a significant and high density of historic, cultural, and archaeological zones. It is documented to contain the U.S.'s highest concentration of rock art panels, remnants of the prehistoric Fremont Culture. It also contains many relics of the Homestead and post-Civil War era, when the canyon was the site of a major freight line. Because of the vast cultural and historical resources throughout the canyon, the BLM has found the area to be eligible for NRHP. Approximately 47,263 acres of the proposed ACEC fall within the WTP Project Area, 6,915 acres of which overlap the existing Nine Mile Canyon ACEC managed by the Vernal Field Office.

The potential ACEC provides significant and high quality wildlife habitat for a variety of species and is also known for its large wild horse herd. Nine Mile Creek supports a number of fish species. Additionally, all special-status fish species that currently occur in the Green River are now suspected of moving up into Nine Mile Canyon. This potential ACEC also contains habitat for or known occurrences of several special status plant species.

The potential Nine Mile Canyon ACEC area is internationally significant for prehistoric archaeological resources, nationally significant for cultural/historic resources, regionally significant for its scenic value, and is eligible for the NRHP. The area is vulnerable to adverse change including oil and gas development, as well as OHV use that is expanding into the area.

Potential Desolation Canyon ACEC (152,089 acres)
The potential Desolation Canyon ACEC is contiguous on its northern boundary with the potential Nine Mile Canyon ACEC and Vernal Field Office's Lower Green River ACEC. Approximately 119,000 acres of the proposed ACEC lie within the Desolation Canyon WSA. The proposed ACEC also contains part of the Desolation Canyon NHL and has many sites listed on or eligible for the NRHP. Desolation Canyon meets the relevance criteria due to its scenic and cultural values and ecological systems and processes. Approximately 53,128 acres of the proposed ACEC fall within the WTP Project Area.

Desolation Canyon is Utah's deepest canyon and the viewshed is of a natural, unaltered landscape with dramatic topography, varied vegetative composition, and water features. The canyon contains a series of cultural and historic features including rock art as well as habitation and food storage sites. The landscape of the canyon itself is a historic feature. It is the least changed landscape of all the Green and Colorado River segments explored by John Wesley Powell in 1869. The canyon contains historic structures and artifacts from the homestead era, representing isolated wilderness settlement rather than Utah's typical Mormon village settlement patterns. It is also closely associated with western outlaw history.

Desolation Canyon provides habitat for a number of wildlife, plant, and fish species. The canyon is a migratory corridor for a great many birds and a nesting area for waterfowl and shorebirds. It contains terrestrial habitats that range from desert to subalpine over 5,000 feet of vertical relief. It is a wintering area for herds of elk and deer found on the Tavaputs Plateau. It is also a wintering ground for bald eagle and year round habitat for Rocky Mountain bighorn sheep. There are at least four nesting pairs of peregrine falcon in the canyon. The river is a source of water and habitat for most of the species in the region. The nominated area also includes potential habitat for numerous endangered, threatened, or sensitive species.

Potential Four Mile Wash ACEC (50,280 acres)
The northeast corner of the WTP Project Area overlaps with portions of the potential Four Mile Wash ACEC, which is being considered for designation in the Vernal RMP.

The potential Four Mile Wash ACEC is located on both the east and west sides of the Green River. This area has relevance due to its high value scenery, its riparian ecosystem, and its habitat for special status fish.

The relevant values described above are important due to their fragile, sensitive, rare, irreplaceable, exemplary, and unique qualities. This canyon and adjacent landscape provides spectacular scenery viewed by an increasing number of visitors. In addition, its riparian vegetation is rare in the surrounding desert ecosystem.

> Critical habitat for four endangered fish is located within the potential ACEC: These include the Colorado pikeminnow, Bonytail, Humpback chub, and Razorback sucker.

Should all or portions of these potential ACECs be adopted in the ROD of either the Price or Vernal RMPs, existing leases would be considered pre-existing rights, which would include the right to develop those leases. The majority of leases within the WTP Project Area fall within two Federal oil and gas units. Within these units, authorization of off-lease ROWs and other key infrastructure would be permitted as necessary to provide reasonable access and would not be subject to ACEC determinations. Outside of these units, ROWs and infrastructure would not automatically be guaranteed and would be required to undergo regular administrative measures. An ACEC designation by itself does not change the allowed uses of public lands.

3.17.2 Wilderness Study Areas

In 1964, President Johnson approved the Wilderness Act which declared the United States' policy "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness." With the passage of FLPMA in 1976, Congress directed the BLM to inventory, study, and recommend which public lands under its administration should be designated as wilderness.

Beginning in 1978, 22 million acres of BLM-administered Public Lands in Utah were inventoried to identify areas meeting the basic criteria for wilderness characteristics. Recommendations for areas to be designated as part of the National Wilderness Preservation System were made to Congress. To date, Congress has not acted on those recommendations.

With the completion of the inventory in 1980, the BLM identified a total of 3.2 million acres of public lands in 83 different areas of Utah that met the criteria to become WSAs. These areas display wilderness characteristics as described in the FLPMA and the Wilderness Act including:

- <u>Naturalness</u>. The area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.
- <u>Outstanding Opportunities</u>. The area has either outstanding opportunities for solitude, or outstanding opportunities for primitive and unconfined types of recreation.
- <u>Size</u>. The area is at least 5,000 contiguous acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition.
- <u>Supplemental Values.</u> The area may contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Management of WSAs is similar to the management of designated Wilderness Areas. Activities allowed in WSAs include hunting, fishing, travel with motorized vehicles on inventoried routes[3] (unless otherwise restricted through land use planning), camping,

[3] There are no designated vehicle routes within the Jack or Desolation Canyon WSAs, therefore motorized vehicle use is not permitted within these WSAs.

and hiking. The BLM manages WSAs under the *Interim Management Policy for Lands under Wilderness Review* (BLM 1995b). Under this directive, the BLM is required to maintain the wilderness characteristics of each WSA until a final decision is made by Congress as to whether the area should become part of the National Wilderness Preservation System (NWPS). There are six primary provisions of FLPMA with regard to “interim management” of WSAs, as follows:

- WSAs must be managed in a way that will not impair their suitability for preservation as wilderness.
- Activities that are permitted in WSAs must be temporary uses that create no new surface disturbance, and not involve permanent placement of structures.
- Grazing, mining, and mineral leasing uses that existed on October 21, 1976 (prior to FLPMA), may continue in the same manner and degree subject to the non-impairment criteria, unless this would unreasonably interfere with the rights of the lessee. When it is determined that the rights conveyed can be exercised only through activities that will impair wilderness suitability, the activities will be regulated to prevent unnecessary or undue degradation.
- Valid existing rights must be recognized.
- WSAs must be managed to prevent unnecessary or undue degradation (BLM 1995b).

