United States Department of the Interior
Bureau of Land Management
And,
United Stated Department of Agriculture
Forest Service

Environmental Assessment DOI-BLM-CO-S050-2015-0029-EA

Dual Operator Proposal: Development of 25 Federal Natural Gas Wells and Associated Infrastructure on 5 Multi-well Pads

Location: *Western Gunnison County, Colorado.*

June 2015

U.S. Department of the Interior
Bureau of Land Management
Southwest District

Uncompahgre Field Office
2465 South Townsend Avenue
Montrose, CO. 81401
Phone: (970) 240-5300

U.S. Department of Agriculture
Forest Service
Grand Mesa, Uncompahgre and Gunnison
National Forest
Paonia Ranger District
403 N. Rio Grande Ave., PO Box 1030
Paonia, CO. 81428
Phone: (970) 527-4131

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

TABLE OF CONTENTS

TABLE OF CONTENTS **3**

1 INTRODUCTION **6**

1.1 IDENTIFYING INFORMATION 6
1.2 BACKGROUND 6
1.3 PURPOSE AND NEED FOR ACTION 10
1.4 AUTHORITIES 12
1.5 DECISIONS TO BE MADE 12
1.6 CONFORMANCE WITH APPLICABLE LAND USE PLANS 13
1.7 SCOPING AND IDENTIFICATION OF ISSUES 15
1.7.1 Scoping and Public Involvement *15*
1.7.2 Issues *16*

2 PROPOSED ACTION AND ALTERNATIVE(S) **19**

2.1 INTRODUCTION 19
2.2 PROPOSED ACTION 19
2.2.1 Design Features of the Proposed Action *20*
2.2.2 Existing Infrastructure *25*
2.2.3 Project Construction *31*
2.2.4 Well Drilling, and Completion *43*
2.2.5 Water Use *44*
2.2.6 Transportation *51*
2.2.7 Handling of Waste Materials *54*
2.2.8 Production Facilities *58*
2.2.9 Operation and Maintenance *59*
2.2.10 Reclamation *60*
2.2.11 Workforce *61*
2.2.12 Schedule *62*
2.3 NO ACTION ALTERNATIVE 62
2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY 63

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES **64**

3.1 INTRODUCTION 64
3.1.1 Direct and Indirect Impacts Analysis *66*
3.1.2 Cumulative Impacts Analysis *67*
3.2 DIRECT AND INDIRECT IMPACTS ANALYSIS TO RESOURCES 77
3.2.1 Air Quality and Climate *77*
3.2.2 Cultural Resources *86*
3.2.3 Native American Religions Concerns *87*
3.2.4 Soils *88*
3.2.5 Vegetation Management *90*
3.2.6 Invasive, Non-Native Species *96*
3.2.7 Threatened, Endangered (ESA), Sensitive Species *97*
3.2.8 Migratory Birds *112*
3.2.9 Wildlife, Terrestrial *114*
3.2.10 Wildlife, Aquatic *120*
3.2.11 Riparian Zones and Wetlands *121*
3.2.12 Floodplains *122*
3.2.13 Hydrology (Surface Water Resources) *122*
3.2.14 Hydrology (Ground Water Resources) *127*

3.2.15 Wastes (Hazardous or Solid) ... 132
3.2.16 Socioeconomics ... 137
3.2.17 Access and Transportation ... 140
3.2.18 Realty Authorizations ... 143
3.2.19 Livestock Grazing/Rangeland Health ... 145
3.2.20 Noise ... 149
3.2.21 Recreation ... 154
3.2.22 Visual Resources Management ... 155
3.2.23 Geology and Mineral Resources ... 157
3.3 Cumulative Impacts by Resource ... 163

4 SUPPORTING INFORMATION ... 181

4.1 List of Preparers ... 181
4.2 Tribes, Individuals, Organizations, or Agencies Consulted ... 181
4.3 References ... 182

APPENDIX A. LEASE STIPULATIONS ... 190

APPENDIX B. OPERATOR STATED DESIGN FEATURES (FULL LISTING) ... 206

APPENDIX C. CONDITIONS OF APPROVAL ... 251

C.1. Resource (Resource COA applies to # consecutively) ... 251

APPENDIX D. FEDERAL AND STATE NOTIFICATION REQUIREMENTS ... 260

APPENDIX E. HAZARDOUS MATERIALS MANAGEMENT SUMMARY ... 265

E.1. SG Provided Chemical Listing ... 265
E.2. GE Provided Chemical Listing ... 267

APPENDIX F. NOXIOUS WEED LIST ... 270

APPENDIX G. SG TEMPORARY POLYPIPELINE OPERATIONS PLAN ... 275

G.1. General Installation and Operations of SG's Proposed Temporary Surface Poly Pipelines ... 275
SG Federal 11-90-9 Poly Pipeline Operation Plan ... 278
G.2. SG Federal Aspen Leaf Poly Pipeline Operation Plan ... 281

APPENDIX H. DETAILED CONSTRUCTION LAYOUTS AND DRAWINGS ... 284

H.1. SG Allen ... 285
H.2. SG 11-90-9 ... 288
H.3. SG Aspen Leaf ... 290
H.4. GE Henderson ... 291
H.5. GE Spadafora ... 293

APPENDIX I. AIR QUALITY NEAR FIELD IMPACTS MODELING ANALYSIS ... 295

Figure 1 - Location Map ... 9
Figure 2 - Existing Leases ... 11
Figure 3 - Existing SG Aspen Leaf Location and Infrastructure ... 26
Figure 4 - Existing Infrastructure ... 28
Figure 5 - Proposed SG Allen Multi-well Pad and Infrastructure ... 32
Figure 6 - Proposed SG 11-90-9 Multi-well Pad and Infrastructure ... 33
Figure 7 - Proposed GE Henderson Multi-well Pad and Infrastructure ... 34
Figure 8 - Proposed GE Spadafora Multi-well Pad and Infrastructure ... 35
Figure 9 - Buried and Surface Water Pipelines and Water Storage Facilities ... 42

Figure 10- CIAA Buffer Area (Watershed) 69
Figure 11– Deciview on Clearest Days 81
Figure 12 – Deciview on Haziest Days.....81
Figure 13- Range Improvements 147
Figure 14 - Geology 160
Figure 15- 2008 ozone DVC (top left), 2021 ozone DVF (top left) and 2021 – 2008 ozone DVF differences calculated using MATS for the CARMMS 2021 High Development Scenario. 166
Figure 16- Fourth highest daily maximum 8-hour ozone concentrations for the 2008 Base Case (top left), CARMMS 2021 High Development Scenario (top right), 2021 minus 2008 differences (bottom).2008 ozone DVC (top left), 2021 ozone DVF (top left) and 2021 – 2008 ozone DVF differences calculated using MATS for the CARMMS 2021 High Development Scenario. 167
Figure 17- Contribution to fourth highest daily maximum ozone concentrations due to emissions from Federal O&G within the UFO Planning Area for the CARMMS 2021 High Development Scenario. 168

1 INTRODUCTION

1.1 Identifying Information

Project Title: Dual Operator Proposal: Development of 25 Federal Natural Gas Wells and Associated Infrastructure on 5 Multi-well Pads.

Applicants/Operators:

- Gunnison Energy LLC. Contact: Brad Robinson, 1801 Broadway, Suite 1200, Denver, CO. 80202
- SG Interests I, Ltd. Contact: Catherine Dickert, 922 East 2nd Avenue, Durango, CO 81301

Legal Description (Operator/Location/Wells):

SG Interests I, Ltd.:
Single Existing Federal Well Pad (7 New Natural Gas Wells):

1. Township 11 South (T11S), Range 90 West (R90W), Section 15, SESW, 6th PM. "Aspen Leaf" well pad

Two Proposed Federal Well Pads (5 New Natural Gas Wells each (10 total)):

2. Township 11 South (T11S), Range 90 West (R90W), Section 9, SWNW, 6th PM. "11-90-9" well pad
3. Township 12 South (T12S), Range 90 West (R90W), Section 7, NENE, 6th PM. "Allen" well pad

Gunnison Energy LLC:
Single Proposed Federal Well Pad (4 New Natural Gas Wells):

4. Township 11 South (T11S), Range 90 West (R90W), Section 8, SWSW, 6th PM. "Henderson" well pad

Single Proposed FEE/FEE/Federal Well Pad (4 New Natural Gas Wells):

5. Township 11 South (T11S), Range 90 West (R90W), Section 20, NENW, 6th PM. "Spadafora" well pad

NEPA Log Number: DOI-BLM-CO-S050-2015-29 EA

Program/Lease/Casefile:
Program 3160/Lease: COC-66716; COC-08905; COC-13484; COC-13483; and COC-70004

Applicable Land Use Plan/Amendments: Uncompahgre Basin Resource Management Plan Record of Decision 1989, Grand Mesa Uncompahgre and Gunnison National Forests Amended Land and Resource Management Plan 1991.

1.2 Background

This proposed action is coordinated between the Grand Mesa, Uncompahgre and Gunnison National Forests (GMUG) Paonia Ranger District in Paonia, CO and the Bureau of Land Management's (BLM) Uncompahgre Field Office (UFO) in Montrose, CO. The agencies have prepared this environmental assessment (EA) to analyze and disclose the environmental effects to the surrounding physical and natural resources from constructing four new multi-well pads and associated new infrastructure, using one existing multi-well pad and infrastructure, approving up to twenty-five Applications for Permit to Drill (APDs), up to 17 individual APDs from each SG Interests I. Ltd., (SG) and up to eight Gunnison Energy LLC (GE) APDs and analyzing cumulative effects of drilling up to 25 total natural gas wells.

Roads used to access these five multi-well pads include CO State Highway 133 between the communities of Carbondale, CO and Paonia, CO, Gunnison County Road (CR) 265, National Forest System Road (NFSR) 265, NFSR 851, NFSR 851.1B, NFSR 849, NFSR 704 and NFSR 704.4A (Figure 1). These roads provide access to a variety of users for both public and private land access, big game

hunting, livestock grazing, outdoor recreation, historic coal exploration and mining, and natural gas exploration and development activities.

In order to facilitate natural gas well development, each of the proposals will require a variety of surface estates as defined below:

- NFS lands = USDA Federal Surface estate underlain by DOI Federal Subsurface Mineral Estate
- On lease = Federal or Private Surface and all subsurface Federal Mineral estate
- Split-estate = Private Surface and Federal Subsurface Mineral estate
- Fee/Fee = Private Surface and Private Subsurface Mineral estate
- Fee/Fee/Fed = Private Surface and Private Subsurface Estate at the surface hole location, however when directional/horizontal drilling takes place the bottom hole target of the well bore may end up in Federal Subsurface Mineral estate, therefore creating a Fee/Fee/Fed situation.

The entirety of one new multi-well pad (Allen), split-estate portions of a new pipeline and a new access road as proposed by SG in the Federal 12-90-7-1 APD is located within a 40 acre parcel of private land which was BLM managed public land prior to a 1997 land exchange when the surface became private property. The mineral rights were retained by the United States pursuant to Section 206 of FLPMA of October 21, 1976, as amended (43 U.S.C. 1701, 1716). On August 1, 2003, as a result of being included in the Federal fluid minerals lease sale process, the Federal mineral estate of this private parcel became lease parcel COC-66716. Additional pipeline construction and entrance of new access road is located upon NFS lands within the Grand Mesa, Uncompahgre, and GUMG (Figure 5).

Construction of a new multi-well pad, new access road and new pipeline related to the SG Federal 11-90-9-3 APD is located entirely upon NFS lands within the GMUG (Figure 6).

The SG 11-90-15-2 APD is proposed as an additional well located on the original SG 11-90-15-1 well pad. This multi-well pad was constructed in 2008 and includes all necessary infrastructure including an access road and natural gas production pipeline (Figure 3).

Construction of a new multi-well pad, new access road, portions of new co-located pipelines, and a short stretch of road reconstruction related to the GE Federal 11-90-8-H3 APD is located on NFS lands within the GMUG. Additional construction of new co-located pipelines and reconstruction of an access road also occurs on Fee/Fee lands (Figure 7).

The GE multi-well pad (Spadafora), new access road and construction of a short co-located gas and water pipeline is related to both the Fee/Fee/Federal 11-90-20-21 H1 APD and Fee/Fee/Federal 11-90-20-21 H2 APD. Disturbance associated with these two APDs is located entirely on private surface (Fee) overlying private mineral estate (Fee). However both APD proposals are for development of horizontal well bores in which both Fee mineral estate and adjacent Federal mineral estate (Lease COC-70004) will be produced from a single well bore (Figure 8).

Both GE and SG have constructed special facilities from which recycled water may be transferred in order to accomplish portions of the drilling and the majority of the completion phases of natural gas well development (Figure 4). Currently, GE has in place the Hotchkiss Water Storage Facility (HWSF) located on private lands approximately 10 miles from the project area. The project area is already plumbed to the HWSF via an underground buried waterline co-located with GE's Hotchkiss gas gathering system which transfers into the GE Sheep gas gathering system which also includes a co-located buried water line. GE is also in the final stages of permit approvals to construct and operate a new water storage facility in the very near vicinity of the proposed action. This water storage facility will be on private property (Spadafora Water Storage Facility (SWSF)). This facility will be an in-line storage point accepting transfer of large volumes of recycled water between the HWSF from any GE well developments in the vicinity. In the near term, GE does not anticipate having the SWSF available for use in drilling the first few wells of this proposed action. However within 2-3 years the facility will likely be constructed and operational.

SG has constructed and operates the McIntyre flowback pits 3 and 4 water storage facility, located on private land approximately 5 miles from the project area for water storage, use and recapture of water used in drilling and completion of SG natural gas wells. However, SG will typically connect the water storage to each of their developments via temporary above-ground poly pipelines placed cross country, and/or along existing roads for the duration of development in terms of both deliveries to and from the drill

sites. SG also has approved plans to construct the McIntyre flowback pits 1 and 2 nearby the existing McIntyre 3 and 4 flowback pits on private land which may also be used to accept flowback/recycled water.

Both of the operators may also elect to unitize their leaseholds should they determine that operating a certain group of Federal leases in an area would be more appropriate under a Federal unit agreement. GE has been working to execute a unit agreement, the Sheep Park II (COC-77109X) Unit, which includes GE's leases and developments related to this proposed action. SG has also identified an area between the existing Bull Mountain Unit (COC-67120X) and the proposed GE Sheep Park II Unit with the State of Colorado and obtained a logical unit spacing order which includes a portion of the development related to this proposed action.

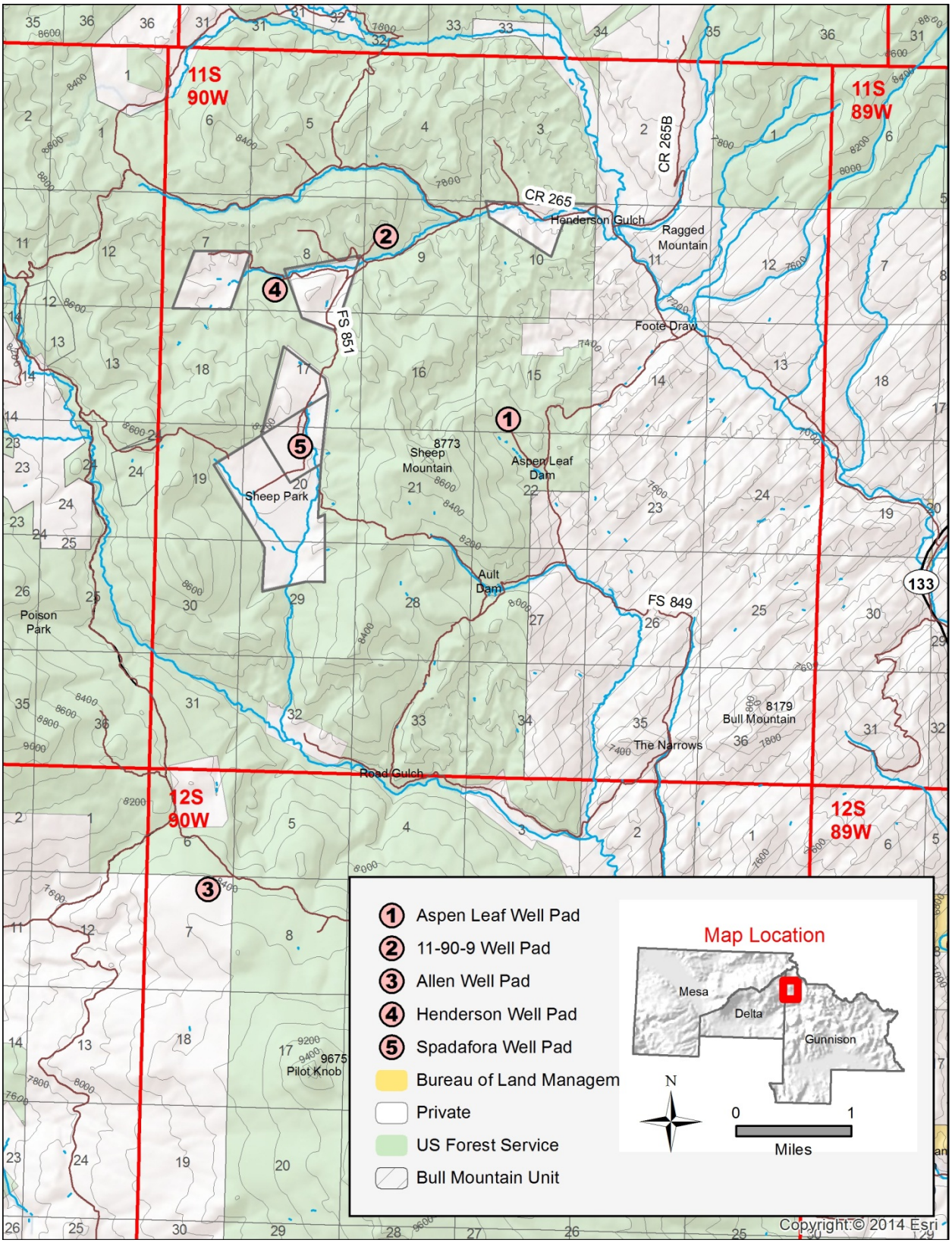


Figure 1 - Location Map

1.3 Purpose and Need for Action

The purpose of the action is to provide SG and GE the opportunity to develop oil and gas resources consistent with their Federal oil and gas leases. The purpose of the agencies' actions is to facilitate production of energy resources and allow GE and SG to exercise lease rights and perform operations consisting of preparing drill sites and access roads, drilling the wells, and completing the wells for production. The BLM UFO is responding to the needs of GE and SG to drill and complete up to 25 wells co-located on 5 pads for exploration and production of Federal mineral estate subject to Federal oil and gas leases (Figure 2) COC-08905, COC-13484, COC-42314, COC-13483 and COC-66716 through the consideration of APDs submitted by the operators. The GMUG will respond to the needs of GE and SG to use National Forest System (NFS) lands subject to Federal oil and gas leases through consideration of Surface Use Plan of Operations (SUPOs) for operations associated with developing and producing oil and gas on the GMUG and consider granting off-lease access across NFS lands which may lead to development of federal leases on private property adjacent to NFS lands.

The need for the action is established by the BLM's and FS's respective responsibilities under the Mineral Leasing Act of 1920 (MLA), as amended [30 USC 181 et seq.], the Mining and Minerals Policy Act of 1970, National Environmental Policy Act of 1969, the Onshore Oil and Gas Leasing Reform Act of 1987 (BLM regulations at 43 CFR 3164), the Energy Policy Act of 2005 and guidance and standards set forth in the Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development (commonly referred to as The Gold Book).

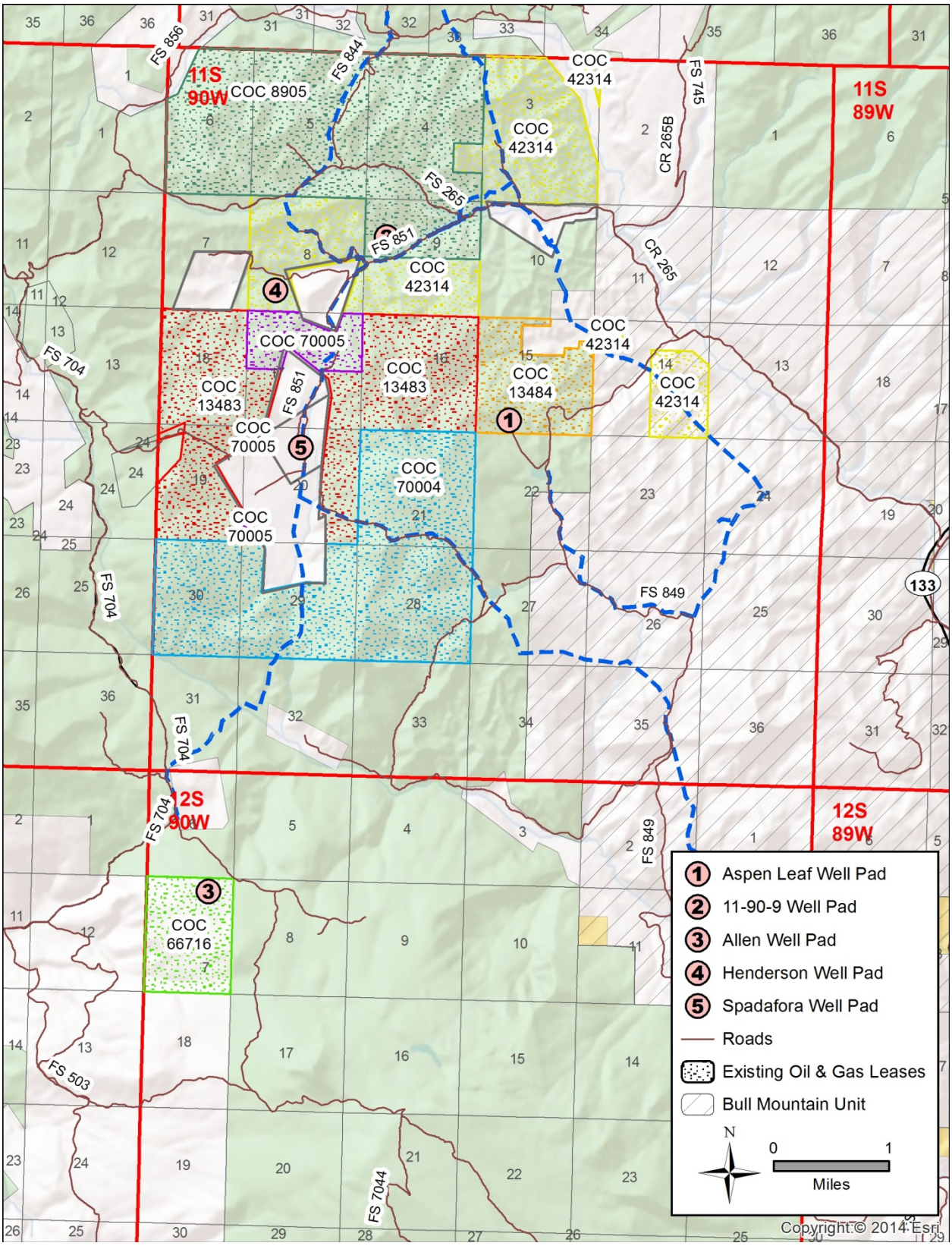


Figure 2 - Existing Leases

1.4 Authorities

The MLA authorizes the BLM to issue oil and gas leases for the exploration of oil and gas and permit the development of these leases through issuance of Applications for Permit to Drill (APDs) to develop Federal mineral estate.

It is the policy of the BLM to make mineral resources available for disposal and to encourage development of mineral resources to meet national, regional, and local needs while protecting other natural resources. The existing leases are binding legal contracts that allow for development of the mineral resource by the lessee.

The Federal Land Policy Management Act (FLPMA) (36 CFR 251 and 43 CFR 2880) allows for use of public land for rights-of-way for oil and gas infrastructure, with appropriate consideration of other public resources.

Regulations governing oil and gas leasing operations on NFS lands are cited in 36 CFR 228 § E. These regulations promote cooperation between the Forest Service (FS), BLM, industry and the public. EO 13212 (May 18, 2001) provides for expeditious review of permits and other actions to increase the supply of natural gas while maintaining safety, public health, and environmental protections. Regulations related to FS consideration of requests to modify, waive or grant exceptions to lease stipulations are cited in 36 CFR 228.104, and are also contained in BLM regulations in 43 CFR 3100. The FS considers mineral exploration and development to be a part of its management program (GMUG Amended Forest Plan, Page II-61). It cooperates with the DOI, through its agent, the BLM, in administering lawful development of leasable minerals.

FS policy (Forest Service Manual 2800 Zero Code – WO Amendment 2800-91-1 Page 3): encourages and facilitates the orderly exploration, development, and production of mineral and energy resources within the NFS in order to maintain a viable, healthy minerals industry and to promote self-sufficiency in those mineral and energy resources necessary for economic growth and national defense; ensures that exploration, development and production of mineral resources are conducted in an environmentally sound manner; and ensures that lands disturbed by mineral and energy activities are reclaimed for other productive uses.

Oil and gas operations in Colorado are also regulated by the Colorado Oil and Gas Conservation Commission (COGCC). The BLM and the COGCC have an MOU in place which encourages both agencies to provide oil and gas lessees/operators with consistent policy and procedures (including statewide oil and gas orders) on Federal/Indian lands.

1.5 Decisions to be Made

Based on the analysis contained in this EA, the BLM, in coordination with the FS regarding any FS SUPOs and Special Use Authorizations (SUAs) requiring a FS decision and/or Road Use Permits (RUPs), and any reasonable requests of split-estate landowners or Fee/Fee landowners, will decide whether or not to approve or deny up to six or more APDs and if so, under what terms and conditions. The decision will also approve additional development on an existing well pad (Aspen Leaf), construction of four new multi-well pads (11-90-9, Allen, Henderson, and Spadafora) and associated gas gathering lines, subsurface water lines, temporary surface poly pipelines and up to 25 total gas wells which may be drilled in the future (within the next 5 years). Under the National Environmental Policy Act (NEPA, Public Law 91-90, 42 USC 4321 et seq.), the BLM and FS must determine if there are any significant environmental impacts associated with the proposed action warranting further analysis in an Environmental Impact Statement (EIS). After obtaining notification from the GMUG Forest Supervisor on whether or not the FS will authorize the SUPO component of the Federal 11-90-9-3 APD, the Federal 11-90-15-2 APD and the Federal 11-90-8-H3 APD along with any SUAs for pipelines or new disturbance for any access built on NFS lands associated with any of the six APDs, the BLM Field Office Manager, who is the responsible official to approve or deny APDs, will decide one or more of the following:

- To approve up to six APDs, additional drilling on an existing well pad, four new multi-well pads with design features as submitted by the operators and concur with any accompanying FS approved SUAs (pipelines) and/or RUPs;

- To approve up to six APDs, additional drilling on an existing well pad, four multi-well pads with design features as submitted by the operators with modifications including any additional mitigation measures, and concur with any accompanying FS approved SUAs (pipelines) and/or RUPs;
- If consistent with the design features and analysis of this EA, additional APDs (up to 19) may be considered for approval at the time of the decision.
- To reach a determination of a Finding of No Significant Impact (FONSI) or not, which would lead to deferral of APDs until an EIS is completed;
- To deny: one or all of the APDs, additional drilling on the one existing well pad, or construction of up to three of the four new multi-well pads.

Any additional resource protection measures identified by either agency as a result of this environmental analysis will be added as Conditions of Approval (COA) to the individual APDs. A list of operator-committed design features as identified in the APD SUPOs submitted for this proposed action (Appendix B), and any additional agency COAs related to the decision in this environmental analysis are included in Appendix C.

1.6 Conformance with Applicable Land Use Plans

The proposed action is subject to and is in conformance with the following land use plans and applicable oil and gas lease stipulations:

Land Use Plan: Uncompahgre Basin RMP Record of Decision

Date Approved: July 1989

Decision Number: Management Unit 16, page 28

Decision Language: "Federal oil and gas estate will be open to leasing with lease terms".

Discussion: Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this site-specific environmental assessment (EA) tiers to and incorporates by reference the information and analysis contained in the Uncompahgre Basin Resource Area Proposed Resource Management Plan/Final Environmental Impact Statement (BLM, 1989). The PRMP/FEIS, approved RMP, and Record of Decision (ROD) are available for review at the BLM Uncompahgre Field Office, 2465 South Townsend Ave, Montrose, CO, or electronically at:

http://www.blm.gov/co/st/en/fo/ufo/uncompahgre_rmp/ufo_rmps___amendments.html

Consistent with lease terms and conditions, the following stipulations were applied to the proposed action related to Lease COC-66717, (the 12-90-7-1 APD, Allen well pad) as part of the review process and will be applied as COAs to the APD:

- Exhibit CO-34: Endangered Species Act Section 7 Consultation Stipulation. The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove a proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 U.S.C. § 1531 et seq., including completion of any required procedure for conference or consultation.

In addition to conformance with applicable BLM Land Use Plan, portions of the proposed action requiring use of NFS lands are in conformance with:

Land Use Plan: Grand Mesa, Uncompahgre and Gunnison National Forests: Amended Land and Resource Management Plan

Date Approved: September 1991

Management Areas:

> 2A – Semi-primitive motorized recreation opportunities in a natural appearing environment. Range management will reduce conflicts between recreation and livestock. Vegetation treatment will enhance plant and animal diversity.
>
> 6B – Livestock grazing. Rangeland will be maintained at or above a satisfactory condition. Semi-primitive non-motorized, semi-primitive motorized and roaded natural recreation opportunities will be provided. Vegetation treatment will enhance plant and animal diversity.
>
> 9A – Riparian area management.

The proposed action would conform to the overall guidance of the GMUG LRMP, the GMUG Oil and Gas Leasing EIS, and the BLM UBRA RMP.

<u>The following general direction applies to applicable activities on NFS lands.</u>

Special Use Management (Non-Recreational): P. III-71

- 01 – Act on special use applications according to the following priorities: (b.) Land and land use activities contributing to increased economic activity associated with National Forest resources, e.g., oil and gas, and energy minerals. (c.) Land and land use activities that benefit only private users, e.g., road permits, rights-of-ways for powerlines, telephones, waterlines, etc.

Transportation System Management: P. III-76-81.

- 03 – Close all newly constructed roads to public motorized use unless documented analysis shows: (a.) Use does not adversely impact other resources; (b.) use is compatible with ROS class; (c.) They are located in areas open to motorized use; (d.) The provide user safety;(e.) They serve an identified public need; (f.) The area accessed can be adequately managed; or (g.) Financing is available, or can be arranged, for maintenance.
- 04 – Manage public motorized use on roads and trails to maintain or enhance effective habitat for elk.
- 05 – Manage road use by seasonal closure if: (a.) Use causes unacceptable damage to soil and water resources due to weather or seasonal conditions; (b.) Use conflicts with the ROS class established for the area; (c.) Use causes unacceptable wildlife conflict or habitat degradation; (d.) Use results in unsafe conditions due to weather conditions; (e.) They serve a seasonal public or administration need; (f.) Area accessed has seasonal need for protection or nonuse.
- 06 – Keep existing roads open to public motorized use unless: (a.) Financing is not available to maintain the facility or manage the associated use of adjacent lands; (b.) Use causes unacceptable damage to soil and water resources; (c.) Use conflicts with ROS class established for the area; (d.) They are located in areas closed to motorized use and are not “designated routes” in the Forest travel management direction; (e.) Use results in unsafe conditions unrelated to weather conditions; (f.) There is little or no public need for them; (g.) Use conflicts with wildlife management objectives.
- 07 – Closed or restricted roads may be used for and to accomplish administrative purposes when: (a.) Prescribed in management area direction statements; (b.) Authorized by the Forest Supervisor; and (c.) In case of emergency.
- 08- All existing roads not needed for multi-resource management will be obliterated at the earliest opportunity. Reduce existing open road mileage in project areas whenever possible.

Arterial and Collector Road Construction and Reconstruction.

- 01 – Construct and reconstruct arterial and collector roads to meet multiple resource needs.

Local Road Construction and Reconstruction.

- 01 – Construct and reconstruct local roads to provide access for specific resource activities such as campground, trailheads, timber sales, range allotments, mineral leases, etc., with the minimum amount of earthwork.
- 02- (1) Construct temporary roads for specific resource activities such as timber sales, emergencies, (e.g. fire suppression), or mineral exploration. Roads needed beyond the timber sale or minerals exploration activity shall be specified roads (i.e., not temporary). (2) Temporary roads shall not be designated as Forest development transportation facilities and shall not be recorded in the transportation inventory system. (3) Forest Road and Trail funds shall not be used for temporary road construction and/or rehabilitation. (4) All temporary roads shall be obliterated as defined by the Forest Plan Glossary. Ninety percent of the obliterated temporary road mileage will not have sustained use three years after obliteration.

Road Maintenance

- Maintain all roads to the following minimum requirements: (a.) All paved roads – Level 5; (b.) All arterial and open collectors – Level 3; (c.) All open local roads – Level 2; and (d.) All closed roads – Level 1.
- 02 – Maintain structures, bridges, cattleguards, etc., to be structurally sound and safe for use.

This site-specific EA also tiers to and incorporates by reference the information and analysis contained in the 1991 Grand Mesa, Uncompahgre and Gunnison National Forests Amended LRMP. These documents are available for review at the US Forest Service Paonia Ranger District, 403 N. Rio Grande Ave, Paonia, CO, or electronically at:

http://www.fs.usda.gov/detail/gmug/landmanagement/planning/?cid=fsbdev7_003229

This EA addresses the resources and impacts on a site-specific basis as required by the National Environmental Policy Act (NEPA). The APDs have been reviewed and all applicable resource protection measures required by the BLM and FS RMPs have been analyzed and included as part of the proposed action and would be applied as COAs to the permit.

1.7 Scoping and Identification of Issues

1.7.1 *Scoping and Public Involvement*

NEPA regulations (40 CFR §1500-1508) require that the BLM and FS use a scoping process to identify potential significant issues in preparation for impact analysis. The principal goals of scoping are to identify issues, concerns, and potential impacts that require detailed analysis. Scoping is both an internal and external process.

The BLM publishes a NEPA log for public inspection. This log contains a list of proposed and approved actions within the BLM UFO. The log is located on the BLM Colorado website:

http://www.blm.gov/co/st/en/BLM_Information/nepa/ufo.html

The FS posts projects in a manner similar to the BLM on its website.

Notification to BLM and FS

Federal 12-90-7-1:
SG provided early notification of this proposal via submittal of a Notice of Staking (NOS) to BLM and FS in May 22, 2013 followed by the APD for the well submitted to the BLM on June 28, 2013. The APD was deemed complete by BLM on February 25, 2014. The onsite was conducted on: June 13, 2013.

Federal 11-90-9-3:
SG provided early notification of this proposal via submittal of an NOS to BLM and FS on September 6, 2011 followed by the APD for the well submitted to the BLM on April 20, 2012. The APD was deemed complete by BLM on June 19, 2012. The onsite was conducted on October 11, 2011

Federal 11-90-15-2:
SG provided early notification of this proposal via submittal of a NOS to BLM and FS on November 5, 2010 followed by the APD for the well submitted to the BLM on November 27, 2013. The APD was deemed complete by BLM on February 4, 2014. The onsite was conducted on December 2, 2013.

Federal 11-90-8-H3:
GE provided early notification of this proposal via submittal of a NOS to BLM and FS on September 11, 2014 followed by the APD for the well submitted to the BLM on November 24, 2014. The onsite was conducted on October 3, 2014. The APD was deemed complete by BLM on February 12, 2015.

Federal 11-90-20-21-H1 & Federal 11-90-20-21-H2:
GE provided early notification of these proposals via submittal of NOSs to BLM and FS on September 11, 2014 followed by the APD for the well submitted to the BLM on November 24, 2014. The onsite was conducted on October 3, 2014. The APDs were deemed complete by BLM on February 12, 2015.

All NOSs were posted in the public reading rooms of BLM UFO, BLM Tres Rios Field Office and FS Paonia Ranger District at the time they were submitted and allowed a minimum of 30 days for public inspection of the application as required by 43 CFR 3162.3-1(g).

A BLM and FS Interdisciplinary Team meeting was held on May 7, 2015 to discuss the proposed action and identify issues.

The BLM, as the lead Federal agency, and FS, as cooperating agency, have coordinated scoping efforts. A 30-day public scoping period was initiated on March 23, 2015, thru April 24, 2015.

1.7.2 *Issues*

1.7.2.1.1 Issues from Scoping

The following issues were identified during both external public and internal scoping as potential issues of concern for the proposed action.

- **Air Quality**
  - What are the consequences to air quality and air quality related values (AQRV's) from pollutants emitted from the proposed action and to what standards are they being evaluated?
- **Climate Change**
  - How will climate change and greenhouse gas emissions that result from proposed action be addressed?
- **Farmlands**
  - Are the impacts from the proposed action resulting in the conversion of farmland to nonagricultural uses?
- **Geology**
  - Is there potential risk of subsurface communication to other nearby gas or water wells as a result of hydraulic fracturing (i.e. Frack Hit)?
  - What are impacts from the proposed action (pad siting, construction, drilling, completion and hydraulic fracturing) with respect to the area's geologic hazards (e.g. slope failure, seismicity), and how can we ensure that risks are appropriately mitigated?
- **Hazardous Materials Management**
  - What are the impacts from the of use of hazardous substances which are used or likely to be used in the process of hydraulically fracturing wells in this proposed action?
- **Recreation**
  - How will impacts from the proposed action be mitigated which have the potential to impact the quality of local recreation opportunities including big game hunting and the areas visual resources?
- **Socioeconomics**

    - What are the socioeconomic consequences of the proposed action to the local community and regional economy?
- **Vegetation**
    - How will the loss of vegetation such as Aspen and foraging species disturbed by the proposed action affect the forest resources and wildlife habitat it provides?
- **Soil and Water Resources (Surface and Ground)**
    - Does the proposed action include efforts to avoid project features which require the discharge of dredged or fill material into waters of the United States?
    - What are the impacts to surface water, subsurface water and soils, during construction, drilling and production of the well?
    - Should water quality baseline studies occur as part of the project approval?
    - Does construction, drilling, the hydraulic fracturing process, as well as production of natural gas lead to decreased water quality and contaminate surface and subsurface water sources for wildlife and local water supplies, both domestic and agricultural?
- **Wildlife (T&E, Sensitive, Migratory birds, Aquatic, Terrestrial)**
    - What are the potential impacts on species identified as threatened, endangered, or of concern (sensitive) to State and Federal agencies?
    - What are the potential impacts on migratory bird species from the proposed action?
    - How will the construction and ongoing use of access roads affect the terrestrial wildlife habitat utilization and connectivity within and adjacent to the project area?
    - How will the proposed action affect the aquatic wildlife resources within and adjacent to the project area?
- **Access and Transportation**
    - How will the introduction of more oil and gas exploration and production traffic affect Highway 133? How will increased traffic and resulting impacts on road conditions, maintenance, and safety be addressed?
    - Considering the various jurisdictional boundaries, how will access rights to the project locations be maintained?
- **Hazardous Materials Management** (incl. health and safety)
    - What are the impacts to human health and safety that may result from the project action?
- **Noise**
    - What are the impacts to resources sensitive to noise from increased noise generated by the proposed action?

1.7.2.1.2 Issues Analyzed

These issues will be addressed in this EA.

Air Quality and Climate Change	Wastes (Hazardous and Solid)
Cultural Resources	Socioeconomics
Soils	Access and Transportation
Vegetation Management	Realty Authorizations
Invasive, Non-Native Species	Livestock Grazing/Range Management
Wildlife (T&E, Sensitive, Migratory Birds, Terrestrial, Aquatic)	Noise
Riparian Zones and Wetlands (incl. Floodplains)	Recreation
Water Resources (Surface and Ground)	Visual Resources Management
Geologic Resources	

1.7.2.1.3 Issues Considered but not Analyzed

The following issues were raised during external and internal scoping, however they have been eliminated from further analysis. The issue is identified below followed by the rationale regarding it's elimination from analysis in this document.

- **Bonding**

- Will the analysis determine any additional bonding related to mitigating adverse impacts which fully indemnifies downstream communities in the unlikely event that a spill should occur after the utmost precautions and considerations have been put in place?

Under the regulations at 43 CFR 3104.5 and 36 CFR 228.109, the BLM or FS may require additional bond coverage for specific APDs. Therefore, this analysis will not address this issue due to bonding requirements already established under existing regulations for both BLM and FS.

- **Fire**
  - How will the proposed action mitigate increased fire risk from the activities, especially during times of drought?

The proposed action does not involve fire management from a resource perspective. The proposed action does include several design features which, in the event of a fire caused by the proposed action, would respond to standards and practices which reduce the risk of and quickly respond to accidental fires caused by the activity. A partial list of fire related design features are mentioned in section 2.2.1 under the heading "health and safety" as well as the full listing in Appendix B.

- **The Social Cost of Carbon (SCC) – Climate Change**
  - What is the social cost of carbon related to the proposed action?

There is no requirement to include SCC calculation in a project specific NEPA analysis. The BLM and FS are presenting a qualitative discussion of the environmental effects of climate change as well as a discussion of socioeconomic impacts in this analysis. The analysis also discusses the potential contribution of this action relative to state and national greenhouse gas emissions.

- **Farmlands**
  - Are the impacts from the proposed action resulting in the conversion of farmland to nonagricultural uses?

Farmland classification is conducted by the Natural Resources Conservation Service (NRCS) for the purposes of identifying the location and extent of the most suitable land for producing food, feed, fiber, forage and oil seed crops (National Soil Survey Handbook, 622.03(b)). Classifications range from Prime, Unique, or of Statewide Importance to Not Prime Farmland. All 5 of the well pads are located on soils classified as Not Prime Farmland.

2 PROPOSED ACTION AND ALTERNATIVE(S)

2.1 Introduction

The proposed action is considered in detail are described below, followed by alternatives considered but not analyzed in detail. The affected environment and environmental consequences described in Chapter 3 are based on this detailed description of the propsed action. The proposed action incorporates the project features described by the operators in each of the APDs, FS SUAs and/or RUPs, split-estate and private (fee) landowners wishes and is consistent with lease terms and conditions. Additional resource protection measures, which may include design features added to the proposed action [i.e. Best Management Practices (BMPs)] and mitigation measures identified through the analysis, would be applied by the BLM and FS as COAs or stipulations, as appropriate. All mitigation measures in the form of COAs are identified in Appendix C.

2.2 Proposed Action

The proposed action is the result of the information contained in six APDs, three each submitted by the two operators to BLM for approval to develop natural gas from subsurface Federal mineral leases COC-08905, COC-13483, COC-13484, COC-42314, and COC-66716 (Figure 2).

The six individual APDs per operator are:

Gunnison Energy LLC (GE)	**SG Interests I. Ltd (SG)**
Federal 11-90-8-H3	Federal 12-90-7-1
FeeFeeFederal 11-90-20-21-H1	Federal 11-90-9-3
FeeFeeFederal 11-90-20-21-H2	Federal 11-90-15-2

In each of the six APDs, both GE and SG propose to incorporate best management practices (BMPs) in order to mitigate the site-specific environmental impacts of implementing the proposed action. These BMPs are considered operator-committed design features and are identified in section 2.2.1 (Design Features). These design features are proposed for use during the following phases of development:

- Initial construction of:
  - Multi-well pads,
  - Construction and reconstruction of access roads,
  - Construction of pipelines,
  - Installation and use of surface placed temporary poly pipelines;
- Interim reclamation of initial surface disturbance no longer necessary for activities to occur;
- Long-term maintenance of roads, well pad working surface and associated facility infrastructure;
- Eventual complete final reclamation of all surface disturbances associated with this activity when final well abandonment occurs.

There are elements in each of the APDs by which the individual operator and the site-specific conditions at the site dictate distinctive operational decisions and/or design features which the operator may employ. Where necessary in this analysis, those elements will be disclosed in relationship to the particular multi-well pad to which they are confined. However, there are elements of the individual APDs which exhibit strong similarities regardless of the operator's plan of operations, operator's design features, dictated by site-specific conditions and/or lease terms. For purposes of clarity of the overall proposed action, these instances will be combined when possible into one unified element of the proposed action.

In addition to the six APDs, the overall number of natural gas wells anticipated to be drilled related to this proposed action is considered to be 25 natural gas wells. Accomplishing this will require the initial construction of four new multi-well pads and the use of an existing well pad. To limit confusion between the discussion in the proposed action regarding individual APDs and the multi-well pad which they are intended, this analysis will typically refer to the multi-well pad rather than the individual APD when possible. Each multi-well pad related to this proposed action (Figure 1) and its relationship to one or more of the six APDs is identified in the Table 2-1 below.

Table 2-1 Multi-well Pad Identification

Operator	Pad	APD Submitted	New or Existing Pad
SG	Allen	12-90-7-1	New
	11-90-9	11-90-9-3	New
	Aspen Leaf	11-90-15-2	Existing
GE	Henderson	11-90-8-H3	New
	Spadafora	11-90-20-21-H1 & H2	New
Totals		**6 APDs**	**4 New/1 Existing**

There are various subsurface geologic resources, such as coal bed methane (CBM) and Mancos Shale (MCS), which the six APDs and 19 future additional wells are targeting. Table 2-2 identifies the name of each multi-well pad, the anticipated wells per pad, targeted formations of those anticipated wells, and which of the six APDs are related to the multi-well pads.

Table 2-2 Targeted Fluid Mineral Bearing Zones

Operator	Pad	Wells (Proposed)	CBM[1]/MCS[2]	APD Submitted (Target Formation)
SG	**Allen**	5	1/4	12-90-7-1 (CBM)
	11-90-9	5	0/5	11-90-9-3 (MCS)
	Aspen Leaf	7	0/7	11-90-15-2 (MCS)
GE	**Henderson**	4	0/4	11-90-8-H3 (MCS)
	Spadafora	4	0/4	11-90-20-21-H1 & H2 (both MCS)
Totals		**25 Wells**	**1 CBM/24 MCS**	**6 APDs**

[1]- CBM = Coal Bed Methane; [2] – MCS = Mancos Shale

All construction associated with the six APDs, submission of the additional 19 APDs for Federal review, and drilling of up to 25 natural gas wells is anticipated to occur within a five (5) year period following approval of this proposed action by the FS and BLM.

Overall, the development of four new multi-well pads (16.0 acres of disturbance) and associated infrastructure (2.0 miles of pipelines (10.4 acres) and 3.0 miles of access roads construction or reconstruction (5.6 acres)) would require an initial surface disturbance of approximately 32 acres within the project area. After initial construction and interim reclamation of well pads and access roads, the long-term disturbance could be reduced by about half to approximately 13.5 acres and 100% of the 10.4 acres utilized for pipelines would undergo reclamation.

2.2.1 *Design Features of the Proposed Action*

BLM Instruction Memorandum No. 2007-021 requires that appropriate environmental BMPs be incorporated into proposed APD approvals after appropriate environmental review. If BMPs are not included as part of the APD, they should be analyzed in the NEPA document and applied as COAs. If analysis has shown there are remaining adverse impacts and mitigation is being considered that was not part of the APD and would fundamentally alter the nature of the project, it would be considered a mitigation measure and included as a COA in the permit as well.

The proposed action includes a multitude of BMPs which each operator included in each of the six APDs which were used to develop the proposed action. It is important to both operators to implement specific measures that could reduce or avoid adverse impacts to the surrounding resources from their development of oil and gas resources. Because these BMPs were selected by each operator and included in their APD proposals, they are identified throughout this environmental analysis as “design features”. Disclosure and implementation of the operator’s design features, if deemed appropriate, also helps the agencies analyze a more thorough and effective proposed action as many design features specifically limit or reduce impacts to resources below allowable thresholds governed by laws, regulations and agency guidance.

Due to the complexity of the proposed action (e.g. two different operators, project activities occurring upon multiple surface management jurisdictions, existing authorizations, APDs which were submitted during different periods of time, etc) a multitude of design features are presented as a result of combining them under one proposed action. The final result of this effort is a list of 263 design features (107 which

were consistent to both operators across all proposals) listed in their entirety in Appendix B, Operator Stated Design Features (Full Listing).

The following is a partial listing of design features provided by operators as described above and listed in Appendix B. Those mentioned here are consistent across all of the components of the proposed action. However, in addition to the listed design features below, there are likely many more additional design features per each individual component (well pad) of this proposed action. For those additional design features see Appendix B.

General

- Project activities will be in conformance with the BLM/U.S. Forest Service Surface Operating Standards for Oil and Gas Exploration and Development, The Gold Book (BLM 2007) where appropriate.
- The operators will obtain the necessary permit approvals from the various authorities in order to conduct activities.
- Operations during drilling will occur 24 hours per day, 7 days a week until the task is complete.
- Operations during completion activities will occur during daylight hours, 7 days per week until the task is complete.
- Bids will be solicited from local construction firms and other contractors for various work available.
- Production facilities will be located and arranged to facilitate safety and minimize long-term surface disturbance, typically clustered at the access end of the pad with tanks in the cut.
- Plugging and abandonment of wells will use industry BMPs and comply with all applicable rules and regulations set forth by the BLM, and/or the COGCC for plugging. Depending upon surface estate, abandonment would comply with the appropriate surface management agency (SMA).
- Trash and garbage will be placed in appropriate caged containers and the container and contents transported to an approved disposal site, (e.g. Delta County sanitary landfill). All containers will be equipped with bear-resistant openings.
- Portable latrines will be provided on site for human waste, and wastes will be pumped from portable toilets and hauled to an approved sanitation facility (e.g. CB Industries)

Air Quality

- Operations will comply with the Colorado Department of Public Health and Environment (CDPHE) standards for emissions.
- All drilling and completion rigs will be powered by Tier 2 engines or better.
- Compressor engines will be permitted as appropriate through the Air Quality Control Division of the CDPHE.

Surface Disturbance (Road, Pad, Pipeline construction and reconstruction)

- On NFS lands construction of new roads or reconstructing of existing roads will be conducted to Forest Service Standards.
- Surface disturbance related to the proposed action is appropriately sized to safely accommodate the proposed activities and is minimized where possible.
- All road surfacing will be completed using gravel from local sources.
- Road maintenance and repairs will be made under specifications and terms of the appropriate road use permit.
- Gates may be installed at entrance of new access roads to limit unauthorized access.

- Cattleguards and perimeter fencing may be placed to deter access by livestock and wildlife.
- Culverts may be placed and/or replaced in access roads where necessary and will be a minimum of 18 inch diameter.
- Road construction plans have been designed by professional engineers.
- Pipelines will be buried to a minimum depth of 3 feet.
- Gathering lines will be tested using compressed air, nitrogen and/or water.
- Frozen soils will not be used to backfill pipelines.
- Pipelines will undergo final reclamation.
- Fresh water will be used to minimize effects of fugitive dust during use of access roads during operations.
- The top 6-8 inches of topsoil will be salvaged for re-use over reclaimed areas.
- All areas that are disturbed during construction of the proposed action are covered by State approved Storm Water Management Plans. BMPs as required by the permits and plans will be installed before, during, and maintained after construction until the location reaches final stabilization following reclamation. All other requirements of the permits will be followed, such as the bi-weekly and post-precipitation event inspections and reclamation of disturbed areas.
- All roads used in conjunction with this project will be maintained in as good or better condition than pre-project condition.
- Any project-related damage to roads will be repaired as soon as possible to avoid adverse impacts on other authorized road uses, provide for continued safe operations, and protect surface resources on other authorized road uses in the GMUG.
- Operations will cease, excepting emergencies, during periods when mud and silt cannot be contained within the road prism, or when construction specification cannot be achieved because of wet or frozen ground conditions.
- Gunnison County will grade and apply magnesium chloride to County Road 265 annually as per the terms of the agreement between GE, SG and Gunnison County (LI#10-241)

Cultural Resources

- Should a discovery of cultural resources occur, immediate notification to the appropriate agencies and steps will be taken to protect the resource from further damage.

Health and Safety

- The drilling crew will have sufficient fire equipment on hand during fire season for suppressing fires on the well pad, access road and pipeline route.
- The operators will be responsible for damage and suppression costs for fires started as a result of operations to the extent permitted by federal and state law.
- All gasoline, diesel, and steam-powered equipment will be equipped with effective spark arresters or mufflers. Spark arresters will meet FS specifications discussed in the "General Purpose and Locomotive (GP/L) Spark Arrester Guide, Volume 1, April, 1988"; and "Multi-position Small Engine (MSE) Spark Arrester Guide, April, 1989". In addition, all electrical equipment will be properly insulated to prevent sparks.
- Firearms and dogs are not allowed on the project location during any phase of the project.
- To further facilitate coordination with local emergency services, mapped locations of the well pads, including GPS location (lat/long) will be provided to the federal agencies with responsibility

for drilling activities. A courtesy copy will be provided to the respective emergency services personnel, as applicable, in advance of any exploration drilling activities.

- For all treatment chemicals, Material Safety Data Sheets (SDS) files will be maintained on-site during drilling and completion.
- The operators will provide for the safety of the public using State Highway 133 during project construction. This includes, but is not limited to, posting of appropriate signs to alert traffic on SH133 of potential stops or delays when construction equipment is either using the highway or turning off or on to the highway to access the project area. Warning signs will be posted at locations designated by the FS to warn the public of increased traffic on roads resulting from project activities.
- Where practicable, recycled water will be used for completions.
- Cuttings exiting the well bore and will be centrifuged to remove liquids which will be reclaimed for drilling.
- Cuttings will be tested in accordance with the requirements of the disposal destination.

Noise

- Noise levels will be maintained as required by COGCC rule 802.

Reclamation

- All areas outside the work area will be reseeded according to the FS/BLM, split-estate or Fee landowner recommendations for seed mixture.
- A well pad that no longer has a producing well will undergo final reclamation following plugging and abandonment of the final well on that pad. Prior to final reclamation of the well pad, a review of the existing reclamation plan will occur and any changes agreed to by BLM/FS, unless private landowner dictates otherwise.
- Final reclamation restoration will include salvage and reuse of all available topsoil.
- Final reclamation of all new roads associated with the proposed action that are no longer needed for ongoing operations will either be turned over to the appropriate authority such as the surface management agency or private landowner for continued use; or decommissioned by obliteration, recontouring and seeding.
- Final reclamation of the well pad will consist of stripping topsoil and interim vegetation from portions of the site that are not at the original (or restoration) contour, recontouring of material storage piles, cut/fill slopes and storm water management plan (SWMP) features, spreading stripped topsoil over the entire disturbed site and ensuring successful revegetation as specified in the final reclamation plan or final reclamation plan approved by the FS/BLM, or private landowner.
- Interim and final reclamation progress will be monitored (including roads and vegetation) through maintenance of pre and post development site inspection records and monitoring of operations for compliance.

Spill Prevention, Countermeasure and Control

- Spills related to project activities will be handled in accordance with the operator's Spill Prevention, Countermeasure and Control (SPCC) Plan.
- Spills will be reported according to the regulations in place for the specific land ownership, type of spill and volume of spill.
- A spill kit will be available on site.

- Spills of any kind will be cleaned up, reported, and disposed of as required by local, state, and federal regulations.
- Waste oils from equipment will be contained on-site in secondary containment and upon demobilization of the drilling and completion equipment, and disposed of at an off-site approved facility.

Weeds

- Prior to ground-disturbance, surveys will be conducted to document noxious weeds within proposed disturbance State listed A and B noxious weeds will be treated prior to ground disturbance.
- Prior to mobilizing onto NFS lands, all equipment will be washed and cleaned to prevent spread of noxious weeds.
- Gravel sources will be checked for weeds.
- Materials used for erosion control and reclamation (i.e. straw bales and seed mixes) will be obtained from sources that are weed-free.

Wildlife

- To determine status of known nests within the project area and to determine if additional raptor species have established nests within 0.25 mile of well pad, road, and gathering line construction, the operators will survey for the presence of nesting raptors prior to initiating activities. Surveys will occur during the appropriate survey season, generally March 1 through July 31. Temporal and spatial buffers will be applied to all active nests in the project area, or until young have fledged nests.
- Fresh water usage would be reported to the BLM and /or Forest Service as required for tracking potential impacts to endangered Colorado river fish.
- Fresh water will be obtained from a variety of sources, nearby streams, private water rights, commercial suppliers, etc.
- Screening or other devices will be installed on stacks and on other openings of heater-treaters or fired vessels to prevent entry by migratory birds.

Visual

- New above ground facilities will be painted Juniper Green in order to match the surrounding vegetation (and existing on site facilities). Safety features of this equipment may be painted hazard orange or similar.
- Lighting will not be installed for production operations.

2.2.2 *Existing Infrastructure*

2.2.2.1 Multi-well Pads

There is one existing multi-well pad, SG's Aspen Leaf location, (Figure 3) which will accommodate the portions of the proposed action related to the SG 11-90-15-2 APD. The Aspen Leaf multi-well pad has an existing natural gas well (11-90-15-1) on a 260 feet x 400 feet working surface located on NFS lands on Federal lease COC-13484. Additional discussion of the relationship between this existing location and the elements of the proposed action are identified in the appropriate section headings below.

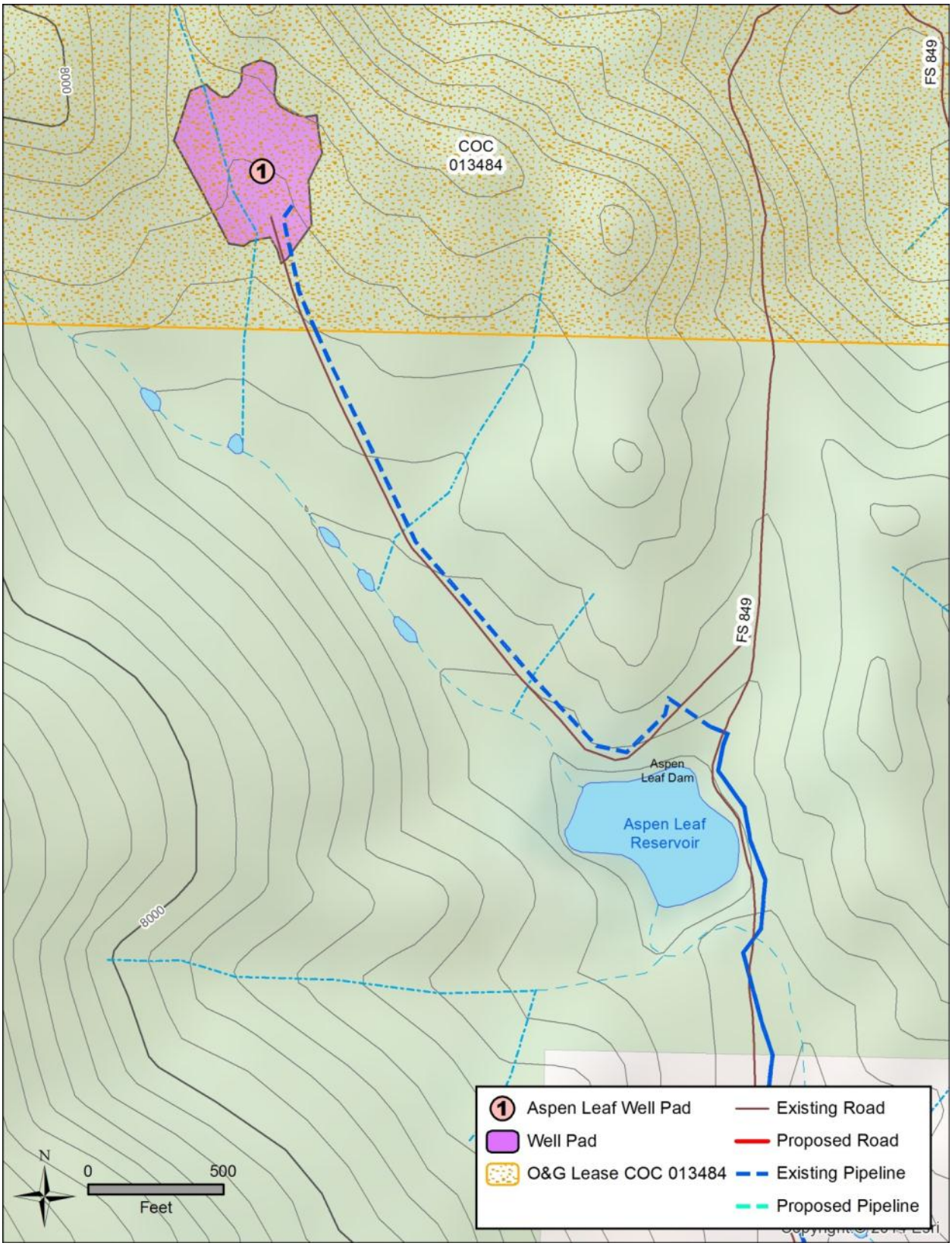


Figure 3 - Existing SG Aspen Leaf Location and Infrastructure

2.2.2.2 Access

The project area can be accessed by travelling north approximately 27 miles from Paonia, CO or travelling south approximately 32 miles from Carbondale, CO on State Highway 133 to its intersection with Gunnison County Road (CR) 265 and then west on CR265. Access to the individual multi-well pads then crosses both NFS and private land jurisdiction once CR 265 crosses the NFS boundary and becomes NFSR 265. Other existing roads which could be used by GE and SG, respectively, to access the five multi-well pads associated with this proposed action are: NFSR 851, NFSR 851.1B, NFSR 849, NFSR 704, NFSR 704.4A and existing access roads in place across private lands. The majority of the proposed access routes are currently adequate to handle the proposed activities and traffic (Figure 4).

The access roads used to reach each of the multi-well pads related to this proposed action are identified in Table 2-3 below.

Table 2-3 Access Roads to Each of the 5 Multi-well Pads

Road	GE		SG		
	Henderson Pad	Spadafora Pad	11-90-9 Pad	Allen Pad	Aspen Leaf Pad
Co. State Hwy 133 to GCR 265	32mi from Carbondale, Co. / 27mi From Paonia, CO.				
GCR 265 to NFSR 849					3.3 mi
South across private 849 Aspen Leaf Ranch NFS boundary					1.1 mi
NFS boundary on NFSR 849 to Existing Access Road					0.9 mi
Existing Access to Aspen Leaf Well Pad					0.6 mi
GCR 265 to NFS Boundary	5.7 mi				
NFSR 265 to NFSR 704				5.4 mi	
NFSR 704 to NFSR 704.4A				5.7 mi	
NFSR 704.4A to New Access Road				0.8 mi	
NFSR 265 to NFSR 851	0.3 mi				
From NFSR 851 Right on Existing Access			0.1 mi		
NFSR 851 to NFS Boundary with Bar K Ranch	1.0 mi				
Private Bar K Ranch Road South (NFSR 851 to NFS Boundary)		0.7 mi			
NFSR 851 south to Bar K Ranch Boundary		0.4 mi			
Bar K Ranch Boundary south 851 to Spadafora Ranch Boundary		0.4 mi			
Bear right (west) onto Private road southwest to New Access Road		0.3 mi			
Private Bar K Ranch road (851) to Bar K Ranch Road East (851.1B)	0.1 mi				
Bar K Ranch Road East (851.1B) to NFS Boundary	0.6 mi				
NFS Boundary east on NFSR 851.1B to New Access Road	0.05 mi				

There is also need for both operators to utilize some existing ranch roads to haul fresh water, recycled, flowback and produced water to and from the multi-well pads in this proposed action. Those instances are further discussed in Section 2.2.6 (Transportation).

Appropriate road use permits will be obtained by GE and SG on both the portions of the route which belong to Gunnison County and those that are NFS roads (36 CFR Part 261.54(d)).

SG has a FS Road Use Permit (FSM 7770) in place with GMUG Paonia Ranger District related to the NFS road use necessary to access the 11-90-9 and the Aspen Leaf multi-well pads.

GE maintains a Road Use Permit for NFSR 265, NFSR 851 and NFSR 704 with the FS.

Aspen Leaf Access

Access road between the well pad and the junction with NFS 849 has seven culverts with rip-rap outfalls. The road crown, drainage ditch, and culverts are being maintained throughout the life of the multi-well pad.

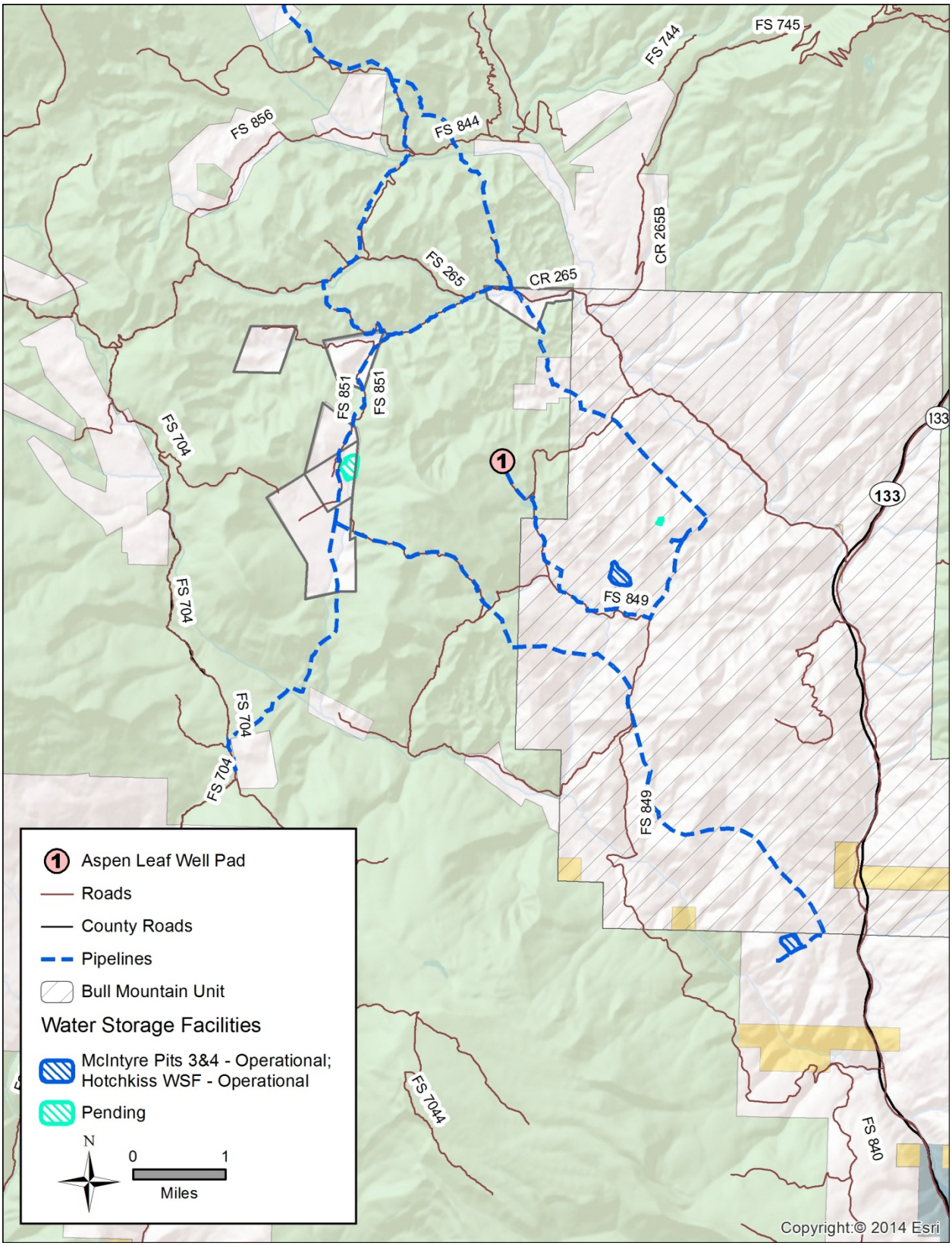


Figure 4 - Existing Infrastructure

2.2.2.2.1 USFS Trailhead

In order for year-round access to occur on NFSR 265, an existing winter trailhead used mainly by snowmobilers, must be relocated. This is to comply with state law (Title 33 Colorado Revised Statutes 14-110(3) (e)), which does not allow snowmobile traffic to use the roadway of streets and highways which are maintained for winter motor vehicle traffic. This will consist of permanently moving the existing snowmobile trailhead at the intersection of NFSR 265 and NFSR 844 on FS to the west a few miles to a site adjacent to the USFS Muddy Guard Station at the intersection of NFSR 704 and NFSR 704.4A.

2.2.2.3 Pipeline (buried)

For purposes of the proposed action, GE and SG will connect proposed pipeline components to nearby existing pipeline infrastructure as described below (Figure 4).

Currently, GE uses the existing Sheep gathering line to collect produced gas from nearby operations and it is intended to carry the produced gas from GE's Henderson and Spadafora well pads. The gas is currently transferred into the Ragged Mountain field pipeline operated by GE and then can either enter the Ragged Mountain transmission line or Bull Mountain transmission line and head to market. GE has been issued a permit from the USFS to construct the Sheep-Bull connector between the Bull Mountain pipeline (T11S, R90W, Sec.3 SWSW) and GE's Sheep pipeline laydown yard (T11S,R90W,Sec.8 SENE). GE anticipates construction of this segment of pipeline to be completed in the next 5 years. When in operation, GE's production from the Henderson and Spadafora locations would likely be sent through the new segment of pipeline.

SG has in operation the Henderson lateral and this pipeline includes a collocated water line and is constructed between the GE Sheep pipeline laydown yard (T11S,R90W,Sec.8 SENE) and follows along NFSR 851, NFSR265 and CR 265 before going cross country (T11S, R90W, Sec. 10 NW) and connecting with the Bull Mountain pipeline (T11S, R90W, Sec. 10 SWNE).

Allen
Natural gas produced from the wells on the multi-well pad will attach to an existing buried Sheep gas gathering line owned and operated by GE north of the proposed multi-well pad. The Sheep gas gathering line then continues north and west until it transfers into either the Ragged Mountain field gathering line or the Henderson lateral, then continues until being transferred into the Ragged Mountain transmission line or the Bull Mountain transmission line and then is carried north across the Grand Mesa to interstate pipelines and eventually to market.

11-90-9
Natural gas produced from the wells on the multi-well pad will tie-in to an existing SG buried natural gas pipeline serving the existing nearby Federal 10-8-11-90R natural gas well. Gas is then conveyed through the Henderson lateral and is transferred to the existing Bull Mountain transmission line then is transferred north across the Grand Mesa to interstate pipelines and eventually to market. A buried water pipeline will also attach to an existing water line servicing the nearby Federal 10-8-11-90R well.

Aspen Leaf
Natural gas produced from the wells on the multi-well pad will attach directly at the location to an existing SG buried natural gas pipeline. The existing pipeline connects to the SG Aspen Leaf trunk line, which then heads south and east from the location until it meets up with the Bull Mountain field gathering pipeline. The gathering pipeline then carries natural gas north to a connection with the Bull Mountain transmission line and carries gas north across the Grand Mesa to interstate pipelines and eventually to market.

A buried water line collocated in the gas pipeline trench connects this location to SG's water gathering system, which takes water to other locations such as the Federal 24-2WDW and/or the McIntyre flowback pits.

Henderson
Natural gas produced from the wells on the multi-well pad will attach to an existing connection point with the Ragged Mountain field pipeline at Little Henderson Creek, then continue north and west until being

transferred into the Bull Mountain transmission line at the Ragged Mountain compressor location and then carried north across the Grand Mesa to market via interstate pipelines.

A buried water line will also be connected from the multi-well pad to an existing buried water line operated by GE. The existing water line goes south and is co-located in the same corridor as the Sheep gas gathering line which then at a junction in the corridor heads east and south across the neighboring Bull Mountain Unit until reaching a transfer point into the Hotchkiss gas gathering pipeline and continues to head south and east until reaching either the HWSF or the Hotchkiss 18-22D water disposal well.

Spadafora
Natural gas produced from the wells on the multi-well pad will attach to the existing Sheep gas gathering line directly adjacent to the pad and head north to an existing connection point with the Ragged Mountain field pipeline, then continue north and west until being transferred into the Ragged Mountain Transmission line or the Bull Mountain Transmission line and then carried north across the Grand Mesa to interstate pipelines and eventually to market.

A buried water line will also be connected from the multi-well pad to an existing buried water line operated by GE directly adjacent to this multi-well pad. The existing water line goes south and is co-located in the same corridor as the Sheep gas gathering line. Then, at a junction in the corridor, the co-located lines head east and south across the neighboring Bull Mountain Unit until reaching a transfer point into the Hotchkiss gas gathering pipeline. The line then continues south and east until reaching either the HWSF or the Hotchkiss 18-22D water disposal well.

2.2.2.4 Nearby Water Wells

Each of the APDs submitted by the operator associated with this proposed action include an investigation of any existing permitted water wells identified within a one-mile radius of the proposed natural gas well. Those identified in the operators APDs are listed below.

Allen and Aspen Leaf
There are no water wells identified.
11-90-9
There are two water wells, permit #69651 Federal 10-8-11-90R and permit #69660 Henderson 1R.
Henderson
There is one water well, permit #266485, Hockenberry.
Spadafora
There is one water well, permit #P250836 Cesario.

2.2.2.5 Existing Water Storage Facilities/ Water Disposal Wells

Both GE and SG own and operate separate water storage facilities and separate water disposal wells, respectively (Figure 4).

GE owns and operates the HWSF located in the Deadman Gulch Unit approximately 10 miles southeast of this project area. This facility stores 450,000 barrels (bbl.) of recycled water and non-tributary water produced from several GE coal seam wells adjacent to the HWSF. GE has also constructed water pipelines throughout the area of the proposed action that were described above in section 2.2.2.3 (Pipeline (buried). Therefore GE does not anticipate trucking the large volume of water to and from the HWSF for any phases of development of the proposed action that requires use of the HWSF.

GE also has in-use the Hotchkiss 18-22D deep water injection disposal well (WDW) drilled 9,180 feet. deep disposing into the Maroon Formation and Precambrian basement. This WDW is located in the Deadman Gulch Unit and adjacent to the HWSF, and is also tied into the buried pipeline connecting the GE elements of the proposed action to the HWSF.

SG owns and operates the McIntyre flowback pits 3 & 4 located in the Bull Mountain Unit a few miles (1-5 depending upon multi-well pad location) east of this proposed action. This facility is designed to store up to 288,574 bbl. of recycled water. SG intends to utilize the recycled water in these pits for portions of the drilling and all of the completion phases of SG's wells. However, the water will be transferred to each of

the multi-well pads via trucking or use of surface placed temporary poly pipelines connecting between the multi-well pad and the McIntyre facility.

SG also has in use the 24-2WDW drilled 9,830 feet. deep disposing into the Maroon Formation. This WDW is located in the Bull Mountain Unit approximately 0.75 miles from the McIntyre flowback pits 3 & 4. Fluids needing disposal can be transferred directly to the 24-2WDW via trucking or received by the 24-2WDW after being deposited in the McIntyre flowback pits after being off-loaded by truck or returned in surface-placed temporary poly pipelines.

2.2.3 *Project Construction*

2.2.3.1 Surface Disturbance Summary

Specific surface disturbance values related to pad construction, new access roads, reconstruction of access roads and pipelines were provided by the operators in each individual APD. For purposes of environmental analysis, these figures are rounded. Table 2-4 below shows the estimated initial surface disturbance necessary to construct a well pad, construct and reconstruct access roads, and construct buried pipelines. The totals exclude the existing disturbance related to the SG Aspen Leaf location, and the proposed surface disturbance for the pad, access road and pipeline for the GE Spadafora location as it occurs entirely on Fee/Fee surface. For detailed drawings related to the surface disturbance components of each proposed location see Appendix H.

Table 2-4 Total Surface Disturbance Summary

Operator	Pad Name	Well Pad (ac)	Access Roads (ac)	Pipeline (ac)	Total (ac)
SG	*Aspen Leaf*[1]	*5.70*	*3.0*	*3.0*	*11.70*
	Allen	4.0	1.1	4.5	9.6
	11-90-9	3.0	0.8	1.4	5.2
GE	Henderson	5.0	2.5	4.3	11.8
	Spadafora[2]	4.0	1.2	0.2	5.4
Total Initial Disturbance[3]		**16.0**	**5.6**	**10.4**	**32**

[1]- Table Acres are the result of previously authorized assumptions from the Federal 11-90-15-1 APD which has been drilled.
[2]-11-90-20-21 H2 is a subsequent APD on the same pad as the H1. For purposes of this table, the 11-90-20-21-H1 assumes all initial and long-term surface disturbances.
[3]- Disturbance associated with the Aspen Leaf is not calculated due to previously existing disturbance and no additional disturbance is proposed in the APD to this location.

Due to the complexity of surface management elements related to this proposed action, which dictate the level of Federal requirements necessary to authorize these types of activities, the initial surface disturbance acreage identified in the table above is further broken down to identify which portions of the proposed project has disturbance occurring directly on Federal leases (Table 2-5) and those portions of the proposed action that are off lease (Table 2-6).

Table 2-5 On Lease Disturbance per APD

Operator	Pad Name	Well Pad (ac)	Access Roads (ac)	Pipeline (ac)	Total (ac)	Surface Estate
SG	*Aspen Leaf*[1]	*5.70*	*0.5*	*0.5*	*6.70*	*NFS*
	Allen	4.0	1	1.0	6.0	Split-estate
	11-90-9	3.0	0.50	1.0	4.50	NFS
GE	Henderson	5.0	1.0	1.5	7.5	NFS

[1]- Table Acres are the result of previously authorized assumptions from the Federal 11-90-15-1 APD which has been drilled.

Table 2-6 Off Lease Disturbance per APD

Operator	Pad Name	Well Pad (ac)	Access Roads (ac)	Pipeline (ac)	Total (ac)	Surface Estate
SG	*Aspen Leaf*[1]	*0.00*	*2.5*	*2.5*	*5.0*	*NFS*
	Allen	0.00	0.1	3.5	3.6	NFS
	11-90-9	0.00	0.3	0.4	0.7	NFS
GE	Henderson	0.00	1.5	2.8	4.3	Fee
	Spadafora[2]	4.0	1.2	0.2	5.4	Fee

[1]- Table Acres are the result of previously authorized assumptions from the Federal 11-90-15-1 APD which has been drilled.
[2]-11-90-20-21 H2 is a subsequent APD on the same pad as the H1. For purposes of this table, the 11-90-20-21-H1 assumes all initial and long-term surface disturbances.

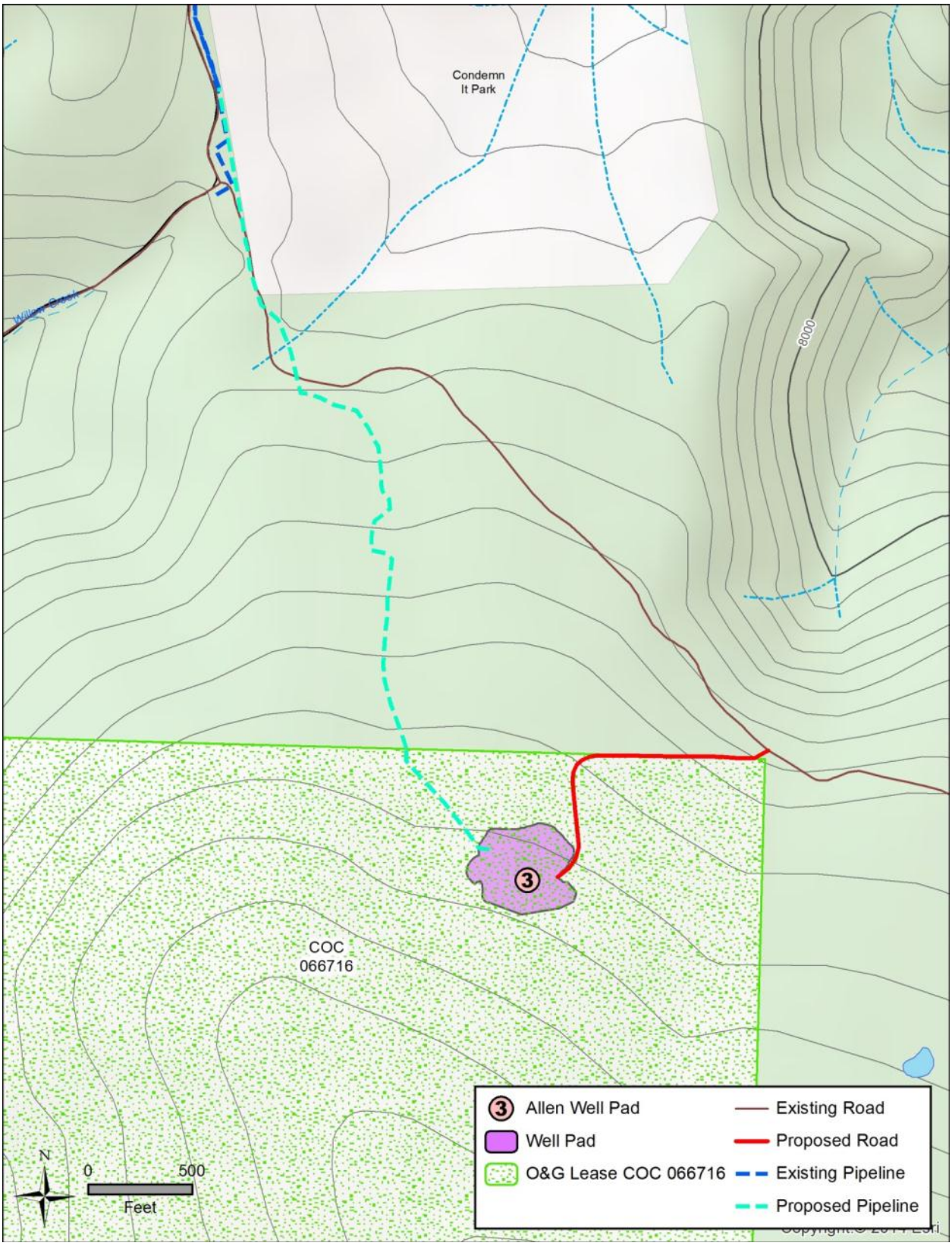


Figure 5 - Proposed SG Allen Multi-well Pad and Infrastructure

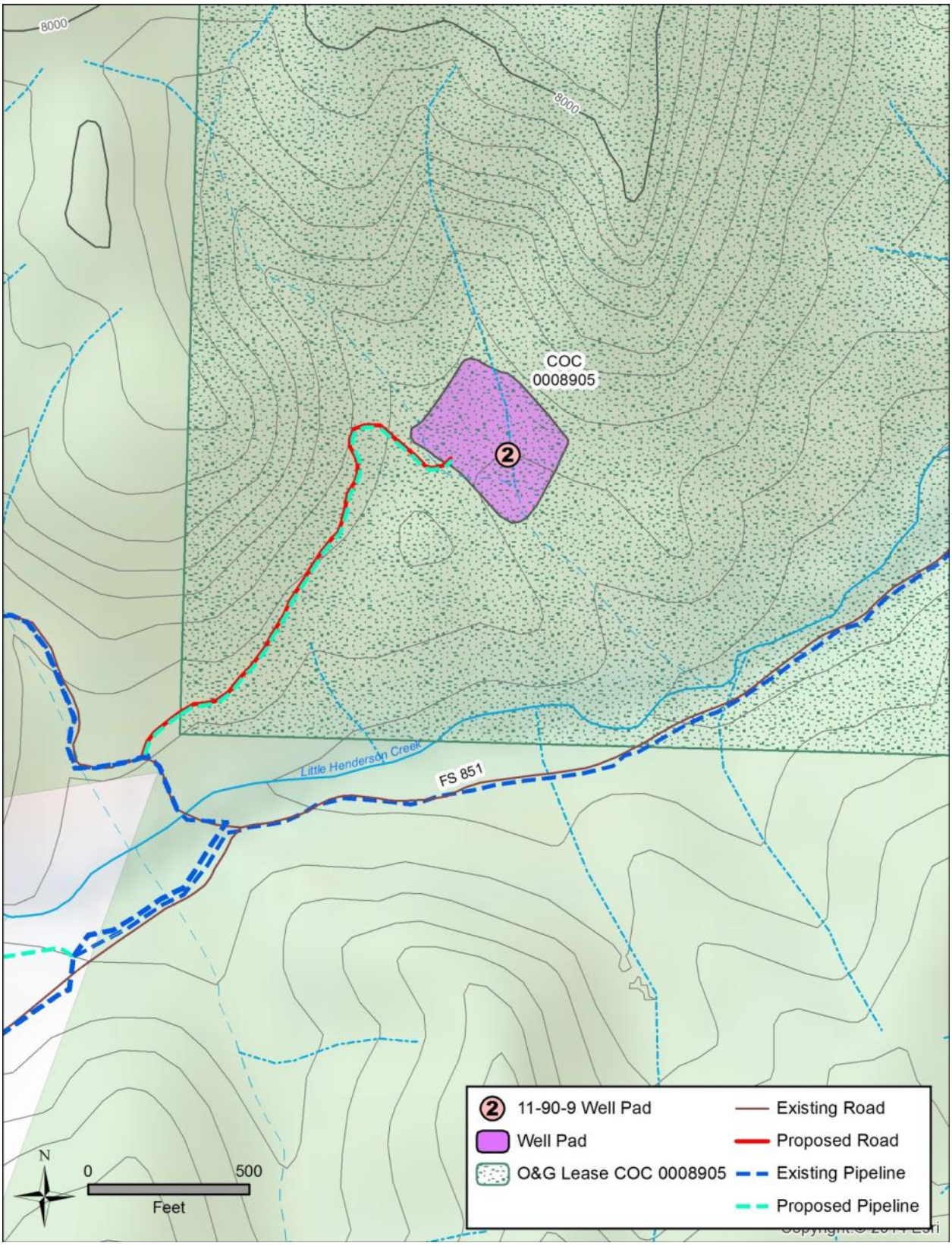


Figure 6 - Proposed SG 11-90-9 Multi-well Pad and Infrastructure

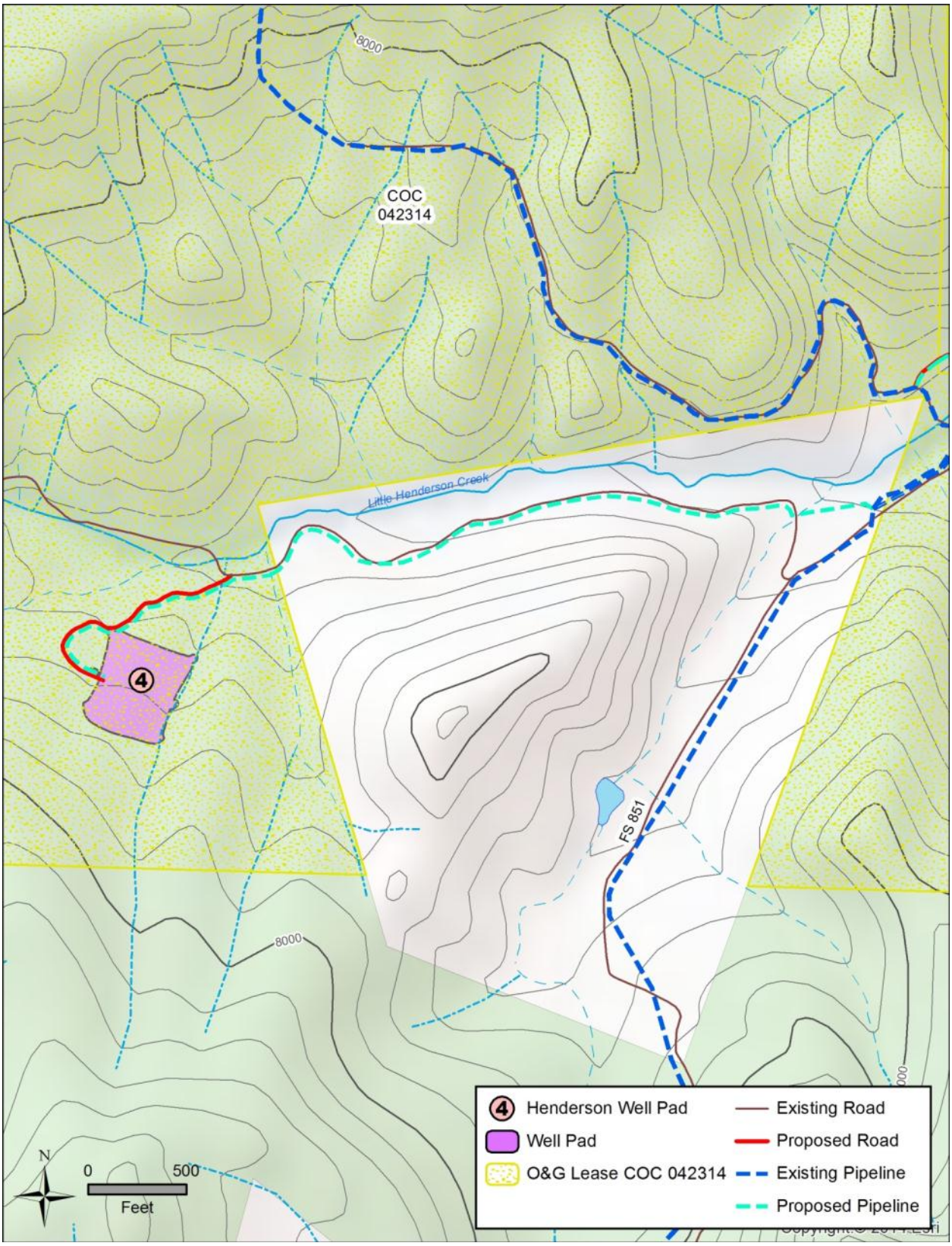


Figure 7 - Proposed GE Henderson Multi-well Pad and Infrastructure

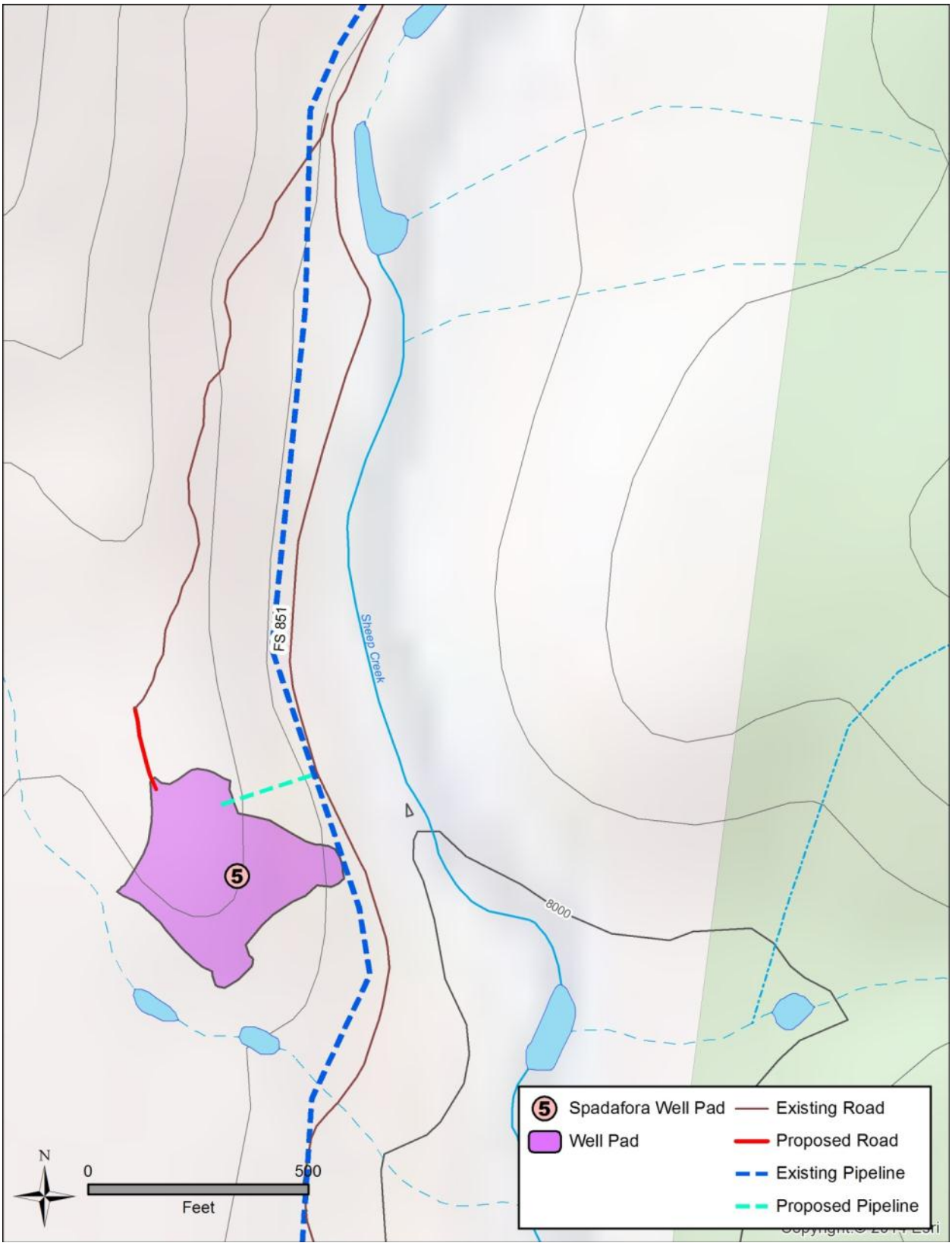


Figure 8 - Proposed GE Spadafora Multi-well Pad and Infrastructure

2.2.3.2 Multi-well Pads

The proposed sizes of the well pads are designed to accommodate a long-term working surface on which wells can be drilled without disturbing or increasing the disturbance to accommodate future drilling. Table 2-7 below identifies the initial well pad disturbance per APD necessary to accommodate a working surface large enough to add additional wells to the pad, the surface estate at the well pad, and the Federal mineral lease where pad disturbance is located (if applicable). Operator committed design features to limit environmental impacts from the construction, use and long-term needs of these well pads are included in section 2.2.1 (Design Features).

