United States Department of the Interior
Bureau of Land Management

Environmental Assessment UT-080-08-342

Enduring Resources'
Southam Canyon Environmental Assessment

Location: Township 10 South, Range 25 East, Sections 7, 18, 19, 30, and 31; and
Township 10 South, Range 24E, Sections 13-15, 22-27, and 34-36.

Salt Lake Meridian

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1.0 - PURPOSE AND NEED

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared to analyze Enduring Resources' proposed natural gas development of the Southam Canyon Project Area (SCPA or Project Area) in Uintah County, Utah. This EA is a programmatic analysis of potential impacts that could result with the implementation of the Proposed Action or alternatives. An EA ensures compliance with the National Environmental Policy Act (NEPA) while assisting the Bureau of Land Management (BLM) in project planning and in making a determination as to whether any "significant" impacts could result from the analyzed actions. An EA also provides evidence for determining whether a statement of "Finding of No Significant Impact" (FONSI) will be prepared or whether an Environmental Impact Statement (EIS) will be required. A FONSI is a document that briefly presents the reasons why implementation of the Proposed Action or alternative will not result in "significant" environmental impacts. If the decision maker determines that this project has no "significant" impacts following the analysis in the EA, a Decision Record and FONSI would be prepared approving the selected alternative. If the project is found to have "significant" impacts, an EIS would be prepared.

1.2 BACKGROUND

Enduring Resources notified the BLM Vernal Field Office (VFO) of their intent to develop gas resources from the Wasatch Formation and Mesaverde Group in the Project Area. The BLM designated approximately 10,575 acres as the SCPA consisting of lands administered by BLM (8,813 acres), the State of Utah (162 acres), and private holdings (1,600 acres). The Project Area includes both leased and unleased areas on Federal, State, and private lands. Although the entire Project Area is analyzed in this EA, BLM standards referenced within this document would apply only to Federal lands and/or leases. Enduring Resources would contact the appropriate Surface Management Agency (SMA) to conduct operations on State, or private lands and/or leases.

The northern border of the SCPA is approximately 40 miles southeast of Vernal, Utah (**Figure 1-1**). The legal location of the Project Area is as follows within the Salt Lake Meridian:

Township 10 South, Range 25 East, Sections 7, 18, 19, 30, and 31; and Township 10 South, Range 24E, Sections 13-15, 22-27, and 34-36.

Six wells have been developed in the Project Area. Two of the existing wells are producing (one of which is operated by Enduring Resources). The remaining four wells have been abandoned. The existing wells within the SCPA are not included in the Proposed Action. Additional existing infrastructure within the SCPA includes roads, pipelines, storage tanks, and other surface facilities.

1.3 PURPOSE & NEED FOR THE PROPOSED ACTION

Enduring Resources' purpose for the proposed development is to allow the company to commercially develop their current oil and gas leases within the Project Area. National mineral leasing policies, and the regulations by which they are enforced, recognize the statutory right of leaseholders to develop mineral resources to meet continuing national needs and economic demands as long as undue environmental degradation is not incurred.

BLM's need for the project is to respond to Enduring Resources' proposal to develop their leases. The BLM is considering this proposal because the activity is an integral part of the BLM's oil and gas program under authority of the Mineral Leasing Act of 1920 (MLA), as amended; by the Federal Land Policy and Management Act of 1976 (FLPMA), as amended; and by the Federal Onshore Oil and Gas Leasing Reform Act of 1987 (FOOGLRA), as amended. Additionally, oil and gas exploration and development is recognized as an appropriate use of BLM-administered public lands in the VFO Approved Resource Management Plan (RMP) (BLM 2008e). BLM's purpose is to consider approval of the Proposed Action in a manner that avoids or reduces impact on sensitive resource values associated with the Project Area, as identified in the RMP.

1.4 CONFORMANCE WITH BLM LAND USE PLAN(S)

The management of public lands under the jurisdiction of the BLM and resources within the Project Area is directed and guided by the VFO *Record of Decision (ROD) and Approved Resource Management Plan* (BLM 2008e). The primary management objectives of the RMP for minerals and energy resources are to:

- Meet local and national non-renewable and renewable energy and other public mineral needs; and,
- Support a viable long-term mineral industry related to energy development while providing reasonable and necessary protections to other resources.

Implementation of the Proposed Action or Alternative C would respond to RMP objectives by allowing Enduring Resources to develop natural gas resources in the Project Area while minimizing or avoiding the potential effects of construction and operational activities on biotic and abiotic resources. Therefore, the Proposed Action and Alternative C would be in conformance with the RMP and ROD. Implementation of the No Action Alternative would also be in conformance with the RMP and ROD, as oil and gas development could be permitted on a case-by-case basis.

1.5 RELATIONSHIP TO STATUTES, REGULATIONS, OR OTHER PLANS

This EA was prepared by the BLM in accordance with NEPA and in compliance with all applicable regulations and laws passed subsequently, including the President's Council on Environmental Quality (CEQ) regulations, U.S. Department of Interior requirements and guidelines listed in the BLM *Manual Handbook H-1790-1* (BLM 2008a), and Utah BLM NEPA Guidebook (BLM 2004). This EA assesses the environmental effects of the Proposed Action (Alternative A) and alternatives, and also serves to document public participation and the decision-making process of this NEPA action.

The alternatives considered in this EA are also consistent with the Uintah County General Plan (Uintah County 2005). The Uintah County Plan generally indicates support for development proposals in its emphasis of multiple-use public land management practices, and its emphasis of responsible use and optimum utilization of public land resources. Within the Uintah County Plan, multiple-use is defined as including, but not limited to, the following historically and traditionally practiced resource uses: grazing, recreation, timber, mining, oil and gas development, agriculture, wildlife habitat, and water resources, as they become available or as new technology allows.

No development is proposed on Tribal lands within the Project Area and therefore, the alternatives would not be directly subject to any Tribal land use regulations or policies.

1.6 IDENTIFICATION OF ISSUES

Announcement of the Proposed Action was posted on the Environmental Notification Bulletin Board (ENBB) on September 24, 2008, which provides for notice of all BLM actions subject to NEPA occurring in each of the Utah field offices.

To support preparation of the EA, BLM staff input was utilized to help identify concerns and issues that should be addressed in the EA. All resources considered are listed in **Appendix A**

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2.0 - PROPOSED ACTION AND ALTERNATIVES

This chapter provides detailed descriptions of the three alternatives for the Southam Canyon EA. Because the three alternatives share a number of common features related to construction, operation, and reclamation activities, **Section 2.1** provides information on the details common to Alternatives A, B and C. Differences between the alternatives, or features unique to an individual alternative, are provided within the alternative-specific discussions in **Sections 2.2** through **2.4**. The alternatives are as follows:

Alternative A – Proposed Action
Alternative B – No Action
Alternative C – Vertical Drilling within the Potential Oil Shale Development Area

Section 2.5 details the applicant-committed environmental protection measures (ACEPMs) that would be implemented under all alternatives to reduce the potential environmental impacts of the proposed development activity.

2.1 DETAILS COMMON TO ALL ALTERNATIVES

Proposed wells, pipelines, and access roads for each of the alternatives are conceptually illustrated in **Figures 2-1, 2-2,** and **2-3**. Gathering pipelines would be installed on the surface within the edge of the 50-foot wide right-of-way (ROW) constructed for the proposed access roads, shown as co-located roads and pipelines. Trunk pipelines would be installed within the existing ROW adjacent to existing roads. Where possible, new roads, well pads, and pipelines would be located as near as possible to existing access roads to minimize new surface disturbance. The routes for the proposed new roads have been designed to minimize road construction impacts. Actual locations of wells, roads, and pipelines may be sited differently during the APD process, which includes site-specific consideration of environmental conditions such as wildlife and plant habitats, archaeological and paleontological sites, as well as consideration of the performance of wells initially completed.

Implementation of any of the alternatives would occur in three primary phases: drilling and construction of facilities; production and maintenance; and decommissioning and reclamation.

2.1.1 CONSTRUCTION AND DEVELOPMENT

Construction of wells, pipelines, access roads, and ancillary facilities are expected to be completed over a 10-year period (less than 10 years for the No Action Alternative). However, favorable economic conditions and evaluation of preliminary drilling results would determine the actual drilling timeframe, as well as the total number of wells drilled and the total number of pads required for construction. Construction activities on Federal lands would follow guidelines described in the "Gold Book," Surface Operating Standards for Oil and Gas Exploration and Development (BLM/FS 2007), as well as other applicable guidelines, including API 1104, "Welding of Pipelines and Related Facilities"(1999) or the latest edition. Construction activities on State and private lands would follow applicable guidelines of the appropriate SMA.

2.1.1.1 Well Pads

Prior to well pad construction or surface disturbing activities, Enduring Resources would obtain approval of an APD by the appropriate authorized officer (AO) for the lease. Each APD would

contain site-specific Conditions of Approval (COAs) that would apply to construction and well operations.

Well pad construction would consist of roughing in an access road to the well pad location and then leveling a roughly rectangular pad by balancing cut and fill areas. Well pads would be constructed from the native sand/soil/rock materials present. A small reserve pit (150 feet x 75 feet x 12 feet deep, occupying approximately 0.25 acre) would be excavated on each pad. All reserve pits would be constructed on the uphill side of the pad (in cut material) and would be fenced "sheep tight" on three sides prior to drilling activity and closed off on the fourth side after drilling is finished. The reserve pit would be designed to prevent the collection of surface runoff and would be constructed with a minimum of one half of the total reserve pit in cut. The appropriate SMA would determine on a case-by-case basis if unlined pits are acceptable, or if site-specific conditions indicate that a synthetic liner in the fluid reserve pit is required.

Stockpiles for both topsoil and subsoil would be established and maintained for future use in backfilling the reserve pit and rehabilitating the location upon abandonment. Depending on the amount of cut and fill required to level each site, these stockpiles would occupy approximately 0.5 acre.

Single well pads are expected to occupy approximately 4.0 acres initially to accommodate drill rigs and equipment. Well pads on which multiple wells would be sited are expected to occupy approximately 5.0 acres initially to accommodate drill rigs and equipment. Since the alternatives contain a combination of both single and multiple well pads, for disturbance calculation purposes, average well pad size is estimated to be 4.5 acres.

2.1.1.2 Access Roads

Under all alternatives, existing roadways would be used where possible and new roads would be constructed where needed. The approximately 22 miles of existing roads within the SCPA would provide the primary trunk roads for access to the new well pads. Conceptual access routes to the proposed well pads are depicted on **Figures 2-1, 2-2**, and **2-3**. Exact locations of access roads would be determined by the appropriate SMA at the time of the onsite inspection. Proposed roads are expected to cross Federal, State, and private surfaces. Prior to any construction, improvement, or maintenance on County-authorized ROWs, Enduring Resources would coordinate with the Uintah County Roads Department to determine County requirements.

Construction of proposed roads on BLM surface would conform to standards outlined in "The Gold Book" (BLM/FS 2007). All construction materials for the proposed access roads would consist of native borrow and soil accumulated during road construction. New access roads on Federal surface would be crowned (2 to 3 percent), ditched, and constructed with a running surface of approximately 18 feet. Although the running surface of the new roads would be 18 feet, initial surface disturbance calculations are based upon a 50 foot wide corridor (the width of a typical road ROW). Co-located pipelines would lie along the surface at the edge of the road ROW.

Graveling or capping the roadbed may be performed as necessary to provide a well constructed, safe road. Prior to construction or upgrading, the proposed road ROW would be cleared of any snow and allowed to dry completely.

All new access roads would be constructed with appropriate drainage and erosion control features, and structures to include cut-and-fill slope and drainage stabilization, relief and drainage

culverts, water bars, and wing ditches similar to those described in the "Gold Book" (BLM/FS 2007). Access roads would be constructed using standard equipment and techniques. Bulldozers and/or road graders would first clear vegetation and topsoil from the ROW. These materials may be windrowed for future redistribution during the reclamation process. Surface disturbance and vehicular use would be limited to the approved ROW.

2.1.1.3 Pipelines

Steel pipe gathering lines with a 4- to 6-inch outside diameter (OD) would be installed on the surface to transport the produced gas from the wells to larger lateral (or trunk) lines. Conceptual pipeline routes are depicted on **Figures 2-1, 2-2** and **2-3**. Exact location of pipelines would be determined at the time of the onsite inspection with the appropriate SMA. Proposed pipelines are expected to cross Federal, State, and private surface.

All proposed pipelines would be laid on the surface with the exception of burial at road crossings in order to provide and maintain access routes. All of the proposed pipelines are expected to be installed parallel to the proposed and existing access roads within the 50-foot ROW. For co-located roads and pipelines, a total initial width of 50 feet was used to calculate disturbance. For pipelines installed along existing roads, an initial 10-foot wide disturbance buffer was used. Removal of vegetation would be kept to a minimum.

2.1.1.4 Compression

Under each alternative, in order accommodate the increased production expected to occur, a 1,500-horsepower (hp) compressor station would be constructed in Section 36 of T10S R25E. The compressor station would require approximately 4 acres of surface disturbance and would consist of a compressor, central glycol dehydrator, meter run, and 300-barrel stock tanks to collect produced water and condensate that would be removed from the gas stream.

2.1.1.5 Well Drilling

Drilling operations would be conducted in compliance with all Federal Oil and Gas Onshore Orders, all State of Utah Division of Oil, Gas, and Mining (UDOGM) rules and regulations, and all applicable local rules and regulations. Enduring Resources estimates that each well will require an average of approximately 20 days to drill.

The drilling operation would be conducted in two phases. The first phase would utilize a surface-hole rig and an air mist system to drill to a depth of approximately 2,000 feet. During the second phase, a larger rotary drilling rig with conventional mud system would be mobilized to drill the remainder of the hole to a total depth of between 8,000 and 9,000 feet. The larger rig would pump fresh water as a circulating fluid to drive the mud motor, cool the drill bit, and remove cuttings from the wellbore. Prior to drilling below the surface casing, a Blowout Preventer (BOP) would be installed on the surface casing and both the BOP and surface casing would be tested for pressure integrity. The BOP and related equipment would meet the minimum requirements of Onshore Oil and Gas Order No. 2.

Drill cuttings from the wellbore (mainly shale, sand, and miscellaneous rock minerals) and drilling fluids carried over with the cuttings would be held in the reserve pit. No chemicals subject to reporting under SARA Title III in an amount equal to or greater than 10,000 pounds would be used, produced, stored, transported, or disposed of annually in association with the

drilling, testing, or completion activities. No hazardous substances subject to reporting under SARA Title III or 40 CFR 355 would be placed in this pit.

Upon drilling the hole to the total depth, a series of data-logging tools would be run in the well to evaluate the potential hydrocarbon resource. If the evaluation concludes that adequate hydrocarbon resources are present and recoverable, then steel production casing would be run and cemented in place in accordance with the well design, as approved in the APD, and any applicable COAs. The types of casing used, and the depths to which they are set, would depend upon the physical characteristics of the formations that are drilled. The casing and cementing program would be designed to isolate and protect the various formations encountered in the wellbore, and to prohibit pressure communication or fluid migration between zones.

2.1.1.6 Completion Operations

Once production casing has been cemented in place, the drilling rig would be released and a completion rig would be moved in. Enduring Resources estimates that an average of approximately 10 days would be required to complete an individual well.

Well completion consists of running a cement bond log to evaluate the cementing integrity, correlating (on depth) the cased hole logs to the open hole logs, perforating the casing across the hydrocarbon producing zones, and initiating a stimulation treatment of the formation to enhance its transmissibility of oil and gas. The typical stimulation used in the area is a hydraulic fracture treatment of the reservoir, wherein freshwater/sand slurry is pumped into the producing formation with sufficient hydraulic horsepower to fracture the rock formation. The sand serves as a proppant to keep the created fracture open, thereby allowing reservoir fluids to move more readily into the well.

2.1.2 OPERATIONS AND MAINTENANCE

Each completed well pad would contain one or more wellheads, three-phase separators with a 0.5 million British thermal unit per hour (MMBtu/hr) boilers, 300-barrel condensate tanks, 300-barrel water tanks, glycol dehydration units, and a meter house. Produced water and condensate would be stored in the tanks and periodically transported by tanker trucks to commercial points outside the SCPA. Produced gas would be transported from the SCPA (through the compressor station) via the Archy Bench/Evacuation Creek Pipeline east of the Project Area.

2.1.2.1 Project Area Maintenance

Trash containers and portable toilets would be located on construction sites during well pad and pipeline installation. Toilet holding tanks would be regularly pumped and their contents disposed of at Vernal, Utah's municipal sewage facility in accordance with applicable rules and regulations regarding sewage treatment and disposal. Accumulated trash and nonflammable waste materials would be hauled to the Uintah County landfill once a week or as often as necessary. All debris and waste materials not contained in the trash containers would be cleaned up, removed from the SCPA, and disposed of at the Uintah County landfill. Cleanup would occur everyday.

2.1.2.2 Water Requirements

Water needed for the drilling and completion of each well would be obtained from the White River (Permit # 49-2279[T77865]) or from other permitted water sources to be determined as necessary. Water would be trucked from the well to drilling locations. Specific details regarding

water use are addressed in the alternative specific discussions in **Sections 2.2** through **2.4**. For the purposes of analysis, all water use would be considered to be diversionary.

2.1.3 DECOMMISSIONING AND RECLAMATION

2.1.3.1 Interim Reclamation

Following completion activities, Enduring Resources would reduce the size of each well pad to the minimum surface area needed for production facilities, while providing for adequate safety measures, and would reshape and stabilize cut and fill slopes to mimic the original topography. Reserve pits would be reclaimed within 360 days after initial production on State or private land (per UDOGM regulations), and within 90 days or as soon as practicable on BLM-administered lands (per Onshore Order #7). On BLM-administered lands, pits may be reused if additional wells are drilled from the same well pad within a one-year timeframe. The subsoil and liner (if used) would be pushed back into the pit, and the topsoil would be respread and reseeded. Enduring Resources would reduce the pad size for single wells to approximately 3 acres. The reduced well pad size for multiple well locations would vary depending on the number of wells on each pad, but would average 4 acres. Since the alternatives include a combination of single and multiple well pads, an average of 3.5 acres was used for calculating disturbance. Roads would be reclaimed to a 24-foot corridor (an 18 foot running surface and 3 feet on either side of the road for drainage ditches). All disturbed areas not necessary for drilling and production operations would undergo the following reclamation standards after completing dirt work and operations.

Portions of well pads and ROWs not utilized for the operational phase of the project would be reseeded using seed mixtures determined by the appropriate SMA. Post-construction seeding applications and reclamation practices would continue as needed, until such time as written approval is received from the SMA. Given the history of reclamation efforts in the area, some locations would require special reclamation practices such as hydromulching, straw mat application on steeper slopes, fertilizing, and soil analysis to determine the need for fertilizer, seed-bed preparation, contour furrowing, watering, terracing, water barring, and the replacement of topsoil.

2.1.3.2 Well Abandonment and Final Reclamation

While the life span of individual wells may vary, the typical life span is estimated to be approximately 20 to 30 years. Abandonment of a well and its facilities would be performed in compliance with all applicable regulations. All hydrocarbons and water-bearing horizons in an abandoned well bore would be isolated via cement plugs. At the time of final abandonment, all aboveground facilities, including pipelines, would be removed and abandoned well pads, roads, and other disturbed areas would be reclaimed.

Final reclamation includes reestablishing soil conditions and revegetating disturbed areas to the specifications of the SMA at the time of abandonment. All disturbed surfaces would be re-contoured to the approximate natural contours, with reclamation of the well pad and access road performed as soon as practical after final abandonment. Re-seeding would be performed in the fall following completion of the reclamation operations, after August 9th and before the ground freezes, or in the spring. Reclamation practices would continue as needed, until determined successful by the appropriate SMA.

2.2 ALTERNATIVE A – PROPOSED ACTION

Under the Proposed Action, Enduring Resources anticipates constructing approximately 152 well pads from which up to 249 wells would be drilled. Of the planned well pads, 89 are expected to support a single vertically drilled well. The remaining 63 well pads would support up to 4 wells. As planned, directionally drilled wells represent approximately 49 percent (122 wells) of the total new wells proposed. The actual number of directionally drilled wells would depend upon the feasibility of directional wells providing for the optimum recovery of natural gas reserves from the SCPA. The majority of the proposed wells would be drilled on 40-acre downhole spacing. Conceptual well locations under the Proposed Action are illustrated in **Figure 2-1**.

In addition to new wells and well pads, the Proposed Action requires the construction of the following primary components:

- Approximately 36 miles of new access roads or upgraded two-tracks;
- Approximately 47 miles of pipeline
- One compressor station (with a 1,500 horsepower gas-fired compressor engine) and, at each well pad the installation of a three-phase separator with a heater, a glycol dehydration unit, and two 300-barrel tanks (one for water and the other for condensate).

Approximately 25 wells per year would be drilled for a maximum of 10 years under the Proposed Action. Typically, water use for drilling and completion would be approximately 0.75 acre-feet (7,758 barrels) per well. Resulting annual water use would be approximately 18.75 acre-feet per year. The 10-year development use would be approximately 187.50 acre-feet. In addition, approximately 0.1 acre-feet (775 barrels) of water per well pad per year would be utilized for dust abatement, or a maximum of 15.2 acre-feet per year. Total estimated water use during the 10-year development period would be approximately 339.50 acre-feet.

At full development, about three pumpers would be employed to check and maintain facilities on a daily basis. An average of five trucks per day would be needed to haul produced water and condensate from the Project Area.

Under the Proposed Action, construction of the proposed well pads, roads, and pipelines would result in an initial disturbance of approximately 858 acres[1]. Disturbance would consist of direct removal of vegetation from grading of the proposed roads, well pads, and other project facilities.

Initial surface disturbance estimates from the Proposed Action are summarized in **Table 2-1**. Initial disturbances are those that would last the 1 to 5 years it generally takes for vegetation to be re-established during normal precipitation in the Uinta Basin (BLM 2006a). Under drought conditions, which are common in the Uinta Basin, revegetation efforts can take a longer time. For that reason, all disturbance calculations referenced throughout this document refer to initial disturbance only.

[1] Surface disturbance calculations are based on conceptual well pad, compressor station, road, and pipeline locations as presented in **Figure 2-1**. Actual surface disturbance may vary based on site-specific analysis through the APD process.

Table 2-1. Alternative A - Initial Surface Disturbance in the SCPA

Design Element	Initial Disturbance (acres)
Well Pads	684
Compressor Station	4
Surface Pipeline (along existing roads)	13
Co-located Roads and Pipeline	218
Total	**858***

* The total disturbance for Alternative A used throughout this document is 858 acres. This total is the result of GIS analysis which eliminates areas of overlapping surface disturbance from individual development components (or approximately 61 acres).

2.3 ALTERNATIVE B – NO ACTION

Under the No Action Alternative, no drilling would be permitted on Federal leases. Drilling and production would continue to occur on State of Utah and private leases. Surface land use would be controlled by State agencies and/or the landowner. Rights-of-way for roads and pipelines would be granted across Federal lands to access the leases on the State and private lands.

The No Action Alternative provides for four well pads on State of Utah leases and 20 on private leases, which would accommodate 36 wells. As planned, directionally drilled wells represent approximately 47 percent (17 wells) of the total new wells proposed. The actual number of directionally drilled wells, however, would depend upon the feasibility of directional wells providing for the optimum recovery of natural gas reserves from the Project Area.

In addition to new wells and well pads, the No Action Alternative requires the construction of the following primary components:

- Approximately 12 miles of new access roads or upgraded two-tracks;
- Approximately 17 miles of pipeline;
- One compressor station (with a 1,500 horsepower gas-fired compressor engine) and, at each well pad the installation a three-phase separator with a heater, a glycol dehydration unit, and two 300-barrel tanks (one for water and the other for condensate).

Wells would be drilled at a variable rate per year for a maximum of 5 years. Typically, water use for drilling and completion would be approximately 0.75 acre-feet (7,758 barrels) per well. Annual water usage would vary depending upon the total wells drilled per year. In addition to water for drilling and completion activities, approximately 0.1 acre-feet (775 barrels) of water per well pad would be utilized for dust abatement each year for a maximum of 2.4 acre-feet of water per year. Total water usage for the 5-year development period is expected to be 29.4 acre-feet.

The total expected initial disturbance for the No Action Alternative as described would be approximately 181 acres. **Table 2-2** shows the approximate initial disturbance from the No Action Alternative. The conceptual locations of facilities are shown on **Figure 2-2**.

Table 2-2. Alternative B - Initial Surface Disturbance in the SCPA

Design Element	Initial Disturbance (acres)
Well Pads	108
Compressor Station	4
Surface Pipeline (along existing roads)	1
Co-located Roads and Pipeline	73
Total	**181***

* The total disturbance for Alternative A used throughout this document is 181 acres. This total is the result of GIS analysis which eliminates areas of overlapping surface disturbance from individual development components (or approximately 5 acres).

2.4 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Within the Project Area, the Oil shale Exploration company (OSEC) holds an existing Research, Development and Demonstration (RD&D) lease on 160 acres of public land (**Figure 2-3)**, OSEC is currently conducting the RD&D project at the existing White River mine site. If the RD&D project proves to be productive, OSEC has a preferential right to commercially lease all or portions of an oil shale development preferential lease area (4,960 acres) within the SCPA (**Figure 2-3**). There is the potential, therefore, that oil shale development and traditional drilling operations for oil and gas could occur simultaneously in the majority of the Project Area in the future. In order to maximize future development needs and minimize risk, Alternative C proposes no drilling within the RD&D area and vertical drilling of wells (at 40-acre surface spacing) within the preferential lease area. The wells would be located on the ground in a manner to facilitate predictability during mining of the preferential oil shale lease area.

Alternative C provides for 196 well pads on, which will accommodate 240 wells. As planned, directionally drilled wells represent approximately 25 percent (59 wells) of the total new wells proposed. The actual number of directionally drilled wells, however, would depend upon the feasibility of directional wells providing for the optimum recovery of natural gas reserves from the Project Area.

In addition to new wells and well pads, Alternative C requires the construction of the following primary components:

- Approximately 50 miles of new access roads or upgraded two-tracks;
- Approximately 61 miles of pipeline;
- One compressor station (with a 1,500 horsepower gas-fired compressor engine) and, at each well pad the installation a three-phase separator with a heater, a glycol dehydration unit, and two 300-barrel tanks (one for water and the other for condensate).

Wells would be drilled at a variable rate per year for a maximum of 10 years. Typically, water use for drilling and completion would be approximately 0.75 acre-feet (7,758 barrels) per well. Annual water usage would vary depending upon the total wells drilled per year. In addition to water for drilling and completion activities, approximately 0.1 acre-feet (775 barrels) of water per well pad would be utilized for dust abatement each year for a maximum of 19.6 acre-feet of water per year. Total water usage for the 10-year development period is expected to be 376 acre-feet.

Initial surface disturbance estimates from Alternative C are summarized in **Table 2-3.** Initial disturbances are those that would last the 1 to 5 years it generally takes for vegetation to be re-established during normal precipitation in the Uinta Basin (BLM 2006a). Under drought conditions, which are common in the Basin, revegetation efforts can take a longer time. For that reason, all disturbance calculations referenced throughout this document refer to initial disturbance only.

Table 2-3. Alternative C - Initial Surface Disturbance in the SCPA

Design Element	Initial Disturbance (acres)
Well Pads	882
Compressor Station	4
Surface Pipeline (along existing roads)	13
Co-located Roads and Pipeline	305
Total	**1117***

* The total disturbance for Alternative A used throughout this document is 1,117 acres. This total is the result of GIS analysis which eliminates areas of overlapping surface disturbance from individual development components (or approximately 87 acres).

2.5 APPLICANT-COMMITTED ENVIRONMENTAL PROTECTION MEASURES

Enduring would adhere to 1) all COAs and stipulations associated with their existing leases; 2) restrictions set out in the Vernal ROD and Approved RMP (BLM 2008e), as applicable; 3) guidelines developed by BLM and USFWS for oil and gas operations; and 4) other statutory or regulatory requirements. In addition to required mitigation measures, several procedures are described below that would be implemented under all alternatives to reduce the potential environmental impacts of the proposed development activity. These ACEPMs are based upon the guidelines developed by BLM for oil and gas operations.

In addition to these ACEPMs, the BLM on-site inspection for each new well pad may identify specific resources that may be affected on a particular location. The on-site inspection would be used to determine which of the below measures would be necessary on a site-specific basis to avoid or reduce impacts.

2.5.1 CULTURAL RESOURCES

A Class III cultural resources survey, conducted by a BLM-approved archaeologist and funded by Enduring Resources, would be conducted on all areas proposed for surface disturbance. Class III cultural resource block surveys have been conducted in portions of the proposed development area and would be utilized where applicable. If these surveys identify areas with a high probability of encountering potentially significant subsurface archaeological sites, a qualified archaeologist would monitor surface disturbance.

Enduring Resources and their contractors would inform their employees about relevant Federal regulations intended to protect cultural resources. Equipment operators would be informed that if a site is uncovered during construction, activities in the vicinity would immediately cease and the BLM Authorized Officer (AO) would be notified. Historic properties considered eligible for the

National Register of Historic Places (NRHP) would be avoided or mitigated through an approved data recovery plan.

2.5.2 PALEONTOLOGICAL RESOURCES

Based on site-specific recommendations from the BLM AO, surveys for paleontological resources would be conducted on areas with sandstone outcrops and where excavations into sensitive formations may be needed for road, well pad, or pipeline construction.

The survey would be conducted by a BLM-approved paleontologist funded by Enduring Resources and would determine fossil localities and the sensitivity of the area for fossil resources. These actions would determine the necessity of having a qualified paleontologist on-site during construction. If paleontological resources were uncovered during ground-disturbing activities, Enduring Resources would suspend all operations that would further disturb such materials and would immediately contact the BLM AO, who would arrange for a determination of significance and, if necessary, recommend a recovery or avoidance plan.

2.5.3 WILDLIFE AND FISHERIES

On BLM land, raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved biologist would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within the species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e).

No construction or surface-disturbing activities would occur within ½-mile of a bald eagle roost site from November 1 through March 31. Temporary actions may occur within this ½-mile buffer outside of this seasonal restriction. If temporary actions must occur within the seasonal restriction, a qualified biologist approved by the appropriate SMA would monitor all project activities within ½-mile of known bald eagle roosts. Enduring Resources' work-related activities would be allowed to occur between 9:00 AM (typically after a bald eagle leaves a roost site for the day) and 5:00 PM (typically before a bald eagle returns to the roost site for the evening). Daytime restrictions may vary depending on the biologist's evaluation of when the eagle is at the roost.

Netting or bird balls would be utilized on open reserve pits as directed by the AO.

To minimize wildlife mortality due to vehicle collisions, Enduring Resources would advise project personnel regarding appropriate speed limits in the SCPA. The Utah Division of Wildlife Resources (UDWR) would be contacted regarding the presence of carrion within or along roadways.

2.5.4 VEGETATION

A pre-project weed inventory of areas proposed for disturbance (e.g., well pads, ROWs, etc.) would be conducted prior to beginning ground-disturbing activities. Inventory data would be

collected using BLM VFO-designed data collection sheets and data elements. Equipment and vehicles entering the Project Area from outside the Uinta Basin would be power washed to remove seeds and plant material.

Enduring Resources would monitor and control noxious and invasive weeds along access road use authorizations, pipeline route authorizations, well pads, or other applicable facilities by spraying or mechanical removal, as approved by the appropriate SMA.

In accordance with the VFO Approved RMP (BLM 2008e), equipment and vehicles entering the Project Area from outside the Uinta Basin would be power washed to remove seeds and plant material. Additionally, on BLM administered land, a Pesticide Use Proposal would be submitted and approved prior to the application of herbicides, pesticides, or other hazardous chemicals.

2.5.5 RECLAMATION

Interim and final reclamation actions would occur on all disturbed areas. These actions are described in detail in the Reclamation Plan (**Appendix B**).

2.5.6 EROSION PROTECTION

Well pads and other project facilities would be constructed to minimize the overland flow of water and sediment leaving the facilities. Erosion protection and silt retention would be provided by the construction of structural and non-structural controls (e.g., silt catchment dams, riprap, bales, and heavy vegetation) where needed and where feasible.

The operators would prepare a Storm Water Management Plan.

In accordance with the VFO Approved RMP (BLM 2008e), if surface-disturbing activities cannot be avoided on slopes from 21-40 percent, a plan would be required and would include an erosion control strategy, GIS modeling, and proper survey and design by a certified engineer.

2.5.7 EXISTING FACILITIES AND RIGHTS-OF-WAY

Cattle guards would be used for fence crossings whenever practicable. If a fence must be cut, H-braces would be installed to support the existing fence and a cattle guard installed to prevent livestock movement.

2.5.8 WETLANDS/RIPARIAN ZONES/FLOODPLAINS

In accordance with the Vernal RMP (BLM 2008e), no new surface-disturbing activities would be allowed within active floodplains, wetlands, public water reserves, or within 100 meters of riparian areas. An exception could be authorized if:

- There are no practical alternatives,
- Impacts could be fully mitigated, or
- The action is designed to enhance the riparian resources.

If an exception is authorized, all well pads located within or immediately adjacent to 100-year floodplains would feature a closed-loop system. The need for closed-loop systems at individual

well pads would be determined by the AO during the onsite process. No well pads will be located within the active channel.

Pipelines within floodplains would be buried to a depth of 15 feet or a scouring analysis would be performed to determine the proper depth of burial to prevent pipeline exposure in the event of a flood.

2.5.9 LIVESTOCK GRAZING

Enduring Resources would repair or replace any fences, cattleguards, gates, drift fences, and natural barriers that are damaged due to project-related activities. Cattleguards or gates would be installed for livestock control on road ROWs when fences are crossed and these structures would be maintained by Enduring for the life of the project.

2.5.10 ROAD USAGE MONITORING

Enduring Resources would meet with the BLM and other appropriate surface owners and government agencies once every 5 years to review usage of existing access roads inside the SCPA. If it is determined by all that a certain access road is no longer used or needed, Enduring Resources would reseed the road and return it to its native condition.

2.5.11 ROAD MAINTENANCE

Enduring Resources would maintain new access roads leading to their facilities inside the SCPA. Access roads are the short spur access roads from the established trunk road network to the well pads.

2.5.12 MULTIPLE MINERAL DEVELOPMENT

Enduring would coordinate with OSEC to minimize subsurface conflict within OSEC's RD&D area.

2.5.13 VISUAL RESOURCES

All operating equipment would be painted a flat non-reflective color that is compatible with the surrounding landscape as specified by the BLM.

3.0 - AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter presents the potentially affected environment (i.e., the physical, biological, social, and economic values and resources) of the SCPA, and provides the baseline for comparison of impacts/consequences described in **Chapter 4**.

The SCPA is located about 40 miles south of Vernal, Utah in the eastern half of the Uinta Basin. The Project Area is characterized by low rolling hills, incised canyons, and rock outcrops representative of the high desert plains. A segment of the White River flows through the northwestern corner of the Project Area and is intersected by Evacuation Creek which effectively bisects the SCPA. The vegetation in the Project Area is typical of the arid to semi-arid Uinta Basin floristic region, where precipitation and soil parent material are controlling factors for plant composition. Vegetation often appears sparse, especially on badland areas. Elevations within the SCPA average approximately 5,403 feet amsl.

Resources considered in this EA include the environmental elements (listed in **Appendix A**), as well as other resources/issues of concern raised by the BLM and the public. The resources that are analyzed in detail in this chapter include Geology, Paleontology, Air Quality, Cultural Resources, Soils, Water Resources (including Floodplains), Vegetation (including Special Status Plant Species & Invasive, Non-native Weeds), Wildlife and Fisheries (including Special Status Species), Livestock and Grazing, Recreation, Visual Resources, Potential Areas of Environmental Concern (ACECs), and Wild and Scenic Rivers. Other environmental elements were considered but dismissed from further analysis because either the alternatives would have no measurable effect on the resource or issue, or because ACEPMs, described in **Section 2.5**, would reduce the impacts of the Alternatives to negligible levels. Dismissed issues/resources are listed in the Interdisciplinary Team (IDT) Analysis Record Checklist, along with the rationale for dismissal. A copy of the IDT Checklist is included as **Appendix A**.

3.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.2.1 PHYSIOGRAPHY AND GEOLOGY

The Project Area lies within the Central Badlands District in the southern portion of the Uinta Basin, south of the White River. The Central Badlands District encompasses a region with strong relief, and includes badland topography consisting of steep erosional slopes, narrow ridges, gullies, and dry washes adjacent to broad areas of pediment and plateaus. Gravelly and sandy pediment slopes, sandy washes, low bluffs and cliffs, ledges and ridges of sandstone, and sandy shale characterize the surface exposures in much of the Project Area. Elevations within the Project Area range from about 4,900 feet amsl along the White River to about 5,980 feet, for a total relief of about 1,080 ft.

Bedrock exposures in the Project Area consist of the Eocene Uinta Formation, and the Evacuation Creek and Parachute Creek members of the Green River Formation (Cashion 1973; Rowley et al. 1985). The Uinta Formation is comprised of multi-colored fine-grained sandstone, siltstone, shale, mudstone, and marlstone, and was deposited as river and lake deposits. The base of the Uinta Formation is conformable with the underlying Parachute Creek Member. The Parachute Creek Member of the Green River Formation consists of gray marlstone and yellow-brown siltstone, sandstone, and tuff. A rich oil shale sequence referred to as the Mahogany Zone occurs

about 500 feet below the contact with the Uinta Formation and is about 100 feet thick. The Parachute Creek Member overlies the Douglas Creek Member of the Green River Formation, the Wasatch Formation, and the Mesaverde Group.

Quaternary alluvium occurs on floodplains, low-lying river terraces, alluvial fans, and within dry washes, especially along the White River and Evacuation Creek. These deposits consist of unconsolidated silt, clay, sand, and gravel. Thin unconsolidated colluvial deposits of Quaternary age are found on steeper slopes in the area, and consist of large flattened rock slabs in an unsorted matrix of silt, sand, and gravel.

Within portions of the Project Area, vertical fractures in the Uinta Formation extend downward into the Green River Formation and are sometimes filled with Gilsonite, a solid, brittle hydrocarbon that is mined to the north of the Project Area near Bonanza.

3.2.2 MINERAL AND ENERGY RESOURCES

The Uinta Basin contains extensive deposits of oil and natural gas, and has been producing mineral and energy resources for over 50 years. Exploration and development of large oil and gas fields is currently proposed or underway for areas to the north and west of the Project Area in the Willow Creek/Hill Creek Area, the Love Unit, the Bonanza and West Bonanza Areas, and the Rock House Area. In addition to oil and gas reserves, the Uinta Basin also contains deposits of oil shale, “Gilsonite” (also known as asphaltum, uintaite, or uintahite), and tar sands.

Potentially minable deposits of oil shale are present within the Uinta Basin, including portions of the Project Area. Oil shale is a compact, sedimentary rock containing large quantities of organic matter that yields oil when distilled (BLM 2005). Oil occurs as kerogen within marlstones of the Parachute Creek Member of the Green River Formation. The Mahogany Zone is the most notable kerogen-bearing unit of the Green River Formation. The Mahogany Zone varies in thickness throughout the Uinta Basin, and generally thickens toward the east (Cashion 1967). In the Project Area, the Mahogany Zone is reported to be about 100 feet thick with the richest bed about 10 feet thick (BLM 2007a).

In 1981, the USGS established the Southeastern Uinta Basin Known Oil Shale Leasing Areas (KOSLA), which have a minimum oil shale yield of 25 gallons per ton, a minimum thickness of 25 feet, and a maximum depth to the deposit of 3,000 feet below ground surface. It is estimated that 90 to 115 billion barrels of oil are contained in these deposits (BLM 2007a). Portions of the Project Area within T10S, R24E are within a designated KOSLA. This area is considered to be suitable for underground oil shale development and contain between 70,000 and 100,000 barrels of oil per acre (BLM 1984).

In 2006, OSEC was granted a lease on 160 acres of land within the Project Area to conduct a RD&D project to evaluate oil shale extraction technologies. This RD&D lease is located on the site of the White River Corporation Mine. Initial testing has shown that the shale in this area will produce about 30 gallons of oil per ton over a 58-foot mining interval (Vernal Express, December 17, 2007). Pilot testing on approximately 10,000 tons of stockpiled shale at the site is currently proceeding. Phase II of the project will involve reopening the White River Mine and testing fresh shale. During Phase III, a 250 ton/hour demonstration retort plant will be constructed on site and is expected to process up to 1.5 million tons of shale per year for two years. Construction of Phase III will begin in 2009 or 2010. If the demonstration plant proves to be operationally, environmentally, and financially successful, OSEC may be granted an additional 4,960 acres of preferential lease rights within the Project Area.

Gilsonite is composed of black, brittle hydrocarbon resins that resemble tar or asphalt. It is used in over 160 products, including printing inks, paints, drilling muds, asphalt, and chemical products. The deposits occur in vertical to near-vertical, long, thin northwest-trending veins that are between a few inches and 30 feet wide and occur primarily in the Green River, Uinta, and lower Duchesne River Formations. Several former and current Gilsonite mines, including the Little Emma, Bonanza, and Little Bonanza mines, are located to the north of the Project Area, north of the White River, where individual veins are mined primarily by shaft and stoping and open-trench methods. This is currently the only Gilsonite producing area in the world, with annual production of about 60,000 tons (WVU 2005). A few known (but unmined) Gilsonite veins are also located within the northwest corner of the Project Area (Cashion 1973).

Deposits of tar sands are located along the margins of the Uinta Basin (BLM 1984). 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). Certain tar sand deposits in the Uinta Basin have been divided into seven Special Tar Sand Areas (STSAs) designated by the USGS under direction from Congress pursuant to the Combined Hydrocarbon Leasing Act of 1981. None of these STSAs are located within the Project Area. Other minor tar sand deposits are located within the Uinta Basin (Blackett 1996).

Sand and gravel deposits exist along the White River and Evacuation Creek. However, there is no active exploitation of these materials in the Project Area. In addition, stones used for decorative building purposes are mined from the Green River Formation in the Uinta Basin. No active decorative stone collecting sites are located within the Project Area. There are no known metal deposits or minable coal deposits within the Project Area.

3.2.3 PALEONTOLOGY

Few if any paleontological surveys have been conducted within the Project Area. According to the BLM (2003), an intensive study was conducted immediately to the east of the Project Area. This study, conducted by Hamblin (1991), resulted in the identification of many vertebrate, invertebrate, and plant fossils in the Uinta and Green River Formations.

The Potential Fossil Yield Classification System, recently developed by the BLM (2007), 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 units 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.

Much of the Project Area is underlain by exposed bedrock of the Uinta and Green River formations. These units have documented occurrences of vertebrate and scientifically important invertebrate and plant fossils. Soils are generally less than 50 cm deep, and bedrock outcroppings are found throughout the Project Area. However, the occurrence of fossils in both formations is sporadic and unpredictable. Therefore, both of these units are classified as **Class 4a (High)** under the new classification system.

3.3 AIR QUALITY AND CLIMATE

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 SCPA and surrounding region.

3.3.1 CLIMATE

The SCPA is located in the Uinta Basin, which has 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 SCPA ranges from 4,902 feet above mean sea-level (famsl) to 5,974 famsl, with an average of 5,403 famsl.

3.3.1.1 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 Project Area have not been directly measured. Local terrain effects will influence the wind profiles specific to the Project Area. However, representative wind speed and direction data for the area are available at the Canyonlands National Park for the years 1995, 1996, 1997, 1998, and 1999 as part of the Clean Air Status and Trends Network (CASTNET) operated by the US Environmental Protection Agency (USEPA) and National Park Service (NPS). This data was prepared for use in the Draft West Tavaputs Plateau Natural Gas Full Field Development Plan EIS (BLM 2008b). **Figure 3.3-1** presents a wind rose depicting wind speed and direction for all five 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-southeast about 18.1 percent of the time. The average measured wind speed is 3 meters per second.

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, thereby restricting dispersion. Conversely, during convective conditions, upward and downward movement in the atmosphere prevails, and vertical mixing of pollutants in the atmosphere is enhanced.

The potential for atmospheric dispersion is relatively high for the 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 Project Area generally will remain warmer at night and are less prone to temperature inversions common to the valleys and drainages.

Mixing height is defined as the thickness of the air mass above ground within which rising warm air from the surface mixes by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine the degree to which pollutants are diluted in this mixed layer. Mixing heights vary diurnally, with local weather systems, and seasonally.

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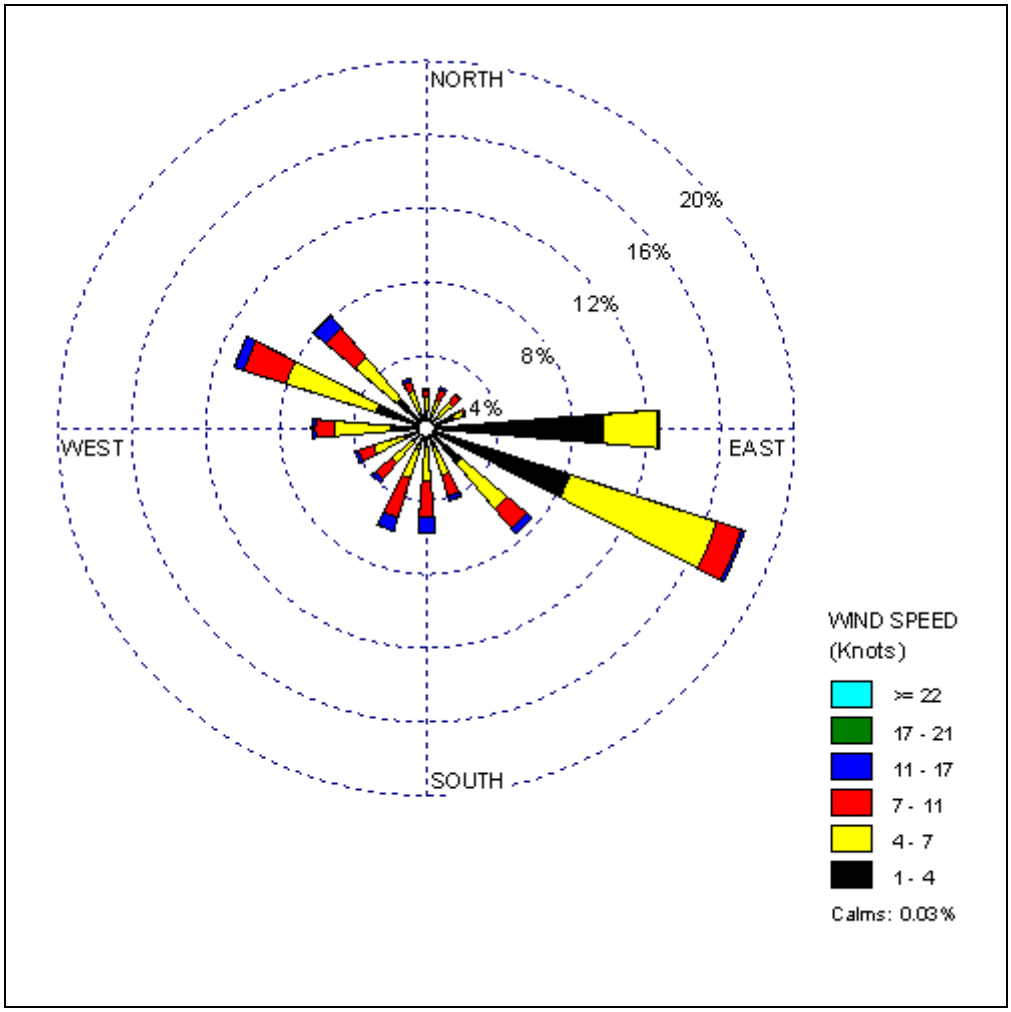
Figure 3.3-1. Wind Rose from AERMET Canyonlands NP Data 1995-1999

Wind Speed Direction (blowing from)



Average Wind Speed 5.52 Knots

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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 proposed Project Area, and is intermittent depending on winds and dust-causing activities.

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

- Exhaust emissions from existing natural gas fired compressor engines used in production of natural gas;
- Natural gas dehydrator still-vent emissions;
- Gasoline and diesel-fueled vehicle tailpipe emissions;
- Combustion and fugitive dust emissions from coal-fired power plants and coal mining and processing;
- Fugitive dust 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 and Utah 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), carbon monoxide (CO), and particulate matter less than 10 or 2.5 microns in aerodynamic diameter (PM_{10} and $PM_{2.5}$). Existing air quality in the region is acceptable based on EPA standards for the protection of human health. The Uinta Basin is designated as an attainment area, meaning that the concentrations of criteria pollutants in the ambient air are less than the NAAQS. Site-specific air quality monitoring data are not available for the Project Area; however, background criteria pollutant concentrations for the Uinta Basin were provided by the Utah Department of Environmental Quality Division of Air Quality (Prey 2008), as shown in **Table 3.3-1**.

Ground-level ozone (O_3) is a secondary pollutant that is formed by a chemical reaction between nitrogen oxides (NO_X) and volatile organic compounds (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 VOCs 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.

Note that the NAAQS has been recently revised to reflect changes to the PM_{10}, $PM_{2.5}$, and O_3 standards. The changes reflect a tighter $PM_{2.5}$ 24-hour standard for the 98th percentile of a three

year average [lowered from 65 micrograms per cubic meter (µg/m^3) to 35-µg/m^3] and elimination of the PM_{10} annual standard. The O_3 standard was changed from 0.08-part per million (ppm) (equivalent to 0.084-ppm) for the three-year average of the 4th highest 8-hour (hr) measurements to 0.075-ppm for the three-year average of the 4th highest 8-hr measurements.

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. The area surrounding the SCPA is designated as PSD Class II. For Class II areas, incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for Class II areas are presented in **Table 3.3-1**

Table 3.3-1. Ambient Criteria Pollutant Concentrations in the Uinta Basin

Pollutant	Averaging Period(s)	Uinta Basin Background Concentration [a] (µg/m^3)	NAAQS (µg/m^3)	PSD Class II Increments (µg/m^3)
SO_2	Annual 24-hour 3-hour	5 10 20	80 365 1,300	20 91 512
NO_2	Annual	5	100	25
PM_{10}	24-hour	63.3	150	30
$PM_{2.5}$	Annual 24-hour	9 25	15 35	None None
CO	8-hour 1-hour	1,111 1,111	10,000 40,000	None None
O_3 [b]	8-hour	105	147	None

[a] Source: Dave Prey, Utah Division of Environmental Quality - Division of Air Quality (UDAQ), Personal Communication, June 13th, 2008. The State of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

[b] EPA published a final rule on August 3, 2005, identifying areas for which the one-hour ozone standard was revoked. In that notice, the one-hour ozone standard was revoked effective June 15, 2005, for all areas of Utah. Another final rule was published March 27, 2008 decreasing the 8-hour NAAQS to 0.075 ppm, effective May 27th 2008; the value in the table is equivalent to 0.075 ppm.

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, BTEX compounds (benzene, toluene, ethylbenzene, isomers of xylene), normal-hexane (*n*-hexane), and acrolein.

There are no applicable Federal or State of Utah ambient air quality standards for assessing potential HAP impacts to human health. However, in order to provide a basis for assessing HAP exposures, reference concentrations (RfC) for chronic inhalation exposure, and Reference Exposure Levels (REL) for acute inhalation exposures are applied as evaluation criteria. **Table 3.3-2** 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 3.3-2. HAP Reference Exposure Levels and Reference Concentrations

Hazardous Air Pollutant (HAP)	Reference Exposure Level [REL 1-hr Average] ($\mu g/m^3$)	Reference Concentration [a] [RfC Annual Average] ($\mu g/m^3$)
Benzene	1,300 [b, c]	30
	160,000 [d]	-
Toluene	37,000 [b]	5,000
Ethylbenzene	350,000 [d]	1,000
Xylenes	22,000 [b]	100
n-Hexane	390,000 [d]	700
Formaldehyde	94 [b]	9.8
Acrolein	0.19 [b]	0.02
	69 [e]	-

[a] EPA Air Toxics Database, Table 1 (EPA 2007) http://www.epa.gov/ttn/atw/toxsource/summary.html
[b] EPA Air Toxics Database, Table 2 (EPA 2007)
[c] REL for benzene is based on a 6-hr exposure (OEHHA 1999), predicted concentration is a 6-hr average.
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007) since no available REL
[e] Acute exposure guideline level (AEGL) for mild effects from EPA Air Toxics Database, Table 2 (EPA 2007).

3.4 CULTURAL RESOURCES

A Class I cultural resource inventory was conducted for the SCPA, located on public lands administered by the BLM Vernal Field Office, and SITLA. The objective of the inventory was to identify the extent of previous cultural resource investigations within the Project Area and the number, locations, types, and significance of those previously documented cultural resources. The Class I data review conducted for the Project Area is used to make predictions about the type and potential site density of cultural resources within the Project Area, and provides a basis for assessing the potential impact to archaeological sites in the event that lands are developed for oil and gas exploration.

The cultural resource inventory was conducted in compliance with Federal and State legislation including Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, the National Environmental Policy Act (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 National Register of Historic Places (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).

The cultural-chronological sequence in Project Area includes the Archaic stage (7000 B.C. to A.D. 400), which can be further subdivided into Early, Middle, Late, and Terminal periods; the Formative stage (A.D. 700 to A.D. 1250), which is largely associated with the San Rafael Fremont in the Project Area; the Protohistoric stage (A.D. 1200 to A.D. 1750), largely associated with Numic-speaking (Ute) peoples; and the historic period, which began with the arrival of Europeans in the eighteenth century.

3.4.1 SUMMARY OF INVENTORY RESULTS

The Class I inventory resulted in the identification of 38 previous cultural resource inventories that have been conducted in the Project Area. Most of the inventories were conducted in advance of oil and gas development, including seismic lines, well pad, and pipeline corridor construction. Twenty four (63 percent) of these previous cultural resource inventories resulted in a finding of no cultural resources. Fourteen (37 percent) of these previous cultural resource inventories identified a total of 32 archaeological sites within the Project Area (**Table 3.4-1**). Of the 32 known archaeological sites that are located within the Project Area, nine (28 percent) were evaluated to be eligible for listing on the NRHP, eight (25 percent) were evaluated to be ineligible for listing on the NRHP, and 15 (47 percent) remain unevaluated, need additional data, or their evaluation is unknown. Prehistoric site types within the Project Area consist of rock shelters, lithic scatters, temporary camps, and rock art. Historic site types within the Project Area consist of temporary camps, ranches/homesteads, corrals, trash scatters, and oil shale mining sites.

Table 3.4-1. Known Archaeological Sites within the Project Area

Site Number	Site Type	NRHP Assessment	Utah Project Number
42UN106	Camp and storage cist	Unevaluated	U-55-UA-001
42UN118	Rock Shelter	Unevaluated	U-55-UA-001; U-65-CJ-001; U-75-UC-0034
42UN324	Rock Shelter	Unevaluated	U-75-UC-0034
42UN352	Open ranch or homestead	No data	U-75-UC-0034
42UN354	Rock Shelter	No data	U-75-UC-0034
42UN366	Rock Shelter with Pictographs	Eligible	U-75-UC-0034
42UN367	Rock Shelter	Unevaluated	U-75-UC-0034
42UN368	Open lithic	Unevaluated	U-75-UC-0034
42UN369	Open lithic	Eligible	U-75-UC-0034
42UN370	Open lithic	Unknown	U-75-UC-0034
42UN371	Pictograph, open camp?	Eligible	U-75-UC-0034
42UN372	Open lithic	Not Eligible	U-75-UC-0034
42UN373	Open lithic	Unevaluated	U-75-UC-0034
42UN374	Open lithic	Unevaluated	U-75-UC-0034
42UN375	Open lithic	Unevaluated	U-75-UC-0034
42UN376	Open lithic	Not Eligible	U-75-UC-0034
42UN380	Open lithic	Not Eligible	U-75-UC-0034
42UN381	Rock Shelter	Not Eligible	U-75-UC-0034

Site Number	Site Type	NRHP Assessment	Utah Project Number
42UN401	Open campsite and historic structure	Unevaluated	U-75-UC-0034
42UN407	Rock Shelter	Unevaluated	U-75-UC-0034
42UN409	Rock Shelter	Unevaluated	U-75-UC-0034
42UN971	Rock Shelter	Eligible	U-80-BL-XXXX
42UN999	Homestead	Not Eligible	U-81-BL-0690 b
42UN1013	Petroglyph	Eligible	U-81-BL-0690 b
42UN1780	Prehistoric Campsite	Eligible	U-89-AF-687 b, s, p
42UN2548	Historic Corral	Eligible	U-98-SJ-0211
42UN2557	Historic Can and Glass Scatter	Not Eligible	U-98-A1-0327 b, p, s
42UN2558	Prehistoric Open Camp and Historic Ranching and Oil Shale Mining (Multicomponent)	Eligible	U-98-A1-0327 b, p, s
42UN2597	Habitation/Oil Shale Exploration	Eligible	U-98-A1-0641 b, p, s
42UN2606	Historic Trash Scatter/Campsite	Not Eligible	U-98-SJ-0782 b, s
42UN3083	Historic Temporary Camp	Not Eligible	U-02-MQ-0243 b, p, s
42UN5376	Historic structure/camp	Unevaluated	U-06-RL-0806 b

Using the results of the Class I inventory, predictions about site density, location, type, and sensitivity within the Project Area as a whole can be made only tentatively. Because inventories in the Project Area have been done mostly in response to clearances required for individual projects, their findings may not be representative of the entire Project Area. However, given the available information, we can anticipate that sites will most likely be associated with temporary use of the area during the prehistoric time period. The available documentation indicates that sensitive sites (eligible to the NRHP) having additional research potential may be common in the immediate study area.

3.5 SOILS

The development of soils is governed by many factors, including climatic conditions (e.g., the amount and timing of precipitation, temperature, and wind), the parent material that the soil is derived from, topographic position (e.g., slope, elevation, and aspect), geomorphic processes, and vegetation type and cover.

3.5.1 PROJECT AREA SOIL TYPES

The Soil Survey of Uintah Area, Utah – Parts of Daggett, Grand, and Uintah Counties, published by the U.S. Department of Agriculture (USDA) Soil Conservation Service, is the primary source

of information concerning soils in the Project Area (USDA 2003). This survey has been supplemented by additional information available on the USDA National Resource Conservation Service (NRCS) soils web site (USDA-NRCS 2007).

Soils in the Project Area are developed on the side slopes of canyons, benches, ridges, hills, alluvial fans, and floodplains. These units cover areas as small as 0.05 acre to as large as 3,615 acres. **Table 3.5-1** summarizes the soil textures, parent materials, landforms, slopes, depth class, runoff speed, and other factors of the soil map units in the Project Area that are relevant to erosion and reclamation potential.