Portions of two WSAs fall within the boundaries of the WTP Project Area: the Jack Canyon WSA and the Desolation Canyon WSA (see **Figure 3.17-1**). Combined, the WSAs comprise approximately 31,217 acres (23 percent) of the WTP Project Area. Approximately 5,120 acres of the WSAs are under oil and gas leases held by BBC, which constitute valid existing rights.

All leases within the Jack and Desolation Canyon WSAs are pre-FLPMA leases that fall within the Peter’s Point Federal Oil and Gas Unit (see **Figure 2.5-1**). **Table 3.17-1** shows all Federal leases that interest the Jack and Desolation Canyon WSAs.

Table 3.17-1 Leases Intersecting the Jack and Desolation Canyon Wilderness Study Areas

Lease Number	Effective Date	Lease Holder
UTU 0000683	3/1/1951	BILL BARRETT CORP
UTU 0000741	3/1/1951	BILL BARRETT CORP
UTU 0000719	3/1/1951	BILL BARRETT CORP
UTU 0000725	3/1/1951	BILL BARRETT CORP
UTU 0000685	7/1/1951	BILL BARRETT CORP
UTU 0000684	7/1/1951	BILL BARRETT CORP
UTU 0000744	3/1/1951	BILL BARRETT CORP
UTU 0000737	3/1/1951	BILL BARRETT CORP
UTU 0003333	1/1/1952	BILL BARRETT CORP
UTU 0004049	5/1/1951	BILL BARRETT CORP
UTU 0004049A	5/1/1951	BILL BARRETT CORP
UTU 0000681	7/1/1951	BILL BARRETT CORP

3.17.2.1 Jack Canyon WSA

The Jack Canyon WSA consists of a total of 7,500 acres of BLM-administered land along the West Tavaputs Plateau and includes the multi-forked canyon drainages of Pine Spring Draw and Upper Jack Creek. Approximately 7,480 acres, or 99.7 percent, of the WSA falls within the WTP Project Area boundary. The WSA is separated from Desolation Canyon WSA, to the south and east, by the Cedar Ridge road and a pipeline route across Jack Canyon. The western and northern edges of the WSA follow existing roads.

The Jack Canyon WSA was not recommended for wilderness designation in the *Utah Statewide Wilderness Study Report* (BLM 1991b). Upon review of the area, the BLM recommended that the entire area be released for uses other than wilderness. Rationale for recommending the release focused on the fact that disturbance projected as a result of oil and gas exploration and development would make it very difficult to maintain the wilderness character of the area. The WSA has proven reserves of oil and gas with about 63 percent of the study area being within the Greater Jack Canyon Known Geologic Structure. Several leases (totaling approximately 1,423 acres) are held by production, and oil and gas operations began in this area in 1952. The BLM concluded that "the oil and gas resources outweigh wilderness values for this WSA (BLM 1991b)." Despite this recommendation, the WSAs are protected under the authority of Section 603 of FLPMA and are managed according to the Interim Management Policy (IMP) and Guidelines for Lands under Wilderness Review (BLM 1991b) to preserve their wilderness values until Congress either designates them as wilderness or releases them for other uses.

The following description of the Jack Canyon WSA was taken primarily from the 1991 *Utah Statewide Wilderness Inventory Report.*

Naturalness

The 1991 *Utah Statewide Wilderness Inventory Report* concluded that 7,350 acres meet the naturalness criterion and about two percent of the WSA (150 acres) around an existing drill site access way and pipeline into the WSA from Cedar Ridge did not meet the naturalness criteria. This site, the Peter's Point 14-9 well, is an area of substantially noticeable imprint within the WSA. The site involves a drill pad, access road, and pipeline leading into the WSA from Cedar Ridge. The pipeline and road are approximately 0.75 miles long and portions were constructed alongside slopes. The drill site is a grassy opening on a bench between Cedar Ridge and Jack Creek. The site was drilled in 1981 and has since been abandoned. The pad has been reclaimed but both the pad and road are still visible for long distances from the north. Debris and pipeline from drilling operations remains on the site.

A second site in Jack Canyon, the Peter's Point 13 well, is located about 0.25 miles from the northeast WSA boundary and was drilled in 1976. The well was plugged in 1979. The 0.25 mile vehicle way to the site is no longer substantially noticeable, but the well site itself noticeably contrasts with the surrounding landscape. Some facilities are still in place and the pad area remains evident.

Three old vehicle ways extend into the WSA from the bench road on the northern boundary. An abandoned drill site, Peter's Point 4, is located along one of these ways.

The ways total 1.5 miles. They have generally revegetated, but in the areas where the ways cut through pinyon-juniper stands, the roads are still evident, as is the drill site.

Solitude

The 1991 Wilderness Inventory Report concluded that about 97 percent of the WSA (7,275 acres) meets the solitude criterion for areas under wilderness review. In about 3 percent of the WSA (225 acres), along the north and south boundaries, opportunities for solitude are less than outstanding, primarily due to offsite influences related to past and present oil and gas activity. Oil and gas imprints are quite visible from a number of locations along the northern boundary of the WSA. Vehicle use of the Cedar Ridge Road and the road in Jack Canyon occurs on a regular basis to access producing gas wells. However, the combination of distance, configuration, terrain, and vegetation provides solitude in most of the WSA.