Table 2-7 Initial Well Pad Disturbance

Operator	Pad Name	Initial Well Pad Disturbance(ac)	Working Surface (ft)	Surface Estate	Federal Lease
SG	Allen	4.0	250 x 325	Split-estate	COC-66716
	11-90-9	3.0	250 x 350	NFS	COC-08905
	Aspen Leaf[1]	0.0	260 x 400	NFS	COC-13484
GE	Henderson	5.0	350 x 350	NFS	COC-42314
	Spadafora[2]	4.0	285 x 290	Fee/Fee	Fee/Fee
Total Initial Disturbance[3]		**16.0**			

[1]- Existing multi-well pad.
[2]-11-90-20-21 H2 is a subsequent APD on the same pad as the H1. For purposes of this table, the 11-90-20-21-H1 assumes all initial and long-term surface disturbances.

Based on the initial acres disturbed identified above in Table 2-7, the following is a more site-specific discussion regarding each new multi-well pad being constructed as a result of this proposed action. The Aspen Leaf well pad is also described, however it is already an existing multi-well pad. All of the information related to these five multi-well pads is based on the information submitted in each of the five APDs. Information regarding the anticipated facilities located on each pad is identified in section 2.2.8 (Production Facilities).

Allen (Figure 5)
SG is proposing to construct a new multi-well pad with a 250 feet x 325 feet working surface to accommodate five natural gas wells. An initial construction disturbance of 4.0 acres will be entirely on split-estate on Federal lease COC-66716. The working surface of the well pad will be graveled with 3 inches of fractured road base.

11-90-9 (Figure 6)
SG is proposing to construct a new multi-well pad with a 250 feet x 350 feet working surface to accommodate five natural gas wells. An initial construction disturbance of 3.0 acres will be entirely on NFS lands on Federal lease COC-08905. The pad will be graveled with 3 inches fractured road base.

Aspen Leaf (Figure 3)
In addition to the 11-90-15-1 natural gas well, SG is proposing to add seven natural gas wells to the 260 feet x 400 feet working surface of this existing multi-well pad located on NFS lands on Federal lease COC-13484. Initially, the multi-well pad required a 5.70 acre construction area; however, SG has implemented interim reclamation measures to reestablish vegetation, stabilize slopes, and limit sediment movement off site. As a result of the implementation of those measures, the current long-term surface disturbance has been reduced to 2.0 acres. Drilling additional wells on this multi-well pad can be accomplished within the 2.0 acre existing disturbance (working surface). The working surface of the well pad is surfaced with a combination of pit run gravel topped with 3 inch minus gravel.

Henderson (Figure 7)
GE is proposing to construct a new multi-well pad with a 350 feet x 350 feet working surface to accommodate four natural gas wells. An initial construction disturbance of 5.0 acres will occur entirely on NFS lands on Federal lease COC-42314. The working surface of the well pad will be graveled.

Spadafora (Figure 8)
GE is proposing to construct a new multi-well pad with a 285 feet x 290 feet working surface to accommodate four natural gas wells. An initial construction disturbance of 4.0 acres will occur entirely on Fee/Fee estate off lease. The working surface of the well pad will be graveled.

2.2.3.3 Access Roads

With the exception of the Aspen Leaf multi-well pad, each of the four new multi-well pads proposed in this action will require a combined one mile of new access construction and approximately two miles of existing access roads will require partial reconstruction (e.g. culvert replacement, widening, gravel surfacing, etc.). Table 2-8 below identifies the anticipated acres of initial disturbance for both new access construction and reconstruction of existing access roads for each multi-well pad. Discussion then follows regarding access road construction and/or reconstruction based on site-specific proposals in each of the five APDs related to the four new multi-well pads.

Operator-committed design features to limit environmental impacts from the construction, use, and long-term needs of these access roads are included in Appendix B.

Table 2-8 Road Construction and Reconstruction Acres and Mileage

Operator	Multi-well Pad	APD	Acres	New Access construction (mile)	Access Reconstruction (mile)
SG	*Aspen Leaf*[1]	*11-90-15-2*	*0*	*0*	*0*
	Allen	12-90-7-1	1.1	0.3	0.9
	11-90-9	11-90-9-3	0.8	0.3	0
GE	Henderson	11-90-8-H3	2.5	0.3	0.8
	Spadafora[2]	11-90-20-21-H1	1.2	0.1	0.3
		11-90-20-21-H2			
		Totals	**5.6**	**1.0**	**2.0**

[1]- Existing multi-well pad.
[2]-11-90-20-21 H2 is a subsequent APD on the same pad as the H1. For purposes of this table, the 11-90-20-21-H1 assumes all initial and long-term surface disturbances.

Allen (Figure 5)
SG is proposing to initially disturb up to 1.1 acres to construct new access (0.3 mile) and reconstruct 0.9 mile of existing access road.

In terms of reconstruction, SG is proposing to maintain the existing 16 foot average driving width, upgrade culverts in FS704 as necessary, and repair or replace several culverts in 0.9 mile section of NFSR 704.4A. Specifically, there are six culverts in NFSR 704.4A south of the intersection with NFSR 704 proposed for upgrade. Table 2-9 below includes a description of the culverts as they exist and the proposed sizes for upgrade. Appendix H.1 includes a design drawing depicting the placement of the proposed culvert upgrades.

Table 2-9 Culvert Upgrades Needed for NFSR 704.4A

ID	Existing (Dia.in)	Proposed Upgrade (Dia. in)	Proposed Upgrade (ft)
1	16	18	24
2	16	18	24
3	12	18	24
4	17	18	24
5	14	18	24
6	18	18	24

A new access road, approximately 0.3 mile/1450 feet in length amounting to 1.1 acres of initial surface disturbance will be constructed from NFSR 704.4A to the proposed multi-well pad. Construction will occur primarily on split-estate land (1.0 acre), however a small portion (<0.1 acre) of new disturbance will occur on NFS lands at the intersection of the new access road and NFSR 704.4A.

The first 50 feet of new access road will be constructed on NFS lands (<0.1 ac of disturbance) in order to create the turn-off from NFSR 704.4A onto the private land. This road as proposed is also widest (60 feet) at this intersection with NFSR 704.4A. SG anticipates the amount of fill material (soil) to be used to assure an appropriate grade when entering the new access road off of NFSR 704.4A to average 5 feet deep within the first 80 linear feet of the proposed road. One 18 inch diameter culvert will also be placed in the new roadbed near NFSR 704.4A, a small section of fence line will be replaced and a new gate will

be installed across the proposed road in order to maintain and secure the private land and NFS boundary.

The remaining 0.3 mile/1400 feet (1.0 acre of disturbance) of the new road as proposed will be constructed across split estate lease COC-66716. The design parameters include creation of a 14 foot wide driving surface, a maximum grade of 13.6%, 200 feet radius for all curves, and surfaced with 6 inches of 3 inch sized fractured road base. Appendix H.1 includes a design drawing depicting the new access road.

Drainage features will be established along the new access road, and the road itself will include an inslope grade of 3% to facilitate drainage from the road prism. No turnouts are planned to accommodate passing traffic on this section of new road. Approximately 400 linear feet of this portion (after initial 80 feet needing 5 feet of fill) of the proposed road will need approximately 3 feet of fill to bring the road up to an acceptable grade for travel. SG also proposes to install a new 18 inch diameter culvert in a low spot just west of a proposed gate.

The remainder of this new access road alignment to the multi-well pad will attempt to utilize the existing grade which will reduce the need for additional cuts and fills. In addition to the earthmoving, placement of culverts and surfacing with gravel, SG also proposes to install two gates, or two cattleguards, or a combination of both on the proposed road. One would be located at the intersection with the NFSR 704.4A and the other would be located at the pad entrance.

From the intersection of NFSR 265 and NFSR 844, it is approximately 10.6 additional miles to the proposed Allen multi-well pad (via NFSR 265/NFSR 704/NFSR 704.4A). SG proposes to maintain year-round access to this location by plowing snow off of one half (from centerline to one edge of road or the other) of NFSR 265, NFSR 704 and NFSR 704.4A roads used for access.

11-90-9 (Figure 6)
SG is proposing to initially disturb 0.8 acres of NFS surface to construct a new access road (0.3 mile). SG does not propose reconstruction of any existing access roads. The new access will have a 14 foot drivable surface, with a maximum grade of 12%. The new access will be graveled, crowned and ditched with appropriate drainage, there are no turnouts planned to accommodate passing traffic, and areas not needed for running surface after initial disturbance will be revegetated and stabilized.

The majority of new access road disturbance (0.6 acre) will occur on lease COC-08905; however, the entrance (0.2 acre) of the new access road from the existing access road will be on NFS lands but off-lease.

There will be three PVC pipe culverts installed in the new access road. A 24 inch diameter culvert will be placed at the start of the new access road where it turns off of the existing access road to the 10-8-11-90R well, an 18 inch diameter culvert will be placed in the new access road approximately 625 feet east of the entrance and a 24 inch diameter culvert will be placed where the new access comes onto the proposed well pad. The access road will be gated and closed to public access and there are no bridges, fence cuts or cattle guards planned.

Henderson (Figure 7)
GE is proposing to initially disturb 2.5 acres to establish and maintain a 14 foot wide running surface, surfaced with 8 inches of gravel, to construct a new access road (0.3 mile) and reconstruct (0.8 mile) an existing access road.

In terms of reconstruction, GE will upgrade 0.8 mile of the existing gravel road from the intersection of NFSR 851 and the NFS boundary until it meets up with the entrance of the new access road construction. A 0.7 mile portion of this road occurs on Fee/Fee estate (1.5 acre), a 0.1 mile portion (0.3 acre) of this existing road occurs on NFS lands. GE is proposing to upgrade this section of road to meet BLM standards for a “resource road” as identified in the BLM Goldbook. Placement of a 36 inch culvert is proposed at the west end of this road section just prior to crossing the private land NFS boundary.

The 0.3 mile new access road construction (0.6 acres) will occur entirely on lease on NFS lands. A cattle guard will be installed at the entrance of the well pad. Two 18 inch diameter and two 24 inch diameter

culverts and one 30 inch diameter culvert are proposed at various points along the new access road. There is a maximum road grade of 9.8% and one turnout is proposed to allow vehicles to pass.

Spadafora (Figure 8)
Once the access road leaves public access at the intersection of the Bar K Ranch and NFSR 851, it is approximately 1.9 miles to the proposed Spadafora multi-well pad. The existing access road then crosses onto Fee/Fee estate owned by Bar K Ranch (0.7 mile), then crosses onto NFS land (0.4 mile), and then crosses a second parcel of Fee/Fee estate owned by Bar K Ranch (0.4 mile). GE is not proposing any reconstruction to these sections of existing access road.

GE is proposing to initially disturb 1.2 acres to establish a 14 foot wide running surface, surfaced with gravel by constructing a new access road (0.1 mi) and reconstruct an existing access road (0.3 mi) located on Fee/Fee estate owned by Spadafora Ranches. GE intends to meet BLM standards for a "resource road" as identified in the BLM Goldbook on this portion of access road.

2.2.3.4 Pipelines (buried)

GE and SG are proposing to convey natural gas captured from natural gas development at each of the five multi-well pads related to this proposed action. In order to convey the produced gas, each operator is going to construct and bury a steel pipeline in a trench originating at the proposed well pad and terminating at the junction selected by the operator where an existing buried pipeline can then convey the produced gas to market. In addition to burying a single pipeline in a single trench, the operator may take advantage of the single trench and co-locate a second pipeline which will carry fluids such as fresh water, recycled water and produced water, depending on the need. Buried water lines (if proposed) would originate at either GE or SG's multi-well pad and eventually terminate at either the SG 11-90-24-2 water disposal well or the GE Hotchkiss Federal 12-89-18-22 water disposal well, respectively. Further discussion regarding use of these fluid conveyance lines also occurs in section 2.2.5 (Water Use) below.

Once initial buried pipeline construction disturbance associated with trenching has occurred, pipeline installation has been completed (e.g. the pipeline is found to be safe and functional after appropriate testing) and the pipeline has been buried using the excavated material from trenching, the entire surface disturbance will undergo final reclamation. Operator committed design features to limit environmental impacts from the construction, use, and long-term needs of these access roads are included in section 2.2.1 (Design Features).

With the exception of the Aspen Leaf multi-well pad (a pipeline to convey produced natural gas already exists), installation of new buried pipeline (10.4 acres of disturbance) is required to convey produced natural gas from the other four new multi-well to market. Table 2-10 below identifies the anticipated acres of initial disturbance for buried pipeline construction for each multi-well pad. Discussion follows of the buried pipeline construction based on the site-specific proposals from each of the five APDs associated with the four new multi-well pads.

Table 2-10 Buried pipeline construction mileage

Operator	Multi-well Pad	Pipeline Acres	Total Pipeline Mileage	Surface Estate	Federal Lease
SG	Allen	4.5	0.8	Split-estate and NFS	COC-66716 & off lease NFS
	11-90-9	1.4	0.3	NFS	COC-08905
	Aspen Leaf[1]	0	0	NFS	COC-13484
GE	Henderson	4.3	0.9	NFS and Fee/Fee	COC-42314
	Spadafora	0.2	0.1	Fee/Fee	N/A
	Totals	**10.4**	**2.1**		

[1]- Proposal will use existing buried pipeline related to existing multi-well pad.

Allen (Figure 5)
SG is proposing to initially disturb 4.16 acres to install a single buried 6 inch diameter steel pipeline in a 0.8 mile by 40 foot wide corridor. The corridor will be constructed primarily cross-country (a short portion <0.1 mile, runs adjacent to NFSR 704.4A) between the Allen multi-well pad to the proposed tie in point near the existing Fee/Fee Jacobs Trust 12-90-6-32 natural gas well. The pipeline will be plumbed into the

existing GE Sheep gathering line. Placement of the pipeline includes crossing both split-estate and NFS lands. A portion of fenceline will be crossed where the pipeline intersects the NFS boundary. SG will remove the fence for construction purposes and replace it with a stock gate once the pipeline undergoes final reclamation. The pipeline will also cross beneath NFSR 704.4A once.

- A 0.2 mi portion of this buried pipeline corridor (0.8 acre) will occur on split-estate Federal lease COC-66716.
- The additional 0.7 mi portion of this buried pipeline corridor (3.5 acres) will occur off lease on NFS lands.

11-90-9 (Figure 6)
SG is proposing to initially disturb 1.4 acres to install two buried steel pipelines co-located in the same trench. Water and natural gas pipelines from the nearby Federal 10-8-11-90R well will be constructed along the access road to the existing pipeline.

- A 0.3 mi portion of this buried pipeline corridor (1.0 acres) will occur on NFS lands on Federal lease COC-08905.
- The remaining 60 foot portion of this buried pipeline corridor (0.4 acres) will occur off lease on NFS lands.

Henderson (Figure 7)
GE is proposing to initially disturb 4.3 acres to install two buried pipelines co-located in the same trench. The co-located pipelines will be located in a 0.9 mile corridor which originates at the proposed multi-well pad and heads east to a tie-in point with the existing GE Sheep gathering line and water line. Portions of this corridor will be constructed either cross-country or along the access road.

- A 0.3 mi portion of this buried pipeline corridor (1.5 acres) will occur on NFS lands on Federal lease COC-42314 and will primarily be placed cross-country rather than adjacent to the access road.
- The additional 0.6 mi portion of this buried pipeline corridor (2.8 acres) will occur primarily off lease on Fee/Fee land and be placed immediately adjacent to the access road.

Spadafora (Figure 8)
GE is proposing to initially disturb 0.2 acres to install two buried pipelines located in the same trench. The co-located pipelines will be located in a <0.1 mile corridor which originates at the proposed multi-well pad and heads east to a tie in point with an existing GE Sheep gathering line and water line.

- All disturbance associated with this buried pipeline corridor is located off lease on Fee/Fee estate.

2.2.3.5 Pipelines (surface)

SG proposes to utilize temporary poly pipelines placed on the land surface. These poly pipelines will bring recycled water to the 11-90-9 and Aspen Leaf multi-well pads from the McIntyre flowback pits, which are owned and operated by SG. The McIntyre flowback pits are located on private land a few miles southeast of these two multi-well pads. The pipelines will be installed during the drilling phase of the 11-90-9-3 APD and/or the 11-90-15-2 APD, and support the operations during drilling and completion phases. These pipelines could remain in place after completion has occurred in order to return flowback water from the completion process back to the McIntyre flowback pits. If there happens to also be any unused fresh or recycled water stored at the multi-well pad that is no longer necessary, it would likely be transferred to the McIntyre flowback pits while these temporary pipelines are in use.
The proposed pipeline routes related to each multi-well pad are described below.

11-90-9 (Figure 9)
As identified in the 11-90-9-3 APD, a proposed temporary pipeline route (5.8 mi) will originate at the well pad, and head southeast cross-country intersecting and running northeast adjacent to FS851 then intersecting and running northeast adjacent to NFSR 265 on lease COC-08905 on NFS lands (1 mi). The pipeline then continues off lease east across NFS lands adjacent to NFSR 265 (0.1 mi). The pipeline then crosses the NFS boundary off lease and continues adjacent to a portion of CR265 and then turns south running cross-country across Fee/Fee lands (0.9 mi). The pipeline then continues south off lease across NFS lands until reaching the NFS boundary (0.4 mi). From the NFS boundary, the pipeline then continues south off lease crossing both Fee/Fee and split-estate lands intersecting NFSR 849, paralleling

a portion of the existing Bull Mountain gathering system (a buried pipeline), intersecting the Federal 24-2 WDW location then the Federal 11-90-26-1 location and terminating at the McIntyre flowback pits 3 & 4 (3.6 mi).

Aspen Leaf (Figure 9)
As identified in association with the 11-90-15-2 APD, a proposed temporary pipeline route (2.1 mi) will originate at the Aspen Leaf multi-well pad and head southeast on lease (0.1 mi) and then off lease adjacent to the well pad access road (0.7 mi) on NFS lands until reaching the NFS lands boundary. The poly pipeline then continues south adjacent to a road off lease on split-estate lands (0.4 mi) until it turns east and goes cross-country off lease across a mix of Fee/Fee land (0.8 mi) and split-estate land (0.1mi), until meeting up with the McIntyre flowback pits 3 & 4.

A poly pipeline operations plan is include in Appendix G. Design features related specifically to the installation, operation, and safety protocols are included in the operations plan.

In regards to drilling additional wells in the future, SG could request to use temporary surface polypipes to serve the drilling and completion of all the wells intended on the 11-90-9 (5 wells) and the Aspen Leaf (7 wells) multi-well pads.

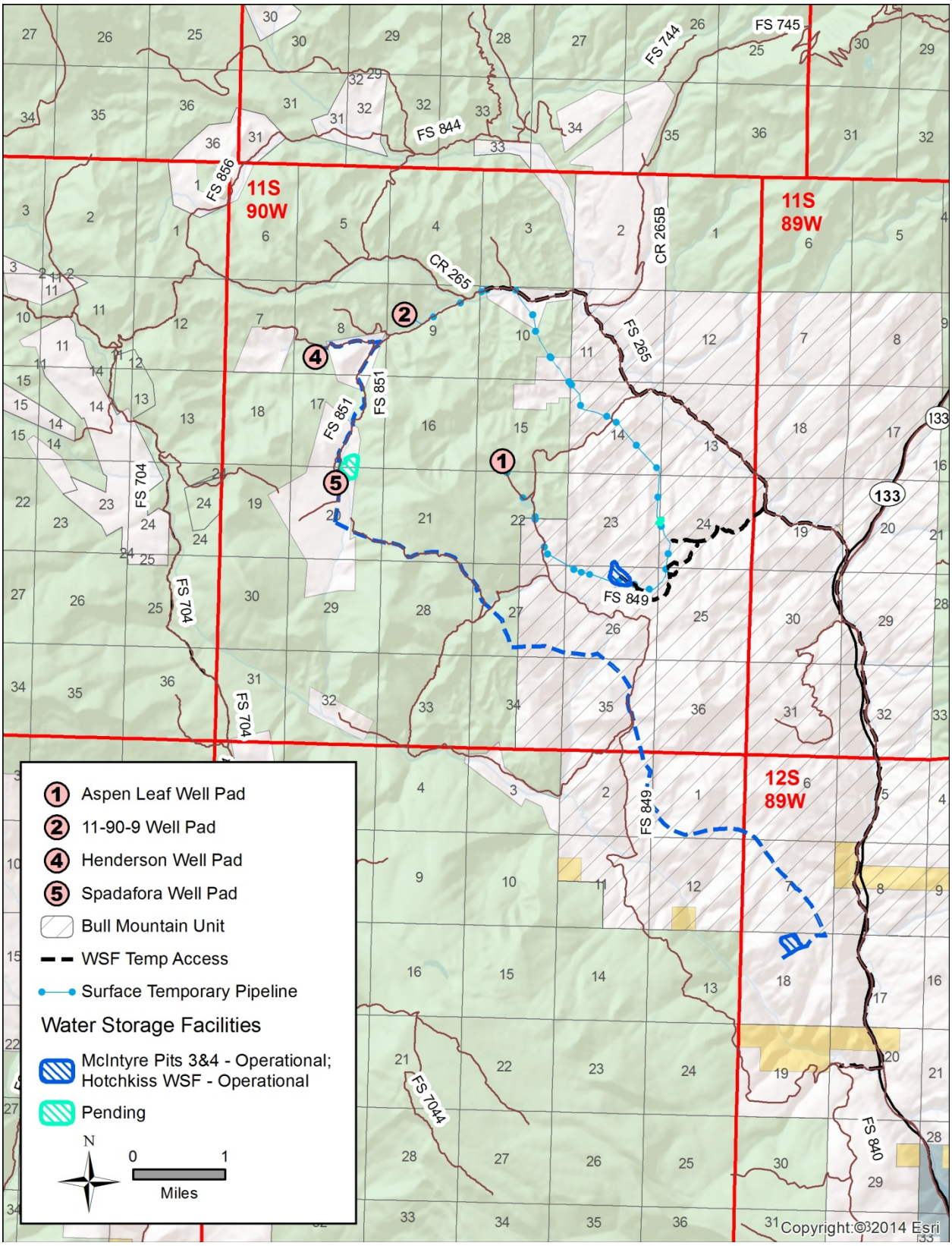


Figure 9 - Buried and Surface Water Pipelines and Water Storage Facilities

2.2.4 *Well Drilling, and Completion*

The targeted fluid mineral bearing zones (CBM or MCS) noted in the drill plan component of an APD directs the type of drilling (vertical, directional, horizontal) and completion techniques (e.g. hydraulic fracturing) the operator will utilize to develop the fluid mineral resource. Table 2-11 below describes the type of well, target mineral bearing zone, mineral interest and which Federal leases may be contacted by the well bore related to the initial six APDs submitted by the operators. For the purposes of analysis, the additional 19 natural gas wells of the proposed action are assumed to be horizontal MCS wells.

Table 2-11 Targeted Mineral Estate per APD.

Operator	Multi-well Pad	APD	Well Type	Target Mineral Zone	Mineral Interests	Federal Lease
SG	Allen	12-90-7-1	Vertical	CBM[4]	All Federal	SHL[1] = COC-66716
						BHL[3] = Same as SHL.
	11-90-9	11-90-9-3	Horizontal	MCS[5]	All Federal	SHL[1]= COC-08905
						IHL[2] = COC-42314
						BHL[3] = COC-13483
	Aspen Leaf	11-90-15-2	Horizontal	MCS[5]	All Federal	SHL[1]= COC-13484
						BHL = COC-13483
GE	Henderson	11-90-8-H3	Horizontal	MCS[5]	All Federal	SHL[1]= COC-42314
						IHL[2] = COC – 70005
						BHL[3] = 13483
	Spadafora	11-90-20-21-H1	Horizontal	MCS[5]	Fee and Federal	SHL[1]= FEE
						IHL[2] = COC-13483
						BHL[3] = COC-70004
		11-90-20-21-H2	Horizontal	MCS[5]	Fee and Federal	SHL[1]= FEE
						IHL[2] = COC-13483
						BHL[3] = COC-70004

[1]SHL- Surface Hole Location; [2]IHL- Intermediate Hole Location; [3]BHL- Bottom Hole Location
[4]CBM – Coal Bed methane; [5]MCS – Mancos Shale

Depending on the type of well, the drilling process can take from approximately 23 days for a CBM well up to 50 days for an MCS well. Time on location to conduct completion operations can take 14 days for a single stage hydraulic fracturing job typical of a CBM well to 36 or more days to perform a multi-stage hydraulic fracturing job associated with horizontal well development. This will result in a total of 23 drilling days and 14 completion days for the single CBM well and 1085 drilling days and 736 completion days for the 24 MCS wells related to this proposed action. The BLM and FS can reasonably expect to process these future APDs within a five (5) year time frame after the initial construction of the multi-well pads as each operator would be drilling and completing natural gas wells by contracting their own drilling rigs and completion companies allowing them to drill and complete their respective wells simultaneously within this five year timeframe.

To drill to the targeted production zone from the pad, GE and SG intend to utilize up to four total (1 GE, 2-3 SG) 1000hp Tier 2 non-road diesel compression ignition drill rigs. In addition to proposing some emission reduction practices as design features, GE and SG have also provided information regarding stationary, mobile and fugitive emission sources related to the proposed action.

Drilling will be performed with circulation of inert bentonite water-based mud, with various viscosity and density-adjusters such as polymers and barite. Density will be adjusted to lift cuttings and suppress formation fluid pressure. Other additives may be used to stabilize bore hole wall expansive clays. Drilling mud lubricates and cools the bit and flushes cuttings to settling tanks at the surface. Drilling mud will be displaced from the well bore in each separate casing setting and cementing event (surface, intermediate and production casings).

To ensure protection of any fresh water aquifers which drilling may encounter, each well bore will be started using a fresh water-based spud mud and cement to drill and set the surface and conductor portions of the well bore. The use of the fresh water-based drilling and cement will continue in the well bore until the operator switches to drill the intermediate and/or production string of the well bore. Table 2-12 below identifies the depths which the operator proposes to drill the surface casing of the well bore using fresh water based mud before switching to a low-solids, non-dispersed gel system polymer type

drilling mud to complete drilling of the well bore through the intermediate and production portions until reaching the target depth. Each of the additional wells on the specified well pad would likely set surface string to similar depths based on proximity of wells to each other and depth of formations being protected.

Table 2-12 Depth of Surface Casing Drilled and Cemented with Fresh Water Based Mud

Operator	Multi-well Pad	APD	Depth of Well Bore Surface String (ft)
SG	Allen	12-90-7-1	1000
	11-90-9	11-90-9-3	400
	Aspen Leaf	11-90-15-2	400
GE	Henderson	11-90-8-H3	900
	Spadafora	11-90-20-21-H1	1,100
		11-90-20-21-H2	960

During the drilling phase, temporary facilities and equipment would be placed on each of the multi-well pads to facilitate the activity. Such facilities include the blow-out preventer mounted to the well bore casing, a drill rig, drill pipe and casing, closed-loop mud systems, water tanks, cuttings storage bins, hazardous materials containment areas, temporary lined pits, trash receptacles, portable toilets, electrical generators, oilers, heaters, light plants, semi-trucks, light-duty trucks, heavy equipment (backhoe, front-end loaders), equipment trailers to support workforce and up to three job-site trailers housing the drilling superintendent, company representative, and the mud logger and mud engineer, occupied 24 hours per day until the drilling phase is completed.

During the completion phase (after production casing has been cemented in place), temporary facilities and equipment would be necessary on any of the multi-well pads to facilitate the operation. Such facilities include the completion rig, pumping and compression units, several surface pipelines and pipeline manifolds, a flare line and flare stack, frac tanks, flowback tanks, hazardous materials containment areas, temporary lined pits, trash receptacles, portable toilets, heavy equipment (back-hoe), equipment trailers to support workforce, semi-trucks, and light-duty trucks.

Well completion will consist of running a cement bond log to evaluate the cement integrity and to correlate the cased hole logs to the open hole logs. The casing will be perforated across the hydrocarbon producing zones, and the formation will be stimulated to enhance the production of natural gas. The typical method used for stimulation consists of a hydraulic fracture treatment in which sand and fluids are pumped into the producing formation with sufficient pressure to fracture the rock formation. The sand serves as a proppant to keep the created fracture open, thereby allowing reservoir fluids to move more efficiently into the well bore.

All wells associated with the proposed action will be cased and completed using anywhere from one (typical for a CBM well) to up to 27 (multiple within a horizontal well) stages of hydraulic fracturing to extract the fluid mineral resources.

Both GE and SG intend to use a combination of fresh water and recycled water to perform drilling and completion operations. Types of water and specific volumes necessary to drill and complete the wells in the proposed action are discussed in further detail below.

2.2.5 *Water Use*

Water use is integral to the proposed action and is necessary across all the components of fluid mineral well development. Phases such as construction, drilling/completion, production and final reclamation all require some volume of water in order to be accomplished. It is also important to distinguish the type of water as both GE and SG are committed to minimize the use of fresh water as much as possible due to its importance as a natural resource.

2.2.5.1 Fresh Water

In general, fresh water will be used throughout the proposed action for:

- Dust abatement on access roads and generated from construction activities.
- Drilling and cementing the surface casing portion of the proposed well bores to protect any subsurface fresh-water aquifers.

- Potentially used to fill pipelines to perform hydrostatic testing prior to flowing natural gas.

Fresh water will be obtained by GE and SG from a variety of sources and unless otherwise stated will be hauled in 80, 100, and/or 130 bbl. capacity water trucks to its destination. Unless otherwise stated in the individual APD, SG may obtain fresh water from the following sources:

- Purchased from a permitted commercial supplier. The closet source is currently Farnsworth Construction and Gravel in Paonia, CO. Any water purchased from this supplier would be hauled via water truck to the project location.
- Purchased from landowners. SG has in the past obtained a water purchase agreement which allowed for use of up to 15 acre feet of water from the Aspen Leaf reservoir and/or Ault reservoir.
- Obtained from free-flowing water sources when there is no call on this water. Sources near the proposed action include East Muddy Creek, and it is likely fresh water will be drawn from Little Henderson Creek.
- Drawn from free-flowing fresh water sources and augmented from Bainard Reservoir No. 1. SG was granted a Water Augmentation Plan in District Court, Water Division No. 4, Case No. 09CS16. Water used through SG's augmentation plan is replaced from the Bainard Reservoir No. 1 when required under the terms of the plan. The surface water rights related to Bainard Reservoir No. 1 are owned by Rock Creek Ranch I, Ltd. Rock Creek Ranch is the entity owned by the principal and general partner of SG. This water Augmentation plan is monitored and implemented by the Colorado Division of Water Resources Water Commissioner, District 40.

Unless otherwise stated in the individual APD, GE may obtain fresh water from the following sources:

- Purchased from a permitted commercial supplier. The closet source is currently Farnsworth Construction and Gravel in Paonia, CO. Any water purchased from this supplier would be hauled via water truck to the project location.
- Obtained from the Oxbow mine, a private source of fresh water in T13S, R90W, Sec. 18.
- Drawn from West Muddy Creek either during free water conditions or water transfer in T12S, R89W, Sec. 20. West Muddy Creek water will be pumped from the pumping station adjacent to GE's Deadman Gulch Unit 12-89-20-12 well pad inside the Deadman Gulch Unit. The road use would be a 0.5 mile stretch of existing split-estate ranch road, then use of CO State Hwy 133 (at the West Muddy creek crossing) north to its intersection with CR265, then on the proposed action access roads to get fresh water to the GE multi-well pads.
- GE operates four freshwater tanks (two-70 ft. diameter and two-120 ft. diameter) located in the Iron Point Unit several miles west of this project area. Water from these tanks may be trucked or transported via a collocated buried water pipeline adjacent to the Sheep Gas Gathering System pipeline for use in the wells drilled on the Henderson or Spadafora locations.

Fresh Water Source and Transport per APD

Allen, 12-90-7-1 APD and Future Wells
SG will use only fresh water mixed with drilling muds to drill the entire length of the well bore. Water will be obtained from Little Henderson Creek at a collection point inside the SG storage yard in T11S, R90W, Sec. 10, NENE then delivered to the location via water truck and stored for use in several tanks which will also serve to capture flowback water from completion activities.

11-90-9, 11-90-9-3 APD and Future Wells
The primary source of fresh water would be Little Henderson Creek. The point at which water would be drawn from Little Henderson Creek is the stretch of creek south of the planned well pad, either near the access road/NFS road intersection or from along NFS road south of the pad. If water is used from East Muddy Creek, it would be drawn from a point close to the pond adjacent to the company field office on CR265; however, SG may also draw water from an undisclosed point on the East Muddy Creek closer to the project site.

Trucks or a temporary surface poly pipeline would be used to transport fresh water to a 400 bbl. upright storage tank on the pad for drilling.
Accurate volumes of fresh water used in drilling and completing the well will be recorded and reported to the FS as part of SG's annual fresh water report for projects on Forest System Lands.

Aspen Leaf, 11-90-15-2 APD and Future Wells
Fresh water to be used during drilling operations will be delivered to the location by water truck obtained from one of the various sources identified by SG previously.
If any fresh water is needed for completions, it will be delivered to the well site by truck or piped via a temporary surface poly pipeline. If fresh water is to be pumped to the location, it would enter an aboveground surface poly pipeline at the points previously described.

Henderson, 11-90-8-H3 APD and Future Wells
Fresh water will be trucked to the well pad from the fresh water source or alternatively through buried pipeline if coming from the fresh water tanks in the adjacent Iron Point Unit (IPU). A portable tank is normally provided by the drill rig contractor. Size and configuration is dependent upon the rig contractor.

Spadafora, 11-90-20-21 H1& H2 APD and Future Wells
Fresh water will be trucked to the location from the fresh water source or alternatively through buried pipeline if coming from the fresh water tanks in the adjacent IPU. A portable tank is normally provided by the drill rig contractor. Size and configuration is dependent upon the rig contractor.

2.2.5.1.1 Fresh Water Dust Abatement

GE and SG will be using fresh water exclusively for dust abatement purposes. During construction and periods of high traffic activity, both operators will be monitoring and controlling the amount of dust which is generated from road use and that which is kicked up during earthmoving activities due to reduced soil moisture levels. Dust abatement measures will be employed to maintain the integrity of the road surface and reduce the levels of dust generated during periods of high traffic related to this proposed action. The typical operating season when dust abatement is likely necessary is approximately 180 days (mid-May thru mid-November). The estimates of fresh water used for dust abatement are influenced by the weather, other users activities, changes in operational schedule, and potentially by landowner/agency requirements.

After turning onto CR265 from CO Hwy 133, the road surface is typically graveled. GE, SG and Gunnison County have an agreement (LI#10-241) whereby Gunnison County will grade and apply magnesium chloride to CR265 annually. Although Gunnison County will be applying magnesium chloride to CR265, this form of dust abatement is not being proposed on any other roads used to access the multi-well pads of the proposed action. Operator committed design features for dust abatement are included in section 2.2.1 (Design Features).

If there is opportunity for cooperation in dust suppression, GE and SG would consult to avoid duplication and excessive water usage. As both operators will be drilling wells independently, it is difficult to determine when these overlaps would likely occur. At times, both operators will likely be simultaneously using portions of NFSR 265, NFSR 851, and NFSR 704 to access GE's Iron Point Unit operations west beyond the project area, SG's Allen and 11-90-9 locations, and GE's Henderson and Spadafora locations.

A total of 19.8 miles of road will have dust abatement applied during operations associated with this proposed action. On roads specific to this proposed action each operator has identified in their APDs that:

- GE will apply fresh water at 40bbl per mile on 4.7 miles of road.
- SG will apply fresh water at 43-298 bbl. per mile on 4 miles of road.
- The two operators would then work out the application of dust abatement to coincide with both operators using approximately 11.1 miles of the same access road.

SG Fresh Water Needs for Dust Abatement
SG anticipates applying fresh water for dust abatement purposes to unpaved (excluding where MgCl is effective) portions of project roads using up to two 80bbl. water trucks regularly during the construction,

drilling and completion phases of this development. SG's portion of the proposed action in which they would be likely responsible to apply dust abatement measures totals approximately 4.0 miles. When measures are taken to abate dust on project roads, SG estimates that between 12,000-50,000 gallons (286 bbl. to 1,192 bbl.) of fresh water would be applied to these project roads per day depending upon project phase.

Application of dust abatement measures will occur for approximately 82 days (12 weeks) during well pad construction, drilling and completions. During the remainder of the operating season outside the winter months (12 weeks), dust abatement will occur on project roads approximately twice per week. Annually, SG could apply water for dust abatement for approximately 131 days.

SG may also be using fresh water for dust abatement on a 2.5 mi portion of private ranch road, named the Narrows Road. This graveled road surface is an access SG uses between CR265 and either the Federal 24-2 WDW or the McIntyre flowback pits and services all of SG's Bull Mountain Unit oil and gas operations. As a result of previous authorizations and developments in the Bull Mountain Unit, SG controls dust on the Narrows Road as needed to facilitate the Bull Mountain Unit operations and that fresh water used for dust abatement has been accounted for otherwise.

GE Fresh Water Needs for Dust Abatement

To develop horizontal shale wells, GE estimates that approximately 1,689 gallons (40bbl) of fresh water would be applied per mile to project roads. Per multi-well pad, dust abatement measures will occur for approximately 101 days (14.5 weeks) during well pad construction, drilling and completions. During the remainder of the operating season outside the winter months (11.5 weeks), dust abatement will occur on project roads approximately twice per week. Annually, GE would perform dust abatement for approximately 124 days.

As stated above, varying amounts of water will be necessary based on multiple factors. Those factors include but are not limited to the particular phase of development each operator may be undertaking at the time, weather conditions and road conditions. As estimated by the operators in the absence of variables beyond the operator's control, volumes of fresh water needed for dust abatement for the project under maximum development (likely year one activities) are shown in Table 2-13 below. Total values for dust abatement include the initial construction activities to create four well pads and perform interim reclamation which includes the drilling and completion of six wells presumed to occur in year one. After well pad construction and interim reclamation measures are in place, the volume of fresh water use (application days) would be reduced in the remaining years to coincide with only drilling/completion of additional wells and/or production/workover maintenance levels.

Dust Abatement Application Upon GE and SG Shared Road Use

Together depending upon road conditions, weather and traffic needs, the operators may apply 40-298 bbl. of fresh water per mile (Table 2-13). Both operators will work out the timing of application in order to eliminate overlapping and duplicating applications on the following project roads:

- To develop the 11-90-9, Henderson and Spadafora Multi-well pads, GE and SG share 0.4 mile of access road (0.3 mi NFSR 265 and 0.1mi NFSR 851).
- To develop the Allen well, GE and SG share 11.1 miles of access road (5.4 mi NFSR 265, 5.7 mi NFSR 704)
    - GE also uses this NFS road to access neighboring well developments in the Iron Point Unit which may also be used to truck water from the four fresh water tanks GE operates in the Iron Point Unit to the Henderson and Spadafora locations.

Table 2-13 Fresh water Usage for Dust Abatement First Year – Highest Rate of Activities Expected

	1bbl = 42 US gallons)			1 Ac/ft = 7,759 bbl.		
Operator	**bbl. per mi**	**Project miles**	**bbl per day**	**Ac.ft p/day**	**Application Days p/y[1]**	**Ac.ft p/year**
SG	71-298	4	284-1192	0.04-0.15	131	5.24-19.7
GE	40	4.7	188	0.03	124	3.7
GE & SG	40-298	11.1	444-3278	0.06-.43	124	7.44-53
Total per Year		**19.8**	**916-4658**	**0.13-0.61**	**n/a**	**16.4-76.4**

[1]- Once pad construction and drilling of all wells proposed on a pad is completed, the number of application days per year would be reduced.

Allen
The portion of the proposed action related to the development of SG's Allen location and subsequent wells on the Allen pad includes approximately 11.1 miles of access roads (5.4 mi NFSR265 and 5.7 mi NFSR 704) which GE and SG would be sharing throughout the drilling season to develop natural gas wells associated with this project.

SG will apply dust abatement on approximately 1.1 miles of NFSR 704.4A between the intersection of NFSR 704 and the pad.

11-90-9
GE and SG will share the dust abatement applications on a 0.3 mile portion of NFSR265 and a 0.1 mile portion of NFSR 851.

SG will apply dust abatement on approximately 0.3 miles of new access to the pad.

Aspen Leaf
SG will apply dust abatement on approximately 2.6 miles of existing access on Fee portions and NFS portions NFSR 849 and the well pad access between the intersection of CR265 and the pad.

Henderson
GE and SG will share the dust abatement applications on a 0.3 mile portion of NFSR265 and 0.1 mile portion of NFSR851.

GE will apply dust abatement under a single collective application to a 0.9 mile portion of NFSR 851 and a 0.1 mile Fee portion of NFSR 851 servicing both the Henderson and Spadafora multi-well pads.

GE will apply dust abatement on approximately 1.8 miles of access on Fee and NFS portions of NFSR 851.1b and the new well pad access road on NFS.

Spadafora
GE and SG will share the dust abatement applications on a 0.3 mile portion of NFSR265 and 0.1 mile portion of NFSR851.

GE will apply dust abatement under a single collective application to a 0.9 mile portion of NFSR 851 and a 0.1 mile Fee portion of NFSR 851 servicing both the Henderson and Spadafora multi-well pads.

Then GE will apply dust abatement on approximately 0.9 miles of access on Fee and NFS portions of NFSR 851 and the new pad access road on Fee.

2.2.5.2 Recycled Water

Besides fresh water, the other type of water the operators may use in portions of the drilling phase and during completions is "recycled" water which is a combination of produced waters from wells and flowback water from well completions which are transferred from the well sites to each of the operators respective water storage facilities.

GE owns and operates the HWSF, which stores produced water and flowback water from GE's operations. The water is referred to as "recycled" when proposed for use in the drilling and completion phases of GE's wells.

SG owns and operations the McIntyre flowback pits 3 & 4 located in T11S, R90W, Sec. 24 which stores produced water and flowback water from SG's operations. The water is referred to as "recycled" when proposed for use in the drilling and completing SG's new wells.

Recycled Water Source and Transport (Figure 9)

Allen, 12-90-7-1 APD and Future Wells
Due to the distance between the proposed well and SG's McIntyre flowback pits, a temporary poly pipeline will not be in use as recycled water and will not be used to drill wells at this location. However, if practicable, recycled water would be trucked to the well site from the McIntyre flowback pits 3 & 4 for completion purposes and may be a 70/30 combination of recycled water and fresh water. Trucks carrying recycled water between the pad and the flowback pits would use a private ranch road for approximately 2.5 miles before continuing on CR265 then following the proposed access route to the location. The recycled water will be brought to the location and be offloaded into several 43 feet long by 8feet wide frac tanks (500 bbl. capacity) placed on the southeast side of the pad.

11-90-9, 11-90-9-3 APD and Future Wells
If SG is able to use temporary surface poly pipelines to transport recycled water to the well pad from the McIntyre flowback pits 3 & 4 for completing the well, water used during completion of the well would be almost entirely recycled water and fresh water would likely not be needed. Water that is left over after drilling (approx. 300-400 bbl.) will be trucked to the Federal 24-2 WDW for disposal.

Aspen Leaf, 11-90-15-2 APD and Future Wells
Recycled water to be used in completions will be piped to the well site from the McIntyre flowback pits 3 & 4 via either an existing buried water pipeline or a temporary surface poly pipeline.

Henderson, 11-90-8-H3 APD and Future Wells
All water that is pumped for fracture stimulation will be recycled water from GE's HWSF and pumped 10 miles to the site via underground pipelines. Water will be continually transferred via the Sheep gathering system and will not be treated prior to use at the well head. On-site storage of 20,000 to 40,000 bbl. of recycled water in 40 to 80 upright 500 bbl. frac tanks will be required.

Spadafora, 11-90-20-21 H1& H2 APD and Future Wells
All water that is pumped for completions will be recycled water that is pumped to location from GE's HWSF through an existing 6 inch water line, co-located with the Sheep gathering system and stored on the location in 40 – 80 upright 500 bbl. frac tanks. Water will be continually transferred via the Sheep gathering system and will not be treated prior to use at the well head.

2.2.5.3 Drilling and Completion Water Use

The quantities of fresh and recycled water necessary for drilling and completion of each of the six APDs associated with this proposed action is identified in Table 2-14 below. Flowback water quantity is also identified as it is necessary to return the water to each of the operator's water storage facilities for future use as recycled water. For purposes of analysis and comparison, the totals are also provided in acre feet (Ac/ft). Each operator has identified the following in terms of fresh water usage and recycled water usage based upon their drilling and completion needs.

SG
SG will be using fresh water to drill the entire well bore and a combination of 70% recycled water and 30% fresh water will be used for completions with an estimated flowback of 80% of the completion fluids. Drilling of the 12-90-7-1 CBM well will require 3,000 bbl. of fresh water to drill and an additional 5,000 bbl. of fresh water for completion. SG estimates that each proposed shale well (16) will require 10,000 bbl. of fresh water to drill and a combination of 60,000 bbl. of fresh water and 140,000 bbl. of recycled water for completions. Therefore, in order to drill and complete the 17 natural gas wells proposed by SG, approximately 1,128,000 bbl. of fresh water is anticipated (Table 2-14).

GE

GE will be using fresh water to drill the initial portion of the well bore and then will switch to using recycled water to drill the remaining portions of the well bore once sufficiently beyond any fresh water zones. GE will then complete the wells using only recycled water and anticipates that only 20% of the completion fluids will return as flowback. GE estimates that each of the eight natural gas wells will require 1,000 bbl. of fresh water and 2,000 bbl. of recycled water to drill the wellbore entirely. GE will then utilize 500,000 bbl. of recycled water exclusively for completion purposes. Therefore to drill and complete the eight natural gas wells proposed by GE, approximately 8000 bbl. of fresh water is anticipated (Table 2-14).

Table 2-14 Drilling and Completion Water Volumes

			Volumes in bbl. (1bbl = 42 US gallons)					(1 Ac/ft = 7,758.37 bbl.)
			Drilling		**Completion**		**Flowback**	**Ac/ft**
Operator	**APD**	**Well Type**	**Fresh**	**Recycled[1]**	**Fresh**	**Recycled[1]**	**(80% SG) (20% GE)**	**Fresh**
SG	11-90-9-3	Shale	10000	0	60000	140000	160000	9.0
	Up to 4 more 11-90-9 wells	Shale	40000	0	240000	560000	640000	37.0
	11-90-15-2	Shale	10000	0	60000	140000	160000	9.0
	Up to 6 more Aspen Leaf wells	Shale	60000	0	360000	840000	1500000	54
	12-90-7-1	CBM	3000	0	5000	0	6400	1.1
	Up to 4 more Allen Wells	Shale	40000	0	240000	560000	640000	37.0
GE	11-90-8-H3	Shale	1000	2000	0	500000	100000	0.13
	Up to 3 more Henderson wells	Shale	3000	6000	0	1500000	300000	0.4
	11-90-20-21-H1	Shale	1000	2000	0	500000	100000	0.13
	11-90-20-21-H2	Shale	1000	2000	0	500000	100000	0.13
	Up to 2 more Spadafora wells	Shale	2000	4000	0	1000000	200000	0.25
Total			171000	n/a	965000	n/a	n/a	148

[1]*-Recycled water is re-used over and over, therefore no grand totals are assumed for recycled water use.*

2.2.5.4 Flowback Water

As a result of the completion process, a significant amount of flowback water returns to the surface immediately after the process takes place. Flowback water typically consists of the fluids and sand that were initially sent down the well bore for the completion process. SG estimates that the volume of flowback water is approximately 80% of the volume of fresh/recycled water which was initially put down the well for the completion effort.

Flowback water from SG's project wells will be recaptured, sent to separators and temporarily stored in frac tanks on the location and then the stored fluid would be transferred into temporary surface poly pipelines or tanker trucks for transfer to the McIntyre Flowback Pits for recycling and ultimately offsite disposal either at the Federal 24-2 WDW located in T11S, R90W, Section 24, NWSW, 6th PM, or sent to a commercial disposal facility.

If SG must haul flowback water, SG will also utilize a portion of existing private ranch road already upgraded to accommodate oil and gas activities in the area, that takes off of CR265 and extends approximately 2.5 miles into the Bull Mountain Unit, to haul and dump at either the McIntyre flowback pits or directly into the SG 24-2WDW.

Flowback water from GE's project wells will be pumped from the location via existing buried 6 inch diameter water lines, co-located with the Sheep gathering system buried water pipeline to GE's HWSF inside the Deadman Gulch Unit T12S, R89W, Section 18.

2.2.6 *Transportation*

Year-round access is maintained for approximately 7.5 miles of CR 265/NFSR 265 until the intersection of NFSR 265 and NFSR 844 (Figure 4). Beyond this intersection, there is no winter maintenance and the intersection doubles as a trailhead popular for snowmobiling activities. Depending upon winter snowpack levels, FS approval may be obtained to use NFSR 265 and NFSR 704. GE has, in the past, used these NFS roads with FS approval during the winter months to access other natural gas developments located beyond those in this proposed action.

Implementation of this proposed action will require, at times, intense use of the transportation system roads identified in section 2.2.2 (Existing Infrastructure, Access). Elements of transportation use such as traffic volume and Average Daily Traffic (ADT) needs directly related to this proposed action are identified in the following Tables 2-15 through 2-20.

The types of vehicles which will be necessary to facilitate development include semi-trucks hauling, heavy equipment, water tanks, drill rig, drilling materials, drilling steel and casing, drilling equipment, and numerous water trucks, dump trucks, fuel trucks and pick-up trucks. GE estimates that the greatest vehicle weight load proposed which may use CR265, NFSR 265, 851, or 851.1B is 120,000 pounds (60 tons). Table 2-15 below represents the total volumes of traffic anticipated by GE and SG related to this proposed action.

Table 2-15 Total Annual Round Trips for Proposed Action.

Operator	Multi-well Pad	Construction/ Reclamation[1]	Drilling[2]	Completion[3]	Production (Annual)[4]	Workover[5]
SG	Allen	142-198	195 (CBM). 411 (MCS)	198 (CBM), 324 (MCS)	886	31
	11-90-9	142-198	513	324		31
	Aspen Leaf	n/a	463	324		31
GE	Henderson	135	725	842	365	15
	Spadafora	135	725	842		15
	TOTAL	**554-666**	**2621-2837**	**2530-2656**	**1251**	**123**

[1]- For analysis purposes, this would only be added to ADT assumed in year one. Once construction and reclamation measures have been applied, the ADT on an annual basis would be reduced.
[2]-For analysis purposes, this data is on a per well basis. Therefore this volume of traffic would occur per well until all wells of the proposed action are drilled.
[3]-For analysis purposes, this data is on a per well basis. Therefore this volume of traffic would occur per well until all wells of the proposed action are completed.
[4]-For analysis purposes, this data is on a per pad basis and account for 1-2 trucks per day for maintenance and production activities year round, regardless if a well is being drilled or completed or if all wells on the pad are in producing status.
[5]-For analysis purposes, this data is on a per well basis and assumes one workover per pad annually.

Average daily traffic estimates were provided by GE and SG via the APDs. The information displayed in Tables 2-16 through 2-20 identify with the multi-well pad the traffic it is related to. Each phase of development is represented in a different table as varying levels of traffic needs can occur based on the operator's needs at the time. Due to one of the six proposed APDs (SG 12-90-7-1) being a CBM well, separate drilling time and completion timetables were added to accommodate that particular development versus the other shale well APDs. The tables below break down the ADT per major phase of development.

Table 2-16 Anticipated ADT for Construction and Reclamation Phases of Development

ADT for Construction and Reclamation of 4 Multi-well Pads[1]							
Operator	**Multi-well Pad**	**Duration (days)**	**Construction (days)**	**Interim Reclamation (days)**	**Final Reclamation (days)**	**Total Rnd Trips**	**ADT**
SG	Allen	19-27	10-14	2-3	7-10	142-198	7
	11-90-9	19-27	10-14	2-3	7-10	142-198	
GE	Henderson	17	11	3	3	135	5 to 6
	Spadafora	17	11	3	3	135	
TOTAL		**72-88 Days**	**42-50 Days**	**10-12 Days**	**20-26 Days**	**554-666**	**12-13**

[1]- Calculated as a one time basis per pad. Once construction has occurred and reclamation measures have been applied, this ADT would no longer be accounted for.

Table 2-17 Anticipated ADT for Drilling Phase of Development

ADT for Drilling 12-90-7-1 CBM Well[1]							
Operator	**Multi-well Pad**	**Duration (days)**	**Mobilization**	**Drilling**	**Demobilize**	**Total Rnd Trips**	**ADT**
SG	Allen	23	3	17	3	195	8 to 9
ADT for Drilling Shale Wells[2]							
Operator	**Multi-well Pad**	**Duration (days)**	**Mobilization (days)**	**Drilling (days)**	**Demobilize (days)**	**Total Rnd Trips**	**ADT**
SG	Allen	40	5	30	5	411	10-11
	11-90-9	50	5	40	5	513	
	Aspen Leaf	45	5	40	5	463	
GE	Henderson	45	5	35	5	725	16 to 17
	Spadafora	45	5	35	5	725	
TOTAL		**225**	**5**	**35-40**	**5**	**2683**	**26-28**

1- Drilling of only one CBM well is analyzed in the proposed action. Once this well has been drilled the ADT assumed for additional wells is not calculated based on CBM.
2- For analysis purposes, this ADT would occur as estimated by the operator for their proposed shale wells, up to 24 total.

Table 2-18 Anticipated ADT for Completion Phase of Development

ADT for Completing 12-90-7-1 CBM Well[1]				
Operator	**Multi-well Pad**	**Duration (days)**	**Total Trips**	**ADT**
SG	Allen	14-28	198	14 to 15
ADT for Completing Shale Wells[2]				
Operator	**Multi-well Pad**	**Duration (days)**	**Total Rnd Trips**	**ADT**
SG	Allen	28	324	11-12
	11-90-9	28	324	
	Aspen Leaf	28	324	
GE	Henderson	36	842	23 to 24
	Spadafora	36	842	
TOTAL		**n/a**	**2656**	**33-36**

1- Completion of only one CBM well is analyzed in the proposed action. Once this well has been completed the ADT assumed for additional wells is not calculated based on CBM.
2- For analysis purposes, this ADT would occur as estimated by the operator for their proposed shale wells, up to 24 total.

Table 2-19 Anticipated ADT for Production Phase of Development

ADT for Production (All Wells on an Annual Basis)[1]				
Operator	**Multi-well Pad**	**Duration**	**Total Rnd Trips**	**ADT**
SG	Allen	Daily by 2 pickups and intermittent by pumper.	886	2 to 3
	11-90-9	Daily by 2 pickups and intermittent by pumper.		
	Aspen Leaf	Daily by 2 pickups and intermittent by pumper.		
GE	Henderson	Daily for life of well	365	1
	Spadafora	Daily for life of well		
TOTAL			**1251**	**3-4**

[1]- For analysis purposes, this data is on a per pad basis and account for 1-3 trucks per day for maintenance and production activities year round, regardless if a well is being drilled or completed or if all wells on the well pad are producing.

Table 2-20 Anticipated ADT for Workovers

ADT for Workovers (All Wells)[1]				
Operator	**Multi-well Pad**	**Duration (days)**	**Total Round Trips**	**ADT**
SG	Allen	10	31	6 to 7
	11-90-9	10	31	6 to 7
	Aspen Leaf	10	31	6 to 7
GE	Henderson	5	15	3
	Spadafora	5	15	3
TOTAL		**40**	**123**	**24-27**

[1]- For analysis purposes, the ADT related to workovers is assumed on an annual basis for the life of the project related to each well of the proposed action once drilled.

2.2.7 *Handling of Waste Materials*

Waste materials produced as a result of this proposed action include garbage and trash brought in by personnel, industrial refuse generated during all phases of development, sewage and sanitation needs, petroleum based fuels and lubricants, cuttings resulting from drilling the well reserve pit contents, fracture stimulation fluids during completion, and flaring of produced gas during completion operations. During all phases of development, the access roads and multi-well pads will be kept clean through methods such as centralized trash collection, portable latrines for containment of human sewage and waste, all regularly collected and hauled to an appropriate disposal facility. Operator committed design features for dust abatement are included in section 2.2.1 (Design Features).

Some extremely hazardous materials may be expected to be used, stored, or transported within the project area. In accordance with 29 CFR 1910.1200 (g) (8) and/or (g) (9), (OSHA, Toxic and Hazardous Substances, Hazard Communication) Safety Data Sheets (SDS) for every chemical or hazardous material brought on-site will be kept on file at the operator's field office. For purposes of making information available, a hazardous materials management summary is included as Appendix E.

SG has in place a spill prevention, control and countermeasures (SPCC) plan, prepared by Fox Engineering in November of 2011, revised in 2012, that applies to all facilities in Gunnison and Delta Counties. This plan describes inspections and other practices to prevent spills, approaches to control and cleanup of spills if they do occur, and contact and reporting details for communication in the event of a spill. These materials are sub-divided into two categories:

- Exploration and Production Waste (E&P Waste) such as produced water, condensate, or any other material that has been down hole.
- Non-E&P Waste such as fuels and oils. This would include materials such as diesel fuel, hydraulic oil, motor oil, and glycol.

At SG's locations, fuels and lubricants will be transported by fuels distributers and will be stored in facilities specifically designed for that purpose.

SG will place production facilities inside a bermed secondary containment area capable of handling 150% of the storage capacity of the largest tank within the berm.

GE will follow measures outlined in their SPCC Plan. GE will take all reasonable precautions to prevent any dumping or spilling of oil or hazardous material on NFS lands, and will take appropriate preventative measures to ensure that any spill of such oil or hazardous materials will be immediately picked up and removed from NFS lands. All releases of any substance to soil or water will be immediately reported to the BLM and FS compliance officers as outlined in GE's SPCC plan.

GE will contain waste oils from equipment on-site in secondary containment sufficient to contain 110% of the single largest container and upon demobilization of the drilling and completion equipment dispose of the waste oils at an off-site approved facility such as Safety-Kleen Systems, 368 Bonny Street, Grand Junction, CO., who recycles them.

GE will place production facilities with the potential to leak or spill produced water, glycol, or other fluid which might be a hazard to public health or safety within an appropriate impervious secondary containment structure that will hold 110% of the capacity of the largest single container within it for 72 hours. Secondary containment will consist of lined corrugated steel containment or compacted earthen berms. Compaction and construction of earthen berms will be performed to prevent lateral movement of fluids through the utilized materials. All loading lines will be placed inside the containment berm.

The general verbal and written notification requirements for various spill materials and amounts included in the operators SPCC Plans are presented in Appendix D**.**

2.2.7.1 Cuttings Handling

Drilling natural gas wells creates cuttings which come to the surface and must be handled according to the operators chosen methods. Cuttings are a combination of drilling fluids mixed with the materials

being drilled and as they return to the surface the operator typically will employ methods to separate the cuttings for disposal and capture the drilling fluids for reuse or disposal. This is accomplished by sending the returning material through shakers and centrifuges at which point the fluids end up being placed in an appropriate container on the location. The cuttings are then handled by placing in a lined earthen pit on the location or ran through a closed-loop system by which nearly all the moisture in the cuttings is further stripped out and captured, and semi-dry cuttings are then placed in storage bins to be hauled away or placed in a lined pit or temporary storage area on the location to await further handling and disposal.

Reuse of drilling fluids could occur if it is needed where the operators are drilling elsewhere. Disposal can occur at commercial facilities and/or be sent to an injection well.

SG will typically dispose of these fluids in the SG Federal 24-2 WDW located in the nearby Bull Mountain Unit. But fluids may be transferred to Industrial Ecosystems Incorporated located at 49 CR3150, Aztec, NM.

GE will typically try to reuse the drilling fluids at other sites where drilling is occurring, however if no sites are available, the liquids may be taken to the Deer Creek Disposal Facility at 5180 US Hwy 50, Whitewater, CO., or transfer to the GE 18-22WDW located in the nearby Deadman Gulch Unit.

If necessary, both GE and SG will transport drill cuttings to the Adobe Buttes Landfill located at 12211 Trap Club Road, Eckert, CO. and GE may also use ECDC Environmental Landfill in East Carbon, UT.

Both operators will dispose of any pit liners used on the location at an authorized disposal facility with the most likely being the Adobe Buttes Landfill located at 12111 Trap Club Road, Eckert, CO.

Use of a closed-loop system usually reduces the footprint of the oil and gas activity on a location by eliminating pit excavations, limiting waste from pit liners, and allows for drilling fluids to be recycled rather than disposed of combined with cuttings.

The volume of cuttings depends upon the diameter and length of the well bore. For a typical vertical CBM well, 100-200 cubic yards of cuttings may return from the well bore and cuttings returning from drilling a deep horizontal well could be at least 450 cubic yards.

SG Cuttings Handling

SG will capture cuttings and drilling fluids as they exit the bore hole and process them using shakers and centrifuges in order to separate some of the fluids and cuttings. Once the cuttings are separated, they will be placed into a cuttings bin which is typically a lined trailer container that holds cuttings aboveground until the trailer is hauled to an approved cuttings disposal area.

All cuttings will be tested in accordance with COGCC sampling protocols and results compared with COGCC Table 910-1 concentration levels prior to disposing of under appropriate Federal and State law.

Allen

At the time a drill rig is contracted for the project, SG will determine whether a reserve pit or a cuttings pit/container is needed.

If a closed loop system is used, the cuttings returned to the surface during the well drilling process may be captured in a cuttings bin rather than a cuttings pit. Should a closed-loop system be deployed, a cuttings bin would be used to capture cuttings. SG anticipates placing eight such containers on each pad capable of holding approximately six cubic yards of cuttings material each. Which, when loaded with drill cuttings, will be tarped to limit seasonal moisture from entering while cuttings are waiting to be hauled away.

In the absence of a closed-loop system, a reserve pit would be dug on the pad and constructed large enough to contain the waste generated from drilling the well. Protection measures such as a liner to protect the surrounding area from contamination and fencing would be installed to deter entry of wildlife until the pit can be removed. Depending upon the timing of drilling additional wells on the pad, the pit may remain usable for additional wells.

In order to create the reserve pit, approximately 1200 cubic yards of soil would be excavated in cut soils to create the pit. The area under the pit over which the liner is laid will be free of rocks and other objects

that could puncture the liner. The excavated pit soils would be stored separate of topsoil, in an area near the pad, out of the way of operating equipment yet close by in order to facilitate closure of the pit once the well is completed.

A minimum of two feet of free board will be maintained between the maximum fluid level and the top of the pits. The pits will be designed to exclude all surface runoff and will be constructed in the cut portion of the well pad. Back slopes will be 2:1 or less.

The reserve pit will be lined with an impervious liner having a minimum thickness of twenty-four (24) mils.

During drilling operations, the cuttings pit will be fenced on three sides with woven wire and the fourth side fenced immediately after the rig has been moved off location. The fence will be 6 foot to 8 foot in height to prevent deer and elk as well as other wildlife from entering the pit. After the rig has been moved off location, bird netting will be placed over the pit to prevent birds from entering the pit area. The pit will remain fenced until it has dried enough to be backfilled.

If fluids must be removed from drilling pits, vacuum trucks will remove these fluids so that the pit liner will not be damaged with heavy equipment. These fluids will be disposed of at the Federal 24-2 WDW in the Bull Mountain Unit.

Pit Reclamation

SG will ensure pits are free of oil and other liquid and solid wastes and allow pits to dry, pump them dry, or solidify them in-situ. Pit liners will be removed and disposed of at a solid waste disposal facility. Prior to backfilling, SG will ensure that there is not a concentration of non-exempt hazardous substances in the reserve pit. Concentrations will not exceed standards of CERCLA, RCRA, or COGCC standards for such oil and gas field standards. Soil testing under the removed liner area will also be conducted prior to backfilling the pit area.

Following testing, cuttings with either be consolidated and left on site or removed to an approved location or facility.

11-90-9 and Aspen
A closed-loop system will be used. Once cuttings are returned during the well drilling process, they will be captured in a cuttings bin rather than a cuttings pit.

Cuttings will be tested in accordance with the requirements of the disposal destination. Cuttings will not be stored on the location past the active drilling phase.

GE Cuttings Handling
GE will handle cuttings from wells drilled on the Henderson and Spadafora well pads in much the same manner. Once they exit the well bore, the liquids will be removed using a centrifuge and reclaimed for drilling.

The cuttings will then come off the mud management equipment into a three-sided metal bin. At least 4 bins will be onsite at all times to ensure sufficient volume is available during variable drilling conditions. Collected cuttings will be moved from the three-sided bins to the temporary cuttings storage pad using a rubber-tired front-end loader and placed in windrows for additional air drying.

A bermed and lined temporary 65 feet x 65 feet cuttings storage pad sufficient to hold 450 cubic yards of cuttings will be constructed on the locations. The cuttings pad will be bermed on all four sides by a 3 foot wide x 3 foot high soil berm. The liner will have a minimum thickness of 30-mil. The liner and the cuttings pad surface will be covered with a 3 inch layer of soil to protect the liner from equipment utilized to place cuttings. Sawdust or wood chips may be added to the windrowed cuttings periodically, depending upon their moisture content. Any storm waters that generate standing water within the bermed area will be pumped out for use in well drilling or completion or hauled off-site for disposal.

When multiple wells are to be drilled in a series, the bermed area would be in use until all drilling efforts are suspended. Wells will be drilled sequentially and cuttings will be handled sequentially through the cutting storage pad. Cuttings will be characterized and hauled to the disposal facility as needed, ensuring the 450 cubic yard capacity is not exceeded.

If drilling is temporarily suspended (e.g., winter shut-down), a temporary top liner will be placed over the bermed area (including all contents). The temporary top liner will be removed when drilling resumes and use of the bermed area will resume.

When drilling is completed, all cuttings will be removed from the bermed area using conventional earthmoving equipment (excavator or loader) and the liner removed for off-site disposal (liners will not be re-used in subsequent bermed areas). All cuttings will be disposed of within six (6) months after well completion. Soils below the liner will be sampled, analyzed, and comparted to COGCC Table 910-1 concentration levels.

Henderson
The cuttings from each windrow will be sampled, analyzed, and compared to COGCC Table 910.1 concentration levels prior to removal. Cuttings will be hauled to an offsite disposal facility regardless of quality.

Cuttings will be removed from the bermed area and placed into truck beds or roll-off bins for transportation. Hauling of the cuttings to the disposal facility will commence within two days of startup.

Spadafora
Each segregated pile of cuttings placed in the cuttings storage pad will be sampled (at least three composited samples per row) and analyzed to determine if they are within regulatory limits for COGCC Table 910-1 concentration levels.

If testing shows that cuttings are not within safe limits compared to COGCC Table 910-1 concentration levels, cuttings will be shipped to a state-approved off-site commercial disposal facility.

Following testing of cuttings, a trench 10 feet deep x 15 feet wide x 75 feet long may be constructed on the cut side of the pad to accommodate approximately 10,000 cubic feet (370 cubic yards) of acceptable cuttings. Excavated materials from the trench will be stored on the cut side of the pad. The trench size assumes complete containment of the estimated volume of the cuttings. Excavated soil from the trench will be placed in a 2-foot layer over the cuttings and blended back into the surrounding edges. The trenches will only be used to contain cuttings. No other exploration and production waste will be allowed in the trench.

2.2.7.2 Fracture Stimulation Fluids

Fracture stimulation fluids are custom-engineered to accomplish various objectives, including:

- Pressuring the formation through perforations in the production casing to fracture the rock, and propagate those fractures some distance from the formation;
- Carrying proppant particulates, sand, ceramic or plastic (to prop fractures open when the pressure is released), and small rubber balls to block perforations and hold injected fluids outside the casing for a short time; and
- Carrying other chemicals to “break” the gel suspending the proppant, disinfect the hydraulically fractured zone, and retard microbial growth which can sour the well, and flush general residual chemicals.

Most constituents used in hydraulic fracturing are either consumed in the treatment (acid, pH buffers), are inert (sand), or are biodegradable. Biocide slows microbial growth that would otherwise grow rapidly in the guar starch, until such time as the fluid can be produced in flowback water or displaced and plugged off in a well that is abandoned.

Chemicals used in the hydraulic fracturing process are included in the list of chemicals used in oil and gas operations Appendix E.

2.2.7.3 Flaring

For SG’s operations, in the event that flaring of produced gas becomes necessary, it must be flared a safe distance from the rig and crew. Due to the size of the locations, it is neither safe nor practical to flare

horizontally or into a pit or side cut. The flaring of gas does not create sparks and is thus not a fire risk to surrounding vegetation so long as the flare is a reasonable distance from combustible vegetation.

If gas is present, SG will flare it during completion operations using a “flare stacked” method. A flare line will be ran to the edge of the pad and directed straight up 15-20 feet from the surface of the pad. The flare itself will reach 5 foot-10 feet from the end of this line.

GE will implement a “green completion” process which will immediately place produced gas into gathering lines and transported to sales. Although a minimal amount of flaring may be necessary to clean the well bore.

2.2.8 *Production Facilities*

After a well is drilled and completed, production equipment will be installed on the multi-well pad. Equipment and facilities located on the pads will include well heads, piping, valves, gas/water meters, vertical treaters, re-circulating pumps, one gas flare (per location), two-phase separator buildings, line heaters, generators, water tanks to handle produced water and potentially well head compression equipment. These facilities can remain on the location for the life of the well, projected to be 30-40 years.

Neither GE nor SG anticipate the need for electric powerline construction to any of the locations. Electrical power, if needed, will be provided at the site by generators. GE will use natural gas to power the generators, and SG is proposing gas powered generators.

Produced water will be stored on the multi-well pads if water production is not sufficient to support continuous pumping. GE will transport the produced water via the Sheep gathering system to GE’s HWSF.

Produced water will be stored on the multi-well pads if water production is not sufficient to support continuous pumping. SG will transport the produced water via trucking from the Allen well location to SG’s McIntyre flowback pits 3 & 4. Otherwise, produced water from the 11-90-9 and Aspen Leaf locations will enter a buried steel water line which will transport the produced water back to the Federal 24-2WDW or the McIntyre Flowback pits 3 & 4.

All facilities or structures will be painted Shale Green (as identified on the Agency’s Standard Environmental Color Chart) to match and blend into the natural background color of the landscape. In cases of split estate, the surface equipment will also be painted in accordance with the BLM requirements unless the private surface owner requests differently.

Production facilities will be located and arranged to facilitate safety and minimize long-term surface disturbance, typically clustered at the access end of the pad with tanks placed on cut.

Allen
In terms of maintaining production of the 12-90-7-1 CBM well, an artificial lift (beam lift) may be needed to assist production of the well any time during its life. The beam lift, typically gasoline/natural gas engine driven, would be approximately 7.5 feet wide, 29 feet long, 20 feet high.

SG anticipates that compression assistance may be needed to assist with production during the life of the wells. Compressors for this purpose are typically skid mounted, diesel engine driven, and 14 feet wide by 20 feet long by 9 feet tall. Any additional power if needed will be provided at the site by gas-powered generators and SG does not anticipate the need for any electric powerline construction to the site.

Four round 400 bbl. tanks with tank heaters, each approximately 12 feet in diameter and 20 feet high. Will be permanently placed on the pad to capture and store produced water.

Safety features of this equipment may be painted hazard orange or similar.

11-90-9
It may be necessary to add well head compression to one or more wells located at this site. Compressor skids are approximately 14 feet wide x 20 feet long x 9 feet high. Compressor horsepower is decided based on specific well conditions. Compressor engines will be permitted as appropriate through the Air Quality Control Division of the Colorado Department of Public Health and Environment.

Safety features of this equipment may be painted hazard orange or similar.

Four 400 bbl. tanks will be located on the well pad to capture produce water. These measure approximately 12 feet wide x 20 feet high. Tanks have heaters that are used during cold weather conditions.

Aspen Leaf
Artificial lift may be needed on one or more of the wells on this location during the life of the well. An example of artificial lift would be a 40 horsepower walking beam. Beam lifts are approximately 7 ½ feet wide x 29 feet long x 20 feet high and are located approximately four feet away from the well head.

It may be necessary to add well head compression to one or more wells located at this site. Compressor skids are approximately 14 feet wide x 20 feet long x 9 feet high. Compressor horsepower is decided based on specific well conditions. Compressor engines will be permitted as appropriate through the Air Quality Control Division of the Colorado Department of Public Health and Environment.

Safety features of this equipment may be painted hazard orange or similar.

Six 400 bbl. tanks will be located on the well pad to capture produce water. These measure approximately 12 feet wide x 20 feet high. Tanks have heaters that are used during cold weather conditions.

Henderson
Two 400 bbl. water tanks will be positioned at the south end of the pad for storage of produced water when sufficient amounts of water are not produced to be continuously flowing.

To limit the amount of traffic to and from the location during the production phase of the well, solar powered remote telemetry will be installed to provide production data. Although routine visits by personnel will still be necessary to maintain facilities and assure functionality at the site year round.

Spadafora
Two 400 bbl. water tanks will be positioned at the south end of the pad for storage of produced water when sufficient amounts of water are not produced so it can be continuously flowing.

To limit the amount of traffic to and from the location during the production phase of the well, solar powered remote telemetry will be installed to provide production data. Although routine visits by personnel will still be necessary to maintain facilities and assure functionality at the site year round.

2.2.9 *Operation and Maintenance*

Should the well be productive, GE and SG would own or have control of the wellhead and associated equipment and necessary piping to connect the well to the new underground gathering lines. Normal-producing natural gas well operation requires approximately weekly visits to monitor well production and pressure. Pipeline operations will also have periodic surface inspections and pressure testing of the line.

During the production life of the well, SG anticipates completing workovers such as well integrity tests, pump changes, well cleanouts, etc., on an annual basis. However GE cannot accurately predict exactly when workovers may be necessary as the need varies from well to well, but does plan on conducting two 5 day maintenance periods per year.

SG will collect any produced water captured in the 400 bbl. produced water tanks approximately three times per week in an 80 bbl. water truck and depending upon quality would be hauled to the McIntyre flowback pits 3 & 4 or disposed of into the Federal 24-2WDW.

GE will send produced water through a manifold and water line to one of the 400 bbl. water tanks on the well pad or directly to the water gathering line co-located with the Sheep gathering system and to either GE's HWSF or to the 18-22 disposal well.

Routine operation and maintenance for both operators includs periodic snow removal during the winter, periodic weed control, maintenance of stormwater features, assurance that all BMPs installed on equipment and around the multi-well pad are functioning properly, and overall the site is kept clean and orderly. Additional operation and maintenance practices proposed by GE and SG are included as design features in section 2.2.1 (Design Features).

2.2.10 ***Reclamation***

Reclamation is required of any disturbed surface that is not necessary for continued production and operations. While development of this proposed action may have a short- or long-term effect on the land, successful reclamation can ensure the effect is not permanent. There are typically two types of reclamation including interim which occurs shortly after cessation of construction and continues for the productive life of the multi-well pad, and final reclamation which occurs after abandonment and plugging of all the producing well(s) on the multi-well pad.

Planning for reclamation prior to construction is critical to achieving successful reclamation in the future. A reclamation plan is a required component of an operator's APD. Both GE and SG include plans for both interim and final reclamation in each of their respective APDs. These plans include the operator's chosen design features which incorporate BMPs which provide for increased assurance that surface disturbances created by the proposed action are appropriately managed.

Control of noxious and invasive weed species will also occur on project disturbances throughout the life of the proposed action. Methods of treatment proposed by the operators may include: mechanical – mowing and/or pulling by hand, or tillage; chemical - application of an approved herbicide by a licensed applicator; cultural - employing practices such as reseeding with non-invasive species that can outcompete noxious species. This type of treatment will be conducted in some fashion on all disturbed areas associated with the project.

2.2.10.1 Interim Reclamation

During the life of the proposed action, all disturbed areas not needed for active support of production operations will undergo "interim" reclamation in order to minimize the environmental impacts of development on other resources and uses.

Table 2-21 describes the long-term disturbance (during production) per multi-well pad and access roads after interim reclamation has occurred (pipelines excluded, see final reclamation section). Interim reclamation measures and techniques will reduce and stabilize the initial disturbances created during construction of the multi-well pads and new or reconstruction of project access roads. The SG Aspen Leaf well pad, although previously constructed, has undergone interim reclamation and as a result of being combined with this prosed action and the long-term disturbance associated with the Aspen Leaf pad is also accounted for in the table below. As a result of GE and SG implementing interim reclamation measures on all five pads, approximately 55% of the total initial disturbance of the proposed action could be stabilized and remain stabilized until final reclamation measures are necessary.

Table 2-21 Long-term Disturbance of Proposed Action (Acres Post Interim Reclamation)

Operator	Multi-well Pad	Well Pad (ac)	Access Roads (ac)	Total (ac)
SG	Allen	2.0	0.6	2.6
	11-90-9	2.0	0.5	2.5
	Aspen Leaf[1]	2.0[2]	1.0	3.0
GE	Henderson	1.7	1.7	3.4
	Spadafora	1.4	0.6	2.0
Total Long-term Disturbance		**9.1**	**4.4**	**13.5**
Total Initial Disturbance[2,3]		**21.2**	**8.6**	**29.8**
Total Interim Reclaimed		12.1	4.2	16.3
% Interim Reclaimed		57%	49%	55%

[1]- Table Acres are those assumed by previously authorization of the Aspen Leaf location housing the existing Federal 11-90-15-1 natural gas well.
[2] - Data from Table 2-4, Project Construction and Surface Disturbance Summary section 2.2.3 (Project Construction).
[3] – To calculate total reduction due to interim reclamation the original 5.7 pad, 3.0 acre of access disturbance which initially occurred at the Aspen Leaf location is added in here (shown in Table 2-5 and 2-6).

GE and SG will conduct interim reclamation on the multi-well pads and project access roads consistent with the design features stated in section 2.2.1 of this proposed action.

2.2.10.2 Final Reclamation

At final abandonment, well locations, production facilities, and access roads must undergo “final” reclamation so the character and productivity of the land and water courses are restored.

Initially, GE and SG disturbed approximately 10.4 acres to construct buried pipelines related to the proposed action. Both operators will conduct final reclamation of the entire 10.4 acres of initial disturbance created for construction of buried pipelines.

After cessation (wells are no longer productive) of production at the multi-well pad(s), the other project elements such as the multi-well pad itself and project access roads no longer necessary to leave in place would undergo final reclamation. Final reclamation activities would include removal of facilities and waste, re-contouring abandoned sites, reseeding, and monitoring of re-vegetation efforts, noxious weed management upon the reclaimed pad location, reclamation of access roads and plugging of buried pipelines.

The methods used by each operator to conduct final reclamation will be consistent with the design features stated in section 2.2.1 of this proposed action.

2.2.11 *Workforce*

Both GE and SG anticipate contracting both specialized and general labor workforce to accomplish the various phases of development related to this proposed action (Table 2-22). In general, drilling, completion, workover and pipeline installation activities require the most highly skilled workforce trained specifically by the companies contracted by GE and SG to perform the work. For initial construction, interim reclamation and final reclamation activities, GE and SG may use a combination of company resources and when possible put the projects out for bid to contractors within the region. GE and SG also employ a variety of skilled labor for production and maintenance activities; however produced water hauling and waste hauling would likely be handled via contractors.

Activities such as construction, completion, production and workovers would likely occur during normal daylight working hours, 7 days a week until task is completed. However drilling will occur in two shifts operating 24 hours per day, 7 days a week until task is completed.

Table 2-22 Minimum Workforce Necessary per Phase of Well Development per Well (Individuals).

Operator	Pad	Construction	Drilling	Completion	Production	Workover/ Planned Maintenance
SG	Allen	5	8	6 (CBM) 30-40 (MCS)	1	6
	11-90-9	5	8	30-40	1-2	6
	Aspen Leaf	5	8	30-40	1-2	6
GE	Henderson	7	36	35	1	10
	Spadafora	7	36	35	2	10

For both GE and SG operations, workers are expected to commute to the project area from their place of residence or area motels. GE anticipates that the demand for short-term housing will be limited to the project's 36 drilling and 35 completion workers. All other workers are anticipated to commute from their place of residence (locally).

2.2.12 *Schedule*

The general progression of activities for the proposed action is to upgrade the access road, construct new access road and multi-well pad; drill, complete, and test the well; and construct a pipeline if the well is productive. The proposed construction activities are scheduled to begin in late spring 2016. The drilling and completion of all 25 wells is also anticipated to be accomplished within a 5 year timeframe ending in late 2021 or early 2022.

SG
Access roads and multi-well pad construction may take approximately 10 days each, CBM well drilling activities are expected to take approximately 23 days, CBM completion activities are estimated to take approximately 17 days, MCS well drilling activities are expected to take between 40-50 days each, MCS completion activities are estimated to take approximately 28 days each, and with mobilization/demobilization per well estimated at 3 days per each well unless consecutive drilling will occur on each pad.

SG anticipates drilling 2-3 wells per year until all 17 are drilled within a 5 year timeframe. Up to three drill rigs could be in operation at any one time.

Production and any additional reclamation activities would continue to occur intermittently on an annual basis.

GE
Access roads and multi-well pad construction may take approximately 17 days per pad, MCS well drilling activities are expected to take approximately 35 days per well, MCS completion activities are estimated to take approximately 36 days per well and mobilization/demobilization per activity is estimated at 3 days for each well pad due to consecutive drilling that is planned.

GE anticipates constructing both multi-well pads and associated infrastructure as well as drill three natural gas wells in 2016. Five additional wells would be drilled in 2017. Wells will be drilled consecutively with only one drilling rig and one completion rig operating at any one time.

Production and any additional reclamation activities would continue to occur intermittently on an annual basis.

2.3 No Action Alternative

The no action alternative constitutes denial of project related Federal APDs and exclusion of proposed action elements which Federal oversight is required to construct, drill, produce, etc. This includes project related Federal APDs which BLM and FS have in hand at the time of decision and elements of the proposed action by which disturbance of Federal surface is necessary. However, this would not preclude:

- GE from constructing the Spadafora well site, pipeline and access road and drilling FEE/FEE natural gas wells upon the Spadafora location.
- GE's Spadafora WSF could also be constructed and operated to support GE's other natural gas operations in the area.
- SG could continue to manage the Federal Aspen Leaf well pad including the existing Federal 11-90-15-1 natural gas well and in-place infrastructure necessary to access the site and convey produced natural gas to market.

2.4 Alternatives Considered but Eliminated from Detailed Study

There were several alternatives suggested as a result of public scoping and after further consideration they were eliminated from further analysis in this environmental assessment.

The alternatives presented included:

- Eliminate venting and flaring of gas from drilling and completions.

Federal regulations provide the operator with specific guidance on venting and flaring of natural gas during operations. EPA rule OOOO (Quad O) provides the requirements by which approved operations must comply. Federal actions associated with this proposed action must comply with this rule, and therefore as an alternative would result in redundancy of analysis with current Federal regulations.