Table 3.5-1. Characteristics of Soils within the Project Area

Map Unit Name and Number	Acreage in Project Area	Soil Unit Name	Soil Teture	Parent Material	Landforms	Percent of Soil Complex	Slope	Depth Class	Drainage Class	Salinity Class	Sodium Class	Reclamation Source Material Rating[1]	Runoff Speed	Water Erosion Kw
Badland-Rock outcrop complex (12)	0.1	Badland	--	Shale and siltstone of the Green River and Uinta Fms	Erosional remnants, hills, and ridges	50	1 to 75%	Very shallow	Somewhat excessively drained	Strongly saline	Strongly sodic	Poor (Cl, D, O, B, S)	Very high	0.10
		Rock outcrop	--	Sandstone and shale bedrock	Cliffs, escarpments, ledges, erosional remnants	35	1 to 100%	Very shallow	--	--	--	--	Very high	--
Badland-Walknolls-Rock outcrop complex (14)	999.1	Badland	--	Shale and siltstone of the Green River and Uinta Fms	Erosional remnants, hills, and ridges	50	1 to 75%	Very shallow	Somewhat excessively drained	Strongly saline	Strongly sodic	Poor (Cl, D, O, B, S)	Very high	0.10
		Walknolls	Very channery sandy loam	Aalluvium derived from sandstone	Hills	35	50 to 90%	Shallow	Well drained	Non-saline	Slightly sodic	Poor (D, B, S, Ca)	Very high	0.10
		Rock outcrop	--	Sandstone and shale bedrock	Cliffs, escarpments, ledges, erosional remnants	35	1 to 100%	Very shallow	--	--	--	--	Very high	--
Cadrina extremely stony loam-Rock outcrop complex (36)	0.3	Cadrina	Extremely stony loam	Slope alluvium and colluvium over residuum derived from shale and sandstone	Hills	65	25 to 50%	Shallow	Well drained	Very slightly saline	Slightly sodic	Poor (St, D, B, O, Co)	Very high	0.05
		Rock outcrop	--	--	Cliffs, escarpments, ledges, erosional remnants	20	25 to 50%	--	--	--	--	--	Very high	--

Map Unit Name and Number	Acreage in Project Area	Soil Unit Name	Soil Teture	Parent Material	Landforms	Percent of Soil Complex	Slope	Depth Class	Drainage Class	Salinity Class	Sodium Class	Reclamation Source Material Rating[1]	Runoff Speed	Water Erosion Kw
Cadrina-Casmos-Rock outcrop complex (38)	118.7	Cadrina	Extremely stony loam	Slope alluvium over residuum derived from shale and sandstone	Hills	40	2 to 25%	Shallow	Well drained	Very slightly saline	Slightly sodic	Poor (St, D, B, O, Co)	Very high	0.05
		Casmos	Channery loam	Slope alluvium over residuum derived from sandstone, siltstone and shale	Hills	30	2 to 40%	Shallow	Well drained	Very slightly saline	Slightly sodic	Poor (D, B, Alk, O, S)	Very high	0.05
		Rock outcrop	--	--	Cliffs, escarpments, ledges, erosional remnants	15	2 to 25%	Very shallow	--	--	--	--	Very high	--
Green River-Fluvaquents complex (90)	123.5	Green River	fine sandy loam, coarse sand	alluvium derived from shale and sandstone	Floodplains	70	0 to 2%	Deep	Moderatelywell drained	slightly saline	Moderately sodic	Fair (O, S, D, WE)	Very slow	0.37
		Fluva-quents	Fine sand, fine sandy loam, loam	Alluvium derived from sandstone, limestone, quartzite, and shale	Floodplains, oxbows	15	0 to 1%	Deep	Very poorly drained	Non-saline	Non-sodic	Fair (S, WE)	Very slow	0.37
Pherson-Hickerson complex (179)	322.4	Pherson	Very gravelly loam, very gravelly sandy loam	Alluvium derived from sandstone and shale	Drainageway	45	2 to 8%	Deep	Well drained	Very slightly saline	Moderately sodic	Fair (D, S, O)	Slow	0.15
		Hickerson	Loam, silty clay loam,	Alluvium derived	Floodplains, alluvial flats	40	1 to 4%	Deep	Moderately well drained	Very sightly saline	Moderately sodic	Fair (S, O)	Medium	0.15

Map Unit Name and Number	Acreage in Project Area	Soil Unit Name	Soil Teture	Parent Material	Landforms	Percent of Soil Complex	Slope	Depth Class	Drainage Class	Salinity Class	Sodium Class	Reclamation Source Material Rating[1]	Runoff Speed	Water Erosion Kw
			sandy clay loam	from sandstone, limestone, quartzite, and shale										
Uffens loam (249)	7.7	Uffens	Clay loam	Alluvium derived from sandstone, limestone and shale	Stream terraces	35	3 to 8%	Very deep	Well drained	Moderately saline	Strongly sodic	Poor (S, Alk, O, Sal, WE)	High	0.43
Walknolls extremely channery sandy loam-Gilston association (257)	3,615	Walknolls	Very channery sandy loam	Slope alluvium and colluvium derived from sandstone	Hills	50	2 to 50%	Very shallow	Well drained	Non-saline	Slightly sodic	Poor (D, B, S, Ca)	High	0.05
		Gilston	Sandy loam, gravelly sandy loam, gypsum loam	Alluvium derived from sandstone	Drainageway	35	2 to 8%	Very deep	Well drained	Moderately saline	Strongly sodic	Poor (Alk, S, Sal, O)	Slow	0.05
Walknolls very channery loam (258)	3,139	Walknolls	Very channery sandy loam	Colluvium derived from sandstone	Hills	85	25 to 50%	Shallow	Well drained	Non-saline	Slightly sodic	Poor (D, B, S, Ca)	High	0.10
Walknolls-Bullpen association (260)	1,882	Walknolls	Very channery loam	Slope alluvium derived from sandstone	Hills	60	2 to 50%	Shallow	Well drained	Non-saline	Slightly sodic	Poor (D, B, S, Ca)	Medium	0.10
		Bullpen		Slope alluvium over residuum derived from sandstone	Hills	30	2 to 25%	Deep	Well drained	Very slightly saline	Moderately sodic	Poor (Alk, O, S, WE)	Medium	0.10

Map Unit Name and Number	Acreage in Project Area	Soil Unit Name	Soil Teture	Parent Material	Landforms	Percent of Soil Complex	Slope	Depth Class	Drainage Class	Salinity Class	Sodium Class	Reclamation Source Material Rating[1]	Runoff Speed	Water Erosion Kw
Walknolls-Gilston association (262)	340.1	Walknolls	Very channery sandy loam	Slope alluvium derived from sandstone	Hills	55	4 to 25%	Shallow	Well drained	Non-saline	Slightly sodic	Poor (D, B, S, Ca)	Medium	0.10
		Gilston	Sandy loam, gravelly sandy loam, gypsum loam	Alluvium derived from sandstone	Draimageway	35	2 to 8%	Very deep	Well drained	Moderately saline	Strongly sodic	Poor (Alk, S, Sal, O)	Slow	0.10

3.5.2 EROSION AND RECLAMATION POTENTIAL OF PROJECT AREA SOILS

For evaluation of potential environmental impacts to soils, the key attributes are their erosion potential and ease of reclamation after soil disturbance. Soil mapping conducted by the NRCS under the USDA typically provides information about each soil type within the mapped area that can be used to evaluate the erosion potential and reclamation potential of each soil unit (USDA-NRCS 2007).

3.5.2.1 Erosion Potential

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. The USDA-NRCS typically rates each of the soil units according to its water erosion potential (K_w). The erosion potential indicates the general susceptibility of a soil to sheet and rill erosion. The value of K_w ranges from 0.02 to 0.69. The higher the K_w value of a soil type, the more susceptible the soil type is to sheet and rill erosion. Erosion hazards become critical issues when protective vegetation is removed during and following activities such as access road and well pad construction. Typically, soils found on steeper slopes have a higher erosion hazard than those found on gentler slopes. Soils with more fines are at greater risk of wind erosion, and soils with more gravel and/or stones have a lower risk of wind erosion.

Most of the soil types within the Project Area have erosion potentials of 0.15 or less, indicating a low to moderate water erosion potential. Higher erosion potentials of 0.37 to 0.43 are given for the Green River-Fluvaquents complex (map unit 90) and the Uffens loam (map unit 249). These soils are located on floodplains and stream terraces. In addition, the Bullpen soils (map unit 260) are identified by the reclamation source material ratings as having high water erosion potential. All soils on slopes greater than 40 percent and badland areas could be considered to have severe water erosion potentials.

3.5.2.2 Reclamation Potential

Reclamation potential is dependent on the soil structure, pH conditions, and soil salinity, among other factors. Excessive salinity (salt content) or sodicity (sodium content) can inhibit the growth of desirable vegetation and therefore, successful reclamation.

The USDA has provided reclamation material source ratings for the soils in the Project Area on the Web Soil Survey (USDA-NRCS 2007). The Green River-Fluvaquents and Pherson-Hickerson soils (map units 90 and 179) are considered to be fair as a source of reclamation material. All of the other soils in the 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 clay, stone, or cobble content, drought conditions, excessive salinity or sodicity, and high water erosion potential.

3.6 WATER RESOURCES

3.6.1 HYDROLOGIC SETTING

The Project Area lies in the Uinta Basin of northeastern Utah. The Uinta Basin is drained by the Green River and its tributaries. The Green River originates in Wyoming along the Continental

Divide and joins the Colorado River about 110 miles south of Green River, Utah. Major tributaries to the Green River include the Duchesne River and the White River. The White River drains the eastern portion of the basin, including those portions of the basin within Colorado and all of the Project Area.

3.6.2 SURFACE WATER

The Project Area lies to the south of the White River, as shown on **Figure 3.6-1**. The Project Area is drained by Evacuation Creek, Southam Canyon, and numerous ephemeral tributaries to these streams. Evacuation Creek, Southam Canyon, and some of the larger ephemeral washes have floodplains associated with them. The ephemeral streams only flow in direct response to rainfall events. They have developed a dendritic drainage pattern and are incised with rills and gullies typical of badland topography.

3.6.2.1 Stream Classification

The Utah Water Quality Board classifies Utah surface water resources according to quality and degree of protection (UDEQ 2000). All streams and water bodies in Utah are assigned to one of five classes. All streams within the Project Area are classified as Class 2B, 3A, and 4. 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. Class 4 streams are protected for agricultural uses including irrigation of crops and stock watering.

3.6.2.2 Surface Water Flow

The USGS formerly maintained a surface water gauging station on the White River at the confluence with Asphalt Wash and five stations along Evacuation Creek. None of these stations were monitored for discharge beyond 1983, but these data are still useful for determining flow conditions for the White River and the other streams in the Project Area.

Table 3.6-1 presents summary flow data for the period of record for two of these gauging stations. Mean monthly stream flow over the period of record for the White River at the gauging station at Asphalt Wash is relatively steady between August and April, ranging from 295 cubic feet per second (cfs) to 497 cfs. The White River is perennial with high flows occurring in spring responding to snowmelt in the mountains of Colorado. During May, June, and July, high flows ranging from about 1,000 cfs to 4,300 cfs often occur due to short duration, high intensity thunderstorms and contributions from snowmelt. Flow in Evacuation Creek ranges from zero (less than one percent of the time) to over 200 cfs (rarely), but is typically less than 0.5 cfs (72 percent of the period of record).

Table 3.6-1. Stream Flow Data for USGS Gauging Stations

USGS Gauging Station ID	Range of Monthly Mean Discharge (cfs)	Peak Daily Discharge (cfs)	Mean Annual Discharge (cfs)	Period of Record
Evacuation Creek near Mouth near Watson, Utah 09306430	0.06 (December) to 4.0 (May)	258 (February 19, 1980)	1.55	October 1974 – September 1981

USGS Gauging Station ID	Range of Monthly Mean Discharge (cfs)	Peak Daily Discharge (cfs)	Mean Annual Discharge (cfs)	Period of Record
White River at Asphalt Wash 09306700	295 (December) – 1,412 (June)	4,380 (June 10, 1975)	535	October 1974 – September 1977

Source: http://waterdata.usgs.gov/nwis

3.6.2.3 Surface Water Quality

Important indicators of water quality include temperature, 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 concentration of various chemical constituents in the water, including metals, ionic constituents such and chloride 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. For a more thorough discussion of water quality, see Fetter (1980).

Water Quality Standards

The U.S. Environmental Protection Agency has established primary and secondary drinking water standards (EPA 2003) 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 and Tribal standards were 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).

Salinity and Sodium Hazards

Excessive salinity and sodium content is a special water quality concern in portions of the Colorado River 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. Waters with SARs in the range 0 to 6 can generally be used on all soils with little problem of a sodium buildup. When SAR's range from 6 to 9, chances for soil permeability problems increase (Hergert and Knudsen 1997). Water with an SAR greater than 9 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 U.S. National Salinity Laboratory (1954) are presented in **Tables 3.6-2** and **3.6-3**.

Table 3.6-2. 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: U.S. National Salinity Laboratory 1954.

Table 3.6-3. 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 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: U.S. National Salinity Laboratory 1954.

Project Area Surface Water Quality

The following section describes the chemical quality of surface waters in the Project Area, based on data collected by the USGS at the two gauging stations listed above (Evacuation Creek near Mouth near Watson, Utah, 09306430; and White River at Asphalt Wash 09306700), and data collected by the State of Utah at two water quality monitoring stations (UDEQ White River station 4933970 and UDEQ Evacuation Creek station 4933870). The locations of these four stations are shown on **Figure 3.6-1.**

Table 3.6-4 provides a summary of the data collected at USGS station 09306700 on the White River at Asphalt Wash. For this station, samples for chemical analysis were collected from August 1974 to July 1978, and from April 1981 to August 1983. Waters in the White River are described as calcium-sodium sulfate-bicarbonate type waters with moderate to very high hardness (140 – 400 mg/L as $CaCO_3$). TDS content is variable during the year, ranging from 222 mg/L to 892 mg/L, and averages 509 mg/L, slightly above the secondary standard of 500 mg/L. The waters are generally neutral to alkaline with pH ranging from 6.50 to 8.60. The maximum values of iron and sulfate are above the secondary standards of 250 mg/L and 300 µg/L, respectively.

However, sulfate exceeded the secondary standard three times and iron only once during the period of record. In addition, concentrations of ammonia, aluminum, and copper exceeded the State of Utah aquatic standards once, six times, and twice, respectively. Total suspended solids (TSS) range from 46 mg/L to over 8,000 mg/L during high-intensity runoff events, and exceeded the aquatic standard of 90 mg/L for all but two measurements conducted during the period of record.

Table 3.6-4. Summary of Water Quality Analyses for White River at Asphalt Wash, USGS Gauging Station 09306700

Parameters	Standards		Summary Statistics		
	Drinking Water	Aquatic Biota[3]	No. of Samples	Range	Mean
General Water Quality Indicators					
Temperature (°C)			108	0 – 23.5	8.93
Specific Conductance (uS/cm)			56	320 – 1,650	752
Dissolved Oxygen (mg/L)		Min 6.5	23	**3.8** - 11.9	8.43
pH (standard units)	6.5-9.0[2]	6.5-9.0	42	6.5 - 8.6	8.02
Total Hardness (mg/L)			50	140 - 400	273
Total Dissolved Solids (mg/L)	500[2]	1,200	52	222 - **892**	**509**
Total Suspended Solids (mg/L)		90	63	46 – **8,700**	**1,400**
Ionic Constituents					
Calcium (mg/L)			52	36 - 83	66.4
Magnesium (mg/L)			52	11 - 48	26.0
Sodium (mg/L)			52	13 - 180	65.9
Potassium (mg/L)			52	1.1 - 6.1	2.3
Chloride (mg/L)	250[2]		52	5.8 - 230	37.7
Sulfate (mg/L)	250[2]		52	55 - **470**	175
Fluoride (mg/L)	4[1], 2[2]	1.2 - 2.4[4]	52	0.1 - **2**	0.35
Ammonia (mg/L)		0.11 – 2.49[4]	51	<0.01 – **0.15**	0.035
Silica (mg/L)			52	7.1 – 17	13.0
Bicarbonate (mg/L)			46	125 - 280	226
Nitrite & Nitrate (mg/L)	10[1]	4	52	0.01 - 0.97	0.15
Trace Metals					
Aluminum (µg/L)	50 - 200[2]	750[3]	39	<10 – **460**	46.0
Arsenic (µg/L)	10[1]	190	36	<1 – 4	1.24
Barium (µg/L)	2,000[1]	1,000	32	<35 – 300	66.6
Boron (µg/L)			34	30 – 100	49.1
Copper (µg/L)	1,300[1], 1,000[2]	12	6	<2 – **105**	**27.2**

Parameters	Standards		Summary Statistics		
	Drinking Water	Aquatic Biota[3]	No. of Samples	Range	Mean
Iron (µg/L)	300[2]	1,000	36	<10 - **1,750**	77.5
Manganese (µg/L)	50[2]		52	11 – 48	26.0
Selenium (µg/L)	50[1]	5	30	0.5 – 3	1.17
Strontium (µg/L)			30	<60 – 1,300	760
Zinc (µg/L)	5,000[2]		18	10 – 210	33.3

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 Quality Standards Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Quality Standards Secondary Maximum Contaminant Level (SMCL)
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code). EPA is in the process of revising the national criteria for aluminum for aquatic life.
[4]Value is dependant on temperature and pH
Source: http://waterdata.usgs.gov/nwis

The Utah Division of Environmental Quality (UDEQ) also monitors and assesses the White River on a regular basis to determine if the river is supporting beneficial uses. Water quality data have been and are currently being collected from the White River at UDEQ station 4933970, located at the crossing of Utah Highway 45, north of the project boundary. **Table 3.6-5** provides a summary of data collected at this station for the period February 1976 to June 2006.

Water quality results recorded at this station are similar to those from the downstream USGS gauging station at Asphalt Wash. The field-measured pH ranges from 6.20 to 9.10 with an average of 8.27, slightly higher than the average of 8.02 reported for the USGS station 09306700. TDS ranges from 222 mg/L to 892 mg/L with an average of 483 mg/L, and TSS concentrations range from 11.2 to 9,999 mg/L with an average of 805 mg/L. The average value is considerably lower than that reported by the USGS. The average TSS concentration exceeds the aquatic biota standard of 90 mg/L.

The UDEQ also analyzed several trace metals that were not reported by the USGS. The EPA STORET database where the UDEQ data are available reports non-detect values simply as “Not Detected”. 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 be assumed to be zero. Therefore, for parameters with non-detect values in the database, a mean cannot be calculated accurately and is not provided here. For these parameters, the range of detected concentrations and the number of detects is provided without a calculated mean.

Aluminum was detected in five of 13 samples at concentrations up to 1,600 µg/L above the drinking water and aquatic standards. The maximum detected concentrations of cadmium, copper, iron, lead, and manganese also exceed standards. Arsenic, barium, boron, selenium, and zinc were also commonly detected. The maximum concentrations of these metals are below the applicable standards.

Table 3.6-5. Summary of Water Quality Analysis for the White River at Utah Highway 45, UDEQ Station 4933970

Parameters	Standards		Summary Statistics			
	Drinking Water	Aquatic Biota[3]	No. of Samples	No. of Detects	Range of Detects	Mean
General Water Quality Indicators						
Alkalinity as $CaCO_3$ (mg/L)			155	155	111 – 293	179
Dissolved Oxygen (mg/L)		>6.5	149	149	**2.6** – 13.01	9.06
pH	6.5 to 8.5[2]	6.5 to 9.0	264	264	**6.20 – 9.10**	8.27
Specific Conductance (umhos/cm)			301	301	282 – 886	710
Temperature (^oC)			144	144	-0.23 – 26.9	11.0
Total Dissolved Solids (mg/L)	500[2]	1,200	149	149	194 – **940**	483
Total Hardness (mg/L)			130	130	132 – 410	283
Total Suspended Solids (mg/L)		90	147	147	11.2 **– 9,999**	**805**
Ionic Constituents						
Bicarbonate (mg/L)			155	155	135 – 357	217
Calcium (mg/L)			155	155	25.1 – 96	64.5
Chloride (mg/L)	250[2]		143	143	3 – 85	19.6
Fluoride (mg/L)	4[1], 2[2]		27	27	0.12 – 0.41	0.27
Magnesium (mg/L)			155	155	7.79 – 51	28.0
Ammonia as N, total (mg/L)		0.11 to 0.49[4]	68	155	0.05 – **0.8**	NC
Nitrite + Nitrate, total (mg/L)	10(1[5])	4	37	43	0.05 – **1.5**	NC
Phosphorus, total (mg/L)		0.05	144	152	0.01 – **5.08**	NC
Orthophosphate (mg/L)			34	52	0.01 – 0.54	NC
Potassium (mg/L)			160	160	1 – 8	2.27
Silica (mg/L)			27	27	10 – 17	14.1
Sodium (mg/L)			155	155	8.53 – 170	55.9
Sulfate (mg/L)	250[2]		155	155	47.8 – **370**	188
Trace Metals						
Aluminum (µg/L)	50 to 200[2]	750	5	13	34 **– 1,600**	NC
Arsenic (µg/L)	10[1]	190	12	29	0.4 – 3	NC
Barium (µg/L)	2,000[1]	1,000	16	20	38 – 150	NC
Boron (µg/L)			29	29	27 – 350	96.1
Cadmium (µg/L)	5	250	3	22	5 – **10**	NC
Chromium (µg/L)	100[1]	74	1	20	5	NC
Copper (µg/L)	1300[1], 1000[2]	9	4	22	3 – **15**	NC
Iron (µg/L)	300[2]	1,000	16	22	5 – **1,500**	NC
Lead (µg/L)	15[1]	2.5	4	22	**4 – 30**	NC
Manganese (µg/L)	50[2]		13	22	27 – **350**	NC

Parameters	Standards		Summary Statistics			
	Drinking Water	Aquatic Biota[3]	No. of Samples	No. of Detects	Range of Detects	Mean
Nickel (µg/L)			0	3	NA	NC
Selenium (µg/L)	50[1]	5	15	27	0.2 – 2	NC
Silver (µg/L)	100[2]	1.6	0	19	NA	NC
Zinc (µg/L)	5,000[2]	120	12	28	5 – 33	NC

All samples are dissolved (filtered) unless otherwise noted
Bolded values exceed standards
NC = Mean not calculated due to undefined non-detect values in database
[1]Federal Drinking Quality Standards Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Quality Standards Secondary Maximum Contaminant Level (SMCL)
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code). EPA is in the process of revising the national criteria for aluminum for aquatic life.
[4]Value is dependant on temperature and pH
[5]Federal Drinking Water Quality Standard is 1 mg/L for Nitrite and 10 mg/L for Nitrate
Source: http://www.epa.gov/storet/dw_home.html

Table 3.6-6 provides a summary of the data collected at USGS station 09306430 on Evacuation Creek. Waters in Evacuation Creek are described as sodium sulfate type waters with very high to extreme hardness (250 – 1,200 mg/L as $CaCO_3$). TDS ranges from 2,150 – 4,710 mg/L with an average of 3,570 mg/L, well above the secondary standard of 500 mg/L. Specific conductance is correspondingly high and ranges from 1,200 to 5,800 uS/cm with an average of 4,080 uS/cm. These values are in the high salinity class as defined by the U.S. National Salinity Laboratory (1954). High salinity water is not suitable for irrigation use on soils with restricted drainage. SAR ranges from 4 to 12. High sodium water with SAR above 9 may produce harmful levels of exchangeable sodium in most soils (U.S. National Salinity Laboratory 1954).

Compared to the White River, Evacuation Creek contains much higher concentrations of most major ions, including calcium, magnesium, sodium, potassium, sulfate, and bicarbonate. All recorded concentrations of sulfate are above the secondary standard of 250 mg/L. The maximum values of fluoride, ammonia, aluminum, copper, iron, and manganese are also above the standards. TSS ranges from 3 mg/L to 178,000 mg/L during high-intensity runoff events, and exceeded the aquatic standard of 90 mg/L for 77 percent of the measurements conducted during the period of record.

Table 3.6-6. Summary of Water Quality Analyses for Evacuation Creek, USGS Gauging Station 09306430

Parameters	Standards		Summary Statistics		
	Drinking Water	Aquatic Biota[3]	No. of Samples	Range	Mean
General Water Quality Indicators					
Temperature (°C)			146	0 – 33.5	14.3
Specific Conductance (uS/cm)			96	1,200 – 5,800	4,080
Dissolved Oxygen (mg/L)		Min 6.5	51	**4.8** – 14.6	8.03
pH (standard units)	6.5-9.0[2]	6.5-9.0	79	**6.0 – 9.2**	7.96

Parameters	Standards		Summary Statistics		
	Drinking Water	Aquatic Biota[3]	No. of Samples	Range	Mean
Total Hardness (mg/L)			66	250 – 1,200	1,038
Sodium-Adsorption Ratio			66	4 – 12	9.1
Total Dissolved Solids (mg/L)	500[2]	1,200	52	**2,150 – 4,710**	**3,570**
Total Suspended Solids (mg/L)		90	57	3 – **178,000**	**16,400**
Ionic Constituents					
Calcium (mg/L)			69	60 – 240	161
Magnesium (mg/L)			69	24 – 210	150
Sodium (mg/L)			69	160 – 990	674
Potassium (mg/L)			69	1.8 – 12	8.2
Chloride (mg/L)	250[2]		69	6.1 – 83	45.0
Sulfate (mg/L)	250[2]		69	**430 – 3,000**	**2,000**
Fluoride (mg/L)	4[1], 2[2]	1.2 - 2.4[4]	69	0.4 – **2.3**	0.82
Ammonia (mg/L)		0.11 – 2.49[4]	57	<0.01 – **0.38**	0.05
Bicarbonate (mg/L)			50	120 – 550	449
Nitrite (mg/L)	1[1]		53	<0.01 – 0.11	0.02
Nitrate (mg/L)	10[1]	4	45	0.01 – 1.8	0.56
Trace Metals					
Aluminum (µg/L)	50 - 200[2]	750[3]	44	10 – **110**	29.8
Arsenic (µg/L)	10[1]	150	40	<1 – 6	1.68
Barium (µg/L)	2,000[1]	1,000	31	20 – 300	63.5
Boron (µg/L)			57	<20 – 8,600	1,700
Copper (µg/L)	1,300[1], 1,000[2]	12[5]	11	<2 – **600**	**83.7**
Iron (µg/L)	300[2]	1,000	54	<10 – **470**	55.2
Manganese (µg/L)	50[2]		54	<10 – **320**	**102**
Selenium (µg/L)	50[1]	4.6	34	<1 – 5	1.91
Zinc (µg/L)	5,000[2]	120	35	<10 – 110	25.1

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 Quality Standards Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Quality Standards Secondary Maximum Contaminant Level (SMCL)
[3]Aquatic life (the most stringent acute or chronic standards from Utah Water Quality Standards, R317-2 Utah Administrative Code and Colorado Basic Standards for Surface Water, 5 CCR 1002-31). EPA is in the process of revising the national criteria for aluminum for aquatic life.
[4]Value is dependant on temperature and pH
[5]Standard for hardness of 100 mg/L; exact value is dependant on water hardness
Source: http://waterdata.usgs.gov/nwis

The UDEQ has also collected water quality data from Evacuation Creek at UDEQ station 4933870, located above the confluence with the White River, from March 1995 to June 1996, and again from July 2005 to June 2006. **Table 3.6-7** provides a summary of these data.

Water quality results recorded at this station are similar to those from the USGS gauging station 09306430. TDS ranges from 630 mg/L to 4,654 mg/L with an average of 3,570 mg/L, and TSS ranges from 0 to 76,680 mg/L with an average of 4,800 mg/L.

As discussed above, for parameters with non-detect values in the database, a mean cannot be calculated accurately and is not provided here. For these parameters, the range of detected concentrations is provided without a calculated mean.

Aluminum was detected in four of nine samples at concentrations up to 477 µg/L above the drinking water and aquatic standards. The maximum detected concentrations of ammonia, phosphorous, copper, iron, and manganese also exceed standards. Barium, boron, selenium, and zinc were also commonly detected. The maximum concentrations of these metals are below the applicable standards.

Table 3.6-7. Summary of Water Quality Analysis for Evacuation Creek Above the Confluence with the White River, UDEQ Station 4933870

Parameters	Standards		Summary Statistics			
	Drinking Water	Aquatic Biota[3]	No. of Samples	No. of Detects	Range of Detects	Mean
General Water Quality Indicators						
Alkalinity as $CaCO_3$ (mg/L)			33	33	125 – 443	368
Dissolved Oxygen (mg/L)		>6.5	33	33	**5.92** – 13.06	8.61
pH	6.5 to 8.5[2]	6.5 to 9.0	66	66	7.90 – 8.73	8.29
Specific Conductance (umhos/cm)			65	65	431 – 4,654	3,570
Temperature (^oC)			33	33	-0.29 – 21.4	14.2
Total Dissolved Solids (mg/L)	500[2]	1,200	33	33	**630 – 3,684**	**3,070**
Total Hardness (mg/L)			19	19	243 – 1197	932
Total Suspended Solids (mg/L)		90	31	31	0 – **76,680**	**4,800**
Ionic Constituents						
Bicarbonate (mg/L)			19	19	152 – 490	418
Calcium (mg/L)			33	33	38 – 175	135
Chloride (mg/L)	250[2]		31	31	11 – 52	39.5
Magnesium (mg/L)			33	33	21.6 – 212	156
Ammonia as N, total (mg/L)		0.11 to 0.49[4]	15	32	0.05 – **1.08**	NC
Nitrite + Nitrate, total (mg/L)	10(1[5])	4	31	31	0.13 – 4.62	1.47
Phosphorus, total (mg/L)		0.05	21	33	0.01 **– 1.83**	NC
Potassium (mg/L)			33	33	3.6 – 8.31	6.09
Sodium (mg/L)			33	33	134 – 765	601
Sulfate (mg/L)	250[2]		33	33	**277 – 2,650**	**1,771**
Trace Metals						
Aluminum (µg/L)	50 to 200[2]	750	4	9	30 – **477**	NC

Parameters	Standards		Summary Statistics			
	Drinking Water	Aquatic Biota[3]	No. of Samples	No. of Detects	Range of Detects	Mean
Arsenic (µg/L)	10[1]	190	3	9	1.79 – 3.06	NC
Barium (µg/L)	2,000[1]	1,000	7	9	25.1 – 180	NC
Boron (µg/L)			3	3	877 – 1310	1130
Cadmium (µg/L)	5	250	0	9	NA	NC
Chromium (µg/L)	100[1]	74	1	9	12.4	NC
Copper (µg/L)	1300[1], 1000[2]	9	2	9	**15.3 – 17**	NC
Iron (µg/L)	300[2]	1,000	6	9	31.5 – **402**	NC
Lead (µg/L)	15[1]	2.5	0	9	NA	NC
Manganese (µg/L)	50[2]		8	9	10 – **157**	NC
Nickel (µg/L)			0	3	NA	NC
Selenium (µg/L)	50[1]	5	9	9	2 – 4.89	2.77
Silver (µg/L)	100[2]	1.6	0	9	NA	NC
Zinc (µg/L)	5,000[2]	120	2	9	30.6 – 33	NC

All samples are dissolved (filtered) unless otherwise noted
Bold values exceed standards
NC = Mean not calculated due to undefined non-detect values in database
[1]Federal Drinking Quality Standards Primary Maximum Contaminant Level (MCL)
[2]Federal Drinking Quality Standards Secondary Maximum Contaminant Level (SMCL)
[3]Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code). EPA is in the process of revising the national criteria for aluminum for aquatic life.
[4]Value is dependant on temperature and pH
[5]Federal Drinking Water Quality Standard is 1 mg/L for Nitrite and 10 mg/L for Nitrate
Source: http://www.epa.gov/storet/dw_home.html

3.6.3 GROUNDWATER

Three main aquifers are present in the southern Uinta Basin in the vicinity of the Project Area. The principal aquifers include unconsolidated alluvial deposits along the major drainages (White River and Evacuation Creek) and two sandstone layers within the Green River Formation (Holmes and Kimball 1987; Hood and Fields 1978; Schlotthauer et al. 1981). Groundwater may also be present in the Uinta Formation as small, isolated, perched water zones in some areas. Deeper water-bearing zones are also present in many geologic units, including the Navajo Sandstone, the Entrada Formation, the Morrison Formation, and the Mesaverde Group (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 the bedrock 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, and consist of silt and clay, with minor amounts of sand and gravel. The average thickness of alluvium along the White River is about 30 feet, and the hydraulic conductivity of these deposits ranges from about one to 25 feet/day. Water from the

alluvial aquifers is discharged by springs, evapotranspiration, wells, and subsurface flow into consolidated aquifers. In many of the tributary streams to the White River, evapotranspiration consumes most of the water in the stream channel. The amount of recoverable water in storage in these aquifers is estimated to be about 200,000 acre-feet (Holmes and Kimball 1987).

Water is also sometimes present in small, discontinuous perched aquifers within the Uinta Formation. In most cases, the formation yields only a couple gallons per minute (gpm) of saline water to wells and springs (Holmes and Kimball 1987; Howells et al. 1987). Locally, some wells yield fresh to slightly saline water and larger yields.

Two sandstone zones within the Green River Formation are considered to be regional aquifers. The Bird's-Nest Aquifer lies between the upper part of the Parachute Creek Member and the Mahogany Oil Shale Zone, and outcrops along the White River and Evacuation Creek within the Project Area. This aquifer is characterized by nodules of nahcolite (natural sodium bicarbonate) set in marlstone overlain by thin, brittle, shale and sandstone beds. 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 of the sandstones (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 Formation (Holmes and Kimball 1987; Howells et al. 1987). This aquifer crops out in Desolation Canyon to the southwest of the Project Area and is generally about 500 feet thick. Well yields from the Green River Formation generally range from about 0.5 to 220 gpm (Feltis 1968).

3.6.3.1 Groundwater Quality

Groundwater in the Uinta Basin ranges in chemical quality from relatively good to briny. Groundwater in the unconsolidated alluvial aquifers generally reflects the overall water quality of the associated streams, rivers, or recharge sources. The highest quality groundwater occurs near the mountains at the north end of the Uinta Basin and also in valley areas. As the groundwater moves downgradient in the basin, it becomes increasingly saline. Water of higher salinity is also found in formations containing shale, gypsum, or salt.

Water from the consolidated aquifers beneath the Project Area is generally high in dissolved solids. Hardness ranges from zero to more than 24,000 mg/L, and averages about 405 mg/L, which is considered to be very hard. The Bird's-Nest Aquifer 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 TDS of water in the Douglas Creek aquifer is also generally between 3,000 and 10,000 mg/L (Schlotthauer et al. 1981).

TDS concentrations in the Uinta Formation are reported to range from 3,260 mg/L to 64,300 mg/L (Schlotthauer et al. 1981). Use of groundwater from the Uinta and Green River Formations is limited to livestock watering and industrial uses because of its poor quality in terms of total dissolved solids and hardness.

3.6.4 FLOODPLAINS

Currently, floodplains are protected by Executive Order 11988 which requires that all Federal agencies take action to reduce the risk of flood loss; minimize the impact of floods on human

safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. The most recent data available regarding 100-year floodplains are from a 1977 U.S. Department of Housing and Urban Development (HUD) and Federal Emergency Management Agency (FEMA) survey, which inventoried public and State lands in Uintah County. Floodplains are present within the drainages of Evacuation Creek, Southam Canyon, and the lower portions of several ephemeral drainages within the Project Area, as well as along the White River. Under the VFO Approved RMP, no surface disturbance or occupancy is allowed within active floodplains (including Evacuation Creek and the White River). An exception to this management prescription may be authorized if there are no practical alternatives, impacts could be fully mitigated, or the action is designed to enhance the riparian resources.

3.7 VEGETATION, INCLUDING WETLANDS/RIPARIAN AREAS AND INVASIVE/NON NATIVE SPECIES

The vegetation communities identified in this section are described using data obtained from the U.S. Department of Agriculture, Natural Resources Conservation Services (USDA-NRCS) Soil Survey Geographic Database (UDSA-NRCS 2006a), as well as the USDA-NRCS Field Office Technical Guides ecological site descriptions (USDA-NRCS 2006b). **Figure 3.7-1** provides a map of the vegetation communities that occur within the SCPA. **Table 3.7-1** provides a breakdown of vegetation communities occurring within the SCPA. A brief discussion of each of the vegetation communities follows.

Table 3.7-1. Vegetation Communities within the Southam Canyon Project Area

Vegetation Community	Estimated Acres	Percent of Total Project Area[1]
Wyoming Big Sagebrush	6,610	62.5%
Pinyon-Juniper	3,663	34.6%
Riparian	135	1.3%
Black Sagebrush	131	1.2%
Desert Shrub	7	0.1%
Badlands/Rock Outcrop	1	< 0.1%

[1] Total project Area is 10,575 acres.

Wyoming Big Sagebrush

The Wyoming big sagebrush vegetation community accounts for approximately 63 percent of the Project Area. At the community's optimal state, its canopy cover is composed of 35 percent shrubs, 25 percent grasses, and 5 percent forbs. Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*) is the most visually dominant species in this vegetation community. Other shrub species associated with this vegetation community include shadscale (*Atriplex confertifolia*), bud sagebrush (*Picrothamnus desertorum*), winterfat (*Krascheninnikovia lanata*), and low rabbitbrush (*Chrysothamnus viscidiflorus*). The herbaceous cover in this community includes Indian ricegrass (*Achnatherum hymenoides*), galleta (*Hilaria jamesii*), needle and thread grass (*Hesperostipa comata*), and scarlet globemallow (*Sphaeralcea coccinea*) (USDA-NRCS 2006a, USDA-NRCS 2006b).

In the SCPA, the Wyoming big sagebrush vegetation community is the most prevalent, and is found mainly in the eastern half of the Project Area. However, this community can also be found intermixed with the pinyon-juniper vegetation community.

Pinyon-Juniper Woodlands

The second most prevalent vegetation community in the Project Area is the pinyon-juniper woodland, which accounts for approximately 35 percent of the SCPA. At the community's optimal state, the canopy cover is composed of 30 percent trees, 20 percent shrubs, 20 percent grasses, and 5 percent forbs, although trees are most visually dominant. Trees in this vegetation community include pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Shrubs include black sagebrush (*Artemisia nova*), birchleaf mountain mahogany (*Cercocarpus montanus*), and mormon tea (*Ephedra viridis*). Grasses include salina wildrye (*Leymus salinus* ssp. *salinus*), bluebunch wheatgrass (*Pseudoroegneria spicata*), galleta, Indian ricegrass, and needle-and-thread grass. Forbs include various asters (*Asteraceae* family), mustards (*Brassicaceae* family), and buckwheats (*Polygonaceae* family) (USDA-NRCS 2006a, USDA-NRCS 2006b).

This community is mainly located in the western half of the Project Area, but is also interspersed with the vegetation sagebrush community discussed above.

Riparian

Riparian vegetation communities occur in floodplains of large, meandering rivers in the Uinta Basin. Sandbars are also associated with large meandering rivers but because of their unstable nature, are usually devoid of vegetation. Riparian vegetation communities are composed of occasional Fremont cottonwood (*Populus fremontii*) stands, with an understory of coyote willow (*Salix exigua*). Other species associated with the riparian vegetation community include skunkbush sumac (*Rhus trilobata*), greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), silverscale saltweed (*Atriplex argentea*), and saltgrass (*Distichlis* spp.). Greasewood can also be found along Evacuation Creek (USDA-NRCS 2006a, USDA-NRCS 2006b).

In the Project Area, riparian vegetation communities are located in the White River corridor and account for approximately one percent of the Project Area.

Black Sagebrush

The black sage brush vegetation community is located near the White River in the north-western portion of the SCPA, and accounts for approximately one percent of the Project Area. This vegetation community is similar to the Wyoming big sagebrush vegetation community in its structure and canopy cover. This vegetation community is visually dominated by black sagebrush. Other dominant species in this vegetation community include shadscale, galleta, and salina wildrye (USDA-NRCS 2006a, USDA-NRCS 2006b).

Desert Shrub

The desert shrub vegetative community tends to be variable in its composition and species dominance. Dominant species in the Project Area primarily include valley saltbush (*Atriplex cuneata*) and shadscale, but bud sagebrush (*Picrothamnus desertorum*) and green molly (*Bassia americana*) can also occur in this vegetation community. Other plant species that occur within the desert shrub vegetation community include: Indian ricegrass, galleta, bottlebrush squirreltail (*Elymus elymoides*), scarlet globemallow, woolly plaintain (*Plantago patagonica*), and desert trumpet (*Eriogonum inflatum*) (USDA-NRCS 2006a, USDA-NRCS 2006b).

This vegetation community accounts for less than one percent of the Project Area and occurs north of the White River in the northwestern portion of the SCPA.

Badlands/Rock Outcrop

Badlands and rock outcrops occur in all vegetation communities in the Uinta Basin. These areas are generally devoid of vegetation due to clay soils and steep slopes; however some plants may be found in small areas where water may accumulate or where the texture of alluvial material is more desirable for plant growth (USDA-NRCS 2006a, USDA-NRCS 2006b). In the SCPA, small areas of rock outcrops and badlands (less than one percent of the Project Area) occur along the White River in the northwestern portion of the Project Area.

3.7.1 INVASIVE, NON-NATIVE SPECIES

Invasive weeds are defined as plants that grow out of place and are competitive, persistent, and pernicious (James et al. 1991). Noxious weeds are invasive species that are designated by a Federal, State, or county government as injurious to public health, agriculture, recreation, wildlife or property. The spread of invasive and noxious weeds is a concern in areas proposed for surface development activities.

The most common locations for weeds include existing disturbance areas such as roadsides, well pads, pipeline ROWs, adjacent washes, and areas where grazing has removed native species. Roads facilitate biological invasion, where disturbed roadside habitats are invaded by non-native species, dispersed by wind, water, vehicles, and other human activities. Roads may be the first points of entry for exotic species into a new landscape, and the road can serve as a corridor for plants moving farther into the landscape (Gelbard and Belnap 2003; Forman and Alexander 1998).

Table 3.7-2 summarizes those weeds designated and published as noxious for Uintah County and the State of Utah. The most problematic noxious weeds in this area of Uintah County are saltcedar (*Tamarix ramosissima*) and hoary cress (*Cardaria draba*). The most common invasive species (not listed on the noxious weed list for the area) in the Project Area are Russian thistle (*Salsola iberica*), halogeton (*Halogeton glomeratus*), and cheatgrass (*Bromus tectorum*). Although not listed below, black henbane (*Hyoscyamus niger*) and houndstongue (*Hieracium cynoglossoides*) are weed species that may also occur in the SCPA, and are of special interest to the BLM VFO.

Table 3.7-2. Noxious Weeds of Uintah County and State of Utah

Common Name	Scientific Name
Bermuda grass	*Cynodon dactylon*
Canada thistle	*Cirsium arvense*
Diffuse knapweed	*Centaurea diffusa*
Dyer's woad	*Isatis tinctoria*
Field bindweed	*Convolvulus arvensis*
Hoary cress	*Cardaria draba*
Johnsongrass	*Sorghum halepense*
Leafy spurge	*Euphorbia esula*

Common Name	Scientific Name
Medusahead	*Taeniatherum caput-medusae*
Musk thistle	*Carduus nutans*
Perennial pepperweed	*Lepidium latifolium*
Perennial sorghum	*Sorghum halepense & S. almum*
Purple loosestrife	*Lythrum salicaria*
Quackgrass	*Elymns repens*
Russian knapweed	*Centaurea repens*
Russian olive	*Elaeagnus angustifolia*
Saltcedar	*Tamarix ramosissima*
Scotch thistle	*Onopordum acanthium*
Spotted knapweed	*Centaurea stoebe*
Squarrose knapweed	*Centaurea rigata*
Yellow starthistle	*Centaurea solstitialis*

3.7.2 WETLANDS/RIPARIAN ZONES

The BLM surveyed wetlands/riparian zones within the VFO. These areas differ from the riparian vegetation communities discussed above (**Section 3.2.7**) in that these areas are based on hydrological function as opposed to vegetation characteristics. BLM riparian management seeks to maintain, restore, improve, protect, and expand wetlands/riparian zones so they are in proper functioning condition for their productivity, ecological diversity, and sustainability. The VFO Approved RMP prohibits new surface-disturbing activities within active floodplains, wetlands, public water reserves, or 100 meters of riparian areas. An exception to this restriction could be authorized by the AO if there are no practical alternatives, impacts could be fully mitigated, or the action is designed to enhance riparian resources (BLM 2008e).

In the SCPA, wetlands/riparian zones are closely associated with the White River and Evacuation Creek. There are approximately 105 acres of wetlands/riparian zones, and approximately 4 miles of linear wetland/riparian features (those wetland/riparian features that were too small to map as a polygon) located along the White River in the northwestern portion of the SCPA. In addition, approximately 5 miles of linear wetland/riparian features follow the northern and southern sections of Evacuation Creek in the SCPA.

3.8 LIVESTOCK GRAZING

The SCPA contains portions of five grazing allotments: Little Emma, Hells Hole, Southam Canyon, Watson, and White River Bottoms allotments. These five allotments in the Project Area are grazed by sheep and cattle during various grazing periods. **Figure 3.8-1** provides a map of the grazing allotments that occur in the Project Area.

An animal unit month (AUM) is defined as “the amount of dry forage required by one animal unit for one month based on a forage allowance of 26 pounds per day” (BLM 2008e). Between the five allotments, there are approximately 1,005 livestock AUMs on 8,374 acres of usable land (those lands with a slope less than or equal to 40 percent) allotted for grazing within the Project Area.

All allotments have been placed in one of three management categories: Category M (Maintain Existing Resource Conditions), Category I (Improve Existing Resource Conditions), and Category C (Custodial Management). Designation of categories is dynamic and primarily based on resource potential, resource use conflicts, opportunity for positive economic return on public investments, and the present management situation (BLM 2008e). Details on each allotment, including management categories, within the SCPA are summarized in **Table 3.8-1**.

Table 3.8-1. Grazing Allotment Information in the Southam Canyon Project Area

Name	Type	Management Status	Use period	Total Allotment acres	Total Active AUMs	Usable[1] Acres w/in Project Area	AUMs[2] w/in Project Area
Hells Hole (#08819)	Sheep	Maintain	12/01-4/30	30,422	3,999	**6,556**	**862**
Little Emma (#15852)	Sheep	Maintain	11/27-4/30	44,782	3,624	**1**	**0**
Southam Canyon (#15843)	Sheep	Maintain	11/01-4/01	13,827	1,315	**1,176**	**112**
Watson (#08815)	Sheep	Custodial	11/15-4/30	25,425	1,258	**626**	**31**
White River Bottoms (#15850)	Cattle	Custodial	6/07-10/15	12,900	480	**15**	**1**
Totals						**8,374**	**1,005**

Source: BLM 2008c, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope less than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total AUMs and total acreage for each grazing allotment

3.9 WILDLIFE AND FISHERIES

The SCPA supports a diversity of wildlife species and habitats. Species occurrences are typically dependent on habitat availability, carrying capacities, and the degree of existing habitat disturbance. The SCPA supports approximately 10,575 acres of wildlife habitat including a large, fairly contiguous upland habitat, dissected by the incised intermittent drainages of Evacuation Creek and Southam Canyon. Past oil and gas development, consisting of six existing wells and their associated ROWs and facilities, has fragmented wildlife habitats in the area. Water resources are limited within the SCPA, and therefore the White River, which flows through the northwestern corner of the SCPA, and the wetland/riparian zones associated with Evacuation Creek, which bisects the SCPA, provide the greatest habitat value for wildlife and fisheries.

3.9.1 GENERAL WILDLIFE

Small mammals potentially found within the SCPA and surrounding region include the cottontail rabbit (*Sylvilagus* spp.), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), and various species of rodents and bats including the Townsend's big-eared bat (*Corynorhinus townsendii*) and fringed myotis (*Myotis thysanodes*). Bird species that may be present include numerous migratory birds (see **Section 3.9.3**) and raptors (see **Section 3.9.4**). Herptiles potentially found in the region include the wandering garter snake (*Thamnophis elegans vagrans*), Great Basin gopher snake (*Pituophis catenifer deserticola*), milksnake (*Lampropeltis*

triangulum), Great Basin spadefoot toad (*Scaphiopus intermontana*), western whiptail (*Cnemidophorus tigris*), sagebrush lizard (*Sceloporus graciosus*), and shorthorned lizard (*Phymosoma douglassii*).

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 relationships of most of these species to the proposed development are not discussed in the same depth as those species that are threatened, endangered, candidate, sensitive, of special economic interest, or are otherwise of high interest or unique value (special status species are discussed in **Section 3.11**).

3.9.2 BIG GAME

Four resident big game species are known to occur in the SCPA: mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*), and bison (*Bos bison*). The UDWR has identified various types of seasonal ranges (e.g., winter, yearlong, and fawning) within the SCPA (**Figures 3.9-1** through **3.9-4**). UDWR ranges are ranked according to their relative biological value and are defined below. Under the VFO ROD and Approved RMP, the BLM has committed to managing big game ranges as defined by the UDWR (BLM 2008e).

> *Crucial*: 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 value habitat will lead to significant declines in carrying capacity and/or numbers of the wildlife species in question.
>
> *Substantial*: 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.

3.9.2.1 Mule Deer

Mule deer occur throughout the western mountains, forests, deserts, and brushlands. Typical habitats include short-grass and mixed-grass prairies, sagebrush and other shrublands, coniferous forests, and forested and shrubby riparian areas. The species is common State-wide in Utah, where it can be found in many types of habitat, ranging from open deserts to high mountains to urban areas. Mule deer often migrate from high mountainous areas in the summer to lower elevations in the winter to avoid deep snow (UNHP-UDWR 2008).

Although mule deer primarily occupy the SCPA during the winter, the species also occupies the portion of the White River corridor in the northwestern portion of the SCPA on a year-round basis. The UDWR has identified a small area (approximately 612 acres) in the northwestern portion of the SCPA as crucial value, year-long fawning habitat (**Figure 3.9-1**). The majority of the SCPA has been identified as crucial value winter habitat (approximately 1,752 acres) and substantial value winter habitat (approximately 7,501 acres) (**Figure 3.9-1**). Seasonal timing restrictions in the Vernal ROD and Approved RMP would apply to portions of mule deer habitat in the SCPA. Specifically, no exploration, drilling, or other development activities would be allowed from May 15 to June 30 in crucial deer fawning habitat. Maintenance of producing wells would be allowed. Additionally, no activities that would result in adverse impacts to deer would

be allowed in crucial deer winter habitat from December 1 through April 30, and no more than 10 percent of such habitat would be subject to surface disturbance and remain un-reclaimed at any given time (BLM 2008e). Mule deer that occupy the SCPA are part of the Book Cliffs mule deer herd unit (Herd Unit #10), which currently falls approximately 35 percent below the UDWR-population objective for this herd (UDWR 2007 – B. Williams, personal correspondence, November 2007).

3.9.2.2 Elk

Elk are common in most mountainous regions of Utah, where they can be found in meadows and forests during the summer, and in foothills and valley grasslands during the winter. The seasonal changes in elevation allow elk to avoid deep snow and find food year-round. Like other members of the deer family, this species relies on a combination of browse, grasses, and forbs, depending on their availability throughout the year. Elk may be active day and night, but most activity occurs at dusk and dawn (UNHP-UDWR 2008).

Elk occupy the southwestern portion of the SCPA during the winter. The UDWR has identified approximately 3,715 acres of substantial value, winter habitat in pinyon-juniper woodlands in the SCPA (**Figure 3.9-2**). Elk that occupy the SCPA are part of the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10), which currently falls approximately 53 percent below the UDWR-population objective for this subunit (UDWR 2007 – B. Williams, personal correspondence, November 2007).

3.9.2.3 Rocky Mountain Bighorn Sheep

The Rocky Mountain bighorn sheep is native to rugged mountainous areas of western North America. In Utah, a great effort has gone into re-establishing Rocky Mountain bighorn sheep, and the species can now be found in a number of mountain ranges. Rocky Mountain bighorn sheep prefer steep rocky slopes, and may migrate from higher elevations to lower valleys in the winter (Fitzgerald et al 1994; UNHP-UDWR 2008).

Rocky Mountain bighorn sheep occupy the SCPA on a year-round basis. The UDWR has identified approximately 2,315 acres of crucial value, year-long bighorn sheep habitat along the Evacuation Creek and White River corridors in the SCPA (**Figure 3.9-3**). No management objectives exist for this Rocky Mountain bighorn sheep population due to the high number of domestic sheep and their grazing allotments within the area (UDWR 2007 – B. Williams, personal correspondence, November 2007).

3.9.2.4 American Bison

Bison once roamed from Canada to northern Mexico. Due to over-hunting and habitat alteration, the species was close to extinction by the early 1900s. Since then, protective measures have improved bison populations such that bison can now be found in several areas of Utah, including the Henry Mountains and Antelope Island. They are hunted on a limited basis in the State. Bison prefer plains, grassland, and open woodland habitats. Bison today make shorter migrations than their pre-1900 predecessors (UNHP-UDWR 2008).

The UDWR has identified almost the entire SCPA (approximately 10,498 or 99 percent of the SCPA) as crucial value, year-long habitat for bison (**Figure 3.9-4**). Bison that occupy the SCPA are part of the Book Cliffs bison herd unit, which has a current population objective of 450 individuals (UDWR 2007 – D. Mangus, personal correspondence, November 2007). Bison were

reintroduced to the Book Cliffs through a joint agreement between the UDWR and the Ute Tribe Fish and Game in August 2008. The initial reintroduction released 14 bison from the annual Hill Creek bison roundup to the Book Cliffs. Another 30 bison have been scheduled for release later in 2008 (UDWR 2008a).

3.9.3 MIGRATORY BIRDS

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703 et seq.), as amended, 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.

The following sections address migratory birds that may inhabit the SCPA, including those species classified as Priority Species by Utah Partners-in-Flight (PIF). Priority Species are denoted by an asterisk (*). Utah PIF is a cooperative partnership among Federal, State, and local government agencies as well as public organizations and individuals organized to emphasize the conservation of birds not covered by existing conservation initiatives. Migratory bird species that may utilize the SCPA are listed below based on preferred habitats (i.e., nesting and foraging habitats) and vegetative communities present in the area. Those migratory bird species, including special status raptors that are Federally-listed under the Endangered Species Act (ESA) of 1973, as amended, candidates for Federal listing under the ESA, or listed as State sensitive are addressed in **Section 3.10**. Non-special status raptor species are addressed in **Section 3.9.4**.

Sagebrush – The following migratory bird species may be associated with sagebrush communities (Wyoming big sagebrush and black sagebrush), which collectively constitute the largest vegetation community within the SCPA: Brewer's sparrow* (*Spizella breweri*), mountain bluebird (*Sialia currucoides*), sage sparrow* (*Amphispiza belli*), horned lark (*Eremophila alpestris*), sage thrasher (*Oreoscoptes montanus*), and vesper sparrow (*Pooecetes gramineus*). These birds may also utilize the desert shrub vegetation community (Parrish et al. 2002).

Pinyon-Juniper – The following migratory bird species may be associated with pinyon-juniper habitat, which is the second largest vegetation community within the SCPA: ash-throated flycatcher (*Myiarchus cinerascens*), black-chinned hummingbird (*Archilochus alexandri*), black-throated gray warbler* (*Dendroica nigrescens*), blue-gray gnatcatcher (*Polioptila caerulea*), Cassin's kingbird (*Tyrannus vociferans*), common nighthawk (*Chordeiles minor*), common poorwill (*Phalaenoptilus nuttallii*), gray flycatcher, gray vireo* (*Vireo vicinior*), loggerhead shrike, Scott's oriole (*Icterus parisorum*), Virginia's warbler* (*Vermivora virginiae*), and western bluebird (*Sialia mexicana*) (Parrish et al. 2002).

Riparian Areas – The following migratory bird species may be associated with riparian areas along the White River within the SCPA: American goldfinch (*Carduelis tristis*), bank swallow (*Hirundo rustica*), belted kingfisher (*Ceryle alcyon*), black-billed magpie (*Pica pica*), black-capped chickadee (*Parus atricapillus*), broad-tailed hummingbird* (*Selasphorus platycercus*), Bullock's oriole (*Icterus bullockii*), downy woodpecker (*Picoides pubescens*), Lewis' woodpecker (*Melanerpes lewis*), northern flicker (*Colaptes auratus*), western kingbird (*Tyrannus verticalis*), western wood-pewee (*Contopus sordidulus*), yellow warbler (*Dendroica petechia*), and Wilson's phalarope (*Phalaropus tricolor*) (Parrish et al. 2002).

3.9.4 RAPTORS

Some of the more common and visible birds within the SCPA are the raptors, or birds of prey. The SCPA provides diverse breeding and foraging habitats for raptors including lowland riparian areas, desert shrub communities, pinyon-juniper woodlands, and lower elevation shrublands. **Table 3.9-1** identifies those raptor species with the potential to occur in the SCPA, and a description of their typical nesting habitats.

Table 3.9-1. Raptor Species with the Potential to Occur in the SCPA

Common Name	Scientific Name	Nesting Habitats
American Kestrel	*Falco sparverius*	Holes in tree cavities, cliff crevices
Bald Eagle	*Haliaeetus leucocephalus*	Large trees near rivers, lakes, marshes, or other wetland areas
Cooper's Hawk	*Accipiter cooperii*	Woodland and riparian zones
Ferruginous Hawk	*Buteo regalis*	Trees and shrubs, cliffs, utility structures, and rock outcrops
Golden Eagle	*Aquila chrysaetos*	Cliff ledges and rock outcrops
Great-horned Owl	*Bubo virginianus*	Cliff ledges or nests of other species
Long-eared Owl	*Asio otus*	Coniferous and deciduous forests, and shrublands
Mexican Spotted Owl	*Strix occidentalis lucida*	Steep-walled canyons with mixed conifer forests
Northern Harrier	*Circus cyameus*	Ground within thick vegetation
Peregrine Falcon	*Falco peregrinus*	Cliff ledges
Prairie Falcon	*Falco mexicanus*	Cliff ledges
Red-tailed Hawk	*Buteo jamaicensis*	Cliff ledges, rock outcrops, aspen, pinyon-juniper woodlands
Sharp-shinned Hawk	*Accipiter striatus*	Coniferous forests
Short-eared Owl	*Asio flammeus*	Arid grassland and shrublands
Swainson's Hawk	*Buteo swainsoni*	Cottonwoods, spruce, or serviceberry

Review of BLM records identified several raptor nests in or within ½-mile of the SCPA. The following nest sites have been documented: two golden eagle (*Aquila chrysaetos*) nests, three red-tailed hawk (*Buteo jamaicensis*) nests, two prairie falcon (*Falco mexicanus*) nests, one great-horned owl (*Bubo virginianus*) nest, and one unknown nest. No bald eagle (*Haliaeetus leucocephalus*) roost sites had been identified along the portion of the White River that flows within or near the SCPA.

In 2006, a baseline aerial raptor nest inventory was conducted for all habitats occurring inside the SCPA (B&A 2006). Potential raptor nesting habitat within the area consists primarily of pinyon-juniper woodlands and cliffs/rock outcrops. Eight raptor nests, including one active golden eagle nest, one inactive accipiter nest, and six other inactive nests, were found at the time of the survey; these nests occurred within the vicinity of, but west of, the SCPA. All but one of the observed raptor nests were built on cliff faces. In addition to these nesting sites, other raptors may have established or could establish territories, nests, and/or roosting sites within or near the SCPA. Nest sites could occur on rock outcrops, on taller shrubs, or in trees.

All raptor species and their nests are protected from take or disturbance under the MBTA; however, because Mexican spotted owls, bald eagles, and golden eagles are considered to be special status raptor species, they are discussed in further detail in **Section 3.10**.

3.9.5 UPLAND GAME BIRDS

Two resident upland game bird species are known to occur in the SCPA: greater sage-grouse (*Centrocercus urophasianus*) and chukar (*Alectoris chukar*). As the sage-grouse is considered to be a special status species, detailed discussion of the grouse follows in **Section 3.10**.

3.9.5.1 Chukar

Intensive efforts began in Utah in 1951 to establish the chukar, a species native to the Middle East and southern Asia. By 1968, about 186,000 chukars had been released at 191 different sites. This wide distribution, largely on public lands, provides the potential for increased hunter participation and harvest (UNHP-UDWR 2008).

The chukar prefers steep, rocky, semi-arid slopes, riparian brush, and open desert (Ehrlich et al. 1988; UNHP-UDWR 2008). Low shrubs and rocky outcrops provide loafing or escape cover. The species seems to prefer rabbitbrush, sagebrush, saltbrush, and cheatgrass vegetative associations below the juniper tree belt, where nests may be built on the ground, usually concealed by rocks, low-growing shrubs, or clumps of grass. Water sources may be used extensively in late summer, when their diet consists of grass seeds, weed seeds, and insects. In winter, new growth cheatgrass is an extremely important principal food item (UNHP-UDWR 2008).

The UDWR has identified approximately 5,705 acres of substantial value, year-long chukar habitat located primarily in sagebrush vegetation along the White River and Evacuation Creek corridors (**Figure 3.9-5**).