Primitive and Unconfined Recreation

As stated in the Wilderness Inventory Report, generally, the opportunities for primitive recreation are considered outstanding throughout the entire WSA (7,500 acres) for hiking, climbing, hunting, camping, and sightseeing related to the WSA's scenic, geologic, and wildlife features.

Supplemental Values

The Jack Canyon WSA is highly scenic when viewed from the canyon bottoms. Variety throughout the WSA, including variety in vegetation, and the existence of erosional remnants and features, creeks and springs, and wildlife habitat all combine in an interesting and scenic landscape. The archaeological potential of the area is largely unknown, but significant sites are known to be present nearby, outside the WSA, in Nine Mile Canyon and Desolation Canyon.

High value wildlife habitat in the WSA includes the intermittent stream and spring riparian associations in Jack Creek and Pine Springs Draw, and cliff and talus habitats. The WSA has small populations of Rocky Mountain bighorn sheep, elk, cougar, and black bear. Sensitive avian species may occasionally visit the WSA and eight other animal species that are considered sensitive may occur in the area.

3.17.2.2 Desolation Canyon WSA

Desolation Canyon WSA includes about 290,845 acres of land along the Desolation and Gray Canyon portions of the Green River, tributary drainages from the Tavaputs Plateau to the river, and tributary drainages from Range Creek north to Rock House Canyon. Desolation Canyon WSA is the largest WSA in Utah. Approximately 24,668 acres, or 8 percent, of the WSA fall within the WTP Project Area boundary.

The Green River forms most of the eastern boundary of the WSA, except in the south in the vicinity of Gray Canyon, where the WSA includes part of the Beckwith Plateau on the west and part of the upper Book Cliffs on the east.

The 1991 *Utah Statewide Wilderness Study Report* recommended 224,850 acres of the WSA for wilderness designation with the recommendation to release 65,995 acres for uses other than wilderness. A substantial portion of the area recommended for release falls within the WTP Project Area and the Peter's Point oil and gas Unit (5,350 acres of the non-recommended portion of the WSA). These areas were recommended for release from consideration as wilderness based upon proven gas resources and the high potential for oil and gas resources. Despite this recommendation, the WSAs are protected under the authority of Section 603 of FLPMA and are managed according to the Interim Management Policy (IMP) and Guidelines for Lands under Wilderness Review (BLM 1995b) to preserve their wilderness values until Congress either designates them as wilderness or releases them for other uses.

The following description of the Desolation Canyon WSA was taken primarily from the 1991 *Utah Statewide Wilderness Inventory Report.*

Naturalness

The Wilderness Inventory Report concluded that "overall, imprints significantly affect about 1 percent (2,935 acres) of the WSA" and "the remaining 287,910 acres of the WSA meets the naturalness criterion for areas under wilderness review" (BLM 1991b). Within the WTP Project Area, since the intensive inventory in 1980, about 4.2 miles of road and five drill pads totaling approximately 6 acres were built to drill five gas well sites. A surface-laid pipeline originally connecting wells south of Jack Creek to those on Peters Point is also located within the Desolation Canyon WSA. This disturbance occurred on leases issued between 1951 and 1971. About 1.5 miles of road also extends to a drill site along Cedar Ridge, south of Jack Creek (now cherry-stemmed/excluded from the WSA). About 3 miles of abandoned road extends out of a southern fork of Cedar Ridge to an abandoned drill site. This road is also cherry-stemmed from the WSA. Some revegetation has occurred along this road.

Other surface-disturbing activities that have occurred since the BLM Wilderness Inventory include seismic lines, trail maintenance, and stream enclosures and stabilization structures on Rock Creek. These activities have not substantially affected the naturalness of the WSA as a whole and will become less noticeable in time due to natural weathering processes.

Solitude

According to the Wilderness Inventory Report, in all, about 99 percent of the WSA meets the criterion for solitude due to very rugged terrain and/or vegetative cover. In the remaining 1 percent (2,935 acres) in the drainages of Jack Creek, on Cedar Ridge, and on the east side of the Green River along existing roads, opportunities for solitude are less than outstanding. In the WTP Project Area specifically, the roads in Jack Creek and on Cedar Ridge affect opportunities for solitude as they are regularly used to check the existing well locations.

Primitive and Unconfined Recreation

The entire WSA is well-suited for a diversity of outstanding primitive recreation. Present use is primarily white-water river running, camping, hiking, fishing, swimming, and sightseeing. Based on these opportunities, the entire WSA meets the outstanding primitive recreation criterion for areas under wilderness review.

Supplemental Values

The WSA has a substantial number of important features. Elevation varies by more than 5,500 feet and types of vegetation and wildlife habitat also vary. In the north portion of the WSA, water is relatively abundant, especially for an area in the arid southwest. The extreme ruggedness of the terrain contributes to the WSA's scenic quality, remoteness, and habitat for species such as raptors and bighorn sheep. The WSA contains both canyon desert and high mountain environments.

Among the special features in Desolation Canyon is the topographical and vegetative diversity. The WSA includes a portion of Desolation Canyon NHL and seven of the known archaeological sites in the area are potential National Register sites. There are six plant species that are considered special status species that occur, or may occur, within the WSA. The diversity of wildlife is unusual compared with public lands surrounding the WSA. Six animal species listed as threatened or endangered occur, or may occur, within the WSA. The Range Creek wild horse herd is on Cedar Ridge in the WSA. Finally, the WSA has about 200 miles of perennial rivers and streams, some of which are WSR inventory segments.

3.17.3 Non-WSA Lands with Wilderness Characteristics

In 1996, due to the substantial passage of time since the BLM's original wilderness inventories in the 1980s, the DOI directed the BLM to re-inventory areas outside of WSAs to determine which possess wilderness characteristics.