- Consider fewer pads to reduce environmental impacts by limiting pace of development.

Both the five year timeframe of development and efforts by both operators to drill multiple wells targeting adjacent resources from each of the well pads in this proposed action is consistent with the intent of Federal best management practices to develop the Federal mineral resource in a logical and timely manner and reduce unnessary disturbance by drilling from fewer locations on the landscape.

- Require a stricter ozone standard be adhered to. (From 75ppb down to 65ppb)

The project will conform to the appropriate standard in place at the time of development.

- Move the 12-90-7-1 pad further from Pilot Knob.

The 12-90-7-1 APD is associated with the Allen location as described in the proposed action. In this case, the proposed location is on a split-estate Federal lease keeping the majority of the project activities off FS lands and outside of the FS managed roadless areas, specifically Pilot Knob CRA.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The proposed action includes site-specific information obtained from each APD submitted by the operators. APDs typically identify each operator's plans for the construction of new well pads; construction, upgrade and use of access roads; well drilling, well completion, installation of connecting gas and water pipelines; continued development drilling and well completions on an existing well pad; use of buried water lines or trucking or use of temporary, surface-placed poly pipelines for water transfer for well completions; and plans for reclamation of the surface.

3.1 Introduction

Critical elements of the human environment specified by statute, regulation, or Executive Order (EO) are described and analyzed in this section. Any element not present within the project area or any element that would not be affected by the proposed action or no action alternative will not be analyzed in this document. Therefore this section provides a description of the human and natural environmental resources that could be affected by the proposed action and the no action alternative.

The BLM and FS determined which resources would be brought forward for analysis by evaluating whether the resources were present within the project area and whether the proposed action would impact those resources. Resources that could potentially be impacted are analyzed in this EA. Table 3-1 presents that resource evaluation.

Table 3-1 Potentially Affected Resources

Resources	Not Present	Potentially Affected	Additional Conditions of Approval Necessary
Air Quality and Climate		X	X
Special Designations, ACECs	X		
Wilderness Study Areas and Lands with Wilderness Characteristics	X		
Wild and Scenic Rivers	X		
Cultural Resources		X	
Native American Religious Concerns		X	
Farmlands (Prime or Unique)	X		
Soils		X	X
Vegetation Management (incl.Forestry, Forest Products)		X	X
Invasive, Non-Native Species		X	X
Threatened, Endangered (ESA), Sensitive Species		X	X
Migratory Birds		X	X
Wildlife, Terrestrial		X	
Wildlife, Aquatic		X	
Riparian Zones and Wetlands (incl. Floodplains)		X	X
Hydrology – Surface		X	X
Hydrology – Ground		X	X
Wastes (Hazardous or Solid)		X	X

Resources	Not Present	Potentially Affected	Additional Conditions of Approval Necessary
Environmental Justice	X		
Socioeconomics		X	
Access and Transportation		X	X
Realty Authorizations		X	X
Livestock Grazing/Rangeland Health		X	X
Fire Management	X		
Noise		X	X
Recreation		X	
Visual Resources Management		X	X
Geology and Mineral Resources		X	X
Paleontological Resources	X		

In accordance with 40 CFR 1502.16, each affected resource is followed by a discussion of the potential environmental consequences of the proposed action and no action alternatives. An environmental effect is defined as a change in the quality or quantity of a given resource due to a modification in the existing environment resulting from project-related activities. Effects may be beneficial or adverse, may be a primary result (direct) or secondary result (indirect) of an action, and may be for a short duration, long-term or permanent. The Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508) defines the impacts and effects that must be addressed and considered by Federal agencies in satisfying the requirements of the NEPA process.

Environmental effects analysis was based upon available data and literature from Federal and State agencies, peer-review scientific literature, and resource studies conducted in the project area. Comparison of effects is intended to provide an impartial assessment to help inform the decision-maker and the public. Actions resulting in adverse effects to one resource may impart a beneficial effect to other resources. For each resource analyzed, environmental consequences include:

- **Direct effects** are caused by the action and occur at the same time and place (40 CFR 1508.8).
- **Indirect effects** are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on natural systems (40 CFR 1508.8).
- **Cumulative effects** are the incremental effects to the environment from the proposed action added to effects associated with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).
- **Short or long-term effects** may vary in degree from a slight discernible change to a total change in the environment. Short-term effects occur during and immediately after project-related activities occur but may be obvious and disruptive. Unless specifically described, short-term effects are defined as those lasting 5 years or less, whereas long-term effects last more than 5 years.

The predicted intensity and duration of effects from implementation of the proposed action for each resource were evaluated to determine how these effects could be avoided or reduced through the application of mitigation measures.

Each APD included operator-committed design features, a portion of which is identified in section 2.2.1 (Design Features) and Appendix B includes the full listing, and have been incorporated into the analysis as a means to reduce or eliminate adverse impacts. Potential environmental consequences for the proposed action and no action altrernative include the effects by alternative (level and duration of effects that would occur as a result of the proposed action and no action alternatives). Where appropriate any additional resource protection measures that would be applied to avoid or further reduce effects are compiled per environmental resource in Appendix C.

The following portions of the proposed action require conformance with BLM's applicable Land Use Plan.

Operator	Multi-well Pad	BLM Conformance
GE	Henderson	Cumulative effects of: Reconstructing portions of the access road on Fee/Fee, Constructing portions of buried pipeline on Fee/Fee, Drilling and completing up to 4 natural gas wells on the pad.
	Spadafora	Cumulative effects of: Constructing a new multi-well pad on Fee/Fee; Constructing new access road on Fee/Fee; Reconstructing Fee/Fee portions of the access road; Construction of the entire buried pipeline, Drilling and completing up to 4 natural gas wells on the pad.
SG	Allen	Affected environment, environmental consequences and cumulative effects analysis of entire multi-well pad, entire new access, partial buried pipeline and drilling and completion of up to 5 natural gas wells on the pad.
	11-90-9	Affected environment, environmental consequences and cumulative effects analysis of portions of temporary poly pipe route, drilling and completion of up to 5 natural gas wells on the pad.
	Aspen Leaf	Affected environment, environmental consequences and cumulative effects analysis of portions portion of temporary poly pipe route, drilling and completion of up to 7 additional natural gas wells on the pad.

The following portions of the proposed action require conformance with the applicable NF Land Use Plan:

Operator	Multi-well Pad	NFS Conformance
GE	Henderson	Affected environment, environmental consequences and cumulative effects analysis of entire multi-well pad, entire new access, reconstruction of partial access, partial buried pipeline (Surface Use Authorization (SUA). Review and authorization of a Road Use Permit (RUP)
	Spadafora	Review and authorization of a RUP
SG	Allen	Affected environment, environmental consequences and cumulative effects analysis of reconstruction of partial access, partial buried pipeline (SUA). Review and authorization of a RUP
	11-90-9	Affected environment, environmental consequences and cumulative effects analysis of entire multi-well pad, entire new access, portion of temporary poly pipe route, entire buried pipelines, SUA. Review and authorization of a RUP
	Aspen Leaf	Affected environment, environmental consequences and cumulative effects analysis of portion of temporary poly pipe route. Review and authorization of a RUP

3.1.1 *Direct and Indirect Impacts Analysis*

This analysis is analyzing the possibility that all well pads will be capable of housing multiple wells and therefore would be considered multi-well pads. The two GE well pads (Henderson and Spadafora) would house four horizontal Mancos Shale (MCS) wells each, The SG - Allen pad would house a single Coal Bed Methane (CBM) well and four additional horizontal MCS wells, the SG – 11-90-9 pad would house five horizontal MCS wells and there are 7 additional horizontal MCS wells planned on the existing SG – Aspen Leaf pad which already has a vertical MCS well in production including all necessary infrastructure. When combined with the 6 APDs initially submitted for project analysis, a total of 25 natural gas wells (1 CBM, 24 MCS) could be developed in the area as a result of the findings in this analysis. Any

of the 19 additional wells beyond the six proposed may be submitted at any point in the future via individual APD respectively from the operators.

Several environmental resources (Air Quality, Hydrology, Wastes, and Geology) include additional analysis/discussion on impacts from hydraulic fracturing. BLM recently released the Hydraulic Fracturing (HF) Rule (March 2015) which improves public awareness of HF locations, provides public disclosure of chemicals used, clarifies and strengthens existing rules related to well construction, requires mechanical integrity tests on wells to be hydraulically fractured, aligns requirements for protection of usable water zones with state authorities and provides opportunities to coordinate standards with states. The HF Rule also requires confirmed wellbore integrity, public disclosure of chemicals used in the HF fluid, and safe management of recovered fluids.

As indicated in this EA, the primary human influences on the project area are private land access, big game hunting, outdoor recreational activities, oil and gas exploration and development, coal mining, limited harvest of timber resources (firewood), and livestock grazing. Livestock grazing and limited timber harvest land uses have remained fairly constant in recent years and large increases in both grazing usage and commercial timber harvest of public lands are not anticipated.

3.1.1.1 Reasonable Foreseeable Development Scenario

The BLM developed a reasonably foreseeable development scenario (RFDS) for oil and gas from analyzing past activity, production, and other sources in support of the Uncompahgre RMP revision (BLM 2012). An RFD scenario provides information about the type and level of oil and gas activity and associated disturbance that could occur subsequent to leasing in the Uncompahgre Field Office planning area. The RFDS is unconstrained by management-imposed conditions as it is based primarily on geology and historical exploration and development activity. It provides information necessary to analyze long-term and/or widespread effects that could result from possible exploration and/or development activities on oil and gas leases. The RFD is not a decision, and it neither establishes nor implies a “cap” on development. NFS lands, other Federal agency lands, and State and private managed lands are included in the base line projection for those lands assessed in the RFD. The timeframe used in the Uncompahgre RMP/EIS’s RFDS is from 2010 through 2030. For more details regarding the cumulative development within the region, see Tables 7a, 7b, 8a, and 8b from the Reasonable Foreseeable Development Scenario for Oil and Gas for the Uncompahgre Field Office (BLM 2012).

According to the RFD the project area is located in an area identified as having high occurrence potential, (see figures 23a and 24a of the Reasonable Foreseeable Development Scenario for Oil and Gas for the Uncompahgre Field Office (BLM 2012)). Mineral production within the area is limited to existing natural gas wells operated by GE and by SG.

3.1.2 *Cumulative Impacts Analysis*

The following factors were considered in this cumulative impact assessment:

- Federal, state, and private actions
- Potential for synergistic effects or synergistic interaction among or between effects
- Potential for effects across political and administrative boundaries
- Other spatial and temporal characteristics of each affected resource

Wilderness areas are only discussed in the context of potential air quality and visibility impacts on wilderness in section 3.2.1, Air Quality and Climate. Otherwise, resources not discussed in detail include Areas of Critical Environmental Concern, Wild and Scenic Rivers, Wilderness Study Areas or lands with wilderness characteristics, Farmlands (Prime or Unique), Environmental Justice, Fire Management, Paleontological Resources, locatable minerals, mineral materials and geothermal resources (Table 3-1).

There are other available analysis documents in the surrounding area which the cumulative effects analysis of this proposed action can be tiered to as well, they are:

- DOI-BLM-CO-2013-0022-EIS: Draft Environmental Impact Statement for the Bull Mountain Unit Master Development Plan; BLM, Uncompahgre Field Office.

- DOI-BLM-CO-2008-0035-EA: Gunnison Energy 16 Well Master Development Plan; BLM Uncompahgre Field Office
- Sheep Gas Gathering System Environmental Assessment. USDA Forest Service, GMUG, Paonia Ranger District; June 2007.
- Reasonable Foreseeable Development Scenario for Oil and Gas for the Uncompahgre Field Office (BLM 2012)).

3.1.2.1 Cumulative Impacts Analysis Areas

Temporal and spatial boundaries used in the cumulative analysis were developed on the basis of resources of concern and actions that might contribute to an impact. The baseline date for the cumulative impacts analysis is 2015. The temporal scope of this analysis is a 50-year planning horizon. Spatial boundaries vary and are larger for resources that are mobile or migrate (e.g., elk populations) compared with stationary resources (e.g. vegetation). Occasionally, spatial boundaries could be contained within the lease boundaries or expand beyond project area. Spatial boundaries were developed to facilitate the analysis and are included under the appropriate resource section heading.

The general cumulative impacts analysis area spatial boundary is loosely defined as the project area plus a 10-mile buffer. Specifically, the cumulative impacts assessment area (CIAA) took a watershed level approach for most resources and the actual CIAA encompasses approximately 265,355 surface acres inside a boundary comprised of 11 Hydrologic Unit Code six (HUC6) sub-watersheds within the upper reaches of the larger North fork of the Gunnison River watershed, rather than that of a strict 10-mile buffer. Each resource topic defines whether this CIAA is appropriate to capture the cumulative effects in relationship to specific issues and resource concerns, see Table 3-2 below. There also may be instances where the watershed CIAA is not appropriate for a specific resource's analysis area (i.e. air resources) and in those instances a different CIAA is described (Table 3-2). Projects and activities that fall within the watershed CIAA were identified by BLM and FS employees with local knowledge of the area. Each was asked to provide information on the most influential past, present, or reasonably foreseeable future actions. Additional information was obtained through discussions with agency officials and review of publicly available materials and websites.

Table 3-2 Cumulative Impacts Analysis Areas by Resource

Resource	Cumulative Impact Analysis Area	CIAA Indicator (i.e. acreage, AUMs, miles, # of sites)	Temporal Boundary (Timeframe)
Air Quality and Climate Change	Air CIAA	+12 Km	50 yr
Socioeconomics	Delta and Gunnison Counties	Counties	50 yr
Cultural Resources, Soils, Vegetation, Invasive/Non-native Species, T-E & Sensitive Species, Migratory Birds, Terrestrial Wildlife, Aquatic Wildlife, Riparian Zones and Wetlands (incl. Floodplains), Hydrology, Access and Transportation, Realty Authorizations, Livestock Grazing/Rangeland health, Noise, Recreation, Visual Resources, Geology and Mineral Resources	Watershed CIAA	Acres, sites, miles, AUMs	50 yr

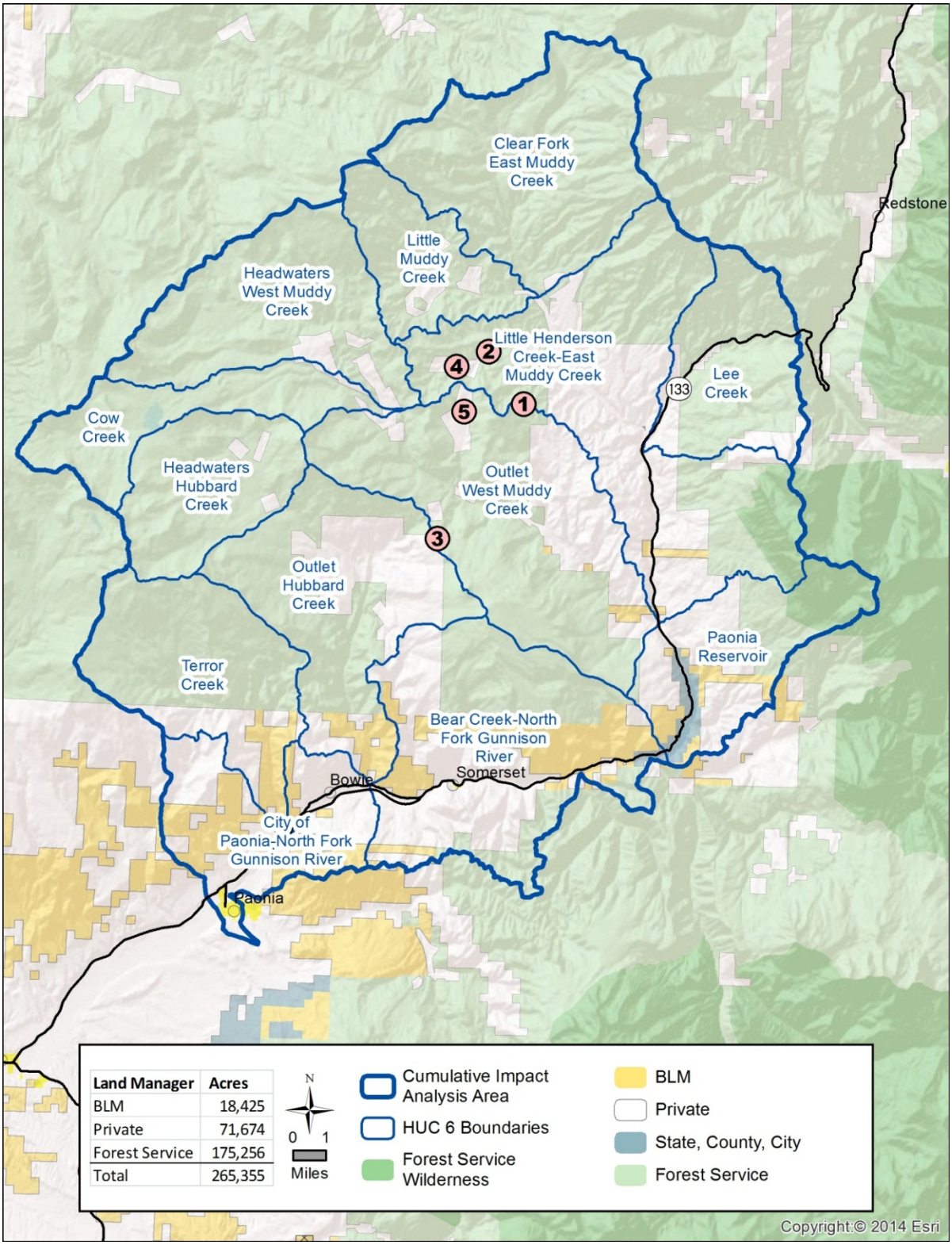


Figure 10- CIAA Buffer Area (Watershed)

3.1.2.2 Past, Present, and Reasonably Foreseeable Future Actions

Past, present, and reasonably foreseeable future actions are considered in this analysis to identify whether and, to what extent the environment has been degraded or enhanced, whether ongoing activities are causing impacts, and trends for activities include impacts on the area. Projects and activities are evaluated on the basis of proximity, connection to the same environmental systems, potential for subsequent impacts or activity, similar impacts, the likelihood a project will occur, and whether the project is reasonably foreseeable. Projects and activities identified as having the greatest likelihood to generate potential cumulative impacts when added to this proposed action are displayed in Table 3-3.

Effects of past actions and activities are manifested in the current condition described in the affected environment in each of the resources sections of chapter 3. Reasonably foreseeable future actions are actions that have been committed to or known proposals that would take place within a 50-year planning period.

Reasonably foreseeable future action scenarios are projections made to predict future impacts – they are not actual planning decisions or resource commitments. Projections, which have been developed for analytical purposes only, are based on current conditions and trends and represent a best professional estimate. Unforeseen changes in factors such as economics, demand, and federal, state, and local laws and policies could result in different outcomes than those projected in this analysis.

The BLM and FS have considered other potential future actions that have been eliminated from further analysis because of the small likelihood these actions would be pursued and implemented within the life of the project or because so little is known about the potential action that formulating an analysis of impacts is premature. In addition, potential future actions protective of the environment (such as new potential threatened or endangered species listings or regulations related to fugitive dust emissions) have less likelihood of creating major environmental consequences alone, or in combination with this environmental analysis. Federal actions such as species listing may cause the BLM and FS to reconsider decisions created from this action because the consultations and relative impacts might no longer be appropriate. These potential future actions may have greater capacity to affect resource uses within the project area however, until more information is developed, no reasonable estimation of impacts could be developed.

Table 3-3 Past, Present, and Reasonably Foreseeable Project, Plans, or Actions that Comprise the Cumulative Impact Scenario

Activity	Projects	Past, Present or Reasonably Foreseeable Future Action (RFFA)
Air Quality	The area near Telluride is in the Telluride PM10 maintenance area. The area is currently in compliance with all applicable National Ambient Air Quality Standards. For as long as the area remains in maintenance, the BLM will analyze any authorized activities in accordance with the provisions of the General Conformity Rule and document any findings in the applicable authorizing NEPA document.	Past, Present
	Increased concern over greenhouse gas emissions and global warming issues may lead to future federal and state regulations limiting the emission of associated pollutants.	Past, Present
Soils	Past, present, and future actions with the potential for cumulative effects to soil resources in the project area include existing and future natural gas development, timber sales, livestock grazing, public use of trails and roads, and wildfires. Erosion control measures and reclamation is required for most of these activities to reduce direct, indirect, and cumulative soils effects. The	Past, Present

	cumulative effects to soils will vary depending on the location and amount of disturbance and the sensitivity of specific soil types to erosion.	
Water: Ditches and Canals	The UFO has been and will continue to be affected by irrigation and drinking water diversions. Reservoir operations have affected water supply, aquatic conditions, and timing. Irrigation rights are expected to continue being bought and sold in the future, with some new property owners informally changing how the right was historically used. Due to population growth and land sales, more agricultural water rights may be converted to municipal and industrial uses. Future oil shale development in the region could also result in water diversions.	Past, Present
	The Natural Resources Conservation Service and US Bureau of Reclamation have been replacing irrigation ditches with buried pipe to conserve water and reduce salinity and selenium within the Colorado River system.	Past, Present
	The Town of Paonia plans to replace its current 2-million-gallon water treatment plant, add an additional 2 million gallons of treated water storage, and incorporate hydropower components on the water lines in an effort to reduce plant costs with sustainable energy. Estimated completion 2015.	Past, Present
Vegetation Management	Forestry. Past, current, and foreseeable forestry uses in the cumulative analysis area include personal and commercial harvest of fuel wood, poles and posts for fence building, wildings (live trees and shrubs), and Christmas trees.	Past, Present, RFFA
	Vegetation treatments. Prescribed fire and mechanical treatments of vegetation (e.g., chaining, rollerchops, Dixie-harrow, drill seeding, hydro-axing, and brush mowing) were very common in the past on public and private rangelands in the cumulative analysis area. These treatments and maintenance of these vegetation treatments are still fairly common and will likely continue (except chaining). In addition, manual and mechanical treatments of large woody invasive species such as tamarisk have occurred in the riparian areas of rivers and streams; this type of restoration work will likely continue in the foreseeable future.	Past, Present, RFFA
	Hazardous fuels reduction. Fuels treatments, including prescribed fires, chemical and mechanical treatment, and seeding, will likely continue and potentially increase in the future.	Past, Present, RFFA
	Several years of drought in western states have resulted in severe stress on pine trees. This stress has made the trees less able to fend off attacks by insects such as mountain pine beetles. Mountain pine beetle infestation has been occurring in Colorado since 1996, and some pinyon pine stands in the cumulative analysis area have experienced ips beetle kill. Sudden Aspen Decline is also impacting parts of the cumulative analysis area.	Past, Present
Livestock Grazing	The UFO manages 240 grazing allotments with 165 grazing permittees. Historically, several areas sustained high levels of both sheep and cattle grazing. Seasonal cattle grazing still occurs, to a lesser degree, from approximately June through September. The FS conducted an Environmental Assessment in 2005 for the Muddy Creek basin (also known as Muddy country).	Past, Present, RFFA

	On National Forest System lands surrounding the project area, there are 11 allotments with multiple permittees managing approximately 12,480 ewe/lamb pairs, 1,048 cow/calf pairs, and 30 horses. These allotments are managed intensely with multi-pasture rotations of relatively short duration.	Past, Present, RFFA
Access and Transportation	Road construction has occurred in association with timber harvesting, historic vegetation treatments, energy development, and mining on BLM-administered lands, private lands, State of Colorado lands, and National Forest System lands. The bulk of new road building is occurring for community expansion and energy development. Road construction is expected to continue at the current rate on BLM and National Forest System lands; the future rate is unknown on private and State of Colorado lands.	Past, Present, RFFA
	This Environmental assessment (COS-050-2015-029EA) proposal identifying that access may be constructed or reconstructed to access 4 new well pads will be constructed to accommodate the development of Federal mineral estate as a result of the proposed action.	Present
Lands and Realty	Colorado Department of Transportation: Activities on State Highway 133 include annual snow maintenance and emergency response actions.	Past, Present, RFFA
	CDOT is working on highway improvement projects on Highway 92 from Hotchkiss to Delta and Highway 50 in the Blue Mesa Lake area; both of these projects are likely to continue for the next several years	Present
	Several gravel pits have also been approved in the past 5 years; however, most are within just a few miles of the city of Delta, Co.	Past, Present
	Residential developments in the area around the communities of Paonia, Hotchkiss, Crawford, and Delta have been growing in population, with many new houses being built. Most of this development has been down-valley from the coal mines in broader portions of the North Fork Valley. This development has increased the traffic load and demand for maintenance on State Highway 133.	Past, Present, RFFA
	Natural gas pipelines: Bull Mountain Transmission; Ragged Mountain Transmission; Bull Mountain Field Gathering line; Sheep Gas gathering line; Henderson Lateral pipeline; Aspen Leaf trunk pipeline; Hotchkiss Ranches gas gathering line, Vessels Oxbow facility connection line from Bore hole 1; local utility service pipelines.	Past, Present
	Sheep-Bull connector natural gas pipeline. A pipeline in which GE will convey produced gas from the Sheep gas gathering line to the SG Bull Mountain Transmission line. It connects on private land at the existing Sheep pipeline yard in T11S, R90W, Sec. 8, NENE, traverses NFS lands to the NE cross country but parallel to NFSR 851 and ties into Bull Mountain Pipeline on NFS lands in T11S, R90W, Sec. 3, SWSW.	RFFA
	This Environmental assessment (COS-050-2015-029EA) proposal identifying that pipeline connections to existing infrastructure is necessary to convey produced gas from up to 25 natural gas wells located on the 4 new pads as a result of the proposed action to accommodate the development of Federal mineral estate.	Present
Recreation	Colorado's population has grown significantly in the past 10 years,	Present, RFFA

<table>
<tr><td></td><td>and an increasing number of people are living near or seeking local BLM-administered lands for a diversity of recreational opportunities characterized by the “mountain resort or outdoor lifestyle.” The primary recreational activities in the UFO are motorized vehicle touring, all-terrain vehicle use, motorcycling, mountain biking, big and small game hunting, fishing, hiking, backpacking, horseback riding, sight-seeing, target shooting, dog-walking, and river boating. Recreation-based visitor use in the UFO has increased in most areas in recent years and is expected to continue to increase on BLM and non-BLM lands.</td><td></td></tr>
<tr><td></td><td>Unauthorized travel. Travel off of designated or existing routes as well as the creation of social trails has occurred and will likely continue to occur.</td><td>Past, Present, RFFA</td></tr>
<tr><td></td><td>Forest Service Special Areas; Roadless Area Conservation; Applicability to the National Forests in Colorado; Final Rule (77 Federal Register 39576-39612, 3 July 2012). The Colorado Roadless Rule provides management direction for conserving and managing approximately 4.2 million acres of Colorado Roadless Areas on National Forest System lands.</td><td>Past, Present</td></tr>
<tr><td rowspan="6">Coal</td><td>There are three active underground coal mines on Federal mineral estate in the cumulative impacts analysis area. The following table contains recent production data for the three coal mines in the North Fork Valley.
<table>
<tr><th colspan="5">Raw Coal Production in the North Fork Valley</th></tr>
<tr><td colspan="5">Year Averages (Tons)</td></tr>
<tr><th>Average Based on[1]</th><th>Bowie No. 2 Mine</th><th>Elk Creek Mine</th><th>West Elk Mine</th><th>Total</th></tr>
<tr><td>5 Yr</td><td>2,935,892</td><td>2,051,704</td><td>6,090,157</td><td>11,077,753</td></tr>
<tr><td>1 Year</td><td>3,000,000</td><td>0</td><td>6,000,000</td><td>9,000,000</td></tr>
<tr><td colspan="5">[1]- Period ends Dec. 31. 2014
Note: Each of these mining operations control coal reserves with a mix of federal and fee coal; however, 90 percent or more of local production is federal. As mining progresses, only federal coal will be available in the reserve base.</td></tr>
</table></td><td>Past, Present</td></tr>
<tr><td>The Elk Creek Mine is a longwall operation north of Somerset, Colorado, operated by Oxbow Mining, LLC, with a loadout immediately north of Somerset. There are 13,430 acres permitted. The operation is in temporary idle status</td><td>Past, Present, RFFA</td></tr>
<tr><td>The West Elk Mine is a longwall operation located south and east of Somerset and is operated by Mountain Coal Company with a loadout about 1 mile east of Somerset. There are 17,160 acres permitted.</td><td>Past, Present, RFFA</td></tr>
<tr><td>Bowie No. 2 Mine is a longwall operation located northeast of Paonia, Colorado, and is operated by Bowie Resources, LLC with a loadout northeast of Paonia. There are 14,540 acres permitted in the combined permits of the Bowie No. 1 and No. 2 Mines accessed by the Bowie No. 2 Mine.</td><td>Past, Present, RFFA</td></tr>
<tr><td>Oxbow has completed exploration drilling to confirm the quality, quantity, and extent of the coal within this area. The Oak Mesa project encompassed about 13,873 acres north of Hotchkiss. The coal exploration license expired under its own terms in September 2014. There has been no interest expressed in leasing the coal reserves.</td><td>Past</td></tr>
<tr><td>U.S. Forest Service issued a Notice of Intent to prepare a</td><td>RFFA</td></tr>
</table>

	supplemental Environmental Impact Statement to propose reinstatement of the North Fork Coal Mining Area exception of the Colorado Roadless Rule. The exception would allow for temporary road construction for coal exploration and/or coal-related surface activities in a 19,100-acre area defined as the North Fork Coal Mining Area. Under the exception, Arch Coal plans to expand its underground West Elk mine.	
Oil and Gas Leasing	The BLM routinely offers land parcels for competitive oil and gas leasing to allow exploration and development of oil and gas resources for public sale. Continued leasing is necessary for oil and gas companies to seek new areas for oil and gas production, or to develop previously inaccessible/uneconomical reserves.	Past, Present, RFFA
	Twenty-five percent (224,950 acres) of the federal fluid mineral estate in the UFO (916,030) is already leased. This includes 160,510 acres (24 percent) of BLM surface and 64,440 acres (27 percent) of split-estate lands (private, state, and local surface with federal fluid mineral subsurface). Total fluid minerals acres leased annually by the BLM over the past 10 years are as follows:	Past, Present

Year	Average Lease Acreages	Total Leased Acres[1]	Total Number of Leases
2004	635	4,250	7
2005	900	54,710	52
2006	510	15,850	29
2007	500	31,560	48
2008	490	23,540	37
2009	80	390	5
2010	n/a	0	0
2011	40	40	1
2012[2]	800	800	1
2013	0	0	0
2014	0	0	0

Source: BLM 2012a
[1]Includes all leased BLM surface acres, plus all federal fluid mineral subsurface under private, local, and State surface. Values are limited to active leases and do not include pending leases.
[2]As of May 2015.

Oil and Gas Development	GE is the sole oil and gas operator in Delta County. Since 2005 they have drilled approximately 10 wells and installed a gathering line in the Oak Mesa area, which is north of Hotchkiss and west of Paonia.	Past, Present
	GE permitted 16 wells on up to 9 pads (Hotchkiss Federal BLM-DOI-UFO-2008-035 EA) in Gunnison County; to date 5 pads have been constructed and nine wells have been drilled to-date. *(These numbers are included in the CIAA well counts in the next row of this table)*	Past, Present
	In the CIAA (incl. Federal and Fee mineral development), 28 natural gas wells have been abandoned, 54 wells are capable of production, and 10 have been approved but not constructed.	Past, Present
	150 Well Bull Mountain MDP: The Bull Mountain Unit Master Development Plan involves the exploration and development of up to 146 natural gas wells, 4 water disposal wells, and associated infrastructure on federal and private mineral leases.	RFFA
	Vessels Coal Mine Methane Capture Project. Methane Drainage	Past, Present

	System situated above Oxbow Mining LLC's Elk Creek Mine near Somerset, CO. Capture of low-level coal mine methane emissions produced at the mine as a result of coal extraction, and combusted on site for either electrical generation with excess flared rather than venting directly to atmosphere.	
	Petrox 2-APDs at Pilot Knob: Two APDs from Petrox Resources proposed for development in the Federal Somerset Unit, a 6,400-acre project area that largely overlies the Pilot Knob Roadless Area north of Somerset.	RFFA
	Spadafora Waste Disposal Pits: The Spadafora Water Storage Facility was approved by the Gunnison County Planning Commission on March 6, 2015. Three water storage pits, each with a pump station and a volume of about 9,240,000 gallons, will sit on roughly 19 acres and will store and recycle produced water for drilling and gas well operations. This facility is located within the project area and immediately adjacent to the Spadafora well pad for APDs GE 11-90-20-21 H1 and H2.	RFFA
	Huntsman Unit Proposal: SG has proposed drilling in the Huntsman Unit (COC 74403X), which includes three SG leases (COC 63886, 63888, and 63889). SG has proposed one APD there for well 10-89-31 #1 inside lease COC 63886.	RFFA
	Deadman Gulch APD: SG has proposed an APD (12-89-30#1) inside the GE Deadman Gulch Unit adjacent to the Petrox Somerset Federal Unit within the Pilot Knob CRA on lease COC 64169.	RFFA
	This Environmental assessment (COS-050-2015-029EA) proposal identifying the 4 new wells pad will be constructed and one existing pad be used to accommodate the development of Federal mineral estate.	Present
	SG permitting Bull Mountain compressor station on private land NE of BMU, T11S, R90W, Section 10, SWNE. 4 Gas or Diesel Motors, 3 Compressors, 1 separator. Intended to provide compression to assist in moving produced gas from the area through the existing Bull Mountain Transmission line.	RFFA

Table 3-4 Past, Present, and Reasonably Foreseeable Disturbance Impacts in the Watershed CIAA (265,355 Acres)

Acres assumption for past ground surface disturbing activities in this CIAA	BLM – 2,278 Private (Pvt) – 4,169 FS – 3,797 **Total = 10,224**		
Disturbance Feature	**Past Development Activity (acres, miles)**	**Present Development Activities (acres, miles, wells)**	**RFFA – Reasonably Foreseeable Future Actions (acres, miles)**
BLM, FS, Private Resource Roads *(Total Past = 290.2 mi)*	BLM – 56.8 mi FS – 223.7 mi Pvt – 9.7 mi	3 Miles	n/a
County Roads (Dirt)	79.6 mi	n/a	n/a
Paved County Roads and State Highways	45.7 mi	n/a	n/a
FS Rights of Way (Power and Pipelines)	86 miles	2.1 Miles	n/a
BLM Rights of Way (Power, Phone Pipelines)	47.2 mi		
Water Ditches and Canals and Water Pipelines *(Total Past = 77.3 mi)*	BLM -5.6 mi FS – 35.7 mi Pvt – 36.0 mi	n/a	n/a
BLM and FS Livestock Grazing Allotments *(Total Past = 183,527 Acres)*	BLM – 16,642 ac FS – 160,518 ac Pvt – 6,368 ac	n/a	n/a
Recreation Sites on BLM, FS & State lands	4 Sites	1 site	n/a
Coal Leasing	23,130 acres	n/a	n/a
Oil and Gas Leasing *(Authorized)*	109,122 ac	n/a	n/a
Oil and Gas Development (wells)	92 Wells (54 exist, 10 approved, 28 abandoned)	25 wells	162
Oil and Gas Development (well pads)	143 acres	16 acres	up to 300 acres

3.2 Direct and Indirect Impacts Analysis to Resources

3.2.1 *Air Quality and Climate*

3.2.1.1 Affected Environment

The project area is located in Gunnison County and is within the Mountain Counties Region for air quality planning (CDPHE 2012). The Mountain Counties Region includes counties that generally are on or near the Continental Divide. Air quality concerns in this region are primarily impacts related to particulate pollution from wood burning and road sanding activities.

Climate

The nearest precipitation and temperature measurements were collected at Redstone, Colorado, (1979-1994), approximately 2.5 miles northeast of the project area at an elevation of 8,070 feet above mean sea level (WRCC 2013). The annual average total precipitation at Redstone, Colorado, is 27.7 inches, with annual totals ranging from 20.2 inches in 1987 to 40.4 inches in 1985. Precipitation is greatest in the spring and fall months. Snowfall occurs from fall though spring with the greatest amount in March. The average annual snowfall is 169.4 inches. The region has cool temperatures, with average daily temperature (in degrees Fahrenheit [˚F]) ranging between 8˚F and 33˚F in January to between 44˚F and 76˚F in July. Extreme temperatures have ranged from negative 29˚F in 1985 to 93˚F in 1991.

Overview of Regulatory Environment

Air quality impacts from pollutant emissions are limited by regulations, standards, and implementation plans established under the Clean Air Act (CAA), as administered by the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) under authorization of the EPA. The operator will comply with all applicable federal, state, and local air laws, regulations, and policies. The APCD is the primary air quality regulatory agency responsible for determining potential impacts once detailed industrial development plans have been made, and those development plans are subject to applicable air quality laws, regulations, standards, control measures, and management practices. Unlike the conceptual “reasonable, but conservative” engineering designs used in NEPA analyses, any APCD air quality preconstruction permitting demonstrations required would be based on very site-specific, detailed engineering values, which would be assessed in the permit application review. Any proposed facility which meets the requirements set forth under division permit regulations is subject to the Colorado permitting and compliance processes.

Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) and Colorado Ambient Air Quality Standards (CAAQS) are health-based criteria for the maximum acceptable concentrations of air pollutants at all locations to which the public has access. Although specific air quality monitoring has not been conducted within the project area, all of Gunnison County is designated as “attainment” by the CDPHE for all criteria pollutants (CDPHE 2012). Criteria pollutants for which CAAQS and NAAQS exist include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in effective diameter (PM_{10}), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). Lead emissions from project sources are negligible and therefore, the lead NAAQS is not addressed in this analysis. States typically adopt the NAAQS but may also develop state-specific ambient air quality standards for certain pollutants. The NAAQS and CAAQS are summarized in Table 3-5.

Table 3-5 Ambient Air Quality Standards.

Pollutant [final rule citation]		Standard Type	Averaging Period	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		Primary	8-hour	9 ppm [a]	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		Primary and secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		Primary and secondary	Annual	53 ppb	Annual mean
Ozone [73 FR 16436, Mar 27, 2008]		Primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter [73 FR 3086, Jan 15, 2013]	$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
		Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
		Primary and secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm [b]	Not to be exceeded more than once per year

[a] mg/m^3 = milligrams per cubic meter, µg/m^3 = micrograms per cubic meter, ppb = parts per billion, ppm = parts per million.
[b] Colorado Ambient Air Quality Standard for 3-hour SO_2 is 0.267 ppm.
Source: National – 40 CFR 50, Colorado – 5 CCR 1001-14

All of the criteria pollutants are directly emitted from a variety of source types, with the one exception being ground level ozone. Ozone is chemically formed in the atmosphere via interactions of oxides of nitrogen (NO_X) and volatile organic compounds (VOCs) in the presence of sunlight and under certain meteorological conditions (NO_X and VOCs are ozone precursors). High ozone episodes occur most typically in urban areas during the summer during periods with high temperatures and abundant sunlight.

Hazardous Air Pollutants
Toxic air pollutants, also known as hazardous air pollutants, 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 effects. No ambient air quality standards exist for hazardous air pollutants; instead emissions of these pollutants are regulated by a variety of regulations that target the specific source class and industrial sectors for stationary, mobile, and product use/formulations. Sources of hazardous air pollutants from the majority of oil and gas operations include well-site production emissions (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde), and compressor station and gas plant combustion emissions (formaldehyde).

Air Pollutant Concentrations
Air quality for any area is generally influenced by the amount of pollutants that are released within the vicinity and up wind of that area, and can be highly dependent upon the contaminants chemical and physical properties. Additionally, an area's topography or terrain (such as mountains and valleys) and

weather (such as wind, temperature, air turbulence, air pressure, rainfall, and cloud cover) will have a direct bearing on how pollutants accumulate or disperse. Monitoring of air pollutant concentrations has been conducted within the region and these sites belong to one of several monitoring networks overseen by state and federal agencies, including: CDPHE (State of Colorado), Clean Air Status and Trends Network (CASTNET), Interagency Monitoring of Protected Visual Environments (IMPROVE), and National Acid Deposition Program National Trends Network (NADP/NTN). Air pollutants monitored at these sites include carbon monoxide, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. Background concentrations of these pollutants define ambient air concentrations in the region and establish existing compliance with ambient air quality standards. The most representative monitored regional background concentrations available for hazardous air pollutants within the project area (as identified by Air Pollution Control Division, 2013) are shown in Table 3-6, Near-Field Analysis Background Ambient Air Quality Concentrations. For the criteria pollutant concentrations shown in Table 3-6, the BLM used the maximum future (2021) predicted Colorado Air resource Management Modeling Study (high development scenario) concentrations from within and around the project area. The reader should note that the future CARMMS scenario included the projected project emissions, and thus provides for a sufficiently conservative analysis starting point. National Emissions Inventory (NEI) data shown in Table 3-7, NEI Data for Gunnison County, CO 2011, provides for a reasonable correlation of emissions loading vs. measured impacts for HAPs related air pollution sources within the project area.

Table 3-6 Near-Field Background Ambient Air Quality Concentrations.

Pollutant / Units	**Background Monitored Concentrations**		**Monitoring Station Information**
	1-Hour / 24-Hour *	**Annual Average ***	
Benzene(µg/m^3)	**28.75**	**9.11**	Garfield County, Colorado (Rifle, Colorado). Monitor ID: 08-045-0007. 1-hour value is maximum for all reported concentrations in year 2013 dataset. Annual average value is average of all values in the year 2013 dataset.
Formaldehyde(µg/m^3)	**4.37**	**1.38**	
n-Hexane(µg/m^3)	**80.01**	**20.46**	
NO_2 (µg/m^3)	**31.09**	**NA**	Background concentration is the overall maximum (of all grid cells) 1st high daily 1-hour value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).
PM_{10} (µg/m^3)	**34.07**	**NA**	Background concentration is the overall maximum (of all grid cells) 1st high 24-hour average value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).
$PM_{2.5}$ (µg/m^3)	**12.52**	**5.52**	Background concentrations are the average (for all grid cells) 1st high 24-hour average and overall maximum (of all grid cells) annual average value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).

□□□□□^{3} = micrograms per cubic meter
* NA ~ averaging time was not modeled for this assessment
*1-hour concentrations shown for all pollutants except PM species which are 24-hour average values

Table 3-7 NEI Data for Gunnison County, CO 2011 (tons).

Sector	PM_{10}	$PM_{2.5}$	VOC	NO_X	CO	SO_2	CO_2	CH_4	N_2O	HAPs
Agriculture	0.41	0.08	0	0	0	0	0	0	0	0
Biogenics	0	0	24,521	158	3,693	0	0	0	0	2,048
Bulk Gasoline Terminals	0	0	10.24	0	0	0	0	0	0	0.1
Commercial Cooking	8.54	7.9	1.16	0	3.34	0	0	0	0	0.42
Dust	1,195	189	0	0	0	0	0	0	0	0
Fires	1,052	883	2,293	137	10,064	73	110,919	469	0	231
Fuel Comb	44.1	41.91	93.26	243.17	578.66	10.59	0	0	0	16.35
Gas Stations	0	0	58.8	0	0	0	0	0	0	1.46
Industrial Processes	157.86	61.82	86.23	12.85	52.58	0.97	0	0	0	3.96
Miscellaneous	0	0	13.39	0.04	0	0.01	0	0	0	1.01
Mobile	57	51	804	673	4,511	4	143,881	12	5	203
Solvent	0.01	0.01	127.35	0.32	0.27	0	0	0	0	58.64
Waste Disposal	6.8	0.7	0.85	0	0	0	0	0	0	0.07
Totals	**2,522**	**1,235**	**28,009**	**1,224**	**18,903**	**88**	**254,800**	**481**	**5**	**2,564**

The Prevention of Significant Deterioration (PSD) provision of the CAA established Class I areas in which very little degradation of air quality is allowed (e.g., national parks and large wilderness areas) and Class II areas (all non-Class I areas). The PSD Class II designation allows for moderate degradation of air quality within certain limits above baseline air quality. The project area pads are within an area designated as Class II. The closest Class I areas to the proposed well site locations are the Maroon Bells / Snowmass Wilderness Area located to the east of the project area (approximately 10 km), the West Elk Wilderness Area to the south (at approximately 14 km), and the Black Canyon of the Gunnison National Park to the southwest (approximately 46 km).

In addition to the criteria PSD pollutants, Class I & II areas may also be analyzed for Air Quality Related Values (AQRVs). AQRVs are metrics for atmospheric phenomenon like visibility and deposition impacts that may adversely affect specific scenic, cultural, biological, physical, ecological, or recreational resources.

Visibility changes can occur when excessive air contaminates (mostly fine particles) scatter light such that the background scenery becomes hazy. Analysis thresholds for atmospheric light extinction are set forth in The Federal Land Managers' Air Quality Related Values Work Group (FLAG) Report (FLAG 2010), with the results reported in percent change in light extinction and change in deciviews. A 5% change in light extinction (approximately equal to 0.5 deciview) is the threshold recommended in the 2010 FLAG Report, and is considered to contribute to regional haze visibility impairment. A 10% change in light extinction (approximately equal to 1 deciview) is considered to represent a noticeable change in visibility when compared with background conditions. The data below is from the closest visibility monitor which is located in the White River National forest just south of the town of Aspen, approximately 52 km east north east of the project area. The data shows that visibility is improving on both the clearest and haziest days.

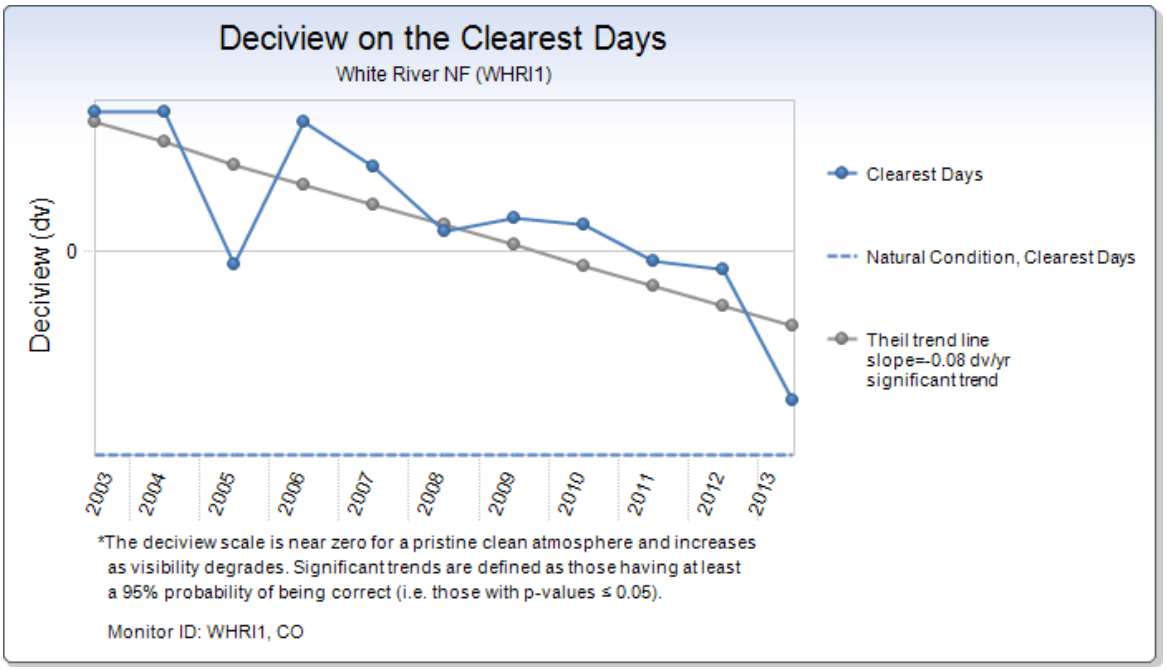


Figure 11– Deciview on Clearest Days

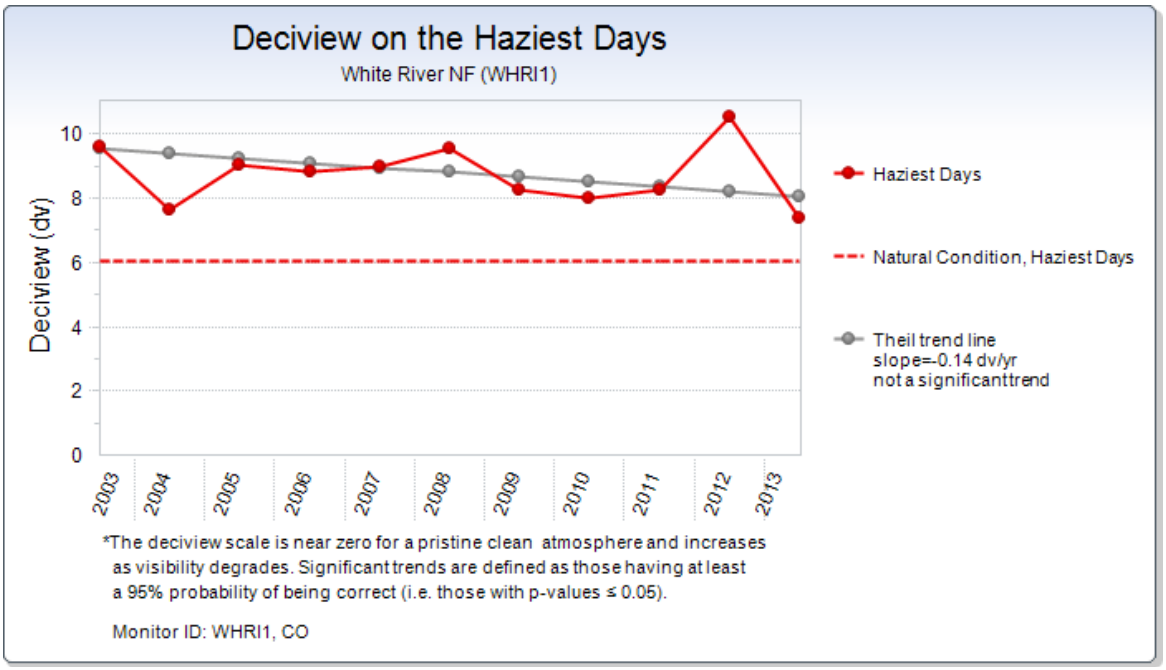


Figure 12 – Deciview on Haziest Days

Deposition (via wet and dry mechanical processes) can cause excess nutrient loading in native soils and acidification of the landscape, which can lead to declining buffering capacity changes in sensitive stream and lake water chemistries (commonly referred to as acid neutralization change (ANC)). The deposition analysis thresholds represent screening-level values for nitrogen and sulfur deposition from project emission sources below which estimated impacts are considered negligible (Table 3-8). The deposition analysis threshold established for both nitrogen and sulfur in western Class I areas are 0.005 kilograms per hectare per year (kg/ha/yr).

Table 3-8 Background Nitrogen and Sulfur Deposition Values (kg/ha-yr)

Site Name	Nitrogen Deposition			Sulfur Deposition		
Gothic	Wet	Dry	Total	Wet	Dry	Total
	1.77	0.23	2.00	0.89	0.09	0.98

Source: EPA 2013

Greenhouse Gases and Climate Change

There is broad scientific consensus that humans are changing the chemical composition of Earth's atmosphere. Activities such as fossil fuel combustion, deforestation, and other changes in land use are resulting in the accumulation of trace greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several industrial gases in the Earth's atmosphere. An increase in GHG emissions is said to result in an increase in the earth's average surface temperature, primarily by trapping and thus decreasing the amount of heat energy radiated by the Earth back into space. The phenomenon is commonly referred to as global warming. Global warming is expected in turn, to affect weather patterns, average sea level, ocean acidification, chemical reaction rates, and precipitation rates, which is collectively referred to as climate change. The Intergovernmental Panel on Climate Change (IPCC) has predicted that the average global temperature rise between 1990 and 2100 could be as great as 5.8°C (10.4°F), which could have massive deleterious impacts on the natural and human environments. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and the burning of fossil carbon fuel sources have caused GHG concentrations to increase measurably, from approximately 280 ppm in 1750 to 400 ppm in 2014 (as of April). The rate of change has also been increasing as more industrialization and population growth is occurring around the globe. This fact is demonstrated by data from the Mauna Loa CO_2 monitor in Hawaii that documents atmospheric concentrations of CO_2 going back to 1960, at which point the average annual CO_2 concentration was recorded at approximately 317 ppm. The record shows that approximately 70% of the increases in atmospheric CO_2 concentration since pre-industrial times occurred within the last 54 years.

3.2.1.2 Methodology

The BLM prepared emissions inventories for each of the project operator's proposed actions. Operators provided detailed information regarding development practices and equipment parameters to the BLM via our online emissions tool. The tool implements standard calculation methodologies (equations and emissions factors) to estimate emissions for all of the potential development and production related activities associated with the proposed action, including:

- Construction activities (number of wells, well pads, access roads, and pipelines)
- Off-Road equipment use (motor graders, bull dozers, trenchers, etc… for all phases of implementation)
- Rigs (drill and completion)
- Completion practices (including statutory requirements)
- Non-Road equipment use (welders, mixers, fracking pumps, etc… for all phases of implementation)
- Well pad equipment – if applicable (separators, tanks, components, pneumatics, engines, pumps, dehydrators, sweeteners, flares, vapor recovery units, etc…)
- On-Road traffic (light and heavy duty truck trips for all phases of implementation)
- Operations parameters (daily visits, estimated production levels, work over and blowdown estimates, etc…)

The project level emissions data for each operator is summarized in the tables below.

Table 3-9 Total Gunnison Energy Proposed Action Emissions (tons)

Pollutant	PM_{10}	$PM_{2.5}$	VOC	NO_X	CO	SO_X	CO_2	CH_4	N_2O	HAPs
Development (total emissions over a 5 year	9	11	7	128	74	5	15,108	1,022	204	0

period)										
Production (annually after all development is complete)	1	1	17	4	7	0	2,693	28	0	3

Table 3-10 SG's Total Proposed Action Emissions (tons)

Pollutant	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**NO_X**	**CO**	**SO_X**	**CO_2**	**CH_4**	**N_2O**	**HAPs**
Development (total emissions over a 5 year period)	15	14	17	320	192	11	40,177	590	118	0
Production (annually after all development is complete)	1	1	35	7	12	0	4,414	56	0	3

For disclosure purposes, GHG emissions were calculated for the proposed project and GHG emissions totals by proposed project phase and operator are shown in the tables above. Standardized protocols designed to measure factors that may contribute to Climate Change, and to quantify climatic impacts, are presently unavailable and therefore, no proposed project specific Climate Change contribution analysis was performed for this environmental assessment. Proposed project GHG emissions totals are compared to future projected year 2020 Colorado state-wide GHG emissions inventory totals to provide the relative magnitude of the proposed project GHG emissions estimates.

Project-Specific Air Quality Modeling Analysis
Appendix I is a modeling report with details for the modeling analysis that was completed for this Environmental Assessment. The following provides an overview of the methodology, modeling programs and datasets used for the project-specific modeling analysis:

- A near-field ambient air quality impact assessment was performed to quantify and evaluate maximum incremental air quality related value (AQRV) impacts at nearby Class I and sensitive Class II areas and cumulative air pollutant concentration impacts at nearby residence ambient receptors within the vicinity of the project area resulting from proposed oil and gas development (drilling, etc.) and production (operation phase) related emissions for the proposed project.
- The analysis was performed using EPA-approved version of the CALPUFF modeling system (Version 5.8.4) with Mesoscale Model Interface Program (MMIF) extracted four kilometer resolution Weather Research Forecast Model (WRF) 2008 meteorology. FLAG 2010 guidance and methodology was followed for the AQRV analyses.
- The modeling analysis includes predicted maximum incremental changes in visibility and nitrogen deposition at nearby United States Forest Service (USFS) Class I and sensitive Class II areas and 1-hour average ambient concentrations for nitrogen dioxide (NO_2), benzene, formaldehyde and n-hexane; 24-hour average concentrations of PM_{10} and $PM_{2.5}$; and annual $PM_{2.5}$, benzene, formaldehyde, and n-hexane concentrations at nearby residences in the modeling domain. Proposed project and existing and projected nearby emissions sources were modeled together for the CALPUFF modeling analysis except for AQRV visibility change and nitrogen deposition which were modeled for proposed project sources only.
- The near-field modeling domain was established to include nearby existing and reasonable foreseeable (future) emissions sources and sensitive receptors (residences) out to 12 kilometers in all directions from the approximate center of the proposed project area. In addition to the residence receptors, receptors were included for Maroon Bells-Snowmass Wilderness (Class I – USFS), Raggeds Wilderness (sensitive Class II – USFS) and West Elk Wilderness (Class I – USFS).
- Project-specific emissions and modeling set-up:
    - For GE, the modeling analysis included well-pad, access road and pipeline construction activities and four (4) new wells drilled / completed modeled together for the new

proposed Spadafora well-pad. Production phase emissions associated with eight (8) new wells were modeled together with the Spadafora construction / development activities.
  - For SG, the modeling analysis included well-pad, access road and pipeline construction activities and five (5) new wells drilled / completed modeled together for the new proposed 11-90-9 well-pad. Production phase emissions associated with 17 new wells were modeled together with the 11-90-9 construction / development activities.
  - Project specific design features accounted for in the modeling analysis include: 50% dust control for construction phase surface disturbance and traffic, Tier-2 drilling / completion engine technology, low-bleed pneumatic devices, green well completion practices and operation phase stationary engines will meet CDPHE Regulation 7 Standards.

- Section 3.2.1 and Table 3-6 of this EA provide information and data for the background concentrations that were used for the modeling analysis. To supplement the HAPs background concentrations and proposed project emissions sources, a CDPHE provided HAPs inventory for nearby permitted activities was processed and nearby existing and projected HAPs emissions sources within 12 kilometers of the proposed project area were included in the cumulative CALPUFF runs. Projected year 2021 modeled criteria pollutant concentrations (CARMMS grid cell data) for the project area were used to represent all criteria pollutant impacts not explicitly associated with the proposed project so no nearby existing and projected emissions sources were included in CALPUFF for criteria pollutants.

The following Section includes a brief summary of the predicted impacts for the project-specific modeling analysis.

3.2.1.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Project-Specific Air Quality Modeling Analysis
As shown in the Appendix I modeling report, NO_2 and PM predicted future near-field concentrations that account for the proposed project emissions and other future oil and gas growth in the region are expected to below applicable air quality standards. The maximum (high 1st high) modeled NO_2 1-hour daily maximum concentration is predicted to be ~ 80% of the NAAQS; the maximum (high 1st high) predicted $PM_{2.5}$ 24-hour and highest annual concentrations are predicted to be 40-50% of the NAAQS and the maximum (high 1st high) predicted PM_{10} 24-hour concentration is predicted to be ~ 25% of the applicable NAAQS. HAPs predicted concentrations for acute short-term and chronic long-term exposures are predicted to be well below applicable thresholds, and the modeled cancer risk associated with proposed project sources is expected to be minimal. Maximum modeled AQRV visibility change and nitrogen (N) deposition associated with the proposed project emissions are predicted to occur at nearby Raggeds Wilderness and were below the applicable thresholds with the largest delta-deciview of 0.35 delta-dv (threshold is 0.5 delta-dv) and maximum N deposition of 0.004 kg/ha/yr (Deposition Analysis Threshold [DAT] ~ 0.005 kg/ha/yr).

As shown above, the overall maximum modeled impacts are below the applicable thresholds for all pollutants and AQRVs. Several conservative assumptions were made for the modeling analyses including the following; refining these assumptions would result in impacts lower than the modeled results:

- Full NO_x to NO_2 conversion for estimating NO_2 1-hour and visibility impacts and therefore, NO_2 impacts are likely overestimated for this analysis.
- Assumes full build-out of well-pads in one year even though that is highly unlikely based on project operator proposed plans. Likely an overestimate based on previous statement alone, but near-field NO_2 1-hour and PM modeling was completed for full build-out of the proposed well-pad with closest proximity to a residence for this modeling analysis.
- The NO_2 1-hour and $PM_{2.5}$ NAAQS are calculated as 3-year (consecutive years) average values. The maximum modeled values shown in Table 4 of this report are predicted concentrations that could occur in any one year and are associated with proposed project full well-pad and

infrastructure build-out. These modeled values would not occur for 3 years at any one ambient residence receptor for the proposed project.

- The CARMMS "High Scenario" year 2021 predicted concentrations were used as "background" concentrations for near-field NO_2 and PM. These future year concentrations account for substantial oil and gas growth in the project area and could be overestimates of future conditions.
- Background HAPs concentrations for this cumulative modeling analysis are for an air quality monitor located in a much higher oil and gas environment than the proposed project location and could be an overestimate of background HAP conditions in the proposed project area.

Greenhouse Gases and Climate Change

According to the U.S. Global Change Research Program (2009), global warming is unequivocal, and the global warming that has occurred over the past 50 years is primarily human-caused. Standardized protocols designed to measure factors that may contribute to climate change, and to quantify climatic impacts, are presently unavailable. Moreover, specific levels of significance have not yet been established by regulatory agencies. Predicting the degree of impact any single emitter of GHGs may have on global climate, or on the changes to biotic and abiotic systems that accompany climate change is highly complex, has considerable uncertainty, and requires intense computer modeling (i.e., super computers). As such, no readily available tools exist to predict impacts a project's emissions would have on the global, regional, or local climate. This analysis is therefore limited to comparing the context of total project GHG emissions, and to emissions recently analyzed by EPA. The analysis also discloses readily available information regarding expected changes to the global climatic system and any empirical evidence of climate change that has occurred to date (see cumulative impacts).

The CDPHE used the EPA's State Inventory Tool to estimate future years GHG emissions inventories for Colorado. In year 2020, it is estimated that Colorado's annual GHG emissions will be approximately 128,060,000 metric tons CO_2(e). The proposed action maximum annual (full development and one year of full production) GHG emissions (total for both proposed project operators as shown in Tables 3-5 and 3-6) would represent about 0.14 % of the state of Colorado's year 2020 annual GHG emissions. Given the relative magnitude of greenhouse gas emissions associated with the development of the proposed project 25 wells as compared to the state's GHG emission levels, the GHG contribution associated with the wells is extremely small.

To provide context for Climate Change contribution, the EPA has recently modeled global climate change impacts from a model source emitting 20% more GHGs than a 1500MW coal-fired steam electric generating plant (approx. 14,132,586 metric tons per year of CO_2, 273.6 metric tons per year of nitrous oxide, and 136.8 metric tons per year of methane). It estimated a hypothetical maximum mean global temperature value increase resulting from such a project. The results ranged from 0.00022 and 0.00035 degrees Celsius occurring approximately 50 years after the facility begins operation. The modeled changes are extremely small, and any downsizing of these results from the global scale would produce greater uncertainty in the predictions. The EPA concluded that even assuming such an increase in temperature could be downscaled to a particular location, it "would be too small to physically measure or detect", see Letter from Robert J. Meyers, Principal Deputy Assistant Administrator, Office of Air and Radiation re: "Endangered Species Act and GHG Emitting Activities (Oct. 3, 2008). The project emissions are a fraction of the EPAs modeled source and are shorter in duration, and therefore reasonable to conclude that the project would have no measurable impact on the climate.

3.2.1.4 Mitigation Measures and Residual Impacts

Air Quality Protection Measures

As described in Section 3.2.1.3 above, the overall maximum modeled air quality impacts for the proposed action are below the applicable thresholds for all pollutants and AQRVs. The modeling analysis accounted for the following project-specific design features that were provided by the proposed project operators. These equipment and practices would need to be operated / followed for the proposed project in order to protect future air quality in the project area and to ensure the applicability of the modeling assessment that was completed for the proposed action:

- Routine clean water application for 50% dust control for construction phase surface disturbance and unpaved road traffic;
- Tier-2 drilling / completion engine technology;
- Low-bleed pneumatic devices;
- Green well completion practices; and
- Operation / production phase stationary engines will meet CDPHE Regulation 7 Engine Standards.
- Since the maximum modeled air quality impacts based on the proposed project design features are acceptable, no additional air quality protection measures would be required by the BLM for the proposed action.

Residual Impacts
As described in the previous sub-section, the maximum modeled air quality impacts based on the proposed project design features are acceptable and therefore, no additional air quality protection measures would be required by the BLM for the proposed action. For this reason, a residual impacts analysis was not completed for this environmental assessment to show the benefits of additional (beyond project design features) air quality mitigation measures and the differences of air quality impact scenarios with and without BLM additional protection measures.

3.2.1.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, the BLM would not authorize any of the proposed action elements. However, because some of the project sites are privately owned surface, a fraction of the well construction and operation related air pollutant emissions could occur as under the proposed action, provided that the wells were drilled or completed such that they would not produce or drain federally-owned oil and gas. Consequently, a small fraction of the air quality and GHG impacts described above for the proposed action could occur, and the air quality impacts associated with no action alternative would be less than those disclosed for the proposed action.

3.2.2 *Cultural Resources*

3.2.2.1 Affected Environment

Cultural resources are defined as fragile and nonrenewable remains of prehistoric and historic human activity, occupation, or endeavor as reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works of art, architecture, and natural features that were important to human history. Cultural resources comprise the physical remains themselves, the areas where significant human events occurred even if evidence of the event no longer remains, and the environment surrounding the actual resource.

Significant cultural resources are defined as those listed in, or eligible for listing in, the National Register of Historic Places. Significant cultural resources are generally at least 50 years old and meet one or more of the criteria presented in 36 CFR Part 60, which specifies that the quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of national, state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that are associated with events that have made a significant contribution to the broad patterns of our history; are associated with the lives of persons significant in our past; embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or have yielded, or may be likely to yield, information important in prehistory or history.

The proposed action is situated within the North Fork area, which is designated as a “Low Probability” zone for the presence of cultural resources. A Class I report (on file at UFO) indicates a probability of fewer than one National Register or eligible site per section. Historic properties in the area are mainly of the later Historic Period of Euro-American settlement.

3.2.2.2 Methodology

Since 1977, 31 individual Class III inventories have been conducted within the general project area. Several class III cultural resource inventories have been conducted for this project, and all of the proposed well sites, access routes and pipelines are included in the surveys. These intensive inventories were conducted in accordance with the Archeology and Historic Preservation: Secretary of the Interior's standards and guidelines (48cfr44716) and standard BLM and USFS procedures. The results from those surveys were submitted to the USFS, BLM and Colorado state historic preservation office (SHPO).

3.2.2.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Based on the review and survey for cultural resources within the project area, there are no cultural resources that would be impacted by the proposed action. Anticipated effects of the proposed action would be negligible and would occur only if subsurface cultural resources are unearthed during construction activities.

3.2.2.4 Mitigation Measures and Residual Impacts

There are no mitigation measures required.

3.2.2.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

There will be no effects to any National Register or otherwise eligible historic property under the no action alternative.

3.2.3 *Native American Religions Concerns*

3.2.3.1 Affected Environment

The North Fork area is historically known as part of the Ute tribe homelands, and such areas may contain Traditional Cultural Properties, culturally sensitive areas and landscapes, and areas of special concern to the modern day Ute tribes.

3.2.3.2 Methodology

Face-to-face consultation has been conducted with the three Ute tribes concerning this project. Consultation occurred by phone, letter and by a direct consultation conference in April 2015. All three tribes have declined to participate and have expressed no concerns for any Religious Concerns.

3.2.3.3 Impacts from the Proposed Action

Direct and Indirect Impacts

No Native American religious concerns have been identified within the project area. If such concerns are identified in the future, the appropriate tribal consultation would be conducted. The proposed action would not result in impacts to Native American religious concerns.

3.2.3.4 Mitigation Measures and Residual Impacts

There are no mitigation measures required.

3.2.3.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

There would be no impacts to any Native American Religious Concerns from this project.

3.2.4 *Soils*

3.2.4.1 Affected Environment

In general, most of the soils in the project area tend to be fine textured throughout their profiles, clay loams, clays, silty clays are the dominate textures. Due to these characteristics most of these soils have a rating of very limited or poor suitability for native surface road situations. Specific characteristics for this rating are low soil strength, excess fines, and high shrink swell. Not all soils received this rating.

Allen
The Allen Well Pad would be located on the Delson stony loam soil type. It has 3 to 20 percent slopes and has a stony loam texture. The erosion hazard for the construction of roads or pads is considered moderate and the runoff potential is very high due to the clay content and slow infiltration rates. The pad location and the soils are situated on a mesa with gentle to moderate slopes where construction of the access road and pipeline would be constructed (Paonia Soil Survey, 1981).

11-90-9
The 11-90-9 Well Pad would be located within the Weed-Herm Complex, 0 to 25 percent slopes, and is a fine-loamy soil type. The erosion hazard for the construction of roads or pads is considered moderate and the runoff potential is very high due to the clay content and slow infiltration rates. The pad location and the soils are situated on valley floors with gentle slopes where construction of the access road and pipeline would be constructed (Web Soil Survey, 2015).

Aspen Leaf
Two soil mapping units would be affected by the Aspen Leaf well pad: Weed-Herm Complex, 0 – 25 percent slopes and Herm-Fughes-Kolob family complex, 25 to 40 percent slopes. These soils are deep, well-drained, gravelly and cobbly clay loarns, derived from interbedded alluvium and residuum weathered from sandstone and shale. Depths to a restrictive layer are greater than 60 inches and the soils are not prone to flooding or ponding. Wind erosion potential is low and water runoff potential is rated very high due to slow infiltration rates. Erosion hazard for water is rated as severe due to low strength. These soils have a land capability class of either 6e or 7e indicating they are not suitable for cultivated crops and are limited to pasture, range, or woodlands due to water erosion and stone fragments (Web Soil Survey, 2015).

Henderson
The Henderson Well Pad would be located within two soil map units. The Weed-Herm Complex, 0 to 25 percent slopes, is a fine-loamy soil type and the Wetopa-Wesday Complex is 5 to 65 percent slopes, and is a fine, smectitic soil type. The erosion hazard for the construction of roads or pads is considered moderate and the runoff potential is very high due to the clay content and slow infiltration rates. The pad location and the soils are situated on valley floors with gentle slopes where construction of the access road and pipeline would be constructed (Web Soil Survey, 2015).

Spadafora
Two soil mapping units would be affected by the Spadafora well pad: Herm-Fughes-Kolob family complex, 25 to 40 percent slopes and Weed-Herm Complex, 0 to 25 percent slopes. These soils are deep, well-drained, gravelly and cobbly clay loarns, derived from interbedded alluvium and residuum weathered from sandstone and shale. Depths to a restrictive layer are greater than 60 inches and the soils are not prone to flooding or ponding. Wind erosion potential is low and water runoff potential is rated very high due to slow infiltration rates. Erosion hazard for water is rated as severe due to low strength. These soils have a land capability class of either 6e or 7e indicating they are not suitable for cultivated crops and are limited to pasture, range, or woodlands due to water erosion and stone fragments (Grand Mesa Soil Survey).

3.2.4.2 Methodology

Acres of disturbance will be analyzed for each of the well pads for direct and indirect impacts and the approximate duration of impacts.

3.2.4.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Potential impacts to soils resources from implementation of the proposed action would likely include: removal of protective vegetation cover, loss of soil profile development, soil structure, and nutrients from topsoil salvage, subsoil excavation, and possible mixing of soil horizons; increased exposure of surface soil materials to erosion forces; compaction of soil materials; and loss of productivity.

Direct impacts to soils would include the removal of vegetation and temporary disturbance of topsoil and subsurface soil through the construction of well pads and pipelines. Compaction due to construction activities at the well pads and along pipelines 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. However, because of the small acreage of surface disturbance associated with the project, these impacts would be minimal in nature.

Allen
The Allen well pad would result in 4 acres of direct impact to soils, 1.1 acres of direct impact from roads and 4.5 acres of direct impact from pipelines. Short term impacts during construction would include mixing of soil horizons and removal of vegetation exposing soil to wind and water erosion. Proposed design features and COGCC regulations including a Storm Water Management Plan would limit the potential for indirect effects downstream of the well pad from the erosion of disturbed soils.

After the initial disturbance due to construction of the facilities, additional impacts to soils during the drilling and completion operations would include contamination from accidental spills. A spill prevention and mitigation plan would reduce long-term impacts.

Once drilling and completion is complete, long term impacts to soils would occur even after interim reclamation. Approximately 2 acres on the well pad and 0.6 acres of roads would remain disturbed for the duration of the production phase of the wells. Production could last indefinitely; therefore these soils would be permanently lost for productive use and would resemble the existing road infrastructure in the area. This is 2.6 acres more than the no action alternative, and is approximately 0.01% of the West Muddy Creek subwatershed containing the well pad and infrastructure.

11-90-9
Construction of the 11-90-9 well pad would directly disturb 5.2 acres of soils, 0.8 acres of direct impact from roads and 1.4 acres of direct impact from pipelines. The types of impacts would be similar to those described for the Allen Well Pad and infrastructure.

Once drilling and completion is complete, long term direct impacts to soils would be approximately 2.0 acres on the well pad and 0.5 acres of roads would remain disturbed for the duration of the production phase of the wells. Production could last indefinitely, therefore these soils would be permanently lost for productive use and would resemble the type of impact similar to the existing road infrastructure in the area. This is 2.5 acres more than the no action alternative.

Aspen Leaf
Once drilling and completion is complete, long term direct impacts to soils would be approximately 2.0 acres on the well pad and 1.0 acres of roads would remain disturbed for the duration of the production phase of the wells. Production could last indefinitely, therefore these soils would be permanently lost for productive use and would resemble the type of impact similar to the existing road infrastructure in the area. This is 3.0 acres more than the no action alternative.

Henderson
The Henderson well pad would result in 11.8 acres of direct impact to soils, 2.5 acres of direct impact from roads and 4.3 acres of direct impact from pipelines. Short term impacts during construction would include mixing of soil horizons and removal of vegetation exposing soil to wind and water erosion. Proposed design features and COGCC regulations including a Storm Water Management Plan would limit the potential for indirect effects downstream of the well pad from the erosion of disturbed soils.

After the initial disturbance due to construction of the facilities, additional impacts to soils during the drilling and completion operations would include contamination from accidental spills. A spill prevention and mitigation plan would reduce long-term impacts.

Once drilling and completion is complete, long term impacts to soils would occur even after interim reclamation. Approximately 1.7 acres on the well pad and 1.7 acres of roads would remain disturbed for the duration of the production phase of the wells. Production could last indefinitely, therefore these soils would be permanently lost for productive use and would resemble the existing road infrastructure in the area. This is 3.4 acres more than the no action alternative.

Spadafora
Construction of the Spadafora well pad would directly disturb 4.0 acres of soils, 1.2 acres of direct impact from roads and 0.2 acres of direct impact from pipelines. The types of impacts would be similar to those described for the Allen Well Pad and infrastructure.

Once drilling and completion is complete, long term direct impacts to soils would be approximately 1.4 acres on the well pad and 0.6 acres of roads would remain disturbed for the duration of the production phase of the wells. Production could last indefinitely, therefore these soils would be permanently lost for productive use and would resemble the type of impact similar to the existing road infrastructure in the area. This is 2.0 acres more than the no action alternative, and is approximately 0.01% of the West Muddy Creek subwatershed containing the well pad and infrastructure.

3.2.4.4 Mitigation Measures and Residual Impacts

The use of design criteria and best management practices has proven to be effective in prevention of erosion and sedimentation. However, the use of silt fence and straw bales for erosion control have often been found ineffective in National Forest habitats due to improper installation or destruction by livestock/wildlife. It is, therefore, recommended that erosion control measures be bio-engineered with native materials (i.e. rock, aspen, other woody vegetation) wherever possible. Monitoring by the operator and diligent adherence to the SWMP will provide quick identification, rectification, and prevention of any deficiencies in the design of devices.

It is recommended that the north-west edge of the proposed location of the 11-90-9 pad be adjusted 50 feet downslope to limit the need to level the topographically higher mound that separates the two ephemeral crenulations that converge at the pad location. This will limit the cut and fill needed to level the site and allow for less direct impact of soil disturbance at the site.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.4.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, current management plans would continue to guide management in the project area, and the proposed Federal oil and natural gas well development and access road construction would not be implemented. Existing roads within the project area would continue to be used for access to local residencies, existing oil and gas operations, and other land use activities. In addition, future oil and gas drilling would continue on private lands in the project area. The Spadafora well pad is Fee/Fee so direct and indirect impacts would be similar to those described in the proposed action.

3.2.5 *Vegetation Management*

3.2.5.1 Affected Environment

Overall vegetation composition is a component of habitat that is also essential to analyzing effects to wildlife.
The existing vegetation types related to the proposed action are identified in Table 3-11 below.

Table 3-11 Vegetation types impacted by the project.

Area	Habitat Type	Approximate Acres
Aspen Leaf	Bare ground, existing pad and road	N/A
Henderson pad and road	Sage/Snowberry	4.7
Henderson pad and road	Aspen, midsize, <40% canopy	2.8
Henderson pipeline	Grass/forb/sage/snowberry alongside road edge	4.3
11-90-9-3 pad and road	Sage/Snowberry	5.0
11-90-9-3 pad	Aspen, midsize, 40-70% canopy	0.2
Allen well pad and road	Aspen, pole/sapling to midsize, >70% canopy	5.1
Allen pipeline	Aspen, sapling (2007 plantation)	1.5
Allen pipeline	Aspen, mid to large size, 40-70% canopy	3.0
Spadafora pad, road, and pipeline	Grass/forb with scattered brush	5.4
Winter Trailhead	Snowberry, grass/forb	2 (est)

Vegetation along the proposed surface poly pipeline routes will not be substantially altered for this project, although some disturbance may occur during installation, maintenance, and removal. Vegetation data for those routes is incomplete, but the routes pass through mainly grass/forb, sage, snowberry, and other low shrub types.

Associated with the Allen location, historic logging activity occurred in the immediate area of the proposed pipeline, multi-well pad and access road in which timber was harvested, delivered and processed at the Louisiana-Pacific Olathe Oriented Strand Board (OSB) plant which was in operation for 16 years and closed in November 2001. Since then, the logged areas consist of younger stands of aspen trees which have regenerated via suckering and an understory of grasses and forbs are flourishing in the area.

Future timber harvest in this area is possible but not likely at any large scale, nor are any large timber sales proposed at this time.

A current trend for aspen has not been done at the forest level. However, much of the aspen is in decline in the project area, and 13% of the aspen state-wide has declined since 2005. On the Paonia District, flights in 2007 showed aspen decline on 20,733 acres of 297,938 surveyed (Region 2 Forest Health GIS data). Of the area flown, approximately 122,000 acres was in aspen type (R2Veg), thus, approximately 17% of the aspen on the flown portion of the district was in decline at that time. This trend in aspen, as well as potential insect infestation in spruce-fir forest, is at the time the most likely agent to cause widespread habitat changes for this species.

3.2.5.2 Methodology

BLM and FS vegetation GIS data was used in this analysis to describe existing vegetation and habitats within the project area.

3.2.5.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Direct effects of the project include habitat alterations from construction of the pads, roads, and pipelines, to the extent and to the types noted in Table 3-11. Pad and road locations will be altered from existing habitat to unsuitable habitat of gravel surface with industrial infrastructure both during construction and for the life of the wells on the pad. Pipelines will be altered from their current condition to bare ground during construction, and then to grass/forb to low shrub conditions after reclamation and for the life of the pipeline. Cut/fill slopes and other areas not on pad or road surfaces will be rehabilitated to grass/forb to low shrub conditions for the life of the roads and pads. After final reclamation of roads, pads, and pipelines (once they are no longer to be used for gas production), they may regrow to pre-existing or other seral conditions, including trees.

The new winter trailhead location will be altered from snowberry/grass/forb to gravel for the foreseeable future.

Burial of drill cuttings from development also has a potential to occur as result of the proposed action. Burial of cuttings on site can induce a positive net effect to various environmental resources (i.e. wildlife, noise, etc.) as truck traffic related to collecting and hauling the cuttings off site for disposal is greatly reduced. However burial of cuttings may directly affect successful establishment of deep rooting reclamation vegetation after final reclamation and abandonment of the well locations has occurred. Of primary concern are elevated Total Dissolved Solids (TDS) and Electrical Conductivity (EC) levels well above background levels at the surface where vegetation is suited to survive. These elevated levels are typical in the composition from cuttings captured by developing the Mancos Shale Formation. Should such cuttings be left at the surface, or within rooting depth of vegetation, the cuttings could present a potentially detrimental effect to the long-term success of vegetation establishment. As further described in section 3.2.15 wastes, (hazardous or solid), both operators will be testing cuttings to be consistent with COGCC table 910-1 standards prior to deciding if they can be buried on location or must be hauled away.

Vegetation removal along the pipeline route could also contribute to the land instability by allowing more water to infiltrate soils.

3.2.5.4 Mitigation Measures and Residual Impacts

The operator must provide the results of sampling cuttings to the SMA for review prior to disposal of cuttings on-site. The operator may request SMA approval, if “strict” adherence with the COGCC Table 910-1 standard can occur, to bury the cuttings on location if they can be covered by an adequate amount of clean soil. Otherwise the cuttings must be hauled to an approved disposal site. “Strict” adherence means constituents cannot exceed the 910-1 standards, with the exception of those that exceed but are reflective of background (e.g. Arsenic) levels.

If these drill sites do not produce any commercially developable gas, the access roads and drill pads should be re-claimed and re-vegetated as soon as possible.

All drill pads, temporary roads and all disturbed area should be re-claimed and re-vegetated. To ensure the satisfactory reclamation and re-vegetation of all disturbed sites sufficient bonding to cover the costs of this work is recommended. In addition, the following re-vegetation practices are recommended to be used to ensure success:

1. All roads, drill pads and staging areas should be re-shaped to their approximate original contours.
2. If soil is stock-piled, the stockpile needs to be contoured for stability and seeded to minimize noxious weed establishment. If the stockpile is temporary, one year or less, a temporary revegetation seed mixture may be used. If the stockpile is going to be in place for over one year, the stockpile must be revegetated with a perennial seed mixture. Seed mixture recommendations are attached.
3. The soil surfaces will be prepared to facilitate successful seed germination and establishment. The seedbed should be firm enough to prevent erosion, but loose enough to allow the seed sprouts to penetrate the soil. Slopes that are 3:1 or flatter should be drill seeded while slopes greater than this should be broadcast seeded. Raking or harrowing immediately before and after broadcasting is highly recommended.
4. Where FS is the SMA, the seed mixes for the Mountain Shrub mix or the Aspen/Spruce-Fir mix, depending on location, is recommended – see Table 3-12 for recommended FS seed mixes. Broadcast seeding application rates for the Mountain Shrub mix is 20 lbs/acre and the Aspen/Spruce-Fir mix is 19 lbs/acre. When drill seeding the drill should be set between .25 and .5 inches deep, and the seeding should be conducted along the contour of the slope to prevent erosion. The application rate for drill seeding should be 10 lbs/acre for the Mountain Shrub mix and 9 lbs/acre for the Aspen/Spruce-Fir mix. The seed-drill needs to be equipped with the following components:
    a. Multiple seed boxes for different types of seed

b. Agitators and picker wheels in at least one box for fluffy seed
c. Double disc furrow openers
d. Intact depth bands with functioning scrapers on all disc openers to ensure consistent, uniform seed depth placement
e. Seed tubes, which drop between disc openers, large enough to handle fluffy seed
f. Packer wheels with adjustable tension, to provide proper soil compaction over and adjacent to the seed
g. Coulter wheels to allow penetration of furrow openers where seeding into heavy mulch or cover crop.

5. Certified weed free straw should be disked or “crimped” into the soil for use as mulch in all disturbed areas. Seeding should occur in the fall of the year allowing for enough time for the seedlings to become established before the onset of winter, usually around mid-September to early November. Any seeding done from June 1 through August 30 has an increased likelihood of failure, due to the uncertainty of summer moisture.

6. Natural materials should be used for erosion and sediment control. Cut oak brush and or aspen should be used to construct silt and sediment control structures. Engelmann spruce and Douglas-fir should not be used due to the increased risk of bark beetle infestation. Silt fencing has been used on a variety of mining activities on the district and it is often torn down by livestock and wildlife. Natural materials have the additional benefit of not having to be picked up once revegetation has been completed. The natural materials cut to clear the ROW can be used or it can be cut along the ROW.

7. If fencing is required to protect re-vegetation, the gas well operator should provide, install, maintain and remove all fencing. Temporary electric fencing has worked well in the past. In addition, the gas well operators should coordinate with the permittees in installing all protective fencing.

Table 3-12 Seed Mixtures for Paonia R.D. (FS lands only)

Habitat type	Elevation	Species	lbs/acre (PLS)	% of Mixture
P/J Woodland	6-7,000	Galleta	3	16
		Western wheatgrass	4	20
		Great Basin Wildrye	3	16
		Indian Ricegrass	3	16
		Sandberg bluegrass	3	16
		Bottlebrush squireltail	3	16
		Total	**19**	**100**

Habitat type	Elevation	Species	Lbs/acre (PLS)	% of Mixture
Mountain Shrub	7-8,000	Mountain Bromegrass	4	20
		Prairie Junegrass	3	15
		Western wheatgrass	4	20
		Indian Ricegrass	3	15
		Rocky Mountain fescue	3	15
		Bluebunch wheatgrass	3	15
		Total	**20**	**100**

Habitat type	Elevation	Species	Lbs/acre (PLS)	% of Mixture
Aspen/Spruce-Fir	8-9,500	Mountain Bromegrass	5	26
		Slender Wheatgrass	3	16
		Nodding Bromegrass	3	16
		Canby Bluegrass	3	16
		Blue Wildrye	5	26
		Total	**19**	**100**

Temporary Revegetation	Elevation	Species	Lbs/acre (PLS)
Regreen (brand name)	All	Tall wheatgrass/winter wheatgrass	20 lbs/acre
Pioneer (brand name)	All	Tritacale/winter wheat	20 lbs/acre

Where BLM is the SMA, the following seed mix shall be used for Allen well, and it is recommended for Spadafora:

Table 3-13 Standard Native Seed Mix for Mountain Shrub Zone, Upper Elevations (7,500-9,000 feet)

	A	B	C	D	E
Species	Desired % of planting	Multiplier (A x 0.01)	PLS lbs for full stand	PLS lbs per acre needed for mix (B x C)	PLS lbs per acre for project (D x # acres)
Western Wheatgrass (*Pascopyrum smitthii*) Variety Arriba	15	0.15	10	1.5	
Slender Wheatgrass (*Elymus trachycaulis*) Variety San Luis	15	0.15	7	1.05	
Bottlebrush squirreltail (*Elymus elemoides*)	15	0.15	8	1.2	
Mountain Brome (*Bromus marginatus*)	15	0.15	12	1.8	
Big Bluegrass (*Poa ampla*)	10	0.1	3	0.3	
Canada Wildrye (*Elymus Canadensis*)	10	0.1	11	1.1	
American Vetch (*Vicia americana*)	3	0.03	25	0.75	
Rocky Mountain *Penstemon (Penstemon strictus*)	6	0.06	2	0.12	
Western Yarrow (*Achilla millefolium var. occidentalis*)	6	0.06	1	0.06	
Mountain Big Sagebrush (*Aretmesia tridentate vaseyena*)	5	0.05	1	0.05	
Totals	**100**	**1.0**		**7.93**	

Possible seed sources:
Arkansas Valley Seed Solutions 877-957-3337; 4625 Colorado Blvd, Denver, CO 80216
Pawnee Butte Seed Co. 970-356-7002; P.O. Box 1604, Greeley, CO 80632
Sharp Bros, Seed Co. 970- 356-4710; 104 East 4th Street Road, Greeley, Colorado 80631
Southwest Seed, 970-565-8722; 13260 CR 29, Dolores, CO 81323.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

To offset the acres of impacts this project will have on vegetation managed by NFS, it is recommended that the FS perform treatment of 100 acres of mountain shrub vegetation in the South Fork Little Henderson Creek drainage by treating over-mature and decadent mountain shrub vegetation in the area, using a hydro-axe. Since this vegetation type is much less productive than the grass/forb type, treatment of 3 or 4 times as much acreage is recommended.