3.9.6 FISHERIES

All drainages in the SCPA are considered part of the Upper Colorado River Basin. Fishery habitat in the SCPA occurs in the White River, which flows through the northwestern corner of the SCPA. **Table 3.9-2** presents those fish species that could occur in or downstream from the Project Area. Two intermittent streams (Evacuation Creek and Southam Canyon) also occur in the SCPA. However, these streams only flow at certain times of the year and therefore, generally do not hold enough water to support fish populations.

Table 3.9-2. Fish Species Potentially Present in or Downstream of the SCPA

Common Name	Scientific Name	Status
Bluehead Sucker	*Catostomus discobolus*	UDWR Conservation Agreement Species
Bonytail	*Gila elegans*	Federally endangered
Carp	*Cyprinus carpio*	Common
Channel Catfish	*Ictalurus punctatus*	Common
Colorado Pikeminnow	*Ptychocheilus lucius*	Federally endangered
Flathead Minnow	*Pimephales promelas*	Common
Flannelmouth Sucker	*Catostomus latipinnis*	UDWR Conservation Agreement Species
Humpback Chub	*Gila cypha*	Federally endangered
Northern Pike	*Esox lucius*	Common
Razorback Sucker	*Xyrauchen texanus*	Federally endangered
Red Shiner	*Cyprinella lutrensis*	Common
Roundtail Chub	*Gila robusta*	UDWR Conservation Agreement Species

Federally-listed endangered species and UDWR-designated sensitive fish species are addressed further in **Section 3.10**.

3.10 SPECIAL STATUS WILDLIFE AND FISHERY SPECIES

This section discusses wildlife and fishery species that have a special-status designation, which includes:

- Species Federally-listed as threatened or endangered, proposed for Federal listing as threatened or endangered, or considered to be a candidate for Federal listing as threatened or endangered under the ESA;
- Species listed as sensitive by the UDWR, including both wildlife species of concern and species receiving special management under a Conservation Agreement in order to preclude the need for Federal listing; and
- Species protected under certain specified regulations.

In accordance with Section 7(a)(2) of the ESA, the USFWS must ensure that any Federal action to be authorized, funded, or implemented does not jeopardize the continued existence of a listed species, or destroy or adversely modify the listed species' critical habitat. It is the BLM's current policy that candidate species and State sensitive species are also managed to prevent a future Federal listing as threatened or endangered.

Special status species that have the potential to occur within the SCPA or be affected by development activities within the SCPA are discussed below. Refer to the "Summary of Potential for and/or Occurrence of Special Status Wildlife Species" (**Appendix D**) for further analysis of all special status species and their potential to occur in the SCPA.

3.10.1 MEXICAN SPOTTED OWL

The Mexican spotted owl (MSO) is Federally-listed as a threatened species. At the northern end of their range, which includes the State of Utah, the MSO is a year-round resident of narrow, shady cool canyons between 4,400 - 6,800 feet in elevation. Most of the owl's activities during the breeding season are believed to occur within the canyons. Owls roost in riparian vegetation of canyon bottoms, on ledges, or cavities in the slickrock canyon. Habitats suitable for MSO nesting appear to be more restricted than those required for foraging or roosting. Areas with high canopy closure and at least a few old-growth trees are usually selected for nesting (USFWS 1995). Canyon habitats used for nesting and roosting are typically characterized by the cooler conditions found in steep, narrow canyons, often containing crevices, ledges, and/or caves. These canyons frequently contain small clumps or stringers of ponderosa pine, Douglas-fir, white fir, and pinyon/juniper. Deciduous riparian and upland tree species may also be present. One common characteristic among the canyon sites is the presence of steep to vertical rock walls in all or part of the canyon. Rock-walled canyons preferred by the owls are generally found at elevations below 7,000 feet to as low as 3,750 feet (Ganey and Balda 1989).

There is no designated critical habitat for the MSO on lands administered by the VFO[2]. The Vernal planning area has been identified as containing suitable MSO habitat according to the

[2] USFWS-designated MSO critical habitat (CP-15) closest to the SCPA is located in Desolation Canyon in Carbon and Emery Counties, Utah.

USFWS 1997 and 2000 models by Willey and Spotskey. The majority of the modeled MSO habitats in the VFO area were further evaluated by computer models or ground-truthed between 2003 and 2005. According to these analyses, portions of the SCPA were considered potential "poor" MSO habitat, and "fair" habitat was identified approximately 0.47 miles northeast of the SCPA (SWCA 2005). At the direction of the BLM, areas of "poor" habitat do not require surveys for the presence of MSO prior to surface-disturbing activities. However, all areas of "fair" or better habitat identified in the *2005 Assessment of Potential MSO Nesting Habitat on BLM-administered Lands in Northeastern Utah* (SWCA 2005) must be surveyed for the presence of MSO prior to any disturbance within ½-mile of these areas. In the summer of 2007 and 2008, MSO surveys were conducted according to USFWS 2003 Mexican Spotted Owl Survey Protocol to evaluate the potential MSO "fair" habitat adjacent to the SCPA. These surveys resulted in some incidental great-horned owl responses, but no MSO response. Due to the lack of MSO response, it was inferred that MSO were absent in the surveyed area at the time the survey was conducted (B&A 2007; B&A 2008).

3.10.2 YELLOW-BILLED CUCKOO

The yellow-billed cuckoo (*Coccyzus americanus*) is a candidate for listing under the ESA. This species is a neotropical migratory species that breeds in the U.S. and Canada, and winters in South America (USFWS 2001). The cuckoo is a riparian obligate bird that feeds in cottonwood groves and nests in willow thickets. Nest sites have been correlated with large patches (greater than 10 hectares) of gallery cottonwood-willow stands, dense understories, high local humidity, low local temperatures, and in proximity to slow or standing water.

In Utah, this neotropical migrant nests in riparian areas and has been documented in cottonwood habitat along the Green River (Howe and Hanberg 2000). In this survey, a total of 16 yellow-billed cuckoos were detected at four different sites along the Green River from Hydes Bottom to the Stirrup. Breeding was not confirmed during this survey; however, it is possible that breeding occurred as indicated by the presence of birds and territories during late season survey efforts (Howe and Hanberg 2000).

Although no yellow-billed cuckoo nests have been identified within the SCPA, potential nesting habitat may occur in riparian vegetation associated with the portion of the White River that flows through the SCPA.

3.10.3 BALD EAGLE

Effective August 8, 2007, the USFWS delisted the bald eagle (*Haliaeetus leucocephalus*) in the lower 48 States from the Federal list of endangered and threatened wildlife (72 FR 37346). However, the bald eagle is still protected under the Bald and Golden Eagle Protection Act (BGEPA) and the MBTA. In addition, the USFWS, in compliance with Section 4(g)(1) of the ESA, will monitor the status of the bald eagle over a 20-year period with sampling events held once every 5 years (USFWS 2007). The result of the post-delisting monitoring plan will be to determine if the population of bald eagles in the lower 48 States warrants expanded monitoring, additional research, and/or resumption of Federal protection under the ESA (USFWS 2007).

Although bald eagles have shown recovery across their range, the number of nesting pairs in Utah is low; to date there are only nine known bald eagle breeding pairs in the State of Utah (72 FR 37346). Although no bald eagle nesting sites exist within or near the SCPA, known winter roost sites are located along the Green River, west of the SCPA. These winter roost sites do not occur within ½-mile of the SCPA. Wintering bald eagles concentrate at established roosting sites for

the purpose of feeding and sheltering in close proximity to sufficient food sources. Winter roosting usually occurs from early November through late March, and bald eagles may periodically utilize the SCPA as foraging habitat during this time period.

3.10.4 GOLDEN EAGLE

The golden eagle (*Aquila chrysaetos*) is protected under the MBTA and 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 their breeding range migrate south for the winter. However, golden eagles in Utah are considered to be year-round residents. Golden eagles are quite common in Uintah County and the VFO. Throughout the summer, golden eagles are found in mountainous areas, canyons, shrublands, and grasslands. During the winter, they inhabit shrubsteppe vegetation, as well as wetlands, river systems, and estuaries. Golden eagle nests are constructed on cliffs or in large trees. In Utah, eggs are laid from late February to early March (UNHP-UDWR 2008).

Review of BLM records identified two golden eagles nests within the SCPA boundary. Additionally, potential nesting and foraging habitat is found throughout the SCPA; therefore, additional breeding golden eagles could or may have established territories/nests in the SCPA.

3.10.5 GREATER SAGE-GROUSE

The greater sage-grouse (*Centrocercus urophasianus*) is a UDWR wildlife species of concern because widespread losses of sagebrush habitat have caused a decline in population size and have limited species distribution within the State. Large fragments of sage-grouse habitat have been lost throughout Utah due to a variety of developments including intensive domestic livestock grazing, indiscriminate pesticide spraying, cropland conversion, wildfires, and the invasion of exotic species (e.g., smooth brome, crested wheatgrass) (UDWR 2002; UNHP-UDWR 2008). Today, sage-grouse are found in 26 of Utah's counties (including Uintah County) and are thought to only occupy 50 percent of their historic habitat (UDWR 2002). In Utah, sage-grouse inhabit sagebrush habitat of the Colorado Plateau and Great Basin geographic regions from 6,000-9,000 feet above mean sea level (UDWR 2002). In Uintah County, Utah, the largest populations of sage-grouse are on Diamond and Blue Mountains, with smaller populations scattered throughout the County (UDWR 2002).

Sage-grouse are a sagebrush-obligate species that rely almost exclusively on contiguous sagebrush ecosystems for leks, nesting sites, feeding sites, rearing sites, protection and wintering grounds. Based largely on the presence of contiguous sagebrush vegetation, the UDWR has identified the following habitats for sage-grouse in the SCPA: approximately 4,804 acres of crucial value brooding areas and approximately 4,804 acres of crucial value winter habitat (see Figure 3.10-1). These two habitats overlap one another in the eastern portion of the SCPA, east of the Evacuation Creek corridor. No leks or nesting habitat have been identified within the SCPA. However, UDWR identified one possible lek (the Watson lek) less than one mile from the southeastern corner of the SCPA. Males and females have been observed in this area, but no strutting has been observed. As such, it is unclear if these sage-grouse are tied to another population or are just a small, isolated group. The UDWR continues to monitor this area each spring; however, no counts have been made. The Watson lek was last monitored in spring 2008, at which time, the UDWR found droppings in the area, but no sage-grouse (UDWR 2008b).

3.10.6 ENDANGERED COLORADO RIVER FISHES

3.10.6.1 Bonytail

The bonytail (*Gila elegans*) is a Federally-endangered fish species. Historically, the bonytail was a common species in the main river channels of the Colorado River systems; however, today the bonytail exists in very low numbers in its natural 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. A few individuals have been caught in the Green River in Hideout Canyon and Gray Canyon, and at the confluence of the Colorado River and the Green River. Releases of hatchery-reared bonytail into the Upper Basin have resulted in low survival, with no evidence of reproduction or recruitment. The bonytail is adapted to mainstem rivers where it has been observed in pools and eddies. Flooded bottomland habitats are important growth and conditioning areas for bonytail, particularly as nursery habitats for young (USFWS 2002a).

In Utah, a total of 139 river miles and their associated 100-year floodplains have been designated by the USFWS as critical habitat for the bonytail in portions of the Green River and Colorado River. Critical habitat for the bonytail is not present in the SCPA. The closest USFWS-designated critical habitat for the bonytail is located in the Green River, upstream from its confluence with the White River (approximately 33 miles from the SCPA) (USFWS 2008).

3.10.6.2 Colorado Pikeminnow

The Colorado pikeminnow (*Ptychocheilus lucius*), formerly known as the Colorado squawfish, is a Federally-endangered fish species. The Colorado pikeminnow is endemic to the Colorado River Basin where it has 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. Today, 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 mainstem of the Colorado River from Palisade, Colorado, to Lake Powell. The Yampa River and Gray Canyon of the lower Green River hold the two principal spawning sites of this species (USFWS 2002b).

A total of 726 river miles in Utah have been designated by the USFWS as critical habitat for the Colorado pikeminnow. This critical habitat occurs in portions of the Green, Colorado, White, and San Juan Rivers and their respective 100-year floodplains, including the portion of the White River (approximately 1.6 river miles) that flows through the SCPA (USFWS 2008).

3.10.6.3 Humpback Chub

The humpback chub (*Gila cypha*) is a Federally-endangered fish species. In Utah, specimens of humpback chub have been reported from the upper Green River, Desolation Canyon on the Green River, the lower Yampa River, the White River, and the Colorado River above and below Glen Canyon Dam. 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 (i.e., a form of limestone) dams. The highest known concentrations of humpback chub are found in the Westwater Canyon and Grand Canyon reaches of the Colorado River. Humpback chub in the Desolation/Gray Canyons of the Green River is the third most abundant population of this species (USFWS 2002c).

In Utah, a total of 139 river miles and their associated 100-year floodplains have been designated by the USFWS as critical habitat for the humpback chub in portions of the Green River and Colorado River. Critical habitat for the humpback chub is not present in the Project Area. The closest USFWS-designated critical habitat for the humpback chub is located in the Green River, upstream from its confluence with the White River (approximately 33 miles from the SCPA) (USFWS 2008).

3.10.6.4 Razorback Sucker

The razorback sucker (*Xyrauchen texanus*) is a Federally-endangered fish species. 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. 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. The largest population of razorback sucker in the Upper Colorado River Basin exists in low-gradient, flat-water reaches of the middle Green River between the Duchesne River and Yampa River (USFWS 2002d).

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. Razorback suckers 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 (USFWS 2002d).

In Utah, a total of 688 river miles and their associated 100-year floodplains have been designated by the USFWS as critical habitat for the razorback sucker in portions of the Green, Colorado, Duchesne, White, and San Juan Rivers. Critical habitat for the razorback sucker is not present in the Project Area. The closest USFWS-designated critical habitat for the razorback sucker is located in the White River approximately 13 miles downstream of the SCPA (USFWS 2008).

3.10.7 STATE SENSITIVE FISHES

3.10.7.1 Bluehead Sucker

The bluehead sucker (*Catostomus discobolus*) is a Utah State sensitive species found in the Upper Colorado River Basin. Bluehead suckers occur in small to large streams, rivers, and tributaries in the Upper and Lower Colorado River Basin, including the Green River. Large adult bluehead may inhabit stream environments as deep as 2 to 3 meters, although they most commonly feed in riffles and swift runs. Spawning occurs in spring and early summer at lower elevations and mid- to late summer in colder waters at higher elevations. Spawning occurs on gravel beds in shallow water (Sigler and Sigler 1996).

Populations of the bluehead sucker currently occur in the mainstem of the 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 about 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. Known distribution of this species includes portions of the Green River downstream of the SCPA (UNHP-UDWR 2008).

3.10.7.2 Flannelmouth Sucker

The flannelmouth sucker (*Catostomus latipinnis*) is listed as a Utah State sensitive species found in the Upper Colorado River Basin. Flannelmouth suckers typically inhabit deep water habitats of large rivers, but are also found in small streams and occasionally in lakes. Flannelmouth suckers spawn during March and April in the southern portions of Utah and from May to June in northern Utah at higher elevations (Sigler and Sigler 1996).

Flannelmouth sucker populations can be found in the Green River from the Colorado River confluence upstream to the Flaming Gorge Reservoir, and the White River from Kenny Reservoir in Colorado to the Green River. Recent investigations of historical accounts and museum specimens 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 Green River in Wyoming and Utah (Flaming Gorge Reservoir), as well as the impoundment of the Colorado River in Glen Canyon, Utah (Lake Powell). Known distribution of this species includes portions of the Green River downstream of the SCPA (UNHP-UDWR 2008).

3.10.7.3 Roundtail Chub

The roundtail chub (*Gila robusta*) is listed as a Utah State sensitive species and is found in the Upper Colorado River Basin. This species is a large member of the minnow family and is found most often in major rivers and smaller tributary streams. The roundtail chub has been described as varying from sedentary to mobile, depending on life stage and habitat conditions (Sigler and Sigler 1996).

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. In the Upper Colorado River Basin (New Mexico, Utah, Colorado and Wyoming), the species has been extirpated from about 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. Known distribution of this species includes portions of the Green River downstream of the SCPA (UNHP-UDWR 2008).

3.11 RECREATION

The Project Area is located primarily on public lands administered by the BLM (83 percent of the 10,575 acre Project Area). The remaining 17 percent is comprised of private, State, and Tribal lands scattered throughout the area. Within the Project Area, visitors encounter extensive open areas where they can participate in dispersed activities in an unrestricted setting. However, the network of roads, along with existing oil and gas facilities and associated development in the area, reduce the primitive character of the Project Area for visitors seeking solitude and relatively pristine landscapes. Primary access to the Project Area is via State Highway 45 as well as Dragon Road and Southam Canyon Road, both Class 1-B gravel roads. These roads provide access to and within the Project Area for recreational users.

Big game hunting in the Project Area takes place in the fall and winter. The SCPA is part of the Limited Entry hunting area for elk and deer. The Project Area is primarily located within the Book Cliffs Bitter Creek wildlife management unit. A small portion of the Project Area is also

located in the South Slope Bonanza management unit. In the spring, antler collection is a popular activity by foot, horseback, and off highway vehicles (OHV).

All of the BLM lands within the the Project Area are designated as "limited" to OHV use to protect important wildlife habitat and recreation values. Areas designated as "limited" restrict OHV use to designated trails and travel routes or to certain seasons (BLM 2008e). There are no developed recreational facilities or established OHV trail systems within the immediate Project Area. Therefore, much of the camping and OHV travel that occurs in or near the Project Area is related to big game hunting.

River Recreation: The majority of recreational use in the project vicinity is associated with the White River which bisects the northwestern corner of the Project Area. The river is used extensively for canoeing, floating, fishing, hunting, wildlife and waterfowl viewing, and exploration of historical sites. The White River is a major source for commercial and private boating draws an estimated 2,000 people per year to this section of the White River. The most popular segment, a portion of which is within the project area, begins at the Bonanza Bridge and ends at the Enron take-out (BLM 2008d, Appendix C). In accordance with the VFO Approved RMP, there would be no new surface disturbing activities allowed within the line of sight from the centerline, up to ½ mile along both sides of the White River from where the river enters T10S, R24E to where the river leaves Section 18, T10S, R23E. This restriction includes lands within the upper portion of the Project Area. Valid leases which predate the RMP (2008e) would be excepted.

3.12 VISUAL RESOURCES

Public lands managed by the BLM within the Project Area have been classified according to BLM's Visual Resource Management (VRM) system, an analytical process used to inventory, manage, and set management objectives for visual resources on public lands. The area classification can be used to determine the visual impact of proposed activities and to measure the amount of disturbance an area can tolerate before the proposed activity exceeds the VRM.

The majority of the Project Area (5,957 acres) occurs within a VRM Class III area. In accordance with Class III objectives, the landscape should partially retain the existing character and changes to the landscape are moderate. The northern portion of the Project Area along the White River (646 acres) is classified as a VRM Class II area. VRM Class II objectives include retaining the existing character of the landscape and allowing for management activities that do not attract the attention of a casual viewer. The remaining 2,209 acres of BLM lands in the Project Area are classified as a VRM Class IV, which allows for changes in the landscape's original composition and character to dominate the viewshed (BLM 2008d, Appendix I).

The SCPA falls within an active oil and gas unit. As such, a number of well pads, ancillary facilities, access roads, and surface pipelines have modified the natural character of Project Area on both Federal and State lands. Six wells have been developed within the SCPA, three within VRM III areas and the other three within VRM IV areas.

Given the viewer sensitivity of recreationists on the White River, GIS viewshed analyses have been completed to determine the extent of lands which can be seen by the casual observer on the river (**Figure 3.12-1**).

3.13 LAND USE AUTHORIZATION

As discussed in **Section 1.2**, the Project Area consists predominantly of lands managed by the BLM (8,813 acres). The remainder of land is managed by the State of Utah (162 acres), and private land owners (1,600 acres).

Federal lands within the Project Area are managed for multiple uses under the VFO Approved RMP and ROD (BLM 2008e). Existing and/or authorized land uses on Federal lands within the Project Area include oil and gas development, oil shale development, water development, and grazing. In addition lands within the Project Area provide habitat for a number of wildlife species and are used for recreational activities.

3.13.1 RIGHTS-OF-WAY

Prior to using or constructing a road, pipeline, or ancillary facility located on BLM-administered lands outside of the lease or unit on which the proposed project is being conducted, oil and gas operators are required to submit a ROW application. ROW applications must also be submitted prior to constructing water management and transportation facilities, electrical generation and transmission facilities, communications systems, and all other transportation systems.

An LR2000 database search was conducted in July of 2008 to identify all pending or authorized ROWs within the Project Area. These ROWs are discussed in **Table 3.13-1**.

Table 3.13-1. Authorized and Pending Rights-of-Way within the Project Area

Applicant or ROW Holder	Type	Status	Township and Range	Section(s)	Acreage
Utah Division of Water Resources	Water Facility	Authorized	10S:24E 10S:25E	11,12,14,15,22 18	2,377
Mid-American Pipeline	O&G pipeline	Authorized	10S:24E 10S:25E	12,13 18	1.25
Uintah County	Road	Authorized	10S:24E 10S:25E	12,13 18	38.7
Uintah County	Road	Authorized	10S:25E	30,31	25.6
Uintah County	Road	Pending	10S:25E	31	0.1
Uintah County	Road	Pending	10S:24E	12,13,14,23,24,26,27,34,35	0.1
XTO	O&G Pipeline	Authorized	10S:24E	27	17.1
Mid-American Pipeline	O&G Pipeline	Authorized	10S:24E 10S:25E	12,13 18	1,181.8
Enduring Resources	Road	Authorized	10S:25E	19	4.6
Enduring Resources	O&G Pipeline	Authorized	10S:25E	19	0.88
Enduring Resources	O&G Pipeline	Authorized	10S:25E	18	2.17
Enduring Resources	O&G Pipeline	Authorized	10S:24E	13	0.38
OSEC	Water Facility	Authorized	10S:24E	15,22	26.9
OSEC	Road	Authorized	10S:24E	14,15,22,23	17.8
ETC Canyon	O&G Pipeline	Authorized	10S:24E	12	17.0

Applicant or ROW Holder	Type	Status	Township and Range	Section(s)	Acreage
Pipeline			10S:25E	18,19	
Moon Lake Electric	Power Transmission Line	Authorized	10S:24E 10S:25E	12 18,19	55.0

As demonstrated by **Table 3.6-1**, there are a number of pending and authorized ROWs and ROW holders within the Project Area. The majority of the ROWs that have been applied for and issued are for road use or pipeline construction.

In addition to ROWs for roads and pipelines, the Project Area contains two ROWs for water facilities. ROW UTU-030745 was issued to the Utah Division of Water Resources for the construction of the White River Dam, which was planned to be constructed as part of the Central Utah Project. The ROW for the White River Dam and reservoir covers approximately 321 acres of the 10,574 acre Project Area (3 percent). An environmental impact statement was completed for the potential White River Dam Project by the BLM Vernal Field Office in 1980; however, the dam was never constructed. Although the State Of Utah has never relinquished the ROW for this water facility, neither the State Of Utah's Water Plan (Utah Division of Water Resources 2001) or the Uintah Basin's Water Plan (Utah Division of Water Resources 1999) give any indication that the White River Dam site will be developed in the reasonably foreseeable future.

The second water management facility is associated within the OSEC's oil shale RD&D area within the Project Area. More information on the RD&D project is provided in the section below as well as in **Section 3.2.2**-(Mineral and Energy Resources).

3.13.2 MINERAL LEASES

In addition to conventional oil and gas extraction, there are other mineral extraction activities that take place within the Project Area. An LR2000 database search was conducted to identify all pending or authorized non-oil and gas mineral leases as well as any mining claims within the Project Area. A list of all non-oil and gas mineral leases and the lessees can be found in **Table 3.13-2**.

Table 3.13-2. Non-Oil and Gas Mineral Leases within the Project Area

Applicant or ROW Holder	Type	Status	Township and Range	Section(s)	Acreage
OSEC	Oil Shale RD&D	Authorized	10S:24E	22,27	160.0
BAARD Energy	Oil Shale RD&D	Pending	10S:24E	22,27	160.0
Frederick Larson	Placer	Pending	10S:25E	30,31	10,176

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4.0 - AFFECTED ENVIRONMENT

4.1 INTRODUCTION

This chapter provides an analysis of the environmental consequences from implementation of the Proposed Action (Alternative A), Alternative B (No Action Alternative), and Alternative C (Vertical Drilling in the Potential Oil Shale Development Area). ACEPMs and additional Resource Protection Measures that would reduce impacts under Alternative A and/or C have been included in **Chapter 2** of this EA, and the analyses in this chapter assume that those measures would be implemented.

Direct impacts to resources, those that are caused by the action and occur at the same time and/or place (40 CFR 1508.8), in the following analyses are described in terms of initial impacts from construction and development activities. In areas where interim reclamation is implemented, ground cover by herbaceous and woody species could re-establish within 7 to 8 years following seeding of native plant species and diligent weed control efforts. However, it is important to note that recent BLM monitoring has documented that reclamation efforts for oil and gas development have largely been unsuccessful at reestablishing soil stability, vegetation, and subsequent forage for wildlife and livestock due to poor soils and drought. BLM field inspections show that initial impacts may be more accurately portrayed as long-term impacts. All surface disturbance proposed under the alternatives, therefore, could remain as long-term (or even permanent) impacts on the landscape if reclamation efforts are not successful.

4.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

4.2.1 GEOLOGY AND MINERALS

4.2.1.1 Alternative A – Proposed Action

Potential impacts to geologic and mineral resources from the Proposed Action include interference with potential mining of oil shale in the Project Area.

<u>Oil Shale</u>

Development of the Proposed Action could potentially conflict with future oil shale development. As described in **Section 3.2**, OSEC was granted a lease on 160 acres of land within the Project Area in Sections 22 and 23 of T10S, R24E, to conduct a RD&D project to evaluate oil shale extraction technologies on the former site of the White River Corporation Mine. Tests conducted to date reveal that the shale produces about 30 gallons of oil per ton using retort processing. Shale mining in this area could be conducted across a vertical interval of about 58 feet at a depth of about 1,200 feet. If the pilot project proves to be successful, OSEC may be granted an additional 4,960 acres of preferential lease rights within the Project Area for the development of a commercial-scale oil shale facility. The shale would be mined by underground room-and-pillar methods. Surface facilities would include fresh and spent shale stockpiles, roads, water management facilities, maintenance shops, and shale retorts.

Under the Proposed Action, both vertical and directionally-drilled wells would be drilled in the preferential lease rights area, and two well pads would be constructed within the 160-acre RD&D area. Surface disturbance within the RD&D area would be approximately 10 acres. An additional 452 acres of surface disturbance would occur within the preferential lease area. A

maximum of 462 acres, therefore, would be unavailable for surface facilities for oil shale production during the 30-40 year LOP.

Within the preferential lease area, well casings would also present obstacles to underground mining of oil shale, as well as health and safety concerns, especially for directionally-drilled well casings. Vertical well casings could be accommodated within the pillars in a conventional room-and-pillar mining plan, where vertical columns of rock (pillars) are left in place to support the ceilings of the mine. Downhole GPS surveys would be performed to accurately locate all well casings within the preferential lease area. Because of the health and safety concerns associated with the unintentional breaching of a well casing, directionally-drilled wells could preclude oil shale mining in their immediate vicinity.

4.2.1.2 Alternative B – No Action

Potential impacts to geologic and mineral resources from the No Action Alternative are similar in nature to those for the Proposed Action but lesser in magnitude. Because no wells would be developed on Federal lands, interference with potential mining of oil shale in the RD&D and preferential lease areas would be minimal under the No Action Alternative.

Oil Shale

Development of the No Action Alternative would have minimal impacts on future oil shale development. The oil shale RD&D and preferential lease areas are located entirely on Federal lands. One co-located pipeline and access road would cross the preferential lease area under the No Action Alternative, precluding a small area from development of surface facilities. No wells would be drilled in the RD&D or preferential lease area.

4.2.1.3 Alternative C – Vertical Drilling in the Potential Oil Shale Development Area

Potential impacts to geologic and mineral resources from the Alternative C are similar to those for the Proposed Action in nature and include interference with potential mining of oil shale in the Project Area.

Oil Shale

Alternative C has been designed to minimize potential conflicts with future oil shale development. Under Alternative C, no well pads would be located in the oil shale RD&D area and only vertical wells would be drilled in the oil shale preferential lease rights area. Initial surface disturbance for the well pads, access roads, pipelines, and compressor station within the preferential lease rights area under Alternative C would be about 711 acres, or about 14.3 percent of the land surface within the preferential lease area. At least this much of the area would be unavailable for the development of surface facilities for oil shale production during the 30-40 year LOP.

Under Alternative C, vertical well casings could be accommodated within the pillars in a conventional room-and-pillar mining plan, where vertical columns of rock (pillars) are left in place to support the ceilings of the mine. This arrangement would allow for more efficient extraction of shale in this area, and reduce the potential health and safety risks associated with the well casings.

4.2.1.4 Recommended Mitigation Measures

The following mitigation measures are recommended consistent with Utah Administrative Code R649-3-27, R649-3-30, and R649-3-31.

- Operators engaged in oil and gas operations on lands which operators are exploring for and developing mineral resources other than oil and gas should enter into a cooperative agreement with respect to multiple mineral management. The agreement should define such items as:
    - The coordination of access to and development within an area.
    - Mitigation of subsurface impact including but not limited to issues pertaining to the interface in the underground environment of oil shale mining operations and other mineral operations.
    - Exchange of geologic, engineering, and production data.
- On wells that are intentionally deviated from the vertical within potential oil shale areas (i.e., the RD&D or preferential lease area) a directional survey shall be run from a point at least 20 feet below the oil shale section to the surface and shall thereafter be filed with the BLM within 20 days after reaching total depth.
- BLM involvement will be requested when any producing well is approached by oil shale mine workings within a distance of 2,640 feet.
- Any casing set into or through the oil shale section shall be cemented over the entire oil shale section.
- If a well is dry, junked, or abandoned, a cement plug shall be placed across the entire portion of the oil shale section extending 200 feet above and 200 feet below the longitudinal center of the Mahogany Zone. When the casing is cemented, cement plugs 200 feet in length shall be centered across the top and across the base of the Parachute Creek member of the Green River Formation. In the event that the casing is not cemented, the BLM should approve the method and procedure to prevent the migration of oil, gas, and other substances through the wellbore from one formation to another.
- The BLM, with concurrence of the operator, may change the surface location of the proposed well if there appears to be any possibility of interference between the proposed well bore and mine workings.
- The BLM shall approve the adequacy and location of the cement plugs after examining the appropriate logs and drilling and testing records for the well, to ensure that the oil shale section is adequately protected.
- Before commencing a drilling operation for oil and gas on any lands within either the RD&D or preferential lease area, the operator shall furnish a copy of the APD, together with a plat or map, to oil shale owners or their lessees whose interests are within a radius of 2,640 feet of the proposed well. The operator shall furnish a notice of intention to plug and abandon any well in areas where oil shale development could occur to the owners of lessees prior to commencement of plugging operations.

- The Operator shall use generally accepted techniques for vertical and directional drilling and maintain the wellbore within an intact core of any mine pillar, should wells be drilled within an active mining location.

4.2.2 PALEONTOLOGICAL RESOURCES

4.2.2.1 Alternative A – Proposed Action

Potential impacts to paleontological resources under the Proposed Action include the loss of scientifically important fossils due to primary surface-disturbing activities such as well pad and access road excavation and grading, and secondary surface activities, such as vehicular and pedestrian traffic. A total of 249 wells would be drilled from 152 well pads with an initial surface disturbance of 858 acres. Where surface-disturbing activities occur on previously disturbed areas, fossil resources would not be affected. However, where surface disturbance is proposed on undisturbed fossiliferous formations, paleontological resources would be at risk. Where fossils occur on the surface within these areas, they may potentially be broken or destroyed during surface-disturbing activities. Disturbance of bedrock for the construction of reserve pits and access roads also results in the potential for exposing, breaking, and destroying fossils. The magnitude of the potential losses cannot be quantified, as fossils may be unknowingly destroyed. Alternatively, construction of well pads and access roads may uncover scientifically important fossils.

Because of the potential for fossil resources to occur in the Project Area, paleontological surveys would be conducted by a BLM-approved paleontologist prior to any surface disturbance in sandstone bedrock or other sensitive geologic formations under the Proposed Action. If significant fossils are encountered during the survey, the paleontologist would assess and document the discovery and contact the appropriate BLM AO. The BLM AO would determine the need for further monitoring of the area or mitigation of the site during surface-disturbing activities. Also, if fossils are encountered by the project operator during excavation, construction would be suspended, and the appropriate BLM AO would be notified. Construction would not resume until the fossils are assessed by the BLM AO, and appropriate mitigation, monitoring, and/or compliance measures are developed and implemented.

4.2.2.2 Alternative B – No Action

Under the No Action Alternative, new wells would not be allowed on Federal lands in the Project Area. Drilling and production would occur only on State and private lands within the Project Area. A total of 36 wells would be drilled under the No Action Alternative, as compared to 249 wells under the Proposed Action. Surface disturbance under the No Action Alternative would be about 21% of that under the Proposed Action. Therefore, the potential for adverse (or beneficial) impacts to paleontological resources from the No Action Alternative is about one-fifth of that for the Proposed Action.

4.2.2.3 Alternative C – Vertical Drilling in the Potential Oil Shale Development Area

Potential impacts to fossils from Alternative C would be similar to those under the Proposed Action. A total of 240 wells would be drilled under the Alternative C, as compared to 249 wells under the Proposed Action. Surface disturbance under Alternative C would be about 1.3 times that for the Proposed Action. Therefore, the potential for adverse (or beneficial) impacts to paleontological resources from Alternative C is about 1.3 times of that under the Proposed Action.

4.2.2.4 Recommended Mitigation Measures

If vertebrate fossils or noteworthy invertebrate or plant fossils are found, the following steps would be taken to reduce loss of paleontological information and resources as directed by the SMA Authorized Officer:

Sampling. Fossil material would be sampled if needed to determine the significance of the find.

Salvage. Salvage would be required, as directed by the Authorized Officer, if the fossil discovery is of scientific interest and the proposed development would destroy the site, if time- and cost-effective, or if the fossil material is small and can be quickly collected. Often, once the material from a particular site has been collected and properly recorded, the need for further protection ceases.

Rerouting. Rerouting of project facilities would occur, as directed by the Authorized Officer, if critical or significant fossil material is discovered directly on the road or pipeline route or proposed well pad or compressor station site. This option would generally be considered if the fossil locality is scientifically very important and should be left undisturbed for subsequent scientific evaluation.

Relocation. Occasionally, as directed by the Authorized Officer, it would be appropriate to move fossils out of the impact zone and relocate them nearby. This option might apply to poorly-preserved fossils of limited extent.

Monitoring. If field surveys suggest that critical or significant fossil material is likely to be encountered in a certain area, monitoring by a qualified paleontologist during ground-disturbing activities would be required, as directed by the Authorized Officer.

4.3 AIR QUALITY AND CLIMATE

The following sections describe and quantify potential impacts that each Alternative could have on air quality. All dispersion modeling was performed using the AERMOD-Prime model (version 07026). The meteorological data used was from surface and upper air stations developed for the West Tavaputs Draft Environmental Impact Statement (BLM 2008b). AERMET, a sub-program of AERMOD, was used to process the meteorological data. As the Project Area has complex terrain, AERMOD was run with the terrain option using USGS digital elevation maps. Fence lines were set up 100 meters (m) from each source. Receptors were spaced as follows: 25 m apart on fence lines, 100 m apart up to 500 m from the fence lines, 500 m apart up to 1,000 m from the fence lines, and 1,000 m apart up to 5,000 m from the fence lines.

All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis. PSD increment consumption analyses are typically applied to large industrial sources during permitting, and are solely the responsibility of the State of Utah and the EPA. The maximum modeled concentrations for NO_2 reflects an adjustment by a factor of 0.75, in accordance with standard EPA methodology (60:153 FR 40469, Aug 9, 1995) to convert from the modeled NO_x concentration to NO_2.

4.3.1 ALTERNATIVE A – PROPOSED ACTION

The emission sources associated with the Proposed Action would be those associated with well development and well production. This includes vehicle traffic, construction, drilling, and completion activity during the development phase of the Proposed Action, followed by continuous emissions from condensate storage tanks, dehydration units, compressor engines, and operations traffic. Air pollutants from these sources would include NO_X, CO, PM_{10}, $PM_{2.5}$, and VOCs. Benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde would be the primary HAPs. Detailed emission calculations for each activity are shown in **Appendix F**.

During the 10-year construction and drilling phase, vehicle tailpipe and road dust emissions would increase within the Project Area. Vehicle emissions would result from work crews commuting to and from the work site and from the transportation and operation of equipment to construct wells pads, access roads, and pipelines. NO_X, SO_2, and CO would be emitted from vehicle tailpipes. Fugitive dust would increase with additional vehicle traffic on unpaved roads and from wind erosion in areas of soil disturbance. Drill and completion rig operations would result mainly in an increase of NO_X and CO emissions, with lesser amounts of SO_2. These emissions would be short-term for the drilling and completion times.

Emission rates were calculated using applicable EPA emission factors and anticipated level of operational activities, such as estimated vehicle trips, load factors, and hours of operation. Development emissions would produce elevated pollutant levels but would be short-term and localized for the duration of the activities.

After construction, NO_x, CO, VOC, and HAP emissions would result from the long-term operation of storage tank vents, well pad separators, dehydration units, and compression engines. Additionally, road dust (PM_{10} and $PM_{2.5}$) and tailpipe emissions would be produced by vehicles serving the wells.

Estimated emissions from the Proposed Action are summarized in **Tables 4.3-1, 4.3-2**, and **4.3-3**. All development-related emission calculations assume a maximum development rate of 35 wells and 21 pads per year. Production emissions are calculated for the full-field development of 249 wells.

Table 4.3-1. Annual Emissions for Development Phases of the Proposed Action

Pollutant	Development Emissions (tons/year)[1]					Total (tons/yr)
	Construction	Wind Erosion	Drilling	Completion	Interim Reclamation	
NO_X	1.1	-	174	27.9	1.0E-02	203
CO	0.4	-	42	36.5	2.8E-02	79
VOC	0.1	-	2.6	0.8	6.1E-03	3.4
SO_2	3.2E-02	-	2.9	0.39	4.3E-04	3.4
PM_{10}	3.8	0.4	67	45	2.2	118
$PM_{2.5}$	0.5	0.2	10	5.5	0.2	16
Benzene	-	-	1.4E-02	2.0E-03	-	1.6E-02
Toluene	-	-	5.2E-03	9.5E-04	-	6.1E-03

Pollutant	Development Emissions (tons/year)[1]					Total (tons/yr)
	Construction	Wind Erosion	Drilling	Completion	Interim Reclamation	
Ethylbenzene	-	-	-	-	-	0
Xylene	-	-	3.6E-03	4.5E-04	-	4.0E-03
n-Hexane	-	-	-	1.6E-01	-	0.2
Formaldehyde	2.6E-02	-	1.5E-03	6.8E-03	-	3.4E-02

[1] Assumes maximum development scenario (35 wells developed in 1 year).

Table 4.3-2. Total Annual Production Emissions from the Proposed Action[1]

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	62	-	-	1.2	22	85
CO	52	-	-	6.8	1.9	61
VOC	4.5E-02	1,114	1.0	0.7	3.6	1,119
SO_2	-	-	-	0.1	-	0.1
PM_{10}	4.7	-	-	181	0.5	186
$PM_{2.5}$	4.7	-	-	18	0.5	24
Benzene	1.3E-03	0.4	0.1	-	2.3E-02	0.5
Toluene	2.1E-03	0.4	0.2	-	2.1E-02	0.6
Ethylbenzene	-	0.1	3.6E-02	-	2.1E-03	0.1
Xylene	-	0.1	0.1	-	9.7E-03	0.3
n-Hexane	1.12	4.0	3.6E-02	-	0.1	5.2
Formaldehyde	0.05	-	-	-	0.3	0.3

[1] Emissions include 249 producing wells (including associated operations traffic)

Table 4.3-3. Southam Proposed Action Annual Emissions (tons/year) [1]

Pollutant	Development	Production	Total
NO_x	203	85	288
CO	79	61	140
VOC	3.4	1,119	1,122
SO_2	3.36	0.06	3.4
PM_{10}	118	186	304
$PM_{2.5}$	16	23.0	40
Benzene	2.E-02	0.5	0.6
Toluene	6.E-03	0.6	0.6

Pollutant	Development	Production	Total
Ethylbenzene	-	0.1	0.1
Xylene	4.E-03	0.3	0.3
n-Hexane	0.2	5.2	5.4
Formaldehyde	0.03	0.3	0.4

[1] Emissions include 249 producing wells (including associated operations traffic) and 35 wells being developed in one year.

Detailed emission comparisons are presented in **Tables 4.3-4, 4.3-5**, and **4.3-6** for all alternatives for NO_x, PM_{10}, and $PM_{2.5}$ respectively. Alternatives B and C emissions and impacts are discussed in later sections.

Table 4.3-4. Comparison of NO_x Emissions by Alternative

Oxides of Nitrogen (NOx) Emission Comparison by Alternative Activity/Total	NOx (Tons per Year)		
	Alt A 249 wells	Alt B 36 wells	Alt C 240 wells
Construction	1.12	0.63	1.38
Drilling	174	89	179
Completion	27.9	14	28.7
Total Development	***203***	***104***	***209***
Wellsite Separators	54.5	16	60.4
Operations Traffic	1.19	0.26	1.24
Total Well Production	***64***	***16***	***61.7***
Central Compression Facilities	22	22	22
Total Production	***85***	***38***	***83***
Project Total	**288**	**134**	**293**

Table 4.3-5. Comparison of PM_{10} Emissions by Alternative

Particulate Matter less than 10 microns in diameter (PM_{10}) Emission Comparison by Alternative Activity/Total	PM_{10} (Tons per Year)		
	Alt A 249 wells	Alt B 36 wells	Alt C 240 wells
Construction	3.7	2.2	5.2
Drilling	66	34.1	68
Completion	45	23.1	46
Total Development	***118***	***61***	***122***
Wellsite and Central Separators	4.1	1.2	4.0
Operations Traffic	181	44	188
Total Well Production	***186***	***45***	***192***
Central Compression Facilities	0.5	0.5	0.5
Total Production	***186***	***46***	***192***
Project Total	**304**	**105**	**315**

Table 4.3-6. Comparison of $PM_{2.5}$ Emissions by Alternative

Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$) Emission Comparison by Alternative Activity/Total	$PM_{2.5}$ (Tons per Year)		
	Alt A 249 wells	**Alt B 36 wells**	**Alt C 240 wells**
Construction	0.5	0.3	0.8
Drilling	10	5.0	10
Completion	5.5	2.8	5.6
Total Development	***16***	***8.1***	***17***
Wellsite Separators	4.1	0.6	4.0
Operations Traffic	18.2	4.5	18.9
Total Well Production	***22***	***5.1***	***23***
Central Compression Facilities	0.5	0.5	0.5
Total Production	***23***	***5.6***	***24***
Project Total	**40**	**14**	**41**

4.3.1.1 Criteria Pollutant Ambient Air Quality Impacts

The predicted criteria pollutant impacts are compared to applicable Utah and NAAQS standards and to prevention of significant deterioration (PSD) Class II increments. All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis.

Development

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of the Proposed Action. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate.

Based on a maximum of 35 wells developed per year with two drill rigs, a model with two pad/roads being constructed, two wells being drilled, and two wells being completed was run with the closest six proposed well pads. Each modeled well pad had a 0.24-mile road. A total of 1,106 receptors were evaluated by the model.

Table 4.3-7 shows the maximum predicted air quality impacts compared to the appropriate NAAQS. The predicted impacts would be less than the applicable NAAQS during the development phase. Maximum impacts commonly occurred at fence line receptors, as shown on **Figure 4.3-1**, 24-Hour $PM_{2.5}$ Southam Canyon Predicted Impacts.

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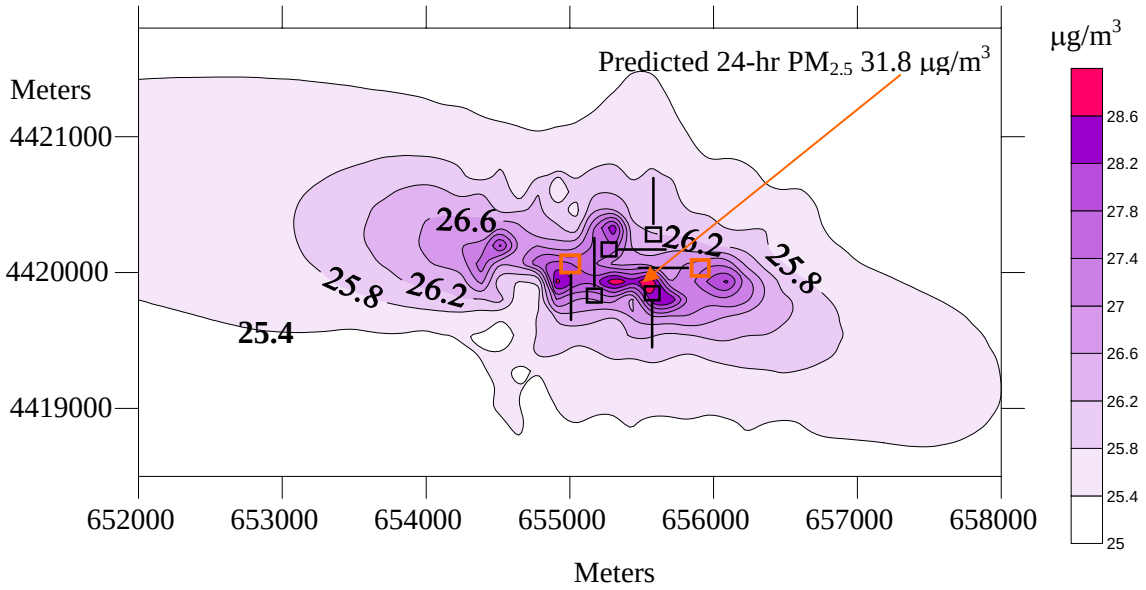
Figure 4.3-1. 24-Hour $PM_{2.5}$ Southam Canyon Predicted Development Impacts



□ = Well Pad being constructed □ = Well Pad —— = Road

Activity by location:			
Construction	Drilling Completion	Completion Drilling	Construction

Background $PM_{2.5}$ = 25 µg/m^3

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Table 4.3-7. Proposed Action Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact (µg/m^3)	Uinta Basin Background Concentration [e] (µg/m^3)	Maximum Project Impact Plus Background (µg/m^3)	National and Utah Ambient Air Quality Standard (µg/m^3)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	6.8	25	31.8	35	91%
	Annual Mean	2.85 [d]	9	11.85	15	79%
PM_{10}	24-hour Maximum Average [b]	9.19	63.3	72.5	150	48%
NO_2 [c]	Annual Mean	2.72	17	19.7	100	20%
CO	1-hour Maximum	2,681	1,111	3,792	40,000	9%
	8-hour Maximum Average	1,202	1,111	2,313	10,000	23%
SO_2	3-Hour	172	20	192	1300	15%
	24-Hour	42.6	10	52.6	365	14%
	Annual	5.21	5	10.21	80	13%

[a] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[b] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[c] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[d] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

Operations

Dispersion modeling was performed to predict the impacts of pollutant emissions compared to significance criteria for $PM_{2.5}$, PM_{10}, NO_2, and CO for the operations phase of the Proposed Action. Predicted emissions for SO_2 for operations are less than 1 ton per year (see **Table 4.3-3**) and were not modeled. The compressor station, 6 proposed well sites with 8 proposed wells, and associated roads were modeled. A total of 1,340 receptors were evaluated by the model.

Table 4.3-8 summarizes the criteria pollutant impacts resulting from the Proposed Action operations. All concentrations are predicted to be below the NAAQS and the PSD Class II increments.

Table 4.3-8. Proposed Action Near-Field Operations Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration (µg/m^3)	Percent of PSD Class II Increment	Background [a] (µg/m3)	Project + Background (µg/m3)	Percent of NAAQS (Project + Background)
NO_2	Annual [b]	5.0	20%	17	22	22%
PM_{10}	24-hour [c]	2.7	9%	63	66	44%

Pollutant	Averaging Period	Predicted Concentration (µg/m^3)	Percent of PSD Class II Increment	Background [a] (µg/m3)	Project + Background (µg/m3)	Percent of NAAQS (Project + Background)
$PM_{2.5}$	Annual	0.8	N/A	9	26	74%
$PM_{2.5}$	24-hour [d]	0.3	N/A	25	9.3	62%
CO	1-hour	135	N/A	1,111	1,246	3%
CO	8-hour	28	N/A	1,111	1,139	11%

[a] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for $PM_{2.5}$.
[b] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[c] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[d] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.

4.3.1.2 Hazardous Air Pollutant (HAP) Ambient Air Impacts

The primary source of HAPs is from condensate storage tanks, with smaller amounts from other production equipment. Small amounts of HAPs are emitted by construction equipment. However, these emissions are estimated to be less than 1 ton per year, and were not modeled. The central compressor station and the nearest 6 well pads were modeled (8 wells).

Predicted Potential Non-Cancer Health Effects

Modeled HAP concentrations were compared to available dose-response assessment data used by the EPA Office of Air Quality Planning and Standards for risk assessments of HAPs. Short-term impacts from HAP exposure were assessed by comparing maximum 1-hour average impacts to the HAP-specific acute reference exposure level (REL) and annual average impacts to the HAP-specific reference concentration (RfC for continuous inhalation exposure). The REL is the acute concentration at or below which no non-cancer adverse health effects are expected. The RfC is the average concentration (i.e., an annual average) at or below which no long-term, non-cancer adverse health effects are expected. As shown in **Table 4.3-9** the predicted concentrations exceed the acrolein 1-hr REL, all other HAPs are below non-cancer effect risk levels.

Table 4.3-9. Proposed Action Non-Carcinogenic Acute REL and RfC Impacts

HAP	REL [a] (µg/m^3)	Predicted Maximum One-Hour Impact	Percent of REL	RfC[i] (µg/m^3)	Predicted Maximum Annual Impact (µg/m^3)	Percent of RfC
Acrolein	0.19 [a]	1.18	621%	0.02	0.017	85%
Acrolein	69 [b]	1.18	1.71%	0.06 [g]	0.017	28.3%
Acrolein	230 [c]	1.18	0.51%	6.9 [h]	0.2	2.9%
Acrolein	450 [d]	1.18	0.26%	-	-	-
Formaldehyde	94 [a]	5.3	5.6%	9.8	0.08	0.82%
Benzene	1,300 [a,c]	32.3	2.48%	30	2.14	7.13%
Benzene	160,000 [d]	171	0.11%	-	-	-
Toluene	37,000 [a]	156	0.42%	5,000	2.0	0.04%

HAP	REL [a] (µg/m^3)	Predicted Maximum One-Hour Impact	Percent of REL	RfC[i] (µg/m^3)	Predicted Maximum Annual Impact (µg/m^3)	Percent of RfC
Ethylbenzene	350,000 [d]	0.18	0.000%	1,000	0.03	0.003%
Xylenes	22,000 [a]	52.1	0.24%	100	0.67	0.67%
n-Hexane	390,000 [d]	1,759	0.451%	700	21.8	3.11%

[a] California EPA Reference Exposure Level (REL) for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007)
[b] Acute Exposure Guideline Level (AEGL) for 1-hr and 8-hr exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007)
[c] Acute Exposure Guideline Level (AEGL) for 1-hr and 8-hr exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007)
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007) since no available REL
[e] REL for benzene is based on a 6-hr exposure (OEHHA 1999), predicted concentration is a 6-hr average.
[f] EPA Air Toxics Database, Table 1 (EPA 2007)
[g] California EPA chronic REL
[h] Mininum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007) compared to 24-hr predicted concentration
[i] RfC is the reference concentration for no observed adverse effect from chronic inhalation (non-cancer) EPA Air Toxics Database, Table 1 (EPA 2007) http://www.epa.gov/ttn/atw/toxsource/summary.html

The sources of acrolein for the Proposed Action are the compressor engines. Exposure to acrolein would be limited, therefore, primarily to workers in proximity to the well pads and compressor station. **Figure 4.3-2** shows the area of predicted exceedance. Acrolein is a very reactive compound with a half-life in air of 1 day. Exposure to lower levels of acrolein can cause eye, nose, and throat irritation, and can lower breathing rates. Higher levels of acrolein can damage the lungs and cause death (ATSDR 2007 EPA's website documentation for the acrolein RfC indicates EPA has medium confidence in the RfC as it is based on medium quality data (http://www.epa.gov/iris/subst/0364.htm). The exceedence of the REL for no adverse shown in **Table 4.3-9** is not a violation as there is no law or standard for exposure to acrolein. The predicted level of acrolein is 0.26% of the guideline for "Immediately Dangerous to Life or Health" so workers in the area are not expected to be in immediate danger, although sensitive workers may experience eye, nose, and/or throat irritation.

Predicted Potential Cancer Risk

The risk from long-term exposure to carcinogenic HAP emissions is assessed by comparison to the generally acceptable risk range of one additional cancer per one million exposed persons (1 x 10^{-6}) to one additional cancer per 10 thousand exposed persons (1 x 10^{-4}) (40 CFR § 300.430 (e)(2)(i)(A)(2)). Benzene and formaldehyde, the project HAP carcinogens, are evaluated.

Screening level risk assessment involves application of a HAP-specific unit risk factor. The unit risk factor is an upper-bound estimate of the probability of one additional person contracting cancer based on continuous exposure to 1-ug/m^3 of the substance over a 70-year lifetime. Exposure adjustment factors are calculated to adjust for actual exposure times. Cancer risk is estimated for two exposure scenarios: the most likely exposure (MLE) that individuals will experience and the maximally exposed individual (MEI).

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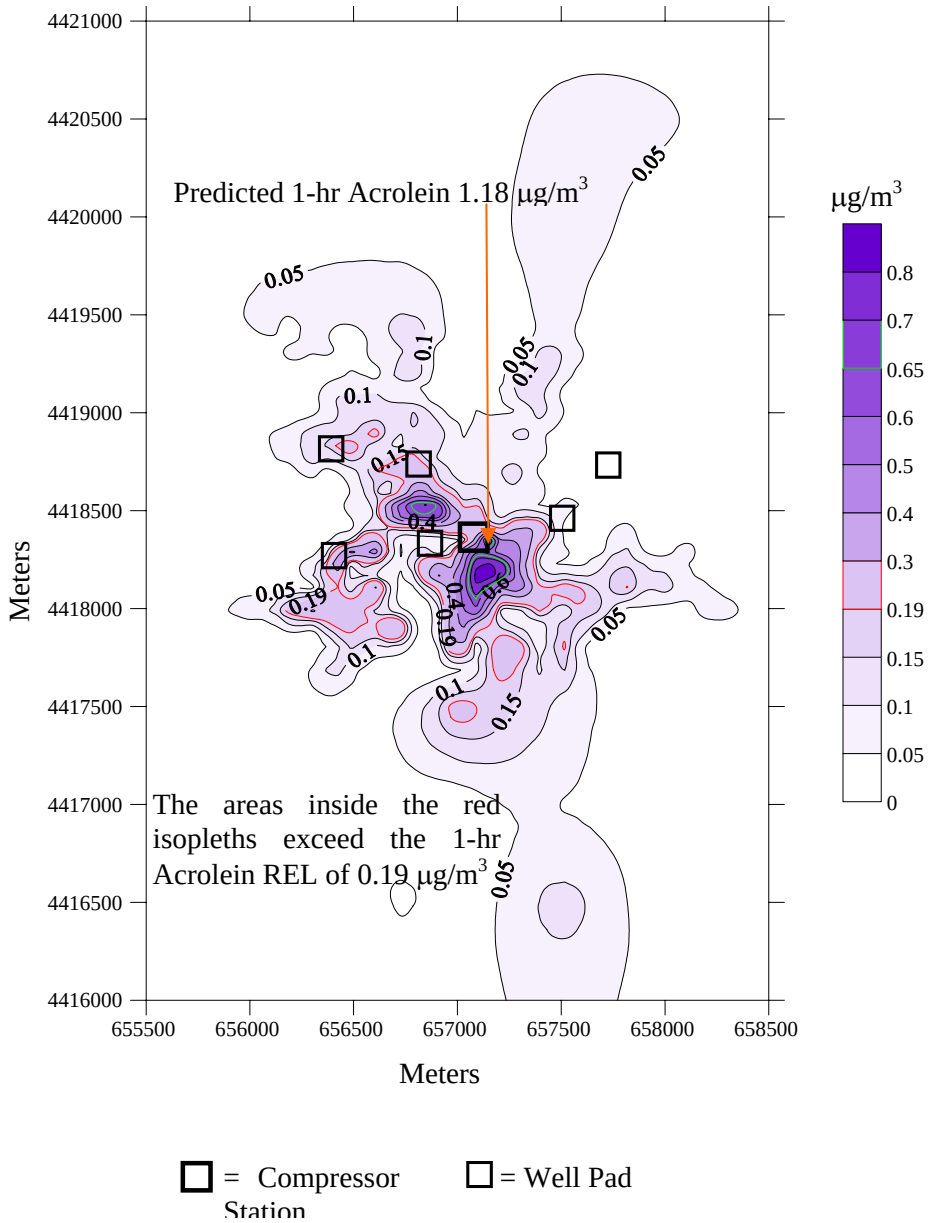
Figure 4.3-2. 1-Hour Acrolein Southam Canyon Predicted Operations Impacts



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The MLE applies to people living in the Project Area. For the MLE exposure adjustment factor, it is assumed a family stays at a residence an average of 9 years and spends 64 percent of the day away from the home (EPA 1997). It is further assumed that households are exposed to one-quarter of the maximum concentration the remaining (36 percent) of the time. This results in an adjustment factor of 0.095 [(9/70)*((0.64*1)+(0.36*0.25))].

An example of an MEI could be an Enduring Resource's pumper that visits well sites daily. For the MEI exposure adjustment factor, exposure is assumed to occur continuously (12 hours per day, 265 days per year) for the life of project (assumed to be 40 years). The calculated adjustment factor is 0.204 [(12/24)*(260/365)*(40/70)].

Table 4.3-10 presents the unit risk factor, exposure adjustment factor, and the estimated cancer risk for the MLE and MEI exposure scenarios for benzene. A range of unit risk factors is available for benzene. Both cancer risk ranges are in the acceptable range of cancer risk.

Table 4.3-10. Proposed Action Carcinogenic HAP Risk

Exposure Scenario	Hazardous Air Pollutant	Unit Risk Factor ($1/\mu g/m^3$)	Exposure Adjustment Factor	Modeled Annual Impact ($\mu g/m^3$)	Cancer Risk
MLE	Benzene	2.2×10^{-6} to 7.8×10^{-6}	0.095	2.14	4.5 in 10 million To 1.6 in a million
	Formaldehyde	1.3×10^{-5}	0.095	0.08	9.9 in 100 million
		MLE Max Total Risk			**1.7 in a million**
MEI	Benzene	2.2×10^{-6} To 7.8×10^{-6}	0.204	26.7	9.6 in 10 million To 3.4 in a million
	Formaldehyde	1.3×10^{-5}	0.204	0.27	2.1 in 10 million
		MEI Max Total Risk			**3.6 in a million**

MEI = maximally exposed individual
MLE = most likely exposure

Individuals are exposed to both pollutants at the same time so the risk could be cumulative. There is uncertainty involved in adding cancer risk estimates together when exposure is to a mixture. Compounds in mixtures can interact synergistically (amplifying effects), antagonistically (reducing the effects), independently (no interaction), or they can have additive effects. The 'Max Total Risk' rows in **Table 4.3-12** represent the sum of the benzene and formaldehyde risk which is likely to be a conservative risk estimate. As a result of the Proposed Action it is possible that 2 additional people out of 1,000,000 people exposed at the most likely exposure level could contract cancer. A maximally exposed individual would have a 3.6 in 1,000,000 increased chance of contracting cancer.