In 1999, the BLM released the *1999 Utah Wilderness Inventory* (BLM 1999). Of the 3.1 million public land acres examined, 2.6 million acres of land (outside of existing WSAs) were found to have wilderness characteristics – defined as "naturalness" and possessing "opportunities for solitude and primitive and unconfined recreation." Naturalness describes areas of lands that are affected primarily by the forces of nature and where the imprint of human activity is substantially unnoticeable. If sights, sounds, and evidence of other people are rare or infrequent, isolation and seclusion provide opportunities for primitive and unconfined recreation.

The 1999 *Utah Wilderness Inventory Report*, concluded that certain areas surrounding both the Jack Canyon and Desolation Canyon WSAs did, in fact, possess wilderness values. These areas were labeled as Jack Canyon Wilderness Inventory Area (WIA) and Desolation Canyon WIA. They are also known as non-WSA lands with wilderness characteristics.

In 2007, the Utah BLM directed those Field Offices that are undergoing land use plan revisions to update non-WSA wilderness inventories so that wilderness characteristics can be fully considered in the planning efforts (see **Appendix M**). During this update, the Vernal and Price Field Offices reviewed pertinent information and changes to wilderness characteristics that may have occurred since the 1999 inventory and 2001/2002 revisions.

The identification of lands with wilderness characteristics within the Desolation Canyon and Jack Canyon areas is administrative, with no recommendations regarding designations of Wilderness Areas or the creation of new WSAs to be made. Identification of lands with wilderness characteristics does not by itself, change the allowed uses of public lands. The right to explore and develop existing oil and gas leases on lands with wilderness characteristics remains valid. There is no regulatory authority regarding management within or surrounding these areas.

Within the range of alternatives for the recent Price Field Office land use planning effort, these lands were considered and thoroughly analyzed for the protection, preservation, and maintenance of those wilderness characteristics as well as for the impacts that could occur if other resource developments and uses were allowed. The BLM did not carry either the Desolation Canyon or Jack Canyon areas forward for protection of wilderness characteristics because lands within these areas have other important resources or resource uses that would conflict with protection, preservation, and maintenance of the wilderness characteristics (Approved RMP, page 93, 2008).

3.17.3.1 Jack Canyon WIA

During the 1999 inventory, Approximately 3,660 acres of the two Jack Canyon inventory units were found to have wilderness characteristics when considered in conjunction with the contiguous Jack Canyon WSA (due to size). Most of the area was found to be natural, with vegetation and topography providing screening of the minor intrusions related to past oil and gas exploration and the cherry-stemmed road to the south. Evidence of past oil and gas exploration included old seismic lines, vehicle ways, and two reclaimed drill holes. The inventory units have outstanding opportunities for solitude and primitive and unconfined recreation when considered with the contiguous WSA. The 2002 *Price Field Office Revisions to the 1999 Utah Wilderness Inventory* added approximately 171 acres within the Jack Canyon inventory area because they were found upon further review to possess wilderness character.

The 2007 review of the Jack Canyon WIA revealed that, as of May 2007, additional gas well pads, roads and facilities have been constructed in a State land inholding in Section 2, T13S:R16E. More facilities are also planned in this area, much of which is within the Peter's Point Federal Oil and Gas Exploratory Unit within the WTP Project Area. The leases within this unit have existed since the 1950s and have been developed. Other wells have been analyzed and authorized within the Jack Canyon WIA under the *West Tavaputs Plateau Drilling Program, Carbon and Duchesne Counties, Utah* (BLM 2004c). Two existing ROWs also traverse the area (U40096 and U40133).

The presence (notwithstanding the development and maintenance) of those ROWs effectively forms a boundary splitting the WIA in two. The 1,465 acre area south of the ROWs is contiguous to the Jack Canyon WSA on the east end. A portion of the ROW (U40133) separates the WSA from the WIA for several miles on the south, along Jack Canyon Ridge, but ends on a point above the canyon. This portion retains wilderness characteristics to a large degree.

Approximately 2,000 acres north of the ROW (which is located in the bottom of a tributary north of Jack Creek) lacks wilderness characteristics because of the roads, wells, and facilities. Two roads accessing the SITLA parcel (described above) affect naturalness and the opportunities for primitive recreation and solitude. The area also no longer meets the size criteria, nor would it be manageable for wilderness values given the development that is occurring and that which is planned. Had that information been fully appreciated at the time of the 1999 inventory (and subsequent revision in January 2002) the area in question between Sagebrush Flat and the tributary of Jack Creek would not have been considered for inclusion in the WIA. The 2007 update corrects that oversight. The revised 1,465 acre Jack Canyon WIA is fully encompassed within the WTP Project Area (see **Appendix M**).

The majority of the 1,465 acre revised Jack Canyon WIA is unleased. However, portions of the area do fall within the Peter's Point Federal Oil and Gas Unit and contain pre-FLPMA leases (see **Figure 2.5-1**). **Table 3.17-1** shows all Federal leases that intersect the Jack Canyon WIA.

Table 3.17-2 Leases Intersecting the Jack Canyon Wilderness Characteristics Area

Lease Number	Effective Date	Lease Holder
UTU 0000719	3/1/1951	BILL BARRETT CORP
UTSL 0069551	11/1/1950	BILL BARRETT CORP
UTSL 0071595	2/1/1951	BILL BARRETT CORP
UTU 0000681	7/1/1951	BILL BARRETT CORP

The inventory units of the Jack Canyon WIA are quite scenic, have interesting geological features, and offer high-value wildlife habitat. A portion of the area is used by the Range Creek wild horse herd.

3.17.3.2 Desolation Canyon WIA

Approximately 204,643 acres of the Desolation Canyon WIA analyzed in the 1999 inventory were found to have wilderness characteristics. The WIA is a continuation of the many features and landforms found throughout the Desolation Canyon WSA. In combination with the WSA, the WIA represents one of the largest blocks of roadless BLM public lands within the continental United States.