3.2.5.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

No direct or indirect human-caused change in existing condition of current vegetation is anticipated if no action is undertaken for the Federal elements of this project. Conditions will continue as they currently exist, modified as per the other actions given in the cumulative effects contributions described in the EA and existing natural processes. Within the last ten years, aspen within the Paonia District has suffered substantial declines. Statewide, surveys have documented the decline on approximately 17% of the

aspen in the state of Colorado, as of 2008.
http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_038824.pdf

Aspen decline may result in both short- and long-term loss of aspen at a landscape scale in this area. While the aspen decline has slowed substantially in the last few years, there are still visible signs of decline in many stands in the project vicinity.

The Spadafora well pad is Fee/Fee so direct and indirect impacts could still occur and likely be as described in the proposed action.

3.2.6 *Invasive, Non-Native Species*

3.2.6.1 Affected Environment

Appendix F includes lists of noxious weeds identified under the Colorado Noxious Weed Act (Title 35, Article 5.5). The "A" list includes species in Colorado that the Department of Agriculture Commissioner designated for eradication. "B" listed species are those designated by the Commissioner (in consultation with the state noxious weed advisory committee, local governments, and other interested parties) for inclusion in state noxious weed management plans designed to stop the continued spread of these species. "C" listed species are also designated for state noxious weed management plans to support control and weed management on private and public lands by local governments with the goal of providing additional education, research, and biological control resources to jurisdictions that choose to require management of List C species (Colorado Department of Agriculture, 2014). Gunnison County has identified 18 species of noxious weeds that should be controlled within Gunnison County (Colorado State University, 2014), of which most are common in the valleys and in the agricultural areas. Noxious weed species in the mountainous sections of Gunnison County, which may occur in the project area, include absinthe wormwood (Artemisia absinthium), Canada thistle (Cirsium arvense), hoary cress (Cardaria draba), Russian knapweed (Acroptilon repens), musk thistle (Carduus nutans), oxeye daisy (Leucanthemum vulgare), and spotted knapweed (Centaurea maculosa). Noxious weed species observed in the vicinity of the project area include absinthe wormwood and Canada thistle. Some invasive species, such as cheatgrass, are present in the area, but are not listed as noxious. They occur in the shrub and grass communities.

3.2.6.2 Methodology

FS LMP objectives for Range Resource Management include:

- Treat noxious weeds

Additional direction can be found in FSM 2200 and FSH 2209.11, 13 and 14.

The BLM UFO currently manages weed infestations through integrated weed management, including biological, chemical, mechanical, manual, and educational methods. The 1991 and 2007 Records of Decision for Vegetation Treatment on BLM Lands in Thirteen Western States (BLM 2007a), and the 2007 Programmatic Environmental Report (BLM 2007g), guide the management of noxious weeds in western states. The BLM UFO finalized a noxious weed management strategy in 2013 (BLM 2013) that guides the treatment of weeds in the field office.

3.2.6.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Ground-disturbing activities create opportunities for infestations of noxious weeds. There are known populations of Canada thistle, musk thistle, ox-eye daisy and scentless chamomile near the project sites. The seeds from these weeds can be air-born, vehicle-born or transported by wildlife and livestock. Any area where the existing vegetation is removed and bare soil is left exposed creates a potential site for noxious weed infestations.

Gas well operations in this area continue to increase. Gas well traffic is continuous and since many of the noxious weeds we are treating seem to be located along the roadways we seem to be getting continuous new infestations of noxious weeds along roadsides as well as in the general area.

3.2.6.4 Mitigation Measures and Residual Impacts

It is recommended that the gas well operators to be responsible for controlling all noxious weeds along all roads that they use to access their facilities as well as in the general area of their operations following construction for the life of operation of the gas wells. (This includes Gunnison County road from Highway 133 to the Gunnison National Forest boundary, NFSR 265 from the Forest Boundary to the Gunnison/Delta County Line, NFSR 849, and NFSR 851. In addition they need to control noxious weeds on the well pads and drill sites of the existing and the proposed wells. Treatments on NFS lands need to be reported to the Paonia Ranger District by October 1 of each year for coordination and reporting purposes. Treatments where BLM is the SMA need to be reported to BLM UFO as required in the operators specific Pesticide Use Proposal.

All disturbed sites, including road sides, drilling site and soil stock piles need to be re-vegetated with an approved seed mix within the same growing season that they are disturbed. Musk thistle in the Muddy country was introduced in the 1970's by gas well operations. The recommended seed mixtures for the basic vegetation types for interim revegetation on the Paonia Ranger District are described in section 3.2.5.4 vegetation. In addition, all equipment that is moved on to the national forest from outside of Delta and Gunnison Counties should be cleaned at a wash station prior to entering the national forest to reduce the risk of transporting noxious weed seeds from infested sites onto the construction sites.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.6.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Noxious weeds are spread through biological dispersal methods as well as by ongoing human activities such as hunting, grazing, and other uses of the project area. Therefore, noxious weeds, including current species and possible new introductions, could potentially continue to spread and increase the number of acres infested, under the no action alternative. However, there is no reason to believe that the no action alternative would result in any considerable increases in acres of noxious weeds in either the short or long-term.

3.2.7 *Threatened, Endangered (ESA), Sensitive Species*

3.2.7.1 Affected Environment

A list of Threatened, Endangered, Proposed, and Candidate species was collected by the Forest Fish, Wildlife, and Rare Plants program lead on May 14, 2015, from the USFWS website, and emailed to the author. Fish species are addressed in a separate document. Table 3-14 showing the complete species list for the Forest is shown below (excluding fish species). There is only one federally listed terrestrial species that has the potential to be found in the project area, the Canada lynx. Listed plant species, and many terrestrial species, are not known or expected to occur in or near the project area due to range and/or habitat limitations, and will not be impacted by the project. Species not carried forward for analysis may be considered to have a "no effect" determination from this project.

Table 3-14 Federally Threatened and Endangered or Candidate Species considered for this project.

Species	***Scientific Name***	***Status***	***Habitat Description and Requirements***	***Habitat in Project Area, or Potential Impacts to Species?***

Species	***Scientific Name***	***Status***	***Habitat Description and Requirements***	***Habitat in Project Area, or Potential Impacts to Species?***
Uncompahgre fritillary	*Boloria acrocnema*	*Endangered*	*Alpine habitats above timberline. Documented on the Forest but not known or expected to occur in or near the project area.*	*No*
Canada lynx	*Lynx canadensis*	*Threatened*	*Spruce-fir, mixed conifer, lodgepole pine forest (primary), mixed deciduous/conifer (secondary).*	*Yes*
Mexican spotted owl	*Strix occidentalis lucida*	*Threatened*	*Desert canyons, Ponderosa forest. Suspected but not confirmed on the GMUG NF. Not known or expected to occur in or near the project area.*	*No*
DeBeque phacelia	*Phacelia scopulina var. submutica*	*Threatened*	*Barren patches of shrink-swell clay of the Wasatch Formation at about 5,000 to 6,200 feet elevation in the southern Piceance Basin. Documented to occur on the GMUG, but not know or expected to occur in or near the project area.*	*No*
Colorado hookless cactus	*Sclerocactus glaucus*	*Threatened*	*Coarse soils derived from cobble and gravel river and stream terrace deposits, or rocky surfaces on mesa slopes at 4,400 to 6,200 feet in in the lower Gunnison and Colorado drainages. Documented to occur on the GMUG, but not know or expected to occur in or near the project area.*	*No*
Gunnison Sage-grouse	*Centrocercus minimus*	*Threatened*	*Sage-dominated landscapes. Nearest known population south of Crawford, approximately 30 miles south of project area. No populations expected in or near project areas.*	*No*
Gunnison Sage-grouse critical habitat		*Threatened*	*Approximately 156,000 designated acres on NFS lands. Nearest designated habitat south of Crawford, approximately 30 miles south of project area.*	*No*
Yellow-billed cuckoo	*Coccyzus americanus*	*Threatened*	*Dense multistory riparian or deciduous forests. Locally found near Hotchkiss. Not known or expected to occur inor near the project area.*	*No*

Species	***Scientific Name***	***Status***	***Habitat Description and Requirements***	***Habitat in Project Area, or Potential Impacts to Species?***
Yellow-billed cuckoo critical habitat		*Proposed*	*Proposed areas include a unit near Paonia, CO, along the North Fork Gunnison River. Proposed habitat is not near nor affected by project.*	*No*

Forest vegetation GIS data as of January 24, 2012 was used in this analysis to describe existing vegetation and habitats within the project area, with field visits occurring during previous analyses and in May of 2015 to verify conditions at project sites. Minor vegetative changes have occurred in the analysis area since that date and were considered for this analysis. Aspen stands in the area have substantial mortality in the past ten years and vegetation models in many cases do not reflect conditions on the ground. The analysis area for the Biological Assessment for terrestrial species is the sum of the two Lynx Analysis Units (Crater Lake and Chalk Mountain) in which the project lies, totaling 78,072 acres. Existing vegetation at the two potential analysis scales (the project footprints and the two LAUs), is shown in Table 3-15, based on provided GIS of the project. These values may not exactly match those in the EA due to rounding. Values may also not match those of previous analyses due to changes in project specifications and/or changes in habitat over time. Table 3-16 shows vegetation structural stages within the project area. Additional analysis includes a lynx linkage area in the vicinity of McClure Pass, outside of the two LAUs. No vegetative analysis of this linkage area was conducted as impacts are limited to vehicular traffic on Colorado Highway 133 in that area.

Table 3-15 Existing Vegetation Data (rounded to 1/10 acre)

Primary Vegetation Type (Cover Type)	**Acres of project footprint within Chalk LAU**	**Acres of project footprint within Crater LAU**	**Acres (combined)**	**Acres Chalk Mountain LAU**	**Acres Crater Lake LAU**	**Acres in analysis area (combined)**
Forb				131.0	1585.2	1716.2
Grass (various)				1660.9	1253.7	2914.6
Bare ground				7.2	388.7	395.9
Gambel oak (shrub)				911.2	944.4	1855.6
Mountain shrub				1450.0	2577.0	4027
Sage				1258.4		1258.4
Snowberry				423.0	324.3	747.3
Willow (shrub) *				1255.6	994.7	2250.3
Aspen	2.8	3.0	5.8	15590.7	18970.5	34561.2
Cottonwood				0	8.7	8.7
Douglas fir				0	1.5	1.5
Spruce-fir				8713.0	19359.1	28072.1
Water				2.4	260.6	263
Total	2.8	3.0	5.8	31403.3	46668.4	78071.7

* Includes alder cover type.

Table 3-16 Project Footprint Vegetation Structural Stages (all vegetation types) within LAUs. All habitat is within pure aspen cover types.

Vegetation Structural Stage	Treatment Area (acres) rounded to nearest 1/10 acre
Natural meadow/low shrub	
Natural shrubland	
Grass/forb to sapling/pole cover <40%	
Sapling/pole cover 40-70%	
Sapling/pole cover >70%	1.5
Mature/overmature, cover <40%	2.8
Mature/overmature, cover 40-70%	1.5
Mature/overmature, cover >70%	

Habitats within the overall project disturbance footprint (both within and outside of LAUs) include grass/forb, sage, snowberry, and aspen. Transportation routes to and from this area go through similar habitats as well as through spruce-fir, mixed aspen/conifer, and riparian areas. The project area lies at 7400 to 8500 feet elevation.

Colorado River Fish and 3 Species fish - Federally listed and Sensitive fish
Although the USFWS-listed Bonytail (Gila elegans), Humpback chub (Gila cypha), Razorback sucker (Xyrauchen texanus),Colorado pikeminnow (Ptychocheilus Lucius), and the BLM sensitive Roundtail chub (Gila robusta), Bluehead sucker (Catostomus discobolus), Flannelmouth sucker (Catostomus latipinnis) do not occur within the project area, water depletions from projects effecting drainages supplying rivers where these species are present have the potential to affect fish populations. The closest occupied habitat for endangered Colorado River fishes is in the lower Gunnison River, where razorback suckers and Colorado pikeminnows are present. This portion of the river is also designated critical habitat for these two fish species1; however, the project area is located more than 55 miles downstream of the project area. The Gunnison River is known to contain populations of flannelmouth sucker, bluehead sucker, and roundtail chub at least up to the confluence with the North Fork of the Gunnison River where water temperature likely limits occupation much further upstream. Because bluehead sucker can tolerate colder average water temperatures this species has been observed in the lower portion of West Muddy Creek by USFS personnel as recently as 2007.

Other Sensitive Species
Amphibians
Northern Leopard Frog (Lithobates pipiens). This species occurs in the project area in irrigated meadows, riparian areas and creeks, and prefers sunny, grassy wetlands. Where it is located, it can occur in large numbers, with more than 100 individuals, typically juveniles, per pond at times (D. Garrison, pers. obs), but its range appears to be restricted on the district at this time. The species utilizes wetlands for breeding and growth of young, which migrate out from natal ponds in late summer and fall, and overwinter in mud. It requires abundant aquatic vegetation for breeding and adjacent semi-aquatic vegetation for cover when adults disperse short distances to feed. Leopard frogs feed primarily on emergent adults of aquatic insects or on terrestrial insects attracted to the water.

Within the vicinity of the proposed Henderson Well Pad, northern leopard frogs were observed in ponds northwest of the pad location and western terrestrial garter snakes have also been observed. In the vicinity of the proposed Spadafora Well Pad, northern leopard frogs and tiger salamanders were observed in two ponds northeast of the pad location and in ponds along Sheep Creek.[8,9]

[1] U.S. Fish and Wildlife Service (USFWS). 1994. Determination of Critical Habitat for the Colorado River Endangered Fishes: Razorback Sucker, Colorado Squawfish, Humpback Chub, and Bonytail Chub. Federal Register 50 CFR Part 17. Available online at http://ecos.fws.gov/docs/federal_register/fr2545.pdf.

Similar surveys have not been conducted/ provided for the Aspen, 11-90-9, and Allen locations. However, the species are likely present in any riparian/aquatic habitat within or adjacent to all the proposed construction activities proposed for these three locations.

Mammals

The following bat species may forage and/or roost within the project area: Big free-tailed bat (Nyctinomops macrotis), Spotted bat (Euderma maculatum), Townsend's big-eared bat (Corynorhinus townsendii), Fringed myotis (Myotis thysanodes), There are no suitable maternal roost or winter hibernation sites for any of the identified species in the project area; although, there may be suitable roosting habitat within the project area.[2] Occurrence of these species within the project area would primarily be during foraging or dispersal activities.

Fringed Myotis

The fringed myotis lives in coniferous woodlands and other forests at mid-elevations in Colorado. They are found in habitats including ponderosa pine, pinyon-juniper, oak, and desert habitats. They roost in rocks, caves, mines, buildings, and trees, especially under bark of large conifers such as ponderosa pine (Keinath 2004). They are known to hibernate in caves, mines, and buildings and may not migrate. No fringed myotis have been captured in mistnet surveys on the district.

Hoary Bat

This species is known to occur on the Forest and is typically found foraging in open habitats along the larger stream courses or over open wetlands such as stock ponds. The hoary bat is a migratory, solitary tree roosting species and is expected to roost in streamside cottonwoods and larger aspens throughout the district, especially those which have died and have loose bark. Mistnet surveys for bats were conducted at several locations on the district in 2007 to 2009, and a total of 51 hoary bats were captured at 8 locations during those surveys. Fourteen of the 51 bats were captured along West Muddy Creek, the survey location nearest to the project area, approximately 3 miles north of the Allen site and two miles west of the Spadafora site.

Spotted Bat

This species is known to occur in the Black Canyon of the Gunnison, approximately 30-35 miles south of the project area, and may occur at other sites closer to the project. Spotted bats typically roost in cliffs and rock walls but forage widely, including in forest openings and subalpine meadows in spruce, pine and pinyon-juniper woodlands, riparian areas, and agricultural areas (Luce and Keinath 2007). Threats to their populations include loss or reduction in value of wet meadow habitats and other foraging areas. Spotted bats have not been caught in any mistnet survey on the district.

Townsend's big-eared bat

Townsend's big-eared bats typically roost in caves, mines, and buildings (Gruver and Keinath 2006). They can forage in a wide variety of habitats, primarily in or near vegetation such as forest canopies. They are not known to occur in or near the project area, but are widely scattered throughout the western United States and may occur near the project area. They have not been captured in mistnet surveys on the district.

Birds

See section 3.2.8 for an analysis of impacts to migratory birds and analysis below for impacts to sensitive species such as Northern goshawk, Flammulated Owl, Purple Martin, Olive-sided flycatcher, Brewer's Sparrow.

Northern goshawk

This species occurs on the GMUG. Nesting occurs in mature forest types (spruce-fir, lodgepole pine, ponderosa pine and aspen). Foraging habitat may include younger or more open canopy forests. The goshawk may be vulnerable to nest abandonment due to disturbance within the area. Alternate nests are

[2] Colorado Natural Heritage Program (CNHP). 1994. Bats of Colorado. Available online at http://www.cnhp.colostate.edu/RASwebpage/cbwg_website/cbwg_index.htm.

commonly used, but nest tree fidelity was stronger in uncut forests compared to treated forests (USDA 2005a).

Table 3-17 Potentially suitable goshawk habitat on the GMUG NF by vegetation cover type and habitat structural stage.

Cover Type	1	2	3A	3B	3C	4A	4B	4C/5	Total
Aspen		4743	55301	211399	41446	23567	227148	176278	739881
Cottonwood Riparian			248	100		2530	1532	42	4452
Gambel oak		291383	472	82		416			292353
Mountain shrub		165073							165073
Sagebrush		101838							101838
Wet meadow	4573								4573
High elevation riparian (blue spruce)			101	242	560	234	597	836	2570
Douglas fir			3396	8226	2416	8848	16192	6590	45668
Lodgepole pine		758	7100	124674	54741	4658	49472	38887	280290
Pinyon-juniper			28542	37131	625	29956	39064	1554	136862
Ponderosa pine		251	10530	13060	94	42180	44102	965	111182
Spruce-fir		269	38910	99888	11933	72923	322729	201388	748040
Total acres	4573	564315	144600	494792	111815	185312	700836	426540	2632782

*Potentially suitable habitat derived from HABCAP modeling based on Hoover and Wills, 1984.

Based on actual known locations of nest sites, suspected breeding territories, and sightings, the northern goshawk appears to be well distributed throughout the GMUG in suitable habitat. Records of known goshawk nest activity on the GMUG show that numbers of breeding goshawks and nest success has remained relatively stable, although low over a 17-year period (USDA 2001). Breeding Bird Survey data show a slight increasing trend for this species in Colorado from 1966-2012 (Sauer et al. 2014), although this is based on limited data as this is an uncommon species.

The primary threat to goshawk populations is alteration of its preferred habitat from timber management practices. Although the goshawk uses a wide range of forest communities during the breeding season, it prefers mature and old growth forest for nesting and hunting. Although there is some evidence goshawks are resilient of forest fragmentation and can re-establish when cleared areas are reforested, the thresholds for population persistence have not been identified. Locally, the species persists at sites whose landscapes include recent timber harvest and existing road networks. Issues related to habitat alteration include forest fragmentation, creation of even-aged, monotypic stands, potential increase in area of younger age class, and loss of tree species diversity (Kennedy 2003).

Flammulated owl

This species is known to occur on the Forest. Flammulated owls have a strong association with ponderosa pine, but also use aspen forests in the montane life zone. Locally, ponderosa pine is widely scattered, and occurs primarily along the west face of the Raggeds southerly into the West Elk Wilderness along Coal Creek. There is no pine in or near the project area. This species is migratory, but

shows high site tenacity by adults. As an insectivore, they can occur at relatively high densities compared to other owls (Hayward and Verner 1994, USDA 2005). These owls depend on cavities for nesting, open forests for catching insects, and brush or dense foliage for roosting (Kingery 1998).

Flammulated owls are documented on other portions of the GMUG NF, in aspen stands on the Paonia District and utilizing next boxes (NRM FAUNA database). No Breeding Bird Survey information is available for this species (Sauer et al 2014). Surveys for this species have occurred in the general area of the project, including at three of the proposed pad locations (Aspen Leaf, 11-90-9-3, and Henderson) prior to previous analyses of those locations. A cursory listening survey was conducted at 4 of the 5 sites (excluding Spadafora) on 5/17/15 by the author and another biologist, with no detections. Broadcast call surveys in suitable habitat within ¼ mile of project construction activities, including new pads, roads, and pipelines, will be needed to determine the current use of the area by flammulated owls. In the absence of current survey data, habitat suitable for this species will be presumed to be occupied.

Purple martin

This species is known to occur on the Forest and is primarily associated with patches of mature to decadent aspen. Nest site availability may be a key limiting factor to populations in R2 (USDA 2005a) although suitable habitat appears to be currently abundant in the northern portion of the Paonia district (D. Garrison, pers. obs.). The preferred habitat of purple martins in the Rocky Mountains is mature aspen forest with nearby meadows and open water. Martins nest in cavities in live aspen trees (Wiggins 2005) and snags (D. Garrison, pers. obs.). Cavity formation is by other species such as the northern flicker, in trees with heart rot. This species shows an upward population trend in Colorado based on limited data, but is relatively stable to slightly decreasing across the US (Sauer et al. 2014). Numerous colonies of purple martins are known on the district, with over 100 known breeding sites, and martin nest trees have been located throughout the general project area. There are known nest sites near or on the existing road/proposed pipeline route to the Allen pad (historic data), on private lands near the Henderson pad along the existing road/proposed pipeline route (D Garrison, pers. obs. on 5/13/15), adjacent to the proposed access road/pipeline for the 11-90-9-3 pad (D. Garrison, pers. obs. 2013-2014), and at several locations along roads accessing project sites, including NFSR 265 and 704 (historic and personal observations by the author). Martins arrived in the area for spring migration in mid-May 2015 and current year surveys are unlikely to occur before this document is completed due to time constraints. Surveys in suitable habitat within ¼ mile of project construction activities, including new pads, roads, and pipelines, will be needed to determine the current use of the area by purple martins.

Olive-sided flycatcher

This species is known to occur on the Forest. They primarily breed in spruce/fir forest, but use the forest-opening ecotone and are a colonizer of post-disturbance habitats. Openings, conifers, snags and an abundant insect food source are the crucial elements (USDA 2005a). They occur less regularly and less abundantly in deciduous or mixed aspen/conifer forests (Kingery 1998). This species shows a relatively stable but slightly downward trend in Colorado (Sauer et al. 2014). Olive-sided flycatchers are occasionally seen and/or heard on the district, in a variety of habitats, usually near water or large openings while foraging (D Garrison, pers. obs.), and usually where large conifers are present to provide perches from which to forage. This species has been observed at several locations in the project area.

Brewer's sparrow

The Brewer's sparrow is a sagebrush community obligate, typically associated with big sagebrush (*Artemisia tridentata*) of less than 1.5 meters in height (Holmes and Johnson 2005), as well as in shrub parklands within coniferous forests. On the GMUG, secondary habitat includes various mountain shrub species other than sagebrush. (USDA 2005g). This species shows a moderate downward trend in Colorado from 1966-2012, but is based on limited data (Sauer et al 2014).

This species has not been observed by the author in surveys at project sites and other extensive time spent in or near the project area. However, it has been documented along portions of NFSR 265, which is a Breeding Bird Survey route (eBird 2015, Pardieck et al 2015) and in surveys at the Spadafora location (Monarch and Associates 2014). It is likely present in the project area in small numbers due to the limited immediate habitat. Predisturbance project surveys will also assist in determining presence of this species and therefore impacts to individuals and nesting and foraging habitats.

Plants
Implementation of this project will have NE on neither *Sclerocactus glaucus* nor *Debeque phacelia* as no suitable hábitat is present. There is one sensitive plant specie, *Astragulus iodopetalus*, that the project May Impact individuals, but is not likely to cause a trend towards Federal listing or result in loss of viability in the planning area. Weber and Wittmann (2012) reported that this species is found in sagebrush habitat in Colorado and often about oak thickets. There are known occurrences in Montrose and Gunnison County south of project location approximately 40 miles. Per communication with Gay Austin (BLM Botanist) on June 8, 2015, there is not enough known information on this species.

3.2.7.2 Methodology

The U.S. Fish and Wildlife Service (FWS) has issued a Programmatic Biological Opinion [1,3] which has determined that water depletions within the Colorado river basin and it's tributaries have an adverse effect on the four Colorado river basin endangered fish. See the Environmental Assessment and project record for additional information.

FS policy requires that a review of programs and activities, through an effects analysis document (referred to in current FS policy as a biological evaluation or BE), be conducted to determine their potential effect on threatened and endangered species, species proposed for listing, and Regional Forester-designated sensitive species (FSM 2670.3). Under the ESA, the effects analysis report is called a biological assessment (BA) and must be prepared for federal actions that are "major construction activities" to evaluate the potential effects of the proposal on listed or proposed species and critical habitats. The contents of the BA are at the discretion of the federal agency, and will depend on the nature of the federal action (50 CFR 402.12(f)). A BE may be used to satisfy the ESA requirement to prepare a Biological Assessment. Preparation of a Biological Evaluation as part of the NEPA process ensures that TEPS species receive full consideration in the decision-making process.

Greenback Cutthroat Trout-
A detailed description of the biology, ecology, and status of this species on the GMUG is available on the internet at:
http://www.fs.usda.gov/detail/gmug/landmanagement/resourcemanagement/?cid=stelprdb5199668

Consultation History Terrestrial T&E Species
Portions of this project have been previously analyzed either as isolated projects or as portions of larger projects. Pad construction and drilling of a single well on the Aspen Leaf portion of the project was analyzed in 2008 (USDA 2008a), and was determined to "may affect, not likely to adversely affect" Canada lynx at that time due to a projected loss of 1.9 acres of "other foraging" habitat along FS Road (NFSR) 849 for placement of a pipeline. In 2009, the project was changed to reroute the pipeline such that there would be no loss of that habitat, and therefore there would be no effect to lynx as a result of the project (USDA 2009). Subsequent changes to lynx analysis units in consultation with the US Fish and Wildlife Service now place that project area well outside any habitat deemed suitable for Canada lynx. The project was determined to have no effect on any other terrestrial T&E species. The Henderson portion of the project was analyzed as part of a 4-pad GE project in 2010 (USDA 2010), and was determined to have no effect on any terrestrial T&E species. The 11-90-9-3 portion of the project was analyzed in 2013 (USDA 2013) and was determined to have no effect on any terrestrial T&E species. The Spadafora and Allen portions of this project have not been analyzed by the USFS prior to this date. For this analysis, the proposed action will be used. Field visits have been previously conducted by the author on multiple occasions to three of the five pad locations (USDA 2008a, 2009, 2010, and 2013) for project-related or similar activity evaluation, and additional visits were conducted in May of 2015 by the author to all but the Spadafora pad location. At these times, field verification of habitat and project activities occurred. All but the Spadafora location have been visited several times for other purposes by the author, as well, in the last several years. Additional information and analysis used overhead imagery and USFS GIS layers available to the author.

Sensitive Species
Information on distribution, dispersal capability, abundance, population trends, habitat trends, habitat vulnerability, and risks based on life history and demographics has been reviewed for USFS R2 Sensitive

Species, and is available on Region 2's website (www.fs.fed.us/r2/projects/scp). This information has been incorporated where relevant, but extensive life histories of species are not described herein, nor are individual species assessments cited where those species are not carried forward for detailed analysis. The list of species reviewed for this project was taken from the Region 2 Sensitive Species Matrix (USDA 2015) and was downloaded on 05/06/2015, and was checked against the official Region 2 sensitive species list (USDA 2013) for accuracy. This excluded R2 Sensitive Species which were not known or expected to occur on the GMUG. A list of all possible sensitive species on the Forest is given in Appendix 1. There are several sensitive species that are known to be or are potentially present in the project area. Numerous species which may occur on the GMUG, but are not known or expected to occur in the project area, due to absence of suitable habitats or range limitations, were not carried forward for analysis, and will not be affected by the project. Plant and fish species are addressed in separate documents.

3.2.7.3 Impacts from the Proposed Action

Direct and Indirect Impacts

See next.

3.2.7.3.1 Threatened, Endangered Species – Canada Lynx

General Impacts

Disturbance to denning or foraging is highly unlikely. This is not anticipated to be a measurable impact as the project area is at much lower elevation than denning has occurred in Colorado, there is abundant lynx habitat outside of the project area, at higher elevations and in higher quality (dense spruce-fir) habitat. Therefore, there will be no direct impacts to lynx as a result of these portions of the project.

Traffic is not anticipated to be a substantial impact. A measurable increase in traffic along NFSR 704.4A, 704, 265, and 851, within or immediately adjacent to suitable lynx habitat, will occur, including heavy truck traffic. An incremental increase in traffic on Highway 165 over McClure Pass, in a lynx linkage area, is expected to occur. These traffic contributions are not expected to have a measurable impact on lynx or lynx habitat.

Snow compaction will not increase as a result of this project. Plowing of some routes will occur, including in LAUs. This is not expected to have any effect on lynx due to the location of the activity.

Specific Project Sites

Three of the 5 proposed pad locations (Aspen Leaf, Spadafora, and 11-90-9-3) and associated pipeline and road construction lie outside of any LAUs and are not considered suitable lynx habitat.

Aspen Leaf, Spadafora, and 11-90-9-3

A short portion of the access road leading to the Spadafora leads through habitat modeled as suitable. Field verification shows that this habitat is pure aspen that is more than 800 meters from any spruce-fir habitat within the LAU and is not suitable for lynx. Therefore, there is no risk to Canada lynx from onsite traffic associated with this portion of the project. Roads associated with the Aspen Leaf and 11-90-9-3 locations do not run through LAUs. As none of these locations lie within lynx habitat, there will be no direct impacts to lynx as a result of these portions of the project.

Allen

The Allen pad and all of the proposed access road, with the exception of the last 20-30 feet adjacent to NFSR 704.4A, lie on private lands outside of the mapped LAUs and are not considered suitable lynx habitat.

Approximately 0.7 miles of proposed pipeline with a footprint of approximately 3 acres for the Allen pad lies within habitat mapped using GIS models as suitable habitat. However, a field visit to this area found that the vegetation polygon to the east of the proposed pipeline route, which is in the model as having a 10% spruce-fir component in aspen and thus was considered to be primary habitat, has in fact a less than 1% spruce-fir component and thus is not primary habitat. If this correction is made in the model, both of the stands along the pipeline route no longer type as suitable habitat. Field visits to the pipeline route determined that the stands on both sides of the route do contain cover and may provide hare habitat in

some limited amount. However, the nearest portion of the pipeline route to any spruce-fir stands (which themselves occur outside of the mapped boundary of the LAU and are therefore not defined as suitable) is approximately 500 meters, and approximately 2 km to the nearest contiguous spruce portion of the LAU, which would preclude these stands as being considered suitable under current direction.

Traffic associated with the Allen pad construction and operations is anticipated to be approximately 1357 round trips for construction, reclamation, drilling, completion, and workover operations, as well as 886 round trips per year for production (May 26, 2015 draft version EA, Table 2-15). Pad construction will occur within a relatively short time frame, while drilling activities may occur over several years. The traffic levels associated with this well lie within the general use of the 704 and 265 roads, both of which have been used for similar activities at similar levels in the past. Portions of both roads lie within mapped LAUs and cross habitat mapped as suitable. While traffic accidents are a major cause of lynx mortality and thus may seem to pose a risk along these roads, both of these roads are low-speed routes, with anticipated maximum speeds of 25 mph. The low traffic levels and speeds reduce the risk to a discountable and insignificant level. Habitat along this route is below the elevation at which lynx have been known to den in Colorado, and is distant from the spruce-fir core area in the LAU. Therefore, there is no anticipated impact to lynx resulting from use of these roads for the project.

Henderson

A portion of the Henderson pad, access road, and pipeline footprint totaling approximately 2.8 acres lies within aspen habitat mapped using GIS models as suitable habitat. However, field visits both in the past for previous analysis and during May of 2015 determined that the habitat onsite is not suitable due to lack of canopy cover and density of the shrub layer in the remaining stand. Additionally, the area of impact is approximately 800 meters from the nearest inclusion of spruce within the otherwise pure aspen stand and almost 5km from the nearest contiguous spruce stands within the LAU. Therefore, the initial determination that this is not suitable lynx habitat made in the prior analysis is reiterated here. As a result, there would be no direct impacts to lynx or lynx habitat resulting from this pad. None of the remainder of the pad, pipeline, or proposed access route associated with this pad is in habitat which would be considered even potentially suitable (sage, snowberry, grass/forb, and existing road) and is outside of the LAU boundary. All onsite traffic associated with this pad location would be outside of mapped LAUs other than at the pad itself, which, being unsuitable and more than 800 meters from any spruce habitat, results in no effects to Canada lynx from onsite traffic.

Surface Poly Pipeline

The two pipelines proposed in this project lead from the Aspen Leaf and 11-90-9-3 pad locations to water storage facilities to the south and east. None of the pipeline routes are in or near lynx analysis units or lynx habitat, and will have no direct impact on lynx.

Snow compaction

This project, as proposed, will result in effectively permanent plowing of NFSR 265 from the current snowmobile parking lot near the junction of NFSR 844 to the junction of NFSR 704 and then to the new snow park location along NFSR 265 west of the Muddy Guard Station. The plowing will replace 4.1 miles of what has in the past been groomed snowmobile trail, 3.6 miles of which is within the Chalk Mountain LAU. Additionally, 5.6 miles of NFSR 704 will also be plowed, within the Chalk Mountain and Crater Lake LAUs, as will 0.8 miles of NFSR 704.4A within the Crater Lake LAU. All of these routes have been plowed at times in the past, but on a case-by-case basis. The NFSR 704 and 704.4A plowing will (Design Feature # 91) allow for continued snowmobile traffic. This route is not and has not in the past been groomed and sees only occasional snowmobile traffic.

None of the plowed areas are within the spruce-fir core of the LAUs, and run either through aspen, open cover types, or through pockets of spruce-fir along the very edge of the LAUs. These actions are not anticipated to have a direct or indirect impact on lynx, or result in changes in snowmobile traffic levels or an increase in compacted routes within the LAU. Related to this, a private business within the Crater Lake LAU that had recreational and permitted outfitter snowmobile traffic associated with it, and was the primary user of the 265 route in question, has been replaced with a noncommercial entity, and snowmobile traffic at this winter trailhead is expected to decrease over past levels. The grooming of

NFSR 265 from the new trailhead to NFSR 701 (the Sunlight-to-Powderhorn OSV trail, itself groomed) is expected to continue and is not connected to this project other than by changing the origin of some traffic.

Offsite Traffic

Traffic associated with this project is expected, in part, to utilize Colorado Highway 133 in the McClure Pass area. For the purposes of this analysis, an assumption of 30% traffic over McClure pass was used, to conform with other analysis for nearby similar projects (Bull Mountain). Traffic coming from the south up Highway 133 goes through no lynx analysis units or mapped linkage areas. The projected contribution to traffic flows over McClure pass is not considered to be significant. Contributions are well below one percent of average traffic at the start of the project and will contribute less as traffic increases in the future on this route. Traffic on this route is also highly variable, with season, weather, construction projects, and special events, and spikes in traffic from project vehicles mesh into this pattern. Therefore, this traffic is considered to have no effect on the Canada lynx.

3.2.7.3.2 Federally listed and Sensitive fish

No direct impacts from the proposed action are anticipated for the USFWS-listed Bonytail, Humpback chub, Razorback sucker, Colorado pikeminnow, and the BLM sensitive Roundtail chub, Bluehead sucker, Flannelmouth sucker.

Given that the proposed action would result in the depletion of approximately 224.4 acre-feet of water from within the Colorado River basin, this project falls under BLM Colorado's Programmatic Biological Assessment (PBA) for water depleting activities associated with BLM's fluid minerals program in the Colorado River basin in Colorado.[3]

In response to BLM's PBA, the U. S. Fish and Wildlife Service (FWS) issued a Programmatic Biological Opinion (PBO)(ES/GJ-6-CO-08-F-0006) on December 19, 2008, which concurred with BLM's determination that water depletions are "Likely to Adversely Affect" the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Likewise, the project is also likely to adversely affect designated critical habitats for these endangered fish along the Green, Yampa, White, Colorado, and Gunnison rivers. However, the FWS also determined that BLM water depletions from the Colorado River Basin are not likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, or razorback sucker, and that BLM water depletions are not likely to destroy or adversely modify designated critical habitat.

A Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin was initiated in January 1988. The Recovery Program serves as the reasonable and prudent alternative to avoid jeopardy and aid in recovery efforts for these endangered fishes resulting from water depletions from the Colorado River Basin. The PBO addresses water depletions associated with fluid minerals development on BLM lands, including water used for well drilling, hydrostatic testing of pipelines, and dust abatement on roads. The PBO includes reasonable and prudent alternatives developed by the FWS which allow BLM to authorize oil and gas wells that result in water depletion while avoiding the likelihood of jeopardy to the endangered fishes and avoiding destruction or adverse modification of their critical habitat. As a reasonable and prudent alternative in the PBO, FWS authorized BLM to solicit a one-time monetary contribution to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) in the amount equal to the average annual acre-feet depleted by fluid minerals activities on BLM lands.

This project has been entered into the Uncompahgre Field Office fluid minerals water depletion log which will be submitted to the Colorado State Office at the end of the Fiscal Year.

[3] Bureau of Land Management. 2008. Programmatic Biological Assessment for BLM's Fluid Minerals Program in Western Colorado re: Water Depletions and Effects on the Four Endangered Big River Fishes: Colorado Pikeminnow (Ptychocheilus lucius), Humpback Chub (Gila cypha), Bonytail Chub (Gila elegans), and Razorback Sucker (Xyrauchen texanus). Document available at the BLM Uncompahgre Field Office. Montrose, Colorado.

3.2.7.3.3 Other Sensitive Plant and Animal Species

Amphibians

Northern leopard frog

The proposed action would have similar effects to occupied suitable habitat for Northern leopard frogs to those described in the riparian and wetlands section of this document, as leopard frogs and other amphibians are dependent on riparian and wetland resources for all stages of their complicated life cycle.

There will be the potential for the loss of individual frogs from trampling or direct mortality during the construction and development periods, and the potential for substances hazardous to frogs leaving pad sites. Some temporary diminished habitat effectiveness would occur in wetlands crossed by pipeline ROWs. There would be indirect impacts from stormwater sedimentation to wetlands from roads. However, these impacts may be diminished with proper installation and maintenance of stormwater mitigation features proposed by the operators. Water depletions from area ponds and reservoirs may also occur for construction and well development/completion, possibly impacting eggs, larvae and foraging habitats for adults. As northern leopard frogs are hibernating during the winter months, activities on roads and pads (i.e., wintertime operations) would have no impact.

Mammals

The proposed action will result in the direct long term loss of 32 acres of suitable foraging and roosting habitat. Foraging habitat for BLM sensitive bat species, Big free-tailed bat, Spotted bat, Townsend's big-eared bat, Fringed myotis, could be temporarily impacted during construction and drilling activities. Water in the reserve pit may become contaminated and use of this water by bats could result in mortalities. Bird netting applied over reserve pits, as discussed in the migratory bird section above, should minimize the chance for this type of mortality on local bat populations. The operator intends to operate 24 hours per day during drilling and completions. This activity would require high-powered lighting in the immediate vicinity of the drill rig and well pad. Because bats forage at night, light structures may impact foraging rates or behavior. There are no known published studies of bats foraging specifically around night-time drilling operations; however, research involving bats and other night light structures such as street lights may be relevant and comparable. Studies have noted species in the bat genera Myotis and Plecotus (synonym Corynorhinus), which the fringed myotis and Townsends's big-eared bat belong to, respectively, avoid street lights possibly as a predator avoidance strategy.[4] The fringed myotis and Townsend's big-eared bat are the only bat species on the BLM sensitive list to potentially occur in the area. Additionally, the fringed myotis forages primarily in the tree canopy layer where it gleans prey off vegetation.[5] With the exception of the Allen location, well pad construction is entirely in open habitats, fringed myotis, spotted bats, and big free-tailed bats would not typically forage in those specific locations. With expected predator avoidance strategy used by Myotis and other bat species, populations are not expected to be impacted. Similarly, Townsend's big-eared bat is also a foliage gleaner, but forages in open habitats and over water and may be more likely to occur during night-time drill construction activities than the fringed myotis. However, this genus of bat also avoids lights and, if currently present, may shift foraging to areas away from drilling activities

Birds

Norther goshawk

There are no goshawk or other raptor nests within or immediately adjacent to the areas proposed for clearing related to this project on NFS lands. There is a known goshawk territory slightly more than one mile from the Allen pad location, on Pilot Knob. However, this site has not been monitored for many years and the location of the birds, if they still occupy the area, is unclear. Substantial suitable habitat exists in the area of the Allen pad. The habitat to the east of the Spadafora pad site may also be suitable for goshawks (The author has not examined the habitat in person at this time) but has been surveyed by Monarch (Monarch and Associates 2014) who did not find any birds during surveys in 2013 and 2014. The area surrounding the other three pad locations is less suitable for goshawks, in a mosaic of forested

[4] Jones, J. 2000. Impact of lighting on bats. Available online at http://www.lbp.org.uk/downloads/Publications/Management/lighting_and_bats.pdf.

[5] Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. Mammals of Colorado. Niwot: University of Colorado Press.

and nonforested stands, and is occupied by several red-tailed hawks and a great-horned owl, making it much less likely to be used for nesting or foraging by goshawks. Some goshawk surveying has been done in the area surrounding the other three pad locations, but survey data is not current. Surveys for goshawks in suitable habitat within ¼ mile of project construction activities, including new pads, roads, and pipelines, will be needed to determine the current use of the area by goshawks. In the absence of current survey data, habitat suitable for this species will be presumed to be occupied. The project proposal includes design criteria for conducting such surveys.

Flammulated Owl
These owls are very tolerant of humans, nesting close to occupied areas and tolerating observation by flashlight at night. The effects of mechanical disturbance have not been assessed, but moderate disturbance may not have an adverse impact on the species (Hayward and Verner 1994).
The territory occupancy begins in late April or early May, with fledging in mid to late July (Hayward and Verner 1994). Project activities, including removal of suitable habitat, are likely to occur during the nesting period, and may result in loss of nests and young. Implementation of the proposed action would result in the loss of 6 acres of suitable nesting and foraging habitat (mature aspen) and 6.6 acres of potential future habitat (sapling/pole aspen) for this. None of this habitat will regenerate during the life of the pads and wells, and is effectively lost to this species. While no known sites occur within the proposed units, this species is known to occur in the area in similar habitat. Disturbance to individuals nesting along roads used for this project may also occur, although traffic on these routes already exists and this species is tolerant of human uses.

Purple Martin
The nest-building through fledging period runs from about June 6 through July 31 for this species (Kingery 1998). This species uses aspen habitats, similar to flammulated owls. Project activities, including removal of suitable habitat, are likely to occur during the nesting period, and may result in loss of nests and young. Predisturbance surveys and avoidance of identified nesting sites where possible will reduce but not eliminate the potential for direct impacts. Implementation of the proposed action would result in the loss of approximately 6 acres of suitable nesting and foraging habitat (mature aspen) and 6.6 acres of potential future habitat for this species (sapling/pole aspen). None of this habitat will regenerate during the life of the pads and wells, and is effectively lost to this species. Disturbance to nesting individuals will occur near construction sites and along routes used to access the project. However, these birds routinely select nest cavities in close proximity to active roads and are therefore not expected to be substantially impacted by traffic along existing routes.

Olive-sided flycatcher
The nest-building through fledging period runs from about June 5 through August 2 for this species (Kingery 1998). This species is associated with spruce/fir habitats. None of these habitats will be lost during project activities, and thus no loss of nesting habitat is anticipated. Disturbance to nearby nesting individuals, especially along roadways, could occur during project activities. The species is known to occur in the project area and utilize it for foraging. Project activities may cause disturbance to foraging individuals.

Brewer's sparrow
This species is known to occur in the area of the project. Construction of pads, roads, and pipelines in sage habitats during the nesting and rearing seasons may result in direct mortality to nests or young, as well as disturbance to nearby individuals. Construction activities will result in the long-term loss of up to 22 acres of grass/forb/shrub habitats likely used by this species.

Plants
Direct impacts may include crushing of individual plants by foot and heavy equipment during well pad and pipeline construction. Indirect effects may include compaction of soil from heavy equipment and foot traffic in the area of any individual plants and the potential introduction of noxious weeds. For all other sensitive species there will be a No Impact determination as suitable habitat is not present because the project location is below species elevation occurrence.

3.2.7.4 Mitigation Measures and Residual Impacts

Canada Lynx
If the proposed action is implemented, no suitable lynx habitat will be directly impacted by the project. This project will maintain habitat connectivity, as it occurs at a small scale in suitable habitat.

Federally Listed and Sensitive Fish
No direct impacts from the proposed action are anticipated for the USFWS-listed Bonytail, Humpback chub, Razorback sucker, Colorado pikeminnow, and the BLM sensitive Roundtail chub, Bluehead sucker, Flannelmouth sucker.

Other Sensitive and Plant and Wildlife Species
Northern leopard frog
The proposed action may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide. However, surveys in suitable habitat adjacent to and potentially impacted by project construction activities, including new pads, roads, and pipelines, will be needed to determine the current use of the area by leopard frogs.

Fringed myotis, Spotted bat, Townsend's big-eared bat,
The proposed action would not significantly or adversely impact the continued existence of the Big free-tailed bat, Spotted bat, Townsend's big-eared bat, or Fringed myotis and would not contribute to the need to list either of those species.

Hoary bat
Implementation of the proposed action "may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend towards federal listing" for the hoary bat. This is based on the loss of 6 acres of possible suitable roosting habitat and 6.6 acres of future roosting habitat in the project area, the possible disturbance to roosting individuals, and a slight risk of mortality at maternity roost sites, offset by the quantity of aspen habitat remaining in the cumulative effects area. There may also be changes to foraging behavior due to habitat changes.

Northern goshawk
The GMUG Forest Plan (III-26) contains a standard and guideline that "no activity shall be allowed within one quarter mile of an active Ferruginous hawk, Swainson's hawk, goshawk, osprey, or prairie falcon nest from March 1 to July 31 if they would cause nesting failure or abandonment". In order to insure this is met, surveys will need to be conducted within ¼ mile of the Allen and Spadafora pad construction sites in the year immediately prior to (to allow for change in plans) and during construction (to allow for movement of birds into the area), assuming no goshawks are determined to nest in the area during the construction year. If goshawks are found in the buffer area, the FS biologist will need to be consulted for resolution. If no surveys are conducted, the habitat will be assumed to be occupied and a limited operating period matching the S&G dates will need to be implemented. Goshawk surveys are not required around the other three pad/road/pipeline locations due to the presence of numerous other raptor species in the areas making goshawk occupancy unlikely, but if goshawks are found in the area, the FS biologist should be consulted immediately. General raptor surveys, including monitoring of known nest sites, should ensure compliance with other species addressed in the standard, as well as being likely to detect any goshawks using or nesting in the other areas of the project. Predisturbance surveys will insure compliance with Forest Plan standards and guidelines related to this species. The negative effects from this project are of small magnitude and do not result in a Forest-wide decrease in trends or deter from meeting the MIS objectives in the Forest Plan. The EA contains design criteria covering these survey efforts, so they are expected to occur.

Flammulated Owl
Implementation of the proposed action "may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend towards Federal listing" for the Flammulated owl. This is based on the loss of 6 acres of suitable nesting habitat in the project area and the potential for direct loss of nests or young during the breeding season, long-term loss of 12.6 acres of aspen habitat, potential minor disturbance to nesting individuals during project activities, offset by the quantity of aspen habitat remaining in the cumulative effects area. Predisturbance surveys will help determine presence or

absence of this species prior to or during construction activities, and sites should be avoided if possible. The EA contains design criteria covering such surveys.

Purple Martin
Implementation of the proposed action "may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend towards federal listing" for the purple martin. This is based on the loss of 6 acres of suitable nesting habitat in the project area, the potential for direct loss of nests or young during the breeding season, long-term loss of 12.6 acres of aspen habitat, and potential disturbance to nesting individuals during project activities, offset by the quantity of aspen habitat remaining in the cumulative effects area. Predisturbance surveys will help determine presence or absence of this species prior to or during construction activities, and sites should be avoided if possible. The EA contains design criteria covering such surveys.

Olive-sided flycatcher
Implementation of the proposed action "may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend towards federal listing" for the olive-sided flycatcher. This is due to the possible disturbance to nesting or foraging birds during construction or transport operations, the low amount of habitat change across the landscape, and the abundance of suitable habitat across the landscape. Predisturbance surveys will help determine presence or absence of this species prior to or during construction activities, and any nesting sites located during surveys should be avoided if possible. The EA contains design criteria covering such surveys.

Brewer's sparrow
Implementation of the proposed action "may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend towards federal listing" for the Brewer's sparrow. This is due to the possible loss of nests during construction, possible loss of nesting and foraging habitat due to pad, road, and pipeline construction, and disturbance to possible nesting individuals during project activity. If predisturbance surveys show an absence of this species in potential habitats, the above impacts will be reduced or eliminated. Predisturbance surveys will help determine presence or absence of this species prior to or during construction activities, and sites should be avoided if possible. The EA contains design criteria covering such surveys.

Plants
No sensitive plants species have been documented in the project area and therefore no effects are considered for mitigation.

Other:
Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.7.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

The direct and indirect impacts of the no action alternative would not change current habitat or population conditions of any FS sensitive or management indicator or BLM sensitive species associated with the Henderson, Allen, and 11-90-9 locations species in the short term. Long-term changes would continue to be dependent on existing conditions, current succession of vegetative types, and other actions within the project area, as indicated in the cumulative effects section of the EA and discussions in this analysis.

The Spadafora location would also enter and develop gas reserves from fee/fee estate thus the location would be built irrespective of a federal decision. Furthermore, since the Aspen Leaf location is already built the impacts to similar to those described for the proposed action have already occurred and continue to be a part of the affected environment into the foreseeable future.

Aspen decline may result in both short- and long-term loss of aspen at a landscape scale in this area. The primary project type likely to impact goshawk in the area is timber harvest. However, prior harvest does

not appear to have resulted in nest failure or abandonment at the two locations within the area near timber harvest. Future timber harvest in this area is possible but not likely at any large scale, nor are any large timber sales proposed at this time. Road construction or other habitat fragmenting activities may also contribute to impacts to this species. Personal use and commercial fuelwood cutting are unlikely to contribute to functional habitat loss as these do not usually substantially alter stands and occur almost exclusively within 300 feet of open roads, where goshawks are less likely to nest. The majority of other activities are unlikely to contribute to any impacts to this species.

3.2.8 *Migratory Birds*

3.2.8.1 Affected Environment

The analysis area for impacts to migratory birds of conservation concern includes the CIAA area totaling 265,355 acres of Private, FS, and BLM administered public lands where both direct and indirect effects occur. Construction time frames have not been proposed for the action therefore the analysis assumes that construction could occur across all seasons outside the stated winter restrictions identified in Appendix B "Operator Committed Design Features" specifically #79.

Surveys for biological resources were conducted within 0.25 mile of proposed well pad and associated access roads and gathering lines for the Spadafora #20-21 and Henderson #8-14 well pads. Surveys were conducted for nesting raptors and migratory birds. Surveys were conducted in 2009, 2010, 2013, and 2014.[6],[7],[8],[9] Similar surveys have not been conducted for the Allen, SG 11-90-9, and Aspen Leaf locations proposed however, due to similar habitat types and proximity within the project area similar occupations are assumed. All potential raptor nesting habitat within 0.25 mile of proposed disturbance for the Spadafora and Henderson well pads were surveyed and/or checked. Raptor surveys were not conducted for the Allen and 11-90-9 locations and not needed for the existing Aspen Leaf location. Opportunistic observations of mammals, migratory birds, and listed and FS sensitive animals and plants were made while conducting vegetative surveys and raptor surveys; species and/or sign were documented.

Migratory species of conservation concern observed within the project area include: Brewer's sparrow (BLM and Forest Sensitive species) and peregrine falcon Table 3-18.

Table 3-18 Migratory Birds of Conservation Concern Observed in the project area During Biological Surveys or Breeding bird surveys

Avian Species	Habitat Present In Project Area	Species Present In Project Area
Golden Eagle	No nesting habitat	Yes
American peregrine falcon	No nesting habitat	Yes
Prairie Falcon	No nesting habitat	Yes
Brewer's sparrow	Yes	Observed
Willow flycatcher	Yes	Yes
Veery	Yes	Yes
Cassin's Finch	No	Migrant

[6] Monarch & Associates. 2010a. Gunnison Energy Corporation: Sheep Pipeline; Wildlife Habitat Evaluations and Inventory for T &E , Sensitive, Management Indicator Species and Nesting Raptors. July.
[7] Monarch & Associates. 2010b. Gunnison Energy Corporation: Four Well Exploration Project, Habitat and Wildlife Surveys. January.
[8] Monarch & Associates. 2014a. Habitat and Wildlife Report for the Proposed 814 Drill Site, Access Road and Pipeline Corridor. Prepared for Gunnison Energy LLC. October.
[9] Monarch & Associates. 2014b. Habitat and Wildlife Report for the Proposed Spadafora Drill Site. Prepared for Gunnison Energy LLC. October.

3.2.8.2 Methodology

The U.S. Fish and Wildlife Service (FWS) has compiled a list of migratory bird species, which appear to be declining in numbers or distribution or for which more information is needed. See the Environmental Assessment and project record for additional information.

3.2.8.3 Impacts from the Proposed Action

Direct and Indirect Impacts

No impacts are anticipated for the Cassin's finch from the proposed action as the project area is primarily utilized during migration to and from breeding areas.

Minimal impacts are anticipated for Golden eagle, peregrine falcon, and prairie falcon. The project area does not contain suitable nesting habitat. The primary impacts anticipated are the loss of approximately 32 acres of foraging habitat.

Affects to migratory species are expected to be most pronounced for Brewer's sparrow, and to a lesser extent Veery, and willow flycatcher. These species return to summer breeding ranges in April, begin nesting in earnest in late May or early June, and have fledged young by mid-August. No direct loss of nesting habitat is anticipated for Veery and willow flycatcher as no riparian habitat has been identified for direct disturbance. The Spadafora, Henderson, and 11-90-9 well pads and associated infrastructure will result in the direct loss of suitable nesting and foraging habitat for Brewer's sparrow totaling 22.4 acres. In the context of acres of available habitat within the project area these losses comprise a very small percentage of habitat loss. Direct mortality of individual birds may occur from vehicle collision on all project roads due to increased vehicle use.

Since development activities may occur between May 1 and August 31, it is possible that construction and drilling operations would take place during the breeding season and some nests may be lost during construction. Long-term impacts to migratory songbird breeding habitat include direct habitat loss and loss of functional habitat due to avoidance of certain areas. Under natural succession regimes, it would take 20-30 years to replace the destroyed sagebrush habitat and possibly a hundred years to replace the destroyed aspen and gamble's oak woodland habitat assuming reclamation would allow for successional processes to achieve the climax vegetation community. Such habitat restoration would not be expected to begin until all wells have reached the end of their effective life which could be as much 50 years. Even after the initial disturbance associated with construction, drilling, and completion, it can be expected that nest densities around the project area may continue to be depressed. In sagebrush stands, nest densities of brewer's sparrows and sage sparrows were reduced by 39-60% within 100 m of roads in a natural gas field (Ingelfinger and Anderson 2004).[10]

Applicant committed design feature # 16 (Appendix B) will result in no direct impact to nesting migratory raptor species from construction of the locations, roads, and pipelines. However, the modifications to the natural environment may result in in less suitable or modified nesting territories for some raptors within 0.25 miles of the proposed developments. Such impacts are likely to be most pronounced around the locations during the construction, drilling and completions phase of the project. Nesting territories may become more desirable once the production phase of the project is fully implemented due to reduced human disturbance. The operator has committed to using netting on the Aspen Leaf and Allen well pads where migratory species may be exposed to drilling and frac fluids. The operators have proposed to use closed loop systems on the 11-90-9, Henderson, and Spadafora locations. Based on the commitment to use nets and closed loop systems no impacts to migratory species are anticipated from exposure to drilling and completion related fluids.

[10] Ingelfinger, F. and S. Anderson. 2004. Passerine response to roads associated with natural gas extraction in a sagebrush steppe habitat. Western North American Naturalist 64:385-395.

3.2.8.4 Mitigation Measures and Residual Impacts

To minimize impacts on migratory bird populations, it is recommended that no surface disturbing activities occur from May 15 through July 15. This timeframe encompasses the core breeding season for the majority of migratory birds in the project area. Project activities should strive to retain and avoid modifying identified cavity trees, snags, and perches in the project area.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.8.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

There would be no action authorized that would have potential to influence the reproductive success or annual survival rates of local migratory bird populations associated with the Henderson, Allen, and 11-90-9 locations. However, impacts to migratory species would be expected to be identical to those described for the Spadafora and Aspen Leaf locations. The Spadafora location would also enter and develop gas reserves from fee/fee estate thus the location would be built irrespective of a federal decision. Furthermore, since the Aspen Leaf location is already built the impacts to migratory species have already occurred and continue to be a part of the affected environment into the foreseeable future.

3.2.9 *Wildlife, Terrestrial*

3.2.9.1 Affected Environment

The area of analysis for determining direct and indirect impacts of this project to most species listed herein is the footprint of disturbance of the project buffered by approximately ¼ mile, as well as the locations of the surface poly pipeline, and any proposed surface road use accessing the project area. Some species may have other areas considered. The Abert's squirrel is a ponderosa pine obligate, is not known or expected to occur in this area, and will not be discussed. American marten is associated with spruce-fir habitats, which are not impacted by this project, and will not be further discussed

Elk

Elk are widespread and disperse readily across landscapes, with few habitat-related limitations. Populations are abundant (and stable or increasing) on the Forests in R2 and the GMUG. Value of habitats on Forests is increasing as habitat on adjacent private lands is lost to human development. Females are sensitive to disturbance during calving season and herds are sensitive to disturbance in the winter (USDA 2005b).

Elk use a combination of open meadows for foraging and woodlands for cover, calving and thermal regulation. The elk herds in the project area are migratory, using higher elevation forests and meadows during the summer and lower elevations and exposed south slopes during winter to avoid deeper snows. The project area lies in elk summer range, but not within a mapped calving area. Four of the 5 pad locations and much of the associated infrastructure lies within mapped winter range, but not within severe winter range. The proposed activities lie within the Colorado Division of Parks and Wildlife's (CDPW) Game Management Unit (GMU) 521, which is part of elk Data Analysis Unit (DAU) E-14. The elk population estimate for this DAU, based on 2013 post- hunting surveys, was 15,980 elk (CDPW 2015a), within the objective population of 15-19,000. CPW reports that during the 2014 hunting season (the last for which data is currently available) for GMU 521 there were 3,503 total hunters, who harvested 693 elk, a 20% success rate. (CDPW 2015). Elk populations in the DAU have varied from 14-20 thousand within the last several years according to aerial survey data from the state. Information on the portion of the herd within the Muddy Creek drainage is available in the draft EIS for the Bull Mountain gas project to the east of this project (USDI 2015).

The primary issues affecting elk distribution are lack of habitat security due to motorized and non-motorized travel and recreation activities (USDA 2005c). In recent years, the GMUG has implemented the

Gunnison Travel decision, which resulted in the closure of 8.61 miles of motorized routes in the 704, 849, and 265 (east of the 704 junction) roadsheds within 1 mile of activities proposed herein, and the restriction of 0.98 miles of otherwise open routes to administrative use only. Within the northern part of the Paonia district in the general cumulative impacts area for the project, a total of 39 miles of routes have been closed to motorized use in the past ten years, and almost 22 miles have been restricted to administrative traffic only, reducing traffic substantially on those routes. This excludes gas- and coal-related routes which were not addressed in the Gunnison Travel decision. Newly constructed routes for this project are either on private lands or will be restricted to administrative access only, and will not be open to public motorized use, but may be used by horses, bicycles, or foot traffic (as may any other portion of the surrounding public lands). Existing designated forest system routes within and around the project area will remain open to motorized use, including OHVs, passenger vehicles, and commercial vehicles.

Merriam's wild turkey

Turkey are widespread and locally abundant across the Paonia district, especially in oak and other shrub habitats, but they occur in all areas below approximately 10,000 feet at times. Turkeys are known to occur in and near the project area. They are tolerant of human activities, and in winter are commonly found in yards and along roadways in close proximity to humans. They nest in a variety of habitats on the district, although typically in areas with dense local cover. Brood rearing frequently occurs in areas such as openings, riparian areas, springs, burns, and aspen stands, all of which provide the invertebrates needed for food for the young birds. Breeding Bird data shows a strong upward trend in populations of this species in Colorado (Sauer, et al 2014). However, populations of turkey are directly controlled by hunting seasons determined by the CPW and less influenced by habitat than many other species. Other population pressures include predation from species such as coyotes. Habitat alteration can have both harmful and beneficial impacts to turkeys, and treatments which provide a mosaic of habitat features, allowing for all life stages of turkeys, are desired for this species (USDA 2005d).

Table 3-19 Turkey habitat on the GMUG NF based on habitat parameters and quality

Habitat Parameter	Habitat quality		Total acres
	Primary	Secondary	
Winter feeding / cover	293157	27912	321069
Summer feeding / cover	490131	1281664	1771795
Nesting	9587	101595	111182
Brood rearing	718345	45879	764224
Roosting	43974	200047	244021

Red-naped sapsucker

In Colorado, red-naped sapsuckers forage in aspen, willows and cottonwoods close to their nest sites, which are almost exclusively in mature aspen stands. Typical nest stands, dominated by large aspen, have a variety of diseases that create the heart rot needed for suitable cavity excavation (Kingery 1998). Nest stands have trees infected with shelf or heartwood fungus (for drilling nest cavities) and nearby willow stands (for drilling sap wells). Published literature on this species is limited, with the most recent data and information collected by the Forest in its update to the species assessment (USDA 2014). With limited survey and monitoring data due to its relatively low abundance, it is difficult to determine overall trends in population for this species. According to BBS, populations appear to be stable or increasing in the United States, with areas of local declines. From the period 1966 to 2012, species shows a positive trend of +3.0% in Colorado (Sauer et al. 2014). The species is present in low density throughout the aspen woodlands of the GMUG. Red-naped sapsuckers have been seen or heard in and near the project area and are seen in aspen stands throughout the district in relatively low numbers (D. Garrison pers. obs.). No known nest trees have been found within the project footprint as of the date of this document. Predisturbance project surveys will also assist in determining presence of this species and therefore impacts to nesting and foraging habitats.

3.2.9.2 Methodology

Three of the 5 proposed pad locations (Aspen Leaf, 11-90-9-3, and Henderson) and their associated roads and pipelines have been previously analyzed, including field surveys for multiple species, including ones analyzed herein. Four of the 5 sites (excluding Spadafora, which is on private lands) were visited in May of 2015 on one or more occasions and reassessed, including cursory surveys for breeding birds, owls, and amphibians and searches for raptor nests. Aerial photographs, vegetation typing, and results of past and present surveys by both USFS and private individuals were used to determine preliminary species which may be impacted by the project, as well as species which may have needed further examination. Reviews were conducted to determine which species are known from the area or have suitable habitat present and could potentially occur. Primary sources included district wildlife sightings records, NRIS FAUNA corporate data, and information from species assessments prepared for Sensitive Species in Region 2 (USDA 2015b). For birds, the Cornell Laboratory eBird database (eBird 2015) and Breeding Bird Survey data (Pardieck et al 2015) were checked to determine other sightings in the area. Monitoring for some species is requested subsequent to this analysis but prior to implementation, and if actual results of those surveys differ substantially from predicted values, additional analysis may be required, or specific design criteria or mitigations may need to be implemented to protect species. Such monitoring is included in the list of Operator Stated Design Features (Draft EA Appendix B) and so is expected to occur.

HABCAP (Habitat Capability) modeling was not used for this analysis. It was developed as a comparative tool to model differences in habitat capabilities between alternatives by calculating changes in habitat types and structural stages. A Habitat Capability Index (HCI) for each species is determined from the relative amounts of particular habitat types within the analysis area, based on the species' uses of that habitat for various functions and at various times of the year. Other factors, such as road density, are included for some species such as elk. It estimates capability at a single point in time, and does not simulate change over time. Due to the nature of this project, this model is expected to provide little useful information. The scale of habitat changes is minor, especially at the watershed and cumulative effects scales, and increases in road mileage within the analysis area are also minor. Such impacts, however, will be assessed for species as appropriate.

GIS information provided for this project includes proposed locations for pads, including construction footprints, new and existing pipeline locations, new and existing road locations, and associated infrastructure. Other GIS data used for this analysis includes mapped locations of wildlife species, known seasonal ranges of elk, and vegetation data.

3.2.9.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Direct effects of the project include habitat alterations from construction of the pads, roads, and pipelines, to the extent and to the types noted in section 3.2.5 vegetation and Table 3-11. Such changes may result in impacts to breeding, roosting, or foraging wildlife. Habitat will not be altered substantially by the placement, maintenance, and removal of pipelines even though disturbance will occur. The impacts on the fee surface/federal mineral locations will be similar to those analyzed for the FS locations.

The surface poly pipeline should have limited direct impacts to wildlife species. Habitat will not be altered substantially by the placement, maintenance, and removal of the pipeline, but disturbance may occur during those activities.

Plowing of roads may alter movement of some types of animals during winter months, although most species discussed here will not be impacted by that. Change of traffic use in winter may also change impacts to nearby wildlife, although traffic on plowed roads is generally less noisy than snowmobile traffic on unplowed routes.

Changes in traffic use of existing roads may result in direct mortality to wildlife due to collisions, although roads within the project area are low-speed and such collisions therefore unlikely. Off-Forest traffic,

specifically along CO 133, is anticipated to increase slightly over current levels. Changes in traffic patterns may also create disturbance to nesting, roosting, or denning animals.

Water depletions associated with this project may reduce surface water availability in streams and impoundments in or near the project area, as well as downstream within the Gunnison and Colorado watersheds.

Elk

Project activities will result in the direct short-term conversion of ~37 acres of various habitat types usable as forage and cover by elk into non-vegetated road, pad, and pipeline routes. Some of this will be revegetated in the short term to grass/forb and low shrub types, usable as forage by elk. However, pad and road footprints will be effectively lost as a forage base for the life of the well sites. While this loss is measurable, forage availability is not a limiting factor for elk in this area and such losses should not result in any changes to elk population within the project area.

Declines in elk use of habitat adjacent to forest roads have been documented in many studies (Lyon 1979; Rowland et al. 2000). A study of elk in relation to logging disturbances found that there was a buffer zone of 500 to 1,000 meters (1640-3280 feet) separating areas of high elk use from areas of disturbance (Edge and Marcum 1985). Another study looked at reproductive success of elk following disturbance by humans during calving season (Phillips and Alldredge 2000). They found that elk subjected to human-induced disturbance through a 3-4 week period during calving season over two years showed lower calf survival. Generally, habitats provide more effective security the further they are from roads. Considering documented road avoidance by elk, the minimum distance between secure habitats and an open road is ½ mile (Hillis et al. 1991). Hebblewhite (2008) reviewed literature on impacts of energy development on ungulates and included road avoidance in that, citing a mean value of 1131 meters (.70 miles) of influence from roads and 1125 meters from wells for ungulates.

The project will result in construction of 1 mile of new roads within the area. This will increase road density slightly (approximately .04 miles per square mile within the external limits of the project footprint). However, USFS travel management activities have resulted in the recent reduction of motorized routes within the project roadsheds by 8.61 miles, and reduction of use to administrative traffic only, on an additional 0.98 mile of routes. The newly constructed roads will not be open to the general public (two are on private lands, two are behind existing locked gates) and will not see general traffic. Once pad construction and drilling is completed, long-term use of the roads will be one to several passes per day maximum for monitoring purposes and an estimated one workover per pad per year.

Map modeling of new pad and road locations was not conducted for this analysis. Two of the new pad locations (Henderson and 11-90-9) are between existing routes and influence zones from those locations will overlap existing zones, incrementally reducing habitat quality around those pads. One pad (Spadafora) is in a private property meadow used for grazing, adjacent to an existing road, and its influence zone will slightly increase the road effect footprint in that area, although largely within the private lands. The final new location, Allen, will also slightly increase the road influence zone in the general area, although there are roads on either side of that location which already cause effects. The Aspen Leaf pad already exists and its footprint effects already occur.

None of the proposed activities are within mapped elk production areas. However, elk may calve at any location on and off the Forest, and were observed by the author in the area in late May of 2015, implying that calving is likely to occur in the area. Therefore, if activities occur during calving season (likely), elk may be displaced by project activities. Numerous studies have shown that elk will move back into an area once the disturbance is over. While construction is limited in duration, operations traffic, including workover rigs, will continue to impact the area. The Aspen Leaf, Henderson 1, 10-8, and other existing active pads in the area are still visited by elk throughout the year (D Garrison, pers. obs.).

The entire project area, and surrounding landscape, is considered as summer resident habitat.

Currently, low level summer recreational use is known to occur in the area, primarily OHV riding on the Thousand Acre Flats / Springhouse Park area ATV and road loop. Motorized use is limited to existing roads and trails, which occur throughout the area. There is little other recreational activity in the area during summer.

Project activities may occur into the fall hunting seasons. There will be some minor direct impacts to hunting opportunities in the immediate area of the new pad locations. However, the Aspen Leaf pad already exists and is in use, and hunters in that area typically accessed lands farther west than the pad location, in the large expanses of aspen. The Allen and Spadafora pad locations are on private lands, and access is restricted to hunters with permission to hunt those lands. The Henderson and 11-90-9 locations do see a limited amount of hunting pressure, but the Henderson area is behind private property and less accessible than much of the surrounding landscape, and the 11-90-9 area is easily visible from NFSR 851 and the author has never observed a hunter actually at the pad or road location during hunting season patrols.

There are numerous dispersed campsites in or near the project area, which are typically used as elk camps, which have been identified. There are 7 camps in the vicinity of the Henderson, 11-90-9, and Spadafora sites, along the 851 road. These camps will not be directly impacted by project activities but traffic will change along the 851 road, likely including during hunting seasons. None of these camps will be rendered unusable by the project. Additionally, these camps currently exist and are used even though there are two existing well pads in the immediate vicinity.

There are 3 campsites identified north of the Aspen Leaf site. These sites will experience similar changes to traffic but will not be rendered unusable, and have experienced increased traffic when the Aspen Leaf pad and initial well were constructed. There are 35 identified campsites along the 265 and 704 roads leading to the Allen well. Twenty-one of those sites are on the 704 road, and will be behind the traffic control point for safety along that road, which may result in delays to access camps. None of these sites will be rendered unusable by the project but will experience similar changes in traffic. Beyond the Allen site are an additional 28 identified campsites, which may experience similar access delays but will not see project-related traffic past the camps. The project itself will not eliminate any existing campsites, as new construction is behind locked gates.

Disturbance to both local elk populations, and to hunters whose camps are no longer desirable due to project activities and/or traffic, is therefore anticipated. As a result, changes to elk hunting pressure in both the immediate project vicinity (an anticipated minor reduction in pressure during construction years or when traffic spikes) and other portions of GMU 521 (increased pressure spread across the unit when activities in the project area spike) are expected. Due to the small scale of the disturbance and the size of the GMU, it is not anticipated that harvest will change measurably across the GMU as a result of this project.

There are no mitigation measures / design features directly related to recreational hunting opportunities, nor are any proposed. Limitation of operations during hunting seasons for the purposes of reducing conflict is not considered reasonable by the author and was not proposed.

Four of the 5 pad locations fall within mapped elk winter range, but none of the construction is within severe winter range. Pad and road use in winter and early spring, when elk are at their most vulnerable state, is expected to result in changes to distribution and habitat use of elk in the project vicinity, although elk do use existing pads and nearby habitat within the same general area. Construction activities are generally restricted on elk winter range by lease stipulations (see EA), but some activities are allowed by law during winter. Remote monitoring of sites has the potential to reduce the need for plowing into the sites and daily visits, but current technological limitations prevent that from readily occurring.

Changes in plowing patterns in the area may also directly and indirectly impact elk. Plowed roads are open to motorized wheeled traffic, which is much more common than snowmobile traffic. In addition, plowed roads allow movement of wildlife in deeper snow conditions and may result in collisions between vehicles and animals, although the slow speed of the roads in question generally eliminates the potential for that. Traffic on plowed roads is likely to contribute to disturbance on animals during the winter months on the 265 and 704 road segments that are not currently routinely open in winter. This could be mitigated by gating the 704 road, although gating of the 265 is not optimal as this route accesses the new trailhead. At this time there are no plans to gate the 704 or any other open route in that area.

Merriam's wild turkey
Nesting typically begins in late April for turkeys, generally before all shrubs are leafed out. Nests usually occur within very dense local cover, and in forested stands are usually in areas with at least 60% canopy cover. If nests fail, turkeys will make multiple nesting attempts.
Individual nests could be directly lost or abandoned as a result of project activities, but turkeys may re-attempt nesting elsewhere if project actions are detrimental. Direct mortality to eggs or displacement of adults and young is possible if turkeys are nesting onsite during construction activities. Long-term effects in cover type and abundance are unlikely to cause substantial impacts to turkeys, as they utilize a wide variety of habitats in this area. Long-term changes in human use of the area are similar to that described for elk above.

Red-naped sapsucker
The nest-building through fledging period runs from about May 20 through August 25 for this species (Kingery 1998). Project activities during this time may result in abandonment of nests or alteration of territorial boundaries in the project area. Individual nests with eggs or young could be lost during project activities if sapsuckers occur in the construction areas. This would most likely be either from nest abandonment due to disturbance, or through direct mortality.
Habitat changes in this area would be limited to loss of 6 acres of mature aspen stands, currently suitable for nesting and foraging, and 6.6 acres of future potential habitat in the form of young aspen. These stands would be effectively lost to the species for the duration of the use of the pads and roads in this project.

3.2.9.4 Mitigation Measures and Residual Impacts

Elk
The negative effects from this project are largely of short duration and magnitude and do not result in a Forest-wide decrease in trends or deter from meeting the MIS objectives in the Forest Plan.

Merriam's wild turkey
The negative effects from this project are of short duration and magnitude and do not result in a substantial Forest-wide decrease in trends, or deter from meeting the MIS objectives in the Forest Plan.

Red-naped sapsucker
The negative effects from this project are of short duration and magnitude and do not result in a substantial Forest-wide decrease in trends, or deter from meeting the MIS objectives in the Forest Plan.

All impacts will be mitigated by inclusion of design features and lease stipulations related to wildlife and other issues, as described in the EA.

3.2.9.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

No direct or indirect human-caused change in existing condition of current habitat is anticipated if no action is undertaken for this project. Conditions will continue as they currently exist, modified as per the other actions given in the cumulative effects contributions described in the EA and existing natural processes. Within the last ten years, aspen within the Paonia district has suffered substantial declines. Statewide, surveys have documented the decline on approximately 17% of the aspen in the state of Colorado, as of 2008. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_038824.pdf

While the aspen decline has slowed substantially in the last few years, there are still visible signs of decline in many stands in the project vicinity.

Impacts to terrestrial species would be expected to be similar to those described for the action as the Spadfora location would also enter and develop gas reserves from fee/fee estate thus the location would be built irrespective of a federal decision.

3.2.10 *Wildlife, Aquatic*

3.2.10.1 Affected Environment

See TE&S for warm water species impacts.

Pads described in the proposed action are located along Little Henderson Creek (2 pads), in the headwaters of Ault Creek (2 pads), at the headwaters of Sheep Creek (on private land), and in the Pilot Creek watershed (off National Forest). Both Little Henderson pads and the Sheep Creek pad are located within 250 meters of a stream channel; however, only Sheep Creek is perennial. The other two pads are over 700 meters from a perennial stream channel.

3.2.10.2 Methodology

The 1982 Planning Rule 36 CFR 219.19(a)(6) related to Management Indicator Species (MIS) requires the FS to produce a unique list of species to represent Forest communities or ecosystems. These species and the ecosystems in which they represent must be considered for each project to evaluate consistency with the Forest Plan. MIS fishes on the GMUG NF include Brook Trout, Brown Trout, non-native Cutthroat Trout, and Rainbow Trout. Collectively these species are known as Common Trout.

Colorado River Cutthroat Trout-

A detailed description of the biology, ecology, and status of this species on the GMUG is available on the internet at:
http://www.fs.usda.gov/detail/gmug/landmanagement/resourcemanagement/?cid=stelprdb5199668

A detailed description of the biology, ecology, and status of fish classified as Management Indicator Species on the GMUG is available on the internet at:
http://www.fs.usda.gov/detail/gmug/landmanagement/resourcemanagement/?cid=stelprdb5199668

3.2.10.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Direct effects of oil and gas development are difficult to envision given the placement of the well pads on the landscape: all well pads are separated from stream channels by at least 100 meters. Individual fishes could be killed during construction of road-stream crossings. Chemical spills could occur during the construction or extraction phases of the project.

Poorly designed and maintained well pads, roads, and road-stream crossings could enhance sedimentation in streams, reducing water quality and habitat quality. Poorly designed road-stream crossings could function as barriers to upstream movement of fishes and other aquatic life. Increased traffic volume on dirt roads could increase sediment input to streams, reducing water quality and habitat quality.

3.2.10.4 Mitigation Measures and Residual Impacts

There are no known fish populations of conservation or recreational significance in Sheep Creek. Little Henderson Creek was sampled at several locations in May 2015. No fish were located in Little Henderson Creek at that time.

While it is likely that erosion will occur over the course of the project and that this erosion will be additive relative to the current rate and volume of erosion in the project area it is not a foregone conclusion that this erosion will be measurable at a watershed scale. Streams in the project area drain into Muddy Creek, a stream with extremely high sediment loads (hence the name, Muddy Creek). It is doubtful that erosion occurring on pads and roads associated with the project would result in a measurable increase in sediment in Muddy Creek. Therefore, based on the assumption of effective application of BMPs and design features for pad construction, road construction, and operations, This project will have no effect on cold-water fishes and aquatic life.

3.2.10.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

There would be no action authorized that would have potential to effect cold-water fishes and aquatic life.

3.2.11 *Riparian Zones and Wetlands*

3.2.11.1 Affected Environment

Riparian areas, including seasonal wetlands, ponds, intermittent streams, perennial streams, and floodplains occur in and near the project area. Surrounding areas include meadows, mountain shrub stands, large expanses of aspen, and spruce-fir forest. The project lies at 7400 to 8500 feet elevation.

3.2.11.2 Methodology

Biological field survey to determine the presence and boundaries of wetlands, floodplains, and riparian areas adjacent to the proposed project areas

3.2.11.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Allen Location
There are no wetlands or riparian zones associated with the Allen Well Pad. The pipeline is proposed to cross a small tributary to Muddy Creek in Condemn It Park.

11-90-9 Location
The proposed 11-90-9 pad location is located 250 feet upgradient from the riparian zone of Little Henderson Creek, providing an adequate buffer to allow there to be no direct or indirect effects to the resource. The proposed access road in on contour through upland vegetation well disconnected from the riparian zone of Little Henderson Creek. The proposed temporary surface pipeline alignment crosses the riparian zone. The riparian has been mapped and field verified to be 170 feet at the proposed crossing location. The riparian at the crossing is best described as willow dominated with functioning active beaver dams. Crossing at this location will likely have direct cause direct and indirect negative effects on the integrity of the beaver ponds and riparian corridor through the delivery of sediment and fill material during construction, operation, and removal of the proposed temporary pipeline. Any activity involving placing fill at this crossing will require Clean Water Act section 404 permitting.

Aspen Leaf Location
There are no wetlands or riparian zones associated with the Aspen Leaf Location. The proposed temporary surface pipeline follows an existing road alignment.

Henderson Location
The proposed Henderson Pad location is adjacent on its east side to an intermittent unnamed tributary to Little Henderson Creek. The current proposed location extends the pad to the centerline of the crenulation. This location will have both direct and indirect negative effects to the intermittent channel by directly delivering sediment and fill material during construction of the pad and then through direct surficial hydrologic connect continually delivering sediment from the disturbance with subsequent precipitation events. The proposed new road alignment maintains a minimum 100 foot buffer from the riparian zone of the Little Henderson Creek. This buffer should adequately mitigate, through disconnection of direct delivery of road sediments, and direct or indirect effects the road might have on the riparian corridor. The road alignment and collocated new buried pipeline cross the intermittent creek mentioned above and two other intermittent flow paths. Any fill in these intermittent flow paths that are directly connected hydrologically to Little Henderson Creek require consultation with the Army Corps of engineers to assure compliance with Clean Water Act section 404 permitting. Except for these three crossings the road and associated pipeline are more than 100 feet from the riparian corridor.

Spadafora Location
A wetland riparian area is associated with Sheep Creek below the Spadafora Well Pad. No disturbance is anticipated in the wetland or floodplain area. There is an existing pipeline that will be used that has already been installed. No further analysis will be conducted.

3.2.11.4 Mitigation Measures and Residual Impacts

It is recommended that the temporary pipeline alignment for Pad 11-90-9 be collocated with the proposed access road alignment. This will mitigate the impacts of the pipeline crossing Little Henderson Creeks beaver dominated riparian by obviating the crossing.

It is recommended that the east edge of the Henderson Pad be located at least 100 feet from the center line of the intermittent crenulation it is currently proposed to have direct contact with. This will provide an adequate green buffer to mitigate the direct connection of sediment delivery from the proposed well pad location.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.11.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

There would be no action authorized that would have potential to effect wetland and/or riparian areas.

3.2.12 *Floodplains*

3.2.12.1 Affected Environment

The BLM is required to meet the objectives of federal floodplain policy. Executive Order 11988 (21), as amended, established this policy and directs agencies to “avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practical alternative.” The objectives of avoiding development and modification of floodplains are to 1) reduce the hazard and the risk of flood loss, 2) minimize the impact of floods on human safety, health, and welfare, and 3) restore and preserve the natural and beneficial floodplain values.

See the Riparian and Wetlands section (3.2.11) for more detailed analysis of impacts to wetlands and floodplains.

3.2.13 *Hydrology (Surface Water Resources)*

3.2.13.1 Affected Environment

Allen Location
The proposed Allen Well Pad, access road, and buried pipeline are located in HUC6 Outlet West Muddy Creek (140200040103). The proposed pipeline alignment crosses the very head of an intermittent drainage that is tributary to West Muddy Creek in Condemn It Park. The 50 feet proposed road alignment on NFS lands crosses no surface hydrologic features. The Allen Well Pad is located on a mesa above Condemn It Park. There is a small unnamed drainage originating just above the park that flows to West Muddy Creek. The well pad is located 1.7 miles up this unnamed drainage from West Muddy Creek. West Muddy Creek is not listed on Colorado Water Quality Control Division’s Monitoring and Evaluation list or 303(d) list. Macroinvertebrate sampling conducted by SWCA Environmental Consultants for GE in the fall of 2012 found habitat structure and function decreased in a downstream direction at 4 locations on West Muddy Creek before reaching the confluence with the East Fork of Muddy Creek. Possible stressors include flow reductions and/or sedimentation (SWCA, 2012). Water quality sampling of West Muddy Creek was conducted from 2008-2012. Similar to prior years, several samples found low concentrations of methane (0.0009-.00053mg/L). There is no water quality standard for methane but the State of Colorado considers concentrations of 7mg/L levels warranting monitoring for changes. Concentrations of

28mg/L are considered an explosive hazard if stored or used in confined spaces such as houses. No detectible concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX) were found (SWCA, 2012).

11-90-9 Location

The proposed 11-90-9 Well Pad is located at the headwaters of the HUC6 Little Henderson Creek-East Muddy Creek (140200040203). It is located in a small dry park at the confluence of two ephemeral drainages tributary to the perennial Little Henderson Creek. The western fork of this ephemeral drainage shows as an intermittent blue line on USGS quadrangles but was confirmed to be ephemeral. This ephemeral drainage is not tied to groundwater and only carries live water immediately following precipitation events. There was no sign of an ordinary high water mark or channelized flow at or above the proposed well pad.

The associated new access road alignment and collocated buried pipeline contour through upland vegetation crossing a crenulation that drains to a small wet meadow depression feature. The associated above ground temporary pipeline travels down gradient along an adjacent ephemeral crenulation to the east. The temporary pipeline crosses the riparian zone of Little Henderson Creek before tying into the existing road alignment. This crossing is through a willow dominated riparian corridor with current beaver pond activity.

Aspen Leaf Location

The Aspen Leaf Well Pad and its existing access road are located in the HUC6 Outlet West Muddy Creek (140200040103) adjacent to an intermittent drainage that is tributary to the Aspen Leaf Reservoir on Ault Creek. The access road crosses multiple ephemeral drainages that are all piped through corrugated metal pipes under the surfaced road. The proposed temporary surface pipeline alignment follows the existing well pad access road then crosses a dry park to follow NFSR 849.

Henderson Location

The well pad location is in the HUC 6 East Muddy Creek watershed. The proposed Henderson Well Pad is located at the headwaters of the 6th code Hydrologic Unit Code Watershed (HUC6) Little Henderson Creek-East Muddy Creek (140200040203). Little Henderson Creek is the primary drainage at the proposed location of the Henderson Well Pad. It is a perennial stream located approximately 525 feet north of the proposed well pad and parallels the access road and gathering line (within 100 feet) to the junction with the existing Sheep Gas Gathering System and FR 851. Four additional surface water features were identified in the project area. One is an unnamed intermittent tributary located adjacent to the well pad location, approximately 25 feet to the east which leads to the nearby perennial Little Henderson Creek. One intermittent tributary to Little Henderson Creek is located approximately 250 feet northwest of the well pad location. The proposed access road and buried pipeline cross this spring fed intermittent as well as another intermittent tributary to Little Henderson Creek is crossed by the existing access road at the junction with FR 851. Neither of these crenulations show as “blue lines” on the USGS Quadrangle maps for the area but were field verified to have morphology and vegetation communities that suggest that they are associated with groundwater and are likely considered Waters of the US in terms of Clean Water Act section 404 permitting. The existing road that the proposed road departs from, that the buried pipeline alignment parallels, crosses one additional intermittent creek east of the proposed road intersection. Additionally, there is one stock pond located approximately 0.5 mile northwest of the well pad location in an ephemeral drainage, and all the surface waters flow into Little Henderson Creek which is a tributary to East Muddy Creek.

Spadafora Location

Sheep Creek is an ephemeral stream located approximately 275 feet east of the proposed location of the Spadafora Well Pad. One ephemeral tributary to Sheep Creek is located approximately 40 feet to the west of the proposed well pad location. This drainage flows through two stock ponds; one is adjacent to the well pad location on the southwest corner, and the other is approximately 125 feet northwest of the proposed well pad location. Sheep Creek is a tributary to the HUC 6 subwatershed of West Muddy Creek with a drainage area of 4.3 square miles. Average annual precipitation is 24 inches and the 100 year peak flood is estimated at 112cfs (USGS Streamstats, 2015). Three water samples were collected from Sheep Creek near the location of the proposed Spadafora Well Pad in the spring of 2010; two from the

creek and one from a pond that drains into the creek. All three found detectable concentrations of methane but below the water quality standard. No BTEX concentrations were found.

3.2.13.2 Methodology

Miles of streams will be analyzed for each of the well pads for direct and indirect impacts and the approximate duration of impacts.

3.2.13.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Allen Location

There is no perennial surface water near the Allen Well Pad or the associated pipeline, so no direct impacts to surface water would occur. There is the potential for indirect impacts to downstream water users if an accidental spill or pipeline rupture were to occur in the West Muddy Creek HUC 6 watershed. Spills could occur on the pad location as well as from trucking accidents along transportation routes. The impact from this type of accident is difficult to predict due to the unknown volume of a spill or the location. From 2006 to present, 10 spills have occurred from oil and gas activities in Gunnison County. The largest area impacted by those spills was 3024 square feet adjacent to a well pad when a ball valve ruptured and spilled 12 barrels of produced water into a drainage ditch (COGCC, 2015).

Long term impacts would occur if a spill was large enough to reach a surface water body and propagate downstream. Contamination of the bed and banks of a stream could be long lasting due to the difficulty in recovering the fluids. Removal of the contaminated soils may be needed as well as drilling ground water wells to document the extent of impact to the alluvial aquifer.

11-90-9 Location

Little Henderson creek is 1000 feet down gradient to the south of the proposed 11-90-9 Well Pad. Direct impacts to Little Henderson Creek would occur if a spill or pipeline rupture of produced water, fracking fluids, diesel fuel, oil, etc. were spilled and reached surface waters in the channel. Depending on the size of the leak or spill, it would travel approximately 2 miles in Little Henderson Creek before reaching the East Fork of Muddy Creek.