4.3.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative drilling and production would continue to occur on State of Utah and privately leased land. The sources of air pollutant emissions from the No Action Alternative are similar in nature to those for the Proposed Action. Annual estimated emissions from Alternative B are summarized in **Tables 4.3-11, 4.3-12**, and **4.3-13**. All development-related emission calculations, including well pad and road construction, well drilling, and well completion, assume a maximum development rate of 18 wells and 12 pads per year. Production emissions are calculated for the full-field development of 36 wells.

Table 4.3-11. Annual Emissions for Development Phases of the Southam Canyon Alternative B

Pollutant	Development Emissions (tons/year) [a]					Total (tons/yr)
	Construction	Drilling	Completion	Interim Reclamation	Wind Erosion	
NO_X	0.6	89	14	5.8E-03	-	104
CO	0.2	21	19	0.0	-	40
VOC	0.0	1.3	0.4	3.4E-03	-	1.8
SO_2	1.8E-02	1.5	0.20	2.4E-04	-	1.7
PM_{10}	2.1	34	23	1.1	0.1	61
$PM_{2.5}$	0.3	5	2.8	0.1	4.9E-02	8.3
Benzene	-	7.3E-03	1.0E-03	-	-	8.4E-03
Toluene	-	2.7E-03	4.9E-04	-	-	3.2E-03
Ethylbenzene	-	-	-	-	-	0
Xylene	-	1.8E-03	2.3E-04	-	-	2.1E-03
n-Hexane	-	-	8.1E-02	-	-	0.1
Formaldehyde	1.4E-02	7.5E-04	3.5E-03	-	-	1.9E-02

[a] Assumes maximum development scenario (18 wells developed in 1 year)

Table 4.3-12. Total Annual Production Emissions from the Southam Canyon Alternative B

Pollutant	Tons/Year					Total [1] (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	16	-	-	0.3	22	38
CO	13	-	-	2.0	1.9	17
VOC	1.1E-02	298	0.3	0.1	3.6	302
SO_2	-	-	-	1.5E-02	-	1.5E-02
PM_{10}	1.2	-	-	44	0.5	46
$PM_{2.5}$	1.2	-	-	4.5	0.5	6.2
Benzene	3.3E-04	0.1	4.7E-02	-	2.3E-02	0.1

Pollutant	Tons/Year					Total [1] (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
Toluene	5.4E-04	0.1	0.1	-	2.1E-02	0.2
Ethylbenzene	-	0.1	8.2E-03	-	2.1E-03	7.3E-02
Xylene	-	2.2E-02	4.8E-02	-	9.7E-03	8.0E-02
n-Hexane	0.28	0.6	8.2E-03	-	0.1	0.9
Formaldehyde	0.01	-	-	-	0.3	0.3

[1] Emissions include 36 producing wells

Table 4.3-13. Southam Alternative B Annual Emissions (tons/year)

Pollutant	Development	Production	Total [1]
NO_x	104	38	142
CO	40	17	58
VOC	1.8	302	304
SO_2	1.7	0.02	1.7
PM_{10}	61	46	107
$PM_{2.5}$	8.3	6.2	14
Benzene	8.E-03	0.1	0.1
Toluene	3.E-03	0.2	0.2
Ethylbenzene	0.0E+00	0.1	0.1
Xylene	2.E-03	0.1	0.1
n-Hexane	0.1	0.9	1.0
Formaldehyde	0.02	0.3	0.3

[1] Emissions include 36 producing wells (including associated operations traffic) and development of 18 wells in one year

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of the No Action Alternative. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate. Based on a maximum drill rate of 18 wells per year with one drill rig, a model with one well being drilled, one well being completed, and one well pad/road being constructed at the three closest proposed well pads was run. Each pad had an associated road a half a mile long. The model evaluated 1,240 receptors.

Predicted potential impacts for Alternative B are presented in **Table 4.3-14**. The closest proposed well pads for the No Action alternative are closer together than the closest proposed well pads for the Proposed Action. Therefore, predicted impacts for PM_{10} are higher than the predicted impacts for the Proposed Action. Additionally, the length of road per pad that is constructed is longer for the No Action Alternative than the length of road for the Proposed Action. A longer graded length results in more PM_{10} emissions without much increase to $PM_{2.5}$ emissions.

Table 4.3-14. Alternative B Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact (µg/m^3)	Uinta Basin Background Concentration [e] (µg/m^3)	Maximum Project Impact Plus Background (µg/m^3)	National and Utah Ambient Air Quality Standard (µg/m^3)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	5.16	25	30.2	35	86%
	Annual Mean [b]	2.23	9	11.2	15	75%
PM_{10}	24-hour Maximum Average [c]	49	63.3	112.3	150	75%
NO_2 [d]	Annual Mean	1.20	17	18.2	100	18%
CO	1-hour Maximum	1,357	1,111	2468	40,000	6%
	8-hour Maximum Average	542	1,111	1653	10,000	17%
SO_2	3-Hour	74.9	20	94.9	1300	7%
	24-Hour	21.9	10	31.9	365	9%
	Annual	1.10	5	6.1	80	8%

[a] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[b] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[c] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[d] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

The maximum impacts from operations occur near the compressor station. The nearest proposed well locations and compressor station are the same for the No Action Alternative as the Proposed Action. Therefore the maximum predicted impacts will be the same for the No Action Alternative as for the Proposed Action, see **Tables 4.3-8** through **4.3-10**.

As HAPs emissions were estimated based upon modeling the central compressor station and the nearest 6 well pads were modeled under the Proposed Action, and the compressor and fewer well pads are proposed under the No Action, impacts are expected to be similar or slightly less than those discussed for Alternative A.

4.3.3 ALTERNATIVE C –VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

The sources of air pollutant emissions from Alternative C are similar in nature to those for the Proposed Action. Annual estimated emissions from Alternative C are summarized in **Tables 4.3-**

15, 4.3-16, and **4.3-17.** All development-related emission calculations, including well pad and road construction, well drilling, and well completion, assume a maximum development rate of 36 wells and 26 pads per year. Production emissions are calculated for the full-field development of 240 wells.

Table 4.3-15. Annual Emissions for Development Phases of the Southam Field Alternative C

Pollutant	Development Emissions (tons/year) [a]					Total (tons/yr)
	Construction	Drilling	Completion	Interim Reclamation	Wind Erosion	
NO_X	1.4	179	28.7	1.3E-02	-	209
CO	0.5	43	37.7	3.5E-02	-	81
VOC	0.1	2.7	0.8	7.6E-03	-	3.6
SO_2	4.0E-02	3.0	0.40	5.3E-04	-	3.5
PM_{10}	4.7	69	47	2.3	0.5	122
$PM_{2.5}$	0.7	10	5.7	0.2	0.2	17
Benzene	-	1.5E-02	2.1E-03	-	-	1.7E-02
Toluene	-	5.3E-03	9.8E-04	-	-	6.3E-03
Ethylbenzene	-	-	-	-	-	0
Xylene	-	3.7E-03	4.6E-04	-	-	4.1E-03
n-Hexane	-	-	1.6E-01	-	-	0.2
Formaldehyde	3.2E-02	1.5E-03	7.0E-03	-	-	4.0E-02

[a] Assumes maximum development scenario (36 wells developed in 1 year)

Table 4.3-16. Total Annual Production Emissions from the Southam Canyon Alternative C [1]

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	60.4	-	-	1.24	22	83
CO	50.8	-	-	6.9	1.9	60
VOC	4.4E-02	1,079	0.9	0.69	3.6	1,084
SO_2	-	-	-	0.06	-	0.1
PM_{10}	4.6	-	-	188	0.5	193
$PM_{2.5}$	4.6	-	-	19.0	0.5	24
Benzene	1.3E-03	0.4	0.1	-	2.3E-02	0.5
Toluene	2.1E-03	0.4	0.1	-	2.1E-02	0.6
Ethylbenzene	-	0.1	3.5E-02	-	2.1E-03	0.1
Xylene	-	0.1	0.1	-	9.7E-03	0.3

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
n-Hexane	1.1	3.9	3.5E-02	-	0.1	5.0
Formaldehyde	4.4E-02	-	-	-	0.3	0.3

[1] Emissions include 240 producing wells

Table 4.3-17. Southam Alternative C Annual Emissions (tons/year)

Pollutant	Development	Production	Total [1]
NO_x	209	83	293
CO	81	60	141
VOC	3.6	1,084	1,088
SO_2	3.47	0.1	3.5
PM_{10}	122	193	315
$PM_{2.5}$	17	24	41
Benzene	2.E-02	0.5	0.5
Toluene	6.E-03	0.6	0.6
Ethylbenzene	-	0.1	0.1
Xylene	4.E-03	0.3	0.3
n-Hexane	0.2	5.0	5.2
Formaldehyde	0.04	0.3	0.4

[1] Emissions include development of 36 wells and 240 producing wells. Discrepancies in totals are from rounding errors.

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of Alternative C. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate.

Based on a maximum of 36 wells developed per year with two drill rigs, a model with two pad/roads being constructed, two wells being drilled, and two wells being completed was run with the proposed well pads closest together. Each modeled well site had a pad and 0.26-mile road. The model evaluated 1,248 receptors.

Table 4.3-18 shows the predicted development impacts for Alternative C. The predicted impacts would be less than the applicable NAAQS during the development phase of Alternative C. The closest proposed well pads for Alternative C are closer together than the closest proposed well pads for the Proposed Action. Therefore, predicted impacts for PM_{10} are higher than the predicted impacts for the Proposed Action. Additionally, the length of road per pad that is constructed is longer for Alternative C than the length of road for the Proposed Action. A longer graded length results in more PM_{10} emissions without much increase to $PM_{2.5}$ emissions.

The maximum modeled impacts for the Proposed Action occur near the compressor station and well locations near the compressor station are the same for both alternatives. Therefore

operations criteria and HAPs impacts for Alternative C are the same as Alternative A; see **Tables 4.3-8** through **4.3-10.** All predicted concentrations remain below the NAAQS and the PSD Class II increments.

Table 4.3-18. Alternative C Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact ($\mu g/m^3$)	Uinta Basin Background Concentration [e] ($\mu g/m^3$)	Maximum Project Impact Plus Background ($\mu g/m^3$)	National and Utah Ambient Air Quality Standard ($\mu g/m^3$)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	6.4	25	31.4	35	90%
	Annual Mean	3.05 [b]	9	12.0	15	80%
PM_{10}	24-hour Maximum Average [c]	11.6	63.3	74.9	150	50%
NO_2 [d]	Annual Mean	2.80	17	19.8	100	20%
CO	1-hour Maximum	1,913	1,111	3024	40,000	8%
	8-hour Maximum Average	879	1,111	1990	10,000	20%
SO_2	3-Hour	101	20	121	1300	9%
	24-Hour	39.3	10	49.3	365	14%
	Annual	3.02	5	8.02	80	10%

[a] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[b] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[c] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations.
[d] Modeled NO_x converted to NO_2 (multiplied by 0.75).
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

4.3.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation is recommended.

4.4 CULTURAL RESOURCES

Ground-disturbing activities, such as well pad and road construction, and secondary surface activities, such as vehicular and pedestrian traffic, can directly and irreversibly damage or destroy sensitive cultural resources. Many of the known archaeological sites – both prehistoric and historic – in the Uinta Basin are shallow and therefore vulnerable to the direct impacts of vegetation clearing, ROW blading, and excavation of soils.

Indirect impacts could include damage or destruction of cultural resources as a result of increased visitation of otherwise remote areas, and as a result of improved public access to these areas provided by Project Area access roads.

4.4.1 ALTERNATIVE A – PROPOSED ACTION

The Proposed Action would include potential initial disturbance of approximately 858 acres, or about 8.1 percent of the land surface in the Project Area. Many of the existing cultural resources surveys within the Project Area were conducted in advance of or in preparation for oil and gas development. Specific potential impacts to cultural resources related to the Proposed Action would not be known until surveys are completed for the proposed 152 well pad locations and ancillary facilities and, if necessary, cultural resource properties are evaluated for eligibility to the NRHP. These surveys and evaluations would be completed at the site-specific application (APD or ROW) stage. Archival record searches identified 33 previously documented archaeological sites within the Project Area.

While the potential for direct impacts to eligible cultural resources is likely to increase with increased well density and associated facilities, those impacts would be mitigated by the preparation and execution of applicant committed environmental protection measures (**Section 2.5**).

The Proposed Action would result in increased human presence in the Project Area during well field development and operations. In addition, proposed well field roads would provide increased motorized access to areas that may contain cultural resources. Vandalism of cultural resources could occur as an indirect effect of the Proposed Action.

4.4.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative, the potential for impacts to cultural resources would be similar in nature to those described for the Proposed Action; however, they would occur on a much smaller scale, as only 24 well pads would be constructed for an estimated initial disturbance of 181 acres.

4.4.3 ALTERNATIVE C – LIMITED SURFACE DISTURBANCE WITHIN SENSITIVE RESOURCE AREAS

Under Alternative C, 196 well pads would be developed within the Project Area (approximately 1,117 acres of initial disturbance). Impacts to cultural resources would be similar in nature and of slightly greater magnitude to those described under the Proposed Action.

4.4.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those discussed in Chapter 2 are recommended.

4.5 SOILS

Potential impacts to soils in the Project Area from the Proposed Action and alternatives include the removal of vegetation, mixing of soil horizons, soil compaction, increased wind and water erosion, contamination of soils with petroleum products, fuels, or produced water, and loss of topsoil productivity.

4.5.1 ALTERNATIVE A – PROPOSED ACTION

4.5.1.1 Surface Disturbance

A total of approximately 858 acres of soils would initially be disturbed during the construction of 89 single-well and 63 multi-well well pads, the compressor station, 47 miles of surface pipelines, and 36 miles of new or improved access roads under the Proposed Action. This represents about 8.1 percent of the total land surface of about 10,575 acres in the Project Area. Under the Proposed Action, a total of 10.2 acres (including two well pads) would be disturbed in the 160-acre oil shale RD&D area and 462 acres would be disturbed in the 4,960-acre potential oil shale preferential lease area.

Interim reclamation activities described in **Chapter 2**, if successful, would decrease the amount of surface disturbance.

4.5.1.2 Increased Erosion

The primary effect of surface disturbances on soil resources is increased water and wind erosion. Excavation of proposed well pads could initially result in increased erosion of Project Area soils. Increased erosion may also be expected from construction and improvement of access roads and trenching for the installation of pipelines. The erosion hazard of the soils that would be disturbed ranges from slight to high. As discussed in **Section 3.5.2**, most of the soil units that would be disturbed have a water erosion Kw of 0.15 or less. Higher erosion potentials are reported for the Green River-Fluvaquents complex (map unit 90), the Uffens loam (map unit 249), and the Bullpen soils (map unit 260). In addition, all soils on slopes greater than 40 percent and badland areas could be considered to have severe water erosion potentials. Increased erosion of soils can subsequently lead to increased sediment delivery to ephemeral and perennial drainages, increased siltation of livestock ponds, loss of vegetative cover, and increased generation of fugitive dust.

Because the exact routes of the proposed pipelines and access roads are conceptual and subject to change during the APD process, increased erosion in the Project Area was estimated using published estimated erosion rates and the total amount of surface disturbance proposed. The current average erosion rate for soils within the Uinta Basin is reported to be about 1.45 tons per acre per year (tons/acre/year) (BLM 1984). Thus, the existing erosion rate is about 15,334 tons per year for the 10,575-acre Project Area.

Studies concerning the amount of increased erosion associated with the construction of oil and gas facilities in the Uinta Basin have not been completed. However, two studies conducted by the USGS on sediment yield from disturbed surfaces provide some insight into the amount of increased erosion that could be expected from construction of well pads, roads, and other project facilities in the Project Area. Lusby and Toy (1976) reported that yields from reclaimed surface mines were initially 300 percent to 600 percent higher than from undisturbed surfaces. Frickel et al. (1975) found that yields increased to about 2.9 tons/acre/year (about a 100 percent increase) in the Piceance Basin of Colorado after construction of oil shale project facilities. Using these studies as examples, it is assumed that average erosion rates for disturbed soils in the Project Area would initially triple from about 1.45 tons/acre/year to about 4.35 tons/acre/year. This increased erosion rate would generate an additional 2,488 tons of erosion annually from the approximately 858 disturbed acres during and immediately after construction of the proposed project facilities. Using the standard statistical measure used to compare two values called Relative Percent

Difference (RPD), this would represent a theoretical increase of about 14 percent from the existing erosion rate for the Project Area.

These erosion estimates, as is the case for all erosion estimates, are subject to considerable uncertainty. Factors which contribute to the uncertainty include the exact location of the various facilities, the actual road and pipeline gradients, the effectiveness of Best Management Practices (BMPs), and climatic conditions. The BMPs employed would be of two types: non-structural and structural controls. Non-structural controls include proper clearing, grading, and construction practices, including the use of aggregate, surface roughening, and crowning and ditching of roadways. Structural erosion control devices would be used along the proposed access roads, at drilling locations, and at other project facilities to minimize the amount of sediment that reaches any ephemeral drainage in the SCPA, where needed. The erosion control devices used would be specified during the APD process for each project facility, but would include sedimentation basins, vegetated strips, silt fences, and fiber rolls as appropriate. As such, these estimates should be considered to be accurate within the range of +/- 100 percent. However, because these estimates were made using the same set of assumptions for each alternative, they provide a valuable way to compare the potential increased erosion that would result under the various alternatives.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

It is also expected that following successful re-vegetation and approximately one to five growing seasons, the erosion rate and potential sedimentation increases would drop to near baseline conditions from well pads and pipeline ROWs, but would remain at elevated levels for the new access roads. That is because portions of the well pads and pipeline ROWs would be reclaimed and re-vegetated, whereas the access road surfaces would continue to be eroded, even in the absence of high traffic volumes.

4.5.1.3 Soil Contamination

Contamination of surface and subsurface soils near gas facilities can occur in oil and gas fields. Sources of potential contamination include leaks or spills of natural gas condensate liquids from wellheads, conveyance pipelines, produced water sumps, condensate storage tanks, and reserve pits. Leaks or spills of saline water, hydrofracturing chemicals, fuels, and lubricants could also result in soil contamination. Of these materials, leaks or spills of natural gas condensate would have the greatest potential environmental impact.

Depending on the size and type of spill, the primary effect on soils would be loss of soil productivity. In addition, petroleum released to surface soils infiltrates the soil and, under the right conditions, can migrate vertically until the water table is encountered, thus contaminating shallow groundwater. Contaminated groundwater could then potentially be discharged by springs or as baseflow into stream channels, leading to surface water contamination.

4.5.1.4 Rangeland Health Standards

Rangeland health standards were adopted by the Utah BLM to assist in the planning process for grazing, recreation, and other activities on BLM lands (BLM 1997). These standards are applicable to the construction of new roads and well pads on BLM lands. Rangeland Health Standard 1 states that “upland soils should exhibit permeability and infiltration rates that sustain

or improve site productivity, considering the soil type, climate, and landform". The Proposed Action would have a minor impact on the attainment of this standard, due to compaction and blending of soils in some locations.

Compaction due to construction activities at the well pads and along access roads would reduce aeration, permeability, and water-holding capacity of the soils. An increase in surface runoff could be expected, potentially causing increased sheet, rill, and gully erosion. In addition, the segregation and reapplication of surface soils would cause the mixing of shallow soil horizons, resulting in a blending of soil characteristics and types. This blending would modify physical characteristics of the soils including structure, texture, and rock content, which could lead to reduced permeability and increased runoff from these areas.

4.5.2 ALTERNATIVE B – NO ACTION

Potential impacts to soils in the Project Area from the No Action Alternative would similar in nature to those described for the Proposed Action, but of much smaller magnitude.

4.5.2.1 Surface Disturbance

Initial surface disturbance under the No Action Alternative would be about 181 acres from the construction of 24 well pads, 17 miles of surface pipelines, and 12 miles of new or improved access roads. This represents about 21 percent of the surface disturbance proposed under the Proposed Action and about 1.7 percent of the 10,575-acre Project Area.

4.5.2.2 Increased Erosion

The estimated increased erosion under the No Action Alternative would be about 525 tons per year from the 181 acres of new surface disturbance, or about one-fifth of that under the Proposed Action. This would represent a theoretical increase of about 3.3 percent from the existing erosion rate for the Project Area.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

4.5.2.3 Soil Contamination

Potential impacts under the No Action Alternative related to soil contamination would be similar in nature to those described for the Proposed Action. Because fewer wells would be installed, the probability of a release that causes soil contamination would be about 14 percent of that under the Proposed Action.

4.5.2.4 Rangeland Health Standards

Potential impacts to Rangeland Health Standards under the No Action Alternative would be similar in nature to those for the Proposed Action, but of much smaller magnitude.

4.5.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C, no drilling would be conducted in the oil shale RD&D area and only vertical drilling would be conducted in the potential oil shale preferential lease area.

4.5.3.1 Surface Disturbance

A total of about 1,117 acres of soils would initially be disturbed during the construction of 196 well pads, 61 miles of surface pipelines, and 50 miles of new or improved access roads. Surface disturbance under Alternative C would be about 1.3 times the surface disturbance under the Proposed Action, or about 11 percent of the 10,575-acre Project Area. The additional surface disturbance would be from the use of only vertical, single-well well pads within the potential oil shale preferential lease area, which would increase the total number of well pads to 196. Under Alternative C, a total of 5.4 acres would be disturbed in the 160-acre oil shale RD&D area and 711 acres would be disturbed in the 4,960-acre potential oil shale preferential lease area. No well pads would be constructed in the oil shale RD&D area. Interim reclamation activities would be conducted as described above for the Proposed Action.

4.5.3.2 Increased Erosion

If it is assumed that average erosion rates for soils in the Project Area would initially triple from about 1.45 tons/acre/yr to about 4.35 tons/acre/yr, an additional 3,239 tons of erosion would occur annually during and immediately after construction of the proposed project facilities, or about 1.3 times that under the Proposed Action. This represents a theoretical increase of about 17.4 percent from the existing erosion rate for the Project Area.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

It is also expected that following successful re-vegetation and approximately one to five growing seasons, the erosion rate and potential sedimentation increases would drop to near baseline conditions from well pads and pipeline ROWs, but would remain at elevated levels for the new access roads. That is because portions of the well pads and pipeline ROWs would be reclaimed and revegetated, whereas the access road surfaces would continue to be eroded, even in the absence of high traffic volumes.

4.5.3.3 Soil Contamination

Potential impacts related to soil contamination under Alternative C would be similar in nature to those described for the Proposed Action, but would be slightly less in magnitude as 9 fewer wells would be developed.

4.5.3.4 Rangeland Health Standards

Potential impacts to Rangeland Health Standards under Alternative C would be similar in nature to those described for the Proposed Action, but would be slightly higher in magnitude.

4.5.4 RECOMMENDED MITIGATION MEASURES

No mitigation beyond those measures described in **Chapter 2**, along with required standards is recommended.

4.6 WATER RESOURCES

4.6.1 ALTERNATIVE A –PROPOSED ACTION

4.6.1.1 Surface Water

Potential impacts to surface water resources in the Project Area from the Proposed Action include:

- Increased sedimentation and turbidity of surface water as a result of surface disturbance and increased sediment delivery into ephemeral drainage channels, perennial streams, and livestock ponds via runoff;
- Increased sediment loading to the White River, potentially slightly increasing salinity levels in the Colorado River system;
- Adverse effects on surface water quality – i.e., potential contamination of surface water resources from spills or discharges of drilling fluids, petroleum, or other chemicals used for natural gas drilling and production activities;
- Reduction of water flows to livestock ponds by interception of surface water runoff;
- Increased peak stream flows in Evacuation Creek, Southam Canyon, and the White River due to compaction of soils; and
- Impacts to floodplains.

The magnitude of these potential impacts depends on several factors, including the proximity of surface disturbances to ephemeral tributaries of the White River, slope aspect and gradient, soil type, the duration and timing of the construction activity, and the success or failure of reclamation and mitigation measures. The potential for adverse impacts to surface water resources would be greatest during project construction activities and would likely decrease in time due to natural stabilization, interim and final reclamation, and re-vegetation efforts.

<u>Increased Sedimentation and Turbidity</u>

Increased erosion and subsequent increased sediment delivery to perennial streams and ephemeral drainages within the Project Area is likely, especially during the construction of the project facilities. The increased erosion could also potentially lead to an increase in turbidity and salinity in the White River. Both of these effects could have negative impacts on aquatic habitat within affected drainages. In addition, increased sediment delivery to livestock ponds could occur, potentially leading to a reduction of water storage.

Soil loss calculations (presented in **Section 4.5.1.2**) reveal that an estimated 2,488 tons per year of additional erosion could be expected to initially occur annually as a result of the Proposed Action. Over time, short-duration precipitation events and snowmelt could cause soil lost from the proposed facilities to reach the drainages of adjacent ephemeral channels, livestock ponds, Evacuation Creek, Southam Canyon, and the White River.

In sufficient amounts, the additional sediment from construction activities and operational facilities could:

- Clog road culverts and cause road damage;
- Cause accelerated siltation of ephemeral channels and livestock ponds;
- Act as a carrier for other pollutants (trace metals, pesticides, plant nutrients, etc);
- Degrade aquatic habitat by covering stream substrates with fine sediment;
- Increase the turbidity within the White River; and
- Increase salinity levels in the White River (Colorado River system).

Based on data collected at USGS gauging station 09306700 (the median of the calculated sediment loadings in tons/day) on the White River at Asphalt Wash, existing sediment loading in the White River averages about 242,360 tons/year. The highest sediment loading occurs during the months of May and June from snowmelt runoff.

Using the very conservative assumption that all available sediment from the construction of the project facilities would eventually be transported to the White River, development of the Proposed Action could potentially result in maximum increased sediment loadings to the White River equal to the gross additional erosion, which would be an increase of about 1.0 percent over current levels. However, with the proper application and maintenance of BMPs for erosion and runoff control, the actual amount of sediment that would be transported to the ephemeral drainages within the Project Area and on to the White River would be much less.

The amount of additional sediment that would reach the drainages in the Project Area and the White River depends on natural factors and the effectiveness of the BMPs employed. Natural factors which attenuate the transport of sediment into creeks include water available for overland flow, the texture of the eroded material, the amount and kind of ground cover, the slope shape, gradient, and length, and surface roughness (Barfield et al. 1981). The BMPs employed would be of two types: non-structural controls, and structural BMPs to control erosion.

Studies concerning the effectiveness of the BMPs for oil and gas sites have not been conducted. However, several studies conducted in urban settings provide insight into the potential effectiveness of the BMPs that would likely be employed for erosion control in the Project Area. EPA (1999) estimated that the theoretical TSS removal efficiency for retention basins, infiltration basins, and vegetated filter strips are all in the range of 50-80 percent. Actual performance for these BMP types was measured at urban sites and was reported to be 70 percent for retention basins, 89 percent for infiltration basins, and 81 percent for vegetated filter strips. In another study, EPA (2004) reported ranges of TSS removal of 58-78 percent for retention basins, 75 percent for infiltration basins, and 54-84 percent for vegetated filter strips. Using these studies as examples, it is assumed that the BMPs employed would be about 70 percent effective in removing TSS from runoff from the project facilities. Therefore, if the natural factors that affect sediment delivery are ignored, approximately 30 percent of the increased erosion calculated could be expected to eventually be delivered to the White River, or about 746 tons per year. This amount would increase the sediment loading in the White River by about 0.3 percent over current levels. Turbidity and salinity could be expected to increase by similar amounts.

It is important to note that these calculations are approximate. The actual amount of additional sediment loading to the White River is dependent on the natural factors listed above, precipitation amounts and timing, channel conditions, actual BMP efficiency, and reclamation success or failure. In addition, the erosion calculations are also approximate, and should be regarded as accurate only to within +/-100 percent. Nonetheless, these estimates provide a useful way to compare the potential impacts of the various alternatives against each other, in addition to providing estimates of the increased sediment delivery to the White River.

Water Use and Stream Flow Regimes

Approximately 0.75 acre-feet (7,758 barrels) of water would be needed to drill and complete each well. Thus, the total water use for drilling and completion of the proposed 249 wells over the 10-year development period would be about 187.5 acre-feet (18.75 acre-feet per year). In addition, approximately 775 barrels per well pad per year would be used to control dust, or about 15.2 acre-feet per year. Therefore, the estimated total water use for the project would be about 339.5 acre-feet, of 33.95 acre-feet per year.

Water would be obtained from an existing water right (Water Right #49-2279). This water right draws water directly from the White River and is therefore considered to be diversionary. Additional water, if needed would be drawn from permitted sources to be determined as necessary.

Increased Runoff

Soils compacted on existing roads, new access roads, and well pads contribute slightly greater runoff than undisturbed sites. The increased runoff could lead to slightly higher peak flows in the ephemeral channels in the Project Area and the White River, potentially increasing erosion of the channel banks. The increased erosion could lead to slightly increased turbidity in these streams during storm events. However, the natural turbidity in the ephemeral channels within the Project Area during storm events is very high; therefore, the slightly increased turbidity would have no effect on aquatic organisms in the ephemeral channels.

Surface Water Quality

Contamination of surface water can occur in oil and gas fields. Sources of potential contamination include leaks from wellheads, conveyance pipelines, produced water and condensate storage tanks, and tanker trucks. Leaching of contaminants from impacted soils near these facilities also has the potential to contaminate surface water. In addition to leaks from facilities, accidental spills of hydrocarbon products, including fuels and petroleum products produced by the wells, would have the potential to contaminate surface waters if the spills were to occur directly into a stream or when runoff is present. These events could transmit these fluids to the ephemeral channels of the Project Area, and potentially, on to the White River.

Produced water would be temporarily stored in steel tanks at each well site. The contents of the tanks would be pumped out as needed and transported by tanker truck to licensed disposal sites or reused for drilling at other well locations. Therefore, no impacts to surface water resources in and near the Project Area are expected in association with the routine handling of produced water.

An EPA-registered herbicide may be used to control the spread of noxious weeds in some areas, in consultation with the appropriate SMA. Surface water runoff from areas where herbicides are applied would be diverted away from surface water resources through the use of appropriate

BMPs. Although the use of herbicides could result in increased concentrations of these chemicals in surface water runoff, the effect to surface water resources is anticipated to be negligible, based on the proposed storm water runoff controls that would be used at the proposed drilling sites and on new roads, and the small acreage that could potentially require herbicide application.

Hydrofracturing of the Wasatch Formation and Mesaverde Group sandstones for the proposed new wells would be conducted as part of the Proposed Action. Hydrofracturing is commonly used to enhance the recovery of natural gas from relatively impermeable "tight" sandstones, and involves the injection of water or other fluids, which may contain some petroleum constituents, and sand or some other "proppant" into the formation. Hydrofracturing would occur at depths that are at least 8,000 feet or more below the surface. Therefore, because of the great depth to the fractured zone, the potential for impacts to surface water resources from the proposed hydrofracturing is considered to be negligible.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.1.2 Groundwater

Potential impacts to groundwater resources from the Proposed Action include contamination with produced water, drilling mud, or petroleum constituents. Groundwater exists in shallow unconsolidated alluvium along Evacuation Creek and the White River, and in deeper bedrock formations beneath the Project Area. Spills of fuels or produced fluids from well pads, pipelines, and compressor stations have the potential to contaminate groundwater resources, especially the shallow alluvial groundwater. Spills from facilities or vehicle accidents near ephemeral channels or the White River would have the greatest potential to contaminate groundwater. However, the Proposed Action has been designed to minimize the placement of facilities near floodplains. No well pads would be located on any floodplains in the area. Therefore, the probability of a spill impacting shallow groundwater has been greatly reduced and is considered to be low.

No produced water would be discharged into surface water drainages or allowed to flow onto the ground surface. There is a slight chance that produced water could be spilled during the loading operations. However, given the BMPs that would be employed to control storm water runoff at each drilling location, there is little chance that produced water would enter and contaminate shallow alluvial aquifers. Accordingly, the potential for contamination of groundwater resources by produced water is considered to be low.

4.6.1.3 Floodplains

Floodplains are protected by Executive Order 11988 which requires that all Federal agencies take action to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. Potential impacts to floodplains from the Proposed Action include increased sedimentation, pollution of surface water or shallow groundwater due to accidental spills or loss of containment of petroleum products, fuels and other chemicals, and damage to or loss of riparian vegetation.

Under the Proposed Action, no well pads would be constructed on floodplains in the Project Area. A total of 0.88 mile of surface pipe and 0.15 mile of co-located pipeline and access roads would be constructed on floodplains along Evacuation Creek and Southam Canyon. The total surface disturbance to floodplains would be about 11.3 acres.

4.6.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative, new wells would not be allowed on Federal lands. However, wells would still be drilled on State of Utah and private lands within the Project Area and reasonable access to these lands would be provided across Federal lands as necessary. A total of 36 wells could be drilled under the No Action Alternative, as compared to 249 wells under the Proposed Action.

4.6.2.1 Surface Water

Increased Sedimentation and Turbidity

Potential impacts related to increased erosion and subsequent increased sedimentation of perennial streams and ephemeral drainages within the Project Area would be similar to those described for the Proposed Action, but of a substantially lesser magnitude.

Soil loss calculations (presented in **Section 4.5.2.2**) reveal that an estimated 525 tons per year of additional erosion could be initially expected to occur under the No Action Alternative, or about 21 percent of that for the Proposed Action. The actual amount of additional sediment that would reach the drainages in the Project Area depends on natural factors and the effectiveness of the BMPs employed, and is estimated to be about 30 percent of the gross erosion, as described above for the Proposed Action. Therefore, the estimated additional sediment delivery to the White River from the No Action Alternative is about 158 tons per year, which would increase sediment loading to the river by about 0.06 percent over current levels. Turbidity and salinity could be expected to increase by similar amounts.

Water Use and Stream Flow Regimes

Water use for each well is estimated to about 0.75 acre-feet (7,758 barrels), as described above for the Proposed Action. For the No Action Alternative, the total water use would be approximately 29.4 acre-feet for the five-year development period, or 5.88 acre-feet per year. Water would be diverted from the White River per Water Right #49-2279.

Increased Runoff

Under the No Action Alternative, potential impacts of increased runoff would be similar in nature to those described for the Proposed Action. The amount of increased runoff would be about one-fifth of that for the Proposed Action.

Surface Water Quality

Impacts to surface water quality under the No Action Alternative would be similar in nature to those described for the Proposed Action. As fewer wells would be developed, the chance of a spill event would be substantially less than that for the Proposed Action or Alternative C.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.2.2 Groundwater

Potential impacts to groundwater resources from the No Action Alternative are similar in nature to those for the Proposed Action but of a substantially lesser magnitude because of the fewer numbers of wells that would be developed.

4.6.2.3 Floodplains

Potential impacts to floodplains from the No Action Alternative are similar in nature to those for the Proposed Action but of a substantially lesser magnitude. Under the No Action Alternative, no well pads or other facilities would be constructed on floodplains in the Project Area; therefore, no direct impacts to floodplains would occur. Minor indirect impacts due to increased erosion and sedimentation could occur on the floodplains.

4.6.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Potential impacts to water resources in the Project Area from Alternative C would be similar to those for the Proposed Action but of slightly greater magnitude. Under Alternative C, no drilling would be conducted in the oil shale RD&D area and only vertical drilling would be conducted in the oil shale preferential lease area. A total of 240 wells could be drilled from 196 well pads under the Alternative C, as compared to 249 wells from 152 well pads under the Proposed Action.

4.6.3.1 Surface Water

Increased Sedimentation and Turbidity

Increased erosion and subsequent increased sedimentation of perennial streams and ephemeral drainages within the Project Area under Alternative C would be similar in nature to that described for the Proposed Action but of slightly greater magnitude.

Soil loss calculations (presented in **Section 4.5.3.2**) reveal that an estimated 3,239 tons per year of additional erosion could be expected to initially occur under Alternative C, or about 1.3 times that for the Proposed Action. The actual amount of additional sediment that would reach the ephemeral drainages in the Project Area and the White River depends on natural factors and the effectiveness of the BMPs employed, and is estimated to be about 30 percent of the gross erosion, as described above for the Proposed Action. Therefore, the estimated additional sediment delivery to the White River from Alternative C would be about 972 tons per year, or an increase of about 0.4 percent from current levels. Turbidity and salinity could be expected to increase by similar amounts.

Water Use and Stream Flow Regimes

Water use for each well is estimated to be about 0.75 acre-feet (7,758 barrels). For Alternative C, the total water use would be approximately 396 acre-feet for the ten-year development period, or 39.6 acre-feet per year, as compared to 33.95 acre-feet per year under the Proposed Action. Water would be diverted from the White River per Water Right #49-2279. Additional water, if needed, would be drawn from permitted sources to be determined as necessary.

Increased Runoff

Potential impacts from increased runoff would be similar in nature to those described for the Proposed Action. The amount of increased runoff would be about 1.3 times that under the Proposed Action.

Surface Water Quality

Potential impacts to surface water quality under Alternative C would be similar in nature to those described for the Proposed Action. Because more wells would be developed, the chance of a spill event would be about 1.3 times that for the Proposed Action.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.3.2 Groundwater

Potential impacts to groundwater resources from Alternative C would be similar to those for the Proposed Action and include contamination with produced water, drilling mud, or petroleum constituents. Spills of fuels or produced fluids from well pads, pipelines, and compressor stations have the potential to contaminate groundwater resources, especially the shallow alluvial groundwater. Spills from facilities located adjacent to ephemeral channels and the White River would have the greatest potential to contaminate groundwater. However, Alternative C has been designed to minimize the placement of facilities near floodplains. No well pads would be located on any floodplains in the area. Therefore, the probability of a spill impacting shallow groundwater has been greatly reduced and is considered to be low.

4.6.3.3 Floodplains

Potential impacts to floodplains from Alternative C are similar to those for the Proposed Action, and include increased sedimentation, pollution of surface water or shallow groundwater due to accidental spills or loss of containment of petroleum products, fuels and other chemicals, and damage to or loss of riparian vegetation. Under Alternative C, no well pads would be constructed on floodplains. A total of 0.88 mile of surface pipe and 0.22 mile of co-located pipeline and access roads would be constructed on floodplains along Evacuation Creek and Southam Canyon. The total surface disturbance to floodplains would be about 15.7 acres, or about 1.4 times that under the Proposed Action.

4.6.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation beyond regulations, standards, and the measures described in **Chapter 2** are recommended.

4.7 VEGETATION

4.7.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action, approximately 858 acres of existing vegetation would be removed in the Project Area. **Table 4.7-1** provides a breakdown of disturbance by vegetation community from the Proposed Action.

Table 4.7-1. Surface Disturbance by Vegetation Community for the Proposed Action

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	601	9.1
Pinyon-Juniper	3,663	256	7.0
Riparian	135	0	0
Black Sagebrush	131	0	0
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

Vegetation removal and soil handling associated with the Proposed Action would have both direct and indirect impacts on vegetation resources. Direct impacts would include removal of vegetation, including woodland species, and modification of species composition and structure. Indirect impacts may include increased potential for weed invasion, increased exposure of soils to accelerated erosion, increased potential for fugitive dust, and degradation and loss of topsoil and soil microorganisms.

Specific actions set out under the Proposed Action and ACEPMs, such as revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B**), control of noxious weeds, dust abatement, erosion control, and re-establishing soil conditions, would reduce impacts to vegetation communities in the Project Area.

4.7.1.1 Invasive/Non Native Species

Roads provide a major conduit for the spread of exotic plants into natural areas, particularly in arid and semiarid landscapes of the American West (Gelbard and Belnap 2003). Clearing of vegetation and soils, addition of fill, and grading of roads and well pads could create areas of deep, bare soil that would be susceptible to exotic seed establishment (Trombulak and Frissell 2000). As such, actions associated with the Proposed Action could lead to the transport and establishment of weeds throughout the Project Area. Overall, the Proposed Action could increase establishment of invasive and noxious weeds, such as hoary cress, saltcedar, Russian thistle, halogeton, cheatgrass, and black henbane. Specific negative effects of noxious and invasive

weeds can include: 1) reduction in the overall visual character of an area; 2) competition with, or elimination of native plants; 3) reduction or fragmentation of wildlife and threatened and endangered plant habitats; and 4) increased soil erosion (Gelbard and Belnap 2003).

The potential impacts described above would be reduced based on adherence to ACEPMs and mitigation measures specified in the Vernal ROD and Approved RMP (BLM 2008e). Specifically, Enduring has committed to ACEPMs that include conducting a pre-project weed inventory and controlling and monitoring noxious weeds on disturbed sites. In addition, Enduring Resources and their contractors would be required to power wash construction equipment and vehicles for permitted uses and obtain approval from the AO for a Pesticide Use Proposal prior to pesticide application.

4.7.1.2 Wetlands/Riparian Zones

Under the Proposed Action, the conceptual placement of well pads does show some disturbance in the wetland/riparian zones in the Project Area. As proposed, approximately 1,001 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of three proposed well pads. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process.

In addition to direct impacts, construction activities within and near wetlands/riparian zones can have several indirect impacts on these resources including increased sediment deposition, compaction of sensitive riparian vegetation, water quality degradation, and destruction of important and unique wildlife habitat. Additionally, water quality degradation caused by disturbance to these areas could potentially impact wildlife and plant species downstream.

Specific actions under the Proposed Action, including ACEPMs, would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B),** implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.2 ALTERNATIVE B – NO ACTION ALTERNATIVE

Impacts to vegetation under the No Action Alternative would be similar in nature to those described under the Proposed Action, but lower in magnitude. Under Alternative B, approximately 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action). As such, direct and indirect impacts to vegetation communities in the Project Area would be correspondingly lower. **Table 4.7-2** provides a breakdown of disturbance by vegetation community from Alternative B.

Table 4.7-2. Surface Disturbance by Vegetation Community for Alternative B

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	165	2.5
Pinyon-Juniper	3,663	16	0.4
Riparian	135	0	0
Black Sagebrush	131	0	0

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

4.7.2.1 Invasive/Non Native Species

Impacts from invasive and noxious weeds under the No Action Alternative would be similar in nature to those described under the Proposed Action. Under Alternative B, approximately 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action). As such, impacts from invasive and noxious weeds in the Project Area would be correspondingly lower.

4.7.2.2 Wetlands/Riparian Zones

Impacts to wetlands/riparian zones under the No Action Alternative would be similar in nature to those described under the Proposed Action, but lower in magnitude. As proposed, direct impacts to wetlands/riparian zones would occur in Evacuation Creek in the southern portion of the Project Area. Approximately 51 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of a proposed collocated road and pipeline. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process

Indirect impacts to these resources, as described under the Proposed Action, would be lower under the No Action Alternative, as only 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action).

Specific actions under the Proposed Action, including ACEPMs, would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B)**, implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.3 ALTERNATIVE C – VERTICAL DRILLING ALTERNATIVE

Impacts to vegetation under Alternative C would be similar in nature to those described under the Proposed Action, but higher in magnitude. Under Alternative C, approximately 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action). As such, direct and indirect impacts to vegetation communities in the Project Area would be correspondingly higher. **Table 4.7-3** provides a breakdown of disturbance by vegetation community from Alternative C.

Table 4.7-3. Surface Disturbance by Vegetation Community for Alternative C.

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	734	11.1
Pinyon-Juniper	3,663	384	10.5
Riparian	135	0	0

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Black Sagebrush	131	0	0
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

4.7.3.1 Invasive/Non Native Species

Impacts from invasive and noxious weeds under Alternative C would be similar in nature to those described under the Proposed Action, but greater in magnitude. Under Alternative C, approximately 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action). As such, impacts from invasive and noxious weeds in the Project Area would be correspondingly higher.

4.7.3.2 Wetlands/Riparian Zones

Impacts to wetlands/riparian zones under Alternative C would be similar in nature to those described under the Proposed Action, but higher in magnitude. As a result of the conceptual placement of well pads, roads and pipelines, direct impacts to wetlands/riparian zones would occur in Evacuation Creek in the northeastern portion of the Project Area. As proposed, approximately 769 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of two well pads and a road/pipeline. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process.

Indirect impacts to these resources, as described under the Proposed Action, would be higher under Alternative C, as 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action).

Specific actions under the Proposed Action would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B),** implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those described in **Chapter 2** are recommended.

4.8 LIVESTOCK GRAZING

4.8.1 ALTERNATIVE A – PROPOSED ACTION

The Proposed Action would result in the removal of approximately 713 usable acres of vegetation (involving 87 livestock AUMs) in grazing allotments in the Project Area. **Table 4.8-1** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment. As shown, activities under the Proposed Action would result in the reduction of approximately 0 to 8.9 percent of usable acres and/or AUMs in these grazing allotments.

Table 4.8-1. Estimated Livestock AUMs Affected by the Proposed Action

Allotment Name	Acres		AUMs		Percent of UseableAcres Lost Due to Proposed Action
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable[1] Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	584	862	77	8.9
Little Emma	1	0	0	0	0
Southam Canyon	1,176	78	112	7	6.6
Watson	626	51	31	3	8.1
White River Bottoms	15	0	1	0	0
Total	**8,374**	**713**	**1,005**	**87**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

Indirect effects to livestock grazing could include reduced forage quality due to potential weed infestations; increased development-related traffic; and potential traffic delays to ranchers accessing the Project Area during construction and drilling phases.

Certain actions under the Proposed Action, including ACEPMs, would reduce impacts to disturbed grazing areas. Actions under the Proposed Action include revegetation of disturbed areas and implementation of noxious weed control and monitoring. In addition, any livestock facilities (e.g. fences, cattle guards, gates, drift fences and natural barriers) that are damaged by the Proposed Action would be repaired or replaced. Additional cattleguards or gates would also be installed, as needed, and maintained for the life of the project.

Adherence to the above-mentioned measures would reduce the anticipated impacts to livestock, forage, and existing livestock facilities within the Project Area.

4.8.2 ALTERNATIVE B – NO ACTION ALTERNATIVE

Impacts to livestock grazing under the No Action Alternative would be similar in nature to those described above under the Proposed Action, but would be smaller in magnitude. Under Alternative B, approximately 49 usable acres, involving 6 AUMs, would be disturbed (a 7 percent reduction from the Proposed Action). As such, the potential for ground-disturbing activities to impact grazing allotments in the Project Area would be correspondingly lower. **Table 4.8-2** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment.

Table 4.8-2. Estimated Livestock AUMs Affected by Alternative B.

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. B
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	42	862	6	0.6
Little Emma	1	0	0	0	0
Southam Canyon	1,176	2	112	<1	0.2
Watson	626	5	31	<1	0.8
White River Bottoms	15	0	1	0	0

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. B
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Total	**8,374**	**49**	**1,005**	**6**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

4.8.3 ALTERNATIVE C – VERTICAL DRILLING ALTERNATIVE

Under Alternative C, impacts to livestock grazing would be similar in nature to those described under the Proposed Action, but would be greater in magnitude. Under Alternative C, approximately 952 usable acres, involving 118 AUMs, would be disturbed (a 34 percent increase from the Proposed Action). As such, the potential for ground-disturbing activities to impact grazing allotments in the Project Area would be correspondingly greater. **Table 4.8-3** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment.

Table 4.8-3. Estimated Livestock AUMs Affected by Alternative C

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. C
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	819	862	108	12.5
Little Emma	1	0	0	0	0
Southam Canyon	1,176	83	112	8	7.1
Watson	626	50	31	2	8
White River Bottoms	15	0	1	0	0
Total	**8,374**	**952**	**1,005**	**118**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

4.8.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those described in **Chapter 2** are recommended.

4.9 WILDLIFE AND FISHERIES

4.9.1 ALTERNATIVE A – PROPOSED ACTION

4.9.1.1 General Wildlife

Implementation of the Proposed Action would increase the existing level of functional habitat loss and habitat fragmentation within the SCPA. The estimated surface disturbance of approximately 858 acres of wildlife habitat associated with the construction of well pads, roads, pipelines, compressor station, and related infrastructure would reduce habitat availability and relative habitat values for a variety of common wildlife species. This reduction in habitat would be expected to have a minor to moderate impact on the general wildlife species discussed in **Section 3.9.1** because many of these species are considered habitat generalists, meaning they are

not tightly restricted to specific habitat types (e.g., cottontail rabbits, coyotes, ravens, rodents, and snakes).

Visual and noise disturbances from increased traffic levels and construction, drilling, completion, and production activities, including use of the proposed compressor station, could displace wildlife from habitats in areas of human activity. Construction, drilling, and completion activities could result in displacement from affected habitats in specific, localized areas during the entire construction period for wells, roads, or pipelines (typically a period of several weeks in the vicinity of a well pad). However, production activities could result in displacement only during well visits (generally one, 30 minute visit per day), or for the life of the project for some species if animals are disturbed due to noise from the proposed compressor station. If displaced, individual animals could move into less suitable habitats, which could potentially cause deteriorated physical condition, decreased productivity, and increased general distress.

Overall, the severity of impacts to general wildlife species under the Proposed Action would depend on the seasonal and daily timing of traffic and project-related activities, site-specific topography and vegetation, species' sensitivity to human disturbance, and the availability of suitable habitat within and adjacent to the SCPA.

4.9.1.2 Big Game

Many of the impacts associated with the Proposed Action would be similar among all big game species (i.e., mule deer, elk, Rocky Mountain bighorn sheep, and bison) utilizing habitats in the SCPA. These potential impacts include:

- Decreased habitat values and reduced habitat use within and/or near disturbed areas due to direct habitat loss and fragmentation of habitat;
- Decreased reproductive success and nutritional condition from increased energy expenditure as a physical response to disturbance;
- Increased stress and increased intra- and inter-specific competition for resources due to increased animal densities in adjoining or unsuitable habitats;
- Increased potential for collisions between vehicles and big game; and
- Increased harassment and/or poaching of big game species.

Species-specific habitat losses for UDWR-designated big game ranges associated with the Proposed Action are listed below in **Table 4.9-1**.

Table 4.9-1. Surface Disturbance of Big Game Ranges under the Proposed Action

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	7[1]	1.1	-	-	110	4.8	858	8.2
UDWR Crucial	187	10.7	-	-	-	-	-	-

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
Value, Winter								
UDWR Substantial Value, Winter	636	8.5	282	7.6	-	-	-	-

[1]UDWR crucial value, year-long habitat for mule deer in the SCPA is considered fawning habitat.

Indirect habitat loss (e.g., avoidance of or displacement from well pads and roads), caused by habitat fragmentation of the remaining habitat, could be substantially larger than the direct habitat losses shown below. Habitat loss and displacement are not limited to actual areas of vegetation removed by surface-disturbing activities. Studies have shown that mule deer will generally avoid human-related activities, and therefore, the amount of suitable habitat loss will be greater than the acreage that is eventually developed (D'Eon and Serrouya 2005; Sawyer et al. 2006). Such studies, while useful, are not necessarily characteristic of all populations. For example, Easterly et al. (1991) found some evidence that mule deer acclimated to human activity associated with construction and production of oil fields. The conflicting results of the studies described above show that habitat selection varies based on factors such as species, topography, landscape, climate, season, and intensity of development. As such, impacts related to habitat fragmentation in the SCPA cannot easily be predicted or quantified, but for the purposes of analysis, it is assumed that disturbance on big game ranges would exceed that listed in **Table 4.9-1**.

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial fawning and crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison reintroduced to the area. As surface disturbance associated with the Proposed Action would continue to fragment previously fragmented big game ranges in the SCPA, impacts associated with the Proposed Action would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.1.3 Migratory Birds

Impacts to migratory birds under the Proposed Action would be similar in nature for all migratory bird species, but would vary in intensity depending on the timing, location, and amount of surface-disturbing activities and the species' sensitivities to these actions. If construction and drilling of the proposed well pads and wells were completed in the late summer months (i.e., August – September), many of the migratory species would have left the SCPA for southern wintering grounds, or at least would have fledged SCPCA nests. Disturbance during this time would not likely have a measurable impact on migratory bird populations as a whole or on individual species. If the proposed well construction and drilling were to occur during the nesting months in spring/summer, the Proposed Action could result in some displacement of birds and

destruction of nesting habitat. This would have a greater impact on high-priority migratory bird species due to their smaller population size and limited distribution found in these species.

Proposed surface disturbance estimates for vegetative communities under the Proposed Action, which provide habitat for migratory birds, are summarized in **Section 3.9.3**, and the location of these disturbances is displayed in **Figure 2-1**. Migratory birds utilizing Wyoming big sagebrush and pinyon-juniper vegetation would most likely be impacted greatest by the direct removal of habitat and increased habitat fragmentation in the SCPA. Habitat fragmentation and associated edge avoidance by migratory birds has been documented as leading to lower levels in productivity (Renfrew et al. 2005). As such, in addition to direct loss of habitat, habitat fragmentation and associated noise and increased human presence could cause displacement from foraging and nesting habitats. If displaced, birds could move to less suitable habitats which could cause an increase in competition and deteriorated physical condition.

Due to the extent of Wyoming big sagebrush and pinyon-juniper vegetation within the SCPA (approximately 10,274 total acres), as compared to the total proposed disturbance in these areas (i.e., approximately 858 acres or 8.4 percent), the above-mentioned impacts would most likely be minimal to moderate, with more moderate impacts expected for those birds occupying habitats within the 100-year floodplains for Evacuation Creek and Southam Canyon. Under the Proposed Action, approximately 0.24 mile of pipeline and approximately 0.04 mile of co-located road and pipeline are proposed within Wyoming big sagebrush vegetation in the 100-year floodplain for Evacuation Creek. Additionally, approximately 0.64 mile of pipeline and 0.11 mile of co-located road and pipeline are proposed within pinyon-juniper vegetation in the 100-year floodplain for Southam Canyon.

The presence of reserve pits in oil and gas fields allows for potential exposure of migratory birds to contaminants. Migratory birds mistake these structures for natural bodies of water, and contact with petroleum products in the reserve pit could result in mortality due to loss of thermoregulatory capability or from ingestion of contaminated water during preening. Birds that ingest sub-lethal doses of oil could also experience impaired reproduction. Those birds returning to their nests may inadvertently apply oil to their eggs, which is extremely toxic to developing bird embryos. These impacts would be minimized under the Proposed Action, as Enduring Resources has committed to using deterrents (e.g., netting or bird balls) on open reserve pits, as directed by the AO.

Specific actions under the Proposed Action, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.1.4 Raptors

Implementation of the Proposed Action could affect nesting and breeding raptors that utilize the SCPA. Direct and indirect impacts to raptors may include temporary displacement from suitable habitats during the breeding season due to increased noise levels and visual disturbances on the landscape, and a reduction in habitat for prey species caused by direct habitat loss and fragmentation.

Surface-disturbing activities or areas with concentrated human activity in close proximity (e.g., ½ mile) of an active raptor nest could lead to temporary displacement from nesting sites, avoidance of affected areas, and deterrence from establishing or utilizing other nesting sites. Displacement

could lead to nest failure or nest abandonment, thereby affecting the breeding pair and its annual productivity. Steidl and Anthony (2000) suggest that the greatest energetic costs from disturbance occur in nestlings, potentially decreasing overall reproductive success. Displacement could also lead to increased use of adjacent habitats, which could lead to increased inter- and intra-specific competition for resources. However, as increased noise levels and visual disturbances associated with construction, drilling, and completion activities would be relatively short-term as compared to the life of the project, displacement to adjacent habitats from these activities would likely be temporary in nature and thus would not likely alter the productivity of current raptor populations within the SCPA. In addition, although human activity has been shown to adversely impact breeding raptors, some evidence of raptor habituation to human-induced disturbances has also been documented (Anderson et al. 1989; Steidl and Anthony 2000; Rodriguez-Estrella et al. 1998). It should be noted that displacement to adjacent habitats caused by avoidance of noise pollution from the proposed compressor station not likely be temporary in nature and could exist for the life of the project.

In addition to reducing suitable nesting habitat, surface disturbances associated with the Proposed Action would result in the direct loss of approximately 858 acres of habitat for raptor prey species such as mammals, songbirds, and reptiles. Rodriguez-Estrella et al. (1998) identify loss or fragmentation of habitat of prey species as a contributor to raptor population declines.

Specific actions under the Proposed Action, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO of the appropriate SMA, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.1.5 Upland Game Birds

Impacts to chukar populations under the Proposed Action would be similar in nature to those described above for migratory birds, in that impacts would vary in intensity depending on the timing, location, and amount of surface-disturbing activities. The Proposed Action would result in the direct loss of approximately 496 acres of substantial value, year-long chukar habitat. If construction and drilling of the proposed well pads and wells were completed in spring or early summer (i.e., mid-March through May), chukar could be displaced from breeding or nesting sites, or become vulnerable to ground and aerial predators. Increased access and human presence (e.g., at well sites and project facilities) within the SCPA could also increase the potential for poaching and harassment of chukar, as well as increase hunter access and success. In contrast to these impacts, surface-disturbing activities in the SCPA, primarily along area roads, could increase the presence of cheatgrass, which is an important winter food source for chukar.

Specific actions set out under the Proposed Action, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss. Successful reclamation, in conjunction with implementation of a weed control plan, would

reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.1.6 Fisheries

As previously discussed, the proposed project would utilize water for two main purposes: 1) drilling and completion activities and 2) dust suppression. Total estimated water use during the 10-year development phase would be approximately 340 acre-feet. During the production phase, water use would be approximately 0.1 acre-feet per well pad per year, or a maximum of 15.2 acre-feet per year. Depletions can reduce the ability of the White and Green Rivers to create and maintain their physical and biological environments for fisheries. Water depletions can also contribute to alterations in flow regimes that favor non-native fish species.

Although no ground-disturbing activities would directly occur in the White River corridor as a result of the Proposed Action, fisheries in and downstream of the SCPA could be impacted by water depletion activities, increased siltation due to increased soil erosion, the potential for exposure to hazardous substances in the case of an accidental spill or leak. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.2 ALTERNATIVE B – NO ACTION

4.9.2.1 General Wildlife

Under Alternative B, impacts to general wildlife species and their habitats within the SCPA would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 180 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. In addition, noise disturbances to general wildlife species would be less under Alternative B as well development would only occur on State of Utah and private leases. Overall, as compared to the Proposed Action, Alternative B would result in fewer adverse impacts to general wildlife species associated with functional habitat loss, habitat fragmentation, and displacement within the SCPA.

4.9.2.2 Big Game

Under Alternative B, impacts to big game would be similar in nature, but less in extent as less construction would occur in the SCPA. Species-specific habitat losses for UDWR-designated big game ranges associated with Alternative B are listed below in **Table 4.9-2**.

Table 4.9-2. Surface Disturbance of Big Game Ranges under the No Action Alternative

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of in the SCPA	Acres	Percentage of Range in the SCPA	Bison Acres	Percentage of Range in the SCPA

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of in the SCPA	Acres	Percentage of Range in the SCPA	Bison Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	-	-	-	-	47	2.0	181	1.7
UDWR Crucial Value, Winter	60	3.4	-	-	-	-	-	-
UDWR Substantial Value, Winter	121	6.9	48	1.3	-	-	-	-

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer on BLM-administered lands would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison transplanted to the area. As surface disturbance associated with the No Action Alternative would continue to fragment previously fragmented big game ranges in the SCPA, and estimated surface disturbances would be minimal, impacts associated with the No Action Alternative would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.2.3 Migratory Birds

Under Alternative B, impacts to migratory bird species would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. Additionally, it should be noted that no construction (e.g., pipelines or co-located roads and pipelines) would occur in the 100-year floodplains for Evacuation Creek or Southam Canyon.

Specific actions set out under the No Action Alternative, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds occupying areas on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.2.4 Raptors

Under Alternative B, impacts to raptors would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. The loss of raptor nesting and foraging habitats would be correspondingly less under Alternative B as compared to the Proposed Action.

Specific actions under the No Action Alternative, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors occupying areas on or near access ROWs on Federal lands. On BLM-administered lands, raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.2.5 Upland Game Birds

Under Alternative B, impacts to chukar populations would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 97 acres of surface disturbance (or about 80 percent less disturbance) would occur in substantial value, year-long chukar habitat.