Approximately 31,744 acres of the Desolation Canyon WIA fall within the WTP Project Area. Nearly all of this area appears natural. Opportunities for solitude and primitive and unconfined recreation are found within nearly all of the WIA that falls within the WTP Project Area. While there are many scattered human imprints, their individual and cumulative impact on the wilderness characteristics of the WIA is minor. Included in the human imprints are remnants of past oil and gas exploration, livestock grazing, and recreation pursuits.

In terms of oil and gas development, at the time the NOI was filed for this EIS, there were approximately 25 wells (both producing and non-producing), 12.5 miles of associated road, and 4.5 miles of pipeline in the portion of the Desolation Canyon WIA that falls within the WTP Project Area.

The 2007 team review of the Desolation Canyon WIA revealed that, as of May 2007, additional gas wells and facilities have been established throughout the West Tavaputs Plateau that are affecting this established WIA in the vicinity of Cedar Ridge, Sage Brush Flats, and Peter's Point. Generally, development is occurring within the following areas: T12 and 13S, R16 and 17E. More facilities are also planned in this area, much of which lies within the Peter's Point Federal Oil and Gas Exploratory Unit. The leases within this area have existed since the 1950s and have been developed. Other wells have been analyzed and authorized within the Desolation Canyon WIA under the *West Tavaputs Plateau Drilling Program, Carbon and Duchesne Counties, Utah* (BLM 2004c).

The exact acreage of new, expanded or upgraded pads, wells, pipelines, access roads and other facilities associated with field development within the WIA has been in flux for the past 3 years and will continue to change depending on the APDs, sundry notices and ROWs that are approved and subsequently developed. Development within the area has affected and will continue to directly affect naturalness directly for as long as the facilities remain and effective reclamation has become established. In addition to oil and gas activity, new OHV trails are being pioneered in some places where the area remains "open" to unrestricted vehicle use. Specifically, this activity has been detected in the area adjacent to the road accessing Horse Bench and Nine Mile Creek near the Carbon, Duchesne, and Uintah County lines.

The majority of the Desolation Canyon WIA that is within the WTP Project Area boundary is unleased. Areas within the Desolation Canyon WIA that have been leased include the Sage Brush Flats and Peter's Point areas. As previously mentioned, leases within these areas fall within the Peter's Point Federal Oil and Gas Unit and contain pre-FLPMA leases. In addition, portions of Horse Bench, which is located north of Desolation Canyon and south of Nine Mile Canyon, have also been leased (see **Figure 2.5-1**). All Federal leases on Horse Bench were issued in the 1980s. **Table 3.17-3** shows all Federal leases that intersect the Desolation Canyon WIA.

Table 3.17-3 Leases Intersecting the Desolation Canyon Wilderness Characteristics Area

Lease Number	Effective Date	Lease Holder
UTU 0000685	7/1/1951	BILL BARRETT CORP
UTU 0000744	3/1/1951	BILL BARRETT CORP
UTU 0000737	3/1/1951	BILL BARRETT CORP
UTU 0003333	1/1/1952	BILL BARRETT CORP
UTSL 0071595	2/1/1951	BILL BARRETT CORP
UTU 0004049	5/1/1951	BILL BARRETT CORP
UTU 0008107	11/1/1950	BILL BARRETT CORP
UTU 0000681	7/1/1951	BILL BARRETT CORP
UTU 065783	8/1/1989	BILL BARRETT CORP
UTU 062645	12/1/1987	BILL BARRETT CORP
UTU 062890	2/1/1988	BILL BARRETT CORP
UTU 0013064	8/1/1954	BILL BARRETT CORP
UTU 065782	8/1/1989	BILL BARRETT CORP
UTU 065319	5/1/1989	BILL BARRETT CORP

The Desolation Canyon inventory unit contains cultural, scenic, geologic, botanical, and wildlife values. Elevations and topography in the units vary from desert canyons to high mountain environments. Vegetation and wildlife habitats and species also vary greatly because of the diversity of terrain. Six endangered animal species occur or may occur in the units. Ten special status animal species and six special status plant species also occur of may occur in some of the units.

3.17.3.3 Fragmentation Modeling for WSAs and Non-WSA Lands with Wilderness Characteristics Areas

During the scoping process for this EIS, it was determined that the impact analyses for WSAs and non-WSA lands with wilderness characteristics could be strengthened by a fragmentation analysis. The information presented in this section provides a baseline for comparison with each of the alternatives that are being analyzed in Chapter 4. The goal of the analyses is to quantify the impacts (e.g., sight and sound) that the proposed development could potentially have on opportunities for solitude, and/or opportunities for primitive and unconfined recreation. It should be noted that impacts to size are generally considered equal to the amount of surface disturbance so long as all areas within the WSA or WIA remain contiguous. Similarly, naturalness concerns the physical appearance of the land and is usually not affected beyond the edge of disturbance.

In terms of impacts, for the purposes of analysis, it is assumed that all areas within ½-mile of existing roads and/or inventoried routes could lack opportunities for solitude and/or primitive and unconfined recreation. Of the wilderness characteristics, solitude and/or primitive and unconfined recreation are not required on every acre of the WSA or WIA as long as they are found somewhere within the study/inventory areas. Using this assumption, a GIS-based analysis was conducted to determine those areas within the Jack and Desolation Canyon WSAs and within the Jack and Desolation Canyon WIAs that are within ½-mile of existing roads (e.g., Cedar Ridge, Jack Ridge, and Jack Canyon) and/or inventoried routes.

As shown in **Table 3.17-4**, the baseline analysis shows that within the WTP Project Area, opportunities for solitude and/or primitive and unconfined recreation exist in only 4 percent of Jack Canyon WIA and 39 percent of Jack Canyon WSA. Within Desolation Canyon, these opportunities exist in approximately 60 percent of the WIA and 76 percent of the WSA.

It should be noted that this GIS-based analysis does not take into consideration variables such as existing road conditions and/or use, visual and topographical screening, or noise propagation in mountainous/canyon terrain. Therefore, opportunities for solitude and/or primitive and unconfined recreation would likely exist in isolated areas within the ½-mile buffer.