Long term indirect effects from a large spill or leak would occur if the bed and banks of Little Henderson Creek were contaminated. This would result in the loss of approximately 3.5 miles of perennial stream channel before reaching East Fork Muddy Creek. However, the largest spill to date in Gunnison County covered a distance of 475 feet in a barrow ditch along an access road to the pad. This spill was 12 barrels in size and required removal of soil for testing compliance with state standards. Results found soils to be below the COGCC TABLE 910-1 standards so no further remediation was required. If a spill of this size occurred on this well pad, approximately 200 feet of Little Henderson Creek would be contaminated or 2% of the stream channel in the Little Henderson Creek watershed.

The proposed road and pipeline alignment will add road density to the watershed. Sediment delivery to creeks increases with increased road density proximal to water. The pad is located at the confluence of two ephemeral crenulations that will require consultation with the Army Corps of Engineers to determine if pad construction will require 404 permitting. Crossing of the perennial Little Henderson Creek by the proposed temporary surface pipeline through the beaver dominated riparian zone will require 404 permitting to assure protection of the Waters of the US from contamination with sediment.

Aspen Leaf Location

Ault Creek is 600 feet down gradient to the south of the proposed Aspen Leaf Well Pad. Direct impacts to Aspen Leaf Reservoir and West Muddy Creek would occur if a spill or pipeline rupture of produced water, fracking fluids, diesel fuel, oil, etc. were spilled and reached surface waters in the channel. Depending on the size of the leak or spill, it would travel approximately 4 miles in Ault Creek before reaching the West Fork of Muddy Creek.

Long term indirect effects from a large spill or leak would occur if the bed and banks of Little Henderson Creek were contaminated. This would result in the loss of approximately 3.5 miles of perennial stream

channel before reaching West Muddy Creek. However, the largest spill to date in Gunnison County covered a distance of 475 feet in a barrow ditch along an access road to the pad. This spill was 12 barrels in size and required removal of soil for testing compliance with state standards. Results found soils to be below the COGCC TABLE 910-1 standards so no further remediation was required. If a spill of this size occurred on this well pad, approximately 200 feet of Ault Creek would be contaminated or less than 1% of the stream channel in the Ault Creek watershed.

There are no new roads proposed for this well pad. The proposed temporary pipeline alignment follows an existing road. This poses little potential for direct or indirect effects of sediment delivery from the proposed activity. The road currently has adequate engineered drainage and needs no maintenance to conduct the proposed activities.

Henderson Location
Little Henderson creek is 450 feet down gradient to the north of the proposed Henderson Well Pad. Direct impacts to Little Henderson Creek would occur if a spill or pipeline rupture of produced water, fracking fluids, diesel fuel, oil, etc. occurred and reached surface waters in the channel. Depending on the size of the leak or spill, it would travel approximately 3.5 miles in Little Henderson Creek before reaching the East Fork of Muddy Creek.

Long term indirect effects from a large spill or leak would occur if the bed and banks of Little Henderson Creek were contaminated. This would result in the loss of approximately 3.5 miles of perennial stream channel before reaching East Fork Muddy Creek. However, the largest spill to date in Gunnison County covered a distance of 475 feet in a barrow ditch along an access road to the pad. This spill was 12 barrels in size and required removal of soil for testing compliance with state standards. Results found soils to be below the COGCC TABLE 910-1 standards so no further remediation was required. If a spill of this size occurred on this well pad, approximately 200 feet of Little Henderson Creek would be contaminated, or less than 1% of the stream channel in the Little Henderson Creek watershed.

The proposed road and pipeline alignment will add road density to the watershed. Sediment delivery to creeks increases with increased road density proximal to water. Construction of the new access road, reconstruction/improvement of the existing road, and construction of the proposed pipeline will cross intermittent waterways tributary to the perennial Little Henderson creek. These crossings require engineered designs that will involve fill material in Waters of the US that warrant consultation with the Army Corps of Engineers for Clean Water Act section 404 permitting.

Spadafora Location
Sheep Creek is 275 feet directly east of the proposed well pad. Direct impacts to Sheep Creek would occur if a spill or pipeline rupture of produced water, fracking fluids, diesel fuel, oil, etc. were spilled and reached surface waters in the channel. Depending on the size of the leak or spill, it would travel approximately 3 miles in Sheep Creek before reaching the West Fork of Muddy Creek.

Long term indirect effects from a large spill or leak would occur if the bed and banks of sheep creek were contaminated. This would result in the loss approximately 3 miles of ephemeral stream channel before reaching Muddy Creek. However, the largest spill to date in Gunnison County covered a distance of 475 feet in a barrow ditch along an access road to the pad. This spill was 12 barrels in size and required removal of soil for testing compliance with state standards. Results found soils to be below the COGCC TABLE 910-1 standards so no further remediation was required. If a spill of this size occurred on this well pad, approximately 200 feet of Sheep Creek would be contaminated or approximately 1% of the stream channel in the Sheep Creek watershed.

3.2.13.4 Mitigation Measures and Residual Impacts

Allen Location
Design features submitted by SG as shown in Appendix B and COGCC and CDPHE regulations would minimize the potential for an accidental release reaching surface waters in the area. A spill prevention and countermeasures plan is required by COGCC and a stormwater management plan is required by CDPHE. The combination of these protective measures would reduce the potential for short and long term impacts; however, the potential for impacts is greater than the no action alternative.

11-90-9 Location
Design features shown in Appendix B, and COGCC, CDPHE regulations would minimize the potential for an accidental release reaching surface waters in the area. A spill prevention and countermeasures and control plan is required by COGCC. A stormwater management plan is required by CDPHE. Clean Water Act section 404 permitting is required by the Army Corps of Engineers to assure protection of Waters of the US from sedimentation. The combination of these protective measures would reduce the potential for short and long term impacts; however, the potential for impacts is greater than the no action alternative.

Aspen Leaf Location
Design features shown in Appendix B, and COGCC, CDPHE regulations would minimize the potential for an accidental release reaching surface waters in the area. A spill prevention and countermeasures and control plan is required by COGCC. A stormwater management plan is required by CDPHE. The combination of these protective measures would reduce the potential for short and long term impacts; however, the potential for impacts is greater than the no action alternative.

Henderson Location
Design features shown in Appendix B, and COGCC, CDPHE regulations would minimize the potential for an accidental release reaching surface waters in the area. A spill prevention and countermeasures and control plan is required by COGCC. A stormwater management plan is required by CDPHE. Clean Water Act section 404 permitting is required by the Army Corps of Engineers to assure protection of Waters of the US from sedimentation. The combination of these protective measures would reduce the potential for short and long term impacts; however, the potential for impacts is greater than the no action alternative.

Spadafora Location
Design features submitted by GE shown below and in Appendix B, and COGCC and CDPHE regulations would minimize the potential for an accidental release reaching surface waters in the area. A spill prevention and countermeasures and control plan is required by COGCC and a stormwater management plan is required by CDPHE. The combination of these protective measures would reduce the potential for short and long term impacts; however, the potential for impacts is greater than the no action alternative.

- No reserve pits will be constructed. Drilling fluid systems will be closed-loop. Cuttings from the Spadafora Well Pad will be dried then tested for COGCC Table 910-1 constituents and upon passing will be buried in a trench on-site. If the cuttings fail they will be shipped to an approved off-site disposal facility.
- No refueling or lubricating will take place within 100 feet of wetlands and other waterbodies or drainages. Hazardous materials, chemicals, fuels, etc. will not be stored within 100 feet of wetlands or surface waters.
- In order to detect and determine water quality impacts from future oil and gas activities, GE will continue to conduct a baseline water quality study for the area. In addition, GE will follow a Water Resources Monitoring Plan that has been developed for the area. This monitoring plan will include pre- and post-drilling water monitoring of springs and streams.
- In accordance with Rule 609, Statewide Groundwater Baseline Sampling and Monitoring (COGCC, 2013), water quality monitoring of existing groundwater wells will occur. Up to four initial baseline samples and subsequent monitoring samples will be collected from water sources within a one-half mile radius of a proposed well pad location. Initial sampling will be conducted within 12 months prior to setting conductor pipe in the first well on a pad.
- All construction (well pads, access road, and gathering lines) will be included in a state mandated General Construction Permit for stormwater discharges from the CDPHE. BMPs as required by the permits and plans will be installed before, during, and maintained after construction until the location reaches final stabilization following reclamation. All other requirements of the permits will be followed, such as the bi-weekly and post-precipitation event inspections and reclamation of disturbed areas, to stabilize them.

- Well pads will be designed as zero discharge areas and any accidental releases at these sites will be contained. GE will follow measures outlined in their Spill Prevention Countermeasure and Control Plan (SPCC Plan).

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.13.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, current management plans would continue to guide management of the project area. The proposed Federal oil and natural gas well development and access road construction would not be implemented. Existing roads within the project area would continue to be used to access local residences, existing oil and gas operations, and other land use activities. In addition, future oil and gas drilling would continue on private lands in the project area. Effects to surface water quality from existing uses including livestock use in drainages are expected to continue.

The Spadafora well pad is Fee/Fee meaning that even if the no action alternative is chosen, direct and indirect impacts would still occur if GE built the pad. The impacts would be similar to those described in the proposed action. In addition, GE is in the final stages of permitting the Spadafora Water Storage Facility with the State of Colorado directly east of the proposed well pad on the east side of Sheep Creek. The impacts associated with this facility would be similar to those described in the proposed action.

No direct or indirect impacts would occur on the Allen Well Pad due to the split estate and federal mineral ownership.

3.2.14 *Hydrology (Ground Water Resources)*

3.2.14.1 Affected Environment

The analysis area includes the ground water and geologic formations within a 2 mile radius of each of the well pads to address the extent of horizontal shale well bores.

Groundwater resources in the area include Tertiary and Upper Cretaceous age bedrock aquifer systems and Quaternary age alluvial aquifer systems. Within the North Fork Gunnison River Basin, the thickness of the Upper Cretaceous aquifers varies from 250 to 4,500 feet. Alluvial aquifers are thickest in valley bottoms and usually less than 100 feet thick and are likely connected hydraulically with adjacent bedrock aquifers. Groundwater in the bedrock aquifers flows in the direction of the geologic dip, approximately 4 degrees to the northeast (Ackerman and Brooks 1986).

Produced water from any CBM wells at any of the well pad locations would be considered non-tributary. The state of Colorado has designed groundwater in the Mesaverde, Cameo, and South Canyon Coal Groups as non-tributary waters. (2 CCR 402-17 Produced Nontributary Groundwater Rules).

The estimated formation tops when drilling a CBM well in the project area are shown in Table 3-20 based on wells previously drilled by SG.

Table 3-20 Estimated Geologic Formation Tops for CBM Development

Formation/Group	Depth of Top	Type of Material
Alluvial Gravel	0 (not present)	Pad is located above the alluvium
Wasatch	Surface	Shale,siltstones and lenticular sandstones
Ohio Creek	2,400	Buff sandstone
Mesaverde	2,700	Sandstone, siltstone, coal.
South Canyon Coal	4,100	Coal
Top of Cameo Coal	4,400	Coal
Rollins	4,600	Sandstone

The estimated formation tops when drilling a shale well in the project area are shown in Table 3-21 based on wells previously drilled by GE.

Table 3-21 Estimated Formation Tops for Shale Development

Formation/Group	Depth of Top	Type of Material
Alluvial Gravel	0 (not present)	Pad is located above the alluvium
Wasatch	Surface	Shale,siltstones and lenticular sandstones
Ohio Creek	2,037	Buff sandstone
Mesaverde	2,135	Sandstone, siltstone, coal.
Rollins	4,972	Sandstone
Cozzette	5,596	Sandstone
Corcoran	5,734	Sandstone
Mancos	5,793	Marine Shale, confining layer
Niobrara	8,651	Marine shale

Allen Location

The Allen well pad is situated on the Wasatch Formation present at the surface. SG currently proposes a vertical CBM well targeting gas production in the Cameo Coal Formation. Future wells from this location could also target the deeper Mancos Shale and Niobrara Shale. The estimated formation tops are shown in Table 3-20 and Table 3-21.

Freshwater would be used to drill the length of the surface casing. Three strings of casing are proposed, and would be cemented to the surface. The first conductor casing would extend to a depth of 80 feet. The second string of casing is the surface casing and would extend to a depth of 1,000 feet. The final production casing would extend to the total depth of the well and be cemented to the surface.

There are no active groundwater wells permitted by the state of Colorado within a 1 mile radius of the proposed well.

11-90-9 Location

See Henderson Location discussion below.

Aspen Leaf Location

The occurrence and distribution of shallow ground water resources in the project area are linked to the topography and underlying geology. The drill site and pipeline route sit principally on the Wasatch Formation which consists of siltstones, claystones, shales and sandstones, and will be referred to as the bedrock hydrostratigraphic unit. Based on the primary rock types being fine-grained, the Wasatch Formation is generally not considered to be an aquifer, although it can locally support low volume wells (Ackerman and Brooks, 1986 and Brooks, 1983). However, no water wells are known to be completed in the Wasatch Formation in the project area or the immediate environs. Seasonal seeps and springs may occur in areas where the Wasatch has been subject to mass wasting (i.e. landslide) events.

Henderson Location
The Henderson well pad is located on the Wasatch Formation. GE proposes drilling 4 shale gas horizontal wells targeting gas production in the Niobrara Formation.

According to the Colorado Division of Water Resources (CDWR), there are two groundwater permits near the location of the proposed Henderson #8-14 Well Pad (CDWR, 2014). One is a groundwater well in the SWNE1/4 of Section 8, permitted to SG (Permit #69651). This well is a coal seam methane well. The other is a spring in the NESE1/4 of Section 7. It is permitted to James Hockenberry. This groundwater permit is for domestic and stock use (Permit #266485).

Spadafora Location
The Spadafora well pad is located on a bench composed of weathered Wasatch Formation. GE proposes drilling 2 shale gas horizontal wells targeting gas production in the Niobrara Formation. Other fee/fee wells targeting coal bed methane could also be drilled from the pad.

Fresh water would be used to drill the surface casing. Five strings of casing would be used to reach the target formation. The conductor casing would extend to a depth of 120 feet and be cemented to the surface. The surface casing would extend to a depth of 1100 feet and would also be cemented to the surface. Three additional strings of casing would be cemented to prevent cross contamination of formations.

There is one groundwater well in the NWSW1/4 of Section 20, near the location of the proposed Spadafora Well Pad. It is permitted to Roger Cesario and is permitted for domestic and stock use (Permit #250836).

3.2.14.2 Methodology

The number of groundwater wells potentially impacted and surface water stream segments.

3.2.14.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Impacts Common to all well pad locations
The Grand Mesa has experienced regional uplift of approximately 9200 feet and nearly 5,000 feet of incision surrounding it. This can create a tensile horizontal stress field producing tensile rock failure and the formation of a network of vertical extensional fractures to depths of more than 3200 feet within Grand Mesa. The vertical fractures enhance the vertical flow and depth of penetration of groundwater. Measurements of water temperature in groundwater springs are elevated by up to 10ºC (Lazear, 2009).

The depth of surface fracturing is important when considering hydraulic fracturing in underlying formations. Recent studies funded by Halliburton Energy Services estimated the vertical extent of microseismicity from over 12,000 hydraulic fracturing stimulations across North America. The authors developed a relationship that predicts maximum fracture height as a function of hydraulic fracturing fluid volume. Therefore, the potential for upward fluid migration depends on the upward fracture growth and seismic displacements. These predictions generally bound the vertical extent of all microseismic activity to less than 1200 feet above well perforations, although most were much closer to the well bore (Flewelling et al., 2013).

Studies conducted by the USGS in Garfield County with similar geologic members of the Piceance Basin, found evidence of the migration of methane (thermogentic) from deep in the Wasatch Formation possibly through natural fractures or uncemented annular space in gas wells (McMahon,P.B. et al., 2010).

The fracing process would introduce chemicals into the wellbore and surrounding fractured zones that could affect ground-water quality. Based on experience in nearby gas fields, about 35% of frac fluids are not recovered in the flowback process. However, additional volume of fracing fluids are recovered once the well begins production (GMUG, 2008).

Fracing would occur at depths over 3500 feet below the land surface. Because fracing would be conducted at these considerable depths, effects to ground-water resources in the unconsolidated

deposits that support springs are considered very unlikely to occur. EPA (2004) acknowledges that the thousands of feet of strata separating the fracing zone and the surface would prevent hydraulic fractures from reaching the shallow water-bearing zone.

Allen Location

There are no direct impacts to near surface groundwater aquifers under the proposed action. The casing and cementing plan as well as State and Federal requirements for monitoring of well head pressures to insure proper sealing of the well bore would minimize the potential for direct impacts. Storm water management and spill prevention plan would also minimize the potential for direct impacts to near surface groundwater.

Indirect impacts could occur if hydraulic fracturing of CBM wells intercepts deep fractures that are naturally unsealed due to the presence of migrating groundwater from deep within the Wasatch Formation. These impacts could result in increased methane present in nearby surface water or ground water wells. Other contaminates from deep in the formation may also be present with the methane although in studies conducted in Pennsylvania and New York with documented contamination of methane in domestic wells, there was no evidence for contamination of deep saline brines or fracturing fluids (Osborn S.G., et al., 2011). There is currently no risk to groundwater wells because none are present within a 2 mile radius of the well pad.

Existing baseline monitoring of methane has shown it to be naturally present in numerous locations on the West Fork of Muddy Creek. Further baseline sampling in multiple locations to characterize the source of the methane (shallower biogenic or deeper thermogenic) is required in the mitigation measures below.

Any additional wells that are proposed for this well pad targeting the deeper Mancos or Niobrara Formation will have no direct and very little potential for indirect effects due to the vertical separation of the geologic formation. Deep surface fractures in the Wasatch Formation would be separated by 2600 feet from well bores in the Mancos Formation and up to 5400 feet in the Niobrara Formation.

If thermogenic methane increased in surface waters due to hydraulic fracturing of CBM wells, the effects could be long lasting. Methane is present in most of the surface water sampled in baseline monitoring. If additional methane was generated from hydraulic fracturing, the volume is difficult to predict and could reach a level of concern or hazard. This indirect effect could result in the degradation of water quality and would result in more impact than the no action alternative.

Where pipeline trenching crosses portions of the unconsolidated hydrostatigraphic unit, ground water could be encountered in the trench. It is considered more likely that shallow ground water would be encountered in the trench where it crosses areas that are at a topographic low and have a developed shallow ground-water system, such as perennial stream courses. It is also considered more likely that shallow ground water would be encountered in the period of time directly following snowmelt and seasonal runoff, estimated to be May to June when local water tables are expected to be higher than other times of year.

11-90-9, Henderson and Aspen Leaf Locations

There are no direct impacts to near surface groundwater aquifers under the proposed action. The casing and cementing plan as well as State and Federal requirements for monitoring of well head pressures to insure proper sealing of the well bore would minimize the potential for direct impacts. Storm water management and spill prevention plan would also minimize the potential for direct impacts to near surface groundwater.

Where pipeline trenching crosses portions of the unconsolidated hydrostatigraphic unit, ground water could be encountered in the trench. It is considered more likely that shallow ground water would be encountered in the trench where it crosses areas that are at a topographic low and have a developed shallow ground-water system, such as perennial stream courses. It is also considered more likely that shallow ground water would be encountered in the period of time directly following snowmelt and seasonal runoff, estimated to be May to June when local water tables are expected to be higher than other times of year.

Spadafora Location
There are no direct impacts to near surface groundwater aquifers under the proposed action. The casing and cementing plan as well as State and Federal requirements for monitoring of well head pressures to insure proper sealing of the well bore would minimize the potential for direct impacts. Storm water management and spill prevention plan would also minimize the potential for direct impacts to near surface groundwater.

No indirect impacts are anticipated. The two current APDs are to drill two shale gas wells terminating in the Niobrara Formation. The total vertical depth of these wells would provide (8,700 feet-3,200 feet) 5,500 feet of separation from potential surface fractures in the Wasatch Formation and any fractures migrating upward from hydraulically fractured horizontal well bores. Any additional wells drilled from this well pad are also anticipated to be shale gas wells.

3.2.14.4 Mitigation Measures and Residual Impacts

Allen Location
Collection of baseline data prior to gas-well installation and time series collection of data after well installation is the best way to understand the geologic structure and existing contamination of groundwater (McManhon P.B., et al., 2013).

Baseline samples should be collected to quantify the isotopic composition of methane (biogenic and/or thermogenic) which would aid in understanding the origin of the methane. Noble gases should also be sampled to age date groundwater and in combination with methane data can help distinguish between natural sources of methane or those induced from drilling activities.

Sampling should be conducted at several sites on each of these creeks: West Muddy Creek, Williams Creek, and Pilot Creek.

Residual impacts after applying the sampling mitigation would remain the same. Water quality monitoring will only indicate sources or changes in concentrations of methane and other constituents before and after drilling wells.

11-90-9, Aspen Leaf, Henderson, Spadafora Locations
While there would be local effects to the rock formations in the immediate vicinity of each wellbore, the low transmissivity and hydraulic conductivity of the formations would prevent migration of residual fracing fluids outside the zone of fracturing. The low volumes of produced water measured in adjoining wells suggest that there is limited ground water in the target strata. Given these circumstances, along with the target depths being deep, and that ground-water in these zones is considered unusable based on depth and water chemistry (Noblis 2008), there is negligible risk to ground-water supplies.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.14.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, current management plans would continue to guide management of the project area. The proposed Federal oil and natural gas well development and access road construction would not be implemented. Existing roads within the project area would continue to be used to access local residences, existing oil and gas operations, and other land use activities. In addition, future oil and gas drilling would continue on private lands in the project area. Ground-water withdrawals from existing permitted wells are expected to continue, and would continue to impart small scale depletions to the water-bearing zone principally in the unconsolidated deposits.

The Spadafora well pad is Fee/Fee meaning that even if the no action alternative is chosen, direct and indirect impacts would still occur if GE built the pad. The impacts would be similar to those described in the proposed action. In addition, GE is in the final stages of permitting the Spadafora Water Storage Facility with the State of Colorado directly east of the proposed well pad on the east side of Sheep Creek. The impacts associated with this facility would be similar to those described in the proposed action.

No direct or indirect impacts would occur on the Allen Well Pad due to the split estate and federal mineral ownership.

3.2.15 *Wastes (Hazardous or Solid)*

3.2.15.1 Affected Environment

The affected environment for hazardous materials includes air, water, soil, and biological resources that may potentially be affected by an accidental release of hazardous materials during transportation to and from the well pad locations, storage of, use in construction, drilling up to 25 natural gas wells, and operations on each of the five well pad locations. Sensitive areas for hazardous materials releases include areas adjacent to water bodies, above aquifers, and areas where humans or wildlife would be directly impacted.

Typical hazardous materials present or likely to be present in the project area during development and production are listed in Appendix E, Hazardous Materials Management Summary and include:

- drilling mud and cementing products, which are primarily inhalation hazards
- flammable or combustible motor fuels
- proprietary materials necessary for well completion and stimulation, such as acids and gels (corrosives)
- fluids such as ethylene glycol that may be used in dehydration units, and are known to be toxic to wildlife and cattle
- human solid and liquid wastes, generated primarily during the construction and drilling phases of the project

To develop up to 25 natural gas wells, the operators will transport the majority of hazardous materials (except recycled and flowback water) to and from the location by vehicles over the roads and highways described in the proposed action. Both operators have included project specific design features (Appendix B) related to minimizing impacts to sensitive environmental resources related to handling of hazardous wastes, management of spills, produced water management.

Allen Location
Cuttings and drilling fluids used downhole will be captured and separated upon return to the surface using either a partial closed loop system in combination with a reserve pit or potentially a full closed loop system in which a reserve pit would not be necessary. Cuttings disposal includes sampling of produced cuttings to COGCC Table 910-1 standards prior to selecting either off-site disposal or potentially disposing of cuttings by burial on the well site. If a reserve pit is constructed, it will be constructed in cut material on the location and lined with an impermeable liner prior to use. Any pit liners used on the location will be removed and disposed of at an approved offsite disposal facility as a part of the pit reclamation process.

Produced fluids and flowback water from drilling, completion and produced water from long term production from up to five natural gas wells will be captured in tanks on the location then transported by vehicle to the appropriate disposal facility which may be to a commercial disposal facility, SG's McIntyre flowback pits, or SG's 24-2 WDW.

11-90-9 Location
A full closed loop system is proposed and therefore no reserve pit is necessary on the location. Cuttings and drilling fluids used downhole will be captured and separated upon return to the surface in metal bins on the well pad. Cuttings disposal includes sampling of produced cuttings to COGCC Table 910-1 standards and transport by vehicle to approved off-site commercial disposal facilities.

Produced fluids and flowback water from drilling, completion from up to 5 natural gas wells will be captured in tanks on location and then transported across country via temporary poly pipelines to SG's McIntyre flowback pits and/or disposed of in SG's 24-2 WDW or taken to an offsite commercial disposal facility.

Produced water from long term production from up to five natural gas wells will be captured in tanks on the location then transported via SG's buried pipeline water system and delivered to either SG's McIntyre flowback pits, or SG's 24-2 WDW.

Aspen Leaf Location
A full closed loop system is proposed and therefore no reserve pit is necessary on the location. Cuttings and drilling fluids used downhole will be captured and separated upon return to the surface in metal bins on the well pad. Cuttings disposal includes sampling of produced cuttings to COGCC Table 910-1 standards and transport by vehicle to approved off-site commercial disposal facilities. SG had previously constructed a reserve pit on the Aspen Leaf location to accommodate drilling and completion of the 11-90-15-1 natural gas well, the reserve pit has since been reclaimed on the location.

Produced fluids from drilling, completion from up to seven natural gas wells will be captured in tanks on location and then transported across country via temporary poly pipelines to SG's McIntyre flowback pits and/or disposed of in SG's 24-2 WDW or taken to an offsite commercial disposal facility.

Produced water during production from up to seven natural gas wells will be captured in tanks on the location then transported via SG's buried pipeline water system and delivered to either SG's McIntyre flowback pits, or SG's 24-2 WDW.

Henderson Location
A full closed loop system is proposed and therefore no reserve pit is necessary on the location. Cuttings and drilling fluids used downhole will be captured and separated upon return to the surface in metal bins on the well pad. Cuttings disposal includes placement of captured cuttings on a temporary lined area on the well pad to facilitate drying, sampling of produced cuttings to COGCC Table 910-1 standards and transport by vehicle to approved off-site commercial disposal facilities. Any pit liners used on the location (temporary lined area) will be removed and disposed of at an approved offsite disposal facility as a part of the cuttings disposal process.

Produced fluids from drilling, completion from up to four natural gas wells will be captured in tanks on location and then transported via vehicle or GE's buried pipeline water system to GE's Hotchkiss Water Storage Facility and/or disposed of in GE's 18-22D WDW or taken to an offsite commercial disposal facility.

Produced water during production from up to four natural gas wells will be captured in tanks on the location then transported via GE's buried pipeline water system and delivered to either GE's Hotchkiss Water Storage Facility and/or disposed of in GE's 18-22D WDW or taken to an offsite commercial disposal facility.

Spadafora Location
A full closed loop system is proposed and therefore no reserve pit is necessary on the location. Cuttings and drilling fluids used downhole will be captured and separated upon return to the surface in metal bins on the well pad. Cuttings disposal includes placement of captured cuttings on a temporary lined area on the well pad to facilitate characterization, drying, and sampling of produced cuttings to COGCC Table 910-1 standards prior to selecting either off-site disposal or potentially disposing of cuttings by burial on the well site. Disposal onsite will include a trench constructed on the location which the cuttings (once determined to be within COGCC Table 910-1 standards) may be placed and buried immediately up on placement. This cuttings trench will be constructed in cut material on the location. Any pit liners used on the location (temporary lined area) will be removed and disposed of at an approved offsite disposal facility as a part of the cuttings disposal process. Should cuttings be characterized and sampling identify that the COGCC Table 910-1 standards cannot be met cuttings will be collected, transported by vehicle and deposited at an approved off-site commercial disposal facility.

Produced fluids from drilling, completion from up to four natural gas wells will be captured in tanks on location and then transported via vehicle or GE's buried pipeline water system to GE's Hotchkiss Water Storage Facility and/or disposed of in GE's 18-22D WDW or taken to an offsite commercial disposal facility.

Produced water during production from up to four natural gas wells will be captured in tanks on the location then transported via GE's buried pipeline water system and delivered to either GE's Hotchkiss Water Storage Facility and/or disposed of in GE's 18-22D WDW or taken to an offsite commercial disposal facility.

3.2.15.2 Methodology

The analysis includes the following assumptions:

- Occupational Safety and Health Administration health and safety guidelines would be followed by all workers during all construction, operation, and decommissioning phases of the projects.
- Construction areas will be fenced to exclude public entry.
- The design features identified in Appendix B will be implemented during all stages of the projects as appropriate.

The BLM Instruction Memoranda numbers WO-93-344 and CO-97-023 require that all NEPA documents list and describe any hazardous and extremely hazardous materials that would be produced, used, stored, transported, or disposed of as a result of a proposed project.

The most pertinent of the federal laws dealing with hazardous materials contamination are as follows:

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, Public Law 96-510 of 1980) provides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment. It also provides national, regional, and local contingency plans. Applicable emergency operations plans in place include the National Contingency Plan (40 CFR 300, required by Section 105 of CERCLA), the Region VIII Regional Contingency Plan, and the Gunnison County Emergency Operations Plan (developed by the Gunnison County Office of Emergency Management).

- The Resource Conservation and Recovery Act (Public Law 94-580, October 21, 1976) regulates the use of hazardous substances and strictly regulates the management and disposal of hazardous as well as ordinary solid wastes. Oil and gas lessees are exempt from certain parts of the Act, including Subtitle C (hazardous waste regulations); however, they are not exempt from Subtitle D (solid waste regulations). Oil and gas lessees should know which of their wastes are exempt and nonexempt from Resource Conservation and Recovery Act subtitles.

Use of any substances classified as Extremely Hazardous by the Superfund Amendments and Reauthorization Act of 1986 would be limited to treating chemicals, should they be necessary. Materials generated during drilling include drill cuttings, combined with drilling fluids and additives used to maintain circulation and reduce borehole caving and accomplish cementing of the borehole annulus. These fluids are normally confined to the borehole, storage tanks and if approved, reserve pits on the location.

Hydraulic fracturing is exempt from several federal laws and regulations, such as the Clean Water Act, Clean Air Act, the Emergency Planning and Community Right-to-Know Act, the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and the Safe Drinking Water Act. However, all proposed Federal natural gas wells related to this proposed action are subject to the Federal Hydraulic Fracturing rule on Federal and Indian Lands 43 CFR 3162.3-3 Subsequent well operations; Hydraulic fracturing.

3.2.15.3 Impacts from the Proposed Action

Direct and Indirect Impacts

The types of impacts in the proposed action would likely be the same across all elements of the proposed action regardless of operator. Impacts may vary in degree based on the number of wells drilled, the amount of wastewater produced and other design details specific to drilling an individual well.

Generally impacts on health and safety due to exposure to hazardous and solid wastes can include the following:

- Faults in the manner in which hazardous materials are used, stored, or transported
- The nature and volume of hazardous materials brought into the project area
- The proximity of groundwater to the drilling sites, and the ability of the drilling materials to reach groundwater
- The quality of produced water wells and the amount of produced water and drilling fluids that remain underground after completion
- The quality of pipelines, well casing, and plugs and the subsequent likelihood of leaks
- Amount of diesel fuel used on site in transportation and operations
- Proximity of workers to hazardous materials and proximity of residences to the project components (pads, roads, pipelines)

Based on the actions described in the proposed action, the following are possible impacts that could affect human health and safety:

- Vehicular accidents resulting in spills or leaks of drilling lubricant or processed water
- Tanker or refueling spills that result in surface contaminations, exposure of workers to inhalation and potential skin contact. Depending on the substances spilled, the substance could percolate into shallow aquifers and contaminate groundwater, affecting residents who depend on the Colorado Plateaus aquifers.
- Spills while removing fluids from wellbore
- Well casing breach that could introduce methane and drilling fluid into local shallow aquifers and could result in health and safety risks for residents
- Ignition, explosions, or burns from cigarette smoke or other unexpected heat sources
- Contamination of water or soil during the drilling and hydraulic fracturing processes
- Accidents resulting in improper disposal of wastewater
- Leaks from abandoned wells, water disposal wells, or pipes
- Natural gas upwelling

Water Disposal Wells (GE 18-22D WDW and SG 24-2 WDW)
The injection of produced waters (wastewater) into disposal wells means that contaminated waters are being pumped at high pressure into deep zones underground, usually into the areas from where the oil or gas was extracted, and left there permanently. Produced waters contain potentially harmful pollutants, including salts, oil, grease, inorganic and organic additives, and naturally occurring radioactive material. These pollutants can be dangerous if they are released into the environment and/or if people come into contact them. They can be toxic to humans and aquatic life, radioactive, or corrosive.

Though produced water is injected into deep zones underground, the process of hydraulic fracturing creates new fractures in the deep geologic structures that can change the ability of fluids and gasses to move from one geologic zone to another, potentially creating connectivity between injection zones and shallow drinking water aquifers.

Hydraulic fracturing creates fractures in geologic formations targeted for oil and gas production, which may make it possible for fluids and gasses to move between geologic zones. Additionally, this route of fluid and/or gas exchange may be exacerbated by follow-on injection of produced water (wastewater) into those deep zones via disposal wells. Such injection under pressure is suspected to be the cause of seismic activity around various hydraulic fracturing operations across the United States. Any seismic activity from the disposal phase may be causing new fractures in geological structures and further increasing connectivity between aquifers and other zones, such as those zones containing fossil fuels and injected wastes (BLM 2013a).

A report by the National Research Council reported energy development-induced seismic activity in at least 13 U.S. states, including Colorado, and 20 additional countries (Weinhold 2012). Some of these seismic events have been as severe as magnitude 5.0-7.3 events. Most of these seismic events are linked not directly to the process of hydraulic fracturing, but rather to the associated wastewater disposal process (Weinhold 2012). An analysis conducted by the U.S. Geological Survey and Oklahoma

Geological Survey found that seismic activity in Oklahoma has increased by 50 percent since 2013. As of May 2, 2014, 145 earthquakes of magnitude 3.0 or greater had occurred in Oklahoma, compared to a record-breaking 109 earthquakes in 2013 (USGS 2014). The USGS analysis also points to wastewater injection as a likely cause of the increase in seismic activity (USGS 2014).

While research on this phenomenon is limited, regulators across the country have begun taking steps to protect the public from the increase seismic activity that is potentially being caused by hydraulic fracturing and wastewater injection. As more studies are done on the impacts of hydraulic fracturing, uncertainty around the impacts and which part of the process produces these impacts will likely decrease.

Fracture growth and the potential for upward fluid migration, through geologic formations depend on site-specific factors such as the following:

- Physical properties, types, thicknesses, and depths of the targeted formation as well as those of the surrounding geologic formations
- Presence of existing natural fracture systems and their orientation in the target formation and surrounding formations
- Amount and distribution of stress (i.e., in-situ stress), and the stress contrasts between the targeted formation and the surrounding formations (BLM 2013)

Toxins may also leak into shallow drinking waters through failed well casings. For the project area including the nearby Bull Mountain Unit developments, there have been no reported incidents for well casing failures and related contamination of drinking water aquifers to date.

Spills
Although spills are not intended to occur while oil and gas activities occur there is evidence that spills do happen with regards to oil and gas operations. In Colorado, reported spills increased by 33 percent, with 402 spills reported in 2012 and 534 reported in 2013 (E&E 2014). This increase doesn't necessarily imply increased negligence; this increase could be a result of increased spill reporting or could be due to an increase in the amount of development occurring. The data just show that spills do occur with some frequency and it is therefore necessary to assume that despite state and federal regulations and other safety measures, spills, leaks, and blowouts still occur and it is necessary to consider the risk of this occurring. Further impacts analysis and discussion also occurs in section 3.2.13 Hydrology (Surface Water Resources).

Resource Impacts
Natural gas drilling would also result in impacts on various environmental resources, including consequences on human health, see the following for additional discussion and analysis on the impacts from the proposed action on:

- 3.2.1 Air Quality
- 3.2.4 Soils
- 3.2.5 Vegetation Management
- 3.2.7, 3.2.8, 3.2.9, and 3.2.10, Wildlife Resources
- 3.2.11 Riparian Zones and Wetlands
- 3.2.13 and 3.2.14 Hydrology (Surface and Ground Water Resources)
- 3.2.19 Livestock Grazing

3.2.15.4 Mitigation Measures and Residual Impacts

The EPA and CDPHE require a Spill Prevention, Countermeasure, and Control Plan to be developed and implemented by SG and its subcontractors as applicable and appropriate. The plan is intended to preclude the release of oils such as diesel fuel, gasoline, crude oil, or condensate, into the waters of the United States. The plan must also provide response actions to be taken, and notifications to be made, in the event a release occurs.

According to 29 CFR 1910.1200(g), both operators are required to maintain a file containing Material Safety Data Sheets for all chemicals, compounds, and/or substances utilized during the course of

construction, drilling, completion, and production operations of the project. This file is to be available at all times when employees are present at the site.

All proposed Federal natural gas wells related to this proposed action are subject to the Federal Hydraulic Fracturing rule on Federal and Indian Lands 43 CFR 3162.3-3 Subsequent well operations; Hydraulic fracturing. With this rule, the BLM establishes new requirements to ensure wellbore integrity, protect water quality, and enhance public disclosure of chemicals and other details of hydraulic fracturing operations. Specifically, this final rule will add to existing requirements by providing information to BLM and the public on the location, geology, water resources, location of other wells or fracture zones in the area and fracturing plans for the operation before the well is permitted. To ensure well integrity, the final rule requires specific best practice performance standards for all wells, including cement return and pressure testing for surface casing, cement evaluation logs for intermediate and production casing, and remediation plans and cement evaluation logs for any surface casing that does not meet performance standards. The final rule requires interim storage of all produced water in rigid enclosed, covered, or netted and screened above-ground tanks, subject to very limited exceptions in which lined pits could be used. Public disclosure of all chemicals, subject to limited exceptions for trade secret material, is required after fracturing operations are complete. The existing database FracFocus (http://fracfocus.org) can be used for this disclosure.

All activities associated with construction and operation of the proposed project would be required to be in compliance with applicable local, state, and federal regulations to protect the health and safety of proposed project employees and the general public.

Even though Hydraulic fracturing is exempted from several laws and regulations, the potential risk of contamination would be reduced as a result of compliance with existing regulatory requirements, agency policies, design features in Appendix B and any additional Conditions of Approval in Appendix C.

Agency policies, best management practices, required design features, and existing regulatory requirements would aim to minimize the risk of exposure and impacts on human and animal health from these potential contaminant pathways.

State and federal regulatory requirements as well as design features (Appendix B) included by the operator to prevent drilling and production failures, and contamination by and exposure to hazardous materials, aim to reduce the risk of impacts on human health from natural gas drilling. Additionally, these measures aim to reduce the risk that soil or surface water contamination, groundwater contamination, and direct exposure of workers to hydraulic fracturing chemicals pose to human health.

3.2.15.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

The no action alternative constitutes denial of Federal oil and gas development analyzed in the proposed action. However, oil and gas development could continue on private lands with non-federal minerals. This would result in the same kinds of public health and safety impacts as those discussed under direct, indirect and cumulative effects sections.

3.2.16 *Socioeconomics*

3.2.16.1 Affected Environment

While the gas development project is located within Gunnison County, it is likely that the local workforce will commute from Delta County, and that project construction, infrastructure, and operations have the potential to impact the North Fork Valley within both Gunnison and Delta counties. For these reasons the socioeconomic study area includes both Gunnison and Delta Counties.

Economic and Demographic Conditions
In 2013, Delta County had a population of 30,483 and Gunnison County a population of 15,507 (Census, 2014). The per capita income in 2013 was $34,681 in Delta County and $37,098 in Gunnison County (BEA, 2014). The mining sector, which includes gas development, employs 860 full and part-time positions and accounts for approximately 6% of the 14,971 jobs in Delta County. In Gunnison County,

mining sector employment accounts for approximately 7% or 798 of the 12,182 jobs. Mining sector compensation is averages $72,320 in Delta County and $84,654 in Gunnison County (BEA, 2014).

In 2010, the U.S. Census reported that 14,572 and 11,412 housing units were located in Delta and Gunnison counties (Census, 2015). In 2014 there was a decline in the number of housing units in Delta County (14,485) and an increase in the number of housing units in Gunnison County (11,574) (Census, 2015). Short-term housing within the study area includes apartments, rental homes, hotels, RV parks, and campgrounds.

Social Conditions

In most cases, the social conditions and effects are described in terms of effects to quality of life (QOL), which can be caused by changes in natural resource availability and land use. QOL is what brings pleasure and happiness to life-it can include "feeling a part of the community where you live; knowing where you stand in relationship to other people; having a sense that you and people in your community have control over the decisions that affect your future;….living without undue fear of crime or personal attack…" (Branch et al. 1982). The components of QOL can differ amongst individuals, however generally many components relate to income, employment and job satisfaction, affordable housing, health, food, culture, surrounding land uses and amenities such as recreation and views. Impacts to QOL can be perceived differently by individuals in part due to what they value and prioritize. Federal resource management decisions, such as this project can be perceived to impact QOL differently.

Revenue and Fiscal Conditions

As noted in the previously noted in this document, in order to facilitate natural gas well development the proposals will require a variety of surface and sub-surface estates. Due to this there will be a variety of fees, royalties, and taxes paid to numerous private parties and government entities. While fees and royalties are negotiated between private parties the fiscal impacts of fees and taxes are defined by ordinances, regulations, and statutes.

Property taxes are determined by multiplying the assessed value of the property by the tax rate. The tax rates are set by local government entities and vary by location. Ad-valorem property taxes are also applied to oil and gas production in Colorado based on prior year production. The assessed value is either 87.5 percent or 75 percent depending on whether the production is classified as primary or secondary.

Tax revenue related to natural gas production comes from two main sources: the Colorado Severance Tax and the state's share of federal mineral lease royalties. Colorado Severance Tax is a tax imposed upon nonrenewable natural resources that are removed from the earth. The severance tax is graduated, ranging from 2 percent for income under $25,000 to 5 percent for income of $300,000 and over. Producers may also deduct ad-valorem property taxes paid from severance taxes.

Federal mineral revenue is collected for bonus bids, rents, and royalties on federal mineral leases. Federal royalty rates are generally 12.5 percent of production value. The State of Colorado receives 49% of the total revenue associated with federal mineral leases. Federal mineral lease revenue for the State of Colorado is divided as such: 48.3 percent of all state mineral lease rent and royalty receipts are sent to the State Education Fund (to fund K-12 education), up to $65 million in FY 2009 – FY 2011, and growing at four percent per year thereafter. Any amounts greater than the upper limit flow to the Higher Education Capital Fund. Ten percent of all state mineral lease rent and royalty receipts are sent to the Colorado Water Conservation Board, up to $13 million in FY 2009, and growing at four percent per year thereafter. Any amounts greater than the upper limit flow to the Higher Education Capital Fund. 1.7 percent of all state mineral lease rent and royalty receipts are distributed directly to local school districts originating the revenue or providing residence to energy employees and their children.

3.2.16.2 Methodology

The socioeconomic baseline is identified using Bureau of Economic Analysis, U.S. Census Bureau, and IMPLAN data sets. Regional economic impacts are analyzed using IMPLAN 2012 an input-output model with a regional specific social accounting matrix. An input-output model is a quantitative technique that models the linkages between an economies sectors and estimates changes to employment, income, and

economic production related to a change in economic activity. The total expenditures by GE and SG for the various phases of the project are uncertain as they are dependent on dynamic market conditions. Therefore, to examine regional economic impacts a hypothetical $1,000,000 benchmark is used to illustrate the economic impacts of direct spending by GE or SG on construction, drilling, completion, production, or maintenance phases and the subsequent indirect and induced economic effects. The local purchasing coefficient is set at 40% under the assumption that 40% of goods and services related to the gas development activities would be procured within Delta and Gunnison counties. The remaining 60%, which would include capital such as drilling rigs, is assumed to be procured from outside the Delta and Gunnison regional economy. Economic activity from the reclamation phase has not been analyzed due to the structural economic changes expected to occur over the projects 50 year horizon. This analysis does not estimate direct project employment as the project's direct employment estimates are detailed in Section 2.2.11 Workforce. Fiscal impacts are not quantified due to uncertainties in project expenditures, gas production and prices.

3.2.16.3 Impacts from the Proposed Action

Direct and Indirect Impacts

There are socioeconomic consequences due to individuals' preferences and perceptions within the planning area. These include differing views on gas development's impacts on economic development and quality life within the study area. The socioeconomic consequences of the proposed action include increased regional economic activity beginning with the construction, drilling, and completion phases and persisting at a lower level of economic activity during the production and maintenance phases. Due to the need for housing, food, and other services the direct economic activity of gas development with increase economic activity in other sectors of the regional economy. This increase in economic activity may lead to job creation, a shift from part-time to full-time positions, or increased hours for current workers in the region to meet the labor demands from the increased economic activity. These increases in economic activity often lead to increases in quality of life. Non-economic socioeconomic consequences may include declines in quality of life due to an individuals' negative perception of gas development.

An IMPLAN model of the regional economy shows that for every $1,000,000 of project spending by GE or SG there is a direct effect of $400,000 as 40% of all goods and services related to the project are procured within the Delta and Gunnison regional economy. Additionally, there is an indirect effect of $106,828 and induced effect of $30,732 generated by multiplier effect arising from the project. Overall, the total effect of every $1,000,000 of project spending is estimated to increase regional economic activity by $537,559. The majority of the indirect and induced effect is expected to occur in the industrial maintenance, food and retail services, real estate, and professional services sectors. The level of direct employment expected by the project is detailed in Section 2.2.11 Workforce. Indirect and induced effect employment is estimated to be 1.5 jobs for every $1,000,000 of project spending. Fiscal impacts include tax revenue from sales taxes, property taxes, and Federal Mineral Royalties. The level of economic activity is anticipated to vary over the project's life cycle with most impacts occurring during the project's earlier phases of construction, drilling, and completion.

Impacts to quality of life can be perceived differently by individuals in part due to what they value and how they prioritize their values. Individuals and groups that prioritize increased economic activity may see the proposed action as benefiting their quality of life. Individuals and groups that prioritize environmental protection may see the proposed action as negatively affecting their quality of life.

Additionally, social effects often associated with energy development include changes to population, housing, noise, and traffic. Changes in population, both short-term and long-term changes, can have a direct impact on housing availability. Housing development is not always in sync with population needs, especially if in- or out-migration occurs in a short time-frame. However, within the study area existing housing stock and temporary housing should be able to absorb both temporary and long-term employees. There may be increased truck traffic hauling heavy equipment, materials, and water as well as increased traffic associated with oil workers and increased populations may cause more traffic congestion, increase commuting times, and affect public safety.

3.2.16.4 Mitigation Measures and Residual Impacts

None

3.2.16.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

The no action alternative would deny Federal related project elements (Federal APDs and Federal surface use) of the proposed action but would not preclude GE or SG from all of their planned gas development activities. Regional economic activity would increase at levels below that of the proposed action. There could be declines in quality of life due to gas development or increases in quality of life due to less gas development than under the proposed action. Overall, the no action alternative provides lower levels of regional economic activity.

3.2.17 *Access and Transportation*

3.2.17.1 Affected Environment

Access Current Conditions
Access to the project area is via State Highway 133 and Gunnison County Road 265 approximately 6 miles southwest of McClure Pass, to the Gunnison National Forest boundary where administration of the road changes over to the Gunnison National Forest and the road becomes NFSR 265. Other NFSR's are 704, 844, 849, and 851 (all gravel).

CR/NFSR 265 is graveled except for a paved 120-foot segment where the road meets State Highway 133. The road runs northwest through the area providing access to private homes and ranches, as well as NFS lands. The NFSR's total approximately 30 miles of gravel roads in the project area. Private roads used for access to gas development, private residential access, and agricultural uses also intersect CR/NFSR 265.

The roadway width varies depending on location, but is typically between 15 and 30 feet with periodic turnouts. CR/NFSR 265 crosses two small streams and the bridge width is approximately 28 feet. Gunnison County provides limited snowplow service on this road during the winter months (Gunnison County 2013). Other routes within the area are single lane gravel-surfaced roads and two-track routes used for private access to ranches, agricultural lands, and existing well sites. Several of the private access roads are gated with access limited to administrative uses only.

Transportation Current Conditions
Existing traffic on State Highway 133 consists primarily of local residents, regional travelers, and commercial vehicles, including light and heavy trucks from nearby mineral extraction activities
Traffic on the NFSR's consists primarily of local residents, farmers and ranchers, and commercial vehicles, including light and heavy trucks from the gas extraction. The NFSR's are also used to access recreation and hunting opportunities on NFS lands.

Current use of the roads for energy development includes development of private mineral estate within the Iron Point Unit by GE in the vicinity of this proposal and access into SG's Bull Mountain Unit developments. Several well pads are located on private property and some access is through NFS lands using NFSRs. Upon review of written permission from the private property owners allowing GE and SG to cross their property, the FS will issue a Road Use Permit (RUP) for routes crossing NFS lands. GE and SG currently have some RUPs from FS providing access to the operators where NFSRs are encountered.

On private, off lease lands, GE and SG obtain specific written permission from the private property owners to cross their private property. In split-estate situations, the operator's APD approval to develop Federal mineral estate upon those lands is dependent upon the operator obtaining a surface access agreement prior to APD approval or, when an agreement cannot be reached, a surface protection bond is in place which meets the requirements of 43 CFR 3104.

Total expected traffic associated with this project is shown in Table 3-22 below, developed from Table 2-15 in the draft EA. Construction and reclamation values are one-time events. Drilling and completion

values are per-well. Production values are grouped as trips are to multiple sites within the area on any given day. Workover assumes one rig per pad per year.

Table 3-22 Projected traffic associated with the proposed action. All values are round trips.

Operator	Multi-well Pad	Construction/ Reclamation	Drilling	# of wells	Drilling all wells	Completion	Completion all wells	Production (Annual)	Workover
SG	Allen (CBM)	142-198	195	1	195	198	198	886	31
	Allen (MCS)	(same pad as above)	411	4	1644	324	1296		
	11-90-9	142-198	513	5	2565	324	1620		31
	Aspen Leaf	n/a	463	7	3241	324	2268		31
GE	Henderson	135	725	4	2900	842	3368	365	15
	Spadafora	135	725	4	2900	842	3368		15
TOTAL		554-666	2621-2837	25	13445	2530-2656	12118	12514	123

Total construction-related traffic is therefore estimated at a maximum of 26,352 round trips over the anticipated 5-year construction period, or a volume of 14.4 round trips (28.8 passes) per day over the life of the project. Obviously, traffic will not occur evenly over the year, and will spike with each pad construction and each well drilling operation. This traffic will primarily come up Highway 133 from the south (Paonia, Hotchkiss, Delta), with an unknown but minor percentage coming over Highway 133 from the North. No substantial project traffic is anticipated coming up the Stevens Gulch road from Paonia or over Buzzard Divide from Silt/Collbran, the other two potential accesses to the area, as no requests for commercial use permits for these roads have been received.

Current (2013) traffic levels on Highway 133 average 1400 (CDOT 2015) passes per day (AADT), with projected levels of 1586 by 2020 and 1985 by 2035, an annual increase of more than 1.5%. If provided numbers are accurate and the estimate of the proportion of project traffic using McClure is correct, traffic associated with this project will contribute approximately 8.7 passes per day averaged over the 5 year life of the project. The potential contribution to traffic on this road, therefore, is approximately a 0.6% gross increase to traffic in this corridor in the initial year, with that percentage decreasing over time as overall traffic increases. Net traffic may be different, however. Equipment is likely to be used at multiple locations within this project or on nearby projects such as Bull Mountain for convenience and economic reasons, which may reduce passes over outside roads. Additionally, previous minerals projects in the general area have contributed to past traffic which in many cases has or will cease or decrease as those operations are completed. BLM (2015) analyzed their potential traffic over this route and referenced a value of 2000 average daily traffic as the threshold beyond which impacts became significant.

Production-related traffic of 1251 round trips per year adds an additional 3.5 round trips (6.9 passes) per day. This traffic is expected to almost entirely originate from the south of the Highway 133/CR 265 junction based on existing similar traffic, and was not used in the above lynx analysis of traffic over McClure. This traffic is essentially administrative, related to monitoring and maintenance of facilities and infrastructure, and is largely comprised of pickup trucks.

The values shown in the Table 3-22 also do not reflect associated activity such as monitoring of activities by Federal and State agencies. This contribution is expected to be minor and insignificant compared to the stated construction and operations values from the operators.

3.2.17.2 Methodology

The regulations regarding travel management on National Forest System lands related to vehicle use, including off-highway vehicles authorizes the FS to control the use on roads, trails, and areas open to

vehicles by vehicle class and time of year. These regulations also authorize the FS to require users to make improvements to roads prior to their use in order to accommodate the anticipated traffic. For this project, travel management and vehicle use will be accomplished through SUA and Road Use Permits (RUP). Traffic related to this project will use only those travel routes specifically designated in the RUP or SUA. All other routes and areas are closed to project related vehicle use under Title 16 USC; 36 Code of Federal Regulations.

43 CFR 3162.1 (a)-(c) define the requirements for Operating Rights Owners and Operators in terms of compliance with laws and conduct of operations, particularly the requirements by which the authorized officer can enter upon the locations for purposes of inspection or investigation of authorized activities.

The BLM cannot approve entry onto split estate land for drilling until either a Surface Access Agreement (SAA) has been facilitated and reached between the operator and private landowner, or as a result of the operator failing to reach an SAA (also confirmed by BLM if possible), a sufficient bond based on appropriate law under which the surface was patented is posted by the operator. BLM does not set minimum standards for SAAs, however the BLM and the FS are always willing to discuss concerns with surface owners and operators.

3.2.17.3 Impacts from the Proposed Action

Direct and Indirect Impacts

The proposed action uses a combination of existing state, county, and NFS roads to gain access to the project area for construction, operations and maintenance.

Access Effects
Access to locations within the area would temporarily decrease during construction activities. Construction activities may require the partial or full closure of existing roads in the area. Long-term improvements to existing routes such as more stable surface materials or additional slow vehicle turnouts, and longer sight distances would promote better access to destinations within the area. No additional or new public access roads or routes are included in the project area.

Transportation Effects
New gas development activity within the area would generate additional traffic in the area via Highway 133, CR/NFSR 265 and the network of NFS and private access roads. The nature and type of vehicle trips would vary depending on the phase of well development. During the well pad and pipeline construction phases, vehicles entering and leaving the area would include gravel trucks, semi-trucks, water trucks, pick-up trucks, and flatbed trucks hauling construction equipment. Well drilling and well production phases would also result in an increase in vehicles entering and leaving the area. Traffic associated with the drilling and production phases would include drilling/completion rigs, water trucks, pick-up trucks, work over rigs, and haul trucks.

Heavy vehicles (i.e. those 55,000 pounds or heavier) accelerate the rate of road wear. The longevity of road surface conditions depends on several factors, such as surface type, weather conditions, sub-base characteristics, and the nature and type of vehicle traffic. Interaction of pavement condition and vehicles takes into account vehicle weight, frequency, axle spacing, vehicle speed, number of tires per axle, suspension, and tire pressure. In general, a twofold increase in vehicle weight can increase road surface deterioration by 800 to 1,600 percent (FHWA 2000). Additional maintenance would be required to offset the effects of heavy vehicle use.

Indirect effects of higher traffic volumes would include more frequent road construction, the need for additional patrolling by public safety personnel, and deterioration of the highway's scenic attributes. On CR/NFSR265, increased heavy vehicle traffic would deteriorate the gravel road surface requiring more frequent road maintenance. On-going maintenance would be necessary for long-term transportation quality.

3.2.17.4 Mitigation Measures and Residual Impacts

Project design features and any additional BMPs will be incorporated into the traffic control plan. The plan will include at a minimum methods to comply with the terms and conditions of the current road use permits, compliance with the **Manual on Uniform Traffic Control Devices (MUTCD) - FHWA**, road and route closures, flaggers, escort vehicles These will be specified in the Surface Use Plan of Operations.

Most National Forest System roads were designed using the AASHTO guidelines, constructed for National Forest visitor and commercial user access and are maintained for long-term vehicle use. The system roads in the project area were built to be seasonal roads used during the dry periods of the year. They were never intended to be used for all-season access and will require considerable improvement to accommodate this type of use. Most roads of the project area have been upgraded beyond this minimum standard, however FS704.4A and a portion of FS851 may require additional upgrade prior to use.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.17.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, current management plans would continue to guide management of the roads in the project area. The Federal portions of the proposed action would not be built and there would be no changes to the current project area transportation system, except as authorized for other uses and projects. The NFSRs would be routinely maintained in a condition to safety accommodate intended use and in accordance with maintenance criteria documented in the road management objectives commensurate with budget and use, or by entities under road use permit. In addition, there may be some reconstruction or decommissioning activities funded by other sources taking place in the project area.

3.2.18 *Realty Authorizations*

3.2.18.1 Affected Environment

The project area encompasses several sections of both public and private land surface with Federal minerals. Federal leases COC-08905, COC 013483, COC-13484, COC-042314, COC-66716, COC-70004, COC-70005 have been obtained for the federal mineral rights.

A Special Use Permit will be obtained by SG from the FS regarding the off-lease portion of the buried pipeline associated with the Allen location totaling 0.7 mile/3.5 acre surface disturbance.

GE and SG have obtained a road agreement with Gunnison County for use of county roads. GE maintains a RUP for NFSR 265 and NFSR 851 with the FS and SG has a RUP, which provides access to current well locations and infrastructure.

Surface Use Agreements with private landowners for construction of the well pad (Allen and Spadafora locations) are in place and the operators have been permitted use of all roads required to access to the Allen, Aspen Leaf, Henderson and Spadafora well pads as identified in the operator certification section of each Application for Permit to Drill (APD).

GE has Special Use Permits with the FS for the Sheep Gas Gathering System and the Ragged Mountain Pipeline.

SG has a Special Use Permit with the FS for the Henderson Lateral Pipeline.

3.2.18.2 Methodology

FOREST SERVICE MANUAL 2700, SPECIAL USES MANAGEMENT, CHAPTER 2720, OIL AND GAS DEVELOPMENT (2726.31)

The authority to issue special use authorizations to non-Federal entities for oil and gas pipeline rights-of-way on National Forest System lands for the purpose oil or gas pipeline rights-of-way is Section 28 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 185).

The designation includes only pipelines and directly related facilities for the transportation of oil, natural gas, synthetic liquid or gaseous fuel, and any refined product produced there from.

Section 2726.31a states "Holders of valid BLM oil and gas leases and designated operators of BLM unitized lease areas do not require a special use authorization for pipelines or directly related facilities associated with the lease and located within the boundaries of the lease or unit area, as long as the pipelines or facilities are used solely for the production or gathering of oil and gas.

If the pipelines and related facilities are used for the transportation of oil and gas, whether on-lease or off-lease, the pipeline right-of-way must be issued under the authority of the Mineral Leasing Act."

Section 2726.31.32.a includes "related facilities may include valves, pumping stations, supporting structures, bridges, monitoring and communication devices, surge and storage tanks, terminals, roads, airstrips, and campsites. Related facilities need not connect with or be adjacent to the pipeline and may be the subject of separate authorizations."

FOREST SERVICE MANUAL 2700, SPECIAL USES MANAGEMENT, CHAPTER2720, 2729.01, AUTHORITY
Forests are directed to "Issue authorizations for the impoundment, storage, transmission, or distribution of water under the appropriate provisions of the Federal Land Policy and Management Act of October 21, 1976 (43 U.S.C. 1761), The Act of October 27, 1986, or if in wilderness, under the Wilderness Act of September 3, 1964."

FOREST SERVICE MANUAL 7700, TRANSPORTATION SYSTEM, CHAPTER 7730, 7731.16 – PERMITS
Road Use Permits (RUP) are required to authorize the use of existing National Forest System roads for all commercial purposes (36 CFR 261.54(c)). Permits may fulfill the requirements of an order or authorize a use that an order or regulation restricts. Permits include conditions for road use and for the protection and management of National Forests. Procedures for issuing permits are found in FS Handbook (FSH) 7709.59, section 24.

3.2.18.3 Impacts from the Proposed Action

Direct and Indirect Impacts

GE and SG (the holder(s)) have road use permits with the Paonia Ranger District of the Gunnison National Forest for the use of National Forest System Roads. The road use permits have performance bonds. The bonds guarantee GE and SG will perform their commensurate share of road maintenance.

The FS will amend GE's and SG's current road use permits to include additional routes on National Forest System Lands that need to be authorized as a result of this decision.

Impacts from the disturbance of the off lease, NFS lands, portion of pipeline associated with the Allen location are addressed in various other resource sections (e.g. vegetation, soils, wildlife, etc).

3.2.18.4 Mitigation Measures and Residual Impacts

The holder shall promptly abate as completely as possible and in compliance with all applicable laws and regulations any activity or condition arising out of or relating to use of the roads authorized by this permit that causes or threatens to cause a hazard to public health or the safety of the holder's employees or agents or harm to the environment (including areas of vegetation or timber, fish or other wildlife populations, their habitats, or any other natural resources).

The holder shall immediately notify the responsible official of all traffic accidents and any other serious accidents that occur in connection with the authorized use. The responsibility to protect the health and safety of all persons affected by use of the roads authorized by this permit is solely that of the holder. The

FS has no duty under the terms of this permit to inspect the roads authorized by this permit or authorized activities of the holder for hazardous conditions or compliance with health and safety standards.

3.2.18.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, existing authorizations in the project area would remain at existing levels, which are localized to the existing environment created by private land activities, private land mineral developments, recreational activities and maintenance of existing private and public access road infrastructure.

3.2.19 *Livestock Grazing/Rangeland Health*

3.2.19.1 Affected Environment

The primary uses within the immediate area of the proposed multi-well pad and access road are wildlife habitat and domestic livestock grazing. The access road leads to the sites have been used in the past for a sheep camp as well.

The area includes two allotments, the Henderson-west muddy cattle allotment, and the Sheep park sheep allotment. Table 3-23 below includes the current permittees on these allotments and permit information.

Table 3-23 Current Permittees

Allotment	Permittee	Livestock number, class and season	Animal Unit Months
Henderson-West Muddy	Allen Ranches c/o John Allen 299396 Highway 92 Hotchkiss, CO 81419	135 cow/calf pairs 6/16 – 10/15	714
	Bill & Gwen Carpenter P.O. Box 265 Hotchkiss, CO 81419	100 cow/calf pairs 6/16 – 10/15	529
	Wild Arrow Ranch P.O Box 265 Hotchkiss, CO 81419	75 cow/calf pairs 6/16 – 10/15	397
	Pearce Ranch LLC. c/o: Marty & Ron Pearce 11247 3850 Road Paonia, CO 81428	100 cow/calf pairs 6/16 – 10/15	529
	Dan & Jayne Sullivan 8301 Crawford Road Hotchkiss, CO 81419	283 cow/calf pairs 6/16 – 10/15	1,498
Sheep Park	Hotchkiss Ranches, Inc. P.O. Box 479 Hotchkiss, CO 81428	920 ewe/lamb 6/21 – 09/20	835

Grazing on the Henderson-west muddy allotment is authorized for cattle and sheep are authorized on the Sheep Park allotment. Grazing is based on a deferred rotational strategy that utilizes multiple grazing units that are created by using barbed-wire fences, temporary electric fences and topographic features, herding and sheep camp placement. Grazing plans are developed annually in the spring. Grazing use

varies from 3 to 36 days. This type of rotational grazing use provides rangeland vegetation the opportunity to grow before being grazed and/or re-grow after being grazed.

The project is anticipated to have the following effects on the range resources. The following analysis includes both direct and indirect effects.

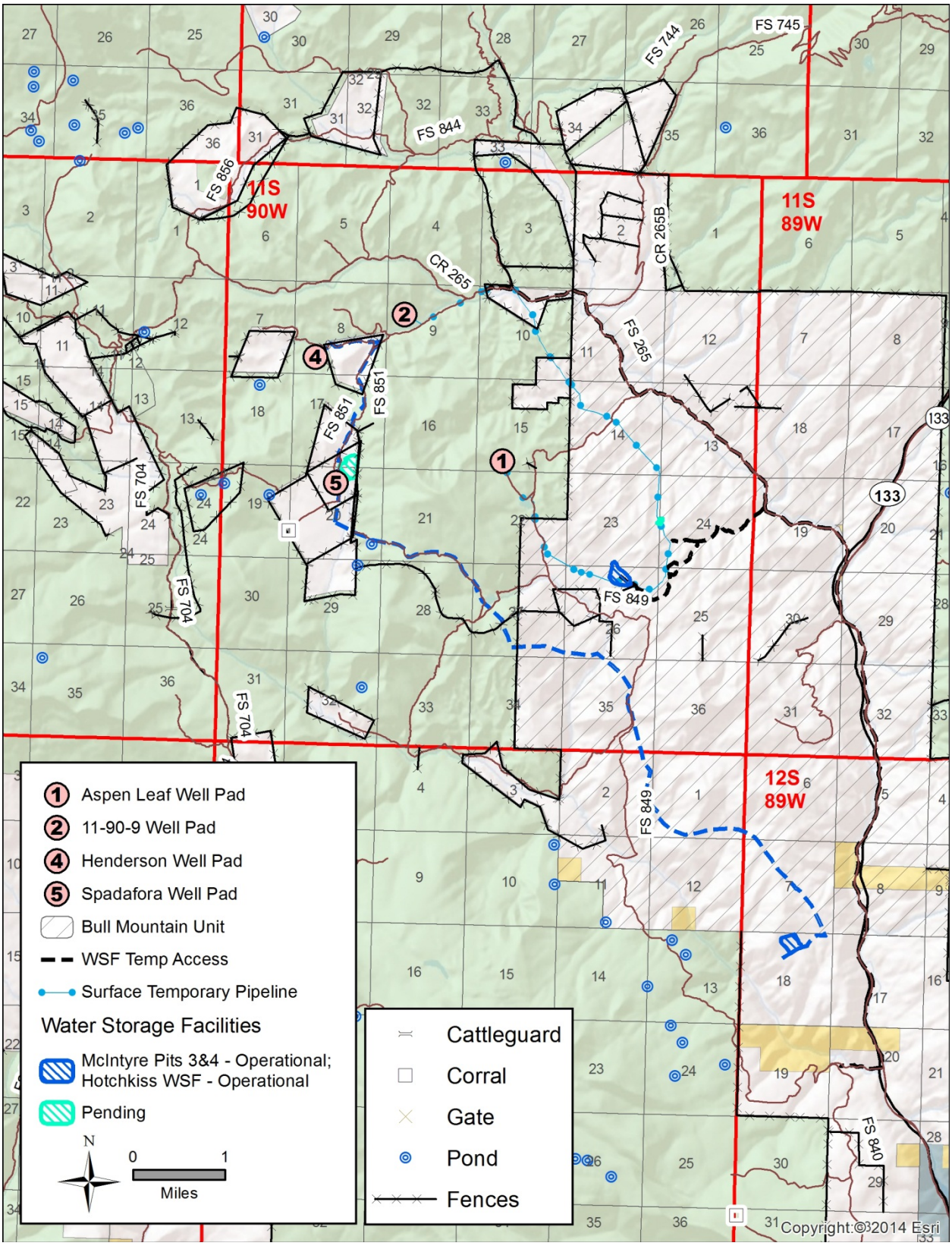


Figure 13- Range Improvements

3.2.19.2 Methodology

LMP objectives for Range Resource Management include:

- Protection of the basic soil, vegetation and water resources
- Provide for multiple uses on the land

Additional direction can be found in FSM 2200 and FSH 2209.11, 13 and 14.

Analysis in terms of forage loss is limited to all the disturbance elements of the propose action related to the 11-90-9 and Henderson location and only the pipeline related to the Allen location as grazing is not an affected resource by the elements of the Allen location which are on split estate lease COC-66716.

Direct impacts to livestock grazing/rangeland health related to the Aspen Leaf location have also previously been accounted for as it is a development which is already an element of the existing environment.

Analysis upon the Spadafora location is also limited as it is located on Fee/Fee lands and is therefore surface resource uses such as livestock grazing are subject to the will of the private landowner.

3.2.19.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Forage Loss – 11-90-9 and Henderson
The construction of access roads and drill pads will result in a long-term loss of forage. The access roads and drill pads are planned to be in place for an extended period of time. The construction of the access roads and drill pads will result in approximately 10 acres of rangeland. This is less than 1% of the total suitable range on the effected allotments. The forage produced on the 10 acres is approximately 20 AUMs. While this is not considered a significant loss in forage production, it is a loss. Combined with previous gas well drilling and associated roads it is becoming a loss that affects resource conditions on the allotment. It is especially noteworthy that much of the disturbance is occurring in the grass/forb vegetation. In the Muddy Landscape Analysis completed in 2005, there were only 4,491 acres of grass/forb vegetation in the 130,000 acres or 3.5 %. This and future development will likely continue to primarily impact the grass/forb vegetation types as these seem to occur in the drainage bottoms and lower portion of slopes.

Range Improvements
There are a number of range improvements located near the proposed pipelines, access roads and drill sites. Attached Figure 1 shows the location of improvements near the project area. These improvements are critical for managing the grazing on the affected allotments. These improvements need to be protected from disturbance during construction and operation. The access roads and drill pads should be located to avoid all stock-ponds. The buffer between the access roads, drill pads and stock-ponds may vary depending on whether they are located above, below or to adjacent to the ponds. A buffer of 100 feet is typically adequate, so long as the pipeline does not negatively affect the flow of water from any spring or seep that might be feeding the pond.

Grazing Management
The proposed project has the potential to impact grazing management. Traffic associated with drilling activities is the primary cause. We have experienced constant difficulties with gates being left open by individuals associated with coal exploration activities. When gates are left open this often results in livestock drifting into the wrong pasture or allotment. When livestock move into the wrong area this results in the loss of control of the livestock, which may result in livestock over-grazing some areas or grazing areas they are not planned to graze, resulting in unsatisfactory conditions.

Livestock Distribution
Construction and exploration activities often have negative effects on livestock. The sounds and commotion of the activities often frighten livestock within an area where they can see and/or hear the activities. This results in livestock not using an area larger than the area of actual disturbance.

3.2.19.4 Mitigation Measures and Residual Impacts

Forage Loss
The impact of this loss could be mitigated by locating as much of the roads and drill sites in oak-brush vegetation as possible. In addition, if further gas well development is planned this could begin to have a significant effect on forage production. In an effort to minimize this impact, it is recommended that gas well development be limited to as few wells as are required to access the gas resource.

Range Improvements
Any damage to any range improvements must be repaired as quickly as possible. If any additional range improvements are located during construction, these improvements should also be protected.

Stock ponds that silt-in due to new roads need to be cleaned as soon as possible. Cattleguards on the major transportation roads as well as new access roads that silt in also need to be cleaned as soon as possible.

Subsidence and the loss of spring flows and water holding capacity to ponds and spring developments are additional potential impacts to range improvements. Any damaged water developments should be replaced with a comparable functional water development.

There are several cattleguards on NFSR 265 that will be used to travel to the access roads and drill sites. These cattleguards need to be kept functional. Any damage caused to the cattleguard, the grates or the wings, need to be repaired immediately if the damage occurs during the grazing season. In addition, if traffic causes the cattleguards to silt in, the cattleguards need to be cleaned immediately.

Other Measures
After drilling is completed and the access road is gated off, the permittee should be provided access to set a sheep camp just beyond the Henderson drill pad.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.19.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

The no action alternative will continue current management activities and will not impart activities that would affect range resources.

3.2.20 *Noise*

3.2.20.1 Affected Environment

The Department of the Interior and the USDA have published surface operating standards and guidelines for oil and gas exploration and development, commonly referred to as The Gold Book (DOI and USDA 2007). This Gold Book contains noise control guidelines for well drilling and production operations. These guidelines state:

> Noise that has the potential to disturb wildlife, livestock, and private surface owners or neighbors should be controlled to reduce sound levels. Suitable mufflers should be installed on all internal combustion engines and certain compressor components. Other noise reduction techniques to consider include siting wells, production facilities, compressors, roads to take advantage of topography and distance, and constructing engineered sound barriers or sound-insulated buildings. The placement of tank batteries and other facilities offsite and the use of remote well monitoring systems can reduce vehicle traffic in the field and the associated noise.

The COGCC has established noise abatement regulations for oil and gas operations (COGCC 2009). These regulations follow Colorado Noise Statute 25-12-103, Maximum Permissible Noise Levels. The

COGCC guidelines state that the goal of the rule is to identify noise sources related to oil and gas operations that impact surrounding landowners and to implement cost-effective and technically feasible mitigation measures to bring oil and gas facilities into compliance with maximum permissible noise levels detailed in Table 3-24 below.

Table 3-24 Regulatory Limits for Noise Generated by Natural Gas Facilities

Zone Area[1,3]	7 AM to 7PM[2]	7 PM to 7AM
Residential/Agricultural/Rural	55 dBA	50 dBA
Commercial	60 dBA	55 dBA
Light Industrial	70 dBA	65 dBA
Industrial	80 dBA	75 dBA

Source: COGCC 2009, Section 802(c).

[1]-In remote areas with no nearby occupied structures, the light industrial standard may be applied.

[2]-In the hours between 7:00 a.m. and the next 7:00 p.m., the noise levels permitted below may be increased 10 dbA for a period not to exceed 15 minutes in any 1 hour period. The allowable noise level for periodic, impulsive or shrill noises is reduced by 5 dbA from the levels shown.

[3]- Sound levels shall be measured at a distance of 350 feet from the noise source. If an oil and gas well site, production facility, or gas facility is installed closer than 350 feet from an existing occupied structure, sound levels shall be measured at a point 25 feet from the structure towards the noise source.

The proposed action is within a rural agricultural area that includes a mix of farming and ranching properties, with dwellings located primarily along SH 133 and county and private roads in the area. Noise levels from human activity are mostly mechanical, consisting mainly of existing natural gas development, new exploration activities, ranching/farming activities, and travel on local roadways. Ambient levels are estimated to range from 35 to 40 dBA, increasing up to 60 dBA with traffic from local roads. The varied terrain and vegetation within the unit provide barriers and buffers for noise. Sensitive receptors in the project area include the residences, recreational users, and wildlife.

Noise from existing natural gas development within the area comes from a number of sources, including truck traffic, drilling and completion activities, and well pumps. No compressor stations are present in the project area. Table 3-25 summarizes noise levels of typical construction equipment.

Table 3-25 Noise Levels Associated with Typical Construction Equipment (dBA)

Equipment	50 feet	500 feet	1,000 feet
Tractor	80	60	54
Bulldozer	89	69	63
Motor Grader	85	65	59
Mechanic Truck	88	68	62
Backhoe	85	65	59
Crane	88	68	62
Air Compressor	82	62	56
Dump Truck	88	68	62
Average, nearest dBA	86	66	60

Source: La Plata County 2002

3.2.20.2 Methodology

Noise from the development and operation of gas wells and construction of associated infrastructure has the potential to impact sensitive land uses and users in the project area. For this analysis, potential sensitive receptor locations were identified in relationship to project well pads, pipelines, and access roads. The nature and types of noise sources associated with construction and operation and approximate noise levels by distance were then described. Actual noise levels at sensitive receptor locations depend upon the exact locations of wells and related infrastructure, the amount of development activity occurring, and the local topography.

Noise is defined as unwanted sound and can be intermittent or continuous, steady or impulsive. Human response to noise is extremely diverse and varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor.

In general, sound waves travel away from the noise source as an expanding spherical surface. The energy contained in a sound wave is spread over an increasing area as it travels away from the source. This results in a decrease in loudness at greater distances from the noise source. A doubling of distance results in an approximately 6-decibel reduction in sound pressure level for single point sources of noise and a 3-decibel reduction in sound pressure level for multiple point sources moving in a straight line such as a highway (Hedge 2011).

The decibel (dB) is the accepted unit of measurement for noise. Because human hearing is not equally sensitive to all sound frequencies, various frequency weighting schemes have been developed to approximate the way people hear sound. The A-weighted decibel scale (dBA) is normally used to approximate human hearing response to sound. Example sound noise levels are shown in Table 3-26, Common Sound Levels.

Table 3-26 Common Sound Levels

Characterization	dBA	Example Noise Condition or Event
Threshold of Pain	130	Surface detonation, 30 pounds of TNT at 1,000 feet
	125	F/A-18 aircraft takeoff with afterburner at 470 feet
Possible building damage	120	Mach 1.1 sonic boon under aircraft at 12,000 feet
	115	F/A-18 aircraft takeoff with afterburner at 1,600 feet
	110	Peak crowd noise at a professional football game in an open stadium
	105	Emergency vehicle siren at 50 feet
	100	F/A-18 aircraft departure climb-out at 2,400 feet
Extremely noisy	95	Locomotive horn at 100 feet
8-hour workplace limit	90	Heavy truck, 35 mph at 20 feet; leaf blower at 5 feet
Very noisy	85	Power lawn mower at 5 feet; city bus at 30 feet
	80	2-Axle commercial truck, 35 mph at 20 feet
Noisy	75	Street sweeper at 30 feet; Idling locomotive, 50 feet
	70	Auto, 35 mph at 20 feet; 300 feet from busy 6-lane freeway
Moderately noisy	65	Typical daytime busy downtown background conditions
	60	Typical daytime urban mixed use area conditions
	55	Typical urban residential area away from major streets
	50	Typical daytime suburban background conditions
	45	Typical rural area daytime background conditions
	40	Quiet suburban area night
Very Quiet	30	Quiet rural area, winter night, no wind
	20	Empty recording studio
Barely audible	10	Audiometric testing booth
Threshold of Hearing	0	--

Source: Baranek 1988

Noise from oil and gas development has been studied at federal, state, and local levels. Within Colorado, the COGCC conducted surveys of noise generated by various types of equipment used for drilling and production of natural gas (COGCC 2006), while La Plata County published a county impact report that included noise analysis from oil and gas operations (La Plata County 2002). Table 3-27 shows noise levels contained within those reports. The noise level reported was extrapolated to other distances; noise levels generally decrease by 6 dBA with a doubling of distance.

Table 3-27 Average Noise Levels Produced During Construction and Operations

Activity	Duration of Noise	Noise Level at 50 Feet (dBA)	Noise Level at 500 Feet (dBA)	Noise Level at 1,000 Feet (dBA)	Noise Level at 2,500 Feet (dBA)
Well Pad, Access Road, Pipeline Construction Equipment[1]	Short-term, daytime	86	66	60	52
Well Drilling[1]	Short-term, 24 hours/day	86	66	60	52
Three-Axle On-Road Vehicle, 35 mph[1]	Short-term, daytime	88	68	62	54
Two-Axle On-Road Vehicle, 35mph[1]	Short-term, daytime	72	52	46	28
Well Pump Units (Electric)[2]	Long-term, 24 hours/day	47	27	21	13
Well Pump Units (Gas)[1]	Long-term, 24 hours/day	67	47	41	33

Source: [1]La Plata County 2002, [2]COGCC 2006

3.2.20.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Actual noise levels at a given location depend upon the topography of the area, atmospheric conditions (e.g., temperature, wind speed and direction, and humidity), vegetative conditions (which can absorb sound), and the presence of structures between a noise source and a noise receptor.

The magnitude of the effect would depend upon the distance between the receptor and the noise source, the duration and frequency of the noise, and the time at which the noise occurred (noise is viewed as more disruptive when it occurs at night). In addition, individuals react differently to changes in ambient noise levels and to various types of sound; therefore, the perceived level of impact may vary by receptor. Noise levels that meet maximum permissible noise levels may still be perceived as a noise impact for some sensitive receptors.

Short-Term

Construction would produce short-term, localized, and intermittent increases in ambient noise levels, while operations may produce long-term increases in ambient noise levels over the life of the project. Well pad construction, road construction/reconstruction and pipeline construction, final reclamation would likely occur just one time per project location for the life of the project.

Construction activities of the proposed action include four well pads, 3 miles of access road construction/re-construction and 2.1 miles of pipeline construction likely occurring during daytime working hours. These activities would require the use of earth-moving equipment (e.g., bulldozers, graders, and backhoes), heavy trucks (e.g., dump trucks and water trucks), generators, and air compressors at the construction site. In addition, heavy truck traffic and personal vehicle traffic would increase along area roadways to bring personnel and supplies to the staging and construction site locations. Noise from these activities would be short term and intermittent. For access roads and pipelines, the construction equipment would not remain in one location for a long period of time given the linear nature of this type of development.

Activities such as well drilling/completions would occur at each project location on a well-by-well basis over the course of 25 wells within the proposed five year timeframe. Well drilling is estimated to take an average of 23 days for coalbed methane wells (1 ea) and 50 days for horizontal shale wells (24 ea). Completions are estimated to take an additional 14 days for a coalbed methane well (1 ea) and 36 days for horizontal shale wells (24 ea). Well drilling and completion would also be a short-term source of noise but would occur 24 hours per day, 7 days per week for an average of 86 days per horizontal shale natural gas well (24 ea) and 37 days for a coalbed methane well 1 ea). The primary noise sources associated

with drilling include large diesel engines that power the rotary rig and pumps and the large diesel-driven air compressors. In addition, heavy truck traffic and personal vehicle traffic would increase along area roadways to bring personnel and supplies to the well site.

Allen Location
Noise from the construction of the Allen well pad, drilling and completing up to 5 natural gas wells, pipeline construction and long-term operations occurs on a mix of split-estate and NFS lands. There are no sensitive receptors within 2500 feet of the well location and the nearest point where public may venture near the location is approximately 700 feet away however, there is no public access into the property.

11-90-9 Location
Noise from the construction of the 11-90-9 well pad, drilling and completing up to 5 natural gas wells, new road construction, pipeline construction and long-term operations would occur on NFS lands from construction activities and from operational activities. There are no sensitive receptors within 2500 feet of the well location however, the location could be accessed by foot from a public road within 1000 feet of the well pad.

Aspen Leaf Location
Noise from the drilling and completing of up to 7 natural gas wells and long-term operations would occur on NFS lands. There are no sensitive receptors within 2500 feet of the well location. The location can be accessed by foot if entering across NFS lands however, the nearest public access road is 1.5 miles away.

Henderson Location
Noise from the construction of the Henderson well pad, drilling and completing of up to 4 natural gas wells, new road construction, partial pipeline construction and long-term operations would occur on NFS lands. A portion of pipeline construction and road reconstruction will also occur on FEE/FEE lands. There is a sensitive receptor (a seasonal private residence) within 1700 feet of the proposed location however, the nearest public access point is nearly one mile away.

Spadafora Location
Noise from the construction of the Spadafora well pad, drilling and completing of up to four natural gas wells, new road construction, pipeline construction and long-term operations would occur on FEE/FEE lands. There are two sensitive receptors (seasonal private residences) 1,300 and 2,000 feet of the project location, respectively. The nearest point of public access is over 1.5 miles from the proposed well pad and it is located entirely on private surface.

Access Roads
There are several hundred noise receptors (private residences) within 2500 of the access roads used to get to the project area within the cumulative effects assessment area (Paonia to McClure Pass on SH 133, CR 264 to NFSR 265, NFSR 851, NFSR 841, NFSR 704 and NFSR 704.4A). The greatest density of noise receptors (85%) is located within 2500 feet of SH133 near the communities of Paonia and Somerset, Colorado. The distribution of the remaining 15% of noise receptors along SH133 north of Paonia reservoir and the remaining project area roads are located between 50 feet and 1000 feet of the roadways becoming more dispersed the further away the project area gets from SH133.

The proposed action estimates that these roads would be utilized over the 5-year period for construction and operations related traffic. These residences would experience intermittent and short-term noise level increases from road improvement as well as noise level increases from construction-related traffic. Construction traffic would generally not occur during nighttime hours and would not affect the nighttime ambient noise levels. However, construction would have the potential to affect recreational users of the areas because related noise could affect game movements within the project area, if occurring during established Colorado big game hunting season timeframes, hunters could also be impacted.

Long-Term
Long-term operation-related activities at each of the five locations would occur throughout the life of each project location. The primary sources of noise during operation include natural gas or electric well pumps at each well, natural gas-fired internal combustion engines to power the compressors at the well site, and intermittent traffic related to operations, interim reclamation and maintenance. Road maintenance would

occur intermittently to replace surface materials and apply dust abatement. Most oil and gas related traffic would be limited to only the minimum workforce necessary to maintain and produce the wells for the remainder of their productive capabilities and periodic workovers may be needed to correct problems with producing wells.

3.2.20.4 Mitigation Measures and Residual Impacts

This analysis assumes that measures for noise abatement would be applied to meet DOI and USDA Gold Book guidelines (DOI and USDA 2007) and COGCC maximum permissible noise levels.

Under the proposed action, well pad construction, access road construction/reconstruction, pipeline construction and well drilling/completion are estimated to be within the maximum permissible noise levels allowed under COGCC rules for gas facility installation.

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.20.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the no action alternative, noise levels in the project area would remain at existing levels which are localized to the existing environment created by private land activities, private land mineral developments, recreational activities and maintenance of existing private and public access road infrastructure.

3.2.21 *Recreation*

3.2.21.1 Affected Environment

Access to the project area is via SH 133 (paved), CR265 (gravel), and NFSR 265, 704, 844, 849, and 851 (all gravel). These roads provides access to hiking, mountain biking, dispersed camping, recreational on-road and off-road travel, cross-country skiing, snowshoeing, snowmobiling and the primary use, hunting. This area experiences a moderate level of recreational use during the summer, fall and winter seasons including access to popular camping, on-road and off-highway vehicle travel, snowmobiling and hunting. Use is busier on weekends and holidays compared with weekdays.

The project area coincides with CPW's Game Management Unit (GMU) 521. Mule deer, elk, pronghorn, moose, black bear and mountain lion are big game species hunted within GMU 521, although no habitats used by moose and/or pronghorn are present in the project area. GMU 521 is within:

1. Deer Data Analysis Unit (DAU) D-51
2. Elk DAU E-14
3. Pronghorn DAU A-99
4. Moose DAU M- 5
5. Bear DAU B-17
6. Mountain lion DAU L-9

One FS permitted outfitter/guide operates in the project area and his operations are mainly during the fall hunting season.

National Forest System Trail 802, the Terror Trail, is located off NFSR 704, and provides recreationalists with opportunities to explore the Electric Mountain area.

Currently there are no developed recreation facilities, such as campgrounds or other developed recreation facilities in the project area. Several miles southeast of the project area is Paonia State Park, which provides fishing, boating, and camping and there is a NFS managed campground at the top of McClure pass adjacent to SH133.

Relocation of a winter trailhead at the intersection of NFSR849 and NFRSR265 to an area near the Muddy Guard Station will be a result of the new portion of NFSR 265 that will require snowplowing.

3.2.21.2 Methodology

Analysis took into account known recreation sites, recreational activities in the project area and authorized recreational trails.

3.2.21.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Noise related to construction could affect game movements within the area and hunters could be impacted during construction and operations.

Construction traffic, drilling and gas well operations would have the potential to affect recreational users of the area. Noise related to construction could affect game movements within the area and hunters could be impacted during construction and during operations.

The one permitted outfitter/guide that operates in the area during fall hunting has clients that could be affected during construction and during operations.

Some trail users of NFS Trail 803 could experience increased vehicle traffic during drilling and operations on the road to the trailhead. Noise from pad construction, drilling and operations could affect their solitude.

The relocation of the winter trailhead to an area near the Muddy Guard Station will have an effect on winter recreation causing trucks with snowmobile trailers to travel farther on the plowed portion of NFSR 265.

Temporary road and trail closures could be implemented to keep recreation users out of the immediate construction area. Implementing these specific measures will improve safety for all users in this area.

3.2.21.4 Mitigation Measures and Residual Impacts

Implementation of design features and applicable BMPs would minimize the effects to recreation resources.

3.2.21.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

In the absence of activities related to the proposed action, the area would continue to experience a moderate level of recreational use during the summer, fall and winter seasons including access to popular camping, on-road and off-highway vehicle travel, snowmobiling and hunting. Use is busier on weekends and holidays compared with weekdays.