Specific actions set out under the No Action Alternative, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.2.6 Fisheries

Under Alternative B, impacts to fisheries in the White and Green Rivers would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA, and thus less water would be used. Total water usage for the 5-year development phase would be expected to be approximately 29.4 acre-feet, or about 91 percent less than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under Alternative B, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be minimized if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.3 ALTERNATIVE C – VERTICAL DRILLING WITHIN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

4.9.3.1 General Wildlife

Under Alternative C, impacts to general wildlife species and their habitats within the SCPA would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Specifically, habitat loss and associated habitat fragmentation would be greatest in the oil shale development area where wells would be vertically drilled. Overall, as compared to the Proposed Action, Alternative C would result in greater adverse impacts to general wildlife species associated with functional habitat loss, habitat fragmentation, and displacement within the SCPA.

4.9.3.2 Big Game

Under Alternative C, impacts to big game would be similar in nature, but greater in extent as more construction would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Vertical drilling would have the greatest effect on UDWR ranges for elk, Rocky Mountain bighorn sheep, bison, and select mule deer ranges (only UDWR substantial value, winter range for mule deer). Impacts to other mule deer ranges in the SCPA (i.e., UDWR crucial value, year-long and UDWR crucial value, winter ranges) would be essentially identical to those expected under the Proposed Action. Species-specific habitat losses for all UDWR-designated big game ranges associated with Alternative C are listed below in **Table 4.9-3**.

Table 4.9-3. Surface Disturbance of Big Game Ranges under Alternative C

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	7[1]	1.1	-	-	136	5.9	1,117	10.6
UDWR Crucial Value, Winter	188	10.7	-	-	-	-	-	-
UDWR Substantial Value, Winter	859	11.5	382	10.3	-	-	-	-

[1]UDWR crucial value, year-long habitat for mule deer in the SCPA is considered fawning habitat.

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these

herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial fawning and crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison transplanted to the area. As surface disturbance associated with Alternative C would continue to fragment previously fragmented big game ranges in the SCPA, impacts associated with Alternative C would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.3.3 Migratory Birds

Under Alternative C, impacts to migratory bird species would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Additionally, it should be noted that construction of pipelines and co-located roads and pipelines in the 100-year floodplains for Evacuation Creek and Southam Canyon would be identical to that described above under the Proposed Action, with the exception of the proposed co-located road and pipelines in the 100-year floodplain for Evacuation Creek (approximately 0.11 miles). Surface-disturbing activities in these floodplains, and other proposed development activities throughout the SCPA, would increase habitat fragmentation in the SCPA.

Specific actions set out under Alternative C, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.3.4 Raptors

Under Alternative C, impacts to raptors would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. The loss of raptor nesting and foraging habitats would be correspondingly greater under Alternative C as compared to the Proposed Action.

Specific actions under Alternative C, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). Prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.3.5 Upland Game Birds

Under Alternative C, impacts to chukar populations would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 605 acres of surface disturbance (or about 22 percent more disturbance) would occur in substantial value, year-long chukar habitat.

Specific actions set out under Alternative C, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.3.6 Fisheries

Under Alternative C, impacts to fisheries in the White and Green Rivers would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA, and thus more total water would be used for the project. Total water usage for the 10-year development phase would be expected to be approximately 396 acre-feet, or about 16 percent more than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be minimized if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.4 RECOMMENDED MITIGATION MEASURES

To avoid entrainment, water would be pumped from an off-channel location – one that does not connect to the river during high spring flows. An infiltration gallery constructed in a BLM and USFWS-approved location would be best.

If the pump head is located in the river channel where larval fish are known to occur, the following measures should be followed: 1) the pump should not be situated in a low-flow or no-flow area, as these habitats tend to concentrate larval fishes; 2) the amount of pumping should be limited, to the greatest extent possible, during that period of the year when larval fish may be present; and 3) the amount of pumping should be limited to the greatest extent possible – during the pre-dawn hours, as larval drift studies indicate that this is a period of greatest daily activity.

All pump intakes should be screened with ¼-inch mesh material. Any fish impinged on the intake screen would be reported to the USFWS (801-975-3330) and the UDWR.

4.10 SPECIAL STATUS WILDLIFE AND FISHERY SPECIES

4.10.1 ALTERNATIVE A – PROPOSED ACTION

4.10.1.1 Mexican Spotted Owl

Although MSO would not likely nest in the SCPA due to the lack of preferred nesting habitat (i.e., steep-walled forested canyons), the Proposed Action would result in the loss of approximately 858 acres of potential foraging habitat for MSO prey species such as small mammals, songbirds, and reptiles. This would constitute an approximately eight percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA. This could affect MSO potentially occupying "fair" habitat northeast, but outside of the SCPA. However, based on MSO surveys conducted in 2007 and 2008, it was inferred that MSO were absent in the surveyed area at the time the surveys were conducted (B&A 2007; B&A 2008). It is therefore unlikely that MSO would be affected by the estimated loss of prey species within the SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under the Proposed Action, including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e), the Proposed Action "***may affect, not likely adversely affect***" the MSO.

4.10.1.2 Yellow-billed Cuckoo

The yellow-billed cuckoo is an obligate riparian species that feeds in cottonwood groves and nests in willow thickets. The Proposed Action would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. However, activities that increase erosion and sedimentation to area drainages could degrade water quality, which could indirectly reduce the proper functioning level of riparian habitats along the White River corridor. Further, construction activities and increased traffic in the SCPA would likely introduce or spread weed species within riparian habitats near or adjacent to disturbed areas. The presence of exotic plant species has been documented as decreasing the habitat sustainability of remaining riparian habitats for the cuckoo (Wiggins 2005). Such impacts could reduce the overall habitat suitability for yellow-billed cuckoo potentially nesting, breeding, or foraging in the area. However, these impacts would be minimized by specific actions set out under the Proposed Action, including ACEPMs that include provisions to implement interim reclamation, utilize proper erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, the Proposed Action may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, the Proposed Action would not likely result in a trend towards Federal listing of this species.

4.10.1.3 Bald Eagle

Given that no known bald eagle roosting sites have been identified along the White River corridor either in or within ½ mile of the SCPA boundary, it is inferred that wintering bald eagles are unlikely to take shelter in the SCPA from early November through late March. Bald eagles may, however, search for prey items along the White River corridor, including the portion of the White

River that flows through the SCPA. As such, increased human presence, traffic, and associated noise levels during the winter could deter bald eagles from these activities within or near the SCPA, particularly in construction areas in close proximity to the White River. In addition, increased traffic in the SCPA could also increase the potential for vehicle collisions with carrion-feeding eagles.

Specific actions set out under the Proposed Action, including ACEPMs to contact the UDWR regarding the presence of carrion on roadways, shoulders, and ROWs would minimize the potential for vehicle collisions with carrion-feeding eagles. Additionally, ACEPMs that include measures to prohibit construction or surface-disturbing activities within ½ mile bald eagle roost sites and limit daily times for work-related activities during the winter (November 1 through March 31), could minimize or eliminate many potential project-related disturbances to bald eagle behavior (e.g., temporary displacement and loss of prey species habitat) should roost sites become established along the White River corridor.

Based upon the analysis above, the Proposed Action could reduce the relative habitat value of potential bald eagle roosting and foraging habitats, but would not likely result in a trend towards Federal re-listing of this species given the current absence of winter roosting sites in and within ½ mile of the SCPA.

4.10.1.4 Golden Eagle

Under the Proposed Action, potential impacts to golden eagles in the SCPA include the following:

- Direct loss of nesting habitats due to construction activities;
- Temporary loss of potential foraging habitat loss due to changes in vegetation structure;
- Temporary displacement or avoidance of nesting sites caused by increased human activity, traffic, and noise levels; and
- Increased potential for collisions with vehicles when foraging on carrion (a primary winter food source for golden eagles).

Although interim reclamation efforts could restore potential habitat for the golden eagle over time, it is important to note that behavioral changes (e.g., temporary displacement or avoidance of territories) would be similar in nature to those discussed in the general raptor discussion (refer to **Section 4.9.1.4**). Therefore, as discussed previously for other raptor species, specific actions set out under the Proposed Action, including ACEPMs, would reduce both direct and indirect impacts to golden eagles. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active golden eagle nests are found, construction would not occur during the nesting season within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, ACEPMs to contact the UDWR regarding the presence of carrion on roadways, shoulders, and ROWs could minimize the potential for vehicle collisions with carrion-feeding eagles.

Based on the analysis above, the Proposed Action could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.1.5 Greater Sage-grouse

Sage-grouse are a sagebrush-obligate species, and rely almost exclusively on contiguous sagebrush ecosystems for leks, nesting sites, feeding sites, rearing sites, protection, and wintering grounds. Sagebrush habitats in the SCPA are primarily contiguous; however, existing roads have already somewhat fragmented these habitats. Additional development across the SCPA would continue to fragment existing sagebrush vegetation and may deter sage-grouse from utilizing certain portions of the SCPA. Surface disturbance associated with the Proposed Action would result in the direct loss of approximately 602 acres of Wyoming big sagebrush, primarily in the northern portion of the SCPA and east of Evacuation Creek.

According to UDWR data, sage-grouse do not currently utilize sagebrush habitats in the SCPA for breeding or nesting purposes; however, contiguous sagebrush parks in the SCPA may be used for brooding areas or winter cover. Numerous studies have determined that sage-grouse are affected by human activity (Lyon and Anderson 2003; Remington and Braun 1991; Braun 1986). The primary effect of the Proposed Action on sage-grouse would be displacement or abandonment of these areas due to increased disturbance from human activity, increased traffic, and noise associated with construction and drilling activities. Lyon and Anderson (2003) determined that traffic disturbance of 1 to 12 vehicles per day during the breeding season may reduce nest-initiation rates and increase distances from leks during lek-site selection. In addition, Ingelfinger (2001) determined that sagebrush obligate bird densities were reduced within 100 meters of a road, regardless of traffic volumes. Noise from construction activities would also affect sage-grouse during the period those activities are taking place at a given location. Sage-grouse may be temporarily displaced by this noise and other human activities until construction activities were completed. Sage-grouse could also experience increased general distress due to project-related noise impacts (e.g., increased traffic near brooding areas or winter habitat) that would occur in the SCPA throughout the life of the project.

Based on the above information, implementation of the Proposed Action may impact individual sage-grouse or could cause overall habitat value in the SCPA to be altered. However, specific actions set out under the Proposed Action, including ACPEMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan, would minimize the above-mentioned impacts to sage-grouse in the SCPA. As such, the Proposed Action could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.1.6 Endangered Colorado River Fish

Based on the similarity of their affected habitats within the White and Green Rivers, and potential impacts associated with the Proposed Action, impact analyses for the bonytail, Colorado pikeminnow, humpback chub, and razorback sucker (collectively known as the endangered Colorado River fish) are discussed together within this EA.

As previously discussed, the proposed project would utilize water for two main purposes: 1) drilling and completion activities and 2) dust suppression. Total estimated water use during the 10-year development phase would be approximately 340 acre-feet. During the production phase, water use would be approximately 0.1 acre-foot per well pad per year, or a maximum of 15.2

acre-feet per year. Depletions can reduce the ability of the White and Green Rivers to create and maintain the physical habitat (areas inhabited or potentially habitable to the Colorado River fish for spawning, development of fish larvae, or feeding, or serving as corridors between these areas) and the biological environment. Water depletions can also contribute to alterations in flow regimes that favor non-native fish species.

In order to address depletion (and other) impacts on the endangered Colorado River fish, a Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) was initiated on January 22, 1988. Under the 1988 Recovery Program, any water depletions from tributary waters within the Colorado River drainage are considered to *"jeopardize the continued existence"* of these fish. In order to further define and clarify the recovery processes in the Recovery Program, a Section 7 agreement was implemented on October 15, 1993, by Recovery Program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP). The RIPRAP identifies actions currently required to recover the endangered fish species in the most expeditious manner. Included in the RIPRAP was the requirement that a one-time depletion fee would be paid to help support the Recovery Program for all non-historic water depletions (i.e., occurring after January 1988) from the Upper Colorado River Basin. The depletion fees ($17.79 per acre-foot as of October 1, 2007) were intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions to the Upper Colorado River Basin (USFWS 2007b). In 1995, the USFWS eliminated these water depletion fees for non-historical water depletions (permitted after January 1988) from the Upper Colorado River Basin of 100 acre-feet or less (USFWS 1995). For analysis purposes in this EA, it is assumed that all water depletions would be considered non-historical. As such, Enduring would be responsible for paying a one-time depletion fee to the Recovery Program. Furthermore, other impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Implementation of the Proposed Action could also degrade USFWS-designated critical habitat for the Colorado River fish in the White and Green Rivers by increasing erosion, sediment yield, and the potential for exposure to hazardous substances in the case of an accidental spill. However, degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, the Proposed Action ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.1.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Although no ground-disturbing activities would directly occur in aquatic habitat for the bluehead sucker, flannelmouth sucker, or roundtail chub as a result of the Proposed Action, these fish could be impacted by water depletion activities, increased siltation due to increased soil erosion, and hazardous substances in the case of an accidental spill or leak. Impacts to these fish species would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be

minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, the Proposed Action would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.2 ALTERNATIVE B – NO ACTION

4.10.2.1 Mexican Spotted Owl

Under Alternative B, impacts to the MSO would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. This would constitute a two percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under the No Action Alternative, including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e) on Federal lands, the No Action Alternative "***may affect, not likely to adversely affect***" the MSO.

4.10.2.2 Yellow-billed Cuckoo

Similar to the Proposed Action, the No Action Alternative would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. Indirect impacts to the yellow-billed cuckoo would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. For access ROWs, these impacts would be minimized on Federal lands by specific actions set out under Alternative B, including ACEPMs that include provisions to implement interim reclamation, utilize erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, Alternative B may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, the No Action Alternative would not likely result in a trend towards Federal listing of this species.

4.10.2.3 Bald Eagle

Under Alternative B, impacts to bald eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. This would constitute a two percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the absence of winter roosting sites in and within ½-mile of the SCPA, and specific actions set out under the No Action Alternative for Federal access ROWs, including ACEPMs that include provisions to contact the UDWR regarding the presence of carrion and seasonally prohibit surface-disturbing activities within ½-mile of bald eagle roosting sites, the No Action Alternative would not likely result in a trend towards Federal re-listing of this species.

4.10.2.4 Golden Eagle

Under Alternative B, impacts to golden eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. Impacts to golden eagles would be minimized for Federal access ROWs by specific actions under Alternative B, including ACEPMs that include provisions to conduct raptor nest inventories prior to surface-disturbing activities, adhere to seasonal restrictions for nesting raptors, and contact the UDWR regarding the presence of carrion.

Based on the analysis above, Alternative B could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.2.5 Greater Sage-grouse

Under Alternative B, impacts to sage-grouse would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 165 acres of surface disturbance in Wyoming big sagebrush (or about 72 percent less disturbance) would occur in the SCPA. Impacts to sage-grouse would be minimized for Federal access ROWs by specific actions set out under Alternative B, including ACEPMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan. As such, Alternative B could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.2.6 Endangered Colorado River Fish

Under Alternative B, impacts to the endangered Colorado River fish would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA, and thus less water would be used. Total water usage for the 5-year development phase would be expected to be approximately 29.4 acre-feet, or about 91 percent less than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under Alternative B, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, Alternative B ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.2.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Under Alternative B, impacts to the bluehead sucker, flannelmouth sucker, and roundtail chub would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, Alternative B would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.3 ALTERNATIVE C – VERTICAL DRILLING WITHIN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

4.10.3.1 Mexican Spotted Owl

Under Alternative C, impacts to the MSO would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. This would constitute an approximately 11 percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under Alternative C including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e), Alternative C "***may affect, not likely to adversely affect***" the MSO.

4.10.3.2 Yellow-billed Cuckoo

Similar to the Proposed Action, Alternative C would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. Indirect impacts to the yellow-billed cuckoo would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. These impacts would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to implement interim reclamation, utilize erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, Alternative C may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, Alternative C would not likely result in a trend towards Federal listing of this species.

4.10.3.3 Bald Eagle

Under Alternative C, impacts to bald eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. This would constitute an approximately 11 percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the absence of winter roosting sites in and within ½-mile of the SCPA, and specific actions set out under Alternative C, including ACEPMs that include provisions to contact the UDWR regarding the presence of carrion and seasonally prohibit surface-disturbing activities within ½-mile of bald eagle roosting sites, Alternative C would not likely result in a trend towards Federal re-listing of this species.

4.10.3.4 Golden Eagle

Under Alternative C, impacts to golden eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Impacts to golden eagles would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to conduct raptor nest inventories prior to surface-disturbing activities, adhere to seasonal restrictions for nesting raptors, and contact the UDWR regarding the presence of carrion.

Based on the analysis above, Alternative C could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.3.5 Greater Sage-grouse

Under Alternative C, impacts to sage-grouse would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 734 acres of surface disturbance in Wyoming big sagebrush (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Impacts to sage-grouse would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan. As such, Alternative C could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.3.6 Endangered Colorado River Fish

Under Alternative C, impacts to the endangered Colorado River fish would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent greater disturbance) would occur in the SCPA, and thus more water would be used. Total water usage for the 10-year development phase would be expected to be approximately 396 acre-feet, or about 16 percent more than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim

reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, Alternative C ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.3.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Under Alternative C, impacts to the bluehead sucker, flannelmouth sucker, and roundtail chub would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, Alternative C would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.4 MITIGATION MEASURES

To avoid entrainment, water would be pumped from an off-channel location – one that does not connect to the river during high spring flows. An infiltration gallery constructed in a BLM and USFWS-approved location would be best.

If the pump head is located in the river channel where larval fish are known to occur, the following measures should be followed: 1) the pump should not be situated in a low-flow or no-flow area, as these habitats tend to concentrate larval fishes; 2) the amount of pumping should be limited, to the greatest extent possible, during that period of the year when larval fish may be present; and 3) the amount of pumping should be limited to the greatest extent possible – during the pre-dawn hours, as larval drift studies indicate that this is a period of greatest daily activity.

All pump intakes should be screened with ¼-inch mesh material. Any fish impinged on the intake screen would be reported to the USFWS (801-975-3330) and the UDWR.

4.11 RECREATION

The potential adverse impacts to recreation from natural gas development in the SCPA would consist primarily of lost recreational opportunities or diminished recreational experience within and near the Project Area.

4.11.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action, 152 well pads, 47 miles of pipeline, and 36 miles of new or upgraded access roads would be constructed within the Project Area. Surface disturbance associated with the new well pads, associated facilities, roads, and pipelines (approximately 858 acres) would be visible to recreational users throughout much of the Project Area. The shift to an even more industrialized landscape, in combination with an increase in noise and traffic associated with construction, drilling, and completion activities would diminish the recreation experience of visitors seeking a more primitive environment.

Increased noise and human activity, from construction, drilling, and operations, as well as noise from the compressor, would likely result in displacement of game species from portions of the SCPA, which would impact hunting, especially for those seeking a more primitive hunting experience. Conversely, the 36 miles of new and upgraded access roads proposed within the Project Area would provide increased access to broader portions of the area, some of which were previously not accessible by vehicle. This increased access could expand trail-related recreational opportunities (such as OHV use and hunting).

River Recreation: If the Proposed Action were implemented, eight well pads and associated facilities have the potential to be seen from the White River (the nearest of which is proposed approximately ¼ mile from the River). Of those eight wellpads, only two fall within one half mile of the White River. These wells would be developed on leases that predated the VFO Approved RMP. The proposed wells may or may not be drilled during the primary recreational season. If wells were drilled during the recreation season, river recreationists may be able to see drill rigs and/or production facilities and activities on the well pads closest to the river, and could possibly see fugitive dust plumes along access roads. Each drilling rig would be operational for up to 20 days, 24 hours a day per well. Night lighting would be visible for long distances. Following drilling, completion rigs could also be visible for another 10 days. Visible development activities would diminish the recreational experience of some visitors seeking a natural setting devoid of human influence.

4.11.2 ALTERNATIVE B - NO ACTION ALTERNATIVE

Effects of surface disturbance on recreational activities and experiences in the SCPA would similar in nature to that described for the Proposed Action, but would be lower in magnitude due to the reduced level of development. There would be no wells within the viewshed of the river.

4.11.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C, 196 wells pads and associated facilities (50 miles of collocated road and pipeline and an additional 11 miles of pipeline) would be constructed within the Project Area for a total of 1,117 acres of surface disturbance. Effects of surface disturbance on recreational activities and experiences in the area would be nearly identical, but slightly greater, to that described for the Proposed Action. Additionally, 11 well pads (3 more than the Proposed Action) would likely be visible from the White River. Of the 11 well pads visible from the river, three lie within one half mile of the river, the nearest being approximately ¼ mile away. These wells would be developed on leases that predated the VFO Approved RMP.

4.11.4 MITIGATION

The following additional mitigation measures are recommended:

- No drilling would be allowed within sight of the river during the high use recreation season (April 1 through August 15).
- Lighting from drill rigs would be down shielded unless human health and safety would be adversely affected.
- Low profile production facilities would be used on well pads within the view shed of the river as directed by the AO.
- Facilities would be painted to blend with the environment as directed by the AO, with the exception of those facilities having OSHA requirements.

4.12 VISUAL RESOURCES

4.12.1 ALTERNATIVE A – PROPOSED ACTION

Short-term visual impacts due to construction, drilling, and completion activities would occur as a result of the Proposed Action. The landscape would be changed by the introduction of visual modifications within the landscape in the form of new lines, colors, forms, and textures. New well pads, facilities, roads, and pipelines would increase visual contrasts created by gas well construction and production activities (e.g., dozers, drilling rigs, truck traffic, heavy equipment, dust, lights, etc.) within the Project Area. Construction, drilling, and completion would take place over a four to six year period and would generally occur in clusters. Drilling activity typically occurs 24-hours per day, therefore, visual impacts during drilling activities would include lighting of drilling rigs during nighttime hours.

Long-term visual impacts of the Proposed Action would consist of reduced visual harmony within the overall landscape due to the introduction of additional long-term visual modification that creates contrasts. Long-term landscape contrasts would result from well pad facilities, pipelines, and roads, yielding a more industrialized visual setting.

Most of the proposed wells, pipelines, and roads (approximately 575 acres of surface disturbance) are expected within VRM Class III areas, in which the landscape should partially retain the existing character and changes to the landscape should be moderate. Approximately 134 acres of surface disturbance on Federal lands from the development of well pads, roads, and pipelines would occur in VRM Class IV areas and approximately 17 acres in VRM Class II areas. As mentioned in **Section 3.15**, VRM Class II areas allow for management activities to be seen, but those activities should not attract the attention of a casual viewer. The class II areas within the SCPA lie near the White River and in the southwestern corner of the Project Area.

Through implementation of mitigation measures Enduring would attempt to minimize the impact of development activities in the visual corridor of the White River and within Class II areas by locating and designing well pads so that they would be screened from viewers on the river by topographic features. In addition, all operating equipment would be painted a flat non-reflective color that is compatible with the surrounding landscape as specified by the BLM. Based upon commitment to these mitigation measures, the Proposed Action would be in compliance with the VRM Class II objectives.

4.12.2 ALTERNATIVE B – PROPOSED ACTION

Under Alternative B, development would be limited to State and private lands on which VRM guidelines do not apply.

4.12.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

General visual impacts due to construction, drilling, and completion activities would be identical in nature to those described in **Section 4.14.1** for the Proposed Action. Specific differences are described below.

As with the Proposed Action, the majority of the development would fall within VRM Class III areas (approximately 711 acres) which would conform with VRM management objectives. Approximately 239 acres of surface disturbance would occur on VRM Class IV areas and 36 acres of disturbance are expected on VRM Class II Federal lands as a result of well pad, road, and pipeline construction.

Through implementation of mitigation measures Enduring would attempt to minimize the impact of development activities in the visual corridor of the White River and within Class II areas by locating and designing well pads so that they would be hidden by topographic features. In addition, all operating equipment would be painted a flat non-reflective color that is compatible with the surrounding landscape as specified by the BLM. Based upon commitment to these mitigation measures, the Proposed Action would be in compliance with the VRM Class II objectives.

4.12.4 RECOMMENDED MITIGATION MEASURES

The following mitigation measures are recommended for VRM Class II areas to reduce visibility from key observation points:

- The edges of well pads would be feathered to blend with the natural surroundings;
- Low profile tanks would be installed as directed by the AO; and
- Tank batteries would be centralized as directed by the AO;
- Topographic and vegetative screening would be utilized as directed by the AO.
- Engines placed in VRM II areas would be muffled with hospital mufflers as directed by the AO so as not to draw the attention of visitors to the area.

4.13 LAND USE AUTHORIZATIONS

4.13.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action there would be approximately 858 acres of surface disturbance within the SCPA. Of the 858 acres, approximately 726 acres, or 85 percent would occur on Federal lands administered by the BLM.

In addition to the aforementioned impacts, implementation of the Proposed Action could result in potential conflicts with other pending or authorized land uses as described in the sections below.

4.13.1.1 Rights-of-Way

If the Proposed Action were implemented approximately three well pads would be constructed on Federal lands within the ROW for the White River Dam. If construction of the dam were to occur, these well pads and associated roads and pipelines would be located in an area that could potentially inundated. Lease number UTU 66422 contains a no surface occupancy stipulation for the Dam. However, as previously discussed in **Section 3.13.1**, although the State of Utah has never relinquished the ROW for this water facility, neither the State Of Utah's Water Plan (Utah Division of Water Resources 2001) or the Uintah Basin's Water Plan (Utah Division of Water Resources 1999) give any indication that the White River Dam will be constructed in the reasonably foreseeable future.

4.13.1.2 Mineral Development

Development of the Proposed Action could potential conflict with future oil shale development in both the 160-acre RD&D area and (if the pilot oil shale project is successful) within the 4,960-acre preferential lease area. Additional information on potential mineral conflicts can be found in **Section 4.2.1.1**.

If mitigation measures contained in **Section 4.2.1.4** were implemented, oil shale extraction activities and conventional oil and gas development within the preferential lease area would be able to occur concurrently and interference could be minimized.

4.13.2 ALTERNATIVE B - NO ACTION ALTERNATIVE

If Alternative B were selected the Proposed Action would not be implemented and no development would be approved on Federal lands. Nonetheless, drilling and production would continue to occur on State of Utah and private lands within the Project Area.

Construction of four well pads on State of Utah lands and 20 well pads private lands which would accommodate a total of 36 wells would result in approximately 181 acres of surface disturbance.

The BLM would be required to grant ROWs for roads and pipelines across Federal lands to access the leases on the State and private lands. Therefore, of the 181 acres, approximately 49 acres or 27 percent would occur on Federal lands administered by the BLM.

4.13.2.1 Rights-of-Way

Under the No Action alternative there would be no development within the White River Dam ROW; therefore, there it is not anticipated that there would be any long-term conflicts with pending or authorized ROWs.

4.13.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C there would be approximately 1,117 acres of surface disturbance within the SCPA. Of the 1,117 acres, approximately 985 acres, or 88 percent would occur on Federal lands administered by the BLM.

4.13.3.1 Rights-of-Way

If the Proposed Action were implemented approximately three well pads would be constructed on Federal lands within the ROW for the White River Dam. Therefore, impacts would be similar to those discussed under the Proposed Action.

4.13.3.2 Mineral Development

In order to reduce land use conflicts between oil shale and natural gas development, under the Alternative C, no development would occur within the oil shale RD&D area. In addition, each of the 124 wells proposed within the preferential lease area would be drilled vertically. Vertical well bores can be mapped more accurately than directional bores which would reduce the potential for conflict with oil shale development in the future. Additional information on potential mineral conflicts can be found in **Section 4.2.1.3**.

If mitigation measures contained in **Section 4.2.1.4** were implemented, oil shale extraction activities and conventional oil and gas development would be able to occur concurrently within the preferential lease area and unintentional interference with these activities could be essentially avoided.

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5.0 - CUMULATIVE IMPACTS ANALYSIS

Cumulative impacts result from the incremental impacts of an action when added to past, present, and reasonably foreseeable future actions, regardless of who takes the action. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. This chapter discusses cumulative impacts as the incremental effect to specific resources or issues that would occur from Alternatives A, B, C in conjunction with other cumulative actions.

5.1 REASONABLY FORESEEABLE DEVELOPMENT

In support of the cumulative impact discussion, this chapter provides a discussion of past and present oil and gas activities in the Uinta Basin, both of which serve as introductions to the outlook for reasonably foreseeable development (RFD) in the Project Area and the greater Uinta Basin. The cumulative impact and RFD analysis is based upon the level of activities and actions identified in the VFO Mineral Potential Report (BLM 2002). Other cumulative activities would be livestock grazing and recreational projects. Spatial boundaries for cumulative impact assessments vary and are larger for resources that are mobile or migrate (i.e., air quality) compared to resources that are stationary. For the analysis purposed of this EA, the Cumulative Impact Analysis Area (CIAA) for most resources is VFO Planning Area, which encompasses approximately 5.5 million acres in Duchesne, Daggett, Uintah and Grand Counties.

5.1.1 OIL AND GAS

The Uinta Basin is a significant source of natural gas and oil, and it is currently one of the most active oil and gas producing areas in the onshore U.S. Oil and gas development is at an all-time high in the basin, with more rigs operating, and more applications for permit to drill (APDs) being processed than ever before. For example, over half of the total oil and gas wells drilled in Utah between 1911 and November of 2000 were drilled within the Uinta Basin. APDs and ROW applications processed by the BLM VFO have illustrated a significant upward trend, estimated to be approximately 15 percent annually. In support of the VFO Draft RMP, a mineral potential report was prepared (BLM 2002). In that report, it was estimated that a total of about 6,530 wells could be drilled in the Uinta Basin by various oil and gas operators over a 5-year period, of which about 67 percent would be new gas wells.

Exploratory drilling is currently proposed in the western and southwestern portions of the Uinta Basin, including BLM, Tribal, and National Forest lands. Production of exploratory wells typically lags discovery by many years. These exploratory wells are typically characterized by larger, deeper, more remote locations requiring greater per-well expenditures, potential delays in infrastructure access and, therefore, greater financial risk.

Future oil and gas development in the Uinta Basin will depend upon the feasibility of exploration, as determined by the underlying geology and further infill development projects within the Basin. Future development will be dependent upon the geologic feasibility of each prospect, the cost to develop the resources, and engineering technological advancements. Development of Tribal lands will continue and perhaps increase as exploratory wells are drilled in the Hill Creek Extension. Drilling in the Ashley National Forest will likely increase as a result of new leasing and management strategies. However, the level of development on Tribal and National Forest System lands is unknown.

The cumulative scenario for this EA is based on the number of existing wells in the VFO Planning Area, as well as the estimated total number of wells anticipated to be drilled over the coming 5 years in this same area. According to the UDOGM, as of August 2008, approximately 9,674 wells had been drilled in the VFO Planning Area. Of these wells, 78 percent (7,522 wells) are currently active (i.e., producing; shut-in; drilled commenced; drilling suspended), leaving 22 percent (2,152 wells) that have been plugged, abandoned, and reclaimed. Under the Mineral Potential Report, an estimated 6,530 oil and gas wells are anticipated in the VFO Planning Area (BLM 2002). The following surface disturbance assumptions have been applied regarding future construction associated with oil and gas development:

- Surface disturbance for a well pad: 2.4 acres;
- Surface disturbance for an access road, assuming 0.2 mile/well: .73 acre/well;
- Surface disturbance for pipelines and flowlines: 0.47 acre/well.

Based on these assumptions, the additional surface disturbance associated with past, present and reasonably foreseeable oil and gas development is estimated to be 50,587 acres, or approximately 0.9 percent of the 5.5 million acre VFO Planning Area. Details of the cumulative development scenario, excluding the Proposed Action and alternatives, are shown in **Table 5-1**.

Table 5-1. Cumulative Oil and Gas Development Surface Disturbance (Excluding Proposed Action and Alternatives) in the Vernal Field Office Planning Area

Planning Area	Existing Active Wells	RFD # Wells	Total # Wells	Well Pads (acres)[1]	Access Roads (acres)	Total Pipelines (acres)	Total Surface Disturbance (acres) in the CIAA
VFO	7,522	6,530	14,052	33,725	10,258	6,604	50,587

[1]Well pad disturbance is overestimated, since it assumes one well per pad. In some cases, two or more wells may be drilled from a single well pad.

Table 5-2 shows the total disturbance of past, present, and reasonably foreseeable development (from **Table 5-1**) with the addition of surface disturbances associated with the Proposed Action and alternatives.

Table 5-2. Cumulative Oil and Gas Development Surface Disturbance in the VFO CIAA, Including the Proposed Action and Alternatives

Alternative	Existing Wells	RFD Wells	Alt Wells	Total # Wells	Well Pads (acres)[1]	Access Roads (acres)	Total Pipelines (acres)	Total Disturbance (acres)
A	7,522	6530	249	14,301	34,322	10,440	6,721	51,483
B	7,522	6530	36	14,088	33,811	10,284	6,621	50,716
C	7,522	6530	240	14,292	34,301	10,433	6,717	51,451

[1]Well pad disturbance is overestimated, since it assumes one well per pad. In some cases, two or more wells may be drilled from a single well pad.

5.1.2 LIVESTOCK GRAZING

Livestock grazing is currently a permitted use of public lands within the VFO Planning Area. Although some minor changes may be expected over the next few years, it is reasonable to expect that livestock grazing would continue. Allocated AUMs would remain essentially unchanged; however, based on use trends over the past seven years, actual use may decline based on

individual grazing permittee's operations and market conditions. The VFO currently administers grazing on 147 allotments. The 147 allotments within the VFO boundary designated for livestock grazing encompass approximately 2,268,120 acres (1,696,416 acres of BLM land; and 571,704 acres of private, State, and Tribal lands). Within the grazing allotments managed by the VFO, 153,370 AUMs are allocated for livestock.

5.1.3 RECREATION

Reasonable foreseeable recreation decisions potentially affecting cumulative impacts in the VFO RMP area could include designation of Areas of Critical Environmental Concerns (ACECs), Wild and Scenic Rivers (WSRs), and Special Recreation Management Areas (SRMAs), as well as trail, campground, and cabin development. These designations and developments would have beneficial impacts on recreation, but would also affect the management of other resources in the Cumulative Impact Analysis Area (CIAA).

5.2 CUMULATIVE IMPACTS

5.2.1 INTRODUCTION

This section discloses the impacts expected when the Proposed Action or alternatives are added to the past and reasonably foreseeable actions. **Table 5-3** presents a comparison of expected surface disturbance under each alternative. Although the CIAAs vary per resource, the table below describes surface disturbance within the Vernal Field Office Planning Area.

Table 5-3 Comparison of Surface Disturbances Associated with the Proposed Action (Alternative A) and Alternatives (B and C) to the CIAA

Alternative	Total Surface Disturbance Proposed in the SCPA by Alternative (acres)	Total Surface Disturbance in the CIAA (acres)[1]	Percentage of Surface Disturbance in the CIAA Caused by Alternatives in the SCPA
A	858	51,483	1.7
B	181	50,716	0.4
C	1,117	51,451	2.2

[1] Acreage determined using per well assumptions listed above in **Section 5.1.1**

5.2.2 GEOLOGY AND MINERALS

5.2.2.1 Geology and Minerals

Cumulative impacts to geologic and mineral resources in the CIAA (the VFO Planning Area) would primarily occur as a result of oil and gas development, which would deplete recoverable oil and gas from the formations underlying the CIAA and alter the local topography due to surface disturbance. Oil and gas development in the CIAA has been, and is expected to continue to be, extensive. Exploration for oil and gas reserves has diminished as infill projects are developed in known fields. Infill drilling continues to be proposed on decreased spacing, resulting in increasingly greater density of surface disturbance and installation of facilities in portions of the CIAA. Extraction of natural gas from geologic formations underlying the CIAA under the Proposed Action and alternatives would be irreversible, and would cumulatively add to depletions of oil and natural gas resources across the CIAA, especially from the Wasatch Formation and Mesaverde Group.

As of August 2008, there were 9,674 oil and gas wells in the VFO Planning Area, of which 7,522 wells are active. Under the Mineral Potential Report, an additional 6,530 oil and gas wells are anticipated in the VFO Planning Area during the next decade (BLM 2002). The Proposed Action and Alternative C would account for as many as 249 wells, or about 1.7 percent of the total reasonably foreseeable 14,052 wells (as of 2008). Under Alternative B (No Action), up to 36 wells would be drilled or about 0.4 percent of the total reasonably foreseeable wells. Development of other large oil and gas fields is currently proposed or is underway for other areas to the north, west, and northwest of the Project Area, including the Greater Deadman Bench Region, the Chapita Wells-Stagecoach Area, the North Chapita Area, the Little Canyon/Hill Creek Area, the Riverbend Area, the Rock House Area, the Antelope Creek and Brundage Canyon fields, and the Bonanza and West Bonanza areas.

In addition to oil and gas development, mining of oil shale could occur in some portions of the CIAA in the future. Oil Shale Exploration Company (OSEC) was granted a lease on 160 acres of land within the Project Area to evaluate oil shale extraction technologies. If the pilot project proves to be successful, OSEC may be granted an additional 4,960 acres of preferential lease rights within the Project Area for the development of a commercial-scale shale oil facility. The shale would be mined by underground room-and-pillar methods. Surface facilities would include fresh and spent shale stockpiles, roads, water management facilities, maintenance shops, and shale retorts. The Proposed Action and alternatives could conflict with future oil shale production in this area by occupying portions of the surface and from potential health and safety concerns associated with well casings that extend through the mining interval.

The Proposed Action and alternatives would have little cumulative impact on other mineral resources, including Gilsonite, tar sands, coal, dimension stone, and metallic minerals. There are a few Gilsonite veins in the Project Area but no current interest in mining them. Tar sands and coal deposits exist near the Project Area; however, better quality, more easily mined deposits exist in other areas of the CIAA, and these areas currently appear to be sufficient to satisfy future demand for these materials. The current demand for dimension stone is satisfied by the common collection areas that exist to the west of the Project Area. The Proposed Action and alternatives would have no cumulative impacts on metallic mineral production in the CIAA.

The potential for increased landslides in the CIAA from oil and gas development is considered to be minor because the frequency of landslides in the Green River Formation, Uinta Formation, and Wasatch Formation, which cover much of the surface of the CIAA, is relatively low. Some slumping of material would likely occur in the cuts created for new access roads, pipelines, well pads, and other project facilities, especially on steep slopes. However, these mass movements would generally be minor in extent and most would not affect any existing structures.

Increased frequency of rock falls could occur as a result of blasting for well pad and access road construction. Areas in canyons with steep slopes where road construction occurs would have the greatest potential for increased rock fall activity. The potential impacts from rock falls include the disruption of traffic routes and destruction of cultural resources. In addition, rock falls that occur in steep canyons could cause safety concerns for workers and the general public.

Debris flows commonly occur in the CIAA. These flows originate in the upper reaches of side canyons and consist of flows of unconsolidated sand, gravel, and boulders that move down the drainage, sometimes cross existing roads.

5.2.2.2 Paleontology

For paleontological resources, the CIAA is the VFO Planning Area. Given the amount of anticipated development, oil and gas activities have the greatest potential to impact fossils in the Basin. Cumulative impacts to paleontological resources would primarily result from activities associated with surface and subsurface disturbance from oil and gas development projects, with additional impacts from recreational use/OHV travel, mining activities, other county and private road construction, and fire management. These activities could have short- and long-term cumulative effects on paleontological resources in the CIAA. Surface-disturbing activities could affect paleontological resources by damaging or destroying fossils. The Proposed Action would disturb an additional 858 acres in the CIAA. This would represent an increase of about 1.7 percent over the estimated total cumulative surface disturbance from past, present, and reasonably foreseeable oil and gas development in the CIAA of 50,587 acres. Alternative C would disturb about 1,117 acres (an increase of 2.2 percent) and the No Action Alternative would disturb about 181 acres (an increase of 0.4 percent). Adverse effects include physical damage to or destruction of fossils, as well as increased vandalism and theft that result from improved access to fossil localities. However, following the procedures for assessment and mitigation described in **Chapter 2** would reduce or remove the potential for most of these adverse impacts. Public education and, where necessary, law enforcement actions would also reduce unauthorized fossil collecting.

Surface-disturbing activities could also have a beneficial effect on paleontological resources by drawing the attention of a qualified paleontologist to areas that are not currently being researched, resulting in the collection of specimens and data that would not otherwise be recovered. Scientifically important fossils could be uncovered in this manner.

5.2.3 AIR QUALITY IMPACTS

Cumulative air quality impacts are defined as the combination of emissions resulting from the Proposed Action, existing nearby permitted sources, and Reasonably Foreseeable Development (RFD) within the region. Areas of concern include the Uinta Basin, the High Uinta Wilderness Area, as well as nearby mandatory federal PSD Class I areas such as Arches and Canyonlands National Parks and Flat Tops Wilderness. Potential Air Quality Related Value (AQRV) impacts to sensitive areas include regional impacts on visibility, total nitrogen and sulfur deposition, and Acid Neutralization Capacity (ANC).

It is anticipated that the pace and level of natural gas development within this region of the State will continue over the next few years. Air quality assessments presented in the technical support document (BLM 2005) for the Vernal Proposed RMP and Final EIS (BLM 2008d) have recently addressed the impacts to air quality in the Uinta Basin and surrounding areas of special concern, considering both existing permitted sources and an extended look at development over a fifteen year timeframe. The development alternatives were based on BLM's proposed plans for resource development, which included estimates for the number of wells drilled for oil and gas, compressor stations, and pipelines, along with other foreseeable development activities by non-BLM entities. In general, results from this analysis indicate that existing air quality in the region is good, and based on Reasonable Development Scenarios in conjunction with existing sources, is not of great concern.

In particular, cumulative well development activities in the Uinta Basin are not expected to affect attainment of NAAQS standards or regional PSD increments. Existing and RFD stationary sources including compressor engines and turbines, while of greater concern, are anticipated to be

adequately spaced to allow for favorable dispersion conditions. A cumulative effects analysis on visibility impairment within nearby Class I and selected Class II areas found that potential changes in visibility and acid deposition were within acceptable guidelines.

The Proposed Action would cumulatively contribute to disturbances occurring immediately adjacent to the Project Area and within the greater Uinta Basin. Several ongoing or recently proposed oil and gas exploration and development projects are underway or proposed within the Uinta Basin. On Tribal lands, these include the Brundage Canyon, Tabby Canyon, and Antelope Creek projects. On public, State, and private lands, these include the Castle Peak and Eight Mile Flat, Greater Deadman Bench, Chapita Wells-Stagecoach, North Chapita, Little Canyon, Sowers Canyon, Bonanza, Love Unit, and West Tavaputs projects.

In general, the increase in emissions associated with the Proposed Action will be localized, in some cases temporary (well development phase), and on a limited scale in comparison with regional emissions. Therefore, it is unlikely that the project would strongly impact the cumulative air quality of the region.

5.2.4 CULTURAL RESOURCES

The CIAA for cultural resources is defined as the boundary of the SCPA. Impacts to the cultural resources in the CIAA would primarily result from activities associated with surface and subsurface disturbance. Surface disturbance from previous oil and gas activities in the CIAA have disturbed approximately 25 acres. While recreational use on the White River is moderate, use of the SCPA for recreation is relatively low. As such, surface disturbance from these activities in the SCPA is rare. Future impacts to the cultural resources in the CIAA would primarily result from surface disturbance associated with additional oil and gas development projects and increased visitation to the SCPA. Additional surface disturbance associated with oil and gas development in the CIAA would occur based upon the alternative selected (Alternative A = 858 acres; Alternative B = 181 acres; Alternative C = 1,117 acres) for this EA. Impacts may also result from specific cultural resource management decisions and from non-surface-disturbing activities that create atmospheric, visual, and/or auditory effects. These latter impacts would apply to sites or locations that together comprise the overall cultural experience for all visitors to the area. These types of impacts cumulatively affect not only the historic setting, feeling, and viewshed of cultural properties, but also their eligibility potential for nomination to the NRHP.

5.2.5 SOILS

The CIAA for soils is defined as the VFO Planning Area. Any surface-disturbing activity that removes native vegetation and topsoil can result in an increase in erosion rates and sediment yield. The Proposed Action would disturb an additional 858 acres of surface soils in the CIAA, an increase of 1.7 percent over the total RFD surface disturbance of 50,587 acres. An additional 181 acres would be disturbed under the No Action Alternative (an increase of 0.4 percent) and 1,117 acres would be disturbed under Alternative C (an increase of 2.2 percent). Additional BLM-authorized actions (other oil and gas developments, mining, livestock grazing, prescribed burns, and recreational activities), and the construction or improvement of county and private roads, that would result in increased erosion and sediment yield within the CIAA, are likely to occur. Of these potential surface-disturbing activities, existing and proposed roads are the features of highest concern. Unlike surface and buried pipelines, active roadways are not reclaimed, thus sediment yield from roads can continue at rates two to three times above background rates into the indefinite future. The Proposed Action would create an additional 36 miles of unpaved roadway in the CIAA. For comparison, the No Action Alternative would create

12 miles of roads and Alternative C would create 50 miles of roads. Using the assumptions provided in **Section 5.1.1**, the CIAA contains an estimated 1,504 miles of access roads for oil and gas facilities, with another 1,306 miles of access roads reasonably foreseeable. Therefore, the Proposed Action and alternatives would increase the total length of unpaved roads associated with oil and gas facilities in the CIAA by about 0.42 to 1.78 percent, depending on the alternative selected. Other unpaved roadways may also be constructed in the CIAA for mining and agricultural use.

Soil loss calculations reveal that under the Proposed Action an estimated 2,488 tons per year of additional erosion could be initially expected to occur. Using the average erosion rate for soils in the Uinta Basin of 1.45 tons/acre/year (BLM 1984), an estimated 7,975,000 tons of erosion occur each year in the 5.5 million acre CIAA. Therefore, the Proposed Action would initially increase gross erosion in the CIAA by about 0.032 percent. Under the No Action Alternative, 525 tons of additional erosion would occur (an increase of 0.0066 percent) and under Alternative C, 3,239 tons of additional erosion is expected (an increase of 0.041 percent). Reasonably foreseeable oil and gas development would add about 28,835 acres of disturbance to the CIAA, using the assumptions provided in **Section 5.1.1**. If it assumed that erosion rates would initially triple on these disturbed surfaces, construction of these projects would potentially increase erosion by about 83,622 tons per year, or an increase of about 1.05 percent over the current erosion rates. Additional increases in erosion rates could also be expected from expanded recreational use, mining activities, livestock grazing, prescribed burns, and construction or improvement of county and private roads.

Rangeland Health Standard 1 states that "upland soils should exhibit permeability and infiltration rates that sustain or improve site productivity, considering the soil type, climate, and landform". The Proposed Action and alternatives would add to other actions that have a negative impact on the attainment of this standard, due to compaction and blending of soils in some locations. Compaction due to construction activities at the well pads and along access roads would result in a small increase in surface runoff from the area. This slightly increased runoff could in turn cause increased sheet, rill, and gully erosion.

The construction and operation of the wells would incrementally increase the chance that leaks or spills of petroleum products, saline water, hydrofracturing chemicals, fuels, and lubricants would occur within the CIAA. Spills of this nature could increase the loss of soil productivity within the area. Other activities, including recreational OHV use, livestock operations, and mining activities, also add to the cumulative risk of contamination of soils.

5.2.6 WATER RESOURCES

In the CIAA, defined as the VFO Planning Area for water resources, construction of oil and gas facilities has the greatest potential impact on erosion and sedimentation rates. In addition to oil and gas development, recreational activities (OHV use and the development of facilities including campgrounds), mining activities (Gilsonite, sand and gravel, and, potentially oil shale), county and private road construction, agricultural activities (livestock grazing), and prescribed burns also increase natural erosion rates and contribute sediment to the rivers in the CIAA.

The Proposed Action and alternatives would result in a slight increase in erosion rates and sediment yield. If reclamation and mitigation measures are not successful, additional sedimentation and turbidity of surface water, including that in the White River, could persist. The increased erosion, combined with increases associated with other oil and gas development,

recreational activities including OHV use, livestock grazing, and mining, could have cumulative negative impacts on aquatic habitat within affected drainages.

The increased sediment loading to the White River from the Proposed Action would be about 746 tons per year, or about 0.3 percent of the current sediment loading in the river of about 242,360 tons per year at Asphalt Wash. Under Alternative C, the increased annual sediment loading to the White River would be about 972 tons (an increase of 0.4 percent). For the No Action Alternative, the increased annual sediment loading to the White River would be about 158 tons (an increase of 0.06 percent). Additional increases in sediment delivery could also be expected from expanded recreational use, mining activities, livestock grazing, prescribed burns, and construction or improvement of county and private roads.

Soils compacted on existing roads, new access roads, and well pads contribute slightly greater runoff than undisturbed sites. The Proposed Action and alternatives, when combined with other past, present, and reasonably foreseeable oil and gas projects and other surface-disturbing activities in the CIAA, would slightly increased runoff rates and could lead to slightly higher peak flows in the White River, potentially increasing erosion of the channel banks. The increased erosion would increase turbidity in the river during storm events.

Water for the project would be obtained from the White River (Water Right #49-2279) and would be considered a diversion of the White River

The Proposed Action or alternatives, combined with other oil and gas development and increased recreational activities, would slightly increase the chance that accidental spills of fuels, lubricants, and other petroleum products would occur and contaminate surface water within the CIAA. Spills of fuels or produced fluids from well pads, pipelines, and compressor stations also have the potential to contaminate the shallow alluvial groundwater along Project Area drainages and the White River.

Rapid and successful reclamation/re-vegetation of temporarily disturbed areas and installation of sediment control devices are particularly important in minimizing water quality impacts and to assure maintenance of long-term stream health. Mitigation measures included in the Proposed Action and alternatives, including berms, sediment control structures, and proper grading of well pads and access roads, would minimize the erosion of sediment from the proposed project facilities. In addition, mitigation measures applied to the project would minimize the additional sedimentation and the chance for contamination of surface water and groundwater.

The Proposed Action and alternatives could result in a slight increase in sediment yield to floodplains in the CIAA. Under the Proposed Action and alternatives, no well pads would be developed on floodplains. However, the Proposed Action and Alternative C would add 11.7 acres and 15.3 acres of surface disturbance to floodplains in the CIAA, respectively. The potential increased erosion and removal of vegetation in these areas, combined with increases associated with other oil and gas development, recreational activities including OHV use, and livestock grazing, could have cumulative negative impacts on floodplain ecological functioning within the CIAA.

5.2.7 VEGETATION

5.2.7.1 General Vegetation

The CIAA for general vegetation is the VFO Planning Area. Past, present, and reasonably foreseeable oil and gas projects in the CIAA would potentially disturb 50,587 acres of vegetation. In addition to vegetation lost from oil and gas developments, past, present, and reasonably foreseeable forage use by livestock grazing, wild horses, and wildlife, and additional recreational use of habitats, would also affect the productivity, composition, and community structure of vegetation throughout the CIAA. The most common vegetation types to be disturbed would primarily include pinyon-juniper, sagebrush, and mountain shrub. Impacts within the CIAA may include fragmentation of plant communities, competition with noxious weeds, soil compaction, accidental spills of fuels and lubricants, and fugitive dust.

The greatest disturbance to vegetation associated with Alternative A would be 858 acres or 1.7 percent of the cumulative reasonably foreseeable total. There would be 181 acres, or 0.4 percent of the cumulative reasonably foreseeable total, of disturbance to vegetation under Alternative B. Under Alternative C there would be 1,117 acres of disturbance, or 2.2 percent of the cumulative reasonably foreseeable total.

5.2.7.2 Invasive, Non-Native Species

The CIAA for invasive and non-native species is the VFO Planning Area. Past, present, and reasonably foreseeable oil and gas projects in the CIAA would potentially include the construction or upgrade of approximately 10,258 miles of road, and disturbance of approximately 50,587 acres of existing vegetation. As stated in **Section 3.7.1**, roads provide a major conduit for the spread of noxious and invasive weeds into natural areas, especially in areas where soil disturbance occurs. In addition to vegetation lost from oil and gas developments, past, present, and reasonably foreseeable forage use by livestock grazing, wild horses, and wildlife, and additional recreational use of habitats would also potentially increase noxious and invasive weeds throughout the CIAA. Specific negative effects of invasive plants and noxious weeds associated with the proposed development in the CIAA could include 1) reduction in the overall visual character of an area; 2) competition with, or elimination of, native plants; 3) reduction or fragmentation of wildlife habitats; and 4) increased soil erosion.

Under Alternative A, a maximum of 858 acres of surface disturbance would be added to the cumulative total of reasonably foreseeable disturbance in the CIAA. Under Alternative B, a maximum of 181 acres of surface disturbance would be added to the cumulative total of reasonably foreseeable disturbance in the CIAA. Under Alternative C, a maximum of 1,117 acres of surface disturbance would be added to the cumulative total of reasonably foreseeable disturbance in the CIAA.

With the implementation of the ACEPMs and additional protection measures implemented under these alternatives, it is expected that noxious weeds in the Project Area would be controlled, and the spread of noxious weeds would be minimized. Under the No Action Alternative, site-specific mitigation measures for noxious weeds management would be implemented on a well-by-well basis as part of the APD approval process. However, any increase in weeds from the alternatives would incrementally add to past, present, and reasonably foreseeable weed infestations with the CIAA.

5.2.7.3 Wetlands/Riparian Zones

The CIAA for wetlands/riparian zones is the VFO Planning Area; however, riparian/wetland maps in the CIAA have not been finalized by the BLM to the point where acreage calculations of existing wetlands/riparian zones and impacts to those areas can be quantified. As such, cumulative impacts to this resource will not be analyzed quantitatively. In the CIAA, wetlands/riparian zones would most likely be impacted by oil and gas development, recreational activities (OHV use and the development of facilities including campgrounds), county and private road construction, and agricultural activities (livestock grazing).

Wetlands/riparian zones in the Project Area occur along the White River and Evacuation Creek. Under the Proposed Action, the conceptual placement of a well pad does show some disturbance (approximately 1,001 feet) in the wetland/riparian zones in the Project Area. The conceptual placement of well pads, roads, and pipelines under Alternatives B and C also shows some disturbance (approximately 51 feet and 769 feet, respectively) in the wetlands/riparian zones in the Project Area. However, as feasible, surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process. In addition, mitigation measures included in the Proposed Action and alternatives, including sediment control structures and proper grading of well pads and access roads, would minimize impacts to wetlands and riparian zones.

5.2.8 LIVESTOCK GRAZING

The CIAA for livestock grazing is the combined area of all six grazing allotments, which fall within the Project Area. Cumulative impacts from oil and gas development to livestock grazing would include the loss of AUMs during the life of the disturbance. Recreation activities, mining activities, and prescribed burns also contribute to cumulative impacts, but the incremental contribution is not possible to quantify. **Table 5-4** below, displays how the Proposed Action and alternatives would contribute to the past, present, and reasonably foreseeable oil and gas development in the CIAA.

Table 5-4. AUMs Lost in the Livestock Grazing CIAA

Alternative	Allotment Name	Total AUMs in CIAA	AUMs lost from Project Alternative	Past and Present AUMs Lost	Future AUMs Lost	Total Reasonably Foreseeable AUMs Lost in CIAA[1]	Percent of Total AUMs in CIAA
A	Hells Hole	3,999	77	8	6	90	2.3
	Little Emma	3,624	0	99	51	150	4.1
	Southam Canyon	1,315	7	7	10	24	1.8
	Watson	1,258	3	2	3	8	0.6
	White River Bottoms	480	0	0	0	0	0.0
	TOTAL for CIAA	**10,676**	**87**	**115**	**69**	**271**	**2.5**
B	Hells Hole	3,999	6	8	6	19	0.5
	Little Emma	3,624	0	99	51	150	4.1
	Southam Canyon	1,315	<1	7	10	16	1.2
	Watson	1,258	<1	2	3	6	0.4
	White River Bottoms	480	0	0	0	0	0.0
	TOTAL for CIAA	**10,676**	**6**	**115**	**69**	**190**	**1.8**

Alternative	Allotment Name	Total AUMs in CIAA	AUMs lost from Project Alternative	Past and Present AUMs Lost	Future AUMs Lost	Total Reasonably Foreseeable AUMs Lost in CIAA[1]	Percent of Total AUMs in CIAA
C	Hells Hole	3,999	108	8	6	121	3.0
	Little Emma	3,624	0	99	51	150	4.1
	Southam Canyon	1,315	8	7	10	24	1.8
	Watson	1,258	2	2	3	8	0.6
	White River Bottoms	480	0	0	0	0	0.0
	TOTAL for CIAA	**10,676**	**118**	**115**	**69**	**302**	**2.8**

Source for Past, Present and Future well data is UDOGM data. Well status categories are as follows: Past and Present (plugged and abandoned, shut-in, producing, drilling operations suspended, and drilling commenced), and Future (new permit, approved permit). The assumptions discussed in **Section 5.1.1** were applied to number of wells in each category to calculate acreage disturbed (and eventually AUMs lost).

[1] The Reasonably Foreseeable AUMs were calculated by adding the following columns: AUMs lost from Project Alternative, Past and Present AUMs Lost, and Future AUMs lost.

In addition to loss of AUMs, increased roads within the CIAA would cumulatively contribute to difficulties in controlling livestock as more natural barriers to livestock movement are removed, and as more livestock use roads as travel routes. In addition, loss of vegetation and increased traffic and human activity in the CIAA could cumulatively add to livestock displacement in the CIAA. These past, present, and future construction activities, and other visual and noise impacts in the CIAA, could cause livestock to move to adjacent undisturbed areas thereby leading to additional livestock impacts on vegetation in those locations.

5.2.9 WILDLIFE AND FISH SPECIES

For the purposes of this EA, cumulative impact analyses for general wildlife, big game, migratory birds, raptors, upland game birds, and fisheries were analyzed using the CEQ definition of cumulative impacts, so as to meet the intent of NEPA. Refer to **Section 5.2.11** for a discussion of the CEQ definition for cumulative impacts.

The CIAA for general wildlife, big game (mule deer, elk, Rocky Mountain bighorn sheep, and bison), migratory birds, raptors, upland game birds, and fisheries is the VFO Planning Area. This cumulative impact analysis assumes that future surface disturbances in the CIAA would primarily result from oil and gas development. Past and RFD actions in the CIAA from oil and gas development have reduced habitat, contributed to habitat fragmentation, displaced individual wildlife species, resulted in collisions between wildlife and vehicles, and potentially contributed to the poaching of animals. Past and reasonably foreseeable surface disturbance, and thus wildlife habitat loss, from past and future oil and gas activity in the CIAA would be approximately 50,587 acres (refer to **Table 5-2**). Recreational activities, livestock grazing, prescribed burns, and other mining activities (e.g., oil shale development, Gilsonite, and sand and gravel) would also contribute to cumulative impacts, but their incremental contributions are not quantifiable, and therefore are not quantitatively estimated within the scope of this EA.

Surface disturbance calculations are considered a useful indicator of habitat loss because as habitats are removed to support oil and gas development, mining, and other development activities, wildlife carrying capacities of an area would be reduced. While surface disturbance does somewhat correspond to associated wildlife impacts, accurate calculations of cumulative wildlife habitat loss are not determinable because the direct impacts are species-specific and

dependent upon the following: status and condition of the population(s) or individual animals being affected; seasonal timing of the disturbances; value or quality of the project area as well as adjacent habitats; physical parameters of the affected and nearby habitats (e.g., extent of topographical relief and vegetative cover); and type of surface disturbance.