Table 3.17-4 Baseline Fragmentation within WSAs and WIAs

Name of Area	Total acres	Acres in the WTP Project Area	Within ½-mile of Existing Roads		More than ½-mile from Existing Roads	
			Acres	Percent	Acres	Percent
Jack Canyon WSA	7,500	7,480	4,572	61	2,908	39
Desolation Canyon WSA	290,845	24,668	5,853	24	18,815	76
Jack Canyon Wilderness Characteristics Area	1,465	1,465	1,437	96	28	4
Desolation Canyon Wilderness Characteristics Area	211,220	31,744	12,711	40	19,033	60

3.17.4 Wild and Scenic Rivers

The Wild and Scenic Rivers Act (Public Law 90-524) is designed to preserve free-flowing rivers with outstandingly remarkable values (ORVs) in their natural condition for the benefit of present and future generations, balancing the nation's water resource development policies with river conservation and recreational goals. The evaluation of rivers for potential designation into the National Wild and Scenic Rivers System is a three-step process: 1) determine the river's eligibility, 2) assign a tentative classification, and 3) determine suitability for final designation. Rivers can be designated into the national system by an act of Congress or by the Secretary of the Interior at the request of a State governor.

There are currently no rivers or river segments designated as WSRs within the WTP Project Area. Portions of both the Green River and Nine Mile Creek are being analyzed for suitability under the Draft Price RMP (BLM 2004b) and the Draft Vernal RMP (BLM 2005a). Valid existing rights are recognized in areas of wild and scenic classification.

Green River (Draft Price RMP)

The Draft Price RMP (BLM 2004b) analyzes setting aside the Green River from the Carbon/Duchesne County line to Canyonlands National Park as a WSR designation. The river was determined eligible for WSR designation because of its free-flowing character and outstandingly remarkable cultural, historic, recreation, scenic, geologic, and ecological values. The upper Green River, which includes Desolation and Gray Canyons, has been assigned a tentative classification of "wild." The Wild and Scenic Rivers Act (16 USC 1271-1287) defines "wild" river areas as those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted (1968, as amended). Approximately 30 miles of the upper Green River is adjacent to the eastern side of the WTP Project Area.

The following descriptions of the ORVs for the Green River were taken from the Draft Price RMP (BLM 2004b) Appendix 3:

Cultural

The upper segments of the Green River have evidence of occupation and use by prehistoric peoples. It includes rock art and other features that remain important to some Native American populations today, and also includes some of the area of study used in defining the Fremont culture. The prehistoric use represents more than one cultural period (Archaic, Fremont, and Numic). The sites have been largely isolated and retain integrity. They are important for interpreting regional prehistory. Many sites are eligible for the NRHP. For more information about the cultural resources in the area see **Section 3.12**.

Historic

Much of this river corridor is a NHL because of its recognition as the least changed of the river corridors associated with John Wesley Powell and the exploration of the Green and Colorado Rivers. Other historic values are associated with settlement, farming or ranching, mining, Prohibition, recreational river running, waterworks and reclamation. Sites have been largely isolated and therefore retain their original character.

Recreation

A trip through Desolation and Gray Canyons of the Green River, consecutive canyons within the Tavaputs Plateau, is a premier wilderness recreation experience. The 84-mile trip from Sand Wash to Swasey's Beach is world renown. There is also ample opportunity for land-based activity such as hiking in the more than 60 side canyons. For more information about recreational use associated with the Green River, see **Section 3.11.**

Scenic

At over one mile deep, Desolation Canyon is Utah's deepest canyon, cutting through the youngest exposed strata on the Colorado Plateau. Desolation and Gray Canyons consist of complexes of many canyons draining to the Green River. Outstanding scenic values are dictated primarily by the domination of geologic features. In addition to canyon walls rising thousands of feet, there are also many interesting rock formations such as arches and hoodoos. Though the landscape is mostly dry and austere, pleasing contrasts are found in the green ribbon of life along the river, and the hanging gardens and pockets of huge fir trees scattered within the cliffs. Desolation Canyon is inventoried by the BLM as being Class "A" scenic quality under the BLM's VRM system.

Geologic

The Upper Green River is an outstanding example of an antecedent river cutting through structural geology that should have been impassible to it. As the land surface rises towards the south, the Green River continues to flow to the south and decreasing in elevation despite the trend of the surrounding landscape. This results in the deepest canyon in Utah – Desolation Canyon. The corridor of the Green in this stretch also provides the region's best example of reattachment bars and separation bars formed by the processes of fluvial geomorphology in bedrock canyons.

Fish

This portion of the Green River provides habitat for four Federally-listed fish species – Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker. This river contains designated critical habitat for the pikeminnow. Spawning areas for this species have been confirmed within this river, which is also considered important for pikeminnow young.

Known populations of humpback chub and razorback sucker have been confirmed within this river, while bonytail chub is suspected to occur. This river is considered important for the recovery of these four Federally-listed species. **Section 3.10** includes more information about these fish species.

Wildlife

This portion of the Green River is considered to have remarkable value for both avian and terrestrial wildlife populations. With regard to avian species, this river corridor is regionally known for both the diversity of avian species and for supporting habitats for the Federally-listed and BLM-sensitive avian species. See **Section 3.10** for more detailed information.

The Green River segment is also important for bighorn sheep, mule deer, and elk. The entire corridor is identified as lambing habitat for the Rocky Mountain bighorn sheep and is considered important winter range for mule deer and elk (**Section 3.9**).

Ecological

The Green River hosts a variety of avian, terrestrial, and aquatic species populations. The river and its properly functioning riparian area provide a corridor of habitat through an otherwise arid region for many sensitive and Federally-listed species of birds and fish, and populations of bighorn sheep, deer, elk, black bear, mountain lion, and beaver. The corridor supports rare plant species as well. The stability of this ecosystem contributed to the designation of Desolation Canyon NHL.