A certain level of increase in activity can be expected by the reasonably foreseeable oil and gas development proposed on FEE/FEE lands in the project area.

3.2.22 *Visual Resources Management*

3.2.22.1 Affected Environment

The primary sensitive viewing area in the vicinity is SH 133. The viewshed is comprised of the rolling foothills and valleys below and to the west of the Ragged Mountain Range and southwest of McClure Pass. The view is most open and exposed at McClure Pass then begins to narrow and is limited by the valley walls of Muddy Creek and the North Fork of the Gunnison River. CR 265, has less traffic, and is primarily used for local use, with some regional access. This road follows a drainage, which limits its viewshed expanse to the immediate foreground due to the topography.

The project area is located in subsection M331 Hm, Grand Mesa Breaks. The characteristics of this area, locally called the Muddy Basin, are described as having gently rolling, hummocky hills and mesas covered in a mosaic of aspens, Gambel oak and open grassland parks. There are a few substantial expanses of aspen where fall displays are especially attractive.

The culture of this area can be described as agriculturally based to the west and closer to Paonia and transitions into more wild land settings as one travels further east and up in elevation. In most cases within forest “in holdings” (i.e. parcels of private land within the boundaries of the national forest), human presence is evident in a pastoral setting with ranching operations, wood fences, ranch homes, cabins and pastures. On forest lands, livestock grazing and dispersed recreation is noticeable but does not dominate the landscape.

The project area falls within the designated visual quality objective (VQO) of “Modification”. The VQO of Modification refers to landscapes where the valued landscape character “appears moderately altered.” Deviations begin to dominate the valued landscape character being viewed.

The Desired Landscape Character of this area is to maintain as high as possible Partial Retention but allow for Modification to occur. This means that activities, disturbances and constructed features meet the objective for this area but they mostly remain visually subordinate to the natural surroundings with a few deviations present.

Currently the existing visual quality in the proposed project area has already been somewhat modified and so is designated as “Modification”. There are several parcels of land that are privately owned. These ranchlands sustain cattle with cultivated pasture lands. There is also the presence of existing gas pipelines, the Bull Mountain and Ragged Mountain transmission pipelines, the Sheep gas gathering line, the Hotchkiss pipeline that crosses the Narrows southeast of Ault reservoir, the Henderson Lateral which follows NFSRs 265 and 851, the Bull Mountain field gathering line and the Ragged Mountain field pipeline. The presence of these underground lines is perceived by the swath of disturbed vegetation along the pipeline ROWs, although most of the Henderson Lateral was placed within the road prism.

Scenic attractiveness in this area is mostly B, Common Typical with small areas of C, indistinctive. The West Muddy Creek and the riparian zones along the waterway provide some variety within the landscape. Colors within this character create soft neutral tones. Use in this area is primarily moderate and dispersed in the summer with a short spike in visitation during the hunting season. The means of accessing this area include NFSR 265, 849, 851 and 704. All forest roads are assigned concern levels, which are the measure of the degree of public importance. Concern levels range between 1-3 with level one having the highest concern. NFSR 704 is a gravel road which accesses private land and has a concern level of 3. NFSR 265 has more dispersed recreational use and has a concern level of 2. NFSRs 849 and 851 provide access to private lands but access is blocked off to the public.

The proposed route to the Henderson and Spadafora locations enters private land with consent of the owners. The majority of views affected would include the private land owner’s homes and out buildings and the proposed well pads.

3.2.22.2 Methodology

The FS Scenery Management System provides a framework for the orderly inventory, analysis, and management of scenic resources. It presents a vocabulary for managing scenery and a systematic approach for determining the relative value and importance of scenic resources on national forests. Key elements of the system include Landscape Character, Scenic Attractiveness classification, Scenic Integrity, Constituent Concern Levels, and Distance Zones. Visual impacts are analyzed based on whether a visual impact is able to be detected from the travel-ways and whether or not the viewshed meets the area's scenic integrity objectives.

Visual objectives may also be addressed on split estate however, objectives do not apply on FEE/FEE.

3.2.22.3 Impacts from the Proposed Action

Direct and Indirect Impacts

The existing landscape will be changed by the introduction of new elements of form, line, color, and texture. Visual resources in the area would be adversely affected during construction, while using drill rigs and associated equipment, and increased construction traffic. Short-term visual impacts from construction, drilling, and completion will occur at or near the proposed well pad sites, access roads, and

gathering lines. No power lines will be constructed. Long-term impacts will likely occur from removal of vegetation until opportunities for successful reestablishment of the vegetation have occurred.

The Landscape Character of the area surrounding proposed action will diminish in scenic value because disturbance of the natural resources, constructed features, and human presence within the visible landscape will increase, particularly in the short term during construction. Private adjacent land uses also affect the overall character of the landscape. Over time, much of the natural disturbance will blend back to a naturalized state but the constructed features associated with the project facilities that remain, will still be seen.

The constructed features (i.e. well pads, and production facilities) of the proposed action are placed on a mix of private property and NFS lands and possibly be visible from roads on NFS lands. The proposed area has the ability to absorb the proposed disturbance due to its vegetation type and its multiple low foothills without too much loss to the landscape character or its scenic integrity. Views into the private lands from roads 704 and 851 could create an overall negative effect. Users will not be able to distinguish where boundary lines start and end. They view the landscape as a whole ecosystem, not parcels of land. In light of the view-shed context that users will be seeing the scenery and hearing the natural landscape, the VQOs will still be met, but the Landscape Character will be diminished.

3.2.22.4 Mitigation Measures and Residual Impacts

Adherence to applicable design features related to project lighting, painting all long term facilities on location with an environmental color that reduces the potential for equipment and facilities to stand out on the landscape, would be adhered to, so impacts from the proposed action to visual resources would be minimized. Additionally, through the commitment of each operator to employ the multitude of other resource related design features in Appendix B and adherence to applicable lease stipulations in Appendix A, impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

Allen, 11-90-9, Aspen Leaf and Henderson Locations
Due to the design features of the proposed action, the use of BMPs, and maximizing the amount of interim reclamation, the gas facilities will conform to the "moderate" scenic integrity objective for the lands associated with the development. These well pads will be placed within the landscape using the natural lines of topography and vegetation to screen visible impacts.

Spadafora Location
This location is situated entirely on private surface and private mineral estate where visual impacts can occur however, mitigation by Federal oversight cannot be applied. The design features being implemented on the other project locations are accepted as BMPs which the operator recommends to employ at the Spadafora location to minimize the visual resource conflicts which may occur as a result of the development.

3.2.22.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

Development related to the Allen, 11-90-9, Aspen Leaf, and Henderson locations would not cause any impact to visual resources as these portions of the proposed action would not be created, and therefore maintain both the scenery and the VQO at current levels. However there would still be the impact to visual resources from the developments intended to occur on FEE/FEE lands of the project area.

3.2.23 *Geology and Mineral Resources*

3.2.23.1 Affected Environment

The Wasatch Formation is the prevalent geologic unit at the surface where activities related to the proposed action are likely to occur. The exposed bedrock geology in the project area is within the Tertiary Wasatch Formation. The Wasatch is an interbedded and lenticular, tan, yellowish to reddish brown, and reddish purple clay stone, siltstone, sandstone and conglomerate. The Wasatch Formation unconformably overlies the Upper Cretaceous Mesaverde Group. The Mesaverde group is about 6,000

feet (maximum) thick and was deposited as a non-marine sediment in lacustrine, flood-plain and high energy fluvial environments similar to the Wasatch Formation's depositional environment. The Wasatch Formation is highly susceptible to landslides. Quaternary age surficial deposits consist of deeply weathered soils and various alluvial and colluvial deposits. There are also numerous clusters of basalt boulders possibly representing erosional lag deposits. For geologic reference, Figure 14 identifies the Wasatch Formation – Two; areas of Basalt flows – Tbbl; and the various types of Quaternary deposits in the project area, ancient alluvium - Qta, alluvium, Qa, glacial drift - Qd, and landslide deposits – Ql.

Geologic Hazards

Geologic hazards are present in the project area in the form of current and historic unstable slopes, landslides and debris flows. Areas of instability are typically associated with steep slopes, saturated soil conditions, and slope aspects on the down-dip side of the outcropping geologic strata where dipping structures daylight on exposed slopes.

The activity of geologic hazards in this region is most often determined by water content of the soil. Water in the pore space of a soil acts as a lubricating agent, making it much easier for grains to slide past one another. In general, soil movement is more likely to occur on east and north facing slopes due to the regional bedrock dip to the northeast and the prevailing direction of ground water movement.

Hydrocarbon Source Rocks

The proposed action includes the drilling of up to 25 natural gas wells targeting sub-surface fluid mineral bearing zones such as the Corcoran and Cozzette Members of the Mesaverde Group as well as the Mancos Shale interval between the Dakota Sandstone Formation and Mesaverde Group.

The project area is at the southeastern margin of the Piceance Basin, a large structural basin covering approximately 1,000 square miles, which extends northwest to the area near Rangely, Colorado. It is bounded by the Uinta uplift to the north, the White River uplift and the Grand Hogback on the northeast, and the Uncompahgre uplift on the southwest. To the southeast, it butts up against Chair Mountain and the Raggeds. It is separated from the Uinta Basin, which extends westward into Utah, by the Douglas Creek Arch, a topographic rise that roughly parallels the western border of Colorado. The Piceance Basin is cut approximately in half by the Colorado River, which enters the Piceance Basin near Rifle Creek at the south end of the White River uplift, and exits the Piceance Basin at Grand Junction. Water drains from the each end of the Basin toward the Colorado River. The Piceance Basin lies almost entirely within the Colorado Plateau physiographic province. According to the RFD prepared in support of the ongoing UFO RMP revision, the proposed action is located in an area identified as having High occurrence potential (BLM 2012) for development of both Coalbed Methane and Conventional fluid mineral development.

The primary gas source rocks in the southern Piceance Basin are the Mancos Shale and certain members of the Mesaverde Group. The Mesaverde Group is also considered to be a gas reservoir, largely because of its low permeability. The stratigraphic and structural context of these formations is discussed below.

The Mancos Shale, in addition to carbonaceous strata in the overlying Mesaverde Group, is considered a likely source of some of the methane gas now present in the Mesaverde Group (Johnson 1988). Methane is generated when oil or coal is sufficiently heated, and in some areas the Mancos Shale is known to contain up to 4 percent organic carbon, and it may have been a significant source of gas due to its great thickness. The top of the Mancos Shale is reported to be about 4,500 feet below the surface at the southern end of the nearby Bull Mountain Unit, and may be several thousand feet thick (Hettinger and Kirshbaum 2002). The Mancos Shale rests on the Cretaceous Dakota Sandstone. Below these are additional Mesozoic and Paleozoic formations thatlie unconformably on Precambrian crystalline basement rock.

The relatively steady conditions that accompanied the deposition of the Mancos Shale were gradually superseded about 65 to 70 million years ago by a period of more rapid deposition and regional uplift. Sediments eroded from the Sevier Thrust Belt to the west were deposited during a period of changing sea depths, so that shale deposits (away from the shore) alternated with sandstones (near the shore). The Upper Cretaceous Mesaverde Group, which is exposed on nearly all of the margins of the Piceance Basin, including along the eastern side of the nearby Bull Mountain Unit, is important as both a source

and a reservoir for natural gas throughout the region (Tweto 1979). The Mesaverde Group (labeled Kmv on Figure 14, Geology) includes several formations or members, among which are two highly carbonaceous sequences: the Corcoran and Cozzette Members. These are the deepest significant coal-bearing strata in the basin. Towards the end of the Cretaceous, uplift and shallowing of the depositional environment caused by an eastward migrating shoreline resulted in deposition of coarser sediments. Although the sediments of the Mesaverde Formation are generally coarser, the pores between the grains have been filled with various precipitated minerals, including clay minerals that tend to swell when moisture is present, and these fillings reduce the porosity and permeability of the formation. Most of the natural porosity in the gas-bearing formations results from subsequent dissolution of the precipitated material filling the pores, though most of the pores are not well connected to each other (Pitman et al 1988). Hence, although gas is stored within the porosity of the rock formation, it is difficult to recover it. Throughout the basin, gas production has had to be enhanced by hydraulic fracturing (Johnson 1988).

Well Stimulation (Hydraulic Fracturing)
All of the 25 proposed wells will likely include some form of hydraulic fracturing. The purpose of hydraulic fracturing is to overcome the strength of the rock and to open fractures by increasing the pore pressure in the rock. During well stimulation activities associated with some or all well completions, fluids would be injected at high pressure into the targeted geologic formations. Hydraulic fracturing normally produces many micro-earthquakes, but it is unlikely to trigger earthquakes that can be felt at the surface.

Hydraulic fracturing differs from waste injection because injected fluids are removed after hydraulic fracturing, so that the pore pressure increase from hydraulic fracturing is temporary and the affected zone is relatively localized around the well. According to Ellsworth (2013) more than 100,000 wells have been hydraulically fractured in recent years, and no earthquakes larger than M3.6 have been attributed to hydraulic fracturing.

Inducing Earthquakes by Well Stimulation (Hydraulic Fracturing).
Extensive data collected from hydraulic fracturing events in shale formations suggest that the magnitudes of the micro-earthquakes associated with hydraulic fracturing are mainly in the range of M4 to M1, which cannot be felt (Warpinski 2013). The possibility exists that fractures created by hydraulic fracturing might intercept an existing active fault and trigger it to move, but the probability is low.

Breaching Geologic Confining Formations during Hydraulic Fracturing.
Warpinski (2013) compiled data from hydraulic fracturing projects throughout the US, supporting the limited vertical extent of fractures above and below the point of injection. Monitoring of the micro-earthquakes that occur during hydraulic fracturing provides a way of assessing the effectiveness of hydraulic fracturing and determining the length of the fractures. Fractures propagated from hydraulic fracturing tend to be longer in the horizontal direction than the vertical, because of bedding orientation. According to Warpinski, most fractures propagated by hydraulic fracturing of shale are limited to a zone about 1,000 feet above and below the injection point, with almost no fractures extending more than 2,000 feet.

Gas-containing formations targeted for multi-stage hydraulic fracturing (Mancos Shale) are usually much too deep below the depths of freshwater to be intercepted by fractures generated during hydraulic fracturing.

Further explanation of this type of impact when fracturing Coalbed Methane bearing zones is discussed in section 3.2.14 Hydrology (Ground Water Resources).

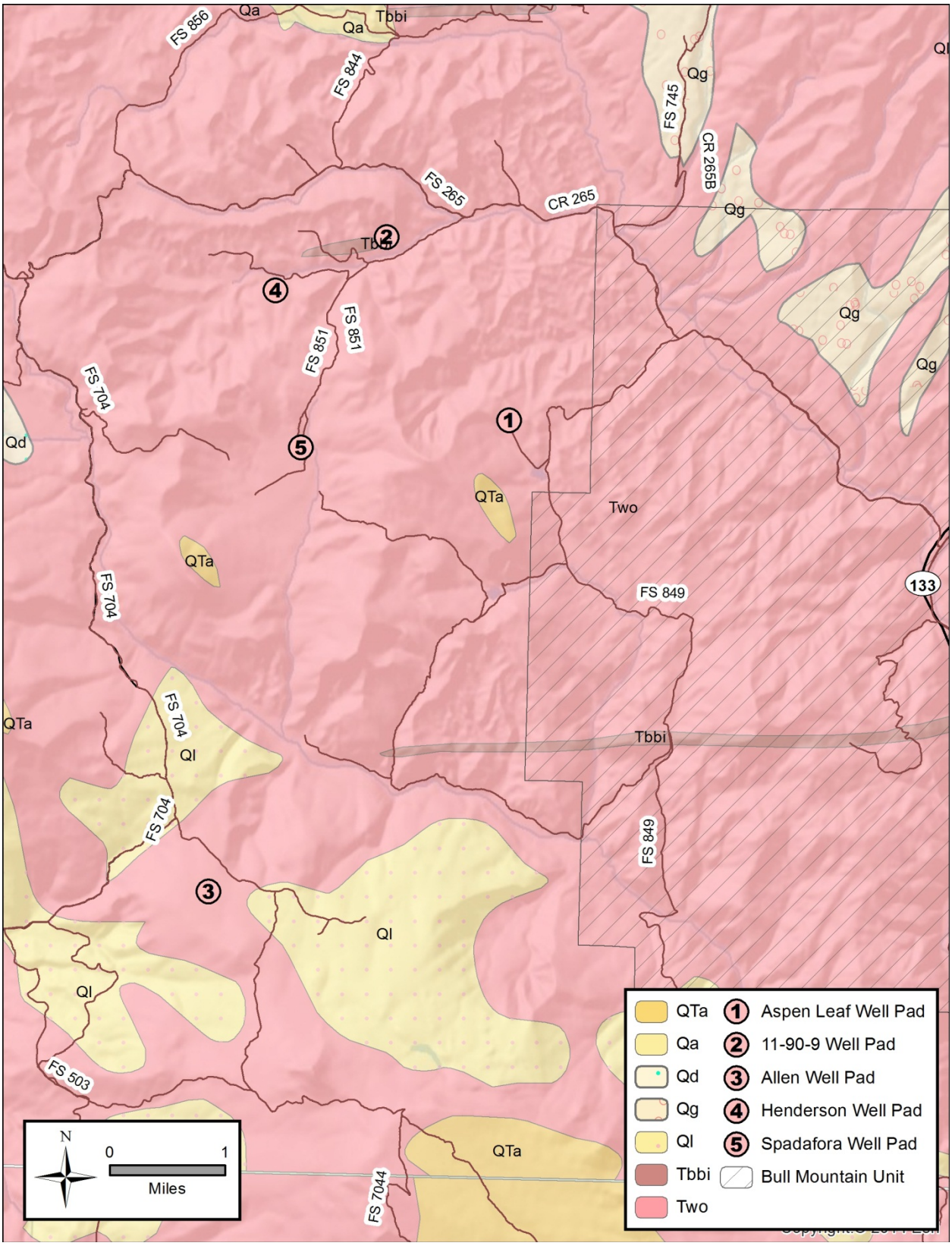


Figure 14 - Geology

3.2.23.2 Methodology

The GMUG LMP defines high geologic hazard areas to be active mudflows, earthflows, landslide, and avalanche areas. The GMUG Oil and Gas Leasing EIS and Record of Decision identifies that areas of high geologic hazards are stipulated as No Surface Occupancy for drilling and other operations to remove risk for accelerated slope movement and related resource damage. The best mitigation in these areas is avoidance (paraphrased).

- FSM 2883 - Identify existing and potential geologic hazards, land base limitations, and affected management activities in all land management plans.
- FSM 2884 - Assess the risk of loss of life and property resulting from geologic hazards with proposed projects and resource development.

Areas of proposed activities, such as construction of well pads, roads, and pipelines, were identified on maps and compared with areas with potential geologic hazards, such as steep slopes, landslides, or active (Quaternary) faults. Engineering judgment was used to identify the types of effects and general magnitude of the effects that could occur.

3.2.23.3 Impacts from the Proposed Action

Direct and Indirect Impacts

Geologic Hazards
The potential effects to geologic resources and geologic hazards include changes to the local topography resulting from surface disturbance, increased slope instability, mass movement in areas of geologic instability, and increased sedimentation due to soil movement into adjacent drainages.

Avalanches, Unstable Slopes, Landslides and Debris Flows:
None of the proposed project disturbance features are placed upon or directly adjacent to unstable slopes, landslides and debris flows.

Steep Slopes
Some of the project activities are proximal to these geologic hazards, but none of the project features directly traverse known geologic hazards.

For the most part, all of the elements of the proposed action avoid steep slopes as four of the five well pads are located on areas of 0-10% slopes. The 11-90-9 location is situated most closely to slopes between 11-25%, however it is engineered in the best location possible to limit excessive cut/fill slopes resulting from construction of the well pad itself. All new access roads are located upon slopes of 10% or less however pipelines going across country such as the Allen buried natural gas line and the two SG temporary poly pipelines may encounter slopes between 0-30%.

Seismic Activity
Landslides can be triggered by earthquakes under some circumstances. The proposed action is in an area that has very low seismic activity, where only very low magnitude earthquakes are likely (USGS 2008). There are no significant active faults in the region of the site (Morgan 2008).

Inducing Earthquakes by Well Stimulation (Hydraulic Fracturing)
Rutqvist et al (2013) performed modeling studies to evaluate the effects of hydraulic fracturing and concluded that “the possibility of hydraulically induced fractures at great depth (thousands of meters) causing activation of faults and creation of a new flow path that can reach shallow groundwater resources (or even the surface) is remote.” Based on these observations, the direct effects of hydraulic fracturing as a trigger for damaging earthquakes are expected to be less than significant for any of the 25 wells of the proposed action.

Breaching Geologic Confining Formations during Hydraulic Fracturing
The Mancos Shale Formation targeted for hydraulic fracturing by 24 of the 25 proposed natural gas wells are usually much too deep below the depths of freshwater to be intercepted by fractures generated during hydraulic fracturing. However, further explanation of this type of impact when fracturing Coalbed Methane bearing zones is analyzed in section 3.2.14 Hydrology (Ground Water Resources).

3.2.23.4 Mitigation Measures and Residual Impacts

The surface disturbance elements of the proposed action do not traverse any significant geologic hazards. It also avoids, to the extent possible, affecting steeps slopes. The overall risk for causing accelerated slope movements is low and numerous design features are included in the proposed action by the operators which would be implemented to minimize potential to affect geologic instabilities (Appendix B).

To insure the stability of facilities required (roads, pipelines, drill pads, etc.) during the oil and gas operations and to insure the stability of lands adjacent to these facilities, the 11-90-9, Aspen Leaf and Henderson are subject to Controlled Surface Use Stipulation: “Moderate Geologic Hazard”. Any areas within the leasehold identified as having moderate geologic hazard falls under jurisdiction of this stipulation Surface occupancy or use is subject to the following special operating constraints. Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e. subsidence, acid drainage).

All proposed Federal natural gas wells related to this proposed action are subject to the Federal Hydraulic Fracturing rule on Federal and Indian Lands 43 CFR 3162.3-3 Subsequent well operations; Hydraulic fracturing. With this rule, the BLM establishes new requirements to ensure wellbore integrity, protect water quality, and enhance public disclosure of chemicals and other details of hydraulic fracturing operations. Specifically, this final rule will add to existing requirements by providing information to BLM and the public on the location, geology, water resources, location of other wells or fracture zones in the area and fracturing plans for the operation before the well is permitted. To ensure well integrity, the final rule requires specific best practice performance standards for all wells, including cement return and pressure testing for surface casing, cement evaluation logs for intermediate and production casing, and remediation plans and cement evaluation logs for any surface casing that does not meet performance standards. The final rule requires interim storage of all produced water in rigid enclosed, covered, or netted and screened above-ground tanks, subject to very limited exceptions in which lined pits could be used. Public disclosure of all chemicals, subject to limited exceptions for trade secret material, is required after fracturing operations are complete. The existing database FracFocus (http://fracfocus.org) can be used for this disclosure.

A mitigation measure regarding well stimulation during completion of a CBM well is identified in section 3.2.14.4 Hydrology (Ground Water Resources).

Additionally, through the commitment of each operator to employ the resource related design features in Appendix B impacts to environmental resources would be minimized or eliminated therefore eliminating the need to apply additional mitigation measures beyond those recommended above.

3.2.23.5 Impacts from the No Action Alternative

Direct and Indirect Impacts

The no action alternative results in no construction activities and no subsurface mineral extraction via drilling and completing of natural gas wells related to the Federal portions of the proposed action. However, the disturbance, placement of project components, drilling and completing of natural gas wells related to development of the Spadafora would still occur as it is located on Fee/Fee. All forces currently acting on geologic resources and geologic hazards in the project area would otherwise remain the same.

3.3 Cumulative Impacts by Resource

See **Table 2-2 Targeted Fluid Mineral Bearing Zones**, **Table 2-4 Total Surface Disturbance Summary**, **Table 3-2 Cumulative Impacts Analysis Areas by Resource**, **Table 3-3 Past, Present, and Reasonably Foreseeable Project, Plans, or Actions that Comprise the Cumulative Impact Scenario** and

Table 3-4 Past, Present, and Reasonably Foreseeable Disturbance Impacts in the Watershed CIAA as a starting point for cumulative effects analysis.

3.3.1.1 Air Quality and Climate Change

As part of the BLM's adaptive management strategy for protecting air resources, the BLM conducted a regional air modeling study to evaluate potential impacts on air quality from future mineral development in Colorado. The Colorado Air Resources Management Modeling Study (CARMMS) (BLM 2014) assesses predicted impacts on air quality and air quality related values (AQRVs) from projected increases in oil and gas development. The CARMMS includes potential impacts using projections of oil and gas development up to a maximum of 10 years in the future to reflect realistic estimations of development projections and technology improvements.

The CARMMS includes cumulative air quality and AQRV impact assessments from future year (year 2021) oil and gas development on federal and non-federal lands within 13 separate Colorado BLM planning areas as well as mining within the 13 Colorado BLM planning areas (BLM 2014). CARMMS also includes emissions from other regional sources including oil and gas emissions throughout the modeling domain which encompasses all of Colorado, western Arizona, western Utah and north-central New Mexico and extends into southern Wyoming, western Nebraska, western Kansas and northwest Texas.

The CARMMS includes use of the Comprehensive Air-quality Model with extensions (CAMx) photochemical grid model (PGM) model to estimate air quality and AQRV impacts for both a base case year (2008) and future year 2021. Emissions from all sources types (anthropogenic and natural) are included in the CAMx modeling. As part of CARMMS future year 2021 emissions estimates were developed for 3 development scenarios for the 13 Colorado planning areas. These include year 2021 high, medium and low oil and gas development scenarios. Modeling results for the CARMMS 2021 (UFO Source Apportionment area, i.e. the planning area) high oil and gas development scenario are applicable for use in estimating potential cumulative ozone and AQRV analyses for existing and potential projected field office sources.

Table 3-28 below presents the current state of the reasonably foreseeable cumulative analysis emissions for the UFO planning area, and the CARMMS 2021 high oil and gas development scenario emissions.

Table 3-28 Foreseeable Cumulative Emissions / CARMMS 2021 Applicability (tpy)

Project	PM_{10}	$PM_{2.5}$	VOC	NO_X	CO	SO_X	CO_2	CH_4	N_2O	HAPs
25 Wells[1]	10	11	60	155	104	5	24,706	742	132	5
Bull Mtn.[2]	66	46	125	413	206	0.8	43,750	ND	ND	14.84
CARMMS Federal	144	37	620	612	788	1	185,482	6,666	3	49
CARMMS Non-Federal	252	62	1,082	1,067	1,352	2	326,891	12,323	5	86

[1] Total production emissions from both operators and the maximum annual construction emissions.
[2] From Bull Mountain EIS (includes both federal and non-federal emissions, proposed action only)

As shown above the CARMMS high development scenario projections can accommodate the emissions from the current reasonably foreseeable projects, and based on the projected levels of emissions it would be reasonable to assume the CARMMS analysis values/result would be conservative.

Regional Ozone Impacts

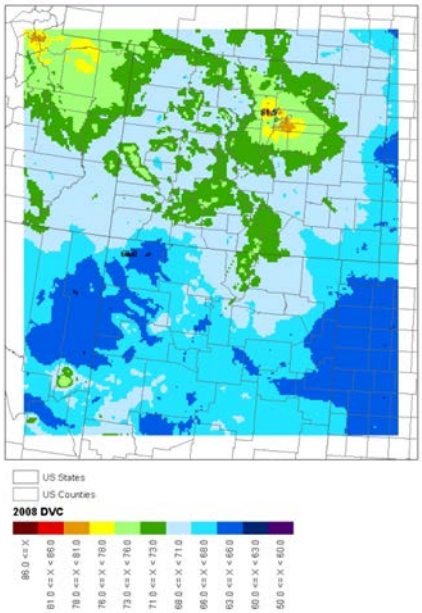
The CARMMS included estimates of future year regional ozone impacts using two analysis methods. One method uses the change in the PGM modeled concentrations between base case or current year (DVC) (year 2008) and future year (DVF) (year 2021) simulations to scale observed ozone concentrations from

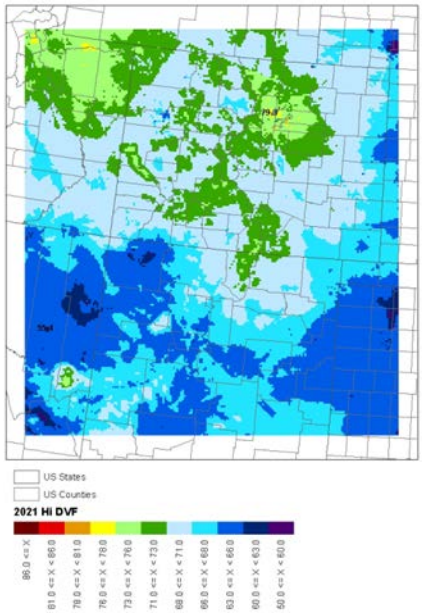
monitoring sites to obtain projected future year ozone concentrations. This method utilized EPA's Modeled Attainment Test Software (MATS) (Abt 2012) projection tool with the CAMx 2008 Base Case and 2021 High Development Scenario ozone concentrations to estimate ozone impacts. The second method uses the absolute modeling results from the CAMx model to estimate ozone impacts.

Figure 15- 2008 ozone DVC (top left), 2021 ozone DVF (top left) and 2021 – 2008 ozone DVF differences calculated using MATS for the CARMMS 2021 High Development Scenario. Figure 15 presents the CAMx predicted ozone concentrations using MATS. The current year DVCs indicate areas of ozone exceedances of the NAAQS (75 ppb) in Denver and Salt Lake City with a maximum DVC of 81.5 ppb just northwest of Denver (Figure 15, top left). For the 2021 High Development Scenario the area of 2021 ozone DVF exceedances is reduced and still limited to smaller areas in the Denver and Salt Lake City area with a peak DVF of 79.3 ppb still northwest of Denver (Figure 15, top right). The 2021 DVF – 2008 DVC difference plot (Figure 15, bottom) shows mainly ozone reductions with the largest reduction in the Denver and Salt Lake City areas but ozone increases in the Piceance Basin (Garfield County, Colorado).

The CAMx absolute modeling results are presented in Figure 16. The ozone NAAQS is defined as the 3-year average of the 4th highest daily maximum 8-hour ozone concentrations. Since CARMMS only has 1 year of modeling results, the 2021 4th highest daily maximum 8- hour ozone concentrations are used for the NAAQS comparison metric. Figure 16 displays the 4th highest ozone concentrations for the 2008 Base Case and the 2021 High Development Scenario and their differences. For the 2008 Base Case, there are ozone exceedance areas in the Denver, Salt Lake City and northern New Mexico, and on the border of UT/AZ (Figure 16, top left). In the 2021 High Development Scenario, the area of ozone exceedances in Denver is reduced and the ozone exceedances in Salt Lake City and on the UT/AZ border area are gone, the area in northern New Mexico remains the same and there is a new ozone exceedance area in the Uinta Basin (Figure 16, top right). The 2021 – 2008 ozone differences (Figure 16 bottom) show more decreases than increases and the areas of ozone increases tend to occur in oil and gas development areas, for example, the D-J, Piceance and Uinta Basins.

Figure 17 presents the maximum ozone contributions due to federal oil and gas emissions in the UFO planning area from the CAMx absolute model results. The maximum ozone contribution from the UFO planning area oil and gas sources is 0.8 ppb. Given that the CARMMS projected UFO planning area oil and gas emissions are greater than the current reasonably foreseeable development emissions, the contribution to regional ozone would likely be less.





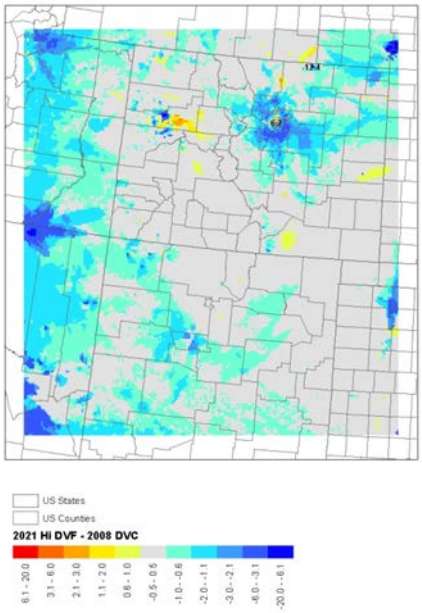


Figure 15- 2008 ozone DVC (top left), 2021 ozone DVF (top left) and 2021 – 2008 ozone DVF differences calculated using MATS for the CARMMS 2021 High Development Scenario.

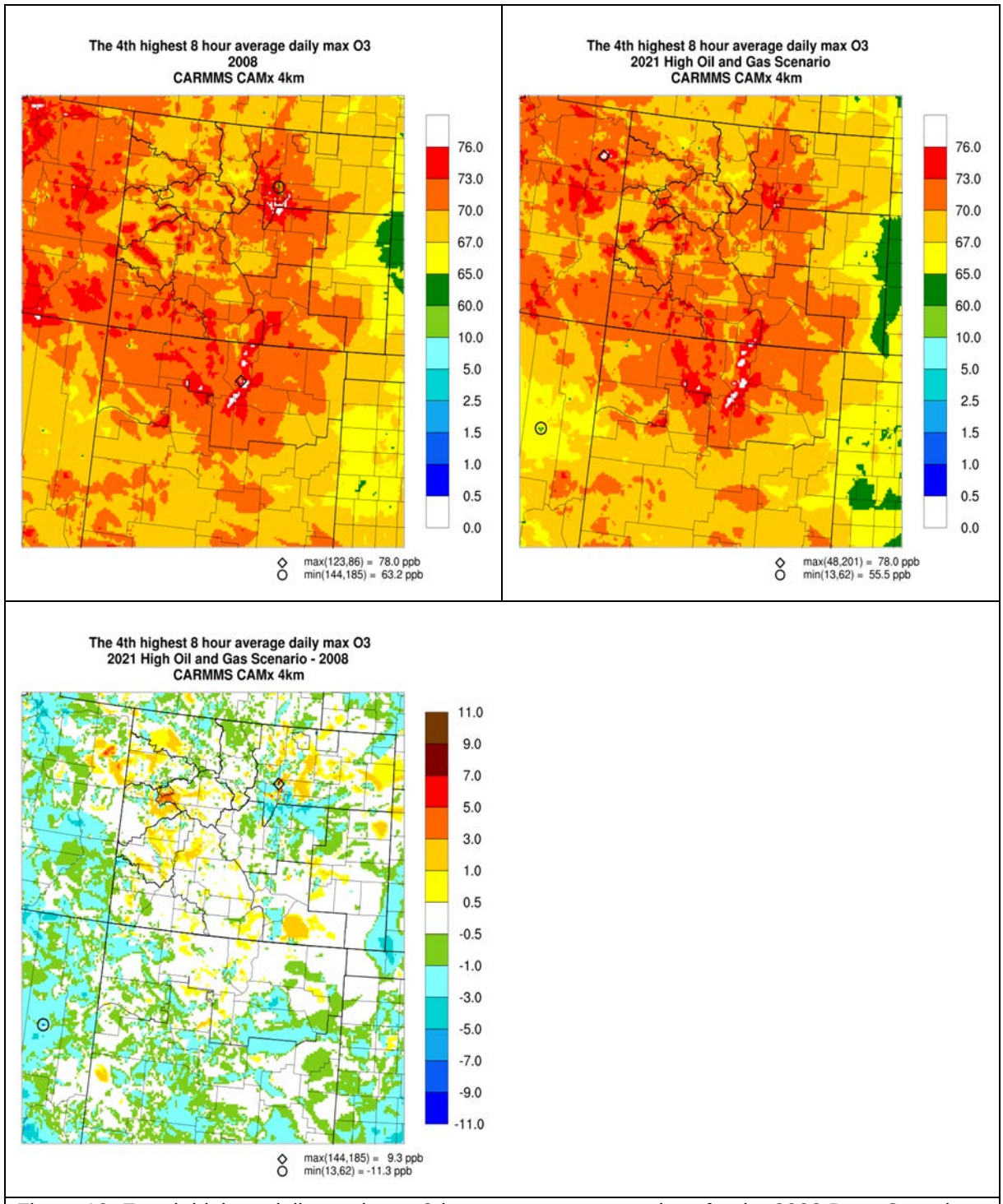


Figure 16- Fourth highest daily maximum 8-hour ozone concentrations for the 2008 Base Case (top left), CARMMS 2021 High Development Scenario (top right), 2021 minus 2008 differences (bottom).2008 ozone DVC (top left), 2021 ozone DVF (top left) and 2021 – 2008 ozone DVF differences calculated using MATS for the CARMMS 2021 High Development Scenario.

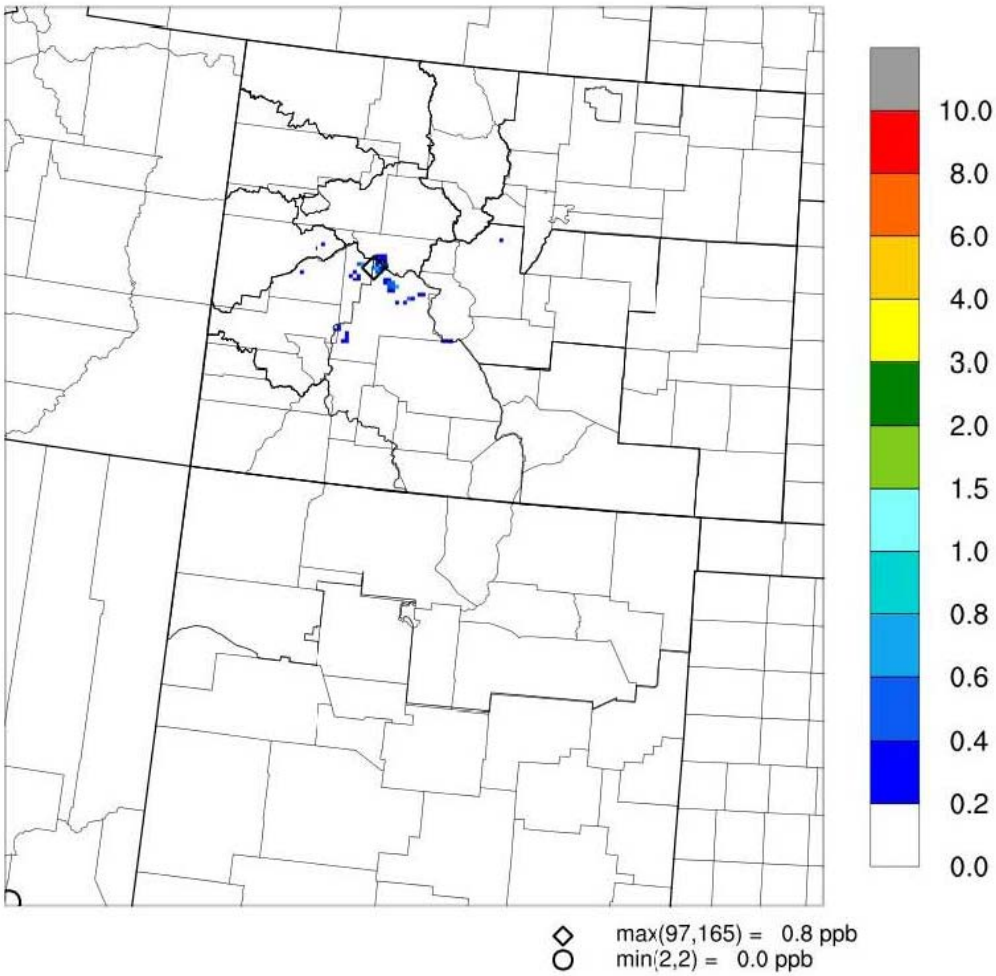


Figure 17- Contribution to fourth highest daily maximum ozone concentrations due to emissions from Federal O&G within the UFO Planning Area for the CARMMS 2021 High Development Scenario.

Cumulative Air Quality and AQRV Impacts

The following CARMMS data has been included to describe the cumulative air quality and AQRV impacts to areas within the region most likely to be potentially impacted relative to the proposed action.

Table 3-29 Cumulative Pollutant Concentrations at Nearby Class I Areas (µg/m^3)

Location	Pollutant	Averaging Time	Modeled Concentration	PSD Increment
Black Canyon of the Gunnison National Park	NO_2	Annual	0.516	2.5
	SO_2	3-hour	0.086	25
		24-hour	0.052	5
		Annual	0.006	2
	PM_{10}	24-hour	0.763	8
		Annual	0.199	4
	$PM_{2.5}$	24-hour	0.555	2
		Annual	0.104	1
Maroon Bells / Snowmass Wilderness Area	NO_2	Annual	0.325	2.5
	SO_2	3-hour	0.114	25
		24-hour	0.032	5
		Annual	0.006	2
	PM_{10}	24-hour	0.635	8
		Annual	0.169	4
	$PM_{2.5}$	24-hour	0.503	2
		Annual	0.122	1
West Elk Wilderness Area	NO_2	Annual	0.309	2.5
	SO_2	3-hour	0.095	25
		24-hour	0.030	5
		Annual	0.005	2
	PM_{10}	24-hour	0.720	8
		Annual	0.211	4

	$PM_{2.5}$	24-hour	0.584	2
		Annual	0.167	1

Cumulative Pollutant Concentrations (CARMMS 2021 High Development Scenario) at Class I and Sensitive Class II Areas (not shown) are all well below the PSD Class I and Class II increments.

The visibility impacts due to RFD oil and gas emissions and mining emissions were examined following the procedures provided by the USFWS and NPS (USFWS and NPS, 2012). These procedures use EPA's Modeled Attainment Test Software (MATS) to project current year observed visibility impairment for the best 20 percent (B20%) and worst 20 percent (W20%) days to the future year using the 2008 Base Case and 2021 High Development Scenario modeling results [which include contributions from all sources categories (anthropogenic and natural)] with and without emissions from RFD sources.

Table 3-29 and Table 3-31 display the cumulative visibility results for the 2021 High Development Scenario and RFD sources for the B20% and W20% days, respectively. Note that since MATS was used and MATS only includes observed data for Class I areas, cumulative visibility results are presented for just the Class I areas.

Table 3-30 Cumulative Visibility (B20%) at Nearby Class I Areas (Δdv)

Class I Area	2008 Base	2021 High	2021 High Improvement from 2008	Contribution from CARMMS High RFD
Black Canyon of the Gunnison National Park	2.25	2.18	0.07	0.01
Maroon Bells / Snowmass Wilderness Area	0.69	0.53	0.16	0.02
West Elk Wilderness Area	0.69	0.57	0.12	0.01

Table 3-31 Cumulative Visibility (W20%) at Nearby Class I Areas (Δdv)

Class I Area	2008 Base	2021 High	2021 High Improvement from 2008	Contribution from CARMMS High RFD
Black Canyon of the Gunnison National Park	9.95	9.31	0.64	0.01
Maroon Bells / Snowmass Wilderness Area	8.68	7.91	0.77	0.02
West Elk Wilderness Area	8.68	8.08	0.60	0.02

As shown above, each of the Class I areas presented can expect to have decreasing visibility impacts for both the best and worst days under the CARMMS high RFD scenario.

Potential cumulative atmospheric deposition impacts within the Class I areas were calculated for RFD sources within the planning area and are shown in Table 3-32 below. The maximum direct total (wet and dry) nitrogen and sulfur deposition are predicted to be well below the cumulative analysis thresholds of 2.3 ky/ha/yr for nitrogen and 3 kg/ha/yr for sulfur at all Class I areas.

Table 3-32 Cumulative UFO RFD Nitrogen and Sulfur Deposition at Nearby Class I Areas

Class I Area	Max Nitrogen Deposition (kg/ha-yr)	Max Sulfur Deposition (kg/ha-yr)
Black Canyon of the Gunnison National Park	0.296	0.006
Maroon Bells / Snowmass Wilderness Area	0.429	0.019
West Elk Wilderness Area	0.309	0.010

Table 3-33 Cumulative UFO ANC Changes at Nearby Sensitive Lakes

Lake Name	Max Nitrogen Deposition (kg/ha-yr)	Max Sulfur Deposition (kg/ha-yr)	Delta ANC Change	Below Threshold?
Avalanche Lake	0.0147	0.0004	0.125	Yes
Capitol Lake	0.0132	0.0003	0.1299	Yes
Moon Lake (upper)	0.0132	0.0003	0.1299	Yes

As shown above in Table 3-33 the Delta ANC change at the selected Class I area sensitive lakes are all below the 10% change threshold applicable to these water bodies. Although not shown, the most sensitive impacted lake, the Deep Creek Lake, in the Raggeds Wilderness Area (Class II) is also below the 1 µL equivalent change threshold for lakes with less than a 25 µL equivalent buffering capacity.

Greenhouse Gases and Climate Change

With respect to Climate Change associated with cumulative (i.e. World-wide) GHG emissions, the following predictions were identified by the EPA for the Mountain West and Great Plains region:

- The region will experience warmer temperatures with less snowfall.
- Temperatures are expected to increase more in winter than in summer, more at night than in the day, and more in the mountains than at lower elevations.
- Earlier snowmelt means that peak stream flow will be earlier, weeks before the peak needs of ranchers, farmers, recreationalist, and others. In late summer, rivers, lakes, and reservoirs will be drier.
- More frequent, more severe, and possibly longer-lasting droughts will occur.
- Crop and livestock production patters could shift northward; less soil moisture due to increased evaporation may increase irrigation needs.
- Drier conditions will reduce the range and health of ponderosa and lodge pole pine forests, and increase the susceptibility to fire.

- Grasslands and rangelands could expand into previously forested areas.
- Ecosystems will be stressed and wildlife such as the mountain line, black bear, long-nose sucker, marten, and bald eagle could be further stressed.

If these predictions are realized as mounting evidence suggests is already occurring, there could be impacts to resources within the region. For example, if global climate change results in a warmer and drier climate, increased particulate matter impacts could occur due to increased windblown dust from drier and less stable soils. Warmer temperatures with decreased snowfall could have an impact on a particular plants ability to sustain itself within its current range. An increased length of growing season in higher elevations could lead to a corresponding variation in vegetation and change in species composition. These types of changes would be most significant for special status plants that typically occupy a very specific ecological niche. Cool season plant species' spatial ranges are predicted to move north and to higher elevations, and extinction of endemic threatened or endangered plants may be accelerated. Invasive plant species would be more likely to out-compete native species.

Increases in winter temperatures in the mountains could have impacts on traditional big game migration patterns. Due to loss of habitat, or due to competition from other species whose ranges may shift northward, the population of some animal species may be reduced. Warmer winters with less snow would impact the Canada lynx by removing a competitive advantage they have over other mountain predators. Earlier snowmelt could also have impacts on cold water fish species that occupy streams throughout the planning area. Climate change could affect seasonal frequency of flooding and alteration of floodplains, which could impact riparian conditions. More frequent and severe droughts would have impacts on many wildlife species throughout the region as well as vegetative composition and availability of livestock forage in some areas. Climate change could increase the growing season within the region, however, so longer growing season in theory would result in more forage production provided there is sufficient precipitation. Drier conditions could have severe impacts on forests and woodlands. This could leave these forests and woodlands more susceptible to insect damage and at higher risk of catastrophic wildfires. Increased fire activity and intensity would increase greenhouse gas emissions.

3.3.1.2 Soils

Existing soil disturbance from the development and construction of past roads, rights-of-ways, treatments, grazing, well pads, pipelines, mine load outs, vents and recreation continue to contribute to degradation of soil health and represent 10,244 acres. Bare ground associated with all of these disturbances leads to transport of soil particles through erosive processes. Once mobilized, soil is dissolved in solution and mobilized downslope dependent on the volume of water present. Rainfall-runoff events in the CIAA are typically caused by monsoonal events that are high volume but short duration. These events may erode soils, delivering them to downstream water bodies but the impact is short duration, limiting the impact.

The reasonably foreseeable future actions (Bull Mountain Unit MDP, Spadafora water storage facility, Sheep-Bull pipeline, Petrox, Huntsman and Deadman Gulch APDs) estimated to be up to 300 acres and represent approximately <0.01% of the CIAA. Design features, conditions of approval, and BMPs associated with federally and state regulated projects (all of the RFFA) reduce impacts to soils by slowing soil movement and minimizing discharge into surface water.

The proposed action would disturb an additional 32 acres of soils representing 0.01% of the CIAA. This comprises an 10% addition to the past and reasonably foreseeable surface disturbance. Interim reclamation of the proposed action as well as the Bull Mountain Unit MDP would result in approximately 16.3 acres of improved soil health conditions. Thoughtful layout of roads, pads and buffer distances from surface water were considered in the proposed action and in coordination with the design features and storm water management plan, further reduce impacts.

The no action alternative would result in 5.4 acres of disturbance from construction of the Spadafora well pad and the associated infrastructure. This construction would likely continue to move forward on Fee/Fee lands. This would be added to the past and RRFA described above and contribute soils being eroded in levels similar to those found currently.

3.3.1.3 Riparian Zones and Wetlands

Roads proximal to riparian areas and wetlands from all forms of land management (oil and gas exploration and production, recreational access, timber harvest activities, rangeland management access) have long lasting cumulative impacts to the resource through ongoing sediment delivery within the water influence zone. For this reason they will be used as a surrogate for the cumulative effects analysis to wetlands and riparian areas for all activates within the 265,355 acre CIAA. There are 206 polygons that have been delineated within the CIAA to likely be wetlands covering 1,430 acres (Johnston and others, 2012). Of these wetlands 8 have been field verified to be peat accumulating fens. In addition to the mapped wetlands there are 9,706 acres mapped as riparian. Wetlands and riparian areas make up about 4% of the area of the CIAA. A water influence analysis zone of 100 feet was used for riparian and wetland areas. Currently 20 acres of wetlands are within 100 feet of existing roads (about 1% of wetlands in the CIAA). No known fens are within 100 feet of roads. There are 535 acres (6%) of mapped riparian zones within 100 feet of roads in the CIAA. The proposed action increases this cumulative influence area by 0.2 acres in the riparian and 0.0 acres in fens and wetlands. The cumulative effected riparian and wetland area of past and proposed actions is 5% of known mapped riparian and wetland areas in the CIAA. This impact is not expected to increase appreciably with future foreseeable land management in the area since current and future activities are designed to avoid the influence zone of wetland and riparian areas.

3.3.1.4 Hydrology (Surface Water)

Existing surface disturbance from the development and construction of past roads, rights-of-ways, treatments, grazing, well pads, pipelines, mine load outs, vents and recreation continue to contribute to degradation of surface waters and represent 10,244 acres of surface disturbance. Bare ground associated with all of these disturbances leads to the mobilization soil particles through erosive processes. Once mobilized, these particles are carried as sediment in solution through the stream system. Rainfall-runoff events in the CIAA are typically caused by monsoonal events that are high volume but short duration. These events may carry large volumes of sediment but the duration is short, limiting the impact.

The reasonably foreseeable future actions (Bull Mountain Unit MDP, Spadafora water storage facility, Sheep-Bull pipeline, Petrox, Huntsman and Deadman Gulch APDs) are estimated to be up to 300 acres and represent approximately 0.01% of the CIAA. Design features, conditions of approval, and BMPs associated with federally and state regulated projects (all of the RFFA) reduce impacts to surface water by slowing erosion and minimizing discharge into surface water. Spills from oil and gas activities in these RFFA would be expected to occur at a rate of 1 spill per year per 100 wells. This is the average rate of spills per well in Colorado since 1999.

The proposed action would disturb an additional 32 acres of soils and vegetation representing 0.01% of the CIAA. This comprises a 10% addition to the past and reasonably foreseeable surface disturbance. Interim reclamation of the proposed action as well as the Bull Mountain Unit MDP would result in approximately 16.3 acres of improved soil and vegetation conditions. While the proposed action includes 6 gas wells, full build out of the pads would result in up to 25 wells. The risk of spills increases with more wells drilled. Previous drilling activity in Gunnison County yielded a higher rate of spills (1 incident per year with 44 active wells). This would indicate a spill rate of closer to 2% per year. Even with the higher spill rate, the surface water management and spill prevention plans in place would reduce the potential impacts of the additional wells.

The no action alternative would result in 5.4 acres of disturbance from construction of the Spadafora well pad and the associated infrastructure. This construction would likely continue to move forward on Fee/Fee lands. This would be added to the past, present and RFFA described above and contribute surface water impacts in levels similar to those found currently.

3.3.1.5 Hydrology (Ground Water)

Past drilling activity includes approximately 92 wells drilled dating back to 1960 in Gunnison County. Some of these wells approximately 54 are currently producing, up to 10 are approved but not drilled while

approximately 28 have been plugged and abandoned. The impact from these wells is not entirely known due to a lack of groundwater monitoring wells, or a significant number of domestic wells in the area. Baseline monitoring done dating back to 2002 shows the presence of methane and BTEX at low concentrations in some surface water and well water. The presence may be due to natural conditions or from prior drilling activities, but the current concentrations are below drinking water standards. Further baseline monitoring is needed to possibly help determine the source for these constituents. See the Groundwater section for more details.

The reasonably foreseeable future actions (Bull Mountain Unit MDP, Spadafora water storage facility, Sheep-Bull pipeline, Petrox, Huntsman and Deadman Gulch APDs) total up to 300 acres and 162 additional wells, and representing approximately 0.01% of the CIAA. Design features, conditions of approval, and BMPs associated with federally and state regulated projects (all of the RFFA) would reduce impacts to groundwater by preventing spills and ensuring casing integrity. However, even with the regulations in place, additional CBM wells in the CIAA would have some risk of intercepting deep fractures in the Wasatch Formation during hydraulic fracturing. Additional shale gas wells would not increase the risk of intercepting fractures due to the separation of the formations.

The proposed action would add an additional 25 wells for a total of 279 wells in the CIAA. This comprises a 9% addition to the past and reasonably foreseeable number of wells. The same small risk in drilling CBM wells would be present as those described in the RFFA section above. Baseline monitoring would help ensure any changes in the production of methane or BTEX and its source is well understood.

The no action alternative would result in 4 additional wells drilled on the Spadafora well pad. This drilling would likely continue to move forward on Fee/Fee lands. This would be added to the past, present and RRFA described above and could contribute to groundwater impacts in levels similar to those found currently.

3.3.1.6 Noxious or Invasive Weeds

Noxious weeds, including tamarisk have invaded and will continue to invade many locations in the CIAA. Noxious weeds are carried by wind, humans, machinery, and animals. Several past, present and reasonably foreseeable future actions common to both public and private lands include recreational use (motorized and non-motorized), firewood cutting, road maintenance and livestock grazing. All of these activities have the potential to contribute to the spread of noxious weeds. However, through analysis before a proposed action is implemented, in compliance with BMPs and implementation of project design features there should be no cumulative significant impacts to the environment due to the actions of this project even though noxious and invasive weeds are expected to continue to spread on all lands. Due to their ability to tolerate certain conditions, some species are expected to remain a serious long-term challenge in the cumulative analysis area.

3.3.1.7 Vegetation Management

No substantial vegetative changes have occurred in the CIAA for several years, although some changes due to timber harvest have occurred in the CIAA due to ongoing activities including camping, hiking, hunting, OHV use on designated trail systems, road and trail maintenance, special uses, firewood cutting, livestock grazing and associated developments. On private lands, ongoing actions include water facilities such as ponds, ditches and canals for irrigation and a pipeline to hook private wells to an existing system (Henderson Lateral, Sheep Gathering line).

For much of the last decade, most of the western US has experienced drought. Inflows to Lake Powell (indicative of the Upper Colorado Basin) have been below average since 2000, and Colorado regularly goes through periods of drought that may be statewide, region-wide, or within a more localized area. Agriculture, drinking water supplies, and wildland fires are all impacted by drought.

Fires within the CIAA are both naturally occurring and used as a management tool. Naturally occurring fires have been widely distributed in terms of frequency and severity. Increasing recurrence and severity of drought conditions have been predicted for this area as a result of climate change. This could, in turn, increase the occurrence and severity of wildfires on BLM-administered land.

3.3.1.8 Rangeland Management

This resource is primarily affected by surface disturbance of forage habitat for the livestock. With the coal mines and increasing oil and gas development, there continues to be a loss of grass/forb vegetation communities, which have become a limiting factor for grazing. On the Forest, some shut-in wells had not been reclaimed, which continues to affect the amount of forage available to livestock.

3.3.1.9 T&E and Sensitive Species

Canada Lynx
As there are no direct or indirect effects to Canada lynx as a result of this project, this project cannot contribute to cumulative impacts to the lynx or any other T&E and sensitive species from project implementation.

Federally Listed and Sensitive Fish
Although the USFWS-listed Bonytail (Gila elegans), Humpback chub (Gila cypha), Razorback sucker (Xyrauchen texanus),Colorado pikeminnow (Ptychocheilus Lucius), and the BLM sensitive Roundtail chub (Gila robusta), Bluehead sucker (Catostomus discobolus), Flannelmouth sucker (Catostomus latipinnis) do not occur within the project area, water depletions from projects effecting drainages supplying rivers where these species are present have the potential to affect fish populations.

Other Sensitive Species
Northern leopard frog
The cumulative effects analysis area for this species is the watershed CIAA surrounding the proposed treatments and activities. Activities in this area which may impact leopard frogs include grazing management, surface activities associated with mining, motorized travel, and water depletions. Grazing can result in loss of riparian vegetation (foraging habitat and cover) and trampling of egg masses. However, frog populations have been located on the forest in areas with livestock concentrations (D. Garrison pers. obs.) and many of the suitable habitat features, as well as occupied sites, on the landscape, especially in the Terror Creek watershed, were created for and are currently managed primarily for livestock use. Motorized travel of all types may result in mortality to individuals moving from wetlands into upland areas. These impacts, however, all presently occur in this watershed and have for many years, and frog populations appear to be healthy. This project is therefore unlikely to contribute significantly to negative cumulative impacts for this species.

Fringed Myotis, Spotted Bat, Townsend's big-eared Bat,
The cumulative effects analysis area for this species is the CIAA buffered area surrounding the proposed treatments and activities. None of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to substantial negative long-term cumulative impacts to this species. Other activities within that area have similar minimal potential impacts to this species, primarily through changes to foraging habitat.

Hoary Bat
The cumulative effects analysis area for this species is the CIAA buffer area surrounding the proposed treatments and activities. Actions similar to those proposed have resulted in incremental losses to habitat within that area, while timber sales and ongoing vegetation activities also remove suitable roosting habitat. However, none of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to substantial negative long-term cumulative impacts to this species. There is abundant suitable habitat throughout the cumulative impacts area for roosting and foraging, and this species is relatively common and widespread throughout the area

Northern Goshawk
The cumulative effects analysis area for this species is the CIAA buffer surrounding the proposed project activities. At this time, there are three known goshawk territories and one potential territory within that area. Two of the known territories are adjacent to prior timber harvest activities and appear to be regularly occupied in spite of such activity. None of the territories is, as of yet, close to current energy development.

Flammulated Owl
The cumulative effects analysis area for this species is the CIAA buffer surrounding the proposed project activities. Flammulated owls are known to occur in the cumulative effects analysis area. Other projects occurring in this area which may impact flammulated owls are commercial and personal use firewood cutting and timber harvest, as well as any past or future energy development or other projects which impact aspen stands. However, none of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to long-term negative cumulative impacts to this species, due to the small scale of past and future projects and the abundance of aspen habitats across the landscape.

Purple Martin
The cumulative effects analysis area for this species is the CIAA buffer surrounding the proposed project activities. Purple martins are known to occur at numerous locations within this area. Other projects occurring in this area which may impact Purple Martins are commercial and personal use firewood cutting and timber harvest, as well as any past or future energy development or other projects which impact aspen stands. However, none of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to long-term negative cumulative impacts to this species, due to the small scale of past and future projects and the abundance of aspen habitats across the landscape.

Olive-sided Flycatcher
The cumulative effects analysis area for this species is the CIAA buffer surrounding the proposed project activities. Other projects occurring in this area which may impact Olive-sided flycatcher are commercial and personal use firewood cutting and timber harvest, as well as any past or future energy development or other projects which impact spruce stands. However, none of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to long-term negative cumulative impacts to this species, due to the small scale of past and future projects and the abundance of spruce-fir habitats across the landscape

Brewer's Sparrow
The cumulative effects analysis area for this species is the CIAA buffer surrounding the proposed project activities. Sage habitats within this area are limited at this and higher elevations, but occur more commonly at lower elevations. There are several sage-dominated parks in the cumulative impacts area. Few of the activities occurring within this area have direct impacts to sage communities, with the exception of livestock grazing, which has occurred in this area for decades. Future energy development may impact similar habitats at similar scales, but no large-scale habitat alteration is anticipated. Other activities, including motorized recreation, may lead to disturbance to nesting birds along existing routes. However, none of the ongoing or reasonably foreseeable activities within this area, when combined with the proposed action, are likely to contribute to substantial long-term negative cumulative impacts to this species.

Plants
Since there are no direct or indirect effects, cumulative effects to plant species will not be addressed.

3.3.1.10 Wildlife, Terrestrial

The cumulative impacts area for the project as a whole consists of the project footprint buffered by approximately ten miles with some edge adjusting to the limits of the North Fork Gunnison watershed (see Watershed CIAA). The EA lists a wide variety of actions within that area, which have differing relevance for each species addressed herein. Actions with the potential to interact with project activities include past and future energy development, associated infrastructure such as roads and pipelines, timber harvest or other vegetation management activities, livestock grazing, recreational hunting and permitted outfitting, and motorized recreation such as OHV or snowmobile riding. Other projects such as water uses (ditches, reservoirs) may also contribute.

Elk
The cumulative effects analysis area for this species is the CIAA buffer area surrounding the proposed treatments and activities. HABCAP modeling was not used to determine the impacts of this habitat

alteration within the cumulative effects area. Due to the scale and type of this project, with limited habitat alteration and the low mileage of new road construction, effects of the project at this scale are negligible and would not show in the model unless taken to unreasonable levels of precision (beyond that of the data used). Because elk are very adaptable, and use a wide variety of habitats, the conversion of habitat to unsuitable condition should not have any substantial long-term effects at the population level. Similar actions within the cumulative impacts area, specifically the proposed gas development in the Bull Mountain Unit and other future energy development, will also result in an incremental reduction in habitat suitability and availability for elk and expected changes to distribution. However, at the scale of the watershed and the data analysis unit used to monitor elk populations, this project, even when considered with all other projects in the area, is not likely to result in significant changes to elk populations. In addition, elk populations in this and other areas on the forest are much more likely to be directly influenced through management of hunting seasons by the Division of Parks and Wildlife than from habitat changes at minor scales.

Within the northern part of the Paonia district in the general cumulative impacts area for the project, a total of 39 miles of routes have been closed to motorized use in the past ten years, and almost 22 miles have been restricted to administrative traffic only, reducing traffic substantially on those routes. This excludes gas- and coal-related routes already in existence. This greatly offsets any new route construction occurring within the watershed at this time.

Merriam's Wild Turkey

The cumulative effects analysis area for this species is the CIAA buffer area surrounding the proposed treatments and activities. HABCAP modeling was not used to determine the impacts of this habitat alteration within the cumulative effects area. Due to the scale and type of this project, with limited habitat alteration and the low mileage of new road construction, effects of the project at this scale are negligible and would not show in the model unless taken to unreasonable levels of precision (beyond that of the data used). None of the ongoing or reasonably foreseeable future activities within this area, when combined with the proposed action, are likely to contribute to substantial long-term negative cumulative impacts to this species. Turkeys in the general area of the project and within the watershed are increasing in numbers and show little regard for human presence in the area, and are commonly seen near infrastructure.

Red-naped sapsucker

The cumulative effects analysis area for this species is the CIAA buffer area surrounding the proposed treatments and activities. HABCAP modeling was not used to determine the impacts of this habitat alteration within the cumulative effects area. Due to the scale and type of this project, with limited habitat alteration and the low mileage of new road construction, effects of the project at this scale are negligible and would not show in the model unless taken to unreasonable levels of precision (beyond that of the data used). Forest-wide habitat for the red-naped sapsucker includes a total of 1.5 million acres of potentially suitable habitat, so the amount of forest-wide habitat affected would be negligible. Regeneration discussion and assumptions are the same as for goshawk noted above, as are discussions of aspen availability within the cumulative effects analysis area.

3.3.1.11 Wildlife Aquatic

Increasing road density on National Forest lands has no positive ecological effect for any species of conservation or recreational significance nor forest habitat type. Research has shown that road densities greater than 1 mile per square mile can have deleterious consequences for stream habitat by way of increased sedimentation (Furniss et al., 1991[11]). Road density in the project area varies by watershed but is greater than 1 mile per square mile in the areas around 4 well pads included in this project already. Additional road construction may increase sediment loads in streams which could affect aquatic life in streams and rivers downstream from the project area.

[11] Furniss, M. J., T. D. Roelofs, and C. S. Yee. 1991. Road construction and maintenance. Pages 297-324 in Inluences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, W. R. Meehan, editor. American Fisheriers Society, Bethesda, Maryland.

3.3.1.12 Migratory Birds

Impacts to migratory birds and raptors from past and present actions within this 265,355-acre CIAA include 32 acres of surface disturbance (and 3.0 miles of road), with corresponding removal or alteration of nesting or foraging habitat, displacement from noise and disturbance, or direct impacts to individuals from vehicular collisions. This is less than 0.01% of the CIAA.

Reasonably foreseeable actions (including the proposed action) would result in an additional 332 acres of nesting or foraging habitat loss used by a variety of migratory birds and raptors from the proposed Bull Mountain Plan of Development and any future natural gas development proposed by either GE, SG, or Petrox approximately 300 acres, and from proposed vegetation management activities on USFS lands). This is approximately 0.01% of the CIAA. Together, past, present, and reasonably foreseeable future surface disturbance would total 10,576 acres (approximately 4% of the CIAA). The proposed activities may also result in direct impacts to nests or individuals from development activities, or direct impacts to individuals from vehicular collisions, or indirect impacts from noise. Vegetation restoration projects and travel management related route closures throughout the USFS lands within the CIAA would have some countervailing cumulative impacts to some migratory birds and raptors by increasing habitat availability for certain species.

Impacts to migratory birds and their habitat from the proposed action would be limited to up to 32 acres of habitat removal, and noise and other human presence related disturbance associated with development and long term production of the 5 facilities contemplated. The proposed action would affect approximately <0.01% of the CIAA. This comprises a <0.01% addition to the total past, present, and reasonably foreseeable future surface disturbance identified above. These impacts would be further localized and minimized from implementation of environmental protection measures and mitigation measures proposed by the operators and/or required by the BLM (e.g., migratory bird nest surveys during the nesting season proposed by GE; BMPs to net open pits, and prevent bird entrapments on open pipes). In addition, the proposed action would be at least partially temporally removed from some or all of the RFFAs (particularly the 2,000-acre Gold Rock Mine), thus the overall cumulative impact to migratory birds and raptors would be further reduced in terms of total cumulative acres of disturbance at one time.

Total surface disturbance under the no action alternative would be limited to that which is associated with the development of Spadafora location totaling approximately 5.4 acres and the 10,576 acres of disturbance caused by the past, present, and Reasonably Foreseeable actions described above.

3.3.1.13 Geology and Mineral Resources

The region does have active natural instability and it may be difficult in many circumstances to distinguish project related effects from natural occurrences. Small scale natural earth movements currently occurring in the project area would likely to continue in the future. It can be reasonably anticipated that they will vary in amount and intensity based on climatic factors over time. It is assumed that past, present, and reasonably foreseeable actions would continue in the future and have the ability to effect geologic resources and instabilities. These actions, if not properly mitigated, could increase slope instabilities in the project area and have negative effects on topography and in turn increase sediment load into adjacent drainages.

3.3.1.14 Socioeconomics

The proposed action would increase regional economic activity including employment and personal income over the project's 50 year horizon. Additionally, there would be an increased need for short and long-term housing and an increase of traffic on roads servicing the multi-well pads.

Under the no action alternative cumulative socioeconomic impacts would be occur similar too but at a scale below that of the proposed action.

3.3.1.15 Realty Authorizations

When combined with the continued use of existing realty authorizations there essentially is no cumulative effects on implementation of the authorizations. However, the issuance of realty authorizations can

contribute to cumulative impacts related to additional surface disturbance on the landscape, extending public access opportunities further into the area, increased use of roads, trails and natural resources of the area which would be accounted for in the cumulative impacts for those other resource sections. Maintenance/repair/reconstruction activities, authorized under the SUP, will continue to be performed by the commercial users for the roads they use.

3.3.1.16 Access and Transportation

Motorists would benefit from the improvements in road surface, drainage or geometry put in place as a part of the proposed action. Road improvements would affect the traditional uses in the area and over time would cause an increase in traffic from recreational use in addition to the expected commercial uses. Improvements, made as a part of the proposed action would reduce the FS maintenance burdens of the affected road segments and the operators would have in the on-going maintenance, under a RUP during the life of the project. Under the RUP the operators would also comply with seasonal road closures and restrictions during the spring thaw when muddy conditions are present and roads are most vulnerable to rutting and damage. Maintenance/repair/reconstruction activities, authorized under the RUP will continue to be performed by the commercial users for the roads they use.

Natural gas development and exploration activities are expected to increase in the foreseeable future as long as the demand and the market conditions are favorable for the gas industry. Even with no further development or expansion, existing gas production facilities will be utilized until the gas field is exhausted which by most estimates is over 20 years. As the number of gas wells and production activities increase the need for all-season access is becoming more important to the production companies. This demand will require improvements to the roadway to accommodate commercial traffic during wet periods. All-season access will also impact winter recreation by changing existing snowmobile patterns and may require the construction of a new snowmobile route through the area. This will also have wildlife impacts by increasing the amount of traffic during sensitive time periods.

Traffic counts are projected to continue to increase as commercial uses continue to grow in this area. This, in addition to increased recreational travel would warrant consideration to improving the routes. Any additional changes would be due to other factors such as increased population, or subdivision of private in-holdings (none pending).

The effects of private land development within the Forest Boundaries may also play a significant role in further development of the Forest transportation system. As new residences are built and the urban interface increases the demand for improved roads and year-around access will increase.

3.3.1.17 Recreation

Recreation use in this area is primarily related to big game hunting, and much more elk than other species. Secondary recreation in this area is motorized travel, typically OHVs on designated routes such as the Thousand Acre Flats OHV trail/road system and system roads. Much of that traffic is related to big game hunting. Winter snowmobile use is very low, excepting the use of CR/NFSR265 to access the STP trail and Hubbard Park (and that is now much reduced). Other minor recreational activities in the project area are color viewing in fall, other hunting, and wildlife watching, but these are a tiny fraction of the hunting use.

3.3.1.18 Wastes (Hazardous or Solid)

Over the last decade exploratory and development activities in and surrounding the proposed action have focused on exploring for and developing coalbed methane natural gas resources, and these activities are expected to continue over the next 20 years (BLM 2012). As these activities continue and potentially increase in the future, the risk of an accidental release of hazardous materials increases. Increased gas operations would likely result in increased transportation, storage, and use of hazardous material in construction, drilling, and operations, which would increase the risk of air, water, soil, and biological resources being affected by hazardous materials.

Additional oil and gas development is expected in the future, and when compounded with the impacts from development in the CIAA, this could result in greater impacts (examples provided below) on human health and safety if not properly mitigated.

- Air pollution from the development of the proposed action compounded with air pollution from other nearby energy development could result in more severe impacts on human health. Increased development over time would also increase the risk of water and soil contamination through leaks, spills, mechanical failure, migration from deep geologic zones, well casing failures and human error.
- Water and soil contamination would impact health and safety by exposing people, livestock, and wildlife to the chemicals described in Appendix E, and depending upon the level of exposure to many of those chemicals negative health effects could occur. With increased development in the analysis area, the likelihood of water contamination would increase and if drilling fluids used in the development of the proposed action were to contaminate local water sources, endocrine disrupting chemicals that interact with other water contaminants could have additive effects.

3.3.1.19 Visual Resources Management

Within the area, past and current oil and gas construction and their associated structures, as well as timber harvests are evident and detract from the visual landscape but do not dominate the landscape. Current water facilities, livestock grazing and their associated grazing facilities are an accepted part of the cultural landscape. Although the additional elements of the proposed action further detract from the visual landscape, the cumulative effects will not have difficulty meeting its VQO of “Modification”.

3.3.1.20 Noise

Development of additional natural gas production facilities under the proposed action would result in the addition of noise sources to those that already exist within the project area. Existing noise sources include traffic and equipment from natural gas development and well maintenance, agricultural activities, and recreational and tourist traffic on SH 133 and CR/NFSR 265.

Natural gas development actions under the proposed action would contribute to increases in ambient noise levels in the short term during construction and over the long term as wells go into production and operate for the life of the wells (estimated to be 40 years). In some areas, the density of development could be considered by some individuals to be noisy. The continuous noise from production wells and compressors may be disruptive or objectionable to some residents as well as recreationists, hunters, and livestock operators and may result in displacement of such activities. Ambient noise levels at build-out would be expected to increase in some areas within the project area as a result of the project in combination with past and reasonably foreseeable future actions.

4 SUPPORTING INFORMATION

4.1 List of Preparers

Table 4-1 List of Preparers

Name	Office/Agency	Title
Thane Stranathan	BLM	Natural Resource Specialist
Jessica Lopez Pearce	FS	Minerals Administrator
Gina Jones	BLM	Southwest District NEPA PE & C
Niccole Mortenson	FS	Engineering and Minerals NEPA Specialist
Albert Borkowski	FS	Special Uses Program Manager
Jedd Sondergard	BLM	Hydrologist, NEPA PE&C
Ben Stratton	FS	Hydrologist
Beth Anderson	FS	Hydrologist
Catherine Freels	FS	North Zone Archaeologist
Glade Hadden	BLM	UFO Archaeologist
Dennis Garrison	FS	Wildlife Biologist
Ken Holsinger	BLM	Wildlife Biologist
Lisa VanAmburg	FS	Rangeland Management Specialist
Chad Meister	BLM	Air Resource Specialist
Forrest Cook	BLM	Air Resource Specialist
Martin Hensley	BLM	Economist
Robert Ernst	BLM	Geologist
Matt Dare	FS	Fisheries Biologist
Suzann Parker	FS	Botanist
David Sinton	BLM	GIS Specialist
Teresa Pfifer	BLM	Asst. Field Manager Lands & Minerals
Levi Broyles	FS	District Ranger

4.2 Tribes, Individuals, Organizations, or Agencies Consulted

Face-to-face consultation has been conducted with the three Ute tribes concerning this project. Consultation occurred by phone, letter and by a direct consultation conference in April 2015. All three tribes have declined to participate and have expressed no concerns for any Religious Concerns.

4.3 References

Ackerman, D.J. and T. Brooks. 1986. Reconnaissance of Ground-Water Resources in the North Fork of the Gunnison River Basin, Southwestern Colorado. USGS Water Resource Investigation Report 85-4230. Denver, CO: USGS.

Austin, Gay, pers. Comm. Botanist – Gunnison District - Bureau of Land Management, Gunnison Colorado.

Braun, C.E., J.H. Enderson, M.R. Fuller, Y.B. Linhart and C.D. Marti. 1996. Northern Goshawks and Forest Management in the Southwestern United States. Wildl. Soc. Tech. Rev. 96-2. pg 9.

Bureau of Land Management. North Fork Land Health Assessment 2006-2007, Uncompahgre Field Office – BLM.

CDOT (Colorado Department of Transportation). 2015. Traffic Data Explorer. Retrieved May 26, 2015. http://dtdapps.coloradodot.info/otis/TrafficData#ui/1/0/0/criteria/133A/0/68.821/true/true/

COGCC spill database, accessed 2015, http://cogcc.state.co.us/data.html#/cogis.

CDPW (Colorado Division of Parks and Wildlife). 2015. 2014 Elk Harvest Summaries. http://cpw.state.co.us/Documents/Hunting/BigGame/Statistics/Elk/2014StatewideElkHarvest.pdf

CDPW 2015a. Elk 2013 Post-hunt Population Estimates. http://cpw.state.co.us/Documents/Hunting/BigGame/Statistics/Elk/2013ElkPopulationEstimate.pdf

CDPW (Colorado Division of Parks and Wildlife). 2005. General Locations of Lynx (Lynx Canadensis) Reintroduced to Southwestern Colorado from February 4, 1999 through February 1, 2005. http://wildlife.state.co.us/NR/rdonlyres/F92E6FCD-BCB5-4711-8EE6-A9398EA77999/0/LynxLocations_Feb2005.pdf

CDPW. 2005a. Lynx Update, August 15, 2005.

CDPW. 2009. Lynx Update, May 25, 2009 http://cpw.state.co.us/Documents/Research/Mammals/Publications/LynxUpdateMay252009.pdf

CDPW. 2010. Post-Release Monitoring of Lynx Reintroduced to Colorado. http://cpw.state.co.us/Documents/Research/Mammals/Publications/2009-10AnnualReportLynxConservation.pdf

Colorado Natural Heritage Program (CNHP). 2012. Rare and imperiled animals, plants and plant communities website database (http://www.cnhp.colostate.edu/). Fort Collins, CO. Accessed July 2012.

Cryer, Douglas H.; and Terry J. Hughes. 2001. Soil survey of Cochetopa Area, Colorado: Parts of Gunnison, Hinsdale, and Saguache Counties. 127 pp. http://datagateway.nrcs.usda.gov/.

Day, Warren C.; Gregory N. Green; Daniel H. Knepper Jr.; and Randal C. Phillips. 1999. Spatial geologic data model for the Gunnison, Grand Mesa, Uncompahgre National Forests mineral resource assessment area, southwestern Colorado and digital data for the Leadville, Montrose, Durango, and Colorado parts of the Grand Junction, Moab, and Cortez 1° X 2° geologic maps. OF-99-427, 32 pp. Denver, CO: U. S. Geological Survey. Digital maps available at http://pubs.usgs.gov/of/1999/ofr-99-0427/.

eBird. 2015. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org (Accessed: May 20, 2015 and June 2, 2015).

Edge, W.D. and C.L. Marcum. 1985. Movements of elk in relation to logging disturbances. Journal of Wildlife Management 49(4): 926-930.

Environment and Energy (journalist Mike Soraghan). 2014. Oil and Gas: Spills up 17 percent in U.S. in 2013. Available online: http://www.eenews.net/energywire/stories/1059999364. Accessed May 23, 2014.

Ellsworth, W. L. 2013. Injection-Induced Earthquakes. Science 341, 1225942. DOI: 10.1126/science.1225942

Fitzgerald, J.P., C.A. Meaney and D.M. Armstrong. 1994. Mammals of Colorado. University Press of Colorado. Niwot, CO. pgs. 81-82

Flewelling, S. A., M. P. Tymchak, and N. Warpinski (2013), Hydraulic fracture height limits and fault interactions in tight oil and gas formations, Geophys. Res. Lett., 40, 3602–3606, doi:10.1002/grl.50707.

Gunther, K.A., M.J. Biel and H.L. Robison. 1998. Factors Influencing the Frequency of Road-killed Wildlife in Yellowstone National Park. In Evink G.L., P.Garrett, D. Zeigler and J. Berry eds. 1998. Proceedings of the International Conference on Wildlife Ecology and Transportation. FL-ER-69-98. Florida Department of Transportation, Tallahasee, FL. Pgs 32-42.

Gruver, J.C. and D.A. Keinath (2006, October 25). Townsend's Big-eared Bat (*Corynorhinus townsendii*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5181908.pdf

Hammerson, G.A. 1999. Amphibians and Reptiles in Colorado, a Colorado Field Guide. Second Edition. University Press of Colorado, Niwot, CO. pgs 82-85, 90-98, 145-151, 375-386,

Hayward, G.D. and J. Verner, Technical Editors. 1994. Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. GTR-RM-253. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Pgs. 41, 119.

Hedge, Allen. 2011. Acoustic Environment. DEA3500. Cornell University. January 2011.

Hillis, J.M., M.J. Thompson, J.E. Canfield, L.J. Lyon, C.L. Marcum, P.M. Dolan and D.W. McCleerey. 1991. Defining Elk Security: the Hillis paradigm. Elk Vulnerability Symposium, Montana State University, Bozeman, MT. April 10-12, 1991. pgs 38-43.

Holmes, J.A. and M.J. Johnson (2005, January 13). Brewer's Sparrow (*Spizella breweri*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182051.pdf

Hoover, R.L. and D.L. Wills, eds. 1984. Managing Forested Lands for Wildlife. Colorado Division of Wildlife in cooperation with USDA Forest Service, Rocky Mountain Region, Denver, CO. 46-50, 58-60.

Interagency Lynx Biology Team. 2013. Canada Lynx Conservation Assessment and Strategy. 3rd Edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-13-19, Missoula, MT. 128 pp. http://www.fs.fed.us/biology/resources/pubs/wildlife/LCAS_revisedAugust2013.pdf

Johnson, R.C. 1989. Geologic History and Hydrocarbon Potential of the Late Cretaceous-Age, Low Permeability Reservoirs, Piceance Basin, Western Colorado., in Evolution of Sedimentary Basins - Uinta and Piceance Basins. U.S. Geological Survey Bulletin 1787: E hnston, Barry C. 2001. Field guide to ecological types of the upper Gunnison Basin. Technical Report R2-RR-2001-02, 295 pp. Lakewood, CO: USDA Forest Service. May, 2001.

Johnston, B., Stratton, B, Young, W., Mattson, L., Almy, J., and G. Austin. 2012. Inventory of Fens in a Large Landscape of West-Central Colorado: Grand Mesa, Uncompahgre, and Gunnison National Forests. Report to Forest Supervisor, 209 pp. Delta, Colorado:Grand Mesa, Uncompahgre, and Gunnison National Forests. April 6, 2012. Published on World Wide Web.

Keinath, D.A. (2004, October 29). Fringed Myotis (*Myotis thysanodes*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5181913.pdf

Kennedy, P.L. (2003, January 2). Northern Goshawk (*Accipiter gentilis atricapillus*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182005.pdf

Kingery, H.E. ed. 1998.Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife. Denver, CO. Pgs 210-211, 228-229, 236-237.

Kotliar, N.B. (2007, February 20). Olive-sided Flycatcher (*Contopus cooperi*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182039.pdf

Lazear, G.D. 2009. Fractures, convection and underpressure: hydrogeology on the southern margin of the Piceance basin, west-central Colorado, USA. Hydrogeology Journal 17:641-664.

Luce, R.J. and D. Keinath. (2007, October 31). Spotted Bat ( ): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5181916.pdf

Lyon, L.J. 1979. Habitat Effectiveness for Elk as Influenced by Roads and Cover. Journal of Forestry. October 1979. p 658-660.

McMahon, P.B., Thomas, J.C., and Hunt, A.G., 2013, Chemistry and age of groundwater in bedrock aquifers of the Piceance and Yellow Creek watersheds, Rio Blanco County, Colorado, 2010–12: U.S. Geological Survey Scientific Investigations Report 2013–5132, 89 p., http://pubs.usgs.gov/sir/2013/5132/.

McMahon, P.B., Thomas, J.C., and Hunt, A.G., 2011, Use of diverse geochemical data sets to determine sources and sinks of nitrate and methane in groundwater, Garfield County, Colorado, 2009: U.S. Geological Survey Scientific Investigations Report 2010–5215, 40 p.

Monarch & Associates. 2014. Habitat and Wildlife Report for the Proposed Spadafora Drill Site. Prepared for Gunnison Energy LLC. October.

Mueggler, W.F. 1985. Vegetation Associations *in* Aspen: Ecology and Management in the Western United States, DeByle and Winokur, eds. General Technical Report RM-GTR-119. Ogden, Utah: USDA Forest Service, Rocky Mountain Research Station. Pg. 45 http://www.fs.fed.us/rm/pubs_rm/rm_gtr119.pdf

"National Soil Survey Handbook, title 430-VI". U.S. Department of Agriculture, Natural Resources Conservation Service. 2005.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 2012).

Osborn, S.G., Vengosh, A., Warner, N.R., and Jackson, R.B., 2011, Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing: Proceedings of the National Academy of Sciences, v. 108, p. 8172–8176.

Pardieck, K.L., D.J. Ziolkowski Jr., M.-A.R. Hudson. 2015. *North American Breeding Bird Survey Dataset 1966 - 2014, version 2014.0*. U.S. Geological Survey, Patuxent Wildlife Research Center www.pwrc.usgs.gov/BBS/RawData/. (Accessed: June 2, 2015).

Phillips, G.E. and A.W. Alldredge. 2000. Reproductive success of elk following disturbance by humans during calving season. Journal of Wildlife Management 64(2): 521-530.

Pitman, J. K., C. W. Spencer, and R. M. Pollastro. 1988. Petrograhy Mineralogy, and Reservoir Characteristics of the Upper Cretaceous Mesaverde Group in the East-Central Piceance Basin, Colorado. in Evolution of Sedimentary Basins - Uinta and Piceance Basins. U.S. Geological Survey Bulletin 1787: G.

Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce, G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management Recommendations for the Northern Goshawk in the Southwestern United States. http://www.fs.fed.us/rm/pubs_rm/rm_gtr217.pdf

Ries, K.G., III, Steeves, P.A., Guthrie, J.D., Rea, A.H., and Stewart, D.W., 2009, Stream_network Navigation in the U.S. Geological Survey StreamStats Web Application, pp. 80-84.

Rowland, M.M., M.J. Wisdom, B.K. Johnson and J.G. Kie. 2000. Elk distribution and modeling in relation to roads. Journal of Wildlife Management 64(3): 672-684.

Ruediger, B. et al. 2000. Canada Lynx Conservation Assesment and Strategy. 2nd Edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. pgs 1-3, 1-10, 1-11, 1-13. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5193264.pdf

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski. 1994. The Scientific Basis for Conserving American Marten, Fisher, Lynx and Wolverine in the Western United States. General Technical Report RM-254. Ft. Collins, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Pgs 8, 24-27, 114-115. http://www.fs.fed.us/rm/pubs_rm/rm_gtr254.pdf

Ruggerio, L.F., K.B. Aubry, S.W. Buskirk and others. 1999. Ecology and Conservation of Lynx in the United States. University Press of Colorado, Boulder, CO. pgs 122, 183-191. http://www.fs.fed.us/rm/pubs/rmrs_gtr030.pdf

Ruggerio, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon and W.J. Zielinski. 1994. The Scientific Basis for Conserving American Marten, Fisher, Lynx and Wolverine in the Western United States. General Technical Report RM-254. Ft. Collins, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Pgs 8, 24-27, 114-115. http://www.fs.fed.us/rm/pubs/rmrs_gtr030.pdf

Rutqvist, J., A. P. Rinaldi, F. Cappa, and G. J. Moridis. 2013. Modeling of Fault Reactivation and Induced Seismicity During Hydraulic Fracturing of Shale-Gas Reservoirs. Journal of Petroleum Science and Engineering. April 28. Online at: http://www2.epa.gov/sites/production/files/2013-12/documents/fault-reactivation.pdf

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, MD. Accessed 05/20/2015..

Shenk, T.M. 2009B. Wildlife research report covering the period from July 1, 2008 – August 31, 2009. Colorado Parks and Wildlife. Available online: http://wildlife.state.co.us/Research/Mammal/Lynx/.

Shenk, T. 2005. General Locations of Lynx (*Lynx Canadensis*) Reintroduced to Southwestern Colorado from February 4, 1999 through February 1, 2005. Colorado Parks and Wildlife, Wildlife Research Center. Fort Collins, CO.

Smith, B.E. and D.A. Keinath. (2007, January 16). Northern Leopard Frog (*Rana pipiens*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182078.pdf

SWCA Environmental Consultants 2013, North Fork Gunnison River and Surface Creek Watershed Monitoring 2012 Annual Report, Gunnison and Delta Counties, Colorado.

Tweto, O. 1979. Geologic Map of Colorado. Colorado Geological Survey Miscellaneous Investigations MI-16. 1:500,000.

1983. Geologic Sections Across Colorado (Section C-C'). Colorado Geological Survey Miscellaneous Investigations MI-1416. 1:500,000.

USDA Forest Service. 1991. Amended Land and Resource Management Plan, Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/detail/gmug/landmanagement/planning/?cid=fsbdev7_003229

USDA Forest Service. 1994. Habitat Capability Model, Rocky Mountain Region, Documentation and Users Guide. USDA Forest Service, Rocky Mountain Region, Renewable Resources, Lakewood, CO. p 4-6.