As shown in **Table 5-5** below, road development and surface disturbance associated with the Proposed Action or alternatives, when added to past, present, and other reasonably foreseeable actions, would have minimal impacts on wildlife habitats across the CIAA. In the context of cumulative impact analyses, each acre of vegetation disturbance adds to a cumulative impact by increasing erosion, incrementally adding to overall native vegetation loss, and potentially increasing invasion of invasive and noxious weeds. Ongoing and planned oil and gas activities, and other land uses within the CIAA, would further reduce the amount of available cover, foraging opportunities, and breeding areas for a wide variety of wildlife at various trophic levels. Additional development could displace wildlife or preclude wildlife from using areas of more intensive human activity. Although implementation of the Proposed Action or alternatives, and the resulting long-term disturbance, in combination with other activities in the CIAA may affect individual fish and wildlife species, including big game, migratory birds, raptors, and upland game species, the Proposed Action or alternatives would not likely result in a loss of viability, nor cause a trend to Federal listing of these species.

Table 5-5. Cumulative Impacts of Road Development and Surface Disturbance Associated with the Proposed Action and Alternatives

Alternative	Road Development by Alternative (acres)	Total Road Development of Alternative Added to Past, Present, and Other RFD Activities in the CIAA (acres)	% of Road Development for Past, Present, RFD, and Alternative in the CIAA	Surface Disturbance by Alternative (acres)	Total Surface Disturbance of Alternative Added to Past, Present, and Other RFD Activities in the CIAA (acres)	Percent of Surface Disturbance for Past, Present, RFD, and Alternative in the CIAA
Alternative A (Proposed Action)	218 (36 miles)	10,476	2.1	858	51,445	1.7
Alternative B (No Action)	73 (12 miles)	10,331	0.7	181	50,768	0.4
Alternative C (Vertical Drilling in the Potential Oil Shale Development Area)	305 (50 miles)	10,563	2.9	1,117	51,704	2.2

5.2.10 SPECIAL STATUS FISH AND WILDLIFE SPECIES

The CEQ regulations for implementing NEPA and the ESA define cumulative impacts differently. Specifically, according to Section 1508.7 of CEQ regulations, a cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. This differs from the ESA definition of cumulative impacts whereby cumulative impacts include

the effects of future State, Tribal, local, or private actions (i.e., non-Federal actions) that are reasonably certain to occur in an action area. Under the ESA definition of cumulative impacts, future Federal actions that are unrelated to a Proposed Action or alternative are not considered in a cumulative impact analysis because they require separate consultation pursuant to Section 7 of the Act. For the purposes of this EA, cumulative impact analyses for special status fish and wildlife species were analyzed using the CEQ definition of cumulative impacts, so as to meet the intent of NEPA.

The CIAA for special status species is the VFO Planning Area. This cumulative impact analysis assumes that cumulative impacts to special status species would be similar in nature to those discussed above for wildlife and fisheries. However, given their ongoing habitat losses, sensitivity to disturbances, and declining population numbers, special status species would be expected to be more sensitive to impacts related to development within the CIAA than other, more common wildlife species. Based on these sensitivities, existing and RFD land uses have reduced, and would likely continue to reduce, the quality and quantity of habitats in the CIAA for special status species.

Declines in the abundance or range of many special status species have been attributed to various human activities on Federal, State, and private lands, such as human population expansion and associated infrastructure development; construction and operation of dams along major waterways; water retention, diversion, or dewatering of springs, wetlands, or streams; recreation, including off-road vehicle activity; expansion of agricultural or grazing activities, including alteration or clearing of native habitats for domestic animals or crops; and introductions of non-native plant, wildlife, or fish or other aquatic species, which can alter native habitats or out-compete or prey upon native species. Many of these activities are expected to continue on State and private lands within the range of the various Federally-protected wildlife and fish species, and could contribute to cumulative effects to the species within the CIAA. Species with small population sizes, endemic locations, or slow reproductive rates, or species that primarily occur on non-Federal lands where landholders may not participate in recovery efforts, would be generally be highly susceptible to cumulative effects. On Federal lands, surveys are required in potential or known habitats of threatened, endangered, or otherwise special status species prior to project implementation. These surveys help determine the presence of any special status wildlife species or extent of habitat, and protective measures would generally be taken to avoid or minimize direct disturbance in these critical areas. Therefore, although implementation of the Proposed Action or alternatives, in combination with other activities in the CIAA may affect individual wildlife species, it is not likely to result in a loss of viability, nor cause a trend to Federal listing of these species (i.e., greater sage-grouse, yellow-billed cuckoo, bald eagle, and golden eagle). Similarly, implementation of the Proposed Action or alternatives, in combination with other activities in the CIAA "***may affect, is not likely to adversely affect***" the MSO.

Reasonably foreseeable future activities that may affect affected river-related resources in the CIAA include oil and gas exploration and development, irrigation, urban development, recreational activities, and activities associated with the Upper Colorado River Endangered Fish Recovery Program. Implementation of all or any of these projects has affected and would continue to affect the environment including but not limited to water quality, water rights, socioeconomic, and wildlife resources.

Cumulative effects to these species would include the following types of impacts:

- Changes in land use patterns that would further fragment, modify, or destroy potential spawning sites or designated critical habitat;

- Shoreline recreational activities and encroachment of human development that would remove upland or riparian/wetland vegetation and potentially degrade water quality; and
- Competition with, and predation by, exotic fish species introduced by anglers or other sources.

Water depletions associated with the Proposed Action or alternatives, in combination with depletions from other activities in the CIAA, would reduce the ability of the Upper Colorado River Basin to create and maintain the physical habitat (areas inhabited or potentially habitable to special status fish for use of spawning, development of fish larvae, feeding, or serving as corridors between these areas) and the biological environment for the endangered Colorado River fish. Additionally, implementation of the Proposed Action or alternatives, in combination with other activities in the CIAA, could also degrade USFWS-designated critical habitat for the endangered Colorado River fish by increasing erosion and sediment yield into the White River. However, these impacts would be minimized by implementation of appropriate erosion control measures in and near floodplains. Based on the cumulative impacts listed above, the Proposed Action or alternatives "*may affect, are likely to adversely affect*" the endangered Colorado River fish and their USFWS-designated critical habitat, and would likely have similar detrimental effects on the physical and biological environment for the bluehead sucker, flannelmouth sucker, and roundtail chub.

5.2.11 RECREATION

The CIAA for recreation is the SCPA. The Project Area includes approximately 25 acres of existing surface disturbance from oil and gas activities as well as numerous existing roads. Disturbances from oil and gas development, road development, and livestock activities have reduced the value of the Project Area for recreationists seeking pristine landscapes, but have also increased access to the area. Recreation activities on public lands in the winter months generally include hunting of mule deer and elk. Throughout the remainder of the year, recreational use can best be classified as dispersed and is generally quite low. The impacts from the Proposed Action and alternatives would incrementally and cumulatively add to the impacts to recreational activities in the Project Area.

5.2.12 VISUAL RESOURCES

The CIAA for visual resources is the VFO Planning Area. Past, present and reasonably foreseeable future actions, including mineral extraction activities (i.e., mining and oil and gas exploration and development), OHV use, trail and road development vegetation manipulation, and fire management could impact the quality of the visual landscape. Oil and gas activities are the predominant source of modification to the landscape. Impacts would result from clearing practices that remove vegetation, grading practices which result in the creation of cut and fill slopes, and the placement of permanent and temporary surface facilities (e.g., pipelines, well facilities, and compressor stations) that add an industrial component to the landscape. Implementation of any alternatives would contribute to these cumulative impacts. Impacts would be greatest in areas where the current landscape is natural with little evidence of human activity and in areas used for non-motorized recreational activity. However, all disturbances within VRM II and IV areas would be in conformance with management objectives.

All development proposed within the VFO Planning Area, which includes areas surrounding the White River, must conform to established VRM class objectives through design, camouflage, and/or topographic screening if the leases were issued subsequent to the VFO Approved RMP.

Conformance with VRM objectives would prevent oil and gas facilities from dominating the visual landscape in sensitive VRM Class designations.

5.2.13 LAND USE AUTHORIZATIONS

Implementation of the Proposed Action or Alternative C in combination with other past, present, and reasonably foreseeable oil and gas exploration and development activities could lead to the displacement of other land uses. In particular, wells could be developed within the ROW for the White River Dam. If construction of the dam were to occur, these well pads and associated roads and pipelines would be located in an area that could potentially inundated. However, as previously discussed in **Section 3.15.1**, although the State of Utah has never relinquished the ROW for this water facility, neither the State Of Utah's Water Plan (Utah Division of Water Resources 2001) or the Uintah Basin's Water Plan (Utah Division of Water Resources 1999) give any indication that the White River Dam will be constructed in the reasonably foreseeable future.

As discussed in **Section 3.15**, the Project Area includes both an oil shale RD&D area as well as a preferential lease area. The BLM is currently in the process of evaluating the impacts of additional tar sands and oil shale development within a Programmatic EIS. Should more public lands become available for oil shale development, multiple mineral management conflicts such as those disclosed within **Section 4.2** and **4.6** of this document could occur throughout large portions of the VFO Planning Area.

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6.0 - CONSULTATION AND COORDINATION

The Council on Environmental Quality (CEQ) regulations under NEPA require an "early and open process for determining the scope of issues to be addressed and for identifying significant issues related to a Proposed Action" (40 CFR 1501.7). In order to satisfy this CEQ requirement, the BLM requested input from other agencies and the public to determine the concerns and issues associated with Enduring Resources' Proposed Action.

6.1 CONSULTATION AND COORDINATION

The persons and agencies coordinated in preparation of the Southam Canyon EA are identified in Table 6.1 along with the purpose and authorities for the consultation, and findings/conclusions.

Table 6-1. List of All Persons and Agencies with Whom Coordination Took Place

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
U.S. Fish & Wildlife Service (USFWS)	Section 7 Consultation under the Endangered Species Act (16 USC 1531)	Section 7 Consultation with the USFWS is ongoing and will be finalized prior to the signing of the Decision Record for this EA.
Utah State Historical Preservation Office	Section 106 Consultation under the National Historic Preservation Act.	Section 106 consultation with the SHPO is ongoing and will be finalized prior to the signing of the Decision Record for this EA.
Tribes having Historic Ties to the Uinta Basin	Section 106 Consultation under the National Historic Preservation Act.	Section 106 consultation with the Tribes is ongoing and will be finalized prior to the signing of the Decision Record for this EA.

6.2 SUMMARY OF PUBLIC PARTICIPATION

Public participation was initiated with the posting of the proposed project on the BLM's Environmental Notice Bulletin Board (ENBB) on April 5, 2007. A 30-day Public Comment Period will be held.

6.3 EA PREPARATION AND REVIEW

This EA was prepared by Buys & Associates, Inc. and reviewed by the BLM Vernal Field Office Staff. The preparers and BLM reviewers are provided in **Table 6-2**.

Table 6-2. List of Reviewers and Preparers of the Southam Canyon EA

BLM Reviewers		
Name	**Title**	**EA Responsibilities**
Stephanie Howard	Environmental Coordinator	NEPA Compliance, Project Management

BLM Reviewers		
Name	**Title**	**EA Responsibilities**
Amy Torres	Wildlife Biologist	Wildlife, T&E Wildlife Species
Stan Olmstead	Natural Resources Specialist	Water Resources/Floodplains
Scott Ackerman	Wildlife Biologist	Wildlife, T&E wildlife species
Robin Hanson	Geologist	Geology/Minerals/Energy
Blaine Phillips	Archaeologist	Cultural Resources
Kyle Smith	GIS, Cartographer	GIS, Maps
Marc Stavropoulos	Rangeland Management Specialist	Livestock Management
Clayton Newberry	Botanist	Threatened, Endangered, and Candidate Plant Species
Chuck Patterson	Recreation Planner	Recreation, ACECs, Wild and Scenic Rivers, Visual Resources, Wilderness Characteristics
Jason West	Recreation Planner	Recreation, ACECs, Wild and Scenic Rivers, Visual Resources, Wilderness Characteristics
Paul Rodriquez	Realty Specialist	Lands/Access
Buys & Associates Preparers		
Name	**Title**	**EA Responsibilities**
Tanja Butler-Melone	Environmental Planner Buys & Associates	Project Manager, Special Designations, Recreation
Debra Bain	Air Quality Scientist Buys & Associates	Air Quality
Melissa Bridendall	NEPA Resource Specialist Buys & Associates	Wildlife and Fishery Species, T&E Wildlife and Fishery Species
Dave Nicholson	Senior Geologist Buys & Associates	Water Resources, Paleontology
Nicole Elliott	GIS Specialist Buys & Associates	GIS, Cartography
Tyler Ashcroft	Environmental Planner Buys & Associates	Transportation, Land Use, Socioeconomics
Shina DuVall	Archeologist Buys & Associates	Cultural Resources
Karin McShea	NEPA Resource Specialist Buys & Associates	Vegetation, Invasive Species, T & E Plant Species

7.0 - REFERENCES & ACRONYMS

7.1 REFERENCES

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7.2 ACRONYMS

ACEC – Area of Critical Environmental Concern
ACGIH – American Conference of Governmental Industrial Hygienists
ACHP – Advisory Council on Historic Preservation
ADT – Average Daily Traffic
AMSL – Above Mean Sea-Level
ANC – Acid Neutralization Capacity
AO – Authorized Officer
APD – Application for Permit to Drill
AQRV– Air Quality Related Value
AUM – Animal Unit Month
BCRMP/ROD – Book Cliffs Resource Management Plan / Record of Decision
BGEPA – Bald and Golden Eagle Protection Act
BLM – Bureau of Land Management
BMP – Best Management Practices
BOP – Blowout Preventer
BTEX – benzene, toluene, ethylbenzene and xylenes
CAA – Clean Air Act (CAA),
CEQ – President's Council on Environmental Quality
CFR – Code of Federal Regulations
CIAA – Cumulative Impact Assessment Area
CO – Carbon Monoxide
COA – Conditions of Approval
CWA – Clean Water Act
DOI – Department of the Interior
EA – Environmental Assessment
EIA – Energy Information Administration
EIS – Environmental Impact Statement
EOG – EOG Resources, Inc
EPA – Environmental Protection Agency's
ESA – Endangered Species Act
FLPMA – Federal Land Policy and Management Act
FONSI – Finding of No Significant Impact
HAP – Hazardous Air Pollutants
IDT – Interdisciplinary Team
KCPA – Kings Canyon Project Area
K_w – Water Erosion Potential
MBTA – Migratory Bird Treaty Act
MCL – Maximum Contaminant Levels
MLA – Mineral Leasing Act of 1920
MSDS – Material Safety Data Sheet
NAAQS – National Ambient Air Quality Standards
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act of 1966 (as amended)
NO_2 – Nitrogen Dioxide
NO_x – Oxides of Nitrogen
NRCS – National Resource Conservation Service
NRHP – National Register of Historic Places
NSO – No Surface Occupancy

OD – Outer Diameter
OHV – Off-Highway Vehicle
ORV – Outstanding Remarkable Values
OSHA – Occupational Safety and Health Act
PM – Particulate Matter
PSD – Prevention of Significant Deterioration
Psi – Pounds per Square Inch
RCRA – Resource Conservation and Recovery Act of 1976
RFD – Reasonably Foreseeable Development
RMP – Resource Management Plan
ROD – Record of Decision
ROW – Right of Way
SAR – Sodium Adsorption Ratio
SARA – Superfund Amendments and Reauthorization Act
SCPA – Southam Canyon Project Area
SHPO – State Historic Preservation Office
SITLA – State and Institutional Trust Lands Administration
SMA – Surface Management Agency
SO_x – Oxides of Sulfur
SPCC – Spill Protection, Countermeasure and Control
SR – State Road
SRCMA – Special Recreation and Cultural Management Area
SRMA – Special Recreation Management Areas
SO_2 – Sulfur Dioxide
SUWA – Southern Utah Wilderness Alliance
Tcf – Trillion Cubic Feet
TDS – Total Dissolved Solids
TLV – Threshold Limit Values
TSL – Toxic Screening Levels
UDAQ – Utah Division of Air Quality
UDEQ – Utah Division of Environmental Quality
UDOGM – Utah Division of Oil, Gas, and Mining
UDWR – Utah Division of Wildlife Resources
USDA – U.S. Department of Agriculture
USFWS – United States Fish and Wildlife Service
USHPO – Utah State Historic Preservation Officer
VFO – Vernal Field Office
VOC – Volatile Organic Compounds
VRM – Visual Resource Management
WRS – Wild and Scenic River

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Appendix A

Interdisciplinary Team Checklist

INTERDISCIPLINARY TEAM ANALYSIS RECORD CHECKLIST

Project Title: Enduring Resources' Southam Canyon Environmental Assessment

NEPA Log Number: UT-080-08-342

File/Serial Number:

Project Leader: Stephanie Howard

DETERMINATION OF STAFF: (Choose one of the following abbreviated options for the left column)

NP = not present in the area impacted by the proposed or alternative actions.
NI = present, but not affected to a degree that detailed analysis is required.
PI = present with potential for significant impact analyzed in detail in the EA; or identified in a DNA as requiring further analysis.
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section C of the DNA form.

Determi-nation	Resource	Rationale for Determination*	Signature	Date
PI	**Air Quality**	Potential impacts from 249 wells. A 1,500 hp compressor is also proposed. Minimum quantities of dust emissions are anticipated.	Stephanie Howard	4/16/08
NP	**Areas of Critical Environmental Concern**	None present per the VFO RMP/ROD, 2008.	Jason West	4/16/08
PI	**Cultural Resources**	Moderate potential for significant sites to be found using current data collection methods. The area was inventoried in 1974-75 in association with the Oil Shale Ua and Ub project. Does not impact the historic cottonwood grove campsite on the White River.	Gabrielle Elliott	4/16/08
NP	**Environmental Justice**	No minority or economically disadvantaged communities or populations are present in the project area which could be disproportionately affected by the proposed action or alternatives.	Stephanie Howard	4/16/08
NP	**Farmlands (Prime or Unique)**	No prime or unique farmlands are present in the Vernal Field Office area.	Stephanie Howard	4/16/08
PI	**Floodplains**	Southam Canyon, Evacuation Creek, and tributaries to them are present within project boundary, all of which have mapped 100 year floodplains. Roads, pipelines, and well pads may be sited within some of them. White River in northwest of project area appears to have been avoided.	Stephanie Howard	4/16/08
PI	**Invasive, Non-native Species**	Potential for spread or introduction of noxious or invasive species. Tamarisk may be present in the project area. A pre-project weed inventory should be conducted within the project area prior to surface disturbance with a copy of the weed survey sheet (see Jessie Salix for form) provided to the BLM. A Pesticide Use Proposal should be approved before disturbance is authorized. Vehicles and equipment should be power washed prior to entering the project area if coming from outside the Uinta Basin. Power washing vehicles and equipment would be necessary when traveling from a weed infested area within the Uinta Basin as well. Annual weed inventories should be conducted along the surface use area and controlled if present. Weeds should be controlled prior to seed development.	Clayton Newberry	4/16/08
NP	**Native American Religious Concerns**	None known at this time.	Gabrielle Elliott	4/16/08

Determi-nation	Resource	Rationale for Determination*	Signature	Date
PI	**Threatened, Endangered or Candidate Animal Species**	Endangered Colorado River fish – Water depletion, sedimentation into White River, No work proposed within critical habitat, but proposed development will be within 0.5 mile of critical habitat. No work proposed within Mexican spotted owl habitat, but a portion of the project area is within 0.5 mile buffer of good or better habitat. Possible habitat for Yellow-billed cuckoo along the White River.	Scott Ackerman	4/16/08
NP	**Threatened, Endangered or Candidate Plant Species**	The Project Area does not include habitat for TEC species.	Clayton Newberry	9/15/08
NI	**Wastes (hazardous or solid)**	*Hazardous Waste:* No chemicals subject to reporting under SARA Title III in an amount equal to or greater than 10,000 pounds will be used, produced, stored, transported, or disposed of annually in association with the drilling, testing, or completing of the wells. Furthermore, no extremely hazardous substances, as defined in 40 CFR 355, in threshold planning quantities, will be used, produced, stored, transported, or disposed of in association with the drilling, testing, or completing of the wells. *Solid Wastes:* Trash would be confined in a covered container and hauled to an approved landfill. Burning of waste or oil would not be done. Human waste would be contained and be disposed of at an approved sewage treatment facility.	Stephanie Howard	4/16/08
PI	**Water Quality (surface/ground)**	The operator has certified compliance with all Onshore Oil and Gas Orders. "Onshore Oil and Gas Order No. 2 Drilling Operations" will assure that the project will not adversely affect groundwater quality. Due to the state-of-the-art drilling and well completion techniques, the possibility of adverse degradation of groundwater quality or prospectively valuable mineral deposits by the proposed action will be negligible. Well completion must be accomplished in compliance with "Onshore Oil and Gas Order No. 2, Drilling Operations", These guidelines specify the following:…*proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, potentially productive zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use.* Various water wells with associated water rights within project area. Also surface water near and within the project area (White River).	Stephanie Howard Robin Hansen	4/16/08
PI	**Wetlands/Riparian Zones**	Riparian area present along northern part of Evacuation Creek within project area.	Stephanie Howard	4/16/08
NP	**Wild and Scenic Rivers**	None present per the VFO RMP/ROD, 2008.	Jason West	4/16/08
NP	**Wilderness**	None present per the VFO RMP/ROD, 2008.	Jason West	4/16/08
NP	**Wilderness Study Areas**	None present per the VFO RMP/ROD, 2008.	Jason West	4/16/08
PI	**Rangeland Health Standards and Guidelines**	Potentially impacted as disclosed in the soils, vegetation, special status species, riparian, water quality, and weeds sections.	Stephanie Howard	4/16/08
PI	**Livestock Grazing**	Within the Hells Hole, Watson BC, and Southam Canyon allotments. Potential to impact range facilities (fences, etc).	Stephanie Howard	4/16/08

Determi-nation	Resource	Rationale for Determination*	Signature	Date
PI	**Woodland / Forestry**	Clearing of ROWs and well pads could impact woodland vegetation.	David Palmer	4/16/08
NP	**Special Status Plant Species other than FWS Candidate or Listed species**	Bureau-sensitive Graham's beardtongue (*Penstemon grahamii*) and other oilshale endemics are reported immediately east of Project Area in T10S R25E E2. These plants are restricted to surface outcrops of Mahogany Bed oil shale, which does not occur in Project Area. Therefore despite the proximity to TES plant occurrences, Project Area itself does not include habitat for these species.	Clayton Newberry	4/16/08
PI	**Non-status vegetation**	Vegetation will be removed/disturbed in the Project Area. Interim reclamation should be conducted in a timely manner to reduce the impacts to vegetation.	Clayton Newberry	4/16/08
PI	**Fish and Wildlife including Special Status Species other than FWS Candidate or Listed species (eg. Migratory Birds)**	Raptor nesting and foraging including golden eagle, bald eagle, red-tailed hawk, prairie falcon, peregrine falcon. Possible impacts to sage grouse (habitat loss). Impacts to migratory birds (food, nesting). Impacts to other sensitive fish species (water depletion, sedimentation). Certain bat species could roost and forage in the area. Big game impacts primarily mule deer and elk (loss of wintering habitat and impacts to migration corridors). UDWR designated Big horn sheep crucial habitat.	Scott Ackerman	4/16/08
PI	**Soils**	Surface disturbance would occur. Increased erosion and sedimentation is expected to occur following surface disturbance.	Stephanie Howard	4/16/08
PI	**Recreation**	The hunting unit affected is the Book Cliffs Bitter Creek unit. Limited entry bull elk 08/16-9/12 (archery), 09/13-09/23 (any weapon) 09/24-10/02 (Muzzelloader), All are considered Premium hunts. Limited entry pronghorn 9/13-9/23 (Any weapon). Concerns are that the proposal would affect the quality of the hunting experience through added noise, loss of scenery, and displacement of hunters from traditional hunting areas.	Jason West	4/16/08
PI	**Visual Resources**	Portions of the proposal fall with VRM Class II. Class II Objective. The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. The remainder of the project is within classes III and IV. The project would be within management objectives in those areas.	Jason West	4/16/08
PI	**Geology / Mineral Resources**	OSEC 160 acre R&D lease. OSEC has filed a mining plan of operations. OSEC preferential oil shale lease area, should the R&D be proven. 5300 acres Black Dragon Unit covers most of the project area, but Enduring is not the unit operator. Need to resolve conflicts between proposed oil shale development and oil and gas. Eventually will need specifically placed oil well locations (no modifications after approval). Specifically designed casing designs, etc. Will need feedback from OSEC. During drilling operations will have to protect mining resources. The project will not impact goblin city.	Robin Hansen	4/16/08
PI	**Paleontology**	Within the lower green river formation.. Moderate potential for paleontology impacts. Very few surveys have been done, but there are some known localities nearby.	Robin Hansen	4/16/08

Determi-nation	Resource	Rationale for Determination*	Signature	Date
PI	**Lands / Access**	The proposed area is located within the Book Cliffs Resource Management Plan area, which allows for oil and gas development with associated road and pipeline right-of-ways. Current land uses, within the area identified in the proposed action and adjacent lands, consist of existing oil and gas development, wildlife habitat, recreational use, and sheep and cattle ranching. The White River dam and hydroelectric project includes a dam, reservoir, 136 Kv power line and access roads within T. 10 S., R., 25 E., sec. 18 N2NWNW, and T. 10 S., R. 24 E., sec. 14, NWNWNE, N2S2NW, NENW, sec. 15, S2NE, SENW, W2E2SW.	Paul Rodriquez	4/16/08
NI	**Fuels / Fire Management**	No planned or ongoing fuel reduction projects in the project area.	Steve Strong	4/16/08
NI	**Socio-economics**	Due to the low number of wells, county socioeconomics are not expected to be measurably impacted by this proposed project.	Stephanie Howard	4/16/08
NP	**Wild Horses and Burros**	No herd areas or herd management areas are present in the project area.	Stephanie Howard	4/16/08
NP	**BLM Natural Areas (wilderness characteristics)**	None present per the VFO RMP/ROD, 2008. The White River natural area is west of the project area, and outside of the project area boundaries, so it is not impacted by this project.	Jason West	4/16/08
NI	**County Transportation Plan**	Contact Uintah County Planning and Zoning Department for the necessary County permits. For road upgrades and maintenance contact the Uintah County Public Lands Department. For crossing of County roads contact the Uintah County Road Department.	Diane Coltharp	4/16/08
PI	**Waters of the U.S. (C.O.E.)**	There is the potential to impact surface waters from road and buried pipeline crossings. Water resources should be mapped and avoided. Unavoidable impacts will require a Corps permit and may require compensatory mitigation.	Sue Nall	4/16/08

FINAL REVIEW:

Reviewer Title	Signature	Date	Comments
NEPA / Environmental Coordinator			
Authorized Officer			

Appendix B

Reclamation Plan

Reclamation Plan for the Southam Canyon Project Area

Onshore Oil and Gas Order Number 1 (72 FR 10328, issued under 43 CFR 3160), which applies to all onshore Federal leases, requires all that APD packages include a Surface Use Plan of Operations and Plans for Surface Reclamation. Section III.D.4.j of Onshore Oil and Gas Order Number 1 requires that reclamation plans include, as appropriate, the following: configuration of the reshaped topography, drainage systems, segregation of spoil materials (stockpiles, backfill requirements, redistribution of topsoil, soil treatments, seeding or other steps to reestablish vegetation, weed control, and reclamation of all disturbed areas. This Reclamation Plan for the SCPA, which relies on the *Surface Operating Standards for Oil and Gas Exploration and Development* or "Goldbook" (BLM and USFS 2007) for guidelines, was prepared to address those requirements.

This Reclamation Plan outlines measures that would be taken to reclaim areas that would be disturbed by the implementation of the development proposed by Enduring in the SCPA. The objectives of this reclamation plan are to re-establish vegetation, reduce dust and erosion, compliment the visual resources of the surrounding area, and generally minimize impacts to the environment.

Section III.D.4.j of Onshore Oil and Gas Order Number 1 and the "Gold Book" call for both interim and final reclamation (BLM and USFS 2007). Interim reclamation refers to measures applied to stabilize disturbed areas and to control runoff and erosion during time periods when application of final reclamation measures is not feasible or practicable. Interim reclamation would be implemented on all disturbed areas that are not needed for production activities (this includes unused portions of road and pipeline ROWs, well pads, compressor stations, and any other disturbed areas). Final reclamation refers to measures that would be applied after well abandonment and at the end of the project. Earthwork for final and interim reclamation would be completed within 6 months of well completion or well plugging (weather permitting) (72 FR 10328). The lifespan of individual producing wells may vary; however, for the purposes of this EA, the lifespan was assumed to be 30 years.

The reclamation plan follows the progression of proposed activities, which would occur in three main phases: 1) drilling and construction of facilities; 2) production and maintenance; and 3) decommissioning and reclamation. Reclamation activities that would occur during or following each of the three phases are discussed below.

Phase I: Construction, Drilling, and Completion

<u>Surface Disturbance:</u>

- All surface disturbance would be kept to a minimum (i.e. existing roads would be utilized where possible, well pads would be constructed to minimize the size of the pad, while allowing for safe construction, drilling, and completion activities).

<u>Noxious Weeds:</u>

- Prior to surface disturbance, a weed inventory of areas proposed for disturbance would be conducted.
- To reduce the spread/introduction of noxious and invasive weed species via project-related vehicles and equipment, Enduring and its subcontractors would power-wash all construction equipment and vehicles entering the Project Area from outside the Uinta Basin.

Fugitive Dust Control

- Enduring would use water or other approved dust suppressants in the Project Area during construction and installation activities, as necessary, to abate fugitive dust.

Topsoil and Surface Preparations:

- At all construction sites, topsoil would be stockpiled separately from other soil materials and maintained for future use in rehabilitating the location.
- After well completion, salvaged topsoil would be evenly re-spread over disturbed surfaces not actively used during the production phase. As directed by the AO, topsoil would be spread as thinly as possible in order to preserve soil microorganisms.

Reserve Pit Reclamation:

- After well completion, reserve pits would be refilled. Prior to filling, reserve pits would be dry and free of oil and other liquid or solid wastes. The pit would be refilled with previously excavated subsoil.

Interim Revegetation:

- After well completion, all disturbed areas not needed for the operation of the well would be reseeded. The seed mixtures to be used would be similar to the vegetation of the surrounding areas and may consist of grasses, forbs, or shrubs. Two recommended seed mixtures are provided in **Tables 1 and 2**. The seed mixture in **Table 1** would be used in the Wyoming big sagebrush vegetation community, and the seed mixture in **Table 2** would be used in the pinyon-juniper vegetation community.
- The seeding contractor would keep all seed tags and provide them to the BLM authorized officer or appropriate SMA.
- Private and State lands would be seeded with a similar seed mixture, unless the landowner requests a different seed mixture.
- Seeding would occur in the fall (August – December).
- Depending on topography and/or timing, seeding can be accomplished either by drill seeding or broadcasting. If the broadcast method is used, the seed rates established for drill seeding would be doubled and seed would be immediately covered to prevent seed desiccation or predation by birds or rodents. The seeds could be covered in several ways including spreading and crimping straw over the seeded area, raking the area by hand, or dragging a chain or chain-linked fence over the seeded area.
- The appropriate SMA would be notified 48 hours in advance of when seeding operations are to commence.
- Erosion control mats would be placed on areas having slopes greater than 40%.

Phase II: Production and Maintenance

Access:

- If necessary for safe access and operation during production, gravel or similar reinforcing material would be used on access routes and necessary portions of well pads (such as in clay soils) to stabilize these areas.

Noxious and Invasive Weeds:

- Enduring would annually inspect well pads and ROWs to identify, treat and control any noxious weed infestations. Any herbicide application on BLM lands would be applied in accordance with the BLM approved Pesticide Use Proposal (PUP). A list of noxious weeds would be obtained from the BLM or the appropriate County Extension Office.

Fugitive Dust Control:

- Enduring would use water or other approved dust suppressants in the Project Area during construction and installation activities, as necessary, to abate fugitive dust.

Revegetation

- Revegetated areas will be inspected regularly to document location and extent of areas with successful revegetation, and areas needing further reclamation. Success criteria would be determined by the BLM or appropriate SMA.
- Areas that do not meet the success criteria two growing seasons after seeding, would be reseeded as directed by the AO. At that time additional treatments, such as soil amendments or irrigation, would be considered and applied, as directed by the AO.

Phase III: Decommissioning and Reclamation

Plugging the Well:

- Prior to well abandonment, the operator shall submit and receive approval for the Sundry Notices and Reports on Wells (Form 3160-5) from the Authorized Officer.

Topsoil and Final Surface Preparation:

- After well plugging, all disturbed areas would be re-contoured back to the original contour or a contour that blends with the surrounding landform (roads must also be reclaimed unless the appropriate SMA or surface owner requests that they be left unreclaimed).
- To achieve final reclamation of an area previously reclaimed using interim reclamation methods, all topsoil and vegetation must be restripped from areas that were not previously reshaped.
- The appropriate SMA would determine if any gravel or similar materials used to reinforce an area are to be removed or buried in place during final reclamation.
- Salvaged topsoil would be respread evenly over the surfaces to be revegetated.
- The soil surface would be prepared to provide a seedbed for re-establishment of desirable vegetation. Site preparation may include gouging, scarifying, dozer track-walking, mulching, or fertilizing. The seedbed preparations would be determined by the appropriate SMA at the time of final reclamation.

Final Revegetation:

- All disturbed and recontoured areas would be reseeded using techniques outlined under Phase I and II of this project. The seed mixtures to be used would be similar to the vegetation of the surrounding areas and may consist of grasses, forbs, or shrubs. **Tables 1 and 2** provide recommended seed mixtures. The seed mixture in **Table 1** would be used in the Wyoming big sagebrush vegetation community, and the seed mixture in **Table 2** would be used in the pinyon-juniper vegetation community. Final determination of the appropriate seed mixture would be developed by the appropriate SMA on a site-specific basis at the time of field review of the facility.

- Compacted soil areas may need to be ripped and regraded.
- Final revegetation and reclamation success would be determined by the appropriate SMA.

Table 1. Wyoming Big Sagebrush Vegetation Community Seed Mixture		
Common Name	**Scientific Name**	**Rate** [1,2]
GRASSES		
Crested wheatgrass	*Agropyron cristatum* 'Hycrest'[3]	1.0 lbs/acre
Bottlebrush Squirreltail	*Elymus elymoides*	1.0 lbs/acre
Sand Dropseed	*Sporobolus cryptandrus*	1.0 lbs/acre
Western Wheatgrass	*Pascopyrum smithii*	1.0 lbs/acre
Needle and Threadgrass	*Stipa comata*	1.0 lbs/acre
FORBS		
Globemallow	*Sphaeralcea parvifolia*	1.0 lbs/acre
Yellow beeplant	*Cleome lutea*	0.5 lbs/acre
Shaggy fleabane	*Erigeron pumilus*	0.5 lbs/acre
Hoary Aster	*Machaeranthera canescens*	0.5 lbs/acre
SHRUBS		
Wyoming sagebrush[4]	*Artemesia tridentate v. wyomingensis*	2.0 lbs/acre
Shadscale	*Atriplex confertifolia*	2.0 lbs/acre
Forage Kochia[4]	*Kochia prostrata*	0.5 lbs/acre
Fourwing saltbush	*Atriplex canescens*	0.5 lbs/acre
	Pure Live Seed Total	**12.5 lbs/acre**

[1] Rate numbers are in Pure Live Seed (PLS).
[2] Seed rates are specific to the drill seeder method. If broadcasting is used to disperse the seed, the seed rates above should be doubled.
[3] Either Hycrest variety will be used, or a more drought tolerant variety
[4] This species will be broadcast on the surface and left uncovered after the other seed is either drill seeded or broadcast and covered. It is important to keep seeds of this species uncovered.

Table 2. Pinyon-Juniper Vegetation Community Seed Mixture		
Common Name	**Scientific Name**	**Rate** [1,2]
GRASSES		
Crested wheatgrass	*Agropyron cristatum* 'Hycrest'[3]	1.5 lbs/acre
Bottlebrush Squirreltail	*Elymus elymoides*	1.5 lbs/acre
Western Wheatgrass	*Pascopyrum smithii*	1.0 lbs/acre
Needle and Threadgrass	*Stipa comata*	1.0 lbs/acre
FORBS		
Globemallow	*Sphaeralcea parvifolia*	0.5 lbs/acre
Evening Primrose	*Oenethera caespitosa*	0.5 lbs/acre
Shaggy fleabane	*Erigeron pumilus*	0.5 lbs/acre
Hoary Aster	*Machaeranthera canescens*	0.5 lbs/acre
SHRUBS		
Wyoming sagebrush[4]	*Artemesia tridentate v. wyomingensis*	2.0 lbs/acre
Black sagebrush[4]	*Artemisia nova*	1.0 lbs/acre

Table 2. Pinyon-Juniper Vegetation Community Seed Mixture		
Common Name	**Scientific Name**	**Rate** [1,2]
Forage Kochia[4]	*Kochia prostrata*	1.0 lbs/acre
Pure Live Seed Total		**11.0 lbs/acre**

[1] Rate numbers are in Pure Live Seed (PLS).
[2] Seed rates are specific to the drill seeder method. If broadcasting is used to disperse the seed, the seed rates above should be doubled.
[3] Either Hycrest variety will be used, or a more drought tolerant variety
[4] This species will be broadcast on the surface and left uncovered after the other seed is either drill seeded or broadcast and covered. It is important to keep seeds of this species uncovered.

References Cited

Bureau of Land Management and U.S. Forest Service. 2007. Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development.

Appendix C

Summary of Potential Occurrence Table for Plant Species

SUMMARY OF POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS PLANT SPECIES FOR ENDURING RESOURCES' PROPOSED SOUTHAM CANYON PROJECT AREA (SCPA)

Species	Status [1]	Habitat	Potential for Occurrence of Special Status Species	Eliminated From Detailed Analysis? (Yes/No)
Arabis vivariensis park rock cress	S	Uintah County. Weber Formation sandstone and limestone outcrops; mixed desert shrub or pinyon-juniper communities; 5000-6000 feet; flowers May.	None - No potential habitat. The geological formation and soils associated with this species do not occur in the Project Area.	Yes
Astragalus equisolensis horseshoe milkvetch	0	Uintah County. East of Green River Horseshoe Bend; Duchesne River Formation soils; mixed desert shrub communities; 4790-5185 feet; flowers May-early June.	None - No populations, potential or suitable habitat occurs for this species in this area. Known populations occur along the upper Green River; outside of the Project Area.	Yes
Astragalus hamiltonii Hamilton milkvetch	S	Uintah County. Duchesne River, Mowry, Dakota and Wasatch Formations; mixed desert shrub or pinyon-juniper communities; 5240-5800 feet; flowers May-June.	None - No potential habitat. The geological formation and soils associated with this species do not occur in the Project Area.	Yes
Cirsium ownbeyi Ownbey thistle	S	Daggett, and North East Uintah Counties. East Uinta Mountain canyons; pinyon-juniper, mixed desert shrub or riparian communities; 5500-6200 feet; flowers late May-August.	None - No potential habitat. Known populations occur in north east Uintah County, outside of the Project Area.	Yes
Cleomella palmeriana var. *goodrichii* Goodrich cleomella	S	Uintah County. Morrison Formation, heavy clay; mat-salt-bush, Cicsco woodyaster, salt desert shrub community; 4000-6000 feet; flowers May.	None - No potential habitat. The geological formation and soils associated with this species do not occur in the Project Area.	Yes
Cryptantha barnebyi Oilshale catseye	0	Uintah County. Lower Parachute member, Evacuation Creek. Occurs south and southeast of Bonanza. Shale slopes, semi barren mixed desert shrubs or pinyon juniper. 4600-600 feet.	None - No potential habitat. Known populations occur south and outside of the Project Area.	Yes
Erigeron untermannii Untermann's Daisy	S	Duchesne, and Uintah Counties. Tavaputs Plateau; Green River, Uinta Formations; dry calcareous ridges; pinyon-juniper or mountain brush communities; 7000-7800 feet; Flowers May–June.	None - No populations, potential or suitable habitat occurs for this species in this area. Species occurs at higher elevation than the Project Area.	Yes
Habenaria zothecina alcove bog orchid	S	Uintah County. unconsolidated Quaternary alluvium; seeps, hanging gardens, riparian areas in mixed desert shrub, pinyon-juniper, or oak brush communities; 4360-8690 feet; flowers late July-August.	None - No potential habitat. Known populations occur in northern Uintah County; therefore outside the Project Area.	Yes
Hymenoxys lapidicola rock hymenoxis	S	Uintah County. Blue Mountain; Weber Formation, sandy ledges and crevices; pinyon-juniper or ponderosa-manzanita communities;	None - No potential habitat. The geological formation and soils associated with this species do not occur in the Project Area.	Yes

Species	Status [1]	Habitat	Potential for Occurrence of Special Status Species	Eliminated From Detailed Analysis? (Yes/No)
		5700-8100 feet; flowers June.		
Lepidium barnebyanum Barneby's pepperplant	E	Tribal land in Duchesne County. West Tavaputs Plateau, Indian Canyon. Uinta Formation. White shale outcrops and ridges, barren inclusions in pinyon juniper. 6200-6500 feet.	None - No potential habitat. Known populations occur outside of Uintah County; therefore outside of the Project Area.	Yes
Lepidium huberi Huber's pepperplant	S	Uintah County. Uinta Mountain foothills, Book Cliffs; Chinle, Park City, Weber Formations; eroding cliffs, alluvium; black sage or mountain brush communities; 5000-9700 feet; flowers June-August.	None - No potential habitat. The geological formation and soils associated with this species do not occur in the Project Area.	Yes
Mentzelia goodrichii Goodrich's blazingstar	S	Duchesne County. Green River Formation; escarpments of Willow and Argyle Canyons; steep white calciferous shale cliffs; open mountain brush communities; 8100-8800 feet; flowers July - August.	None - No potential habitat. Known populations occur outside of Uintah County; therefore outside of the Project Area.	Yes
Penstemon acaulis var. *acaulis* stemless beardtongue	S	Daggett County. Browns Park Formation, ashy, gravelly or sandy ridges and knolls; sagebrush-desert grass or pinyon-juniper communities; 5840-7285 feet; flowers June-July.	None - No potential habitat. Known populations occur outside of Uintah County; therefore outside of the Project Area.	Yes
Penstemon gibbensii Gibbens beardtongue	S	Daggett County. Brown's Park (Bridger Basin endemic); Green River Formation; sandy/shaly bluffs, slopes; juniper, thistle, buckwheat, serviceberry community; 5500-6400 feet.; flowers June.	None - No potential habitat. Known populations occur outside of Uintah County; therefore outside of the Project Area.	Yes
Penstemon goodrichii Goodrich's penstemon	S	Duchesne, and Uintah Counties. near Lapoint, Tridell, Whiterocks; Duchesne River Formation; clay badlands; desert shrub, shadscale, pinyon-juniper or mountain brush communities; 5590 to 6215 feet; flowers late May - June.	None - No potential habitat. Known populations occur in northern Uintah County; outside of the Project Area.	Yes
Penstemon grahamii Graham's penstemon	S	Uintah, and Duchesne Counties. Green River Formation; oil shale or white shale knolls and talus; semi-barren mixed desert shrub or pinyon-juniper communities; 4600-6700 feet; flowers from late May - mid-June.	None – No potential habitat. Known populations are restricted to surface outcrops of Mahogany Bed oil shale, which occurs close to but not in Project Area.	**Yes**

Species	Status [1]	Habitat	Potential for Occurrence of Special Status Species	Eliminated From Detailed Analysis? (Yes/No)
Penstemon scariosus var. *albifluvis* White River penstemon	C	Uintah County. Green River Formation; South East of Bonanza; shale slopes; semi-barren mixed desert shrub or pinyon-juniper communities; 5000-6000 feet; flowers late May-June.	None – No potential habitat. Known populations are restricted to surface outcrops of Mahogany Bed oil shale, which occurs close to but not in Project Area.	**Yes**
Schoenocrambe argillacea Clay reed-mustard	T	Uintah County. Book Cliffs; contact zone of upper Uinta and lower Green River Formations; mixed desert shrub, Indian ricegrass and pygmy sagebrush communities; 5000-5650 feet; flowers May-early June.	None - No potential habitat. Known populations occur in western portion of Uintah County, outside of the Project Area.	Yes
Schoenocrambe suffrutescens Shrubby reed-mustard	E	Duchesne, and Uintah Counties. Green River Formation; Badlands Cliffs, Gray Knolls, Little Rock Pack Mountain; calcareous shale; mixed desert shrub, pinyon-juniper or mountain brush communities; 5400-6000 feet; flowers late May - mid-August.	None – No potential habitat. Known populations occur in the western portion of Uintah County, outside of the Project Area.	Yes
Sclerocactus brevispinus Pariette cactus	T	Duchesne, and Uintah Counties. Pariette Bench south of Myton; Uinta Formation (Wagonhound Member), fine alkaline clay; shadscale, mat-saltbush community; 4700-5400 feet.	None - No potential habitat. Known populations occur in the western portion of Uintah County, outside of Project Area.	Yes
Sclerocactus wetlandicus Uinta Basin hookless cactus	T	Duchesne, and Uintah Counties. Alluvial benches of Green River watershed from Ouray to Carbon County line; cold desert shrub communities; 4700-6000 feet.	None – No potential habitat. Project Area occurs east, and outside, of the species range.	Yes
Spiranthes diluvialis Ute lady's'-tresses	T	Daggett, Duchesne, and Uintah Counties. Green River tributaries, Uinta Mountains, Browns Park, Book Cliffs; unconsolidated alluvium; wetland meadow communities; 4400-6810 feet; flowers late July – September.	None - No potential habitat. Known populations occur in the northern portion of Uintah County, outside of the Project Area.	Yes
Thelesperma caespitosum Duchesne Greenthread	S	Duchesne County: Uinta Mountains, Tavaputs Plateau; Bishop Conglomerate Formation; cushion plant community on rim crests above mountain brush; 7500-9000 feet; flowers May - June.	None - No potential habitat. Known populations occur outside of Uintah County; therefore outside of the Project Area.	Yes

[1]Status: E= Federally endangered; T= Federally threatened; C = Federal candidate; S = BLM sensitive; 0 = nonstatus, removed from status, potential status.

Source: adapted from BLM Vernal Field Office Special Status Plant Species List, 2007.

Source for location information: UNHP 2005, UNPS 2007, Goodrich 1986, and Welsh et al. 1993.

References:

Goodrich, S. and Neese, E. 1986. *Uinta Basin Flora*. USDA Forest Service- Intermountain Region- Ogden, Utah 1986 in Cooperation with USDA FS- Ashley National Forest and USDI Bureau of Land Management - Vernal District.

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Utah Natural Heritage Program (UNHP). 2005. Plant Information: A Progress Report. By M.A. Ben Franklin. Utah Division of Wildlife Resources. Publication Number 05-40. December 2005

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Appendix D

Summary of Potential Occurrence Table for Wildlife and Fishery Species

SUMMARY OF POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS WILDLIFE AND FISHERY SPECIES FOR ENDURING RESOURCES' PROPOSED SOUTHAM CANYON PROJECT AREA (SCPA)

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Mammals				
Black-footed ferret *Mustela nigripes*	Endangered	Semi-arid grasslands and mountain basins. It is found primarily in association with active prairie dog colonies that contain suitable burrow densities and colonies that are of sufficient size.	None: The distribution of this species is limited to a nonessential, experimental population reintroduced into Coyote Basin in Uintah County, Utah, starting in 1999.	Yes
Brown (Grizzly) bear *Ursus arctos*	Threatened	Reported to occur in scattered localities in montane areas of northern, central, and southwestern Utah. The species probably occurred sporadically in arid regions such as the Bonneville Basin and the Colorado Plateau.	None: The species has been extirpated from Utah, with last sightings occurring in the 1920's.	Yes
Canada lynx *Lynx canadensis*	Threatened	Primarily occurs in Douglas-fir, spruce-fir, and subalpine forests at elevations above 7,800 feet above mean sea level (amsl). The lynx uses large woody debris, such as downed logs and windfalls.	None: If extant in Utah, this species most likely occurs in montane forests in the Uinta Mountains.	Yes
Big free-tailed bat *Nyctinomops macrotis*	WSC	Rare summer resident of Utah, primarily in southern half of the State, although individuals may rarely occur in northern Utah. Species prefers rocky and woodland habitats. Roosting occurs in caves, mines, old building, and rock crevices.	None: Roosting habitat does not occur in the Project Area and the species is not expected to be present.	Yes
Fringed myotis *Myotis thysanodes*	WSC	Occurs primarily within the Colorado Plateau of southern and eastern Utah, although distributed statewide. Habitat includes: mixed conifer and aspen, desert riparian, and pinyon-juniper. Roosts tend to be associated with areas having rocky outcroppings, cliffs, and canyons.	Low: Although suitable roosting habitat is not found in the Project Area, the species may forage in pinyon-juniper woodlands, located primarily in the western half of the Project Area.	**No**
Kit Fox *Vulpes macrotis*	WSC	Scattered localities throughout Utah especially in the western portion of the state. Associated with sparsely vegetated arid habitat, primarily greasewood-, shadscale-, or sagebrush-dominated habitat.	None: One historic sighting in Uintah County, but recent sightings only outside of Uintah County, and therefore outside of the Project Area.	Yes

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Spotted bat *Euderma maculatum*	WSC	Inhabits desert scrub, sagebrush-rabbitbrush, pinyon-juniper woodland, and ponderosa pine and montane forest habitats. The species also uses lowland riparian and montane grassland habitats. Suitable cliff habitat typically appears to be necessary for roosts/hibernacula.	None: The species potentially occurs throughout Utah; however, no occurrence records exist for the extreme northern or western parts of the State. Known occurrences have been reported in northeastern Uintah County. Roosting habitat does not occur in the Project Area and the species is not expected to be present.	Yes
Townsend's big-eared bat *Corynorhinus townsendii*	WSC	Inhabits a wide range of habitats from semi-desert shrublands and pinyon-juniper woodlands to open montane forests. Roosting occurs in mines and caves, in abandoned buildings, on rock cliffs, and occasionally in tree cavities. Foraging occurs well after dark over water, along margins of vegetation, and over sagebrush.	Low to moderate: The species occurs in Duchesne and Uintah Counties. Although suitable roosting habitat is not found in the Project Area, the species may forage in the northwestern portion of, and north of, the Project Area along the White River.	**No**
White-tailed prairie dog *Cynomys leucurus*	WSC	Inhabits grasslands, plateaus, plains, and desert shrub habitats. White-tailed prairie dogs form colonies or "towns" and spend much of their time in underground burrows, hibernating during the winter.	None: No prairie dog colonies have been identified within the Project Area. As suitable habitat does not occur in the Project Area, the species is not expected to be present.	Yes
Birds				
Southwestern willow flycatcher *Empidonax traillii extimus*	Endangered	Nesting sites are in dense riparian vegetation, typically dense stands of willows (*Salix* sp.) with cottonwood (*Populus* sp.) gallery forest overstory.	None: Although suitable habitat is present in the northwestern portion of, and north of, the Project Area along the White River, the distribution of this species does not occur within the Project Area. Known distribution has been documented south of the Project Area along the Green River.	Yes

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Mexican spotted owl *Strix occidentalis lucida*	Threatened	Found primarily in canyons with mixed conifer forests, pine-oak woodlands, and riparian areas. This species nests on platforms and large cavities in trees, on ledges, and in caves. Breeding and nesting season: approximately March through August.	None: The Final Assessment of Potential Mexican Spotted Owl Nesting Habitat on BLM-Administered Lands in Northeastern Utah identified areas of "poor" MSO habitat along the western boundary of the Project Area, and "fair" habitat east/northeast but outside of the Project Area (SWCA 2005). MSO would not likely nest or forage within the "poor" habitat in the Project Area, but could occupy "fair" habitat, located approximately 0.47 mile east/northeast of the Project Area. As such, discussion of this species was not eliminated from detailed analysis. Surveys conducted by Buys & Associates (B&A) in 2007 and 2008 did not document any MSO within "fair" habitat. Additionally, no USFWS-designated critical habitat for MSO is present in or within a 0.5 mile buffer of the Project Area.	**No**
Yellow-billed cuckoo *Coccyzus americanus*	Candidate; Utah PIF Priority Species	Riparian obligate and usually occurs in large tracts of cottonwood/willow habitats. However, this species also has been documented in lowland deciduous woodlands, alder thickets, deserted farmlands, and orchards. Breeding season: late June through July.	Low: Suitable habitat is present in the northwestern portion of, and north of, the Project Area along the White River. No yellow-billed cuckoo nests have been identified within the Project Area.	**No**
American white pelican *Pelecanus erythrorhynchos*	WSC; Utah PIF Priority Species	Inhabits areas of open water including large rivers, lakes, ponds, and reservoirs with surrounding habitats ranging from barren to heavily vegetated sites. Typically nests on isolated islands in lakes or reservoirs; rarely nests on peninsulas.	Low: In Utah, the species is known to nest on islands associated with Great Salt and Utah lakes. In northeastern Utah, the species occurs as a transient on larger water bodies.	Yes
Bald eagle *Haliaeetus leucocephalus*	WSC; BGEPA	In Utah, breeding occurrences are limited to nine nesting pairs. Winter habitat typically includes areas of open water, adequate food sources, and sufficient diurnal perches and night roosts.	Low: Bald eagles utilize ungulate winter ranges that provide carrion. Bald eagles are known to roost along the Green River, west of the Project Area.	**No**
Bobolink *Dolichonyx oryzivorus*	WSC; Utah PIF Priority Species	Inhabits mesic and irrigated meadows, riparian woodlands, and subalpine marshes at lower elevations (2,800 to 5,500 feet amsl). Suitable breeding habitat for this ground nester includes tall grass, flooded meadows, prairies, and agricultural fields; forbs and perch sites also are required.	None: This species does not breed in most of Utah. Occurs in low abundance and isolated patches primarily in the northern half of the State.	Yes

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Burrowing owl *Athene cunicularia*	WSC	Inhabits desert, semi-desert shrubland, grasslands, and agricultural areas. Nesting habitat primarily consists of flat, dry, and relatively open terrain; short vegetation; and abandoned mammal burrows for nesting and shelter.	None: Burrowing owls nest in desert/grassland habitats and are found in close association with prairie dog colonies in northeastern Utah. As suitable habitat for prairie dogs does not occur in the Project Area, the burrowing owl is not expected to be present.	Yes
Ferruginous hawk *Buteo regalis*	WSC; Utah PIF Priority Species	Resides mainly in lowland open desert terrain characterized by barren cliffs and bluffs, pinyon-juniper woodlands, sagebrush, rabbitbrush, and cold desert shrub. Nesting habitat includes trees and shrubs, promontory points, and rocky outcrops.	Moderate: This species is known to occur in the Uinta Basin as a summer resident and a common migrant. Although no ferruginous hawk nests have been identified, potential nesting substrates (in pinyon-juniper woodlands) are present.	**No**
Golden eagle *Aquila chrysaetos*	BGEPA[3]	Common resident in Utah that typically resides in open country, especially in mountainous regions. Nests are constructed on inaccessible cliffs or in large trees.	High: Review of BLM records indicated two golden eagle nests in the Project Area. Additionally, one golden eagle nest was identified approximately 0.6 mile west of the Project Area during an aerial raptor nest inventory conducted by B&A in May 2006 (B&A 2006).	**No**
Greater sage-grouse *Centrocercus urophasianus*	WSC; Utah PIF Priority Species	Inhabits upland sagebrush habitat in rolling hills and benches. Breeding occurs on open leks (or strutting grounds) and nesting and brooding occurs in upland areas and meadows in proximity to water and generally within a 2-mile radius of the lek. During winter, sagebrush habitats at submontane elevations commonly are used.	Moderate: The species is widespread, but declining, with extant populations in Uintah and Daggett Counties. The UDWR has mapped crucial brooding and crucial winter habitat for sage-grouse in the eastern half of the Project Area. No leks have been identified.	**No**
Lewis' woodpecker *Melanerpes lewis*	WSC; Utah PIF Priority Species	Inhabits open habitats including pine forests, riparian areas, and pinyon-juniper woodlands. Breeding habitat typically includes ponderosa pines and cottonwoods in stream bottoms and farm areas. The species inhabits agricultural lands and urban parks, montane and desert riparian woodlands, and submontane shrub habitats.	Low: In Utah, the species occurs primarily in the northeastern and southeastern part of the State, with small numbers in the northwestern corner. No open ponderosa pine forests occur in the Project Area.	Yes
Long-billed curlew *Numenius americanus*	WSC; Utah PIF Priority Species	Inhabits shortgrass prairies, alpine meadows, riparian woodlands, and reservoir habitats. Breeding habitat includes upland areas of shortgrass prairie or grassy meadows with bare ground components, usually near water.	None: Widespread migrant in Utah. Breeding birds are fairly common but localized, primarily in central and northwestern Utah. Potential nesting has been reported in Uintah County, but has not been confirmed.	Yes

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Mountain plover *Charadrius montanus*	WSC; Utah PIF Priority Species	In the Uinta Basin, small mountain plover populations breed in shrub-steppe habitat where vegetation is sparse and sagebrush communities are dominated by *Artemesia* spp. with components of black sage and grasses. Nest locations also vary with respect to topography.	Low: This species is rare in the Uinta Basin (six documented historical sightings). A review of BLM records did not indicate any occurrences of this species in the Project Area	Yes
Northern goshawk *Accipiter gentilis*	CS	Nests in higher elevations in mature conifer forests, aspen stands, and along valley cottonwood habitats. Winter habitat includes lower elevation pinyon-juniper woodlands.	None: No mature forests occur in the Project Area. Additionally, no northern goshawk nests have been identified within the Project Area.	Yes
Short-eared owl *Asio flammeus*	WSC	Inhabits arid grasslands, agricultural areas, marshes, and occasionally open woodlands. In Utah, cold desert shrub and sagebrush-rabbitbrush habitats also are utilized. Typically a ground nester.	Low: The species breeds in northern Utah and occurs as a migrant potentially throughout the state. It is known to occur in Uintah County, with occurrence probable in Duchesne County. Although no short-eared owl nests have been identified in the Project Area, potential breeding and wintering habitat exists throughout much of the Project Area.	**No**
Three-toed woodpecker *Picoides tridactylus*	WSC; Utah PIF Priority Species	Occurs in the Wasatch, Uinta, La Sal, and Abajo Mountains, and south-central part of Utah. The species forages primarily on scaly barked conifers, such as lodgepole pine and fir, and breeding habitat is primarily spruce-fir forest.	None: The species occurs in the northern portion of Uintah County, outside of the Project Area.	Yes
Fishes				
Bonytail chub *Gila elegans*	Endangered	Endemic to the Colorado River system, restricted to the Green River. Uses main channels of large rivers and favor swift currents.	None: This species occurs in the Green River downstream of the Project Area. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**
Colorado pikeminnow *Ptychocheilus lucius*	Endangered	Endemic to the Colorado River system. Uses large swift rivers.	Moderate: This species occurs in the Green River downstream of the Project Area. The White River has been designated as critical habitat for this species. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Humpback chub *Gila cypha*	Endangered	Endemic to the Colorado River system within deep, swift-running rivers, with canyon shaded environments.	None: This species occurs in the Green River downstream of the Project Area. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**
Razorback sucker *Xyrauchen texanus*	Endangered	Endemic to large rivers of the Colorado River system.	None: This species occurs in the Green River and a portion of the White River downstream of the Project Area. The White River has been designated as critical habitat for this species. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**
Bluehead sucker *Catostomus discobolus*	CS	Occupies a wide range of aquatic habitats ranging from cold, clear mountain streams to warm, turbid rivers.	None: This species occurs in the Green River downstream of the Project Area. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**
Colorado River cutthroat trout *Oncorhynchus clarkii pleuriticus*	CS	Cool, clear water, high-elevation streams and lakes.	None: No potential habitat is found downstream of the Project Area. Depletions in potential habitat would occur.	Yes
Flannelmouth sucker *Catostomus latipinnis*	CS	Adults occur in riffles, runs, and pools in streams and large rivers, with the highest densities usually in pool habitat. Young live in slow to moderately swift waters near the shoreline areas.	None: This species occurs in the Green River downstream of the Project Area. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**

SPECIES	STATUS[1,2]	HABITAT[4]	POTENTIAL FOR AND/OR OCCURRENCE OF SPECIAL STATUS SPECIES[3]	ELIMINATED FROM DETAILED ANAYSIS? (YES/NO)
Roundtail chub *Gila robusta*	CS	Adults inhabit low to high flow areas in the Green River; young occur in shallow areas with minimal flow.	None: This species occurs in the Green River downstream of the Project Area. Permit #49-2279[T77865] would result in depletion to the White River. Additional water sources could be hydrologically connected to the Upper Colorado River Basin, and therefore, could result in new water depletions.	**No**
Herptiles				
Cornsnake *Elaphe guttata*	WSC	This species is found along the Colorado and Green River corridors, generally from Moab (Grand County), north to Dinosaur National Monument (Uintah County). Although little data are available to describe habitat use in Utah, studies suggest the importance of riparian tracts.	Low: Although riparian habitat exists in the Project Area, the predicted habitat for this species is located south of the Project Area in Grand County. It is therefore unlikely that the species would occur in the Project Area.	Yes
Smooth greensnake *Opheodrys vernalis*	WSC	Occurs in montane habitats, most frequently in mountain riparian assemblages associated with mixed conifer, conifer-deciduous, and subalpine forests.	None: In Utah, the species occurs in the Wasatch, Uinta, Abajo, and La Sal Mountains. Distribution and habitat for this species does not occur in the Project Area	Yes

[1] Status abbreviations are as follows: WSC = Wildlife species of concern; CS = Species receiving special management under a Conservation Agreement in order to preclude the need for Federal listing; BGEPA = Bald and Golden Eagle Protection Act; and PIF = Partners in Flight.
[2] Status Source: (BLM 2007; Parrish et al. 2002; UNHP-UDWR 2008a).
[3] Although this species is not listed as a Utah sensitive species by the UDWR, the golden eagle was analyzed in this table based on its protection under the BGEPA.
[4] Habitat Source: (UNHP-UDWR 2003; UNHP-UDWR 2008b).