Nine Mile Creek

The Draft Price (BLM 2004b) and Draft Vernal (BLM 2005a) RMPs analyze setting aside portions of Nine Mile Creek for WSR designation. Segments of Nine Mile Creek were determined to be eligible for WSR designation because of outstandingly remarkable historic, cultural, and scenic values.

Under the Draft Price RMP, the segment of Nine Mile Creek between Minnie Maud Creek and Bulls Canyon has been assigned a tentative classification of “recreational.” The Wild and Scenic Rivers Act (16 USC, 1271-1287) defines “recreational” river areas as those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past (1968, as amended). The segment between Bulls Canyon and the Green River has been assigned a tentative classification of “recreational.”

Under the Draft Vernal RMP, 13 miles of Nine Mile Creek within Duchesne County, between the Carbon County line and the confluence with Gate Canyon, is being analyzed for WSR designation. This segment was determined to be eligible for WSR designation because of outstandingly remarkable scenic and cultural values in the immediate environment. This segment of Nine Mile Creek was also assigned a tentative classification of “recreational.”

The following descriptions of the ORVs for Nine Mile Creek were taken from the Draft Price RMP (BLM 2004b) Appendix 3:

Historic

Nine Mile Creek provides one of the best examples of Non-City of Zion settlement, an unusual pattern in Utah. Values include sites associated with community development and decline; fur trade and exploration; farming or ranching; military history; communication; transportation; irrigation; and Civilian Conservation Corps. It is currently being nominated to the NRHP for both its historic and prehistoric values. See **Section 3.12** for more information.

Cultural

Nine Mile Canyon has the greatest concentration of prehistoric rock art in the world. It also has some of the most visible and best preserved remains of the Fremont Culture. Rock art and other features remain important to some Native American populations today. The prehistoric use represents more than one cultural period (Archaic, Fremont, and Numic). The sites have been somewhat isolated and retain integrity. They are important for interpreting regional prehistory. Nine Mile Canyon is eligible for the National Register and is currently being nominated for this special designation.

Scenic

Nine Mile Canyon was dedicated as a Backcountry Byway in 1990. The main visual features are the dramatic topography of high canyon walls, dissected by steep side canyons and punctuated with isolated buttes, mesas, and outcrops. A lush riparian zone of willow and cottonwood marks the canyon bottom. A series of farms and ranches provide a rural appearance to an otherwise primitive landscape. Prehistoric rock art adorn the canyon walls adding intrinsic interest to foreground views. Water features include the flowing stream and beaver ponds. This canyon is inventoried as Class “A” scenery under the BLM’s VRM system for its dramatic topography, vegetation, and water features. See **Section 3.16** for more information.

3.17.5 Backcountry Byways

The BLM Backcountry Byways are components of the National Scenic Byway system. The Scenic Byways program was established by the U.S. DOT in 1991. Backcountry Byways are a system of low-standard roads that pass through public lands with high archaeological, cultural, historic, natural, recreational, and/or scenic qualities. Designation and management can occur at local, State, or national levels.

The Nine Mile Canyon Scenic Byway is a State Scenic Byway and a BLM Backcountry Byway. It follows the length of Nine Mile Canyon from Wellington, along Soldier Creek Road, through Nine Mile Canyon along Nine Mile Canyon Road, continues to the north through Gate Canyon, and terminates at Highway 40. The total length of the byway is approximately 78 miles. Within Nine Mile Canyon is the greatest concentration of rock art sites in the United States. A spur of the byway extends to the Great Hunt Panel in Cottonwood Canyon, likely the best known of the many rock art panels in the area. Both a management plan and interpretive plan exist for Nine Mile Canyon.

3.17.6 National Landmarks

One NHL falls within the WTP Project Area. The Desolation Canyon NHL was established in 1969 as part of the centennial of John Wesley Powell’s first exploration of the Green and Colorado River systems. The NHL extends from the confluence of Nine Mile Creek to the confluence of Florence Creek, for one mile on either side of the river. Of all the rivers explored by Powell, this segment was judged to be the least changed. It is managed to provide visitors a landscape experience similar to Powell’s. Approximately 14,720 acres of the Desolation Canyon NHL are included in the WTP Project Area.

3.18 NOISE

3.18.1 Introduction

Noise is generally described as unwanted sound. Discussions of environmental noise do not focus on pure tones because commonly heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-weighted correction factors are employed. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to noise.

The ambient noise level can be defined as the cumulative effect from all noise-generating sources in the area and constitutes the normal or existing level of environmental noise at a given location. The decibel (dB) is the measurement unit commonly used to describe sound levels. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-weighted correction factors are utilized. The dBA scale is a logarithmic function that emphasizes the audio frequency-response curve audible to the human ear and thus more closely describes how one perceives sound. The dBA measurement is on a logarithmic scale. To the average human ear, the apparent increase in "loudness" doubles for every 10-dBA increase in noise. Taking a baseline noise level of 50 dBA in a daytime residential area, noise of 60 dBA would be twice as loud, 70 dBA would be four times as loud, and 80 dBA would be eight times as loud.

The propagation of noise is a function of several environmental factors that might enhance or attenuate sound propagation, the most important being the distance from the noise source, the presence or absence of terrain that may inhibit sound propagation, and the wind. The distance between a noise source and a receiver influences the perceived noise intensity. As the distance between a source and a receiver doubles, the noise intensity decreases by a factor of four. Terrain features, such as naturally occurring hills and dense vegetation, may attenuate sound propagation. Alternately, sound may be enhanced by reflection from natural features such as canyons and valleys. Sound is best propagated in the same direction the wind is blowing. Stable air conditions and calm winds between 2 and 11 miles per hour (1 and 5 meters per second) are most conducive for sound propagation.

General noise related impacts are discussed within **Section 4.18** of this EIS. Resource-specific noise-related impacts are discussed within the resource-specific analyses in Chapter 4.