USDA Forest Service, 2001. Management Indicator Species Assessment, Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/detail/gmug/landmanagement/planning/?cid=fsbdev7_003229

USDA Forest Service. 2004. Matrix of Management information for R2 TES species. Rocky Mountain Regional Office (R2), Lakewood, CO. Accessed September 2012.

USDA Forest Service. 2005. Management Indicator Species Assessments for the Grand Mesa, Uncompahgre and Gunnison National Forests. Version 1.0. Delta, CO. Available online: http://www.fs.usda.gov/goto/gmug/wildlife.

USDA Forest Service. 2005. Canada Lynx Conservation Agreement; US Forest Service and US Fish and Wildlife Service. USFS Agreement #00-MU-11015600-013. http://omnilearn.net/esacourse/pdfs/Canada_Lynx_CA.pdf

USDA Forest Service 2005b. Rocky Mountain Elk (*Cervis elaphus nelsoni*) Species Assessment Draft. Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5199934.pdf

USDA Forest Service 2005c. Environmental Assessment, Management Indicator Species, forest Plan Amendment to the LRMP for the Grand Mesa, Uncompahgre, and Gunnison National Forests. March, 2005. Delta, CO. http://www.fs.usda.gov/detail/gmug/landmanagement/resourcemanagement/?cid=stelprdb5199918

USDA Forest Service 2005d. Merriam's Turkey (*Meleagris gallapovo merriami*) Species Assessment. Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5202737.pdf

USDA Forest Service 2005e. Red-naped Sapsucker (*Sphyrapicus nucahlis*) Species Assessment. Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5199831.pdf

USDA Forest Service 2005f. Northern Goshawk (*Accipiter gentilis*) Species Assessment. Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5199933.pdf

USDA Forest Service 2005g. Brewer's Sparrow (*Spizella breweri*) Species Assessment. Grand Mesa, Uncompahgre, and Gunnison National Forests. Delta, CO. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5199815.pdf

USDA Forest Service 2007. Sheep Gas Gathering System Environmental Assessment. GMUG,Paonia Ranger District; June.

USDA Forest Service, 2008. Biological Evaluation and Management Indicator Species Assessment for Federal 11-90-15 Well and Pipeline. Paonia, CO. May 16.

USDA Forest Service. 2008. Southern Rockies Lynx Management Direction Record of Decision. Denver, CO. http://coloradoforestry.org/pdfs/southern-lynx-rod.pdf

USDA Forest Service. 2008a. Biological Assessment for Federal 11-90-15 Well and Pipeline. Paonia, CO. May 5.

USDA Forest Service. 2009. Supplement to the Biological Assessment, Biological Evaluation, and MIS report for the Federal 11-90-15-1 well and associated gathering line project. Paonia, CO. July 30.

USDA Forest Service. 2010. Biological Assessment for Gunnison Energy Master Development Plan. Paonia, CO. July 27.

USDA Forest Service. 2011. Chapter 2670 - Threatened, Endangered and Sensitive Plants and Animals. Forest Service Manual (Supplement 2600-2011-1), Rocky Mountain Region (Region 2), Lakewood, CO. Accessed September 2012.

USDA Forest Service. May 2012. R2 Matrix of TES Species by Unit. Rocky Mountain Regional Office (R2), Lakewood, CO. Accessed September 2012.

USDA Forest Service 2013. Regional Forester Sensitive Species List. August 24, 2013. http://fsweb.r2.fs.fed.us/rr/R2_TES_Site_2007/sensitive/fsm_r2_2670_2013-1_FINAL.pdf

USDA Forest Service. 2013. Biological Assessment for SG Interests I 11-90-9 #3 Well. Paonia, CO February 8.

USDA Forest Service, 2014. Update to the Management Indicator Species Assessment for the Red-naped Sapsucker. Delta, CO. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3837155.pdf

USDA Forest Service 2015. Rocky Mountain Region Threatened, Endangered, Proposed, and Sensitive Species, February 17, 2015. Downloaded May 6, 2015. http://fsweb.r2.fs.fed.us/rr/R2_TES_Site_2007/sensitive/matrices/2015-02-17_r2_tes_by_unit.docx

USDA Forest Service. 2015a. Sensitive Species Evaluation Forms. www.fs.fed.us/r2/projects/scp.

USDA Forest Service, 2015b. Region 2 Species Conservation Assessments. http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml

USDA, Natural Resources Conservation Service, Soil Survey of the Paonia Area, Colorado. Parts of Delta, Gunnison, and Montrose Counties. In cooperation with the Colorado Agricultural Experiment Station. 1981.

USDA, Natural Resources Conservation Service, Soil Survey of the Grand Mesa Area, Colorado. Parts of West Elk Area, Parts of Delta, Garfield, Gunnison, Mesa and Montrose Counties. In cooperation with the Colorado Agricultural Experiment Station.

USDI Bureau of Land Management. 2015. Draft Environmental Impact Statement for the Bull Mountain Unit Master Development Plan. Montrose, CO. http://www.blm.gov/style/medialib/blm/co/information/nepa/uncompahgre_field/13-22_bull_mountain.Par.23863.File.dat/Bull_Mtn_DEIS_Jan2015_508_reduced.pdf

2012. Reasonable Foreseeable Development Scenario for Oil and Gas for the Uncompahgre Field Office, Colorado. Prepared by BLM Wyoming State Office, Reservoir Management Group for BLM, Uncompahgre Field Office, Montrose, CO. February 2012.

2013a. 2013. Hydraulic Fracturing White Paper. BLM Wyoming State Office. July 5, 2013.

USDI Bureau of Land Management 2008: Gunnison Energy 16 Well Master Development Plan; DOI-BLM-CO-2008-0035-EA BLM Uncompahgre Field Office. February 10.

USDI Fish and Wildlife Service. 2005. Recovery Outline; Contiguous United States Distinct Population Segment of the Canada Lynx, 9/14/05. USFWS, Helena, Montana. 21pp. http://www.fws.gov/mountain-prairie/species/mammals/lynx/final%20lynx%20RecoveryOutline9-05.pdf

USDI Fish and Wildlife Service. 2005a. Proposed Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx; Proposed Rule. Federal Register, Vol. 70, No. 216, pp 69294-68328. https://www.federalregister.gov/articles/2005/11/09/05-22193/endangered-and-threatened-wildlife-and-plants-proposed-designation-of-critical-habitat-for-the

USDI Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Contiguous Unites States Distinct Population Segment of the Canada Lynx; Final Rule. Federal Register, Vol. 71, No. 217, 66008-66061. https://www.federalregister.gov/articles/2006/11/09/06-9090/endangered-and-threatened-wildlife-and-plants-designation-of-critical-habitat-for-the-contiguous

USDI Fish and Wildlife Service. 2009. Endangered and Threatened Wildlife and Plants; Revised Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx (Lynx canadensis); Proposed Rule. Federal Register, Vol. 74, No. 36, pp. 8616-8702. https://www.federalregister.gov/articles/2009/02/25/E9-3512/endangered-and-threatened-wildlife-and-plants-revised-designation-of-critical-habitat-for-the

USDI Fish and Wildlife Service. 2014. Inter-Agency Southern Rockies Lynx Project Decision Screens. http://fsweb.r2.fs.fed.us/rr/R2_TES_Site_2007/esa/2014-08-15_LynxScreens_2014_&Agreement_corrected_FINAL.pdf

USDI Fish and Wildlife Service. 2014a. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary. Federal Register, Vol. 79, No. 177, pp.54781-54846. https://www.federalregister.gov/articles/2014/09/12/2014-21013/endangered-and-threatened-wildlife-and-plants-revised-designation-of-critical-habitat-for-the

Warpinski, M. 2013. Understanding Hydraulic Fracture Growth, Effectiveness, and Safety Through Microseismic Monitoring. http://dx.doi.org/10.5772/55974 . Accessed on January 13, 2014.

Weinhold, B. 2012. Energy Development Linked with Earthquakes. Environmental Health Perspectives Vol. 120, No. 10. October 2012.

Wiggins, D. (2005, March 31). Purple Martin (*Progne subis*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182038.pdf

This page intentionally left blank

APPENDIX A. LEASE STIPULATIONS

Well Pad	Legal Description	Lease Number	Stipulation Legal Description	Year Leased
GE Henderson 11-90-8-14	Sec 8 T11S R90W Mer 6PM	COC-42314 (surface)	T11S R90W 6th PM, Sec 3: Lots 1 thru 14, N1/4SW1/4, SE1/4SW1/4, S1/2SE1/4, NW1/4SE1/4. Sec 4: NE1/4SE1/4. Sec 8: Lots 1 thru 6, N1/2, SW1/4SW1/4. Sec 9: S1/2. Sec 15: SE1/4NE1/4, S1/2SE1/4NE1/4NE1/4, S1/2SW1/4NE1/4, S1/2N1/2SW1/4NE1/4, N1/2NW1/4NW1/4NE1/4, N1/2NE1/4NE1/4NW1/4, W1/2E1/2NW1/4, SE1/4SE1/4NW1/4, S1/2NE1/4SE1/4NW1/4, W1/2NW1/4, S1/2.	11/1/1970
Lease Stipulation				
(a) At least two weeks before beginning of any clearing, construction, or operations, including access and work road location and construction, the lessee shall prepare a "Lessee Surface Management Operation Plan" with the District Ranger, Paonia, Colorado. The final plan shall be prepared in triplicate, including maps, for the approval by the Forest Supervisor. Such approval will be conditioned on reasonable requirements needed to prevent soil erosion, water pollution, and unnecessary damages to the surface vegetation and other resources of the United States and to provide for the restoration of the land surface and vegetation. The plan shall contain all such provisions as the Forest Service may deem necessary to maintain proper management of the lands and resources within the operating area. Where appropriate, depending upon the location and type of operation, the Forest Supervisor may require the plan to contain, at a minimum, the following items: 1. The location, construction specifications, maintenance program, and estimated use by the lessee, his employees and agents, of all access and work roads. 2. The exact location and extent of any and all areas to be occupied during the operations. 3. The methods to be used in the operations, including disposal of waste material. 4. The size and type of equipment to be used in the operation. 5. The capacity, size, character, standards of construction and location of all structures and facilities to be constructed. 6. Typical profiles of cuts and fills of all areas upon which vegetation will be destroyed and/or soil laid bare and the steps which will be taken to prevent and control soil erosion thereon, including but not limited to the proposed program for rehabilitation and revegetation of these disturbed lands both during and upon cessation of operations. 8. The steps which will be taken to prevent water pollution. 9. The character, amount, and time of use of explosives, or fire, including safety precautions which will be taken during their use. 10. Forest User, permitted livestock, and wildlife protection. If later operations require departure from or additions to the approved plan, these revisions or amendments, together with justification statement for proposed revisions, will be submitted to the District Ranger for approval of the Forest Supervisor. Any and all operations conducted in advance of approval of an original, revised, or amended operating plan, or which are not in accord with an approved plan, constitute a violation to the terms of this lease and the Forest Service reserves the right to close down the operation until such corrective action, as is deemed necessary, is taken by the lessee.				

GE Henderson 11-90-8-14	Sec 8 T11S R90W Mer 6PM	COC-42314 (surface)	T11S R90W 6th PM, Sec 3: Lots 1 thru 14, N1/4SW1/4, SE1/4SW1/4, S1/2SE1/4, NW1/4SE1/4. Sec 4: NE1/4SE1/4. Sec 8: Lots 1 thru 6, N1/2, SW1/4SW1/4. Sec 9: S1/2. Sec 15: SE1/4NE1/4, S1/2SE1/4NE1/4NE1/4, S1/2SW1/4NE1/4, S1/2N1/2SW1/4NE1/4, N1/2NW1/4NW1/4NE1/4, N1/2NE1/4NE1/4NW1/4, W1/2E1/2NW1/4, SE1/4SE1/4NW1/4, S1/2NE1/4SE1/4NW1/4, W1/2NW1/4, S1/2.	11/1/1970
Lease Stipulation				
(b) (1) To guarantee the successful rehabilitation and revegetation of abandoned operating areas, as provided for in the "Lessee Surface Management Operating Plan," paragraph (a) above, the Forest Service is agreeable to the reduction of lease or operator bonds to an amount necessary to cover the estimated cost of rehabilitation and revegetation, providing, that the lessee has otherwise satisfied the conditions of this lease and the United States Geological Survey and the Bureau of Land Management have approved such a reduction. (2) In lieu of bond, the lessee may upon mutual agreement with the Forest Supervisor deposit cooperative funds sufficient to cover the cost of rehabilitating abandoned operating areas. When such funds have been deposited, the Forest Supervisor shall notify the United States Geological Survey what the requirement of the Forest Service have been satisfied, providing, the all other conditions of the lease which concern the Forest Service have been satisfied. (c) No occupancy of the surface of the following areas is authorized by this lease. The lessee is, however, authorized to employ directional drilling to develop the mineral resources under these areas provided that such drilling or other works will not disturb the surface area or otherwise interfere with their use by the Forest Service. It is understood and agreed that the use of these areas for National Forest purposes is superior to any other use. Areas to be excluded from direct drilling occupancy are: (1) Within 500 feet on either side of the centerline of any and all roads and/or highways within the lease areas. (2) Within 200 feet on either side of the centerline of any and all trails within the lease area. (3) Within 500 feet of the normal high-water line of any and all lakes, ponds, and reservoirs located within the lease area. (4) Within 500 feet of the normal high-water line of any and all streams in the area. The distances in subparagraphs 1, 2, 3, and 4 immediately above may be reduced when specifically agreed to in the operating plan, see paragraph (a). (5) Within 400 feet of any and all springs within the lease area. (6) Within 400 feet of any improvements either owned, permitted, leased or otherwise authorized by the Forest Service.				
GE Henderson 11-90-8-14	Sec 8 T11S R90W Mer 6PM	COC-42314 (surface)	T11S R90W 6th PM, Sec3: N22SW, SESW, S2SE, NWSE, Lots 1-14; Sec 4: NESE; Sec 8: N2, SWSW, Lots 1-6; Sec 9: S2; Sec 14: SWNE, NWNW, SE, Lots 3.	11/1/1970
Lease Stipulation				

NO SURFACE OCCUPANCY: WETLANDS / FLOODPLAINS / RIPARIAN AREAS. No surface occupancy or use is allowed on the lands described below (legal subdivision or other description). or portions of Sec. ,T.m,R.___,PM , as shown on the attached map which becomes a part hereof. Wetlands, Floodplains and Riparian Areas of any defined drainage or location containing these specific ecosystem types come under jurisdiction of this stipulation. Drill pads, staging areas and storage sites will not be allowed in these areas. When road locations must occur in these areas, streams will be crossed at right angles and access across other areas will be held to a minimum. Streams will not be paralleled by roads through these areas. Location of these areas which is more specific than can be identified on USGS topographic maps will come at the APD stage based on on-the-ground observations. For the purpose of: The management of wetlands and floodplains are subject to Executive Orders 11990 and 11988, respectively. The purpose of the EO's are to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and floodplains and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternative. Also, it is recognized that there is a direct relationship between impacts on such areas and effects on water quality and aquatic ecosystems. There is a high risk of irreversible and irretrievable impacts on the latter with operation and developments in wetlands, floodplains and riparian areas. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered flit can be shown through environmental analysis and the application of mitigation measures that the impacts to wetland, floodplain and riparian resources will be minimized and that no other alternative route for a road or pipeline is feasible because of environmental effects. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

GE Henderson 11-90-8-14	Sec 8 T11S R90W Mer 6PM	COC-42314 (surface)	T11S R90W 6th PM, Sec 3: N2SW, SESW, S2SE, NWSE, Lots 1-14; Sec 4: NESE; Sec 8: N2, SWSW, Lots 1-6; Sec 9: S2; Sec 14: SWNE, NWNW, SE, Lots 3.	11/1/1970

Lease Stipulation

CONTROLLED SURFACE USE STIPULATION: BIG GAME WINTER RANGE. Surface occupancy or use is subject to the following special operating constraint. Limit road use to periods when animals are not present on the winter range. Restrict road use to operators. Recontour and revegetate to prior existing conditions (to extent possible) new roads when work is complete. Operation and maintenance of production facilities will be scheduled to minimize adverse effects on big game (Elk, Mule Deer, Big Horn Sheep and Turkey) from December 1 to April 30. On lands described below: All or portions of Sec.m,T.a,RI__,PM____ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is classified as big game winter range for one of the four species listed above falls under jurisdiction of this stipulation. For the purpose of: Protecting big game winter range for Elk, Mule Deer, Bighorn Sheep and Turkey. These ranges are extremely important for animal survival during winter. Disturbances and habitat losses may place unnecessary stress on the wintering wildlife herds and cause an increase in herd mortality. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)

GE Henderson 11-90-8-14	Sec 8 T11S R90W Mer 6PM	COC-42314 (surface)	T11S R90W 6th PM, Sec 3: N2SW, SESW, S2SE, NWSE, Lots 1-14; Sec 4: NESE; Sec 8: N2, SWSW, Lots 1-6; Sec 9: S2; Sec 14: SWNE, NWNW, SE, Lots 3.	11/1/1970
Lease Stipulation				
CONTROLLED SURFACE USE STIPULATION: MODERATE GEOLOGIC HAZARD. Surface occupancy or use is subject to the following special operating constraints. Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e. subsidence, acid drainage). On lands described below: All or portions of See. ,T. ,R. ,PM__ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is identified as having moderate geologic hazard falls under jurisdiction of this stipulation. For the purpose of: To insure the stability of facilities required (roads, pipelines, drill pads, etc.) during the oil and gas operations and to insure the stability of lands adjacent to these facilities. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(1) To conduct all operations authorized by this lease (permit) with due regard for good land management, not to cut or destroy timber without first obtaining permission from the authorized representative of the Secretary of Agriculture, and to pay for all such timber cut or destroyed at the rates prescribed by such representative; to avoid unnecessary damage to improvements, timber, crops, or other cover; unless otherwise authorized by the Secretary of Agriculture, not to drill any well, • carr1 on operations, make excavations, construct tunnels, drill, or otherwise disturb the surface of the leased (permitted) lands within 200 feet of any building standing on the leased (permitted) lands and whenever required in writing by the authorized representative of the Secretary of Agriculture to fence or fill all sump holes, ditches and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the leased (permitted) lands to their former condition, including the removal of structures as and if required, and when required by such representative to bury all pipelines below plow depth.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation				
(2) To do all in his power to prevent and suppress forest, brush or grass fires on the leased (permitted) land and in its vicinity, and to require his employees of contractors, subcontractors, and employees of contractors or subcontractors to do likewise. Unless prevented by circumstances over which he has no control, the lessee (permittee) shall place his employees, contractors, subcontractors, and employees of contractors and subcontractors employed on the leased (permitted) land at the disposal of any authorized officer of the Department of Agriculture for the purpose of fighting forest, brush, or grass fires on or originating on the leased (permitted) lands or on adjacent areas or caused by the negligence of the lessee (permittee) or his emplo7eea, contractors, subcontractors and employees of contractors and subcontractors, with the understanding that payment for such services shall be made at rates to be determined by the authorized representative of the Secretary of Agriculture, which rates shall not be less than the current rates of pay prevailing in the vicinity for services of a similar character: Provided, that if the lessee (permittee), his employees, contractors, subcontractors, or employees of contractors or subcontractors, caused or could have prevented the origin or spread of said fire or fires, no payment shall be made for services so rendered. During periods of serious fire danger to forest, brush, or grass, as may be specified by the authorized representative of the Secretary of Agriculture, the lessee (permittee) shall prohibit smoking and the building of camp and lunch fires by his employees, contractors, subcontractors, and employees of contractors or subcontractors within the leased (permitted) area except at established camps, and shall enforce this prohibition by all means within his power: Provided, that the authorized representative of the Secretary of Agriculture may designate safe places where, after all inflammable material has been cleared away, campfires may be built for the purpose of heating lunches and where, at the option of the lessee (permittee), smoking may be permitted. The lessee (permittee) shall not burn rubbish, trash or other inflammable materials except with the consent of the authorized representative of the Secretary of Agriculture and shall not use explosives in such a manner as to scatter inflammable materials on the surface of the land during the forest, brush, or grass fire season, except as authorized to do so or on areas approved by such representative. The lessee (permittee) shall build or construct such fire lines or do such clearing on the leased land as the authorized representative of the Secretary of Agriculture decides is essential for forest, brush, and grass fire prevention which is or may be necessitated by the exercise of the privileges authorized by this lease (permit), and shall maintain such fire tools at his headquarters or at the appropriate location on the leased (permitted) land as are deemed necessary by such representative.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(3) In the location, design, construction and maintenance of all authorized works, buildings, plants, waterways, roads, telegraph or telephone lines, pipeline!!, reservoirs, tanks, pumping stations, or other structures or clearance, the lessee (permittee) shall do all things reasonably necessary to prevent or reduce to the fullest extent scarring and erosion of the land, pollution of the water resources and any damage to the watershed. Where construction, operation, or maintenance of any of the facilities on or connected with this lease (permit) causes damage to the watershed or pollution or the water resources, the lessee (permittee) agrees to repair such damage and to take such corrective measures to prevent further pollution or damage to the watershed as are deemed necessary by the authorized representative of the Secretary of Agriculture.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				

(4) To pay the lessor (permitter) or his tenant or the surface owner or his tenant, as the case may be, for any and all damage to or destruction of property caused by lessee's (permittee's) operations hereunder; to save and hold the lessor (permittee) or the surface owner or their tenants harmless from all damage or claims for damage to persons or property resulting from lessee's (permittee's) operations under this lease (permit).				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(5) To recognize existing uses and commitments, in the form of Department of Agriculture grazing, timber cutting, and special use permits, water developments, ditch, road, trail, pipeline, telephone line, and fence rights-of-way and other similar improvements, and to conduct his operations so as to interfere as little as possible with the rights and privileges granted by these permits or with other existing uses.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(6) To install and maintain cattle guards to prevent the passage of livestock in any openings made in fences by the lessee (permittee) or his contractors to provide access to the lands covered by this lease (permit) for automotive and other equipment.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(7) If lessee (permittee) shall construct any camp on the land, such camp shall be located at a place approved by the authorized representative of the Secretary of Agriculture, and such representative shall have authority to require that such camp be kept in a neat and sanitary condition.				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				
(8) To comply with all the rules and regulations of the Secretary of Agriculture governing the national forests or other lands under his jurisdiction which are embraced in this lease (permit).				
SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954
Lease Stipulation				

(9) Unless otherwise authorized, prior to the beginning of operations to appoint and maintain at all times during the term of this lease (permit) a local agent upon whom may be served written orders or notices respecting matters contained in this stipulation, and to inform the authorized representative of the Secretary of Agriculture, in writing, of the name and address of such agent. If a substitute agent is appointed, the lessee (permittee) shall immediately so inform the said representative.

SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation

(10) To address all matters relating to this stipulation to Forest Supervisor, Gunnison National Forest, Gunnison, Colorado, who is the authorized representative of the Secretary of Agriculture, or to such other representative as may from time to time, be designated, provided that such designation shall be in writing and be delivered to the lessee (permittee) or his agent.

SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation

(11) If all or any part of the leased (permitted) lands lie within a municipal watershed, or are, in the opinion of the authorized representative of the Secretary of Agriculture, primarily valuable for watershed protection, the lessee (permittee) shall reseed or otherwise restore the vegetative cover, as required by the authorized representative of the Secretary of Agriculture, for watershed protection and erosion prevention on any areas damaged because of the operation.

SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation

NSO: WETLANDS / FLOODPLAINS / RIPARIAN AREAS. No surface occupancy or use is allowed on the lands described below (legal subdivision or other description). or portions of Sec. ,T.m,R.___,PM , as shown on the attached map which becomes a part hereof. Wetlands, Floodplains and Riparian Areas of any defined drainage or location containing these specific ecosystem types come under jurisdiction of this stipulation. Drill pads, staging areas and storage sites will not be allowed in these areas. When road locations must occur in these areas, streams will be crossed at right angles and access across other areas will be held to a minimum. Streams will not be paralleled by roads through these areas. Location of these areas which is more specific than can be identified on USGS topographic maps will come at the APD stage based on on-the-ground observations. For the purpose of: The management of wetlands and floodplains are subject to Executive Orders 11990 and 11988, respectively. The purpose of the EO's are to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and floodplains and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternative. Also, it is recognized that there is a direct relationship between impacts on such areas and effects on water quality and aquatic ecosystems. There is a high risk of irreversible and irretrievable impacts on the latter with operation and developments in wetlands, floodplains and riparian areas. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered flit can be shown through environmental analysis and the application of mitigation measures that the impacts to wetland, floodplain and riparian resources will be minimized and that no other alternative route for a road or pipeline is feasible because of environmental effects. Any changes to this stipulation will be made in

accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation

CONTROLLED SURFACE USE STIPULATION: BIG GAME WINTER RANGE. Surface occupancy or use is subject to the following special operating constraint. Limit road use to periods when animals are not present on the winter range. Restrict road use to operators. Recontour and revegetate to prior existing conditions (to extent possible) new roads when work is complete. Operation and maintenance of production facilities will be scheduled to minimize adverse effects on big game (Elk, Mule Deer, Big Horn Sheep and Turkey) from December 1 to April 30. On lands described below: All or portions of Sec.m,T.a,RI__,PM____ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is classified as big game winter range for one of the four species listed above falls under jurisdiction of this stipulation. For the purpose of: Protecting big game winter range for Elk, Mule Deer, Bighorn Sheep and Turkey. These ranges are extremely important for animal survival during winter. Disturbances and habitat losses may place unnecessary stress on the wintering wildlife herds and cause an increase in herd mortality. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)

SG Federal 11-90-9-3	Sec 9 T11S R90W Mer 6PM	COC-8905 (surface)	T11S R90W 6th PM, Sec 4: Lots 1-12, SW,NWSE,S2SE. Sec 5: Lots 1-12, S1/2. Sec 6: Lots 1-11, SE. Sec 9: N1/2.	11/1/1954

Lease Stipulation

CONTROLLED SURFACE USE STIPULATION: MODERATE GEOLOGIC HAZARD. Surface occupancy or use is subject to the following special operating constraints.
Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e. subsidence, acid drainage).
On lands described below:
All or portions of See. ,T. ,R. ,PM__ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is identified as having moderate geologic hazard falls under jurisdiction of this stipulation.
For the purpose of:
To insure the stability of facilities required (roads, pipelines, drill pads, etc.) during the oil and gas operations and to insure the stability of lands adjacent to these facilities. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest

Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.
Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(1) To conduct all operations authorized by this lease or permit with due regard for good land management, not to cut or destroy timber without first obtaining permission from the authorized representative of the Secretary of Agriculture, and to pay for all such timber cut or destroyed at the rates prescribed by such representative; to avoid unnecessary damage to improvements, timber, crops, or other cover; unless otherwise authorized by the Secretary of Agriculture, not to drill any well, carry on operations, make excavations, construct tunnels, drill, or otherwise disturb the surface of the lands within 200 feet of any building standing on the lands and whenever required, in writing, by the authorized representative of the Secretary of Agriculture to fence or fill all sump holes, ditches, and other excavations, remove or cover all debris, and so far as reasonably possible, restore the surface of the lands to their former condition, including the removal of structures as and if required, and when required by such representative to bury all pipelines below plow depth.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(2) To do all in his power to prevent and suppress forest, brush, or grass fires on the lands and in their vicinity, and to require his employees, contractors, subcontractors, and employees of contractors or subcontractors to do likewise. Unless prevented by circumstances over which he has no control, the lessee or permittee shall place his employees, contractors, subcontractors, and employees of contractors and subcontractors employed on the lands at the disposal of any authorized officer of the Department of Agriculture for the purpose of fighting forest, brush, or grass fires on or originating on the lands or on adjacent areas or caused by the negligence of the lessee or permittee or his employees, contractors, subcontractors and employees of contractors and subcontractors, with the understanding that payment for such services shall be made at rates to be determined by the authorized representative of the Secretary of Agriculture, which rates shall not be less than the current rates of pay prevailing in the vicinity for services of a similar character: Provided, that if the lessee or permittee, his employees, contractors, subcontractors, or employees of contractors or subcontractors, caused or could have prevented the origin or spread of said fire or fires, no payment shall be made for services so rendered.
During periods of serious fire danger to forest, brush, or grass, as may be specified by the ,authorized representative of the Secretary of Agriculture, the lessee or permittee shall prohibit smoking and the building of camp and lunch fires by his employees, contractors, subcontractors, and employees of contractors or subcontractors within the area involved except at established camps, and shall enforce this prohibition by all means within his power: Provided, that the authorized representative of the Secretary of Agriculture may designate safe places where, after all inflammable material has been cleared away, campfires may be built for the purpose of heating lunches and where, at the option of the lessee or permittee, smoking may be permitted.
The lessee or permittee shall not burn rubbish, trash, or other inflammable materials except with the consent of the authorized representative of the Secretary of Agriculture and shall not use explosives in such a manner as to scatter inflammable materials on the surface of the lands during the forest, brush,

or grass fire season, except as authorized to do so or on areas approved by such representative. The lessee or permittee shall build or construct such fire lines or do such clearing on the lands as the authorized representative of the Secretary of Agriculture decides is essential for forest, brush, and grass fire prevention which is or may be necessitated by the exercise of the privileges authorized by this lease or permit, and shall maintain such fire tools at his headquarters or at the appropriate location on the lands as are deemed necessary by such representative.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(3) In the location, design, construction and maintenance of all authorized works, buildings, plants, waterways, roads, telegraph or telephone lines, pipelines, reservoirs, tanks, pumping stations, or other structures or clearance, the lessee or permittee shall do all things reasonably necessary to prevent or reduce to the fullest extent scarring and erosion of the lands, pollution of the water resources and any damage to the watershed. Where construction, operation, or maintenance of any of the facilities on or connected with this lease or permit causes damage to the watershed or pollution of the water resources, the lessee or permittee agrees to repair such damage and to take such corrective measures to prevent further pollution or damage to the watershed as are deemed necessary by the authorized representative of the Secretary of Agriculture.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(4) To pay the lessor or permittee or his tenant or the surface owner or his tenant, as the case may be, for any and all damage to or destruction of property caused by the lessee's or permittee's operations hereunder; to save and hold the lessor or permittee or the surface owner or their tenants harmless from all damage or claims for damage to persons or property resulting from the lessee's or permittee's operations under this lease or permit.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(5) To recognize existing uses and commitments, in the form of Department of Agriculture grazing, timber cutting, and special use permits, water developments, ditch, road, trail, pipeline, telephone line, and fence rights-of-way and other similar improvements, and to conduct his operations so as to interfere as little as possible with the rights and privileges granted by these permits or with other existing uses.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation

(6) To install and maintain cattle guards to prevent the passage of livestock in any openings made in fences by the lessee or permittee or his contractors to provide access to the lands covered by this lease or permit for automotive and other equipment.

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(7) If lessee or permittee shall construct any camp on the lands, such camp shall be located at a place approved by the authorized representative of the Secretary of Agriculture, and such representative shall have authority to require that such camp be kept in in a neat and sanitary condition.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(8) To comply with all the rules and regulations of the Secretary of Agriculture governing the national forests or other lands under his jurisdiction which are embraced in this lease or permit.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(9) Unless otherwise authorized, prior to the beginning of operations to appoint and maintain at all times during the term of this lease or permit a local agent upon whom may be served written orders or notices respecting matters contained in this stipulation, and to inform the authorized representative of the Secretary of Agriculture, in writing, of the name and address of such agent. If a substitute agent is appointed, the lessee or permittee shall immediately so inform the said representative.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(10) To address all matters relating to this stipulation to Forest Supervisor, Gunnison National Forest, at Gunnison, Colorado, who is the authorized representative of the Secretary of Agriculture, or to such other representative as may from time to time, be designated, provided that such designation shall be in writing and be delivered to the lessee or permittee or his agent.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(11) If all or any part of the lands lie within a municipal watershed or are, in the opinion of the authorized representative of the Secretary of Agriculture, primarily valuable for watershed protection, the lessee or permittee shall reseed or otherwise restore the vegetative cover, as required by the authorized representative of the Secretary of Agriculture, for watershed protection and erosion prevention on any areas damaged because of the operation.				

SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
(a) At least two weeks before beginning of any clearing, construction, or operations, including access and work road location and construction, the lessee shall prepare a "Lessee Surface Management Operation Plan" with the District Ranger, Paonia, Colorado. The final plan shall be prepared in triplicate, including maps, for the approval by the Forest Supervisor. Such approval will be conditioned on reasonable requirements needed to prevent soil erosion, water pollution, and unnecessary damage to the surface vegetation and other resources of the United States and to provide for the restoration of the land, surface and vegetation. The plain shall contain all such provisions as the Forest Service may deem necessary to maintain proper management of the lands and resources with the operating area. Where appropriate, depending upon the location and type of operation, the Forest Supervisor may require the plan to contain, at a minimum, the following items: 1. The location, construction specifications, maintenance program, and estimated use by the lessee, his employees and agents, of all access and work roads, 2. The exact location and extent of any and all areas to be occupied during the operations, 3. The methods to be used in the operations, including disposal of waste material. 4. The size and type of equipment to be used in the operation. S. The capacity, size, character, standards of construction and location of all structures and facilities to be constructed. 6, Typical profiles of cute and fills of all areas to be graded for the installation of structures and facilities. 7. The location and size of areas upon which vegetation will be destroyed and/or soil laid bare and the steps which will be taken to prevent and control soil erosion thereon, including but not limited to the proposed program for rehabilitation and revegetation of these disturbed lands both during and upon cessation of operations, 8. The steps which will be taken to prevent water pollution. 9. The character, amount, and time of use of explosives or fire, including safety precautions which will be taken during their use, 10. Forest user, permitted livestock, and wildlife protection. If later operations require departure from or additions to the approved plan, these revisions or amendments, together with justification statement for proposed revisions, will be submitted to the District Ranger for approval of the Forest Supervisor. Any and all operations conducted in advance of approval of an original, revised, or amended operating plan, or which are not in accord with an approved plan, constitute a violation of the terms of this lease and the Forest Service reserves the right to close down the operation until such corrective action, as is deemed necessary, is taken by the lessee.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				

(b) (1) To guarantee the successful rehabilitation and revegetation of abandoned operating areas, as provided for in the "Lessee Surface Management Operating Plan," paragraph (a) above, the Forest Service is agreeable to the reduction of lease or operator bonds to an amount necessary to cover the estimated cost of rehabilitation and revegetation, providing, that the lessee has otherwise satisfied the conditions of this lease and the United States Geological Survey and the Bureau of Land Management have approved such a reduction. (2) In lieu of bond, the lessee may upon mutual agreement with the Forest Supervisor deposit cooperative funds sufficient to cover the cost of rehabilitating and revegetating abandoned operating areas. When such funds have been deposited, the Forest Supervisor shall notify the United States Geological Survey that the requirements of the Forest Service have been satisfied, providing that all other conditions of the lease which concern the Forest Service have been satisfied. No occupancy of the surface of the following areas is authorized by this lease. The lessee is, however, authorized to employ directional drilling to develop the mineral resources under these areas provided that such drilling or other works will not disturb the surface area or otherwise interfere with their use by the Forest Service, It is understood and agreed that the use of these areas for National Forest purposes is superior to any other use. Areas to be excluded from direct drilling occupancy are: (1) Within 500 feet on either side of the centerline of any and all roads and/or highways within the lease areas. (2) Within 200 feet on either side of the centerline of any and all trails within the lease area. {3) Within 500 feet of the normal highwater line of any and all lakes, ponds, and reservoirs located within the lease area {4) Within 500 feet of the normal highwater line of any and all streams in the area. The distances in subparagraphs 1, 2, 3, and 4 immediately above may be reduced when specifically agreed to in the operating plan, see paragraph (a), {5) Within 400 feet of any and all springs within the lease area, (6) Within 400 feet of any improvements either owned, permitted, leased or otherwise authorized by the Forest Service.				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				

NSO: WETLANDS / FLOODPLAINS / RIPARIAN AREAS. No surface occupancy or use is allowed on the lands described below (legal subdivision or other description). or portions of Sec. ,T.m,R.___,PM , as shown on the attached map which becomes a part hereof. Wetlands, Floodplains and Riparian Areas of any defined drainage or location containing these specific ecosystem types come under jurisdiction of this stipulation. Drill pads, staging areas and storage sites will not be allowed in these areas. When road locations must occur in these areas, streams will be crossed at right angles and access across other areas will be held to a minimum. Streams will not be paralleled by roads through these areas. Location of these areas which is more specific than can be identified on USGS topographic maps will come at the APD stage based on on-the-ground observations. For the purpose of: The management of wetlands and floodplains are subject to Executive Orders 11990 and 11988, respectively. The purpose of the EO's are to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and floodplains and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternative. Also, it is recognized that there is a direct relationship between impacts on such areas and effects on water quality and aquatic ecosystems. There is a high risk of irreversible and irretrievable impacts on the latter with operation and developments in wetlands, floodplains and riparian areas. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered flit can be shown through environmental analysis and the application of mitigation measures that the impacts to wetland, floodplain and riparian resources will be minimized and that no other alternative route for a road or pipeline is feasible because of environmental effects. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971
Lease Stipulation				
CONTROLLED SURFACE USE STIPULATION: BIG GAME WINTER RANGE. Surface occupancy or use is subject to the following special operating constraint. Limit road use to periods when animals are not present on the winter range. Restrict road use to operators. Recontour and revegetate to prior existing conditions (to extent possible) new roads when work is complete. Operation and maintenance of production facilities will be scheduled to minimize adverse effects on big game (Elk, Mule Deer, Big Horn Sheep and Turkey) from December 1 to April 30. On lands described below: All or portions of Sec.m,T.a,RI__,PM____ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is classified as big game winter range for one of the four species listed above falls under jurisdiction of this stipulation. For the purpose of: Protecting big game winter range for Elk, Mule Deer, Bighorn Sheep and Turkey. These ranges are extremely important for animal survival during winter. Disturbances and habitat losses may place unnecessary stress on the wintering wildlife herds and cause an increase in herd mortality. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)				
SG Federal 11-90-15-2	Sec 15 T11S R90W Mer 6PM	COC-13484 (surface)	T11S R90W 6th PM, Sec 15: SENE,W2NW,S2.	11/1/1971

Lease Stipulation
CONTROLLED SURFACE USE STIPULATION: MODERATE GEOLOGIC HAZARD. Surface occupancy or use is subject to the following special operating constraints. Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e. subsidence, acid drainage). On lands described below: All or portions of See. ,T. ,R. ,PM__ as shown on the attached map which becomes a part hereof. Any area within the leasehold which is identified as having moderate geologic hazard falls under jurisdiction of this stipulation. For the purpose of: To insure the stability of facilities required (roads, pipelines, drill pads, etc.) during the oil and gas operations and to insure the stability of lands adjacent to these facilities. Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted. Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)

SG Federal 12-90-7-1	Sec 7 T12S R90W Mer 6PM	COC-66716 (surface)	T12S R90W 6th PM, Sec 7: Lots 1-4, E2	8/1/2003

Lease Stipulation
Subject to standard terms and conditions and Exhibit CO-34 “Endangered Species Act Section 7 Consultation Stipulation”. The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 U.S.C. § 1531 et seq., including completion of any required procedure for conference or consultation.

This page intentionally left blank

APPENDIX B. OPERATOR STATED DESIGN FEATURES (FULL LISTING)

The following list of design features were the result of reviewing each operators APD surface use plan and drill plans. The features are organized in relationship to the type of practice they relate to and if possible the environmental resource which the feature is intended to protect or limit impacts to. There are five columns, each of which identify with the operator's multi well pad related to this proposed action. Each of the 5 columns includes either a"1", "x" or "N/A". These are the key identifiers to which the design feature would apply to the operator's specific well as described in the APD or further discussion with the operator on specific features. A "1" means that the design feature is applicable to the operators well pad. An "x" identifies a handful of features in which the operator is deferring to COGCC or Private Landowner agreements rather than state the design feature in relationship to any BLM requirements. An "N/A" means that the APD did not specifically state the design feature was applicable to the well pad. Even though an "N/A" is in a particular block related to a specific design feature, there may be other closely related design features or it could be that one operator does not apply the same design feature as the other.

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	General	**1**	A person designated by the operator will be on-site during initial disturbance and set-up of the operator's respective multi-well pads	1	1	1	1	1
Construction	General	**2**	No construction or routine maintenance activities will be performed during periods when the soil is too wet or adequately support such equipment. If the equipment creates ruts in excess of 4 inches deep, the soil will be deemed too wet to adequately support the construction equipment.	1	1	x	1	1
Construction	General	**3**	SG will attempt to minimize its total surface disturbance from roads, pipelines, well pads, and construction related activities within the guidelines determined by the Forest Service.	1	1	N/A	N/A	N/A
Construction	General	**4**	The well pad is designed with the smallest amount of disturbance while ensuring that the four wells can be drilled and completed in a safe manner.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	General	**5**	GE will flag delineated wetlands in the field prior to construction so they can be avoided.	N/A	N/A	N/A	1	N/A
Construction	General	**6**	The well pad was located in consultation with the private landowner and ultimately placed on the proposed location at the direction of the private landowner.	N/A	N/A	N/A	N/A	1
Construction	Permits	**7**	SG will obtain a timber harvest permit from the Forest Service as needed for removal of the aspen trees within the disturbance area.	1	N/A	N/A	N/A	N/A
Construction	Cultural	**8**	All persons in the area will be informed that any person who, without a permit, injures, destroys, excavates, appropriates or removes vertebrate fossil, historic or prehistoric ruin, artifact, object of antiquity, Native American remains, Native American cultural item, or archaeological resource on public lands is subject to arrest and penalty of law (16 USC 433, 16 USC 470, 18 USC 641, 18 USC 1170, and 18 USC 1361).	1	N/A	x	1	1
Construction	Cultural	**9**	If newly discovered historic or archaeological materials or other cultural resources are identified during construction, work in that area will stop and the FS/BLM Authorized Officer will be notified immediately.	1	N/A	x	1	1
Construction	Cultural	**10**	If inadvertent discovery of Native America Human Remains or Objects of Cultural Patrimony occurs, activity will stop in the area of discovery and a reasonable effort will be made to protect the item(s) discovered. The FS/BLM Authorized Officer will be immediately notified.	1	N/A	x	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Materials	**11**	Fractured road base will be obtained from United's Tri County Pit in Hotchkiss, CO. (3569 J 75 Drive, Hotchkiss, CO), or some similar provider depending upon availability.	1	1	1	N/A	N/A
Construction	Materials	**12**	Gravel and stone will be purchased from Farnsworth Construction and Gravel Company, 175 Highway 133, Paonia, CO.	N/A	N/A	N/A	1	1
Construction	Facilities	**13**	All loading lines will be placed inside the containment berm.	1	1	1	1	1
Construction	Weeds	**14**	Gravel sources will be checked for possible weed issues and treated as necessary.	1	1	1	1	1
Construction	Wildlife	**15**	If vegetation clearing is planned during the core breeding period for migratory birds (May 15 to July 15), GE will survey 2 weeks prior to vegetation clearing to identify presence or absence of migratory birds. This does not apply to operation and maintenance of production facilities.	N/A	N/A	N/A	1	1
Construction	Wildlife	**16**	To determine status of known nests within the project area, and to determine if additional raptor species have established nests within 0.25 mile of well pad, road, and gathering line construction, operators will survey for the presence of nesting raptors prior to initiating activities. Surveys will occur during the appropriate survey season, generally March 1 through July 31. Temporal and spatial buffers will be applied to all active nests in the project area, or until young have fledged nests.	1	1	1	1	1
Construction	Access Roads	**17**	Will consider Gold Book and BLM Best Management Practices when improving or maintaining existing roads (ref. Gold Book)	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Access Road	**18**	Gates may be installed at the entrance of new access roads to limit access.	1	1	1	1	1
Construction	Access Road	**19**	Cattle guards may be installed on the new access roads.	N/A	N/A	1	1	1
Construction	Access Roads	**20**	Culverts will be placed/replaced where necessary in roadways and have a minimum 18 inch diameter.	1	1	1	1	1
Construction	Access Roads	**21**	New road construction has been designed by a licensed professional engineer.	1	N/A	1	1	1
Construction	Access Roads	**22**	Where construction occurs on NFS lands, final design of road construction will be reviewed and approved by the District Ranger.	1	1	1	1	1
Construction	Access Roads	**23**	On NFS lands, all road design packages will conform to AASHTO Guidelines for Geometric Design of Very Low Volume Local Roads (ADT <400).	1	1	1	1	1
Construction	Access Roads	**24**	In coordination with the FS, a pre-use road conditions assessment will be conducted for affected NFS roads (NFSR 265, 851 and 851.1.B, 849, 704, 704.4A)	1	1	1	1	1
Construction	Access Roads	**25**	If any roadwork is required, a work schedule will be submitted to the Paonia District Ranger before any work is started.	1	1	1	1	1
Construction	Access Roads	**26**	Repairs will be made under agency specifications and terms in the Road Use Permit.	1	1	1	1	1
Construction	Buried Pipelines	**27**	The gathering lines will be buried to a minimum depth of 3 feet.	1	1	1	1	1
Construction	Buried Pipelines	**28**	The pipeline will not be constructed during frozen conditions.	1	N/A	1	1	1
Construction	Buried Pipelines	**29**	Gathering lines will be tested using compressed air, nitrogen and/or water.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Buried Pipelines	**30**	Frozen soil will not be used to backfill the pipeline trench.	1	N/A	1	1	1
Construction	Buried Pipelines	**31**	Upon approval of the authorized officer and private landowner, feather the vegetation outside of and adjacent to the pipeline right-of-way in order to reduce visibility of the construction corridor from nearby recreation areas.	N/A	N/A	1	N/A	N/A
Construction	Buried Pipelines	**32**	To reduce the potential effect on surface water and groundwater resources, initial drilling and gathering line construction will occur at times of year when water table is lower, generally May and later.	N/A	N/A	N/A	1	1
Construction	Dust Abatement	**33**	If dust becomes a problem during any phase of the operations, FS/BLM approved dust abatement measures (e.g. fresh water spray, driving speeds of less than 10mph) will be applied to the road and pad location. Chemicals such as Mag Chloride will not be utilized without approval from the FS/BLM)	N/A	N/A	N/A	1	1
Construction	Dust Abatement	**34**	During high vehicle activity, Mag. Chloride may be utilized following approval by FS for dust abatement purposes.	N/A	N/A	N/A	1	1
Construction	Dust Abatement	**35**	Dust control would only occur as needed during the production phase of the project (daily application of water would not be likely).	1	1	1	1	1
Construction	Well Pad	**36**	The well pad surface will be stabilized with gravel such as pit run, fractured road base.	1	1	1	1	1
Construction	Well Pad	**37**	All multi-well pads will be constructed from soils on site.	1	N/A	1	1	1
Construction	Well Pad	**38**	The top 8 inches of this soil will be salvaged for use over the reclaimed areas.	1	N/A	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Well Pad	**39**	The rest of the soil that is manipulated for this project will be considered subsoil and will be separated from the topsoil.	1	N/A	1	1	1
Construction	Well Pad	**40**	Subsoil will be used to create a berm around the well pad along all areas of fill slopes.	1	N/A	1	1	1
Construction	Well Pad	**41**	The rest of the topsoil will be used to cover the subsoil berm on the well pad edge.	1	N/A	1	N/A	N/A
Construction	Well Pad	**42**	The topsoil will be separated by the subsoil by a straw barrier.	1	N/A	1	N/A	N/A
Construction	Well Pad	**43**	If a closed loop system is employed, a cuttings bin will likely be used rather than a reserve pit or cuttings pit.	N/A	1	1	N/A	N/A
Construction	Well Pad	**44**	At the time a drill rig is contracted for the project, it will be determined whether a reserve pit or a cuttings pit/container is needed.	N/A	1	1	N/A	N/A
Construction	Well Pad	**45**	If necessary, a reserve pit will be constructed on site in cut soils.	N/A	1	1	N/A	N/A
Construction	Well Pad	**46**	The pad will be fenced (FS/BLM or private landowner approved) to exclude grazing livestock for the first two growing seasons or until seeded species are firmly established, whichever comes later.	1	1	1	1	1
Construction	Well Pad	**47**	Topsoil and spoil storage will be on the uphill side of the well pad.	1	N/A	N/A	N/A	N/A
Construction	Well Pad	**48**	Stockpiled earth would have silt fence installed around the entire stockpile if a discharge risk is present.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Well Pad	**49**	The well pad will be fenced stock-tight using a 4 strand and sheep restricting wire fence. The well pad will be fenced to keep people, wildlife, and livestock from encountering the cuttings. The fence will remain for the life of the well pad. *Extra information applicable to GE Henderson and Spadafora locations: In deer and elk habitat, fences for livestock exclusion will not exceed 40 inches. The four-strand fence will have smooth top and bottom wires. Distance from the ground to the bottom smooth wire will be no less than 16 inches. Distance from the top wire to the second wire will be no less than 12 inches. Middle wires will be barbed, with 6 inch spacing.*	1	1	1	1	1
Construction	Stormwater	**50**	All areas that are disturbed during construction of the proposed action are covered by State approved Storm Water Management Plans. BMPs as required by the permits and plans will be installed before, during, and maintained after construction until the location reaches final stabilization following reclamation. All other requirements of the permits will be followed, such as the bi-weekly and post-precipitation event inspections and reclamation of disturbed areas.	1	1	1	1	1
Construction	Stormwater	**51**	Structural stormwater BMPs such as road crowning and banking, culverts, waterbars, rolling dips, bar ditches, will be installed at appropriate locations along the access routes to capture and direct stormwater.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Construction	Stormwater	**52**	As necessary, the following stormwater BMPs will be placed to control water velocity, minimize sediment movement and reduce rilling at critical points such as, above and below structural stormwater BMPs, disturbances undergoing reclamation, cut/fill slopes and other areas disturbed during construction could include. These BMPs include but are not limited too, silt fence, rock aprons, rock checks, straw wattles, straw bales, earthen berms, mechanical pocking/pitting, lateral furrows, hydromulch, seeding.	1	1	1	1	1
Construction	Stormwater	**53**	Materials used for erosion control and reclamation (i.e. straw bales and seed mixes) will be obtained from sources that are weed-free.	1	1	1	1	1
Construction	Stormwater	**54**	SG will not chemically or mechanically remove noxious weeds, if those weeds are stabilizing soils, without first taking adequate measures to control for sediment runoff, soil erosion, and stormwater management.	1	1	1	N/A	N/A
Fresh Water Use	General	**55**	Fresh water usage would be reported to the BLM and /or Forest Service as required for tracking potential impacts to endangered river fish.	1	1	1	1	1
Fresh Water Use	General	**56**	Fresh water will be obtained from a variety of sources, nearby streams, private water rights, commercial suppliers, etc.	1	1	1	1	1
Fresh Water Use	Drilling	**57**	Fresh water based drilling mud and cement will be used to spud wells and set surface casing from 400 feet to 1100 feet below the surface.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Fresh Water Use	Completion	**58**	If SG is able to use temporary surface poly pipelines to transport produced water to the well pad for completing the well, water used in completions would be almost entirely recycled water. Fresh water would not likely be needed.	1	1	1	N/A	N/A
Fresh Water Use	Dust Abatement	**59**	Fresh water will be used to minimize effects of fugitive dust during use of access roads during operations.	1	1	1	1	1
Fresh Water Use	Dust Abatement	**60**	Fresh water will be applied to minimize effects of fugitive dust to vegetation adjacent to proposed ground disturbance during well pad, road, and gathering line construction.	1	1	1	1	1
Fresh Water Use	Dust Abatement	**61**	Fresh water would be applied to the road more frequently as traffic volumes increase (and according to weather patterns) to keep dust down.	1	1	1	1	1
Fresh Water Use	Transport	**62**	Trucks or poly pipeline would be used to transport fresh water to the project for drilling.	1	1	1	N/A	N/A
Fresh Water Use	Transport	**63**	If fresh water is needed for completions, it will be delivered to the well site by truck or piped via temporary aboveground poly pipeline.	1	1	N/A	N/A	N/A
Operations	General	**64**	The site must be free of state or county-listed noxious weeds, oil field debris, contaminate soil, and equipment.	1	1	N/A	1	1
Operations	Noise	**65**	Noise levels will be maintained as required by COGCC rule 802.	1	1	1	1	1
Operations	Emissions	**66**	The operation will comply with the CDPHE standards for emissions.	1	1	1	1	1
Operations	Emissions	**67**	All drilling and completion rigs will be powered by Tier 2 engines or better.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Emissions	**68**	BLM and FS will be provided with the final total fuel consumption following drilling and completion, to further understanding of levels of emissions from drilling rigs in the Piceance Basin.	N/A	N/A	N/A	1	1
Operations	Scheduling	**69**	The operator will schedule heavy traffic periods, such as moving the rig in or out, to take place during the week if possible and not on weekends or holidays.	1	1	1	N/A	N/A
Operations	Scheduling	**70**	To avoid conflicts with hunter use in the area, mobilization or demobilization of heavy equipment, drilling equipment, and fracking units will not occur on Friday, Saturday and Sunday of the opening weekends of muzzleloader season, the first big game rifle season, and the second big game rifle season.	N/A	N/A	N/A	1	1
Operations	Scheduling	**71**	SG will also avoid scheduling work requiring heavy equipment and/or high volumes of traffic during the second combined rifle season each year (emergency situations excepted).	N/A	N/A	1	N/A	N/A
Operations	Scheduling	**72**	Operations during drilling will occur 24 hours per day, 7 days a week until task is complete.	1	1	1	1	1
Operations	Scheduling	**73**	Operations during completion activities will occur during daylight hours, 7 days per week until task is complete	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Monitoring	**74**	In order to detect and determine water quality impacts from future oil and gas activities, GE will continue to conduct a baseline water quality study for the area. In addition, GE will follow Water Resources Monitoring Plan that has been developed for the area. This monitoring plan will include pre- and post- drilling water monitoring of springs and streams. In accordance with Rule 609, Statewide Groundwater Baseline Sampling and Monitoring, water quality monitoring of existing groundwater wells will occur. Up to four initial baseline samples and subsequent monitoring samples will be collected from water sources within a one-half mile radius of the well pad location. Initial sampling will be conducted within 12 months prior to setting conductor pipe in the first well on the pad.	N/A	N/A	N/A	1	1
Operations	Permits	**75**	Contractor's will be responsible for following any operator required permit conditions for maintenance or improvements associated with road use permits.	1	1	1	1	1
Operations	Permits	**76**	SG will obtain a Road Use Permit for FS 704 and/or FS 265 as required.	N/A	N/A	1	N/A	N/A
Operations	Permits	**77**	GE will acquire any required NFS, state, and county road use permits. Improvements and maintenance will be conducted so as to prevent impacts to stormwater runoff quality.	N/A	N/A	N/A	1	1
Operations	Socioeconomics	**78**	Bids will be solicited from local construction firms and other contractors for various work available.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Wildlife	**79**	Operational activities will be limited during winter months to minimize effects to wildlife in the area, including road use along proposed access routes to the proposed pads where winter concentration area, severe winter range, and winter range has been delineated for elk, turkeys, and mule deer.	N/A	N/A	N/A	1	1
Operations	Wildlife	**80**	Screening or other devices will be installed on stacks and on other openings of heater-treaters or fired vessels to prevent entry by migratory birds.	1	1	1	1	1
Operations	Wildlife	**81**	After the rig has been moved off location, bird netting will be placed over the pit to prevent birds from entering the pit area.	N/A	1	1	N/A	N/A
Operations	Wildlife	**82**	Solar powered remote telemetry will be installed on the well pad.	N/A	N/A	N/A	1	1
Operations	Wildlife	**83**	To minimize possible effects to elk during winter, well pad construction, drilling or completions would not occur during the recommended timing restrictions (December 1 through April 30).	N/A	N/A	N/A	1	1
Operations	Access Roads	**84**	The right-of-way width of existing roads will be maintained as they presently exist unless authority to widen is given by the FS and/or surface land owner in writing.	1	1	1	N/A	1
Operations	Access Roads	**85**	All roads used in conjunction with this project will be maintained in as good or better condition than pre-project condition.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Access Roads	**86**	Any project-related damage to roads will be repaired as soon as possible to avoid adverse impacts on other authorized road uses, provide for continued safe operations, and protect surface resources on other authorized road uses in the Gunnison NF.	1	1	1	1	1
Operations	Access Roads	**87**	Vehicles will not be towed through the mud.	1	1	1	1	1
Operations	Access Roads	**88**	The speed limit on the access road to the 11-90-9 location will be 15 MPH. Speed limit to all other wells is 20 MPH.	1	1	1	N/A	N/A
Operations	Access Roads	**89**	Speed limits on unpaved access roads will be enforced to minimize dust created during travel; where speeds are not posted on unpaved access roads, speeds will not exceed 25 mph.	N/A	N/A	N/A	1	1
Operations	Access Roads	**90**	Operations will cease, excepting emergencies, during periods when mud and silt cannot be contained within the road prism, or when construction specification cannot be achieved because of wet or frozen ground conditions.	1	1	1	1	1
Operations	Access Roads	**91**	During the life of this well, NFS road 704 will be kept open for both snowmobiles and vehicles by plowing only one side of the access road. The two separate uses will be clearly marked at the end points of the dual use road and at trail access points along the road.	N/A	N/A	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Access Roads	**92**	Typically, to maintain access to a well pad, GE will plow or blow snow when snow cover exceeds 6 inches in depth - to maintain access to the well pad. Access to the well pad is necessary even with remote telemetry. A snowcat mounted with a snowplow or blower will be used to push or blow all but the 2 or 3 inches of snow closest to the well pad surface off the location. The remaining few inches of snow is left behind on the well pad to be driven on, eventually absorbed into the surrounding location, or slowly evaporates away through the season.	N/A	N/A	N/A	1	1
Operations	Access Roads	**259**	SG plows roads as needed to access well pads in winter. Daily access to each well pad is required. Snow is plowed to the roadside. It is not removed.	1	1	1	N/A	N/A
Operations	Road Use	**93**	Gravel will be placed on roads where and when required to maintain the surface integrity.	1	1	1	1	1
Operations	Road Use	**94**	Periodic road blading will be conducted throughout the road system to re-gather gravel and place it within the roadway.	N/A	N/A	N/A	1	1
Operations	Road Use	**95**	Gunnison County will grade and apply magnesium chloride to County Road 265 annually as per the terms of the agreement between SG, GE and Gunnison County (LI#10-241)	1	1	1	1	1
Operations	Pit Management	**96**	A minimum of two feet of free board will be maintained between the maximum fluid level and the top of the pits.	N/A	1	1	N/A	N/A
Operations	Completion	**97**	Where practicable, recycled water will be used for completions.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Completion	**98**	Recycled water use if practicable, would be trucked to the well site from the McIntyre Flowback Pits 3 & 4.	N/A	N/A	1	N/A	N/A
Operations	Completion	**99**	Water will be continually transferred via the Sheep Gathering System and will not be treated prior to use at the wellhead.	N/A	N/A	N/A	1	1
Operations	Completion	**100**	Recycled water to be used in hydraulic fracturing operations will be piped to the well site via either an existing buried water pipeline or a temporary surface poly pipeline (HDPE pipe).	1	1	N/A	N/A	N/A
Operations	Facilities	**101**	Compressor engines will be permitted as appropriate through the Air Quality Control Division of the Colorado Department of Public Health and Environment.	1	1	1	1	1
Operations	Facilities	**102**	Production facilities will be located and arranged to facilitate safety and minimize long-term surface disturbance, typically clustered at the access end of the pad with tanks in the cut.	1	1	1	1	1
Operations	Facilities	**103**	New above ground facilities will be painted Juniper Green in order to match the surrounding vegetation (and existing on site facilities). Safety features of this equipment may be painted hazard orange or similar.	1	1	1	1	1
Operations	Facilities	**104**	Lighting will not be installed for production operations.	1	1	1	1	1
Operations	Facilities	**105**	Due to the remoteness and lack of visibility, the Project will not limit lighting during drilling or completion.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Operations	Facilities	**106**	The location and access roads will be kept orderly and as clean as practicable at all times.	1	1	1	1	1
Operations	Facilities	**107**	The well site cleanup will be concluded once the completion operations have been finished.	1	1	1	1	1
Operations	P+A	**108**	Plug and abandonment of wells will use industry BMPs and comply with all applicable rules and regulations set forth by the BLM, and/or the COGCC for plugging. Depending upon surface estate, abandonment would comply with the appropriate SMA.	1	1	1	1	1
Safety	Fire	**109**	The drilling crew will have sufficient fire equipment on hand during fire season for suppressing fires on the well pad, access road and pipeline route.	1	1	1	1	1
Safety	Fire	**110**	Comply with any fire restrictions in effect at the time of proposed operations and understand that the FS reserves the right to suspend operations during periods of high fire potential.	1	1	1	1	1
Safety	Fire	**111**	Be able to contact emergency services, including Montrose Interagency Fire Dispatch at all times. Fire prevention measures for all equipment will be in place prior to post drilling operations on GE's equipment. SG maintains fire extinguishers in vehicles to handle emergencies.	1	1	1	1	1
Safety	Fire	**112**	Fire extinguishers, at least 5 lbs., ABC with an Underwriters Laboratory rating of 3A-40BC, or greater, will be on or near each internal combustion engine.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Safety	Fire	**113**	Be responsible for damage and suppression costs for fires started as a result of operations to the extent permitted by federal and state law.	1	1	1	1	1
Safety	Fire	**114**	Fires will be reported to the BLM/FS as soon as possible.	1	1	1	1	1
Safety	Fire	**115**	All gasoline, diesel, and steam-powered equipment will be equipped with effective spark arresters or mufflers. Spark arresters will meet FS specifications discussed in the "General Purpose and Locomotive (GP/L) Spark Arrester Guide, Volume 1, April, 1988"; and "Multi-position Small Engine (MSE) Spark Arrester Guide, April, 1989". In addition, all electrical equipment will be properly insulated to prevent sparks.	1	1	1	1	1
Safety	General	**116**	Firearms and dogs are not allowed on the access road or location during any phase of this project.	1	1	1	1	1
Safety	General	**117**	To further facilitate coordination with local emergency services, mapped locations of the proposed well pads, including GPS location (lat/long) will be provided to the federal agencies with responsibility for drilling activities. A courtesy copy will be provided to the respective emergency services personnel, as applicable, in advance of any exploration drilling activities.	1	1	1	1	1
Safety	Flaring	**118**	Gas, if present, will be flared during completion operations.	1	1	1	N/A	N/A
Safety	Flaring	**119**	A "flare stacked" method will be used during flaring.	1	1	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Safety	Flaring	**120**	The flaring of gas does not create sparking and is thus not a fire risk to surrounding vegetation so long as the flare is a reasonable distance from combustible vegetation. The flare will be located on the flat, level well pad allowing approximately 100 feet of separation between the flare and any vegetation.	1	1	1	N/A	N/A
Safety	Flaring	**121**	Gas must be flared at a safe distance from the rig and crew.	1	1	1	N/A	N/A
Safety	Flaring	**122**	Flaring into a pit or side cut is not practical on a location of this size. Flaring horizontally into a pit or side cut near the rig creates the risk of gas accumulations near the crew and equipment, increasing the dangers flaring is intended to mitigate.	1	1	1	N/A	N/A
Safety	Flaring	**123**	GE will implement a “green completion” process which will immediately place produced gas into gathering lines and transported to sales. Although a minimal amount of flaring may be necessary to clean the well bore.	N/A	N/A	N/A	1	1
Safety	Hazardous Materials	**124**	For all treatment chemicals, Material Safety Data Sheets (SDS) files will be maintained on-site during drilling and completion.	1	1	1	1	1
Safety	Hazardous Materials	**125**	Signs will be posted on-site to identify potential hazards including chemical hazards.	1	1	1	1	1
Safety	Signage	**126**	All construction signage will be in compliance with the Manual of Uniform Traffic Control Devices.	1	1	1	1	1
Safety	Signage	**127**	The operator will post warning signs on CR 265 to alert the public of heavy truck traffic.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Safety	Signage	**128**	Provide for the safety of the public using State Highway 133 during project construction. This includes, but is not limited to, posting of appropriate signs to alert traffic on SH133 of potential stops or delays when construction equipment is either using the highway or turning off or on to the highway to access the project area. Will post warning signs, at locations designated by the FS, to warn the public of increased traffic on roads resulting from project activities.	1	1	1	1	1
Safety	Signage	**129**	The operator will use flagmen as necessary during drilling and related equipment moves on and off the drill site when utilizing public roads.	1	1	1	1	1
Safety	Signage	**130**	GE will provide 24-hour manned traffic control guard gates at the entrance of the roads leading to the Project site during drilling and completion.	N/A	N/A	N/A	1	1
Safety	Signage	**131**	Traffic will be controlled via radio communication as needed.	1	1	1	1	1
Hazardous Materials Management	Spill	**132**	Spills related to project activities would be handled in accordance with the operator's Spill Prevention, Countermeasure and Control (SPCC) Plan.	1	1	1	1	1
Hazardous Materials Management	Spill	**133**	All releases of any substance to soil or water will be immediately reported to the BLM/FS compliance officers.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Spill	**260**	Spills are reported according to the regulations in place for the specific land ownership, type of spill and volume of spill.	1	1	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Spill	**134**	The operator will prevent gasoline, diesel fuel, oil, grease, or any other petroleum products and drilling fluids from migrating off the location or from entering any live stream or riparian area. Such as: no refueling or lubricating will take place within 100 feet of wetlands and other water bodies or drainages. Hazardous materials, chemicals, fuels, etc. will not be stored within 100 feet of wetlands or surface waters.	1	1	1	1	1
Hazardous Materials Management	Spill	**135**	A spill kit will be available on site.	1	1	1	1	1
Hazardous Materials Management	Spill	**136**	Spills of any kind will be cleaned up, reported, and disposed of as required by local, state, and federal regulations.	1	1	1	1	1
Hazardous Materials Management	Spill	**261**	Containment of the spill would occur immediately, clean up of a spill will occur as soon as practicable, and proof of cleanup will be provided for the record.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Spill	**262**	Spill containment is planned on each location based on the volume of fluids and in consideration of expected precipitation. If a spill occurs outside of containment, the spill would be stopped, contained and cleaned up as quickly and safely as possible. Spill reports are normally provided to BLM through a Sundry Notice.	1	1	1	N/A	N/A
Hazardous Materials Management	Spill	**137**	Any hazardous substances or contaminated soils will be removed for reuse in drilling operations or disposed of in accordance with applicable federal, state, and local regulations.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Waste Disposal	**138**	Waste oils will be recycled by Safety-Kleen Systems, 368 Bonny Street, Grand Junction, CO.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Waste Disposal	**139**	Drilling mud liquids may be transported via truck to other active GE locations for recycling if drilling elsewhere is underway. Should no wells be available, an alternative commercial disposal for drilling mud liquids is utilization of the Deer Creek Disposal Facility at 5180 US Highway 50, Whitewater, CO.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Waste Disposal	**140**	Drilling fluids which are not restricted by the COGCC WDW permit will be disposed of at the Federal 24-2 WDW in the Bull Mountain Unit.	1	1	1	N/A	N/A
Hazardous Materials Management	Waste Handling	**141**	Trash and garbage will be placed in appropriate caged containers and the container and contents transported to an approved disposal site, (e.g. Delta County sanitary landfill). All containers will be equipped with bear-resistant openings.	1	1	1	1	1
Hazardous Materials Management	Waste Handling	**142**	Portable latrines will be provided on site for human wastes, and wastes will be pumped from portable toilets and hauled to an approved sanitation facility (e.g. CB Industries, 11289 Doughspoon Road, Austin, CO.)	1	1	1	1	1
Hazardous Materials Management	Waste Handling	**143**	Sewage will not be buried on location.	1	1	1	1	1
Hazardous Materials Management	Waste Handling	**144**	Waste oils from equipment will be contained on-site in secondary containment and upon demobilization of the drilling and completion equipment, will be disposed of at an off-site approved facility.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Waste Handling	**145**	All waste oil will be stored in lined containment areas sufficient to contain 110% of the single largest container.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Waste Handling	**146**	Upon demobilization of the drilling rig, the drilling pad will be cleaned of all excess materials, debris, and any other fluids encountered and disposed of in an approved manner. The same process will be repeated upon demobilization of the completion rig and equipment. Immediately upon well completion, the well location and surrounding area(s) will be cleared of all debris, materials, trash, and junk not required for production.	1	1	1	1	1
Hazardous Materials Management	Drilling	**147**	A closed loop system will be used.	1	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**148**	Cuttings will exit the well bore and will be centrifuged to remove liquids which will be reclaimed for drilling.	1	1	1	1	1
Hazardous Materials Management	Cuttings Handling	**149**	The cuttings generated during drilling will come off of the mud management equipment and into a cuttings bin. Several cuttings bins will be on-site at all times to ensure sufficient volume is available during variable drilling conditions.	1	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Cuttings Handling	**150**	A temporary cuttings storage pad, sufficient to hold 450 Cubic yards of cuttings. Wells will be drilled sequentially and cuttings will be handled sequentially. Cuttings will be hauled to the disposal facility as needed, ensuring the 450 cubic yard capacity is not exceeded. If the volume of cuttings generated by drilling approaches the capacity of the bermed area and additional cuttings are to be generated, then cuttings within the bermed area will be characterized and removed to create additional storage space. When multiple wells are to be drilled in a series, then the bermed area would be in use until all drilling efforts are suspended.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**151**	When drilling is completed, all cuttings will be removed from the bermed area.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**152**	The cuttings pad will be bermed on all four sides by a 3 foot wide x 3 foot high soil berm.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**153**	Both the cuttings pad surface and the berm will be lined.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**154**	The liner will have a minimum thickness of 30-mil.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**155**	The liner and the cuttings pad surface will be covered with a 3 inch layer of soil to protect the liner from equipment utilized to place cuttings.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Cuttings Handling	**156**	Collected cuttings will be moved from the three-sided bins to the temporary cuttings storage pad using a rubber-tired front-end loader and placed in windrows for additional air drying.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Handling	**157**	Sawdust or wood chips may be added to the windrowed cuttings periodically, depending upon their moisture content.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Pit Construction	**158**	Pits will be lined with an impervious liner.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Construction	**159**	This pit liner will have a minimum thickness of twenty-four (24) mils.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Construction	**160**	The liner will cover the bottom and interior sides of the pit with edges secured with at least a twelve (12) inch deep anchor trench around the pit perimeter. The anchor trench will be designed to secure and prevent slippage or damage to the liner materials.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Construction	**161**	The area under the pit over which the liner is laid will be free of rocks and other objects that could puncture the liner.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Construction	**162**	The pits will be designed to exclude all surface runoff and will be constructed in the cut portion of the well pad. Back slopes will be 2:1 or less.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Construction	**163**	The pit will remain fenced until it has dried enough to be backfilled.	N/A	1	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Pit Construction	**164**	The lined reserve pit or cuttings pit will be fenced on three sides with woven wire during drilling operations and the fourth side fenced immediately after the rig has been moved off location.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Operation	**165**	Free water (standing on pit surface) may be hauled to an approved disposal facility to facilitate drying of pits.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Operation	**166**	Any storm waters that generate standing water within the bermed area will be pumped out for use in well drilling or completion or hauled off-site for disposal.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Pit Operation	**167**	If fluids must be removed from drilling pits, vacuum trucks will remove these fluids so that the pit liner will not be damaged with heavy equipment.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Content Disposal	**168**	Prior to backfilling, SG will ensure that there is not a concentration of non-exempt hazardous substances in the reserve pit. Concentrations will not exceed standards of CERCLA, RCRA, or COGCC standards for such oil and gas field standards.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Content Disposal	**169**	Pit closure will be according to the COGCC rules and all testing and reporting requirements will be complied with.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Content Disposal	**170**	All testing procedures and test results will be provided to the BLM and or FS depending upon SMA.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Liner	**171**	Pit liners are removed following removal of contents.	N/A	1	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Pit Liner	**172**	Pit liners are disposed of at a solid waste disposal facility.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Liner	**173**	Currently pit liners are disposed of at the municipal solid waste facility of Delta County (Adobe Buttes Landfill, 12211 Trap Club Road, Eckert, CO).	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Reclamation	**174**	SG will ensure pits are free of oil and other liquid and solid wastes and allow pits to dry, pump them dry, or solidify them in-situ.	N/A	1	1	N/A	N/A
Hazardous Materials Management	Pit Reclamation	**175**	Soils below the liner will be sampled, analyzed, and comparted to COGCC Table 910-1 concentration levels. Any soil found in exceedance of regulatory limits will be excavated and hauled to a state-approved off-site commercial disposal facility.	N/A	1	1	1	1
Hazardous Materials Management	Pit Reclamation	**176**	Pits or trenches, will be reclaimed to a natural condition that blends with the rest of the reclaimed pad area in a manner that protects soil stability (compacted) and provides for protection from spills, leaks, and contamination.	N/A	1	1	N/A	1
Hazardous Materials Management	Pit Reclamation	**177**	The reclaimed pit area of the pad will be stabilized during well site operations and reclaimed when the well is no longer productive and final reclamation is taking place.	N/A	1	N/A	N/A	1
Hazardous Materials Management	Pit Reclamation	**178**	The pits will not be trenched (cut) or filled (squeezed).	N/A	1	1	N/A	N/A
Hazardous Materials Management	Wildlife	**179**	Fencing surrounding the reserve or cuttings pit will be 6 foot to 8 foot in height to prevent deer and elk as well as other wildlife from entering the pit.	N/A	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Cuttings Disposal	**180**	Cuttings will not be stored on location past the active drilling phase.	1	1	1	N/A	N/A
Hazardous Materials Management	Cuttings Disposal	**181**	Cuttings will be tested in accordance with the requirements of the disposal destination.	1	1	1	1	1
Hazardous Materials Management	Cuttings Disposal	**182**	Cuttings will be taken to the disposal destination facility as soon as possible.	1	1	1	N/A	N/A
Hazardous Materials Management	Cuttings Disposal	**183**	Cuttings are also tested in accordance with COGCC Table 9-10 standards.	1	1	1	1	1
Hazardous Materials Management	Cuttings Disposal	**184**	Hauling of the cuttings to the disposal facility will commence within 2 days of startup.	N/A	N/A	N/A	1	N/A
Hazardous Materials Management	Cuttings Disposal	**185**	All cuttings will be disposed of whether in the trench or in a commercial disposal facility within 6 months after well completion.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Disposal	**186**	If cuttings are to be transported to off-site disposal facility they could be transported to: Adobe Buttes Landfill located at 12211 Trap Club Road, Eckert, CO; or CB Industries, 11289 Doughspoon Road, Austin, CO; or ECDC Environmental Landfill in East Carbon, UT.	1	1	1	1	1
Hazardous Materials Management	Cuttings Disposal	**187**	Following testing, cuttings are either consolidated and left on site or removed to an approved location or facility.	N/A	1	1	N/A	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Cuttings Disposal	**188**	If testing confirms that cuttings are within safe limits compared to COGCC Table 910-1 concentration levels, they will be buried in trenches excavated along the cut side of the well pad. Any soil found in exceedance of regulatory limits will be excavated and hauled to a state-approved off-site commercial disposal facility.	N/A	N/A	N/A	N/A	1
Hazardous Materials Management	Cuttings Disposal	**189**	When drilling is completed, all cuttings will be removed from the bermed area and the liner removed for off-site disposal (liners will not be re-used in subsequent bermed areas).	N/A	N/A	N/A	1	1
Hazardous Materials Management	Cuttings Disposal	**190**	Following testing of cuttings, a trench 10 feet deep x 15 feet wide x 75 feet long may be constructed on the cut side of the pad to accommodate approximately 10,000 cubic feet (370 cubic yards) of acceptable cuttings. Excavated materials from the trench will be stored on the cut side of the pad. The trench size assumes complete containment of the estimated volume of the cuttings. Excavated soil from the trench will be placed in a 2-foot layer over the cuttings and blended back into the surrounding edges. The trenches will only be used to contain cuttings; no other exploration and production waste will be allowed in the trench.	N/A	N/A	N/A	N/A	1
Hazardous Materials Management	Facilities	**191**	A berm will be constructed around the tank battery, of sufficient capacity to contain at least 150% of the storage capacity of the largest tank within the dike.	N/A	1	N/A	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Facilities	**263**	Secondary containment is designed to hold at least the volume of the largest single tank plus precipitation.	1	N/A	1	N/A	N/A
Hazardous Materials Management	Facilities	**192**	The entire level well pad will be surrounded by a berm with a drainage ditch constructed interior to that berm in order to contain any potential release on the well pad. The berm will be at least 2.5 feet in height around the pad except at the access road entrance. Any fluid in the interior drainage ditch will be contained in the ditch and culvert until clean up. The berm will create a retainment capacity greater than 150% of the largest single container on the location.	N/A	N/A	1	1	1
Hazardous Materials Management	Facilities	**193**	The well pad is designed as a zero discharge area and any accidental releases will be contained.	1	1	1	1	1
Hazardous Materials Management	Facilities	**194**	GE will ensure that tanks will be set on compacted earth to decrease the permeability of the soil in the event of a release. SG will ensure that tanks are set on "cut" areas of the pad as well.	1	1	1	1	1
Hazardous Materials Management	Facilities	**195**	Fuels and lubricants will be transported by fuels distributers and will be stored in facilities specifically designed for that purpose.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Hazardous Materials Management	Facilities	**196**	All installed production facilities with the potential to leak or spill produced water, glycol, or other fluid which might be a hazard to public health or safety will be placed within an appropriate impervious secondary containment structure that will hold 110% of the capacity of the largest single container within it for 72 hours.	N/A	N/A	N/A	1	1
Hazardous Materials Management	Facilities	**197**	Secondary containment will consist of lined corrugated steel containment or compacted earthen berms. Compaction and construction of earthen berms will be performed to prevent lateral movement of fluids through the utilized materials.	N/A	N/A	N/A	1	1
Weed Control	General	**198**	The BLM and/or FS will be consulted regarding appropriate noxious weed control methods.	1	1	N/A	1	1
Weed Control	General	**199**	Prior approval from BLM and/or FS depending upon SMA will be obtained before beginning any herbicide treatment on project-related areas. Pesticide Use Proposals and pesticide application records will be submitted to BLM as appropriate.	1	1	1	1	1
Weed Control	Pre-Treat	**200**	Prior to ground-disturbance, surveys will be conducted to document noxious weeds within proposed disturbance; State listed A and B noxious weeds will be treated prior to ground disturbance.	1	1	1	1	1
Weed Control	Pre-Treat	**201**	Prior to mobilizing onto NFS lands, all equipment will be washed and cleaned to prevent spread of noxious weeds.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Weed Control	Pre-Treat	**202**	Herbicides will be selected based on recommendations by local weed control district, BLM and/or FS depending upon SMA and subject to fee-landowner approval where applicable. All herbicides will be applied in accordance with all applicable laws and regulations on BLM/FS and fee-lands.	1	1	1	1	1
Weed Control	Operations	**203**	As mandated by the CNWA and the COGCA, noxious weeds will be controlled on lands disturbed during development of the well pad, access road, and gathering lines.	1	1	1	1	1
Weed Control	Operations	**204**	To minimize weed establishment on disturbed surfaces, GE will seed temporarily disturbed surfaces on well pads, will establish interim reclamation within one year after last well drilled on a well pad, and will revegetate gathering line-related disturbance upon completion of gathering line construction.	N/A	N/A	N/A	1	1
Weed Control	Operations	**205**	If soil stockpiles are created in weed infested areas, these stockpiles will be kept as close as possible to the infested areas. No soil from weed infested areas will be moved until they are treated. Soil from an infested area will not be used in any other area beside where it was collected.	1	N/A	1	1	1
Weed Control	Operations	**206**	If any soil stockpiles are maintained for longer than 90 days, these stockpiles will be treated for weeds.	1	N/A	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Weed Control	Operations	**207**	At locations where new populations have been identified or pre-existing populations have expanded, action will be taken to eradicate the population or control their spread. The selection of control methods will be based on the available technology and information of the weed species and its control.	1	1	1	1	1
Weed Control	Monitoring	**208**	The distribution and density of noxious weeds will be monitored for the life of the project. Surveys will be conducted concurrent with reclamation monitoring and will occur as early in the year as feasible to identify and control noxious weeds before they produce seed. Monitoring data collected will include the noxious weed species, location, and extent of infestation and an annual report will be provided to BLM/FS regarding the results from monitoring including adaptation to control protocols.	1	1	N/A	1	1
Reclamation	General	**209**	Reclamation activities and standards will be guided by the Gold Book, GMUG Forest Plan Standards and the Forest Service Manual 2840.	1	1	1	1	1
Reclamation	General	**210**	The FS and BLM will be contacted at least 48 hours prior to planning and pre-construction on-sites and prior to commencement of any reclamation and within 48 hours of completion of reclamation work and mobilization of heavy equipment onto NFS lands.	1	1	1	1	1
Reclamation	General	**211**	Appropriate reclamation bonds on NFS lands related to the proposed action will be posted according to 36 CFR 228.109.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	General	**212**	Reclamation shall be undertaken in a timely manner and occur sequentially with ongoing operations. Reclamation will be judged successful when a self-sustaining, vigorous, diverse, native plant community is established and sufficient to control erosion and non-native plant invasion on the site.	1	1	x	N/A	N/A
Reclamation	General	**213**	Erosion control will be deemed sufficient when: adequate ground cover is reestablished, water naturally infiltrates into the soil, the site complies with the approved SWMP and when gullying, headcutting, slumping, and deep or excessive rilling is not observed.	1	1	1	1	1
Reclamation	General	**214**	Proper site preparation will be ensured by spreading of stored and salvaged topsoil or topsoil replacement to an adequate depth and by ripping, tilling, disking, harrowing, and dozer track imprinting where appropriate.	1	1	1	1	1
Reclamation	General	**215**	Whenever possible revegetation efforts will include: use of seed mixes that are weed free, timing seeding to occur at the appropriate season to maximize germination and establishment of vegetation while minimizing soil loss, monitoring revegetation within the site, providing yearly reports to the FS detailing disturbed acres, interim reclaimed acres, and finally reclaimed acres, and controlling all noxious weeds that may become established on disturbed or reclaimed areas.	1	1	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	General	**216**	Woody debris that can be used for reclamation will be salvaged for use in constructing erosion and sedimentation control devices as directed in the project conditions of approval and as allowed by the terms of any timber harvest permit (if required).	1	N/A	1	1	1
Reclamation	General	**217**	Reclamation measures will begin as soon as possible after the disturbance and continue until successful reclamation is achieved. With proper reclamation measures, over time, local native species will become re-established on the site and the area will regain its original productive and scenic potential.	1	1	1	1	1
Reclamation	General	**218**	In consultation with the BLM/FS, a reclamation plan will be prepared in order to effectively manage the reclamation of lands disturbed by the proposed action. All surface disturbance shall be reclaimed to a condition that is consistent with forest and resource management plans, as well as any site specific stipulations or conditions of approval.	1	1	N/A	1	1
Reclamation	General	**219**	Disturbed areas will be reseeded in accordance with the Surface Use Agreement and any applicable permit stipulations as soon as possible after construction activities have been completed.	1	N/A	1	1	1
Reclamation	General	**220**	The long-term objective for final reclamation is to return the land to a condition approximate or equal to that which existed prior to the disturbance.	1	1	x	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	General	**221**	The objective in the short-term is to achieve stability, visual, hydrological, and productivity objectives set by the GMUG Forest Plan and prescribed in the decision documentation and assurance that long-term reclamation objectives will be reached through natural processes.	1	1	x	1	1
Reclamation	Interim	**222**	Interim reclamation describes minimizing the footprint of disturbance through reclamation and revegetation of all disturbed areas not needed for future drilling and production operations. (E.g. cut/fill slopes, borrow ditches, access road outside driving surfaces). This reclamation will consist of returning topsoil to these areas will consist of returning topsoil to these areas, seeding with weed-free seed, and using any salvaged woody debris for surface roughening.	1	1	1	1	1
Reclamation	Interim	**223**	All areas outside the work area will be reseeded according to the FS/BLM, split-estate or Fee landowner, recommendations for seed mixture.	1	1	1	1	1
Reclamation	Interim	**224**	The interim reclamation process has already occurred at this location. This portions of the cleared well site not needed for operational and safety purposes or future drilling were recontoured to a final or intermediate contour that blends with the surrounding topography as much as possible.	N/A	N/A	1	N/A	N/A
Reclamation	Interim	**225**	The topsoil will be seeded to prevent erosion and to preserve its integrity.	1	N/A	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Interim	**226**	Seeding of areas disturbed related to this proposed action is scheduled to take place in the fall following construction.	N/A	N/A	1	N/A	N/A
Reclamation	Interim	**227**	Requirements for seedbed preparation, seed, seeding procedures, mulching, erosion control, fencing, security and monitoring would be as specified for interim reclamation. Topsoil storage piles, stormwater control features, temporarily disturbed areas along road and gathering lines, and cut and fill slopes will be seeded at the time of construction or within 30 days, to stabilize materials, maintain biotic soil activities, and minimize weeds. Seedbed prep will be required unless seeding occurs immediately after construction.	N/A	N/A	N/A	1	1
Reclamation	Interim	**228**	Prior to interim reclamation, GE will meet with the FS/BLM and the adjacent private landowner (when applicable) to inspect the disturbed area, to review the existing reclamation plan and agree upon any revisions to the plan.	N/A	N/A	N/A	1	1
Reclamation	Final	**229**	A well pad that no longer has a producing well will undergo final reclamation following plugging and abandonment of the final well on that pad. Prior to final reclamation of the well pad, a review the existing reclamation plan will occur and any changes agreed to by BLM/FS, unless private landowner dictates otherwise.	1	1	1	1	1
Reclamation	Final	**230**	A well pad that no longer has a producing well will undergo final reclamation within no more than 1 year following plugging and abandonment of the final well on that pad.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Final	**231**	SG will plan to complete all dirt work for final reclamation within six months of well plugging, weather permitting.	1	1	x	N/A	N/A
Reclamation	Final	**232**	If necessary, a revised reclamation plan will be submitted to BLM/FS plan with the Notice of Intent to Abandon and await approval from the authorized officer.	1	1	x	1	1
Reclamation	Final	**233**	Final reclamation restoration will include effective monitoring, revegetation with native species and control of all non-native plants and noxious weeds.	1	1	x	1	1
Reclamation	Final	**234**	All road surfacing gravel and other 'non-native' fill materials will be removed from public lands or buried deep in the recontouring so that it will not reemerge.	1	1	x	1	1
Reclamation	Final	**235**	Final reclamation restoration will include salvage and reuse of all available topsoil.	1	1	1	1	1
Reclamation	Final	**236**	Buried gathering lines will be reclaimed to final reclamation standards at the time of installation (e.g. surface recontouring, covered with salvaged topsoil, surface roughening, seeding, redistribution of salvaged woody debris)	1	N/A	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Final	**237**	Final reclamation of the well pad will consist of stripping topsoil and interim vegetation from portions of the site that are not at the original (or restoration) contour, recontouring of material storage piles, cut/fill slopes and SWMP features, spreading stripped topsoil over the entire disturbed site, and ensuring successful revegetation as specified in the final reclamation plan or final reclamation plan approved by the FS/BLM, or private landowner.	1	1	1	1	1
Reclamation	Final	**238**	As part of final reclamation processes: all equipment, facilities, and trash will be removed from the location; each borehole will be plugged, capped, and its related surface equipment removed; subsurface gathering lines will be purged and plugged at specific intervals; dry hole markers will be subsurface, to prevent their use as perching sites by raptors.	N/A	N/A	N/A	1	1
Reclamation	Final	**239**	The preferred seeding method is drilling, but if this is not feasible on part of the whole pipeline route, seed will be broadcast at twice the rate per acres as drilled seed.	1	N/A	1	N/A	N/A
Reclamation	Final	**240**	Final reclamation will be considered successful when areas disturbed by the proposed action are on the correct trajectory towards restoration; reclaimed topography approximates pre-disturbance condition and blends well with undisturbed areas adjacent; natural processes can move an area from reclamation to one where natural process dominate and is considered restored.	1	1	x	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Final	**241**	Final reclamation of all new roads associated with the proposed action that are no longer needed for ongoing operations will either be: turned over to the appropriate authority such as surface management agency or private landowner for continued use; or decommissioned by obliteration, recontouring and seeding.	1	1	1	1	1
Reclamation	Final	**242**	Final reclamation progress will be monitored (including roads and vegetation) through development and implementation of aggressive and adaptive weed management and monitoring plans and protocols, and comply with prevention measures for noxious weeds; "noxious weeds" shall be those undesirable plant species designated to be "noxious weeds" pursuant to the Colorado Noxious Weed Act.	1	1	1	1	1
Reclamation	Revegetation	**243**	The seedbed will be prepared by scarifying (roughening) spread topsoil prior to seeding, unless seeding takes place immediately or is drilled. Seedbed preparation may include pocking, ripping, disking, or other soil roughening techniques. Drilling of seeds is the preferred methods, however broadcast seeding, followed by dozer walking may also occur.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Revegetation	**244**	Revegetation efforts will consider the ecology of the site, identifying native plant communities present prior to disturbance and those which are most likely to reestablish on the reclaimed site. This will be done in consultation with BLM/ FS personnel or as per the project COAs (mountain shrub mix as directed during onsite inspection). Site preparation efforts would be planned to occur during appropriate season to minimize soil and weather delays and issues with surface water. Exclusion of livestock may also be considered and possible adjustment of reclamation measures to ensure complete revegetation of the site.	1	1	1	1	1
Reclamation	Revegetation	**245**	GE will conduct seeding no more than 24 hours following final seedbed preparation at then Henderson and Spadafora locations. Both GE and SG will implement subsequent reseedings if interim revegetation is unsuccessful, until interim reclamation standards are met.	1	1	1	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Revegetation	**246**	Reseeding will be completed using a certified weed-free seed mixture using methodologies and rates as approved by the BLM/FS and in consultation with the private landowner (where applicable). Weed-free certification, seed tags, and Subsequent Report Sundry Notice describing the reclamation will be submitted to the BLM within 30 days of seeding. Disturbed areas will be seeded with a seed mixture approved by the FS/BLM or the landowner. Seeds will contain no noxious, prohibited, or restricted weed seeds and contain no more than .5% by weight of other weed seeds. Only viability-tested, certified seed for the current year, with a minimum germination rate of 80% and a minimum purity of 90% will be used.	1	1	1	1	1
Reclamation	Revegetation	**247**	Final reclamation revegetation will be pursued through using certified weed free straw, potentially applying fertilizer where appropriate and using erosion control blankets, in combination with mulch and seeding on all slopes greater than 3:1 (33%).	1	1	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Revegetation	**248**	Final reclamation revegetation will be considered successful when: a self-sustaining, vigorous, diverse, native plant community is established on the site, with a density sufficient to control erosion and non-native plant invasion and to re-establish wildlife habitat or forage production; canopy cover from native forbs and grasses exceeds 25% and is comparable to similar undisturbed sites adjacent (in both density and composition); gully erosion is absent; sheet and rill erosion is present on less than 5% of previously disturbed surfaces; bare surfaces present on reclaimed sites are comparable, or relatively similar, to naturally occurring bare soils on undisturbed adjacent sites; and noxious and invasive weeds are absent from the site.	1	1	x	N/A	N/A
Reclamation	Monitoring	**249**	The BLM/FS will be notified of areas (in acres and by map) where final reclamation has been successful.	1	1	x	1	1
Reclamation	Monitoring	**250**	GE will regularly monitor, for reclamation success and for invasive species, all sites categorized as "operator reclamation in progress" and will submit an annual monitoring report of these sites to the FS/BLM by December 1 of each year. The annual report will document whether attainment of reclamation objectives appears likely. If objectives appear unlikely to be achieved, the report will identify appropriate corrective actions.	N/A	N/A	N/A	1	1

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Monitoring	**251**	Interim and final reclamation progress will be monitored (including roads and vegetation) through the establishment of photo and GPS way points preconstruction through restoration.	1	1	x	N/A	N/A
Reclamation	Monitoring	**252**	Interim and final reclamation progress will be monitored (including roads and vegetation) through construction and operation of channel crossings, reclaimed channel crossings, and other reclaimed stream/wetland areas should be photo documented.	1	1	N/A	N/A	N/A
Reclamation	Monitoring	**253**	Interim and final reclamation progress will be monitored (including roads and vegetation) through maintenance of pre and post development site inspection records and monitor operations for compliance.	1	1	1	1	1
Reclamation	Monitoring	**254**	Interim and final reclamation progress will be monitored (including roads and vegetation) through employment of state of the art technology to protect existing vegetation and use mats if possible for drilling and operations to preserve topsoil/vegetative root stock and document.	1	1	N/A	N/A	N/A
Reclamation	Monitoring	**255**	Interim and final reclamation progress will be monitored (including roads and vegetation) through management and conservation of topsoil to maintain soil horizons, microbe health and viability using live top-soiling techniques and top-subsoil segregation and documentation.	1	1	1	N/A	N/A

Type	Resource	#	Design Feature	SG 11-90-9	SG Aspen Leaf	SG Allen	GE Henderson	GE Spadafora
Reclamation	Monitoring	**256**	Interim and final reclamation progress will be monitored (including roads and vegetation) through monitoring of threatened and endangered species, and other sensitive or important wildlife species through seasonal surveys and reports.	1	1	x	N/A	N/A
Reclamation	Monitoring	**257**	Interim and final reclamation progress will be monitored (including roads and vegetation) through monitoring, inspection, and maintenance of construction, operational, and production equipment for wildlife hazards such as unscreened cavities or other holes or openings.	1	1	x	N/A	N/A
Reclamation	Monitoring	**258**	Monitoring reclamation success and informing the surface management agency that each stage of reclamation has been completed and that the site (or portion of) is ready for final inspection when these or interim requirements have been met.	1	1	x	1	1

This page intentionally left blank

APPENDIX C. CONDITIONS OF APPROVAL

C.1. Resource (Resource COA applies to # consecutively)

In cases where the operator's design features did not or could not fully address practices which minimize the level of environmental impact to specific resources analyzed in this environmental assessment, these instances require the following conditions of approval. These must be adhered to either in addition to applicable design features and in some cases directly replace specific design features in order for the operator to conduct the operations of the permit.