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Appendix F

Detailed Emissions Calculations

Buys & Associates, Inc. Environmental Consultants	Project: Enduring Resources Southam Canyon EA Date: 7/16/2008

Existing

7	wells	
2	producing wells	
22	miles road	

Proposed

Total New Wells	249	
Total New Pads	152	
Number of Wells Per Pad	1.64	
Pads with only one vertical well	89	
Directional Well Pads	63	38 with vertical wells
Vertical Wells	127	

Drilling

New Well pad/road construction								
Drilling (10 years 25 well average --Assume max year of 35 wells)	21	new well pads per year for	10	years				
40-acre spacing	35	new wells per year for	10	years				
Well Pad Disturbance	684	acres						
	4.5	acres/pad	196020.00		443	ft/side	134.95	meters
ROW Disturbance								
Roads	109.0	acres						
	0.717	acres/pad						
50' construction ROW 18' running surface, 24' final ROW	36	miles	feet/pad	model volumes	meters/volume			
	0.237	miles/pad	1250.526	52	7.3152			
Pipeline	122.0	acres						
	0.803	acres/pad						
Surface	47	miles						
	0.309	miles/pad						
Power lines	0	acres						
	0	acres/pad						35
	0	miles (cross country)						
	0	miles/pad						
				ft/side	meters/side			
Compressor Stations	4	acres	174240.00	417	127.2			
Pits	0							
TOTAL SHORT-TERM ACRES	919.0							
SHORT-TERM WELL/ROAD DISTURB PER WELL PAD	6.020							
Average Round Trip Distance for Drilling/Construction Traffic =	10	on unpaved off Hwy 45						
Average Round Trip Distance for Operations Traffic =	108.2							

							# of simultaneous operations
New well pad/road construction	5	days	10	hrs/day	50	Total Hours	
Pipeline installation	3	days	10	hrs/day	30	Total Hours	
Avg of days to drill, log and case one gas well	20	days	24	hrs/day	480	Total Hours	2
Time to complete each well	10	days	10	hrs/day	100	Total Hours	2
Time to Frac a well	1	day	8	hrs/day	8	Total Hours	2
Rig Size (hp)	2280	hp (Based on CAZA 82, rig that currently runs in Bonanza)					
	1000	hp Phase 1					

assume 2 pads, 2 rigs, 2 completions simultaneously (Prop Action indicates 1-2 drilling rigs at a time).

Completion

6-10 hours frac time per well		
7 pumps total 9000-10000 hp frac pump engines	10,000	hp
avg of 60-70% load		
1-60hp gensets	60	hp

Production

Pumper Vehicle Traffic: 1 new pumpers visits 83 wells per day and visits all wells daily (based on ch2)						
Central Dehydratation 1,500 hp engine Section 36 T10S R25E						
Each reclaimed production well pad will occupy 3.5 acre	3.5	152460	sq ft	390.461266	390.4612657	
Each completed well pad will have: a well head, 500Mbtu/hr separator heater, condensate oil tank, water tank, and a dehydrator; per well				119.012594	119.0125938	
Pumper Vehicle Traffic: 3 new pumpers (Ch2) each pumper logs ~1500 miles/month (B&A Estimate)	3					
Compression, 1,500 hp Engines to be LE with ox cat, assume 95% control CO, 76% HCHO and acrolein, 50% VOC						
1,500 hp of new compression total	1500	hp				
Assume CS are 4acre sites (135m x 135m)			18210.85	134.95		
20-30 Year LOP (assume average of 25)						
Assume 5 bbls condensate per day per well as in LCU						

Buys & Associates, Inc. **Environmental Consultants**	Project: Enduring Resources Southam Canyon EA Date: 7/16/2008

1. Road and Pad Construction Emissions (Dozer and Backhoe)

Assumptions:

Hours of Construction	5	days per well pad (Estimate)
	10	hours/day
	50	hours per well pad Dozer
	20	hours per well pad Backhoe
Watering Control Efficiency	50	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98
As specified by AP-42 Table 13.2.3-1 Recommended Emission Factors for Construction Operations

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 3.94 lbs TSP/hour/piece of equipment

Emissions = 1.00 lbs PM15/hour/piece of equipment

	Dozer Emissions[a]			**Backhoe Emissions[a]**			**Total**
	lbs/hr	**tons/well**	**tons/yr[b]**	**lbs/hr**	**tons/well**	**tons/yr[b]**	**tons/yr[b]**
TSP	3.94	0.0985	2.10	3.94	0.0394	0.00	2.10
PM15	1.00	0.0251	0.54	1.00	0.0100	0.21	0.75
PM10	0.38	0.0094	0.20	0.38	0.0038	0.08	0.28
PM2.5	0.21	0.0052	0.11	0.21	0.0021	0.04	0.15

a Assumes one dozer and one backhoe. Backhoe emissions are conservatively estimated as equivalent to Dozer emissions.

b Assumes maximum development scenario

Buys & Associates, Inc. **Environmental Consultants**	Project: Enduring Resources Southam Canyon E/ Date: 7/16/2008

2. Road Construction Emissions (Grader)

Assumptions:

Grading Length	4.40	0.24 miles/pad x 3 swaths (10' per swath) [road] + pad 3.69 miles on 443 ft x 443 ft pad (10 ft swath for 443 ft * 44 lengths)
Hours of Construction	3	day grading per road-and pad (Estimate)
	10	hours/day
	30	hours per well pad
Watering Control Efficiency	50	percent (Assumption)
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 10/98)
Distance Graded	4.40	miles
PM10 Multiplier	0.6 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/9
As specified by AP-42 Table 13.2.3-1 Recommended Emission Factors for Construction Operations

Emissions (TSP lbs) = 0.040 * (Mean Vehicle Speed)$^{2.5}$ * Distance Graded * Control Efficiency

Emissions (PM15 lbs) = 0.051 * (Mean Vehicle Speed)$^{2.0}$ * Distance Graded * Control Efficiency

Emissions = 11.83 lbs TSP/well

Emissions = 5.66 lbs PM15/well

	Grader Construction Emissions			
	lbs/well	**lbs/hr/well**	**tons/well**	**tons/yr [a]**
TSP	11.83	0.39	5.91E-03	0.13
PM15	5.66	0.19	2.83E-03	0.06
PM10	3.40	0.11	1.70E-03	0.04
PM2.5	0.37	0.01	1.83E-04	0.004

a Assumes maximum development scenario
a Assumes maximum development scenario

3. Pipeline Construction Emissions (Grader)

Assumptions:

Grading Length	0.31	miles pipeline per pad
Hours of Construction	1	day grading per well pad and road (Estimate)
	10	hours/day
	10	hours per well pad
Watering Control Efficiency	50	percent (Assumption)
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 10/98)
Distance Graded	0.31	miles
PM10 Multiplier	0.6 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98
As specified by AP-42 Table 13.2.3-1 Recommended Emission Factors for Construction Operations

Emissions (TSP lbs) = $0.040 * (\text{Mean Vehicle Speed})^{2.5} *$ Distance Graded * Control Efficiency

Emissions (PM15 lbs) = $0.051 * (\text{Mean Vehicle Speed})^{2.0} *$ Distance Graded * Control Efficiency

Emissions = 0.83 lbs TSP/well

Emissions = 0.40 lbs PM15/well

	Grader Construction Emissions			
	lbs/well	**lbs/hr/well**	**tons/well**	**tons/yr [a]**
TSP	0.83	0.08	0.0004	0.01
PM15	0.40	0.04	0.0002	4.25E-03
PM10	0.24	0.02	1.19E-04	2.55E-03
PM2.5	0.03	2.58E-03	1.29E-05	2.75E-04

a Assumes maximum development scenario

Buys & Associates, Inc. **Environmental Consultants**	Project: Enduring Resources Southam Canyon EA Date: 7/16/2008

4. Development Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
November 2006

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.15 * (S/12)^0.9 + (W/3)^0.45

Silt Content (S)	8.4	Mean value Table 13.2.2-1 for haul roads
Round Trip Miles	10	Unpaved from Hwy 45
Precipitation Days (P)	47	days per year (WRCC data for Bonanza, UT 1938-1993)

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Pad (lbs)	PM10/Pad (lb/day)	PM2.5/Pad (lbs)	PM2.5/Pad (lb/day)
Construction (days pad, road, pipeline	6							
	Semi: Hvy Equip Hauler	60,000	3					
	Haul Trucks: Equipment/Fuel/Water	40,000	5					
	Pickup Truck: Crew	7,000	10					
	Mean Vehicle Weight	25,000	18	1.8018502	324.3	54.1	32.4	5.4
					PM10/Annual Pads (tons)		**PM2.5/Annual Pads (tons)**	
					3.5		0.35	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Well (lbs)	PM10/Well (lb/day)	PM2.5/Well (lbs)	PM2.5/Well (lb/day)
Drilling (days/well)	20.0							
	Semi: Hvy Equip Hauler	60,000	35					
	Haul Trucks: Equipment/Fuel/Water	40,000	45					
	Pickup Truck: Rig Crew	7,000	100					
	Mean Vehicle Weight	30,556	180	1.9721333	3549.8	177.5	355.0	17.7
					PM10/Annual Wells (tons)		**PM2.5/Annual Wells (tons)**	
					62		6	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Well (lbs)	PM10/Well (lb/day)	PM2.5/Well (lbs)	PM2.5/Well (lb/day)
Completion (days/well)	10							
	Pickup: Completion Rig Crew	7,000	55					
	Haul Trucks: Equipment/Fuel/Water	40,000	80					
	Mean Vehicle Weight	26,556	135	1.8514655	2499.5	249.9	249.9	25.0
					PM10/Annual Wells (tons)		**PM2.5/Annual Wells (tons)**	
					43.7		4.4	

	Vehicle Type	Average Weight (lbs)	Round Trips per Well	PM10 (lb/VMT)	PM10/Day (lbs)	PM10/Day (lb/day)	PM2.5/Day (lbs)	PM2.5/Day (lb/day)
Interim Reclamation (days/well)	2							
	Pickup: Crew	7,000	1					
	Haul Trucks: Equipment	40,000	5					
	Mean Vehicle Weight	34,500	6	2.0828801	125.0	62.5	12.5	6.2
					PM10/Annual Wells (tons)		**PM2.5/Annual Wells (tons)**	
					2.2		0.2	

Annual Traffic Fugitive Dust Emissions (tons/year)	**112**	**11.2**

Buys & Associates, Inc. **Environmental Consultants**	Project: Enduring Resources Southam Canyon EA Date: 7/16/2008

5. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	231.0	acres total initial disturbance for roads/pipelines (Proposed Action)
	934,822	square meters total initial disturbance for roads/pipelines
	684	acres total initial disturbance for well pads (Proposed Action)
	2,768,045	square meters total initial disturbance for well pads
	915	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	2	for well pads (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	10	years (Proposed Action)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Perioc

Particle Size Multiplier (k)		
30 um	**<10 um**	**<2.5 um**
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	**Maximum U* Friction Velocity m/s**	**Well U_t* Threshold Velocity[a] m/s**	**Well Pad Erosion Potential g/m^2**	**Road U_t* Threshold Velocity[a] m/s**	**Road Erosion Potential g/m^2**
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	**Wells (tons/year)**	**Roads/Pipelines (tons/year)**
TSP	0.78	0.00
PM10	0.39	0.00
PM2.5	0.16	0.00

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6. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	10.0	miles (Estimated from project area and existing road system)
Hours of Construction	80	hours per site (Proponent)
Number of Heavy Diesel Truck Trips	8	(Proponent)
Number of Pickup Trips	10	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	8.13	0.018	7.17E-04	3.03	0.008	3.34E-04	0.026	0.022
CO	17.09	0.038	1.51E-03	33.64	0.093	3.71E-03	0.130	0.111
VOC [c]	4.83	0.011	4.26E-04	1.84	0.005	2.03E-04	0.016	0.013
SO2	0.32	0.001	2.83E-05	0.21	0.001	2.36E-05	0.001	0.001

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes maximum development scenario

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7. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	10.0	miles (Estimated from project area and existing road system)
Hours of Operation	480.0	hours per site (Proposed Action)
Number of Heavy Diesel Truck Trips	80	(Proponent)
Number of Pickup Trips	100	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	8.13	0.030	0.007	3.03	0.014	0.003	0.044	0.368
CO	17.09	0.063	0.015	33.64	0.155	0.037	0.217	1.825
VOC [c]	4.83	0.018	0.004	1.84	0.008	0.002	0.026	0.220
SO2	0.32	0.001	0.000	0.21	0.001	0.000	0.002	0.018

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes maximum development scenario

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8. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	10.0	miles (Estimated from project area and existing road system)
Hours of Operation	100	hours per site (Proponent)
Number of Heavy Diesel Truck Trips	80	(Proponent)
Number of Pickup Trips	55	(Proponent)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	8.13	0.143	0.007	3.03	0.037	0.002	0.180	0.192
CO	17.09	0.301	0.015	33.64	0.408	0.020	0.709	0.758
VOC [c]	4.83	0.085	0.004	1.84	0.022	1.12E-03	0.107	0.115
SO2	0.32	0.006	0.000	0.21	0.003	1.30E-04	0.008	0.009

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes maximum development scenario

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9. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	10.0	miles (Estimated from project area and existing road system)
Hours of Operation	20	hours per site (Assumption)
Number of Heavy Diesel Truck Trips	5	(Assumption)
Number of Pickup Trips	1	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	**Heavy Haul Trucks**			**Heavy Duty Pickups**			**Total [d]**	
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	8.13	0.045	0.000	3.03	0.003	0.000	0.048	0.010
CO	17.09	0.094	0.001	33.64	0.037	0.000	0.131	0.028
VOC [c]	4.83	0.027	0.000	1.84	0.002	0.000	0.029	0.006
SO2	0.32	0.002	0.000	0.21	0.000	0.000	0.002	0.000

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes maximum development scenario

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10. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	50	hours/site (Proposed Action)	
Development Rate	21	new pads per year (Proposed Action)	
Load Factor	0.4	(Assumed typical value)	
Backhoe Size	100	hp (Assumed Typical value)	20 hrs
Dozer Size	150	hp (Assumed Typical value)	50 hrs
Motor Grader Size	135	hp (Assumed Typical value)	40 hrs

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

Heavy Const. Vehicles	**Backhoe**			**Dozer**			**Grader**		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NOx	8.15	0.719	0.154	8.15	1.078	0.576	7.14	0.850	0.363
CO	2.28	0.201	0.043	2.28	0.302	0.161	1.54	0.183	0.078
VOC [c]	0.37	0.033	0.007	0.37	0.049	0.026	0.36	0.043	0.018
PM10 [d]	0.5	0.044	0.009	0.5	0.066	0.035	0.63	0.075	0.032
PM2.5 [d]	0.5	0.044	0.009	0.5	0.066	0.035	0.63	0.075	0.032
SO2	0.22	0.019	0.004	0.22	0.029	0.016	0.22	0.026	0.011
Formaldehyde	0.22	0.019	0.004	0.22	0.029	0.016	0.12	0.014	0.006

Heavy Const. Vehicles	**Total**	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NOx	2.647	1.093
CO	0.686	0.282
VOC [c]	0.124	0.051
PM10 [d]	0.185	0.077
PM2.5 [d]	0.185	0.077
SO2	0.075	0.031
Formaldehyde	0.063	0.026

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes maximum development scenario

11. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	480.0	hours/well (Proposed Action)
Development Rate	35	wells per year (Proposed Action)
Load Factor	0.4	(Assumed typical value)
Rig Size	1000	hp Phase 1 (vicinity projects estimate)
	2280	hp Phase 2 (Proponent previous projects)
	2152	average
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a] (lb/hp-hr)	Emissions (lb/hr)	Emissions [e] (tons/yr)
Criteria Pollutants & VOC			
NOx	2.40E-02	20.66	174
CO	5.50E-03	4.734	40
VOC [b]	7.05E-04	0.282	2.4
PM10 [c]	5.73E-04	0.493	4.1
PM2.5 [d]	4.79E-04	0.412	3.46
SO2	4.05E-04	0.348	2.92
Hazardous Air Pollutants			
Benzene [e]	1.97E-06	0.002	0.01
Toluene [e]	7.15E-07	0.001	0.01
Xylenes [e]	4.91E-07	4.23E-04	3.55E-03
Formaldehyde [e]	2.01E-07	1.73E-04	1.45E-03
Acetaldehyde [e]	6.41E-08	5.52E-05	4.64E-04
Acrolein [e]	2.01E-08	1.73E-05	1.45E-04
Naphthalene [f]	3.31E-07	2.85E-04	2.39E-03
Total PAH [f,g]	5.40E-07	4.64E-04	3.90E-03
Greenhouse Gases			
CO_2 [a]	1.16	999	8,388
CH_4 [a,b]	7.05E-04	0.607	5.1

[a] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1 Diesel Fuel, 10/96
[b] Emission Factor represents total Hydrocarbon Emissions
[c] Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
[d] Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
[e] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-3, 10/96 converted using boiler conversion factor from Appendix A
[f] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-4, 10/96 converted using boiler conversion factor from Appendix A
[g] PAH (Polycyclic Aromatic Hydrocarbons) includes naphthalene and are a HAP because they are polycyclic organic matter (POM)
[h] Assumes maximum development scenario

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12. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	8	Hours/Well (Proponents)
Development Rate	35	wells per year (Proposed Action)
Load Factor	0.65	(Proponents)
Frac Pump Engine Horsepower	10,000	Horsepower (Proponents)
Temporary Generator Horsepower	60	Horsepower (Proponents)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor [a]	Emissions	Emissions[e]
	(lb/hp-hr)	(lb/hr)	(tons/yr)
NOx	2.40E-02	156.0	21.84
CO	5.50E-03	35.75	5.005
VOC [b]	7.05E-04	4.583	0.642
PM10 [c]	5.73E-04	3.725	0.521
PM2.5 [d]	4.79E-04	3.114	0.436
SO_2 [a]	4.05E-04	2.629	0.368
Hazardous Air Pollutants			
Benzene [e]	1.97E-06	1.28E-02	1.80E-03
Toluene [e]	7.15E-07	4.65E-03	0.001
Xylenes [e]	4.91E-07	3.19E-03	4.47E-04
Formaldehyde [e]	2.01E-07	1.31E-03	1.83E-04
Acetaldehyde [e]	6.41E-08	4.17E-04	5.84E-05
Acrolein [e]	2.01E-08	1.30E-04	1.83E-05
Naphthalene [f]	3.31E-07	2.15E-03	3.01E-04
Total PAH [f]	5.40E-07	3.51E-03	4.91E-04
Greenhouse Gases			
CO_2 [a]	1.16	7,540	1,055.6
CH_4 [a]	7.05E-04	4.583	0.642

Species	Generator Engine Emissions		
	E. Factor [f]	Emissions	Emissions[e]
	(lb/hp-hr)	(lb/hr)	(tons/yr)
NOx	0.031	1.209	0.169
CO	6.68E-03	0.261	0.036
VOC [b]	2.47E-03	0.096	1.35E-02
PM10	2.20E-03	0.086	1.20E-02
PM2.5 [g]	2.20E-03	0.086	1.20E-02
SO_2 [g]	2.05E-03	0.08	1.12E-02
Hazardous Air Pollutants			
Benzene [h]	2.37E-06	9.26E-05	1.30E-05
Toluene [h]	1.04E-06	4.06E-05	5.68E-06
Xylenes [h]	7.25E-07	2.83E-05	3.96E-06
Formaldehyde [h]	3.00E-06	1.17E-04	1.64E-05
Acetaldehyde [h]	1.95E-06	7.61E-05	1.07E-05
Acrolein [h]	2.35E-07	9.18E-06	1.29E-06
1,3-Butadiene [h]	9.95E-08	3.88E-06	5.43E-07
Naphthalene [h]	2.16E-07	8.42E-06	1.18E-06
Total PAH [h]	4.28E-07	1.67E-05	2.33E-06
Greenhouse Gases			
CO_2 [g]	1.15	7,475	1,047
CH_4 [b,g]	2.47E-03	16.055	2.25

[a] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96

[b] Emission Factor represents total Hydrocarbon Emissions

[c] Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2

[d] Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2

[e] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-3, 10/96 converted using boiler conversion factor from Appendix A

[f] AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-4, 10/96 converted using boiler conversion factor from Appendix A

[g] AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96

[h] AP-42 Table 3.3-2 Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines, 10/96 converted using boiler conversion factor from Appendix A

[i] Assumes maximum development scenario

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13. Completion Flare Emissions

Assumptions

Hours of Operation	2 days	(Typical)
Amount of Gas Flared	5 MMscf/well	(Assumption, based on initial Production Rates)
Average Gas Heat Content	950 Btu/scf	(Gas Analyses from Existing Wells)
Average Gas VOC Content	0.007 weight %	(Gas Analyses from Existing Wells)
Average Mole Weight	17.6 lb/lb-mole	(Gas Analyses from Existing Wells)
Development rate	35 gas wells per year	

Equations

NOx/CO Emissions (lb/well) = Emission Factor (lb/MM Btu) * Gas Amount (MMscf/well) * Heat Content (Btu/scf)

PM/HAP Emissions (lb/well) = Emission Factor (lb/MMscf) * Gas Amount (MMscf/well)

$$\text{Flare Gas Wt. (lb/well)} = \frac{\text{Flare Gas Volume (MMscf/well)} * 10^6 \text{ (scf/MMscf)} * \text{Mole Weight (lb/lb-mole)}}{379.49 \text{ (scf/mole)}}$$

VOC Emissions (lb/well) = Flare Gas Wt. (lb/well) * VOC wt. % * 0.02 (Assumes 98% destruction Efficiency)

Species	Emission Factor (lb/MMBtu)	Well Emissions (lb/well)	Well Emissions (lb/hr/well)	Total Emissions [m] (tons/yr)
Criteria Pollutants				
NO_x [a]	0.068	323	6.73	5.7
CO [a]	0.37	1757	36.60	31
VOC	N.A.	0.3	0.01	0.0
SO_x [b]	0.00	0.0	0.00	0.00
TSP [c]	7.6	38	0.792	0.67
PM_{10} [c]	7.6	38	0.792	0.67
$PM_{2.5}$ [c]	7.6	38	0.792	0.67
Hazardous Air Pollutants				
Benzene [d]	2.1E-03	1.1E-02	2.2E-04	1.8E-04
Toluene [d]	3.4E-03	1.7E-02	3.5E-04	3.0E-04
Hexane [d]	1.8	9.0	0.2	0.2
Formaldehyde [d]	7.5E-02	3.8E-01	7.8E-03	6.6E-03
Dichlorobenzene [d]	1.2E-03	6.0E-03	1.3E-04	1.1E-04
Naphthalene [d]	6.1E-04	3.1E-03	6.4E-05	5.3E-05
POM 2 [d,e,f]	5.9E-05	3.0E-04	6.1E-06	5.2E-06
POM 3 [d,g]	1.6E-05	8.0E-05	1.7E-06	1.4E-06
POM 4 [d,h]	1.8E-06	9.0E-06	1.9E-07	1.6E-07
POM 5 [d,i]	2.4E-06	1.2E-05	2.5E-07	2.1E-07
POM 6 [d,j]	7.2E-06	3.6E-05	7.5E-07	6.3E-07
POM 7 [d,k]	1.8E-06	9.0E-06	1.9E-07	1.6E-07
Arsenic [l]	2.0E-04	1.0E-03	2.1E-05	1.8E-05
Beryllium [l]	1.2E-05	6.0E-05	1.3E-06	1.1E-06
Cadmium [l]	1.1E-03	5.5E-03	1.1E-04	9.6E-05
Chromium [l]	1.4E-03	7.0E-03	1.5E-04	1.2E-04
Cobalt [l]	8.4E-05	4.2E-04	8.8E-06	7.4E-06
Manganese [l]	3.8E-04	1.9E-03	4.0E-05	3.3E-05
Mercury [l]	2.6E-04	1.3E-03	2.7E-05	2.3E-05
Nickel [l]	2.1E-03	1.1E-02	2.2E-04	1.8E-04
Selenium [l]	2.4E-05	1.2E-04	2.5E-06	2.1E-06
Greenhouse Gases				
CO_2 [c]	120,000	600,000	12,500	10,500
CH_4 [a]	0.14	665	13.8	11.6

a AP-42 Table 13.5-1, Emission Factors for Flare Operations, 9/91
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98
[e] POM (Particulate Organic Matter) grouped according to subgroups described at EPA's Technology Transfer Network
[f] POM 2 includes: Acenaphthene, acenaphtylene, anthracene, 2-Methylnaphthalene, benzo(g,h,i)perylene,
[g] POM 3 includes: 7,12-Dimethylbenz(a)anthracene.
[h] POM 4 includes: 3-Methylchloranthrene.
[i] POM 5 includes: Benzo(a)pyrene and dibenzo(a,h)anthracene.
[j] POM 6 includes: Benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene.
[k] POM 7 includes: Chrysene.
[l] AP-42 Table 1.4-3, Emission Factors for Metals from Natural Gas Combustion, 7/98
[m] Assumes proposed development rate

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14. Operations Vehicle Tailpipe Emissions

Assumptions:

Number of New Pumpers:	3	(Proponent Number of Pumpers at Peak Production)
Pumper Mileage:	**4,000**	miles/pumper/month (Assumption 0.5 miles between well pads and roundtrip from Vernal)
Total Annual New Pumper Mileage:	144,000	miles/year
Number of Condensate Haul Truck Round Trips:	2	trips per day (based on Section 2.2)
Average Round Trip Mileage for Condensate Transport:	**108**	miles (from Vernal)
Total Annual Condensate Truck Mileage:	78,986	miles/year
Number of Water Haul Truck Round Trips:	3	trips per day (based on Section 2.2)
Average Round Trip Mileage for Water Transport:	56	miles (Average distance to Myton or Ouray)
Total Annual Water Truck Mileage:	61,320	miles/year
Daily Hours of Operation:	12	hours per day (Assumption)
Annual Hours of Operation:	4368	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	**Heavy Duty Pickups**			**Heavy Haul Trucks**			**Total**	
	E. Factor [a] (g/mile)	**Emissions (lb/hr)**	**Emissions (tons/yr)**	**E. Factor [b] (g/mile)**	**Emissions (lb/hr)**	**Emissions (tons/yr)**	**Emissions (lb/hr)**	**Emissions (tons/yr)**
Criteria Pollutants & VOC								
NO_x	3.03	0.220	0.481	8.13	0.324	0.708	0.544	1.189
CO	33.64	2.445	5.340	17.09	0.681	1.488	3.126	6.828
VOC [c]	1.656	0.120	0.263	4.600	0.183	0.401	0.304	0.663
SO_2	0.21	0.016	0.034	0.32	0.013	0.028	0.028	0.062
Greenhouse Gases								
CH_4 [d]	0.184	0.013	0.029	0.230	0.009	0.020	0.023	0.049

0.96454736

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b AP-42 Append. H Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons - Methane Offset
d AP-42 Append. H Tables 7.10A.2 and 4.10A.2 H.D. Methane Offsets, High Altitude, 1986+ and 1988+ Vehicle Year

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Environmental Consultants

Project: **Enduring Resources Southam Canyon EA**

Date: **7/16/2008**

15. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
November 2006

365 days (Estimate)

Unpaved Roads

E (PM10) / VMT = 1.5 * (S/12)^0.9 * (W/3)^0.45 * (365-p)/365)
E (PM2.5) / VMT = 0.15 * (S/12)^0.9 + (W/3)^0.45 * (365-p)/365)

Silt Content (S)	8.4	Mean value Table 13.2.2-1 for haul roads
W = average weight in tons of vehicles traveling the road		
Precipitation Days (P)	47	days per year **
Avg. Round Trip Miles	10	miles on unpaved roads ***

Vehicle Type	Ave. Weight (lbs)	Round Trips per Day*
Pickup Truck: Crew	7,000	3
Haul Truck: Oil	48,000	2
Haul Truck: Water	48,000	3
Mean Weight	32,625	8

Paved Roads

E (PM10) / VMT = 0.016 * (sL/2)^0.65 * (W/3)^1.5 - 0.00047 * (1-(p/(365*4))
E (PM10) / VMT = 0.0024 * (sL/2)^0.65 * (W/3)^1.5 - 0.00036 * (1-(p/(365*4))

Silt Loading (sL)	0.33	grains/square foot
W = average weight in tons of vehicles traveling the road		
Round Trip Miles	68	From Vernal
Precipitation Days (P)	45	days per year**

	PM_{10} (lb/VMT)	Total PM_{10} (lbs/yr)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/VMT)	Total $PM_{2.5}$ (lbs/yr)	$PM_{2.5}$ (lb/day)
Unpaved	2.03	355,349	974	0.20	35,535	97
Paved	0.06	6,603	18	0.01	960	3
Total		361,952	992		36,495	100

Annual Traffic Fugitive Dust Emissions (tons/year)	**181.0**			**18.2**	

*Maximum round trips per day on an access road.
** WRCC data for Bonanza, UT 1938-1993
*** Estimated average round trip from Vernal

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16. Average Produced Gas Characteristics
(Average of Uintah Basin from IPAMS)

Gas Heat Value (wet): 949.7 Btu/scf

C1-C2 Wt. Fraction: 0.8654
VOC Wt. Fraction: 0.0066
Non-HC Wt. Fraction: 0.1280
Total: 1.0000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	93.9570	16.043	15.074	0.856	1010.000	948.966	910.000	855.009
Ethane	0.5700	30.070	0.171	0.010	1769.800	10.088	1618.000	9.223
Propane	0.1620	44.097	0.071	0.004	2516.200	4.076	2316.000	3.752
i-Butane	0.0240	58.123	0.014	0.001	3252.100	0.781	3005.000	0.721
n-Butane	0.0220	58.123	0.013	0.001	3262.400	0.718	3013.000	0.663
i-Pentane	0.0070	72.150	0.005	0.000	4000.900	0.280	3698.000	0.259
n-Pentane	0.0040	72.150	0.003	0.000	4008.800	0.160	3708.000	0.148
Hexanes	0.0070	86.177	0.006	0.000	4756.200	0.334	4404.000	0.309
Heptanes	0.0008	100.204	0.001	0.000	5502.500	0.042	5100.000	0.039
Octanes+	0.0005	114.231	0.001	0.000	6249.100	0.033		0.000
Nonanes	0.0000	128.258	0.000	0.000	6996.400	0.000		0.000
Decanes	0.0000	142.285	0.000	0.000	7743.200	0.000		0.000
Benzene	0.0004	78.120	0.000	0.000	3715.500	0.014		0.000
Toluene	0.0003	92.130	0.000	0.000	4444.600	0.014		0.000
Ethylbenzene	0.0000	106.160	0.000	0.000	5191.500	0.001		0.000
Xylenes	0.0001	106.160	0.000	0.000	5183.500	0.004		0.000
n-Hexane	0.0016	86.177	0.001	0.000	4756.200	0.077		0.000
Helium	0.0000	4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.3260	28.013	0.091	0.005	0.000	0.000	0.000	0.000
Carbon Dioxide	4.9170	44.010	2.164	0.123	0.000	0.000	0.000	0.000
Oxygen	0.0000	32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.0000	34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.00		17.62	1.00		965.59		870.12

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

	AVG		
Nitrogen	0.326		
Methane	93.957		
Carbon Dioxide	4.917		
Ethane	0.57		
H2S	0		
Propane	0.162		
Isobutane	0.024		
n-Butane	0.022		
Isopentane	0.007		
n-Pentane	0.004		
Hexanes+	0.004		
Heptanes	0.004		
Octanes	0.003		
Nonanes	0		
	100	0	0

		Factor**
c6+		0.011000
other hexanes	0.6385	0.007024
n-hexane	0.1479	0.001627
heptane	0.0687	0.0007557
224 trimethylper	0.0267	0.0002937
octanes+	0.048	0.000528
benzene	0.0331	0.0003641
toluene	0.0285	0.0003135
ehtylbenzene	0.0014	0.0000154
xylenes (mpo)	0.0072	0.0000792
	1	

**from GRI published factors from Glycol Dehydration Handbook

GLYCALC

Carbon Dioxide	4.917
Hydrogen Sulfic	0
Nitrogen	0.326
Methane	93.957
Ethane	0.57
Propane	0.162
Isobutane	0.024
n-Butane	0.022
Isopentane	0.007
n-Pentane	0.004
Cyclopentane	0
n-Hexane	0.001627
Cyclohexane	0
Other Hexanes	0.007024
Heptanes Plus	0.000756
Methylcyclohex	0
2,2,4 Trimethyl	0.0003
Benzene	0.0004
Toluene	0.0003
Ethylbenzene	0.0000
Xylenes	0.0001
C-8 + Heavies	0.0005
	100
Xylenes	0.0000
C-8 + Heavies	0.0000
	194.75702

Buys & Associates, Inc. **Environmental Consultants**	Project: Date:	Enduring Resources Southam Canyon EA 7/16/2008

17. Central Compression

Assumptions:

Engine Type: TBD
Total Compression per Station 1,500 Horsepower (Proponent)
Total New Compression: 1,500 Horsepower (Proponent)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr) * Power (hp)}}{\text{453.6 g/lb}}$$

Pollutant	Emission Factor [1,2] (lb/MMBtu)	Emission Factor (g/hp-hr)	Emissions (lb/hr/station)	CS1 Emissions **1,500 hp** (tons/yr)	Total Emissions[3] Proposed Action (tons/yr)
NO_x [4]		1.5	4.96	21.7	22
CO [4]		0.1	0.43	1.9	1.9
VOC [4]		0.3	0.83	3.6	3.6
PM_{10} [5]	9.9871E-03	0.036	0.12	0.53	0.5
$PM_{2.5}$ [5]	9.9871E-03	0.036	0.12	0.53	0.5
SO_2 [6]	5.88E-04	0.00E+00	0.00	0.00	0
Benzene [4]	4.40E-04	0.00160	0.01	2.31E-02	2.3E-02
Toluene [4]	4.08E-04	0.00148	4.90E-03	2.15E-02	2.1E-02
Ethylbenzene [4]	3.97E-05	0.00014	4.77E-04	2.09E-03	2.1E-03
Xylenes [4]	1.84E-04	0.00067	2.21E-03	9.68E-03	9.7E-03
n-Hexane [4]	1.11E-03	0.00403	1.33E-02	5.84E-02	0.1
Formaldehyde [4]	5.28E-02	0.02	6.61E-02	0.29	0.29
Acetaldehyde [4]	8.36E-03	0.02	5.02E-02	0.22	0.22
Acrolein [4]	5.14E-03	4.48E-03	1.48E-02	6.49E-02	0.1
Methanol [4]	2.50E-03	4.54E-03	1.50E-02	6.58E-02	0.1
1,1,2,2-Tetrachloroethane[4]	4.00E-05	7.26E-05	2.40E-04	1.05E-03	1.1E-03
1,1,2-Trichloroethane[4]	3.18E-05	5.77E-05	1.91E-04	8.36E-04	8.4E-04
1,3-Dichloropropene[4]	2.64E-05	4.79E-05	1.59E-04	6.94E-04	6.9E-04
1,3-Butadiene[4]	2.67E-04	4.85E-04	1.60E-03	7.02E-03	7.0E-03
2,2,4-Trimethylpentane[4]	2.50E-04	4.54E-04	1.50E-03	6.58E-03	6.6E-03
Biphenyl[4]	2.12E-04	3.85E-04	1.27E-03	5.58E-03	5.6E-03
Carbon Tetrachloride[4]	3.67E-05	6.66E-05	2.20E-04	9.65E-04	9.7E-04
Chlorobenzene[4]	3.04E-05	5.52E-05	1.83E-04	8.00E-04	8.0E-04
Chloroform[4]	2.85E-05	5.18E-05	1.71E-04	7.50E-04	7.5E-04
Ethylene Dibromide[4]	4.43E-05	8.04E-05	2.66E-04	1.17E-03	1.2E-03
Methylene Chloride[4]	2.00E-05	3.63E-05	1.20E-04	5.26E-04	5.3E-04
Naphthalene[4]	7.44E-05	1.35E-04	4.47E-04	1.96E-03	2.0E-03
Phenol[4]	2.40E-05	4.36E-05	1.44E-04	6.31E-04	6.3E-04
Styrene[4]	2.36E-05	4.29E-05	1.42E-04	6.21E-04	6.2E-04
Tetrachloroethane[4]	2.48E-06	4.50E-06	1.49E-05	6.52E-05	6.5E-05
Vinyl Chloride[4]	1.49E-05	2.71E-05	8.95E-05	3.92E-04	3.9E-04
PAH -POM 1[4,7,8]	2.69E-05	4.89E-05	1.62E-04	7.08E-04	7.1E-04
POM 2[4,8,9]	5.93E-05	1.08E-04	3.56E-04	1.56E-03	1.6E-03
Benzo(b)fluoranthene/POM6[4,8]	1.66E-07	3.01E-07	9.97E-07	4.37E-06	4.4E-06
Chrysene/POM7[4,8]	6.93E-07	1.26E-06	4.16E-06	1.82E-05	1.8E-05
TOTAL HAPS	7.22E-02	5.43E-02	0.2	0.8	0.8
Greenhouse Gases					
CO_2	110	400	1,321	5,787	5,787
CH_4	1.25	4.54	15	66	66

[1] - AP-42 Table 3.2-2 Uncontrolled Emission Factors for a 4 stroke Lean Burn engine, 7/0

[2] - Conversion from lb/MMBtu to g/hp-hr assumes an average heat rate of 8,000 Btu/hp-hr (*3.632

[3] - Assumes maximum development scenario

[4] - Average BACT emission rates (95% reduction of CO, 76% reduction of formaldehyde and acrolein, 50% reduction all other VOCs/HAPs

[5] - PM = sum of PM filterable and PM condensable

[6] - Gas analysis indicates no sulfur compounds, see Central Gas Composition page.

[7] Polycyclic Aromatic Hydrocarbons (PAH) defined as a HAP by Section 112(b) of the Clean Air Act because it is Polycyclic Organic Matter (POM) AP42 Table 1.4-3 footnotes.

[8] - POM (Particulate Organic Matter) grouped according to subgroups described at EPA's Technology Transfer Network website for the 1999 National-Scale Air Toxics Assessment at http://www.epa.gov/ttn/atw/nata1999/nsata99.html

[9] - POM 2 includes: Acenaphthene, acenaphtylene, 2-Methylnaphthalene, benzo(e)pyrene, benzo(g,h,i)perylene, fluoranthene, fluorene, phenanthrene, and pyrene.

18. Wellsite Dehydrator Emissions

Assumptions

Average Production Rate: 0.3 MMscf/day/well (proponent estimate from Big Pack EA)
Number of Active Wells Requiring Separators: 249 wells at Peak Production
75 MMscfd Total Gas Production

Gas Composition: (Average of Uintah Basin from IPAMS)

Inlet Gas Conditions: Inlet gas saturated at 800 psi and 75F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

50% Control Efficiency in order to meet Utah BACT

Emissions

Species	Well Dehydrator Emissions (lbs/hr/well)	Well Dehydrator Emissions (tons/year/well)	Total Project Emissions (tons/year)
Total VOC	0.0022	9.6E-03	0.7
Hazardous Air Pollutants			
Benzene	0.0003	1.3E-03	0.1
Toluene	0.0004	1.8E-03	0.1
Ethylbenzene	0.0001	4.4E-04	3.3E-02
Xylenes	0.0003	1.3E-03	0.1
n-Hexane	0.0001	4.4E-04	0.0
Greenhouse Gases			
CH_4	0.0456	0.2	15

19. Central TEG Dehydrator Emissions
Southam Canyon Station, Section 36, T10S, R25E

Assumptions

Production Rate: 75 MMscf/day

Gas Composition: (Average of Uintah Basin from IPAMS)

Inlet Gas Conditions: Inlet gas saturated at 800 psi and 75F

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0
95% Control Efficiency in order to meet Federal MACT Standards

Emissions

Species	Central Dehydrator Emissions (lb/hr)	Total Project Emissions (tons/year)
VOC	0.0547	0.24
Benzene	0.0076	0.03
Toluene	0.0105	0.05
Ethylbenzene	0.0008	3.5E-03
Xylenes	0.0078	0.03
n-Hexane	0.0008	3.5E-03
Total HAPs	0.0278	0.12
Methane	1.1966	5.24

Buys & Associates, Inc. **Environmental Consultants**	Project: Enduring Resources Southam Canyon EA Date: 7/16/2008

20. Heater Emissions

Assumptions

Wellsite Heater Size	1,000	MBtu/hr	Assumption (500 Mbtu/hr dehy reboiler + 500 Mbtu/hr separator)
Proposed Central Facility Heaters	6,000	MBtu/hr	Assumption (3,000 Mbtu/hr dehy reboiler + 3,000 Mbtu/hr separator)
Firing Rate	30	minutes/hour on average for entire year (Typical value)	
	4,380	hours/year	
Fuel Gas Heat Value	950	Btu/scf (Gas Analyses from Existing Wells)	
Fuel Gas VOC Content	0.007	by weight (Gas Analyses from Existing Wells)	
Development size	249	new wells	

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000 \text{ (Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000 \text{ (scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000 \text{ (lbs/ton)} * 1{,}000 \text{ (Btu/scf - Standard Fuel Heating Value)}}$$

VOC Emissions (tons/yr) = TOC Emissions (tons/yr) * VOC wt. fraction

	Wellpad Heater Emissions			Central Facility Heaters			Total Heater	
	Emission Factor (lb/MMscf)	Well Emissions (lb/hr/well)	Total Emissions [l] (tons/yr)	Emission Factor (lb/MMscf)	Facility Emissions (lb/hr/site)	Total Emissions [l] (tons/yr)	Well Emissions (lb/hr/pad)	Total Emissions [l] (tons/yr)
NOx [a]	100	0.050	55	100	0.300	2.6	0.050	62
CO [a]	84	0.042	46	84	0.252	2.2	0.042	52
TOC [c]	11	0.006	6.0	11	0.033	0.3	0.006	6.9
VOC	N.A.	0.000	0.0	N.A.	0.000	1.9E-03	0.000	0.0
SOx [b]	0.00	0.000	0	0.00	0.00	0.0	0.000	0
TSP [c]	7.6	0.004	4.1	7.6	0.023	0.2	0.004	4.7
PM_{10} [c]	7.6	0.004	4.1	7.6	0.023	0.2	0.004	4.7
$PM_{2.5}$ [c]	7.6	0.004	4.1	7.6	0.023	0.2	0.004	4.7
Benzene [d]	2.1E-03	1.050E-06	1.1E-03	2.1E-03	6.30E-06	5.52E-05	1.05E-06	1.3E-03
Toluene [d]	3.4E-03	1.700E-06	1.9E-03	3.4E-03	1.02E-05	8.94E-05	1.70E-06	2.1E-03
Hexane [d]	1.8	9.000E-04	1.0	1.8	5.40E-03	4.7E-02	9.00E-04	1.1
Formaldehyde [d]	0.075	3.750E-05	4.1E-02	0.075	2.25E-04	1.97E-03	3.75E-05	4.7E-02
Dichlorobenzene [d]	1.2E-03	6.000E-07	6.5E-04	1.2E-03	3.60E-06	3.15E-05	6.00E-07	7.5E-04
Naphthalene [d]	6.1E-04	3.050E-07	3.3E-04	6.1E-04	1.83E-06	1.60E-05	3.05E-07	3.8E-04
POM 2 [d,e,f]	5.9E-05	2.950E-08	3.2E-05	5.9E-05	1.77E-07	1.55E-06	2.95E-08	3.7E-05
POM 3 [d,g]	1.6E-05	8.000E-09	8.7E-06	1.6E-05	4.80E-08	4.20E-07	8.00E-09	1.0E-05
POM 4 [d,h]	1.8E-06	9.000E-10	9.8E-07	1.8E-06	5.40E-09	4.73E-08	9.00E-10	1.1E-06
POM 5 [d,i]	2.4E-06	1.200E-09	1.3E-06	2.4E-06	7.20E-09	6.31E-08	1.20E-09	1.5E-06
POM 6 [d,j]	7.2E-06	3.600E-09	3.9E-06	7.2E-06	2.16E-08	1.89E-07	3.60E-09	4.5E-06
POM 7 [d,k]	1.8E-06	9.000E-10	9.8E-07	1.8E-06	5.40E-09	4.73E-08	9.00E-10	1.1E-06
CO_2 [c]	120,000	60	65,437	120,000	360	3,154	60	7.5E+04
Methane [c]	2.3	1.2E-03	1.3	2.3	6.9E-03	0.060	1.2E-03	1.4

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 7/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 7/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 7/98
Scale Air Toxics Assessment at http://www.epa.gov/ttn/atw/nata1999/nsata99.html
pyrene.
[g] - POM 3 includes: 7,12-Dimethylbenz(a)anthracene.
[h] - POM 4 includes: 3-Methylchloranthrene.
[i] - POM 5 includes: Benzo(a)pyrene and dibenzo(a,h)anthracene.
[j] - POM 6 includes: Benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene.
[k] - POM 7 includes: Chrysene.
l Assumes maximum development scenario

21. Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate : 3.0 bbls condensate per day per well (assumption based on proponent avg for West Bonanza EA)

Size of Development: 249 Producing Wells

Calculations:

Uinta Basin Flash Gas Data from IPAMS

Emissions:

Component	Well Flash/Work/Breathing (tons/yr/well)	Project Emissions[a] (tons/yr)
Total VOC	3.83	954
Benzene	1.6E-03	0.4
Toluene	1.4E-03	0.4
Ethylbenzene	1.1E-04	2.8E-02
Xylenes	4.7E-04	0.1
n-Hexane	1.6E-02	4.0
Greenhouse Gases		
CO_2	0.09	23.3
CH_4	2.64	658

a Assumes maximum development scenario

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Environmental Consultants

Project: Enduring Resources Southam Canyon EA
Date: 7/16/2008

22. Central Facility Condensate Storage Tank Flash/Working/Standing Emissions

Assumptions:

Average Condensate Production Rate :
Facility 1 125 bbls condensate per day (Estimate)

Calculations:

Uinta Basin Flash Gas Data from IPAMS

Emissions:

Component	Facility 1 Flash/Work/Breathing (lbs/hr)	Facility 1 Flash/Work/Breathing (tons/yr)	Total Emissions (tons/yr)
Total VOC	36.5	160	160
Hazardous Air Pollutants			
Benzene	0.015	0.06	6.5E-02
Toluene	0.013	0.06	5.9E-02
Ethylbenzene	0.001	4.71E-03	4.7E-03
Xylenes	0.004	0.02	2.0E-02
n-Hexane	0.152	0.67	0.7
Greenhouse Gases			
CO_2	0.89	3.91	3.9
CH_4	25.2	110	110

	AVG		
Nitrogen	0.3		
Methane	85.1		
Carbon Dio	1.1		
Ethane	7.6		
H2S	0		
Propane	3.3		
Isobutane	0.6		
n-Butane	0.9		
Isopentane	0.4		
n-Pentane	0.3		
Hexanes+	0.5		
Heptanes	0		
Octanes	0		
Nonanes	0		
	100.1	0	0
	Storage Factor**		
c6+			0.50
other hexar	0.5319		0.26595
n-hexane	0.1913		0.09565
heptane	0.1002		0.0501
224 trimeth	0.0103		0.00515
octanes+	0.1241		0.062
benzene	0.0205		0.01025
toluene	0.0159		0.00795
ehtylbenzei	0.0011		0.00055
xylenes (m	0.0046		0.0023
	0.9999		

COMPONEN	MOLE PERCENT	OMPONEN MOLE WEIGHT (lb/lb-mole	NET MOLE WEIGHT lb/lb-mole)	WEIGHT FRACTION	tons/year
					159.6875
Methane	85.1000	16.043	13.653	0.690	110.168841
Ethane	7.6000	30.070	2.285	0.115	18.4412628
Propane	3.3000	44.097	1.455	0.074	11.7426636
i-Butane	0.6000	58.123	0.349	0.018	2.81412191
n-Butane	0.9000	58.123	0.523	0.026	4.22118287
i-Pentane	0.4000	72.150	0.289	0.015	2.32884166
n-Pentane	0.3000	72.150	0.216	0.011	1.74663125
Hexanes	0.2660	86.177	0.229	0.012	1.84941766
Heptanes	0.0501	100.204	0.050	0.003	0.4051039
Octanes+	0.0620	114.231	0.071	0.004	0.57150404
Nonanes	0.0000	128.258	0.000	0.000	0
Decanes	0.0000	142.285	0.000	0.000	0
Benzene	0.0103	78.120	0.008	0.000	0.06461446
Toluene	0.0080	92.130	0.007	0.000	0.05910331
Ethylbenz	0.0006	106.160	0.001	0.000	0.00471159
Xylenes	0.0023	106.160	0.002	0.000	0.019703
n-Hexane	0.0957	86.177	0.082	0.004	0.66515059
Helium	0.0000	4.003	0.000	0.000	0
Nitrogen	0.3000	28.013	0.084	0.004	0.67814804
Carbon Di	1.1000	44.010	0.484	0.024	3.90649875
Oxygen	0.0000	32.000	0.000	0.000	0
Hydrogen	0.0000	34.080	0.000	0.000	0
TOTAL	100.09		19.79	1.00	159.6875

**from GRI published factors Glycol Dehydratic Relative Mole Weight (lb [Mole Percent * Molecular weight (lb/lb-mole)] /

Weight Fraction = Net Mole Weight / Total Mole Weight

GLYCALC

Carbon Di	1.1
Hydrogen	0
Nitrogen	0.3
Methane	85.1
Ethane	7.6
Propane	3.3
Isobutane	0.6
n-Butane	0.9
Isopentane	0.4
n-Pentane	0.3
Cyclopenta	0
n-Hexane	0.09565
Cyclohexa	0
Other Hex	0.26595
Heptanes	0.0501
Methylcycl	0
2,2,4 Trim	0.0052
Benzene	0.0103
Toluene	0.0080
Ethylbenze	0.0006
Xylenes	0.0023
C-8 + Hea	0.0621
	100.1
Xylenes	0.0000
C-8 + Heav	0.0006
	198.80045

23. Development Emissions Sumary

Pollutant	Well Development Emissions (tons/year)[a]					Total
	Construction	Drilling	Completion	Infrastructure development	Wind Erosion	(tons/yr)
NO_X	1.1	174	27.9	1.0E-02		203
CO	0.4	42	36.5	2.8E-02		79
VOC	0.1	2.6	0.8	6.1E-03		3.4
SO_2	3.2E-02	2.9	0.39	4.3E-04		3.4
PM_{10}	3.7	66	45	2.2	0.4	118
$PM_{2.5}$	0.5	10	5.5	0.2	0.2	16
Benzene		1.4E-02	2.0E-03			1.6E-02
Toluene		5.2E-03	9.5E-04			6.1E-03
Ethylbenzene						0
Xylene		3.6E-03	4.5E-04			4.0E-03
n-Hexane			0.2			0.2
Formaldehyde	2.6E-02	1.5E-03	6.8E-03			3.4E-02

a Assumes maximum development scenario

24. Well Production Summary

Species	Production Heaters (tons/yr)	Storage Tanks (tons/yr)	Well Dehydrators (tons/yr)	Operations Vehicle (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC					
NO_x	54.5			1.19	55.7
CO	45.8			6.8	52.6
VOC	0.04	954	0.7	0.66	955
SO_2	0.00			0.06	0.1
PM_{10}	4.1			181	185
$PM_{2.5}$	4.1			18.2	22
Hazardous Air Pollutants					
Benzene	1.1E-03	0.4	0.1		0.5
Toluene	1.9E-03	0.4	0.1		0.5
Ethylbenzene		0.0	3.3E-02		0.1
Xylene		0.1	0.1		0.2
n-Hexane	9.8E-01	4.0	3.3E-02		5.0
Formaldehyde	4.1E-02				4.1E-02
Dichlorobenzene	6.5E-04				6.54E-04
Naphthalene	3.3E-04				3.3E-04
POM 2[d,e,f]	3.2E-05				3.2E-05
POM 3[d,g]	8.7E-06				8.7E-06
POM 4[d,h]	9.8E-07				9.8E-07
POM 5[d,i]	1.3E-06				1.3E-06
Benzo(b)fluoranthene/POM6[g]	3.9E-06				3.9E-06
Chrysene/POM7[h]	9.8E-07				9.8E-07
Total HAPs	1.03	4.9	0.4	0.0	6.3
Greenhouse Gases					
CO_2	65437				65,437
CH_4	1.25		14.9		16

[a] Emissions for Peak Field Development

Buys & Associates, Inc. Environmental Consultants	Project: Enduring Resources Southam Canyon Date: 7/16/2008

25. Central Facility Emission Summary

Central Facility 1

Pollutant	Central Compression Emissions 1,500 hp (tons/year)	Central Dehydrator Emissions 75MMscfd (tons/year)	Central Heater Emissions 3,000 Mbtu/hr (tons/year)	Central Condensate Tank Emissions 125 bbls/day (tons/year)	Total Facility Emissions (tons/year)
Criteria Pollutants & VOC					
NO_x	22		2.63		24
CO	1.9		2.21		4.1
VOC	3.6	0.24	1.90E-03	37	40
SO_2	0.00		0		0.00
PM_{10}	0.53		2.00E-01		0.73
$PM_{2.5}$	0.53		2.00E-01		0.73
Hazardous Air Pollutants					
Benzene	0.02	0.03	5.52E-05	0.01	0.07
Toluene	0.02	0.05	8.94E-05	0.01	0.08
Ethylbenzene	0.00	0.00		0.00	0.01
Xylene	0.01	0.03		0.00	0.05
n-Hexane	0.06	0.00	4.73E-02	0.2	0.26
Formaldehyde	0.29		1.97E-03		0.29
Total HAPs	0.40	0.12	4.94E-02	0.2	0.76
Greenhouse Gases					
CO_2	0		3154	0.9	3,155
CH_4	0	5.24	0.06	25	30.5

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26. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Related Emissions (tons/year) [a]					Total
	Production Heaters	Condensate Tanks	TEG Dehydrators	Operations Vehicle	Compressor Engines	(tons/year)
NO_X	62	0.0	0.0	1.2	22	85
CO	52	0.0	0.0	6.8	1.9	61
VOC	4.5E-02	1,114	1.0	0.7	3.6	1,119
SO_2	0.0E+00	0.0	0.0	0.1	0.0	0.1
PM_{10}	4.7	0.0	0.0	181	0.5	186
$PM_{2.5}$	4.7	0.0	0.0	18	0.5	24
HAPs						
Benzene	1.3E-03	0.4	0.1	0.0	2.3E-02	0.5
Toluene	2.1E-03	0.4	0.2	0.0	2.1E-02	0.6
Ethylbenzene	0.0E+00	0.1	3.6E-02	0.0	2.1E-03	0.1
Xylene	0.0E+00	0.1	0.1	0.0	9.7E-03	0.3
n-Hexane	1.12	4.0	3.6E-02	0.0	0.1	5.2
Formaldehyde	0.05	0.0E+00	0.0E+00	0.0	0.3	0.3
Acetaldehyde	0.0	0.0	0.0	0.0	0.2	0.2
Acrolein	0.0	0.0	0.0	0.0	0.1	0.1
Methanol	0.0	0.0	0.0	0.0	0.1	0.1
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	1.1E-03	1.E-03
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	8.4E-04	8.E-04
1,3-Dichloropropene	0.0	0.0	0.0	0.0	6.9E-04	7.E-04
1,3-Butadiene	0.0	0.0	0.0	0.0	7.0E-03	7.E-03
2,2,4-Trimethylpentane	0.0	0.0	0.0	0.0	6.6E-03	7.E-03
Biphenyl	0.0	0.0	0.0	0.0	5.6E-03	6.E-03
Carbon Tetrachloride	0.0	0.0	0.0	0.0	9.7E-04	1.E-03
Chlorobenzene	0.0	0.0	0.0	0.0	8.0E-04	8.E-04
Chloroform	0.0	0.0	0.0	0.0	7.5E-04	7.E-04
Dichlorobenzene	7.5E-04	0.0	0.0	0.0	0	7.E-04
Ethylene Dibromide	0.0	0.0	0.0	0.0	1.2E-03	1.E-03
Methylene Chloride	0.0	0.0	0.0	0.0	5.3E-04	5.E-04
Naphthalene	3.8E-04	0.0	0.0	0.0	2.0E-03	2.E-03
Phenol	0.0	0.0	0.0	0.0	6.3E-04	6.E-04
Styrene	0.0	0.0	0.0	0.0	6.2E-04	6.E-04
Tetrachloroethane	0.0	0.0	0.0	0.0	6.5E-05	7.E-05
Vinyl Chloride	0.0	0.0	0.0	0.0	3.9E-04	4.E-04
PAH -POM 1[6]	0.0	0.0	0.0	0.0	7.1E-04	7.E-04
POM 2[d,e,f]	3.7E-05	0.0	0.0	0.0	1.6E-03	2.E-03
POM 3[d,g]	1.0E-05	0.0	0.0	0.0	0	1.E-05
POM 4[d,h]	1.1E-06	0.0	0.0	0.0	0	1.E-06
POM 5[d,i]	1.5E-06	0.0	0.0	0.0	0	1.E-06
Benzo(b)fluoranthene/POM6[d]	4.5E-06	0.0	0.0	0.0	4.4E-06	9.E-06
Chrysene/POM7[h]	1.1E-06	0.0	0.0	0.0	1.8E-05	2.E-05
Total HAPs	1.2	5.0	0.5	0.0	0.79	7
Greenhouse Gases						
CO_2	74,898	4			5,787	80,689
CH_4	1.4	110	20	4.9E-02	66	198