3.18.2 Common Noise Levels

The following presents a discussion of noise levels common to most people in small communities and rural areas. These levels are meant to represent the average noise levels over a given period (for example, a 24-hour interval or a yearly average) in various land use areas. Depending on the location and the quantity and type of noise sources, these levels can have a large variation but generally vary in the range of 3 to 5 dBA (EPA 1974). For a comparison to a normal human activity, the noise level experienced during normal conversation of 2 people 5 feet apart is 60 dBA. **Table 3.18-1** shows examples of commonly experienced noise levels and the relative strength of the "loudness" of noise levels compared to normal conversation.

Table 3.18-1 Common Noise Levels

Noise Source	Average Noise (dBA)	"Loudness" (compared to normal conversation)	Range of Noise (dBA)
Flaring natural gas from a well	100	16	95-105
Ambulance siren at 100 feet	100	16	95-105
Motorcycle at 25 feet	90	8	85-95
On a typical construction site	85	6	80-90
Single truck passing at 25 feet	80	4	75-85
Compressor station at 50 feet	75	3	70-80
Urban shopping center	70	2	65-75
Single car passing at 25 feet	65	1.5	60-70
Average highway noise at 100 feet	60	1	55-65
Normal conversation 5 feet apart	60	1	57-63
Residential area during day	50	50%	47-53
Recreational area	45	37%	40-50
Residential area at night	40	25%	37-43
Rural area during day	40	25%	37-43
Rural area at night	35	18%	32-37
Quiet whisper	30	12%	27-33
Threshold of hearing	20	6%	17-23

% percent
Source: EPA (1974), Harris (1991)

3.18.3 Existing Noise Environment

The noise environment of the WTP Project Area is defined by the regulatory environment, background noise levels, existing noise disturbances, location of sensitive receptors, and topography.

3.18.3.1 Regulatory Environment

Neither the BLM, the State of Utah, nor Carbon, Duchesne, or Uintah Counties have established noise standards for the WTP Project Area. However, the EPA established a noise level of 55 dBA as a guideline for acceptable environmental noise (EPA 1974). This established noise level is used for a basis of evaluating noise effects when no other local, county, or State standard has been established. It is important to note that this noise level was defined by scientific consensus, was developed without concern for economic and technological feasibility, and contained a margin of safety to ensure its protective value of the public health and welfare. Furthermore, this noise level is directed at sensitive receptors (residences, schools, medical facilities, recreational areas) where people would be exposed to an average noise level over a specific period of time. Additionally, this noise level represents an average noise level (L_{eq} dBA) over a relatively extended period of time (e.g., 24 hours or less) and considers volume-related impacts only. Intermittent and short-term noise levels (e.g., a heavy truck passing a location), can also occur and can have a salient effect on human receptors. Finally, the EPA's threshold does not account for changes in ambient tones or tonal noises or repetitive low frequency noises, which may fall below the 55 dBA threshold, but may have a substantial effect on personal comfort or on other noise-sensitive receptors.

In this context, public health and welfare includes personal comfort and well-being, and the absence of mental anguish, disturbances, and annoyance as well as the absence of clinical symptoms such as hearing loss or demonstrable physiological injury. A 55 dBA noise level should not be misconstrued as a regulatory goal. Rather, the 55 dBA noise level should be recognized as a level below which there is no reason to suspect that the public health and welfare of the general population would be at risk from any of the identified effects of noise. These regulations may be applicable during construction and operation phases of the Proposed Action. These codes limit worker exposure to noise levels of 90 dB or lower over an 8-hour period (OSHA 1970).

3.18.3.2 Background Noise Levels

No background noise measurements are available specifically for the WTP Project Area. Therefore, background noise measurements for the majority of the WTP Project Area, including those areas where past oil and gas development has occurred, is assumed to be typical of EPA's "Farm in Valley" category (EPA 1971). The background noise levels for this category are 39 dBA for daytime/evening and 32 dBA during the nighttime. Noise levels reported for Glen Canyon National Recreation Area (Grasser and Moss 1992) indicated average hourly noise levels varying from 25 dBA at 7:00 am and then steadily increasing to about 45 dBA by noon and then slowly decreasing 30 dBA by 6:00 pm and lowering to 25 dBA through the rest of the evening and night. The higher noise levels during the day are attributed mostly to higher wind speeds during the day. Based on this report, it can be assumed that a night noise level in the Jack and Desolation Canyon WSAs, the Jack and Desolation Canyon WCAs, the Desolation Canyon NHL, the Green River WSR corridor, and other remote locations within the WTP Project Area would be 25 dBA and the daytime level would be 30 to 45 dBA mostly depending on wind conditions. In areas in the WTP Project Area not mentioned above, the anticipated background level of 32 to 39 dBA is an adequate estimate. It should be noted that background noise would be higher along major transportation corridors such as Nine-Mile Canyon Road.

3.18.3.3 Existing Noise Disturbances and Sensitive Receptors

Currently, oil and gas drilling and production activities represent the majority of the noise disturbances near the WTP Project Area. Noise levels are elevated near well pad and access road construction, drilling rigs, and along access roads. The main truck traffic noise occurs along Nine Mile Canyon, Gate Canyon, Harmon Canyon, and Cottonwood Canyon roads. No other significant noise sources are nearby.

The majority of the terrain consists of mesas and benches dissected by steep canyons and rock outcrops, providing a moderate level of noise attenuation. The vegetation consists mainly of sparse to moderately-dense stands of pinyon pine-juniper, with a transition to sagebrush and grasslands, allowing for moderate sound absorption and attenuation. The western extent of the WTP Project Area provides significant topographic relief. Sensitive receptors include the few residents within Nine Mile canyon, wildlife, frecreational users.

Typical noise levels have been measured for oil and gas activities. Well drilling activities, well flaring, and gas compression generally account for the most significant noise disturbances. Well drilling noise has been measured at 78 dBA at the source and 50 dBA at 1,320 feet. Well flaring noise was recorded at 98 dBA at the source and 66 dBA at 500 feet. Noise levels from on-location production facilities averaged 48 dBA at the source, and noise from compression facilities was 64 dBA at the source and 40 dBA at 1,320 feet (BLM 1999).