27. Total Project Emissions Summary

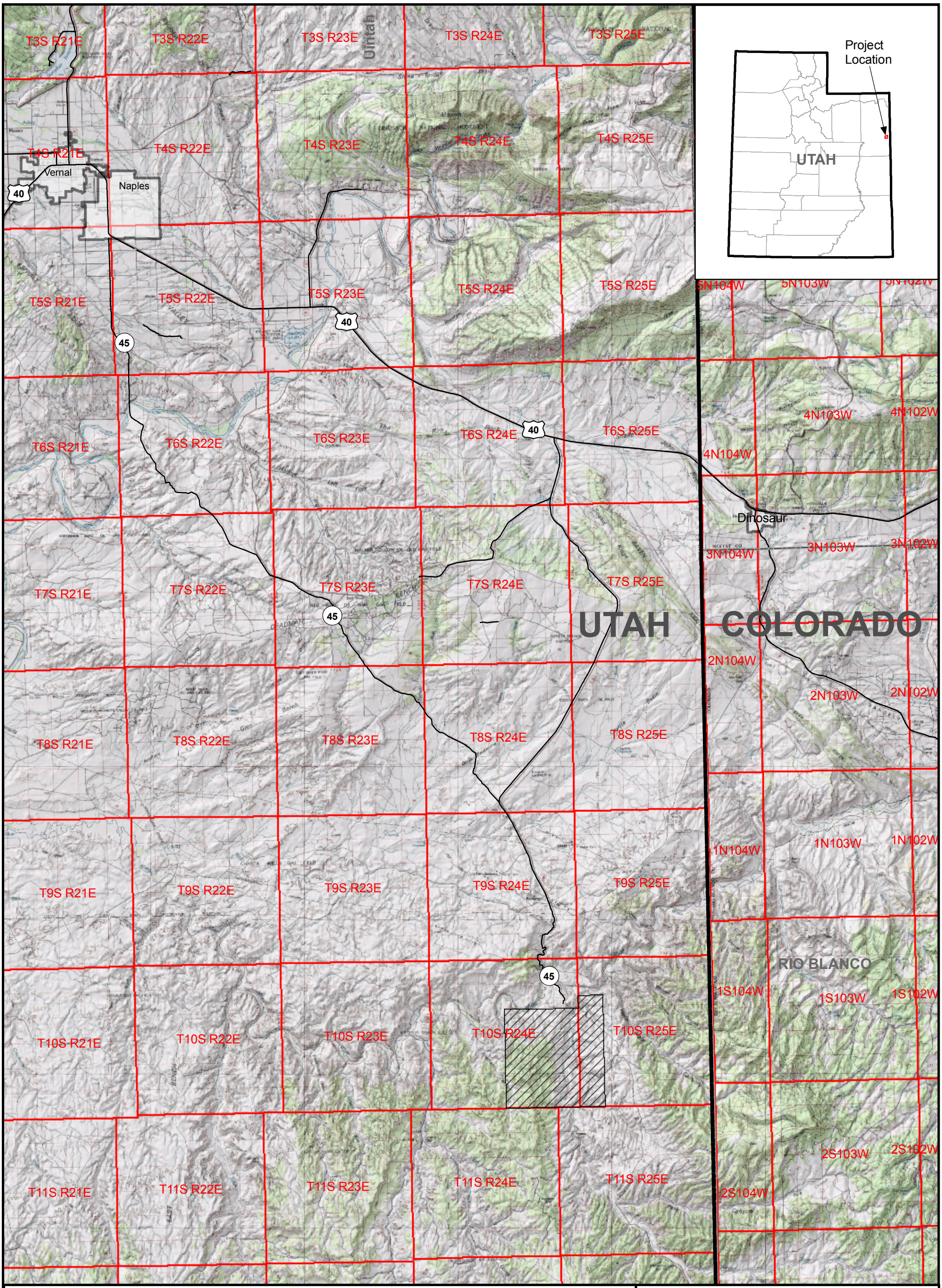
Pollutant	Project Emissions (tons/year)			Total Emissions (tons/year)
	Well Development	Project Production	Compressor Engines	
Criteria Pollutants and VOC				
NO_X	203	64	22	288
CO	79	59	1.9	140
VOC	3.4	1,115	3.6	1,122
SO_2	3.36	0.1	0.0	3.4
PM_{10}	118	186	0.5	304
$PM_{2.5}$	16	23.0	0.5	40
Hazardous Air Pollutants				
Benzene	2.E-02	0.5	0.0	0.6
Toluene	6.E-03	0.6	0.0	0.6
Ethylbenzene	0.0	0.1	2.E-03	0.1
Xylene	4.E-03	0.3	0.0	0.3
n-Hexane	0.2	5	0.1	5.4
Formaldehyde	0.03	0.05	0.3	0.4
Acetaldehyde	6.6E-04	0.0	0.2	0.2
Acrolein	2.1E-04	0.0	0.1	0.1
1,1,2,2-Tetrachloroethane	0.0	0.0	1.1E-03	1.1E-03
1,1,2-Trichloroethane	0.0	0.0	8.4E-04	8.4E-04
1,3-Dichloropropene	0.0	0.0	6.9E-04	6.9E-04
1,3-Butadiene	1.3E-06	0.0	0.01	7.0E-03
Carbon Tetrachloride	0.0	0.0	9.7E-04	9.7E-04
Dichlorobenzene	0.0	7.5E-04	0.0	7.5E-04
Ethylene Dibromide	0.0	0.0	1.2E-03	1.2E-03
Methylene Chloride	0.0	0.0	5.3E-04	5.3E-04
Naphthalene	2.4E-03	3.8E-04	2.0E-03	4.7E-03
Tetrachloroethane	0.0	0.0	6.5E-05	6.5E-05
Vinyl Chloride	0.0	0.0	3.9E-04	3.9E-04
POM 2	0.0	3.7E-05	1.6E-03	1.6E-03
POM 3[d]	0.0	1.0E-05	0.0	1.0E-05
POM 4	0.0	1.1E-06	0.0	1.1E-06
POM 5[f]	0.0	1.5E-06	0.0	1.5E-06
Benzo(b)fluoranthene/POM6[g]	0.0	4.5E-06	4.4E-06	8.9E-06
Chrysene/POM7[h]	0.0	1.1E-06	1.8E-05	1.9E-05
Total HAPs	0.2	6.7	0.7	7.6
Greenhouse Gases				
CO_2	18,888	74,902	5,787	99,576
CH_4	2,119	132	66	2,316

28. Stack Parameters

Equipment	Height (meters)	Temp (K)	Exit Velocity (m/s)	Diameter (meters)
Compressor	6.1	730	50	0.3048
Drill Rig	8	800	50	0.1
Frac Eng	4	811	50	0.1016
Boiler	4.6	700	2.84	0.2286
TANK	6.7056	282	0.001	0.0508
TEG Dehydrator	3.65	366	0.001	0.05
Flare	6.096	811	20	0.05

Appendix G

Figures



Legend

Southam Project Area

Township/Range Boundaries

N W E S

0 10 20 Miles

Southam Canyon EA Location Map

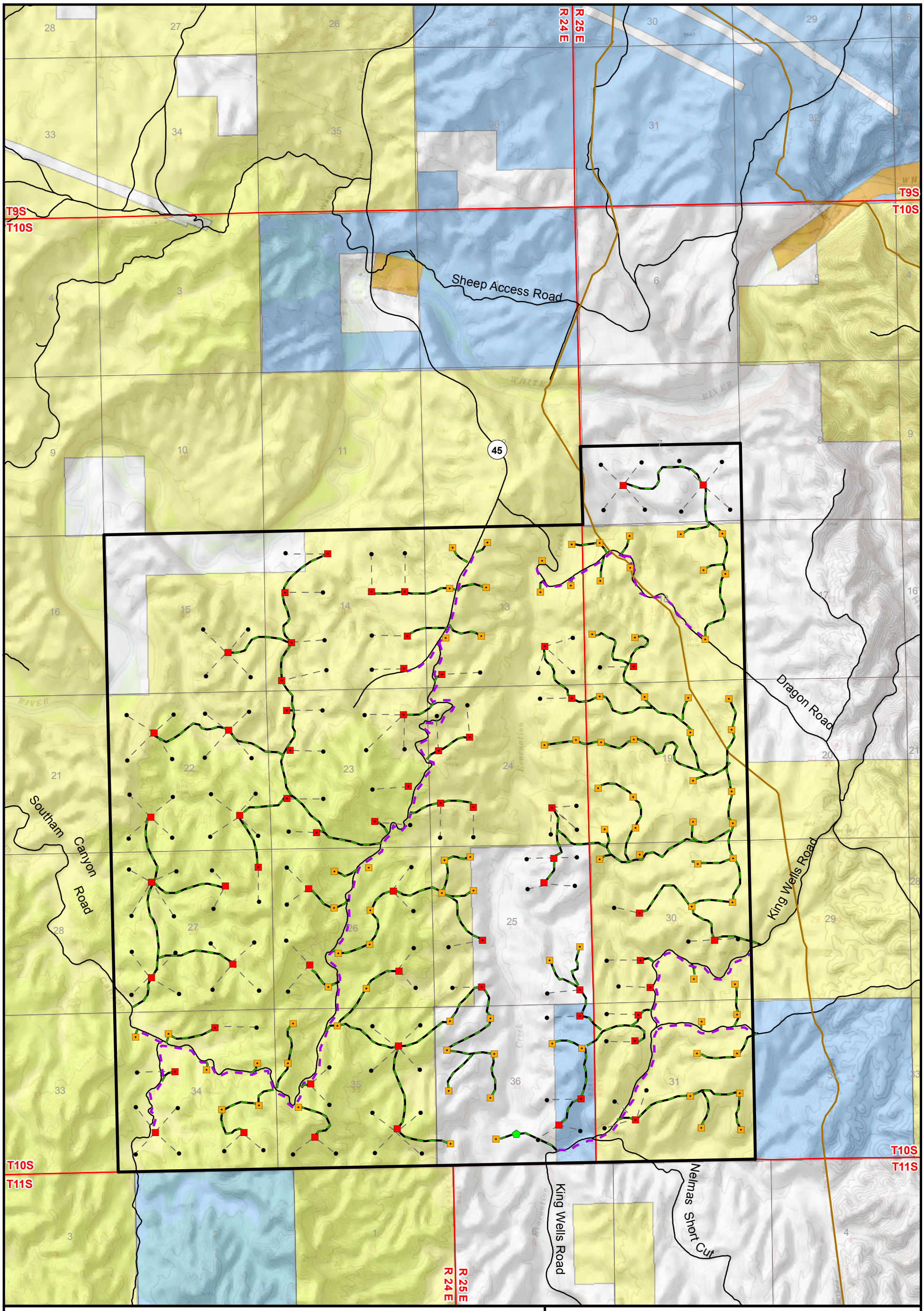
Uintah County, UT

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 1-1



Legend

- Project Area Boundary
- Proposed Vertical Well Pad
- Proposed Well Vertical & Directional Well Pad
- Proposed Well Pad for Directional Wells
- Bottomhole Location
- Compressor
- Directional Drilling Route
- Proposed Pipeline Along Existing Road
- Proposed Collocated Road and Pipeline
- Existing Pipeline
- Existing Road

Surface Ownership

- Federal
- Private
- State
- Tribal

0 0.5 1 2 Miles

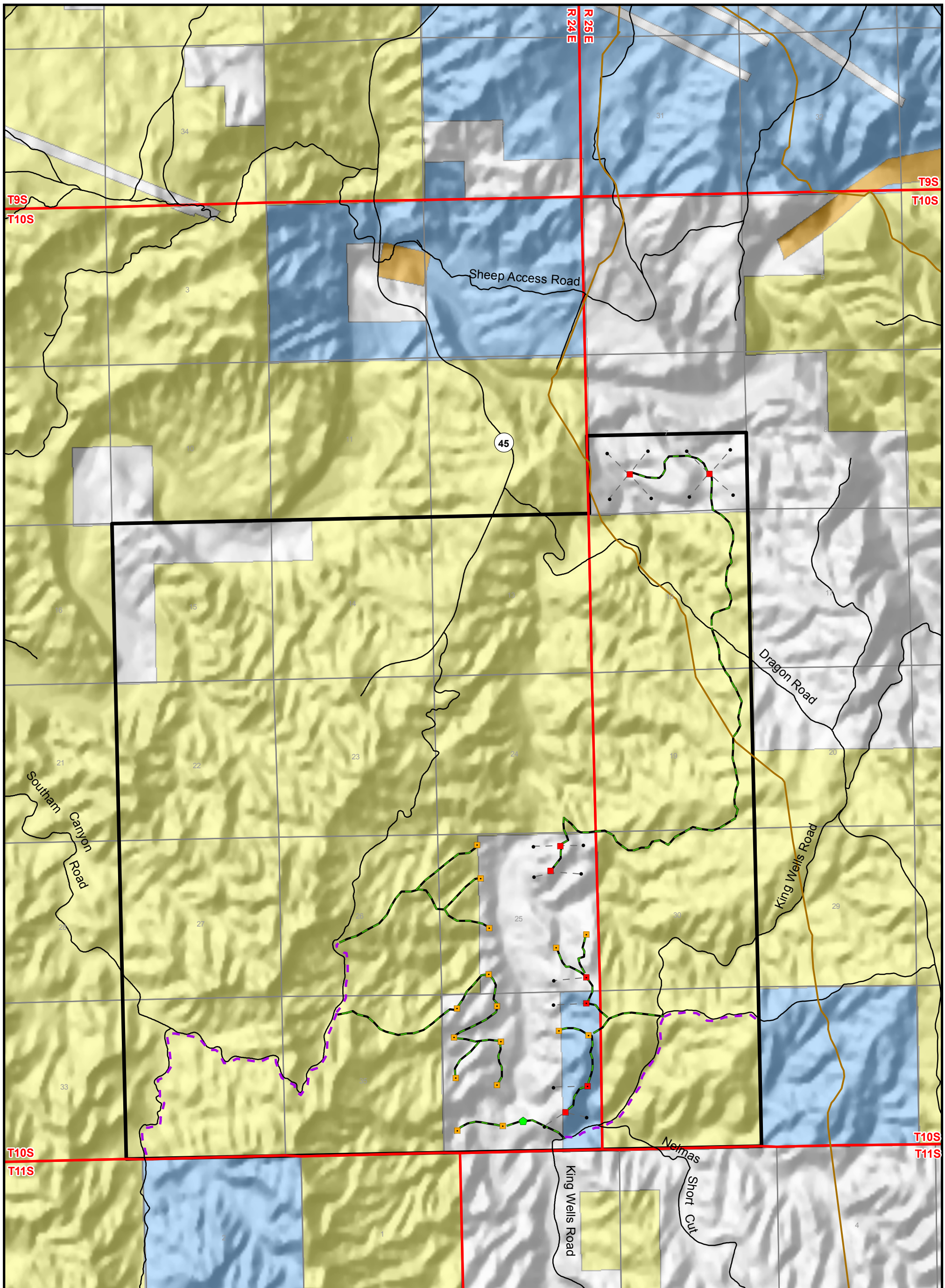
N S E W

Southam Canyon EA
Alternative A - Proposed Action

Enduring Resources, Inc.

Date: November 14, 2008 | Buys & Associates, Inc.

Figure 2-1



Legend

- Project Area Boundary
- Proposed Vertical Well Pad
- Proposed Well Vertical & Directional Well Pad
- Proposed Well Pad for Directional Wells
- Bottomhole Location
- Compressor
- Directional Drilling Route
- Proposed Pipeline Along Existing Road
- Proposed Collocated Road and Pipeline
- Existing Pipeline
- Existing Road

Surface Ownership

- Federal
- Private
- State
- Tribal

0 1 2 Miles

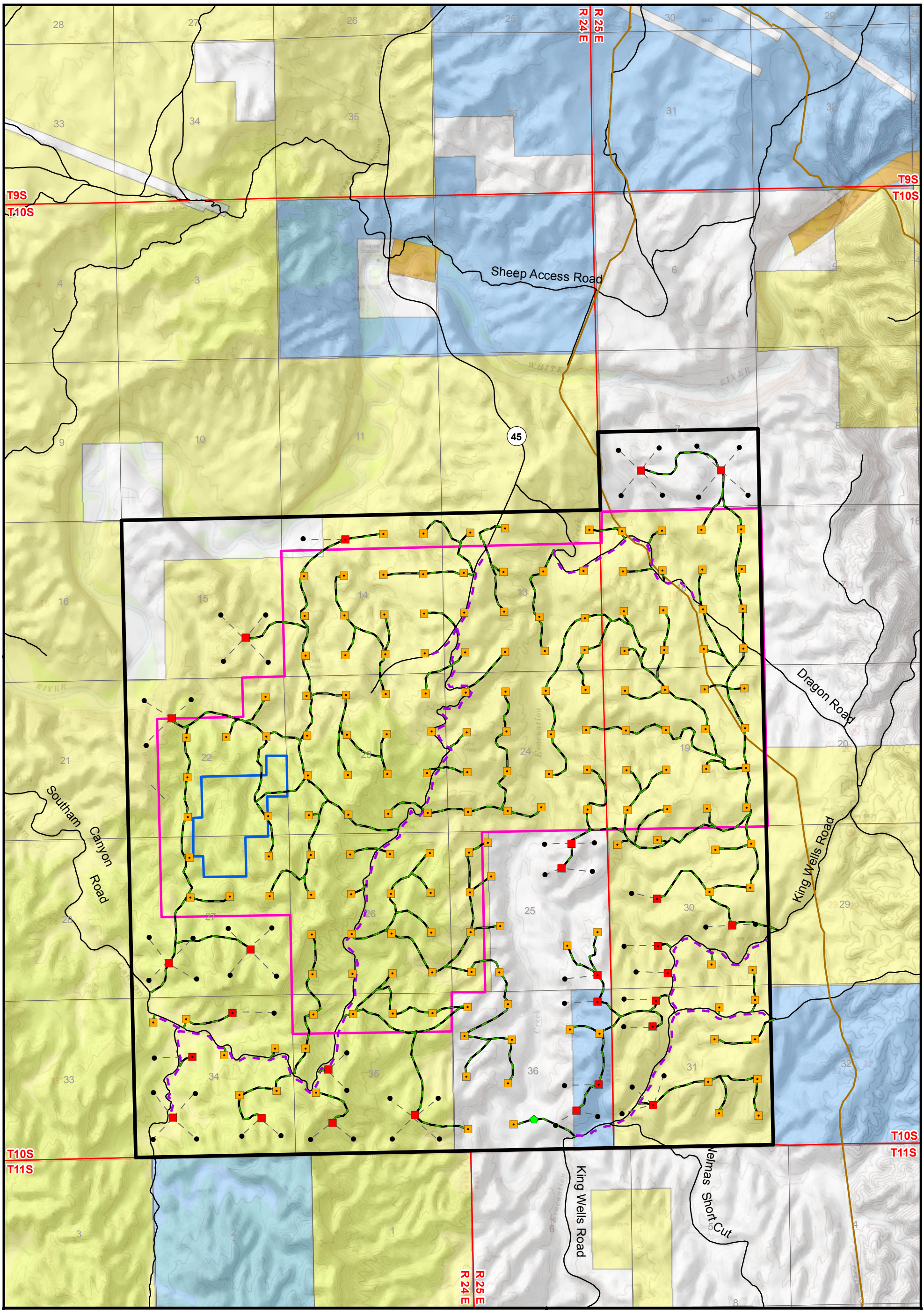
N W E S

Southam Canyon EA
Alternative B - No Action

Enduring Resources, Inc.

Date: November 14, 2008 | Buys & Associates, Inc.

Figure 2-2



Legend

- Project Area Boundary
- Proposed Vertical Well Pad
- Proposed Well Vertical & Directional Well Pad
- Proposed Well Pad for Directional Wells
- Bottomhole Location
- Compressor
- Directional Drilling Route
- Proposed Pipeline Along Existing Road
- Proposed Collocated Road and Pipeline
- Existing Pipeline
- Existing Road
- Oil Shale Research and Development Area
- OSEC Preferential Lease Area

0 0.5 1 2 Miles

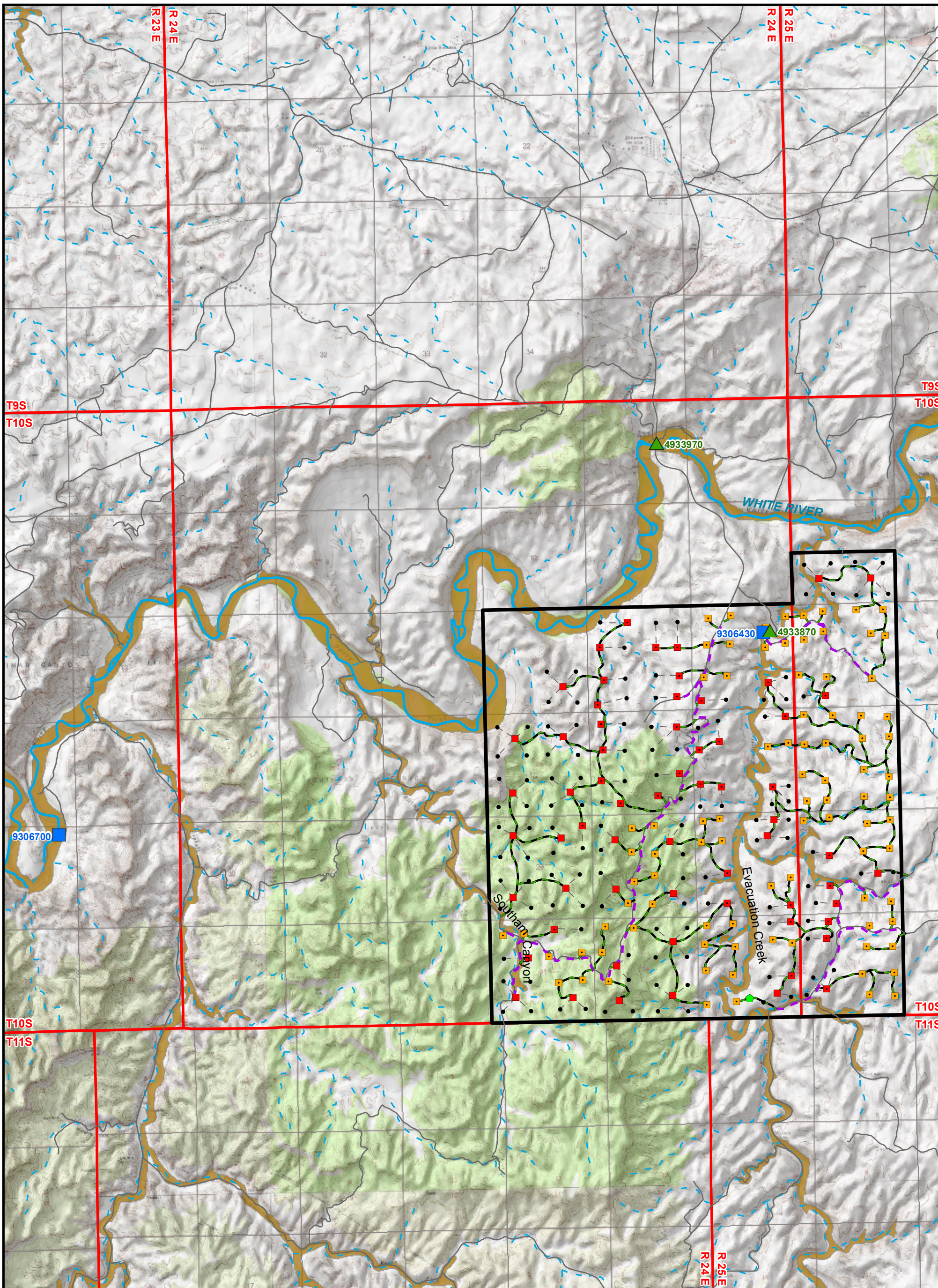
N W E S

Southam Canyon EA Alternative C - Vertical Drilling in the Potential Oil Shale Development Area

Enduring Resources, Inc.

Date: November 14, 2008 | Buys & Associates, Inc.

Figure 2-3



Legend

- Project Area Boundary
- Utah Water Quality Stations
- USGS Gauging Stations
- Existing Road
- Perennial River or Stream
- Intermittent River, Stream, or Wash
- 100-Year Floodplain

0 1 2 Miles

N W E S

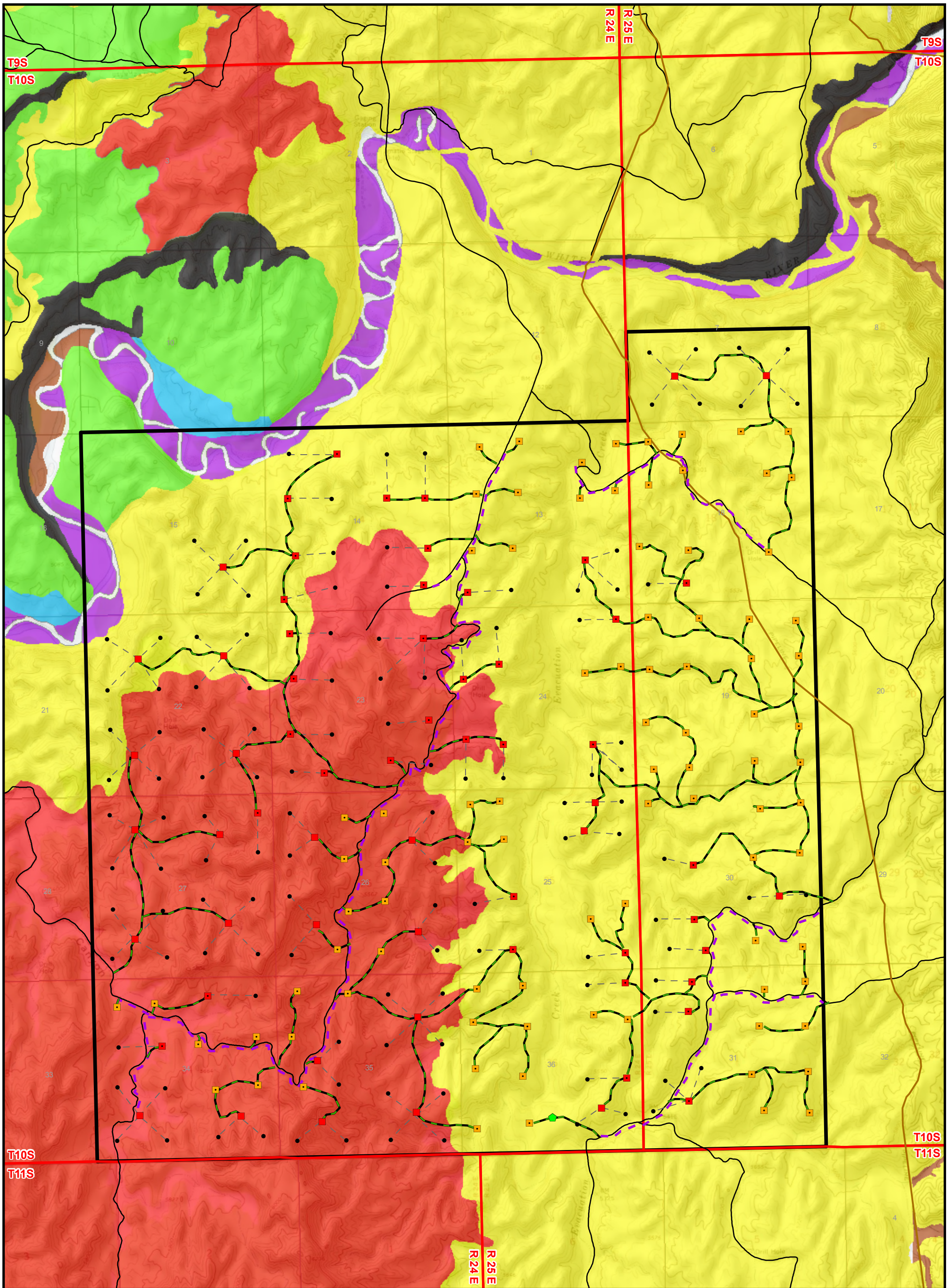
Southam Canyon EA Surface Water

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.6-1



Legend

Project Area Boundary

Vegetation Type

- Wyoming Big Sagebrush
- Black Sagebrush
- Pinyon Juniper
- Badland/Rock Outcrop
- Desert Shrub
- Greasewood
- Riparian

0 1 2 Miles

N W E S

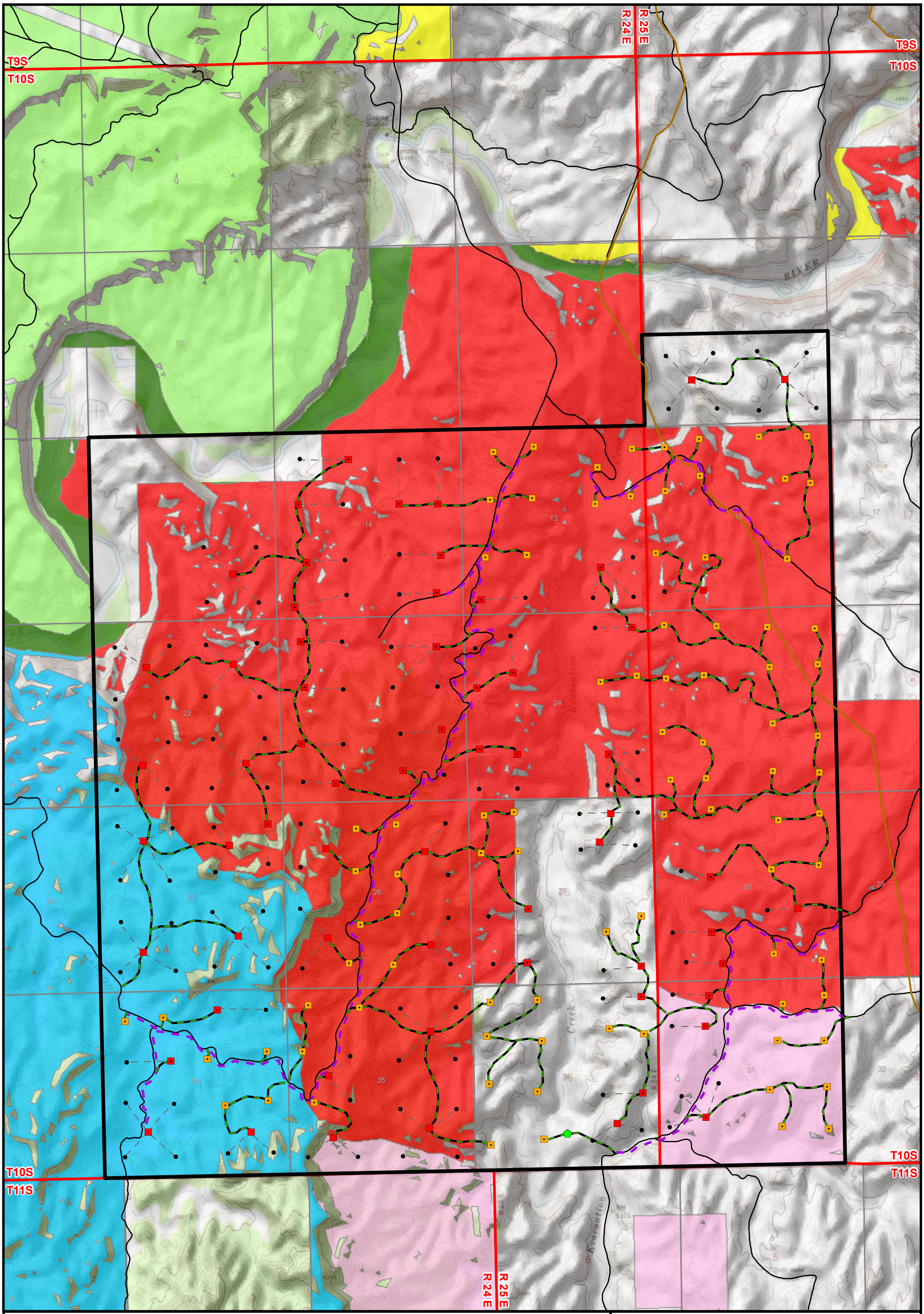
Southam Canyon EA Vegetation

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.7-1



Legend

- Stateline
- Little Emma
- Hells Hole
- White River Bottoms
- Southam Canyon
- Watson
- Southam Project Area

0 1 2 Miles

N W E S

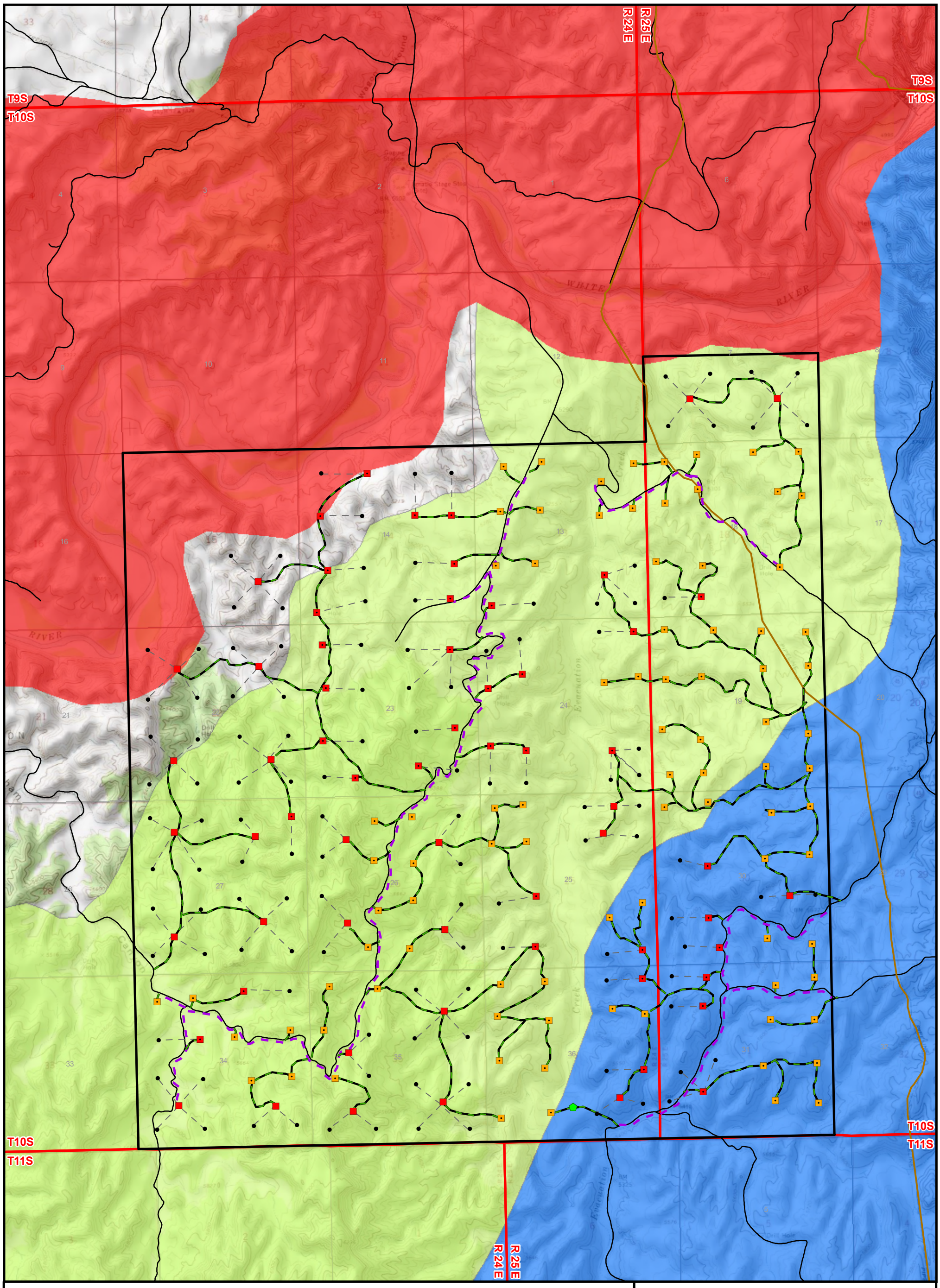
Southam Canyon EA Livestock Grazing

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.8-1



Legend

Project Area Boundary

Crucial Value, Year Long Range

Crucial Value, Winter Range

Substantial Value, Winter Range

0 1 2 Miles

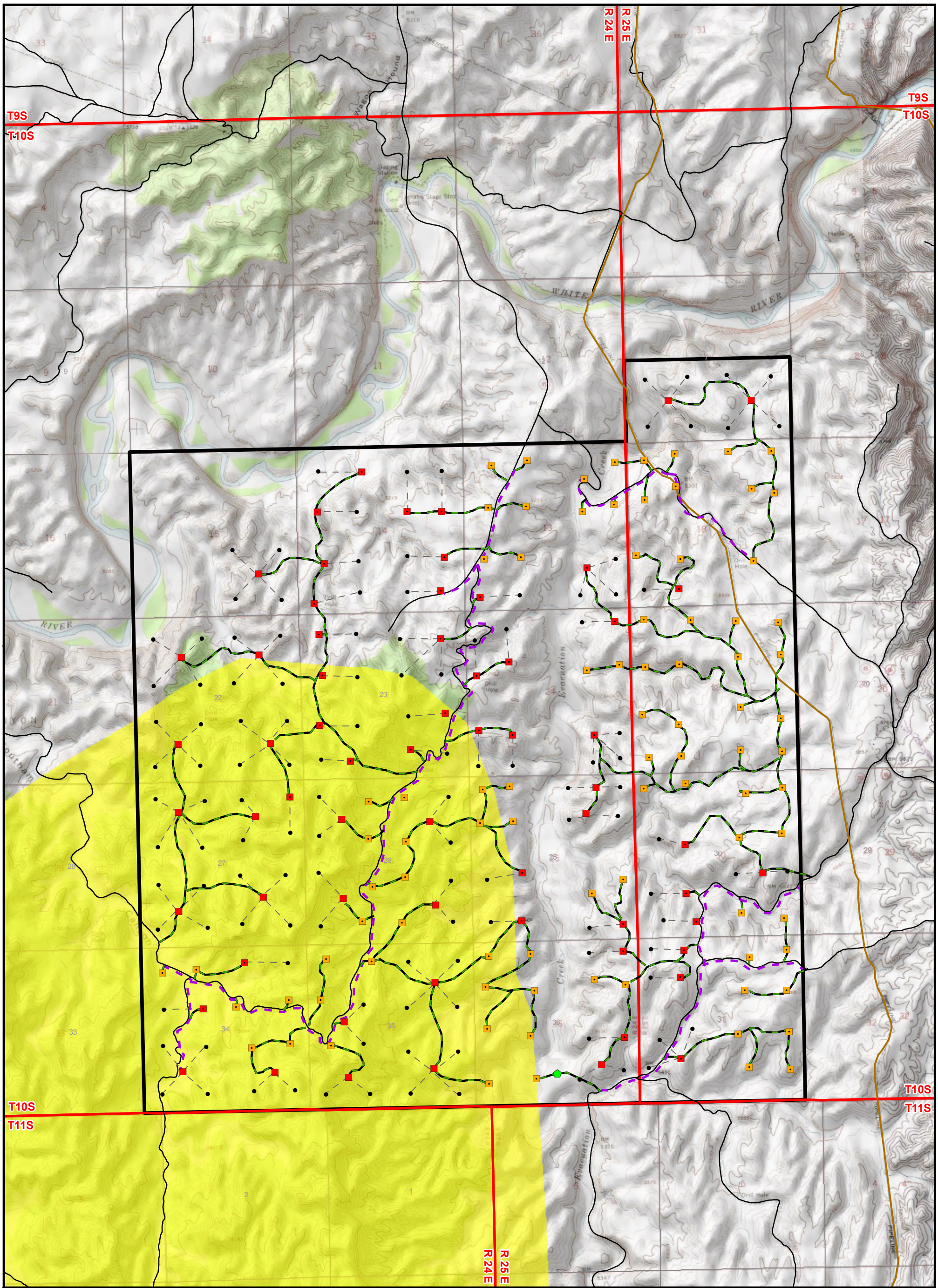
N W E S

Southam Canyon EA
Mule Deer Habitat

Enduring Resources, Inc.

Date: November 14, 2008 | Buys & Associates, Inc.

Figure 3.9-1



Legend

Project Area Boundary

Substantial Value, Winter Range

0 1 2 Miles

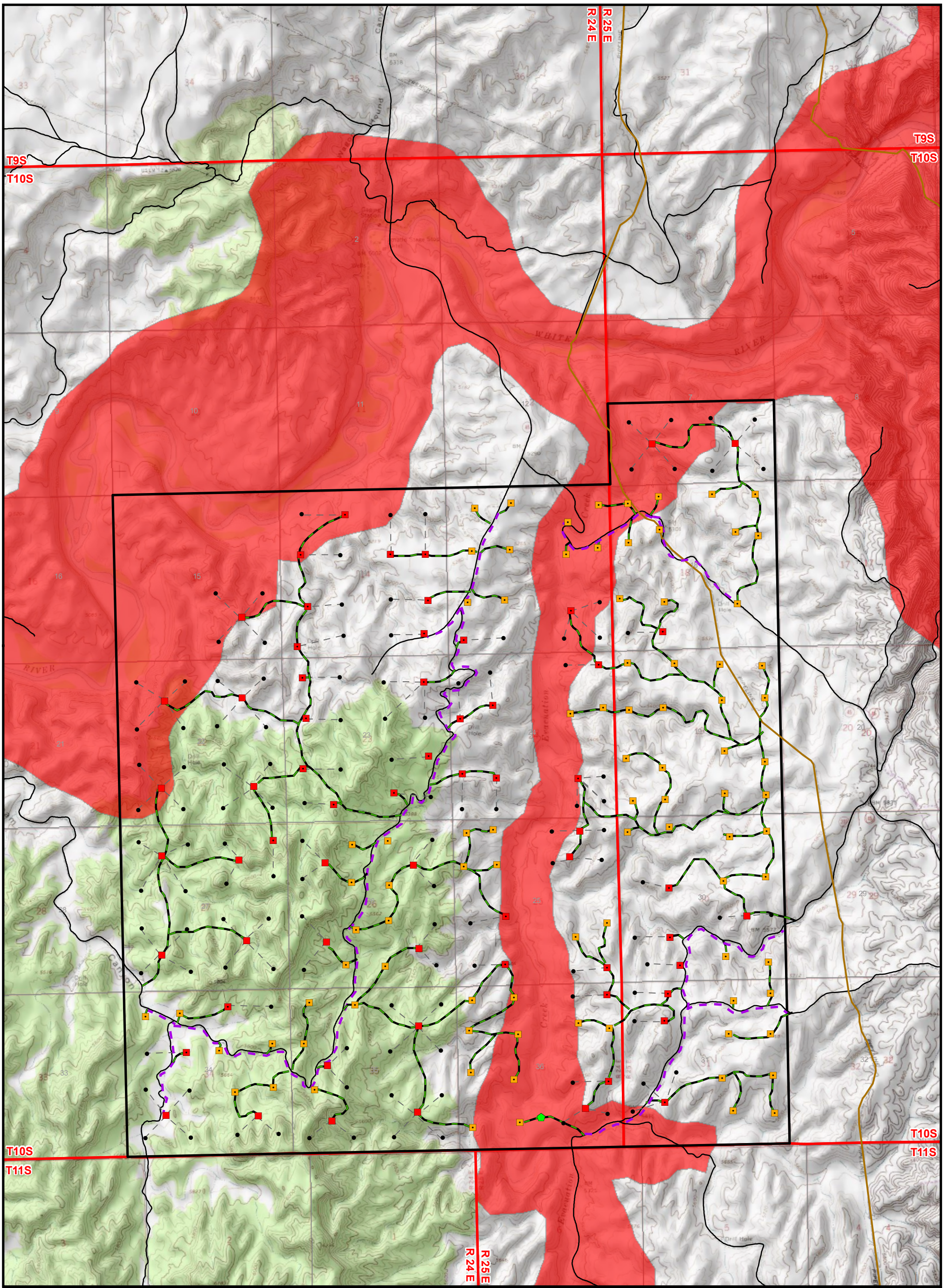
N W E S

Southam Canyon EA
Elk Habitat

Enduring Resources, Inc.

Date: November 14, 2008	Buys & Associates, Inc.

Figure 3.9-2



Legend

Project Area Boundary

Crucial Value, Year Long Range

0 0.9 1.8 Miles

N W E S

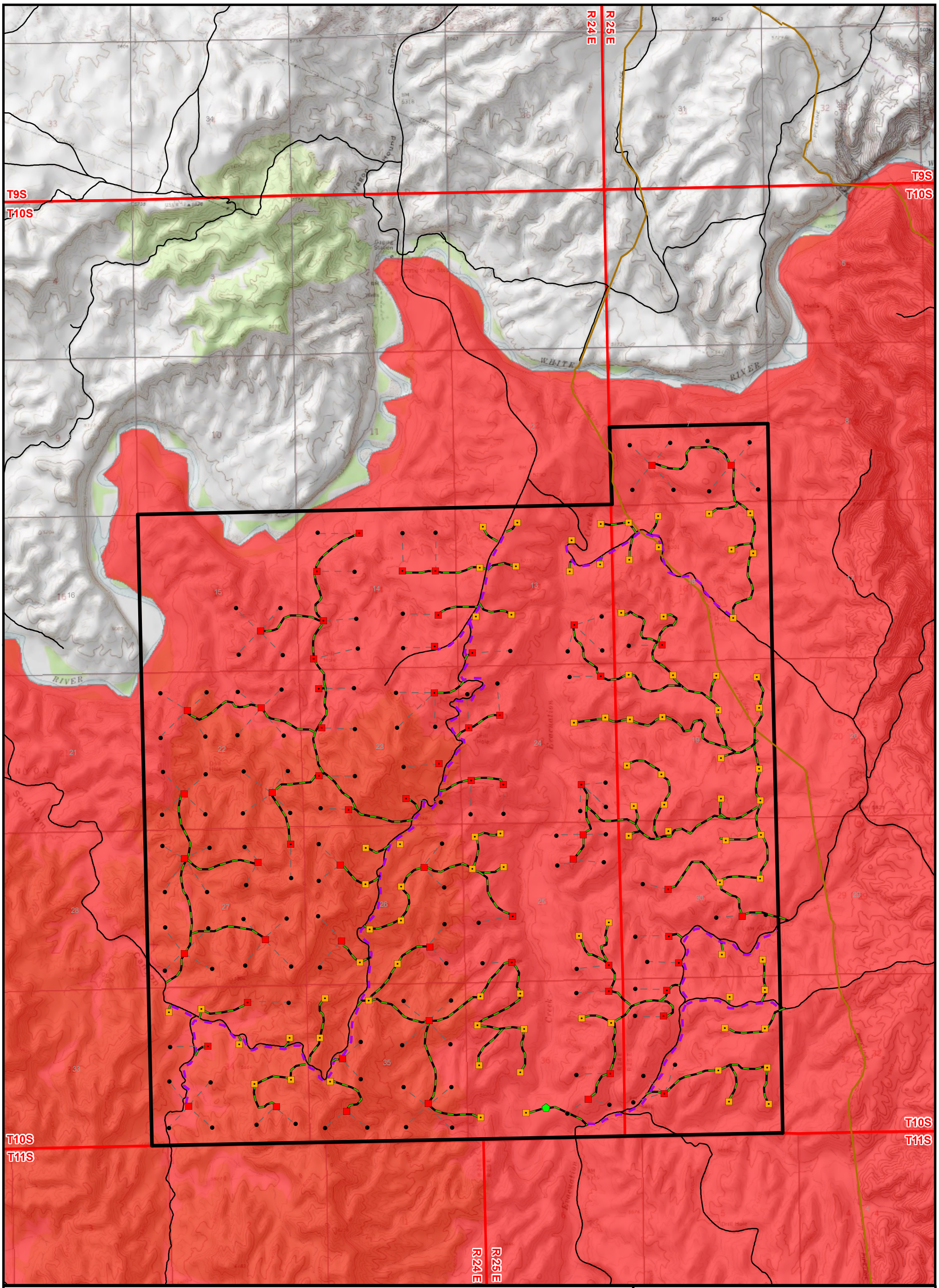
Southam Project Rocky Mountain Bighorn Sheep Habitat

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.9-3



Legend

Project Area Boundary

Crucial Value, Year Long Range

0 1 2 Miles

N W E S

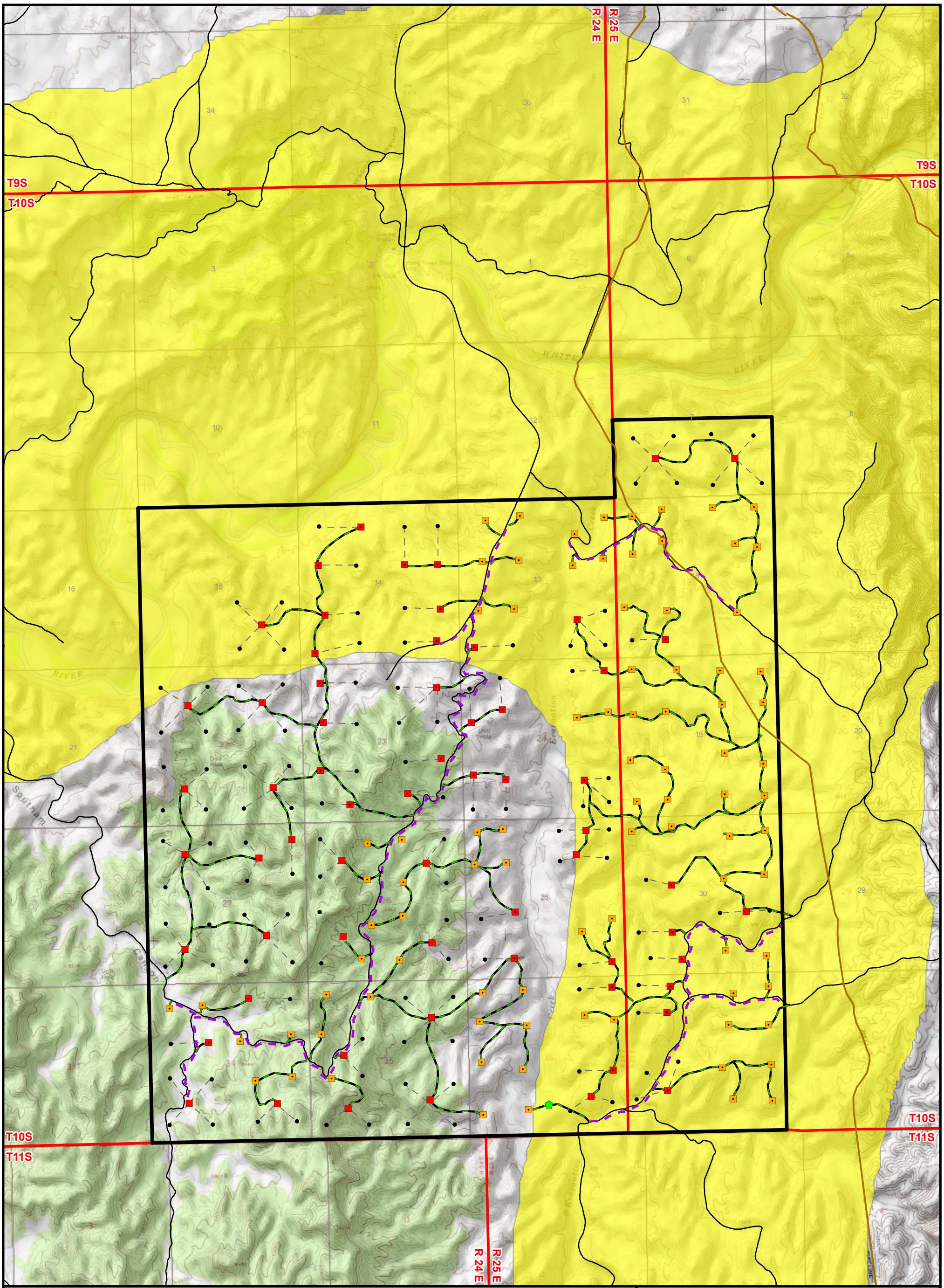
Southam Canyon EA American Bison Habitat

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.9-4



Legend

Southam Project Area

Substantial Value, Year Long Range

0 1 2 Miles

N W E S

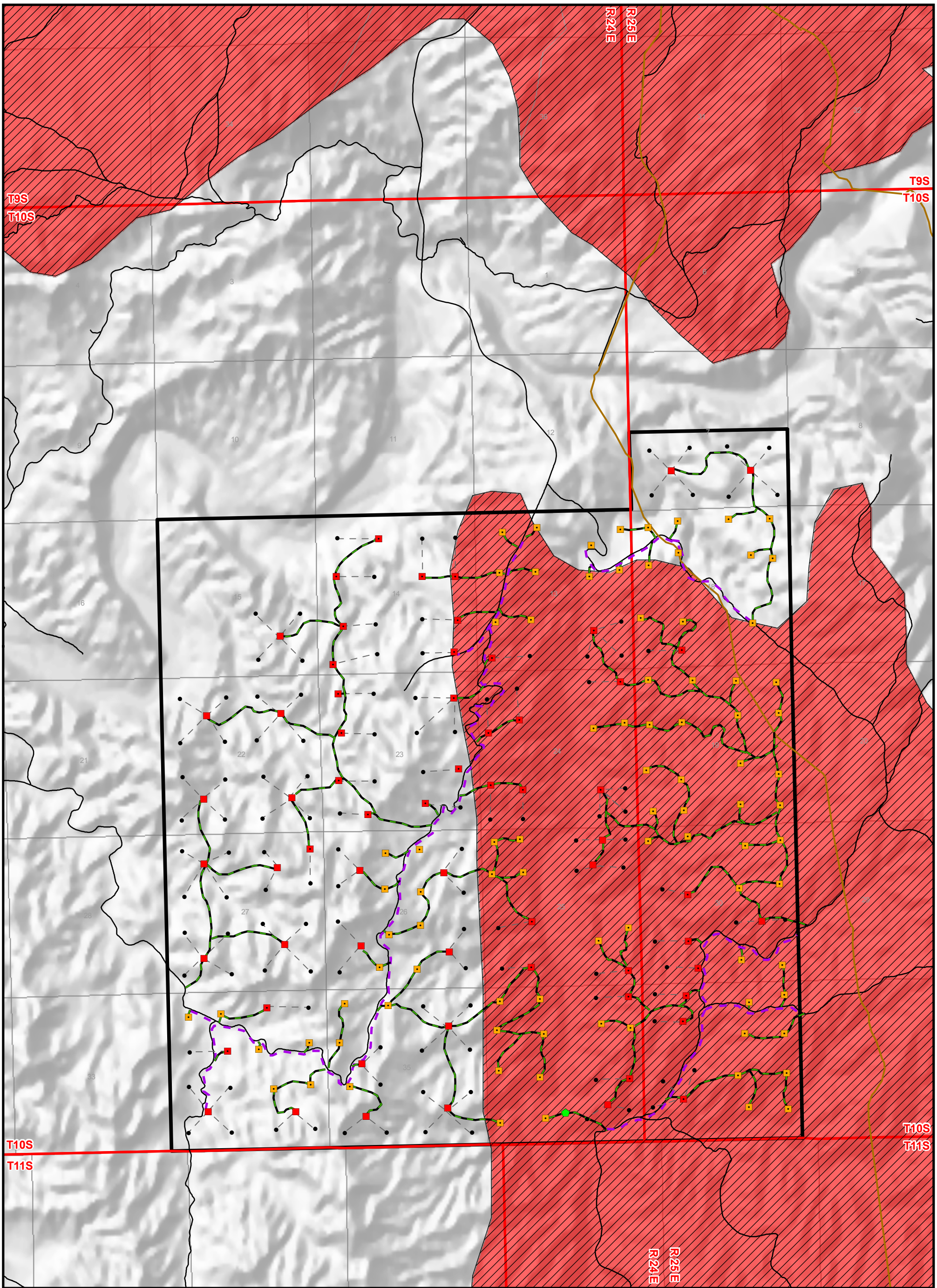
Southam Canyon EA Chukar Habitat

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.9-5



Legend

Project Area Boundary

Crucial Brooding Areas

Crucial Winter Habitat

0 1 2 Miles

N W E S

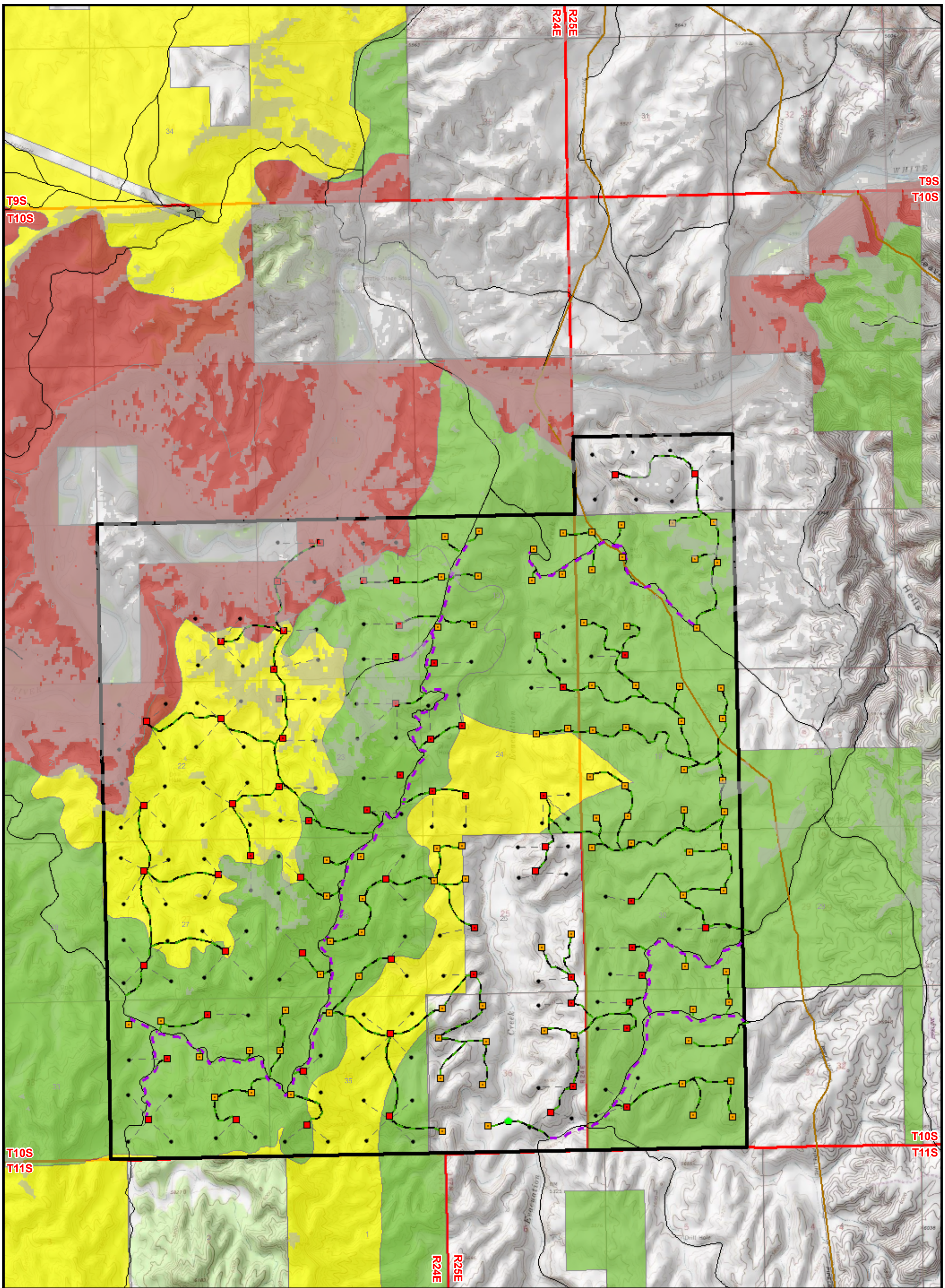
Southam Canyon EA Sage-grouse Winter Habitat and Brooding Areas

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.10-1



Legend

VRM Class

Project Area Boundary

Class 2

Class 3

Class 4

Areas Visible From The White River

0 1 2 Miles

N W E S

Southam Canyon EA VRM Classifications and Viewshed From the White River

Enduring Resources, Inc.

Date: November 14, 2008

Buys & Associates, Inc.

Figure 3.12-1