Air Quality and Climate Change

As described in Section 3.2.1.3, the overall maximum modeled air quality impacts for the proposed action are below the applicable thresholds for all pollutants and AQRVs. The modeling analysis accounted for the following project-specific design features that were provided by the proposed project operators. These equipment and practices would need to be operated / followed for the proposed project in order to protect future air quality in the project area and to ensure the applicability of the modeling assessment that was completed for the proposed action:

1. Routine clean water application for 50% dust control for construction phase surface disturbance and unpaved road traffic;
2. Tier-2 drilling / completion engine technology;
3. Low-bleed pneumatic devices;
4. Green well completion practices; and
5. Operation / production phase stationary engines will meet CDPHE Regulation 7 Engine Standards.

Soils

1. The use of silt fence and straw bales for erosion control have often been found ineffective in National Forest habitats due to improper installation or destruction by livestock/wildlife. It is, therefore, recommended that erosion control measures be bio-engineered with native materials (i.e. rock, aspen, other woody vegetation) wherever possible.
2. Monitoring by the operator and diligent adherence to the SWMP will provide quick identification, rectification, and prevention of any deficiencies in the design of devices.
3. It is recommended that the north-west edge of the proposed location of the 11-90-9 pad be adjusted 50 feet downslope to limit the need to level the topographically higher mound that separates the two ephemeral crenulations that converge at the pad location. This will limit the cut and fill needed to level the site and allow for less direct impact of soil disturbance at the site.

Vegetation Management

1. The operator must provide the results of sampling cuttings to the SMA for review prior to disposal of cuttings on-site. The operator may request SMA approval, if "strict" adherence with the COGCC Table 910-1 standard can occur, to bury the cuttings on location if they can be covered by an adequate amount of clean soil. Otherwise they cuttings must be hauled to an approved disposal site. "Strict" adherence means constituents cannot exceed the 910-1 standards, with the exception of those that exceed but are reflective of background (e.g. Arsenic) levels.
2. If these drill sites do not produce any commercially developable gas, the access roads and drill pads should be re-claimed and re-vegetated as soon as possible.
3. All drill pads, temporary roads and all disturbed area should be re-claimed and re-vegetated. To ensure the satisfactory reclamation and re-vegetation of all disturbed sites sufficient bonding to cover the costs of this work is recommended.
4. In addition, the following re-vegetation practices are recommended to be used to ensure success:
    - All roads, drill pads and staging areas should be re-shaped to their approximate original contours.
    - If soil is stock-piled, the stockpile needs to be contoured for stability and seeded to minimize noxious weed establishment. If the stockpile is temporary, one year or less, a

temporary revegetation seed mixture may be used. If the stockpile is going to be in place for over one year, the stockpile must be revegetated with a perennial seed mixture. Seed mixture recommendations are attached.

- The soil surfaces will be prepared to facilitate successful seed germination and establishment. The seedbed should be firm enough to prevent erosion, but loose enough to allow the seed sprouts to penetrate the soil. Slopes that are 3:1 or flatter should be drill seeded while slopes greater than this should be broadcast seeded. Raking or harrowing immediately before and after broadcasting is highly recommended.

5. Certified weed free straw should be disked or "crimped" into the soil for use as mulch in all disturbed areas. Seeding should occur in the fall of the year allowing for enough time for the seedlings to become established before the onset of winter, usually around mid-September to early November. Any seeding done from June 1 through August 30 has an increased likelihood of failure, due to the uncertainty of summer moisture.
6. Natural materials should be used for erosion and sediment control. Cut oak brush and or aspen should be used to construct silt and sediment control structures. Engelmann spruce and Douglas-fir should not be used due to the increased risk of bark beetle infestation. Silt fencing has been used on a variety of mining activities on the district and it is often torn down by livestock and wildlife. Natural materials have the additional benefit of not having to be picked up once revegetation has been completed. The natural materials cut to clear the ROW can be used or it can be cut along the ROW.
7. If fencing is required to protect re-vegetation, the gas well operator should provide, install, maintain and remove all fencing. Temporary electric fencing has worked well in the past. In addition, the gas well operators should coordinate with the permittees in installing all protective fencing.
8. Where FS is the SMA, the seed mixes for the Mountain Shrub mix or the Aspen/Spruce-Fir mix, depending on location, is recommended – see Table 3-12 for recommended FS seed mixes. Broadcast seeding application rates for the Mountain Shrub mix is 20 lbs/acre and the Aspen/Spruce-Fir mix is 19 lbs/acre. When drill seeding the drill should be set between .25 and .5 inches deep, and the seeding should be conducted along the contour of the slope to prevent erosion. The application rate for drill seeding should be 10 lbs/acre for the Mountain Shrub mix and 9 lbs/acre for the Aspen/Spruce-Fir mix. The seed-drill needs to be equipped with the following components:
    i. Multiple seed boxes for different types of seed
    ii. Agitators and picker wheels in at least one box for fluffy seed
    iii. Double disc furrow openers
    iv. Intact depth bands with functioning scrapers on all disc openers to ensure consistent, uniform seed depth placement
    v. Seed tubes, which drop between disc openers, large enough to handle fluffy seed
    vi. Packer wheels with adjustable tension, to provide proper soil compaction over and adjacent to the seed
    vii. Coulter wheels to allow penetration of furrow openers where seeding into heavy mulch or cover crop.

Seed Mixtures for Paonia R.D. (FS lands only)

Habitat type	Elevation	Species	lbs/acre (PLS)	% of Mixture
P/J Woodland	6-7,000	Galleta	3	16
		Western wheatgrass	4	20
		Great Basin Wildrye	3	16
		Indian Ricegrass	3	16
		Sandberg bluegrass	3	16
		Bottlebrush squireltail	3	16

		Total	**19**	**100**

Habitat type	Elevation	Species	Lbs/acre (PLS)	% of Mixture
Mountain Shrub	7-8,000	Mountain Bromegrass	4	20
		Prairie Junegrass	3	15
		Western wheatgrass	4	20
		Indian Ricegrass	3	15
		Rocky Mountain fescue	3	15
		Bluebunch wheatgrass	3	15
		Total	**20**	**100**

Habitat type	Elevation	Species	Lbs/acre (PLS)	% of Mixture
Aspen/Spruce-Fir	8-9,500	Mountain Bromegrass	5	26
		Slender Wheatgrass	3	16
		Nodding Bromegrass	3	16
		Canby Bluegrass	3	16
		Blue Wildrye	5	26
		Total	**19**	**100**

Temporary Revegetation	Elevation	Species	Lbs/acre (PLS)
Regreen (brand name)	All	Tall wheatgrass/winter wheatgrass	20 lbs/acre
Pioneer (brand name)	All	Tritacale/winter wheat	20 lbs/acre

9. Where BLM is the SMA, the following is required (recommended in the case of the Spadafora location):

The standard native seed mix for mountain shrub zone, upper elevations (7,500-9,000 feet) in the Table below should work well in the upper elevation zone in the 15 inch+ rainfall zone. Use the complete mix on larger projects where substantial amounts of ground will be disturbed, and the likelihood of reseeding from adjacent vegetation is low. On small projects where linear or small patches of vegetation are disturbed and there is abundant adjacent native vegetation for reseeding, use just the slender wheatgrass and western wheatgrass (at 4 lbs PLS seed for each species per acre, under the drill rate, double this rate for aerial application with no seed incorporation).

BLM Standard Native Seed Mix for Mountain Shrub Zone, Upper Elevations (7,500-9,000 feet)

	A	B	C	D	E
Species	Desired % of planting	Multiplier (A x 0.01)	PLS lbs for full stand	PLS lbs per acre needed for mix (B x C)	PLS lbs per acre for project (D x # acres)
Western Wheatgrass (*Pascopyrum smitthii*) Variety Arriba	15	0.15	10	1.5	
Slender Wheatgrass (*Elymus trachycaulis*) Variety San Luis	15	0.15	7	1.05	
Bottlebrush squirreltail (*Elymus elemoides*)	15	0.15	8	1.2	
Mountain Brome (*Bromus marginatus*)	15	0.15	12	1.8	
Big Bluegrass (*Poa ampla*)	10	0.1	3	0.3	
Canada Wildrye (*Elymus Canadensis*)	10	0.1	11	1.1	
American Vetch (*Vicia americana*)	3	0.03	25	0.75	
Rocky Mountain *Penstemon* (*Penstemon strictus*)	6	0.06	2	0.12	
Western Yarrow (*Achilla millefolium var. occidentalis*)	6	0.06	1	0.06	
Mountain Big Sagebrush (*Aretmesia tridentate vaseyena*)	5	0.05	1	0.05	
Totals	**100**	**1.0**		**7.93**	

Price and seed availability vary, so not all species may be available at the time you need them, or priced affordably. However the major ones should usually be available. The rate shown below is for a drilled seeding, or some other method that incorporates the seed into the soil. Rates should be doubled if the seed is to be aerially applied. If price or availability is a concern, reduce or leave out those species and increase percentages of remaining species correspondingly (column A in table below, total to this column should equal 100%, carry through changes in columns B, D, and E following instructions under column headings).

BLM places the following requirements on seed mixes which are put on BLM managed lands:

1) Use the following minimum PLS (Pure Live Seed) tolerances

PLS tested %	Tolerance % points
81-100	-7
61-80	-6
41-60	-5
21-40	-4
0-20	-3

2) All seed must comply with BLM and Colorado weed seed guidelines. There should be no prohibited species seed, and no more than allowable levels of restricted species seed. In addition, there should be no more that 0.5% total weed seed, less than 2% other seed, and no trash larger than ¼ inch in length. Seed shall not be stored in burlap bags.
3) The UFO places additional local restrictions on seed to minimize cheatgrass spread. If seed tests show any *Bromus tectorum* or *Bromus japonicus*, the BLM should be consulted with for approval. No mix placed on BLM shall contain more than 150 *Bromus tectorum* and/or *Bromus japonicus* seeds per pound.

4) BLM requires additional seed tests on seeding projects that are greater than 20 acres and/or require over 200 lbs of seed. For these seeding projects, the project operator should have the seed supply company store the purchased seed prior to mixing, and pull samples to be sent to a certified laboratory, preferably Colorado State Laboratory at the following address. Seed test results must comply with the criteria listed above before seed is mixed, shipped and applied to the project area:

Colorado State Laboratory
Colorado State University
Department of Soil and Crop Sciences
Fort Collins, CO 80523

5) BLM will need copies of seed tags and test results for all seed applied regardless of project size.

6) Only State Certified weed free mulch shall be used

Invasive, Non-Native Species

1. It is recommended that the gas well operators to be responsible for controlling all noxious weeds along all roads that they use to access their facilities as well as in the general area of their operations following construction for the life of operation of the gas wells. (This includes Gunnison County road from Highway 133 to the Gunnison National Forest boundary, FR 265 from the Forest Boundary to the Gunnison/Delta County Line, FR 849, and FR 851.
2. Operators need to control noxious weeds on the well pads and drill sites of the existing and the proposed wells. Treatments where FS is the SMA need to be reported to the Paonia Ranger District by October 1 of each year for coordination and reporting purposes. Treatments where BLM is the SMA need to be reported to BLM UFO as required in the operators specific Pesticide Use Proposal.
3. All disturbed sites, including road sides, drilling site and soil stock piles need to be re-vegetated with an approved seed mix within the same growing season that they are disturbed. The recommended seed mixtures for the basic vegetation types for interim revegetation on the Paonia Ranger District are described in section 3.2.5.4 vegetation.
4. All equipment that is moved on to the national forest from outside of Delta and Gunnison Counties should be cleaned at a wash station prior to entering the national forest to reduce the risk of transporting noxious weed seeds from infested sites onto the construction sites.

T & E and Sensitive Species

Other Sensitive and Plant and Wildlife Species

Northern leopard frog

1. Surveys in suitable habitat adjacent to and potentially impacted by project construction activities, including new pads, roads, and pipelines, will be needed to determine the current use of the area by leopard frogs.

Northern goshawk

2. The GMUG Forest Plan (III-26) contains a standard and guideline that “no activity shall be allowed within one quarter mile of an active Ferruginous hawk, Swainson’s hawk, goshawk, osprey, or prairie falcon nest from March 1 to July 31 if they would cause nesting failure or abandonment”.
    a. In order to insure this is met, surveys will need to be conducted within ¼ mile of the Allen and Spadafora pad construction sites in the year immediately prior to (to allow for change in plans) and during construction (to allow for movement of birds into the area), assuming no goshawks are determined to nest in the area during the construction year.
    b. If goshawks are found in the buffer area, the Forest Service biologist will need to be consulted for resolution. If no surveys are conducted, the habitat will be assumed to be occupied and a limited operating period matching the S&G dates will need to be implemented. Goshawk surveys are not required around the other three pad/road/pipeline locations due to the presence of numerous other raptor species in the

areas making goshawk occupancy unlikely, but if goshawks are found in the area, the Forest Service biologist should be consulted immediately.

c. General raptor surveys, including monitoring of known nest sites, should ensure compliance with other species addressed in the standard, as well as being likely to detect any goshawks using or nesting in the other areas of the project. Predisturbance surveys will insure compliance with Forest Plan standards and guidelines related to this species.

Flammulated Owl, Purple Martin, Olive-sided flycatcher, Brewer's sparrow

3. Predisturbance surveys will help determine presence or absence of this species prior to or during construction activities, and sites should be avoided if possible.

Migratory Birds

1. To minimize impacts on migratory bird populations, it is recommended that no surface disturbing activities occur from May 15 through July 15. This timeframe encompasses the core breeding season for the majority of migratory birds in the project area. Project activities should strive to retain and avoid modifying identified cavity trees, snags, and perches in the project area.

Riparian Zones and Wetlands (incl. Floodplains)

1. It is recommended that the temporary pipeline alignment for Pad 11-90-9 be collocated with the proposed access road alignment. This will mitigate the impacts of the pipeline crossing Little Henderson Creeks beaver dominated riparian by obviating the crossing.

2. It is recommended that the east edge of the Henderson Pad be located at least 100 feet from the center line of the intermittent crenulation it is currently proposed to have direct contact with. This will provide an adequate green buffer to mitigate the direct connection of sediment delivery from the proposed well pad location.

Hydrology (Surface Water)

11-90-9, and Henderson, Location

1. Clean Water Act section 404 permitting is required by the Army Corps of Engineers to assure protection of Waters of the US from sedimentation.

Hydrology (Ground Water)

Allen Location

1. Collection of baseline data prior to gas-well installation and time series collection of data after well installation is the best way to understand the geologic structure and existing contamination of groundwater (McManhon P.B., et al., 2013). Baseline samples should be collected to quantify the isotopic composition of methane (biogenic and/or thermogenic) which would aid in understanding the origin of the methane. Noble gases should also be sampled to age date groundwater and in combination with methane data can help distinguish between natural sources of methane or those induced from drilling activities. Sampling should be conducted at several sites on each of these creeks: West Muddy Creek, Williams Creek, and Pilot Creek.

Wastes (Hazardous and Solid)

1. According to 29 CFR 1910.1200(g), both operators are required to maintain a file containing Material Safety Data Sheets for all chemicals, compounds, and/or substances utilized during the course of construction, drilling, completion, and production operations of the project. This file is to be available at all times when employees are present at the site.

2. All proposed Federal natural gas wells related to this proposed action are subject to the Federal Hydraulic Fracturing rule on Federal and Indian Lands 43 CFR 3162.3-3 Subsequent well operations; Hydraulic fracturing. With this rule, the BLM establishes new requirements to ensure wellbore integrity, protect water quality, and enhance public disclosure of chemicals and other details of hydraulic fracturing operations. Specifically, this final rule will add to existing requirements by providing information to BLM and the public on the location, geology, water resources, location of other wells or fracture zones in the area and fracturing plans for the operation before the well is permitted. To ensure well integrity, the final rule requires specific best practice performance standards for all wells, including cement return and pressure testing for surface casing, cement evaluation logs for intermediate and production casing, and remediation

plans and cement evaluation logs for any surface casing that does not meet performance standards. The final rule requires interim storage of all produced water in rigid enclosed, covered, or netted and screened above-ground tanks, subject to very limited exceptions in which lined pits could be used. Public disclosure of all chemicals, subject to limited exceptions for trade secret material, is required after fracturing operations are complete. The existing database FracFocus (http://fracfocus.org) can be used for this disclosure.

3. All activities associated with construction and operation of the proposed project would be required to be in compliance with applicable local, state, and federal regulations to protect the health and safety of proposed project employees and the general public.

Access and Transportation

1. Project design features and any additional BMPs will be incorporated into the traffic control plan. The plan will include at a minimum methods to comply with the terms and conditions of the current road use permits, compliance with the **Manual on Uniform Traffic Control Devices (MUTCD) - FHWA**, road and route closures, flaggers, escort vehicles .

2. Most National Forest System roads were designed using the AASHTO guidelines, constructed for National Forest visitor and commercial user access and are maintained for long-term vehicle use. The system roads in the project area were built to be seasonal roads used during the dry periods of the year. They were never intended to be used for all-season access and will require considerable improvement to accommodate this type of use. Most roads of the project area have been upgraded beyond this minimum standard, however FS704.4A and a portion of FS851 may require additional upgrade prior to use.

Realty Authorizations

1. The holder shall promptly abate as completely as possible and in compliance with all applicable laws and regulations any activity or condition arising out of or relating to use of the roads authorized by this permit that causes or threatens to cause a hazard to public health or the safety of the holder's employees or agents or harm to the environment (including areas of vegetation or timber, fish or other wildlife populations, their habitats, or any other natural resources).

2. The holder shall immediately notify the responsible official of all traffic accidents and any other serious accidents that occur in connection with the authorized use. The responsibility to protect the health and safety of all persons affected by use of the roads authorized by this permit is solely that of the holder. The Forest Service has no duty under the terms of this permit to inspect the roads authorized by this permit or authorized activities of the holder for hazardous conditions or compliance with health and safety standards.

Livestock Grazing

Forage Loss

1. The impact of this loss could be mitigated by locating as much of the roads and drill sites in oak-brush vegetation as possible.

Range Improvements

2. Any damage to any range improvements must be repaired as quickly as possible. If any additional range improvements are located during construction, these improvements should also be protected.

3. Stock ponds that silt-in due to new roads need to be cleaned as soon as possible. Cattleguards on the major transportation roads as well as new access roads that silt in also need to be cleaned as soon as possible.

4. Subsidence and the loss of spring flows and water holding capacity to ponds and spring developments are additional potential impacts to range improvements. Any damaged water developments should be replaced with a comparable functional water development.

5. There are several cattleguards on FR 265 that will be used to travel to the access roads and drill sites. These cattleguards need to be kept functional. Any damage caused to the cattleguard, the grates or the wings, need to be repaired immediately if the damage occurs during the grazing

season. In addition, if traffic causes the cattleguards to silt in, the cattleguards need to be cleaned immediately.

Other Measures

6. After drilling is completed and the access road is gated off, the permittee should be provided access to set a sheep camp just beyond the Henderson drill pad.

Noise

1. Measures for noise abatement would be applied to meet DOI and USDA Gold Book guidelines (DOI and USDA 2007) and COGCC maximum permissible noise levels.

Visual Resources Management

1. Adherence to applicable design features related to project lighting, painting all long term facilities on location with an environmental color that reduces the potential for equipment and facilities to stand out on the landscape is required.

Geology and Mineral Resources

1. To insure the stability of facilities required (roads, pipelines, drill pads, etc.) during the oil and gas operations and to insure the stability of lands adjacent to these facilities, the 11-90-9, Aspen Leaf and Henderson are subject to Controlled Surface Use Stipulation: “Moderate Geologic Hazard”. Any areas within the leasehold identified as having moderate geologic hazard falls under jurisdiction of this stipulation. Surface occupancy or use is subject to the following special operating constraints. Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e. subsidence, acid drainage).

2. All proposed Federal natural gas wells related to this proposed action are subject to the Federal Hydraulic Fracturing rule on Federal and Indian Lands 43 CFR 3162.3-3 Subsequent well operations; Hydraulic fracturing. With this rule, the BLM establishes new requirements to ensure wellbore integrity, protect water quality, and enhance public disclosure of chemicals and other details of hydraulic fracturing operations. Specifically, this final rule will add to existing requirements by providing information to BLM and the public on the location, geology, water resources, location of other wells or fracture zones in the area and fracturing plans for the operation before the well is permitted. To ensure well integrity, the final rule requires specific best practice performance standards for all wells, including cement return and pressure testing for surface casing, cement evaluation logs for intermediate and production casing, and remediation plans and cement evaluation logs for any surface casing that does not meet performance standards. The final rule requires interim storage of all produced water in rigid enclosed, covered, or netted and screened above-ground tanks, subject to very limited exceptions in which lined pits could be used. Public disclosure of all chemicals, subject to limited exceptions for trade secret material, is required after fracturing operations are complete. The existing database FracFocus (http://fracfocus.org) can be used for this disclosure.

This page intentionally left blank

APPENDIX D. FEDERAL AND STATE NOTIFICATION REQUIREMENTS

Federal and State reporting requirements for spills, along with whether notification must be in writing or verbal are based on:

- The type and volume of material spilled;
- Affected environmental media (i.e. soil, water)

For materials not listed in the tables below, personnel should consult the SDS sheet for the material spilled, determine if it is Exploration and Production (E&P) waste and submit the appropriate forms if required. In addition, whenever more than 1,000 gallons of oil are discharged in a single incident or more than 42 gallons of oil have been discharged in each of two incidents over a 12 month period, SG will submit a report to the US Environmental Protection Agency Regional Administrator as outlined in Part 112.4 of SG's Spill Prevention Containment and Control (SPCC) Plan.

Federal and State Written Notification Requirements.

E & P Waste						
Chemical	**Media Affected**	**Minimum Amount to Report RQ**	**Reporting Requirement (Written)**	**COGCC**	**CDPHE**	**BLM**
	Surface water/ Groundwater	Any Amount Impacting Water (FEE/FED)	10 days (State) 15 days (Fed)	**X**	**X**	**X**
Condensate/Crude Oil	Soil	>5 bbls but <20 bbls (FEE)	10 days	**X**		
		>20 bbls (FEE)	10 days	**X**		
		>10 bbls but <100 bbls (FED)	10 days (State) 15 days (Fed)	**If > 20 bbls**		**X**
		>100 bbls (FED)	10 days (State) 15 days (Fed)	**X**		**X**
Produced Water/ Flowback Water	Surface water/ Groundwater	Any Amount Impacting Water (FEE/FED)	10 days (State) 15 days (Fed)	**X**	**X**	**X**
	Soil	>5 bbls but <20 bbls (FEE)	10 days	**X**		
		>20 bbls (FEE)	10 days	**X**		
		>10 bbls but <100 bbls (FED)	10 days (State) 15 days (Fed)	**If > 20 bbls**		**X**
		>100 bbls (FED)	10 days (State) 15 days (Fed)	**X**		**X**
Non E & P Waste						
Diesel Fuel/Gasoline	Surface water/ Groundwater	Any Amount Impacting Water (FED)	15 days		**X**	**X**
	Soil	> 25 gallons (FEE/FED)	10 days		**X**	
		>10 bbls but <100 bbls (FED)	15 days		**X**	**X**
		>100 bbls (FED)	15 days		**X**	**X**
Waste Oil/Lube Oil	Surface water/ Groundwater	Any Amount Impacting Water (FED)	15 days		**X**	**X**
	Soil	> 25 gallons (FEE/FED)	None		**X**	
		>10 bbls but <100 bbls (FED)	15 days		**X**	**X**
		>100 bbls (FED)	15 days		**X**	**X**

Federal and State Verbal Notification Requirements.

E & P Waste							
Chemical	**Media Affected**	**Minimum Amount to Report RQ**	**Reporting Requirement (Verbal)**	**National Response Center**	**COGCC**	**CDPHE**	**BLM**
Condensate/Crude Oil	Surface water/ Groundwater	Any Amount Impacting Water (FEE/FED)	Immediately	**X**	**X**	**X**	**X**
	Soil	>5 bbls but <20 bbls (FEE)	None				
		>20 bbls (FEE)	24 Hours		**X**		
		>10 bbls but <100 bbls (FED)	24 Hours		**If > 20 bbls**		
		>100 bbls (FED)	24 Hours		**X**		**X**
Produced Water/ Flowback Water	Surface water/ Groundwater	Any Amount Impacting Water (FEE/FED)	Immediately	**X**	**X**	**X**	**X**
	Soil	>5 bbls but <20 bbls (FEE)	None				
		>20 bbls (FEE)	24 Hours		**X**		
		>10 bbls but <100 bbls (FED)	24 Hours		**If > 20 bbls**		
		>100 bbls (FED)	24 Hours		**X**		**X**
Non E & P Waste							
Diesel Fuel/Gasoline	Surface water/ Groundwater	Any Amount Impacting Water (FED)	Immediately	**X**		**X**	**X**
	Soil	> 25 gallons (FEE/FED)	24 Hours			**X**	
		>10 bbls but <100 bbls (FED)	24 Hours			**X**	
		>100 bbls (FED)	24 Hours			**X**	**X**

Waste Oil/Lube Oil	Surface water/ Groundwater	Any Amount Impacting Water (FED)	Immediately	**X**		**X**	**X**
	Soil	> 25 gallons (FEE/FED)	24 Hours			**X**	
		>10 bbls but <100 bbls (FED)	24 Hours			**X**	
		>100 bbls (FED)	24 Hours			**X**	**X**

This page intentionally left blank

APPENDIX E. HAZARDOUS MATERIALS MANAGEMENT SUMMARY

E.1. SG Provided Chemical Listing

Extremely hazardous materials which may be expected to be used, stored, or transported within the project area. In accordance with 29 CFR 1910.1200 (g)(8) and/or (g)(9), Safety Data Sheets (SDS) for every chemical or hazardous material brought on-site will be kept on file at the operator's field office.

Hazardous Materials that may be Used, stored, and Transported within the Project Area

Material	Use
Calcium chloride	Drilling
Type III cement	Casing
Surfactant wash	Drilling
Mud Clean I	Drilling
Cement, Premium Lite HS	Casing
Cement, Premium Lite Plus	Casing
KCl water	Drilling
Poz (fly ash)	Drilling
CSE-2	Drilling
Bentonite II	Drilling
Kol Seal	Drilling
Methanol	Operations
1% KCl	Operations
CaCl	Workover
Packer fluid	Operations
Pegasus 805	Operations
Rock Drill gear oil	Operations
EC106A biocide - Nalco	Operations
04VD008 Scale corrosion inhibitor	Operations
50/50 Antifreeze	Operations
Diesel	Fuel for drilling rig and workover rig
Silica Flour	Drilling
Ultra Flush II	Drilling
NALCO Biocide ECT 35A corrosion inhibit	Operations
NALCO Biocide EC1071A corrosion inhibit	Operations
Gear oil	On rig during drilling/completion ops
Zetag Polymer	Drilling
DI-30	Drilling
Fiber Plug	Drilling
Fiber Seal	Drilling
Walnut hulls, medium	Drilling
Walnut hulls, fine	Drilling
Sodium bicarbonate	Drilling
Soda Ash	Drilling
Sawdust	Drilling
SAPP	Drilling
Pronto Plug Fine	Drilling
NOV XAN D	Drilling
NOV Thin L	Drilling
NOV PLEX	Drilling
NOV PAC LV	Drilling

Hazardous Materials that may be Used, stored, and Transported within the Project Area

Material	Use
NOV Fiber Fine	Drilling
NOV Fiber Coarse	Drilling
NOV EFS #13	Drilling
NOV Drill Liquid	Drilling
NOV Carb (M)	Drilling
NOV Biocide GA25-R	Drilling
Mica Fine	Drilling
Maxi-Thin	Drilling
Lime	Drilling
Lignite	Drilling
K+Formate	Drilling
Caustic soda	Drilling
Barite	Drilling
Aqua-Block	Drilling
LGC-36 Guar	Completion
15% Hydrochloric Acid	Completion
HAI-81M, acid inhibitor (isopropanol, ethyl octynol, kerosene, propargyl alcohol, methanol)	Completion
LOSURF-300M, surfactant (ethanol, aromatic petroleum naphtha)	Completion
BC-140, crosslinker (borate, ethylene glycol)	Completion
BA-40L, buffer (sodium carbonate and potassium carbonate)	Completion
SandWedge, conductivity enhancer (aromatic petroleum & isopropanol)	Completion
GBW-30, enzyme breaker (carbohydrates, hemicellulase enzyme)	Completion
BE-6 Biocide (2-bromo-2-nitro-1, 3-propanediol)	Completion
FR-66 friction reducer (hydrotreated light petroleum distillate)	Completion
Ferrotrol 300L, prevents precipitation of metal oxides (citric acid)	Completion
XLW-32, maintains fluid viscosity as temp increases (methanol)	Completion
GBW-15L, allows delayed breakdown of gel polymer chains (sodium cloride)	Completion
Alpha 125, eliminates bacteria (glutaraldehyde)	Completion
AI-2, acid corrosion inhibitor (ethylene glycol monobutylether, propargyl alcohol, isopropyl alcohol, proprietary component)	Completion
OB-Fe, gel breaker (propylene glycol, ferrous sulfate, heptahydrate)	Completion
Bioclear 200, biocide (2,2-dibromo-3-nitrilopropionamide, polyethylene glycol mixture)	Completion
SAS-2, gelling agent (hydrotreated light distallate, mineral spirits, propylene glycol, ethoxylated alcohols)	Completion
FE-1A, dissolves minerals, initiate fractures in rock (acetic acid, acetic anhydride)	Completion
FR-46, removes oxygen from the water to protect pipe from corrosion (ammonium bisulfate)	Completion
CL-31 crosslinker, (potassium metaborate and potassium hydroxide)	Completion
Vicon NF Breaker (chlorous acid, sodium salt and sodium chloride)	Completion
CL-37 crosslinker (triethanolamine zirconate, propanol, and glycerine)	Completion
BA-40L buffering agent (potassium carbonate)	Completion
Gel-Sta L stabilizer (sodium thiosulfate)	Completion
SP Breaker (sodium persulfate)	Completion

E.2. GE Provided Chemical Listing

Chemicals used in GE Oil and Gas Operations

The chemical products listed below may be utilized during the drilling and production of oil and gas operations. Operational conditions may require chemical products not presented here, likewise some products listed may not be utilized at all. Available chemical abstract numbers are presented on the particular material safety data sheet (MSDS).

Chemical	Purpose	Chemical Abstract Number (CAS)
Barite - barium sulfate and crystalline silica, quartz		7727-43-7 14808-60-7
Cl-31	Corrosion inhibitor	000067-56-1 000067-63-0 000064-18-6 000100-44-7
ClayCare - Choline Chloride and water		67-48-1 7732-18-5
Defoamer 530- Propane-1,2-diol propoxylated		25322-69-4
DWP-621-1 -Anionic water soluble polymer	Friction Reducer	CAS Not Provided
DPW913-1- Quatemized KCL Substitute		CAS Not_provided
DWP-944-3 Biocide		25322-68-3 10222-01-2
DynaDet	Detelll_ent	CAS Not_Qrovided
EvoCon II	Surfactant	CAS P ietary
Evolube OPE II	Drilling Performance Enhancer	CAS Proprietary
EvoMod Synthetic inorganic polymer	Viscosifier	
ExWATE- Barium Sulfate		7727-43-7 1332-58-7 14808-60-7 471-34-1
FERROTROL 300L - Citric acid		77-92-9
FlexFirm KA - Anhydrous Potassium silicate powder		1312-76-1 14808-60-7
HAI-40M	Corrosion Inhibitor	15619-48-4 67-56-1 67-63-0
Hydrochloric Acid		7647-01-0
HR-601 (Lignosulfonate)	Cement Retarder	

Chemical	Purpose	Chemical Abstract Number (CAS)
LoSurf-3000	Surfactant	64-17-5 64742-94-5 91-20-3 95-63-6 127087-87-0
Methyl alcohol		67-56-1
NEWCARB- Calcium Carbonate		471-34-1
NEWPAC B- Celulose		
NewPhalt - Sulfonated asphalt		CAS Proprietary
NewPHPA D -Anionic water-soluble polymer	Shale control	CAS Not Provided
NEWZAN D- Xartnar Gum		11135-66-2
NoFoam X	Defoamer	CAS - Pro_ >rietarv
PHENO SEAL - Melamine and phenolic resins		CAS Not Provided
Potassium Chloride - Inorganic salt		7447-40-7
Chemical	Purpose	Chemical Abstract Number (CAS)
SAPP - Sodium acid Pyrophosphate		7758-16-9
Caustic Soda - Caustic Soda Anhydrous		CAS Not Provided

This page intentionally left blank

APPENDIX F. NOXIOUS WEED LIST

The following noxious weeds are listed noxious weeds by the state of Colorado, included in the Gunnison Basin Weed District Management Plan, or listed by the BLM. The goal for Colorado A Listed weeds is eradication. The goal for B Listed weeds is to stop their spread. C Listed weeds are those weeds that are managed by local jurisdictions within the state of Colorado. The state also maintains a Watch List for weeds that pose a threat to agriculture and the environment of Colorado. The goal for weeds on the Watch List is to further understanding of their distribution in order to determine if they should receive official listing.

Weed Name	Scientific Name	County Listed	Colorado (A, B, C Listed or W for Watch List)	BLM Listed
Velvetleaf	*Abutilon theophrasti*		C	
Russian knapweed	*Acroptilon repens*		B	
Jointed goatgrass	*Aegilops cylindrica*		B	√
Camelthorn	*Alhagi pseudalhagi*		A	√
European beachgrass	*Ammophila arenaria*			√
Spurred anoda	*Anoda cristata*		B	
Scentless chamomile	*Anthemis arvensis*		B	√
Mayweed chamomile	*Anthemis cotula*		B	√
Burdock	*Arctium minus*		C	√
Absinth wormwood	*Artemisia absinthium*	√	B	
Giant reed	*Arundo donax*		A	√
Fivehorn smotherweed	*Bassia hyssopifolia*			√
Black mustard	*Brassica nigra*			√
Wild turnip	*Brassica tournefortii*		W	√
Ripgut brome	*Bromus diandrus*			√
Japanese brome	*Bromus japonicas*			√
Red brome	*Bromus rubens*			√
Downy brome	*Bromus tectorum*		C	√
Mexican bird-of- paradise	*Caesalpinia gilliesii*			√
Lens-podded whitetop	*Cardaria chalepensis*			√
Hoary cress	*Cardaria draba*	√	B	√
Plumeless thistle	*Carduus acanthoides*	√	B	√
Musk thistle	*Carduus nutans*	√	B	√
Italian thistle	*Carduus pycnocephalus*			√
Slender-flowered thistle	*Carduus teniflora*			√
Sea iceplant	*Carpobrotus chilensis*			√
Hottentot fig	*Carpobrotus edulis*			√
Distaff thistle	*Carthamus lantus*			√
Common caraway	*Carum carvi*		B	√
Longspur sandbur	*Cenchrus longispinus*			√
Purple starthistle	*Centaurea calcitrapa*			√

Weed Name	Scientific Name	County Listed	Colorado (A, B, C Listed or W for Watch List)	BLM Listed
Cornflower	*Centaurea cyanus*			√
Diffuse knapweed	*Centaurea diffusa*	√	B	√
Iberian starthistle	*Centaurea iberica*			√
Brown knapweed	*Centaurea jacea*			√
Bighead knapweed	*Centaurea macrocephala*			√
Spotted knapweed	*Centaurea maculosa*	√	B	√
Malta starthistle	*Centaurea melitenisis*			√
Mountain cornflower	*Centaurea montana*			√
Black knapweed	*Centaurea nigra*			√
Vochin knapweed	*Centaurea nigrescens*			√
Meadow knapweed	*Centaurea pratensis*		A	√
Russian knapweed	*Centaurea repens*	√	B	√
Yellow starthistle	*Centaurea solstitialis*		A	√
Feather-headed knapweed	*Centaurea trichocephal*			√
Squarrose knapweed	*Centaurea virgata*		A	√
Chicory	*Chichorium intybus*		C	√
Rush skeletonweed	*Chondrilla juncea*		A	√
Oxeye Daisy	*Chrysanthemum leucanthemum*	√	B	√
Canada thistle	*Cirsium arvense*		B	√
Bull thistle	*Cirsium vulgare*		B	√
Chinese clematis	*Clematis orientalis*		B	√
Poison hemlock	*Conium maculatum*		C	√
Field bindweed	*Convolvulus arvensis*	√	C	√
Andean pampas grass	*Cortaderia jubata*		W	√
Pampas grass	*Cortaderia selloana*			√
Bristly hawkweed	*Crepis setosa*			√
Common crupina	*Crupina vulgaris*		A	√
Artichoke thistle	*Cynara cardunculus*			√
Bermudagrass	*Cynodon dactylon*			√
Houndstongue	*Cynoglossum officinale*		B	√
Spanish broom	*Cytisus junceum*			√
French broom	*Cytisus monspessula*			√
Scotch broom	*Cytisus scoparius*		W	√
Portugese broom	*Cytisus striatus*			√
Foxglove	*Digitalis purpurea*			√
Common teasel	*Dipsacus fullonum*		B	√
Blueweed	*Echium vulgare*			√
Brazilian waterweed	*Egeria densa*			√
Veldt grass	*Ehrharta calycina*			√
Water hyacinth	*Eichhornia crassipes*		W	√
Russian olive	*Elaeagnus angustifolia*		B	√
Quackgrass	*Elytrigia repens*		B	√

Weed Name	Scientific Name	County Listed	Colorado (A, B, C Listed or W for Watch List)	BLM Listed
Lehmann lovegrass	*Eragrostis lehmanniana*			√
Australian fireweed	*Erechtites glomerata*			√
Redstem filaree	*Erodium cicutarium*		C	
Cypress spurge	*Euphorbia cyparissias*		A	√
Leafy spurge	*Euphorbia esula*	√	B	√
Myrtle spurge	*Euphorbia myrsinites*		A	√
Edible fig	*Ficus carica*			√
Fennel	*Foeniculum vulgare*			√
Goat's rue	*Galega officinalis*			√
Baby's breath	*Gypsophila paniculata*		W	√
Halogeton	*Halogeton glomeratus*		C	√
Dame's rocket	*Hesperis matronalis*	√	B	√
Venice mallow	*Hibiscus trionum*		B	
Orange hawkweed	*Hieracium aurantiacum*	√	A	√
Mouseear hawkweed	*Hieracium pilosella*			√
Yellow hawkweed	*Hieracium pretense*			√
Hydrilla	*Hydrilla verticillata*		A	√
Black henbane	*Hyoscyamus niger*	√	B	√
Common St. Johnswort	*Hypericum perforatum*		C	√
Dyer's Woad	*Isatis tinctoria*		A	√
Blue buttons	*Knautia arvensis*			√
Everlasting peavine	*Lathyrus latifolius*			√
Perennial pepperweed	*Lepidium latifolium*		B	√
Himalayan bush clover	*Lespedeza cuneata*		W	√
Dalmation toadflax	*Linaria dalmatica*	√	B	√
Yellow toadflax	*Linaria vulgaris*	√	B	√
Garden loosestrife	*Lysimachia vulgaris*			√
Purple loosestrife	*Lythrum salicaria*	√	A	√
Wand loosestrife	*Lythrum virgatum*			√
Chilean tarweed	*Madia sativa*			√
Eurasian milfoil	*Myriophyllum spicatum*		B	√
Matgrass	*Nardus stricta*			√
Scotch thistle	*Onopordum acanthium, O. taricum*	√	B	√
Wild proso millet	*Panicum miliaceum*		C	√
African rue	*Peganum harmala*		A	√
Crimson fountain grass	*Pennisetum setaceum*			√
Bulbous bluegrass	*Poa bulbosa*		C	
Japanese knotweed	*Polygonum cuspidatum*		A	
Giant knotweed	*Polygonum sachalinense*		A	
Bohemian knotweed	*Polygonum x bohemicum*			
Sulphur cinquefoil	*Potentilla recta*		B	√
Bridal veil broom	*Retama monosperma*			√
Himalayan blackberry	*Rubus discolor*		W	√

Weed Name	Scientific Name	County Listed	Colorado (A, B, C Listed or W for Watch List)	BLM Listed
Mediterranean sage	*Salvia aethopis*		A	√
Giant salvinia	*Salvinia molesta*		A	
Bouncing bet	*Saponaria officinalis*		B	√
Brazilian pepper	*Schinus terebrinthifolius*			√
Schismus	*Schismus arabicus*			√
Tansy ragwort	*Senecio jacobaea*		A	√
German ivy	*Senecio mikanoides*			√
Bitter nightshade	*Solanum dulcamara*			√
Perennial sowthistle	*Sonchus arvensis*		C	√
Johnsongrass	*Sorghum halepense*		C	√
Medusahead	*Taeniatherum caputmedusae*		A	√
Tamarisk	*Tamarix parviflora, T. ramosissima, T gallica, T. chinensis, T. pentanda, T. aphylla*	√	B	√
Common tansy	*Tanacetum vulgare*		B	√
Puncturevine	*Tribulus terrestris*		C	
Gorse	*Ulex europaeus*			√
Siberian elm	*Ulmus pumila*			√
Moth mullein	*Verbascum blattaria*		B	
Common mullein	*Verbascum thapsus*		C	

This page intentionally left blank

APPENDIX G. SG TEMPORARY POLYPIPELINE OPERATIONS PLAN

G.1. General Installation and Operations of SG's Proposed Temporary Surface Poly Pipelines

SG Interests designed and constructed the McIntyre Flowback Pits 3 and 4 in order to store water for use and reuse for drilling and completion activities associated with wells in the Bull Mountain area. Water stored in these pits is a mixture of fresh water, produced water, and flowback water from previous well completions. McIntyre Flowback Pits 1 and 2 were also designed and permitted, but have not been constructed as of March 2015. The basic plan for use of the facilities is to transport water to be stored in the pits via high density polyethylene (HDPE, referred to here as "poly") pipelines on the ground surface.

The diameter and wall thickness required for each project are determined on site specific conditions, but if feasible, we will use the poly pipeline that SG Interests has purchased for this project. This pipe is 1 inch thick and 12 inches in diameter (DR-9). These pipelines can be laid on the ground without creating significant ground disturbance (see example photo below from http://www.wpandd.com/photoGallery.html, Figure 1). Wherever possible, these pipelines will be laid alongside or over existing disturbance such as along an existing access road.

- If Pits 1 and 2 are constructed and operational before completion of the Federal 11-90-9 #4 is scheduled, it is possible that these pits would be used for this project.
- If Pits 1 and 2 are constructed and operational before completion of the Federal 11-90-15 #3 is scheduled, it is possible that these pits would be used for this project.

The location of these pits can be seen on figures in the subsections below related to each project location. Figures depicting possible route variations that may make water transfer more efficient are also provided.

Figure 1. Example of poly pipeline laid on surface (from WPD website)

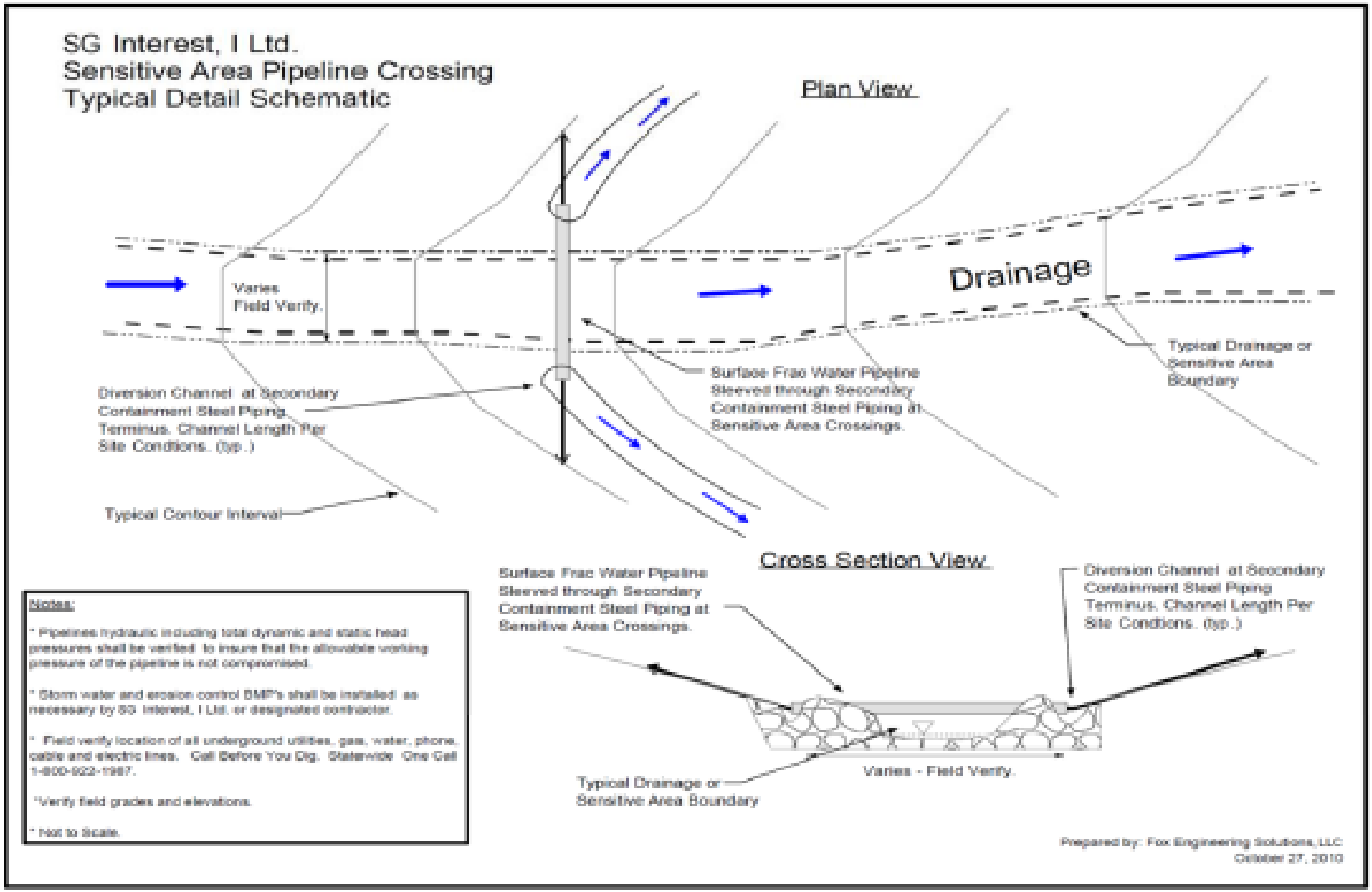


Figure 2. Sensitive area poly pipeline crossing typical schematic.

Before the pipelines are cut and moved to a new location, they will be dried internally using a foam pig pushed by compressed air. The pig will be pushed back toward the pits allowing the fluid to drain into the pits. The pipeline can then either be dragged with a tracked or rubber tired vehicle whole or in sections to the new location or cut into pieces for storage.

Following well completion, the well will flowback at a high rate and the poly pipelines will be used to transport this water back to the pits for recycling. The poly pipelines are expected to be kept in this location for approximately one to three months (unless needed at the locations for additional wells).

Poly pipelines are constructed between the pits and the well location generally by fusing the first several joints of pipe together end to end. The fuses are created by heating facing ends of pipe until they have melted and can then be cooled and fused together. The resulting fuse is as strong as the poly pipe itself. Where the poly pipe must connect to a metal pipe, it can be connected by a mechanical joining system such as a flange. Once several joints of pipe have been fused together, the pipeline is attached to a tracked or rubber tired vehicle and pulled along the pipeline route. Joints of poly pipe are then added to the end of the string of fused pipeline until the vehicle can no longer pull the weight of the fused pipe or it has run out of space to pull the pipe. The fusing operation is then moved to the front of the poly pipeline and used to build another pipeline segment.

If the pipeline route passes through an environmentally sensitive area (as defined by Colorado Oil and Gas Conservation Commission, Rules and Regulations 100 Series) the pipe will be dragged into place from a working space to minimize environmental impact. In this scenario, a cable winch would be positioned at the end of the environmentally sensitive area on a work space such as an existing well pad. The cable is then taken back to the pipeline route starting point. The fusing crew would prepare a length of pipe (typically 400- 500 feet in length depending on the weight of the pipe). The cable would then be attached to the end of the length of pipe. The cable would be used to drag the length of pipe into place. Additional lengths of pipe may be fused to the original length if needed and if the weight allows the longer pipe to be dragged into place. Personnel, communicating with hand-held radios, would monitor the operation to ensure that only minimal damage occurs to the outside of the pipe as it is dragged. Some cosmetic damage is expected, but if a gouge exceeds 10% of the wall thickness, that section of pipe must be cut out and replaced. A new section of pipe may be fused into its place. Surface poly pipelines that cross sensitive areas will have secondary containment to prevent a leak in a poly line from contaminating surface waters (see Figure 2). This containment consists of sleeving the pipe within a steel pipe of greater diameter than the poly pipe. The sleeved ends of the steel containment pipe rest in an area in which an appropriately sized diversion channel has been constructed to direct any water leaking from the poly pipe away from the sensitive area. Sensitive areas are generally waterways and wetlands.

Once the pipeline has been installed, field personnel perform a pressure test using either air or water. For this project, a water, or hydrostatic test, of the pipeline is required. The COGCC Series 1100 regulations have been applied to our approved Form 15 applications as COAs as follows: “Operator shall pressure test surface poly-pipelines in accordance with Rule 1101.e.(1) prior to putting into initial service and following any reconfiguration of the pipeline network. Operator shall notify the COGCC 48 hours prior to testing surface poly pipeline”. The pressure test will be conducted with fresh water and not recycled or produced water.

In cases where the poly pipeline must cross a road, the pipeline may be placed in a culvert under the road surface. Alternatively, the poly pipe may be attached to a temporary pipe road

crossing device. These devices connect between two pieces of poly pipe and provide a drivable steel surface for the crossing (Figure 3).

It is possible that due to topography between the pits and the project, booster pumps may need to be installed along the pipeline route. Booster pumps keep the water pressure in the pipeline more consistent and help prevent large pressure changes following elevation loss. Any booster pumps used in this project will have appropriately sized secondary containment to prevent fuel or pump fluids from reaching the ground surface.

The poly pipeline will be monitored and inspected as follows: “Operator shall conduct daily inspections of surface poly pipeline routes for leaks during active transfer of fluids. Inspections shall be conducted by viewing the length of the pipeline; operator will endeavor to minimize surface disturbance during pipeline monitoring. The operator shall maintain records of inspections, findings and repairs, if necessary, for the life of the pits. “This is required by the COGCC according to our Form 15 COAs. When booster pumps are used along the route, a sudden loss of pressure as measured by the pump’s pressure gauge will alert the pump operator that there is a leak in the pipe. The pump can immediately be shut down and the location of the leak discovered and cleaned up. Pumps are manned during use.

Figure 3. Example road crossing feature from Rain for Rent website: www.temporarypipe.com/products/spillguards/road_crossings.aspx

SG Federal 11-90-9 Poly Pipeline Operation Plan

- The poly pipeline route between the McIntyre Flowback Pits 3 and 4 and the Federal 11-90-9 is approximately 5 ½ miles (29,060 feet) in length. Approximately three miles (16,255 feet) of this route would be laid within existing rights-of-way, road ways, and across well pads. The remaining 2 ½ miles (12,800 feet) of poly pipeline route would be laid on the ground surface outside of previously disturbed areas. These areas can be seen on Figure 2.
- Poly pipelines for the Federal 11-90-9 will be moved into place prior to completing the well.
- If Pits 1 and 2 are used instead of Pits 3 and 4, the portions of poly pipe route shown in Figure 3 that are south of Pits 1 and 2 would not be constructed for this project.
- Construction of the poly pipeline route to the Federal 11-90-9 location is expected to take approximately one week.

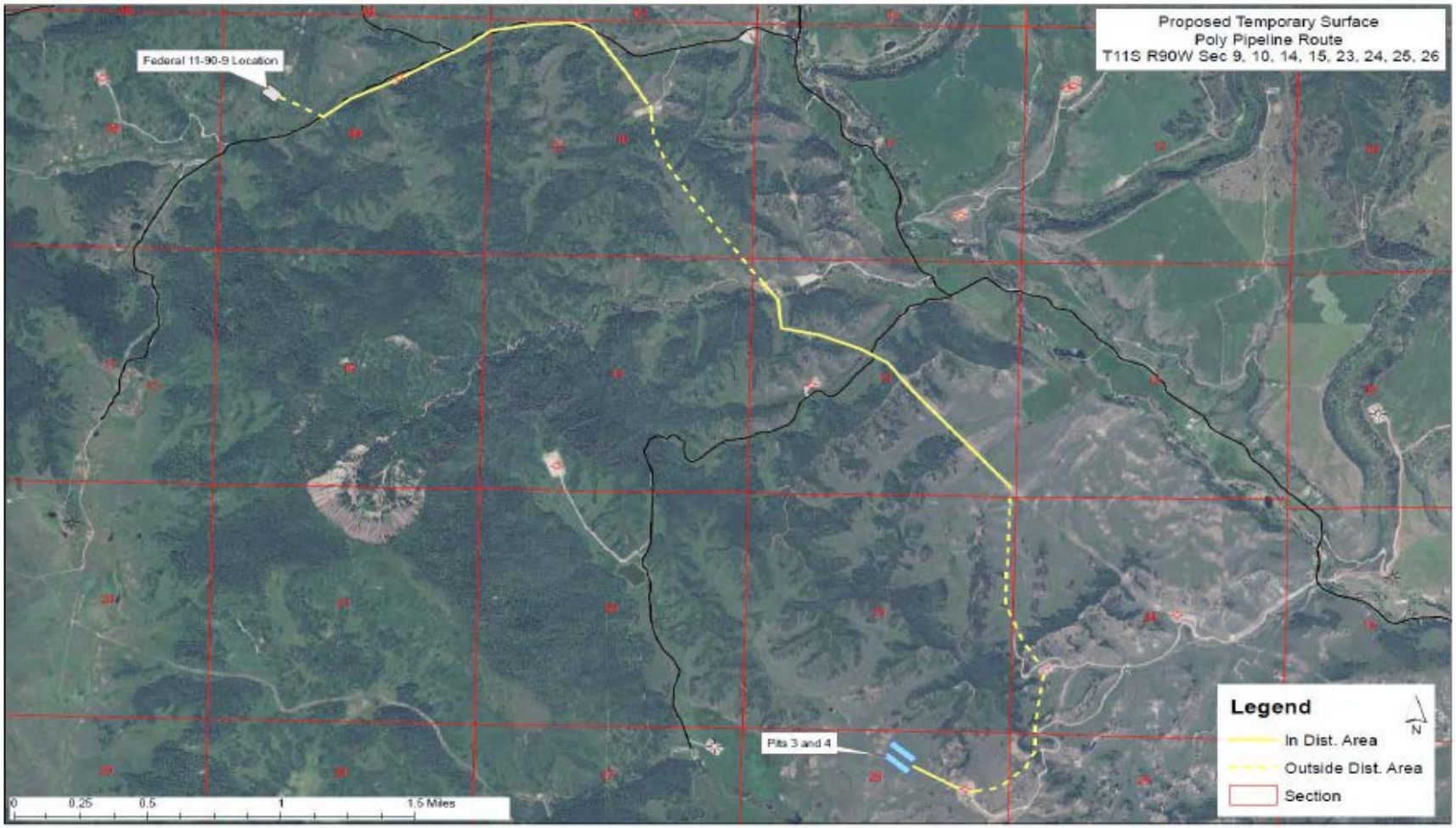
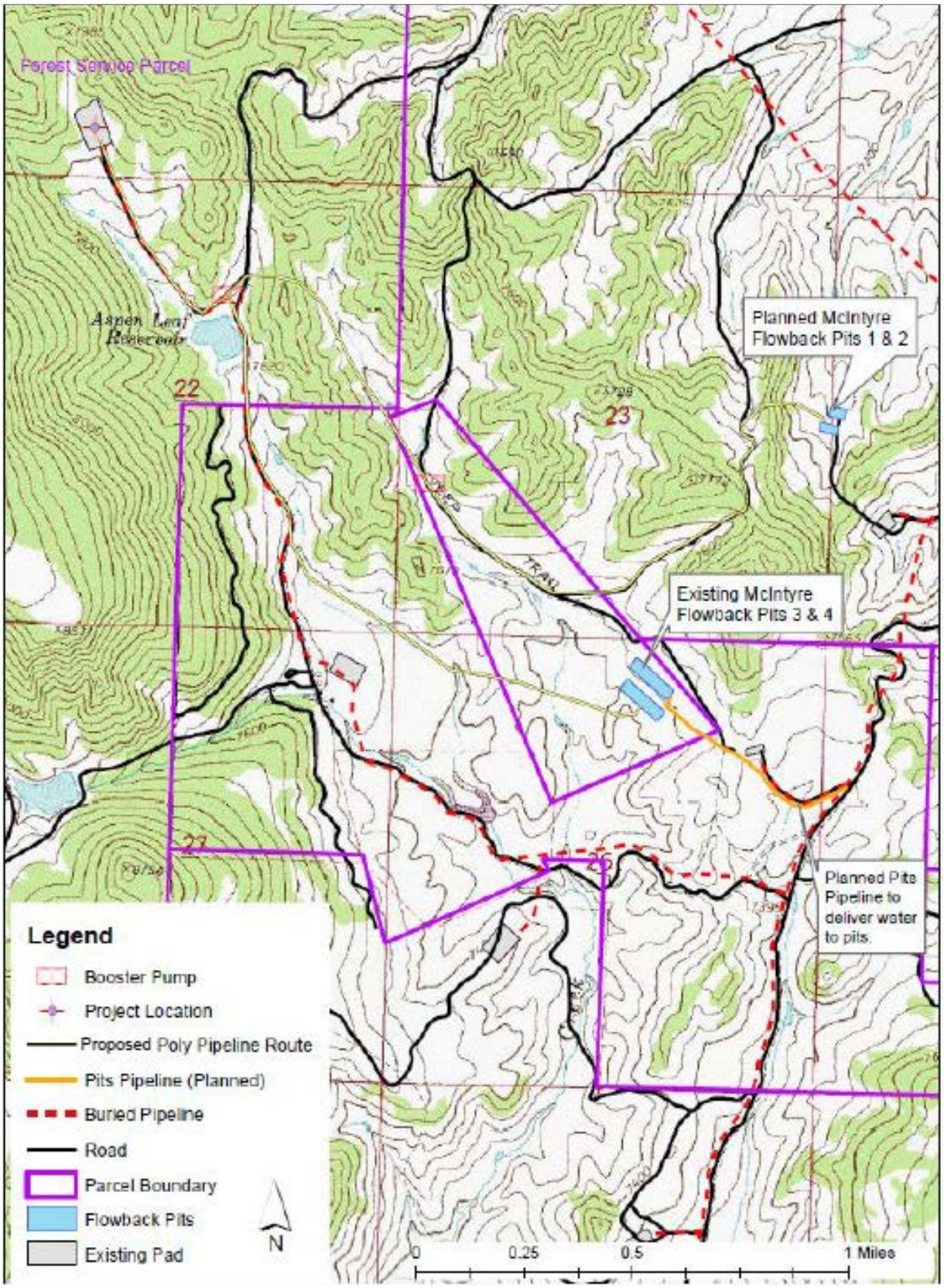


Figure A. Temporary surface poly pipeline route to Federal 11-90-9 Wellpad.

Figure B. Temporary surface poly pipeline route options between McIntyre Flowback Pits and Federal 11-90-9 Wellpad.

G.2. SG Federal Aspen Leaf Poly Pipeline Operation Plan

- The poly pipeline route between the McIntyre Flowback Pits 3 and 4 and the Federal 11-90-15 is approximately two miles (10,900 feet) in length. Approximately one mile (5,650 feet) of this route would be laid within existing rights-of-way, road ways, and across well pads. The remaining mile of poly pipeline route would be laid on the ground surface outside of previously disturbed areas (this mile is on fee land). These areas can be seen on Figure 2.
- Poly pipelines for the Federal 11-90-15 will be moved into place prior to completing the well.
- If Pits 1 and 2 are used instead of Pits 3 and 4, the portions of poly pipe route shown in Figure 3 that are south of Pits 1 and 2 would not be constructed for this project.
- Construction of the poly pipeline route to the Federal 11-90-15 location is expected to take less than one week.

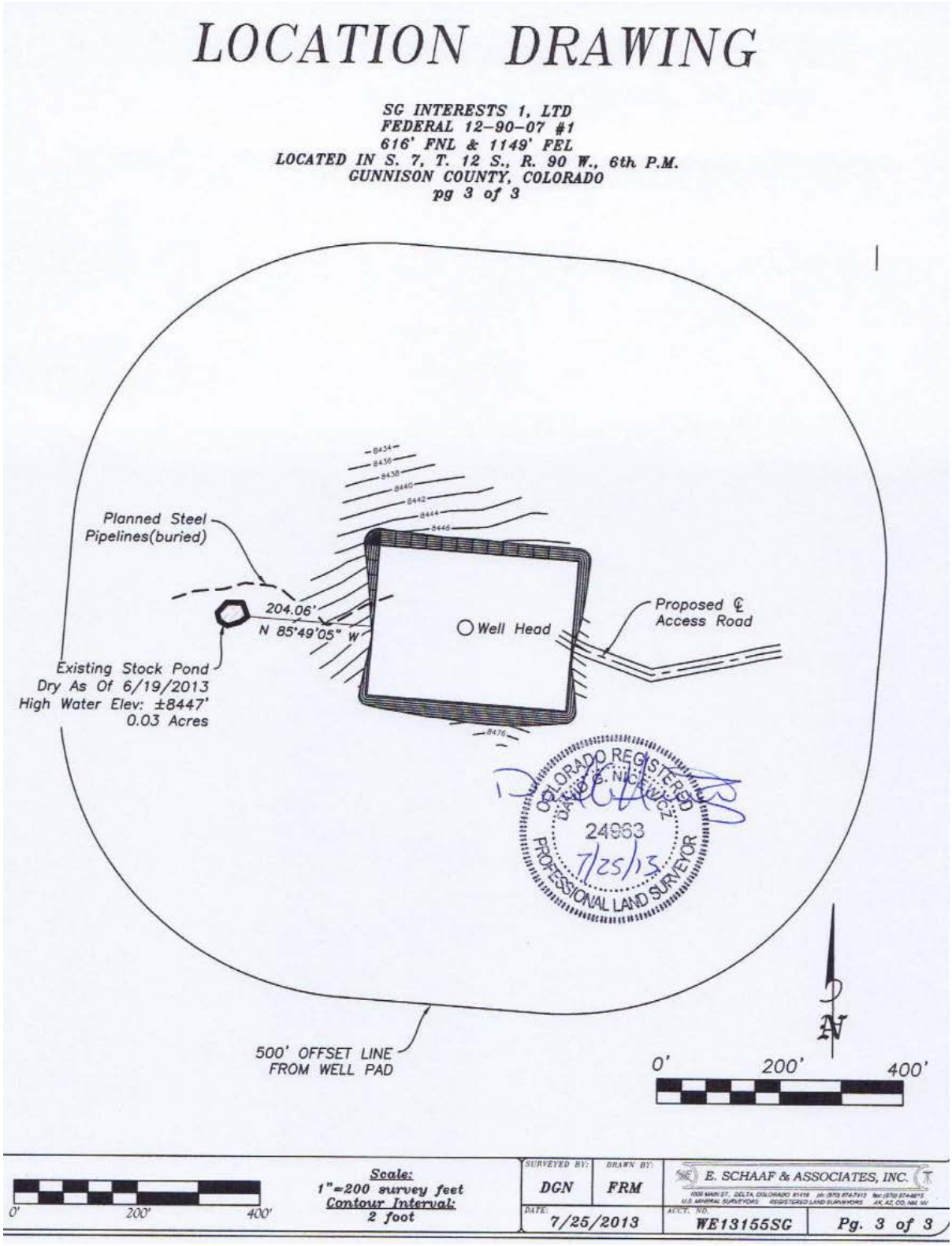


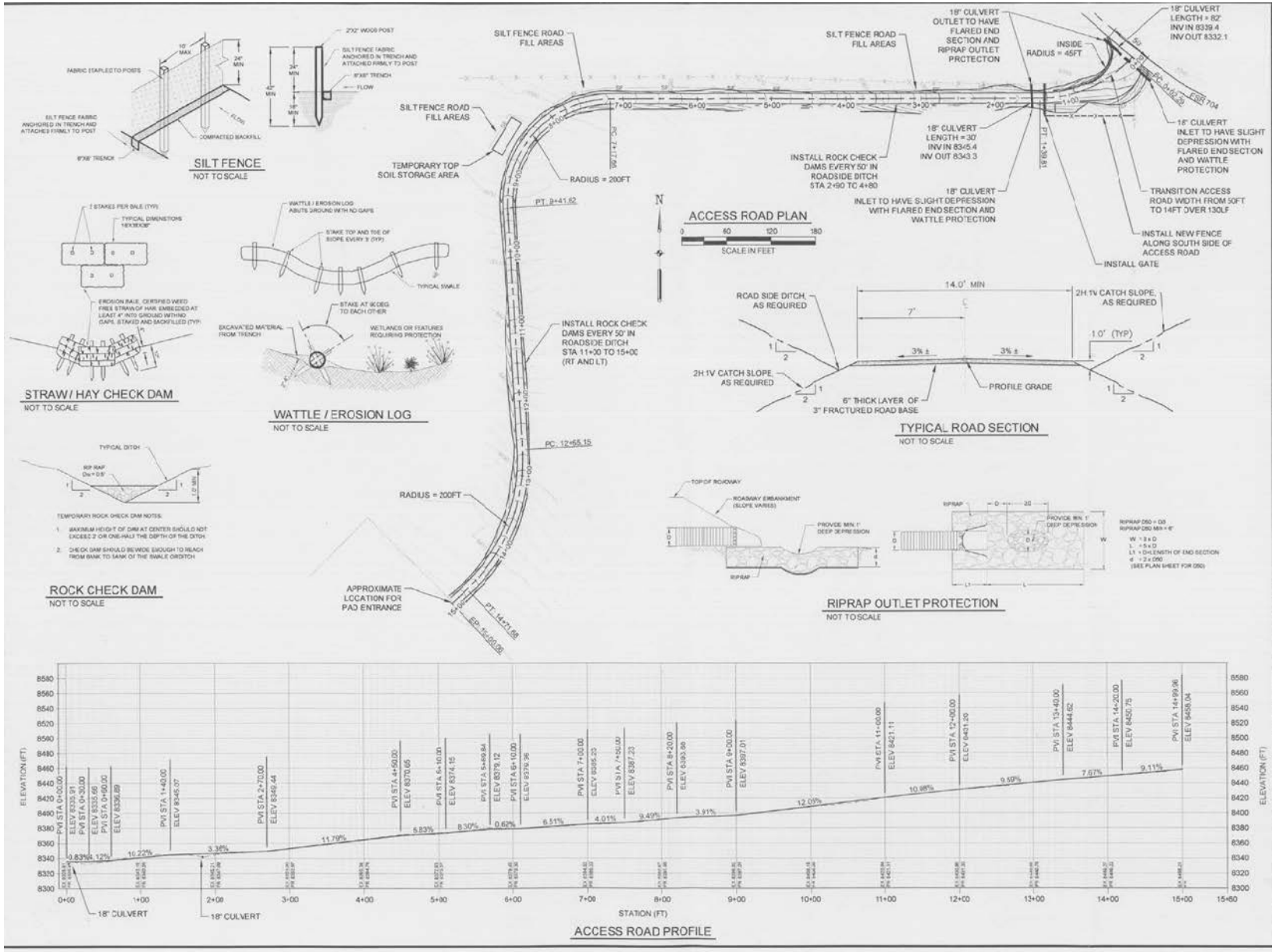
- Figure A. Temporary Surface Poly Pipeline Booster Pump Locations when operating to Aspen Leaf.

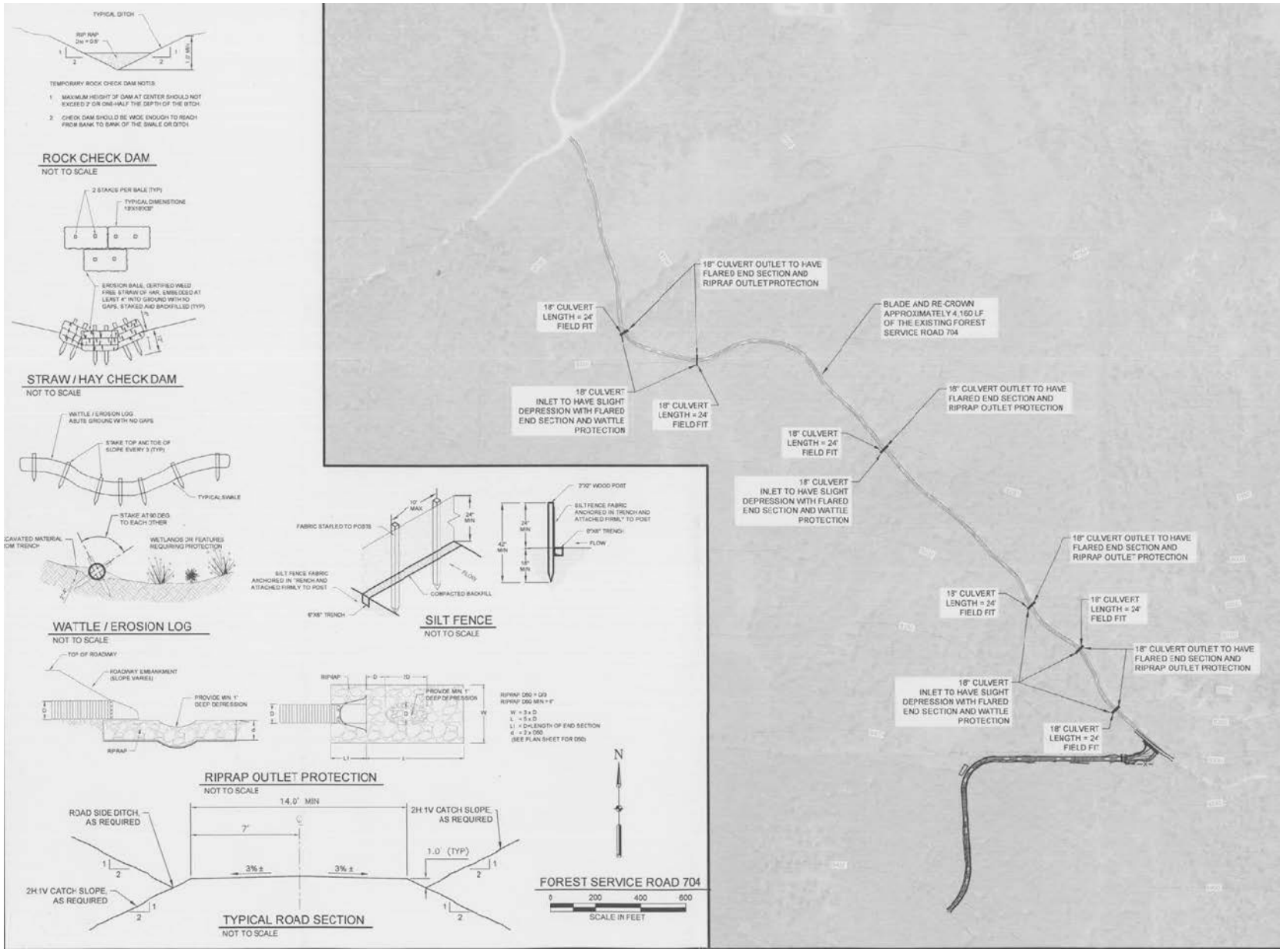
This page intentionally left blank

APPENDIX H. DETAILED CONSTRUCTION LAYOUTS AND DRAWINGS

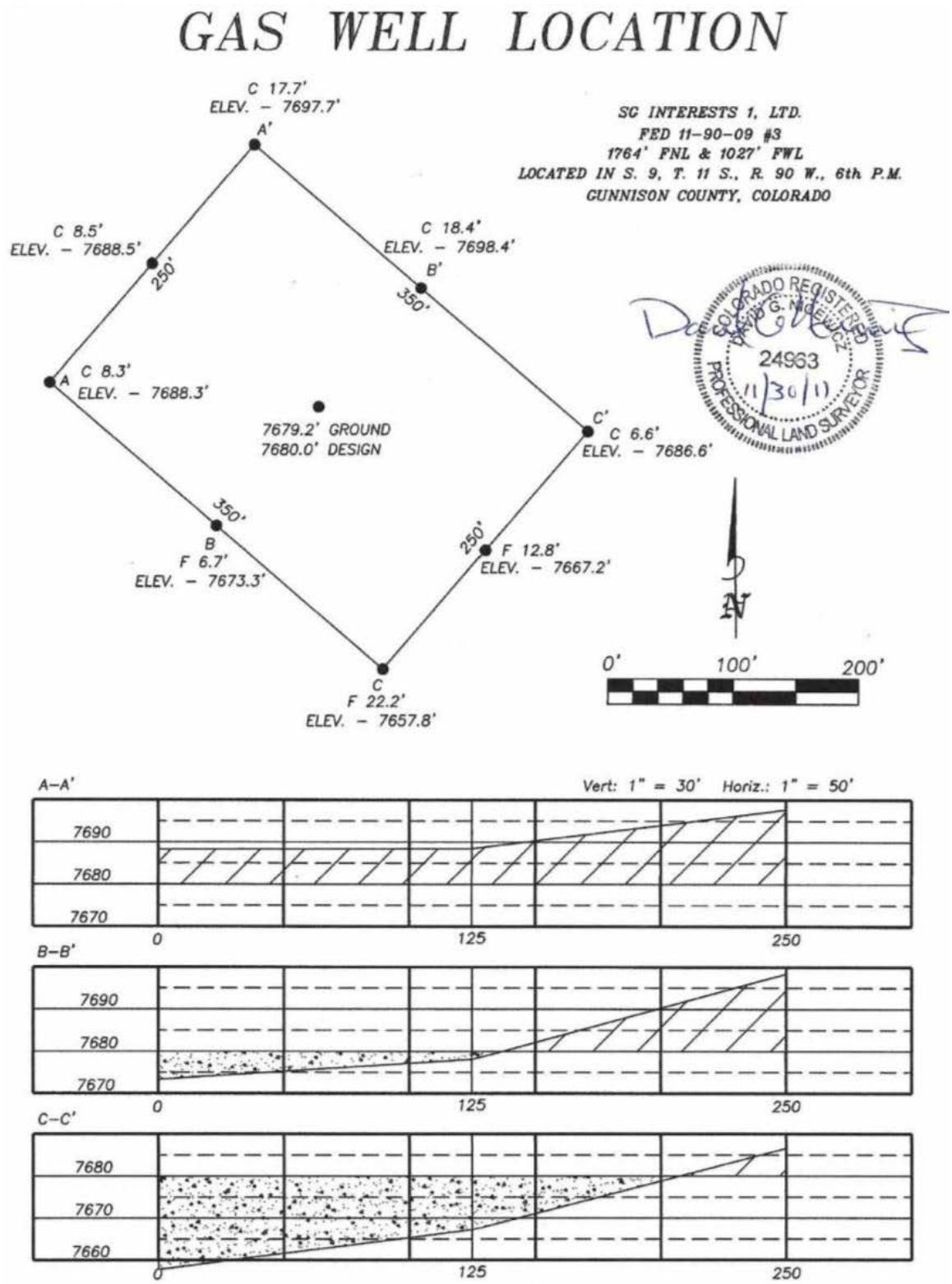
H.1. SG Allen

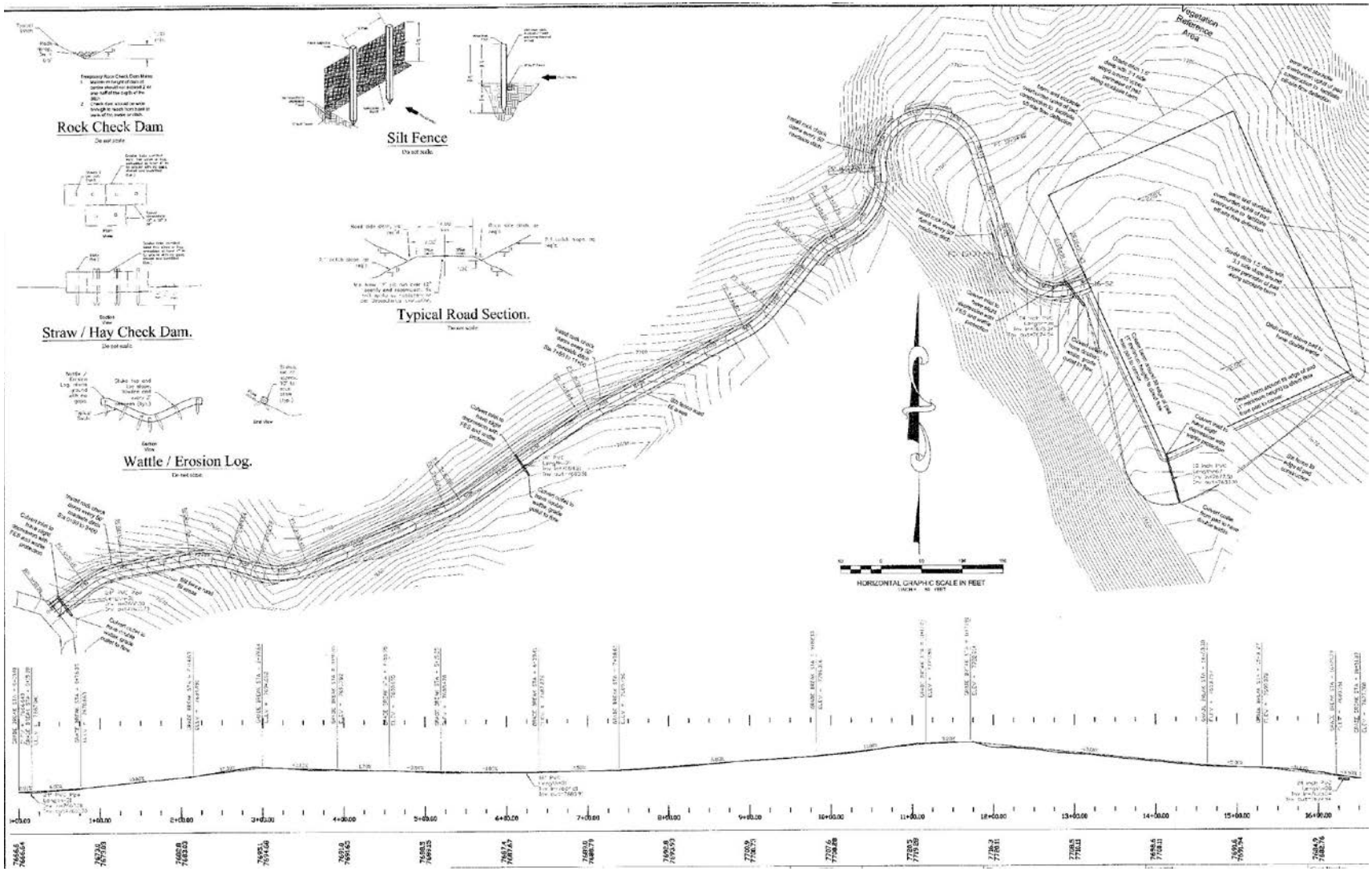

LOCATION DRAWING
SG INTERESTS 1, LTD
FEDERAL 12-90-07 #1
616' FNL & 1149' FEL
LOCATED IN S. 7, T. 12 S., R. 90 W., 6th P.M.
GUNNISON COUNTY, COLORADO
pg 3 of 3
8434
8436
8438
8440
8442
8444
8446
8476
Planned Steel Pipelines(buried)
204.06'
N 85°49'05" W
Well Head
Proposed ℄ Access Road
Existing Stock Pond
Dry As Of 6/19/2013
High Water Elev: ±8447'
0.03 Acres
COLORADO REGISTERED
DARIUS G. NIEWIADOMSKI
24963
7/25/13
PROFESSIONAL LAND SURVEYOR
500' OFFSET LINE FROM WELL PAD
N
0'
200'
400'
Scale:
1"=200 survey feet
Contour Interval:
2 foot
SURVEYED BY: DGN
DRAWN BY: FRM
DATE: 7/25/2013
E. SCHAAF & ASSOCIATES, INC.
ACCT. NO. WE13155SG
Pg. 3 of 3


SILT FENCE
NOT TO SCALE
STRAW / HAY CHECK DAM
NOT TO SCALE
WATTLE / EROSION LOG
NOT TO SCALE
ROCK CHECK DAM
NOT TO SCALE
ACCESS ROAD PLAN
SCALE IN FEET
TYPICAL ROAD SECTION
NOT TO SCALE
RIPRAP OUTLET PROTECTION
NOT TO SCALE
ACCESS ROAD PROFILE
STATION (FT)
ELEVATION (FT)
SILT FENCE ROAD FILL AREAS
TEMPORARY TOP SOIL STORAGE AREA
RADIUS = 200FT
INSTALL ROCK CHECK DAMS EVERY 50' IN ROADSIDE DITCH STA 11+00 TO 15+00 (RT AND LT)
APPROXIMATE LOCATION FOR PAD ENTRANCE
18" CULVERT OUTLET TO HAVE FLARED END SECTION AND RIPRAP OUTLET PROTECTION
18" CULVERT LENGTH = 82' INV IN 8339.4 INV OUT 8332.1
INSIDE RADIUS = 45FT
18" CULVERT LENGTH = 30' INV IN 8345.4 INV OUT 8343.3
INSTALL ROCK CHECK DAMS EVERY 50' IN ROADSIDE DITCH STA 2+90 TO 4+80
18" CULVERT INLET TO HAVE SLIGHT DEPRESSION WITH FLARED END SECTION AND WATTLE PROTECTION
18" CULVERT INLET TO HAVE SLIGHT DEPRESSION WITH FLARED END SECTION AND WATTLE PROTECTION
TRANSITION ACCESS ROAD WIDTH FROM 50FT TO 14FT OVER 130LF
INSTALL NEW FENCE ALONG SOUTH SIDE OF ACCESS ROAD
INSTALL GATE
ROAD SIDE DITCH AS REQUIRED
2H:1V CATCH SLOPE AS REQUIRED
14.0' MIN
7'
3% ±
1.0' (TYP)
PROFILE GRADE
6" THICK LAYER OF 3" FRACTURED ROAD BASE
18" CULVERT
18" CULVERT

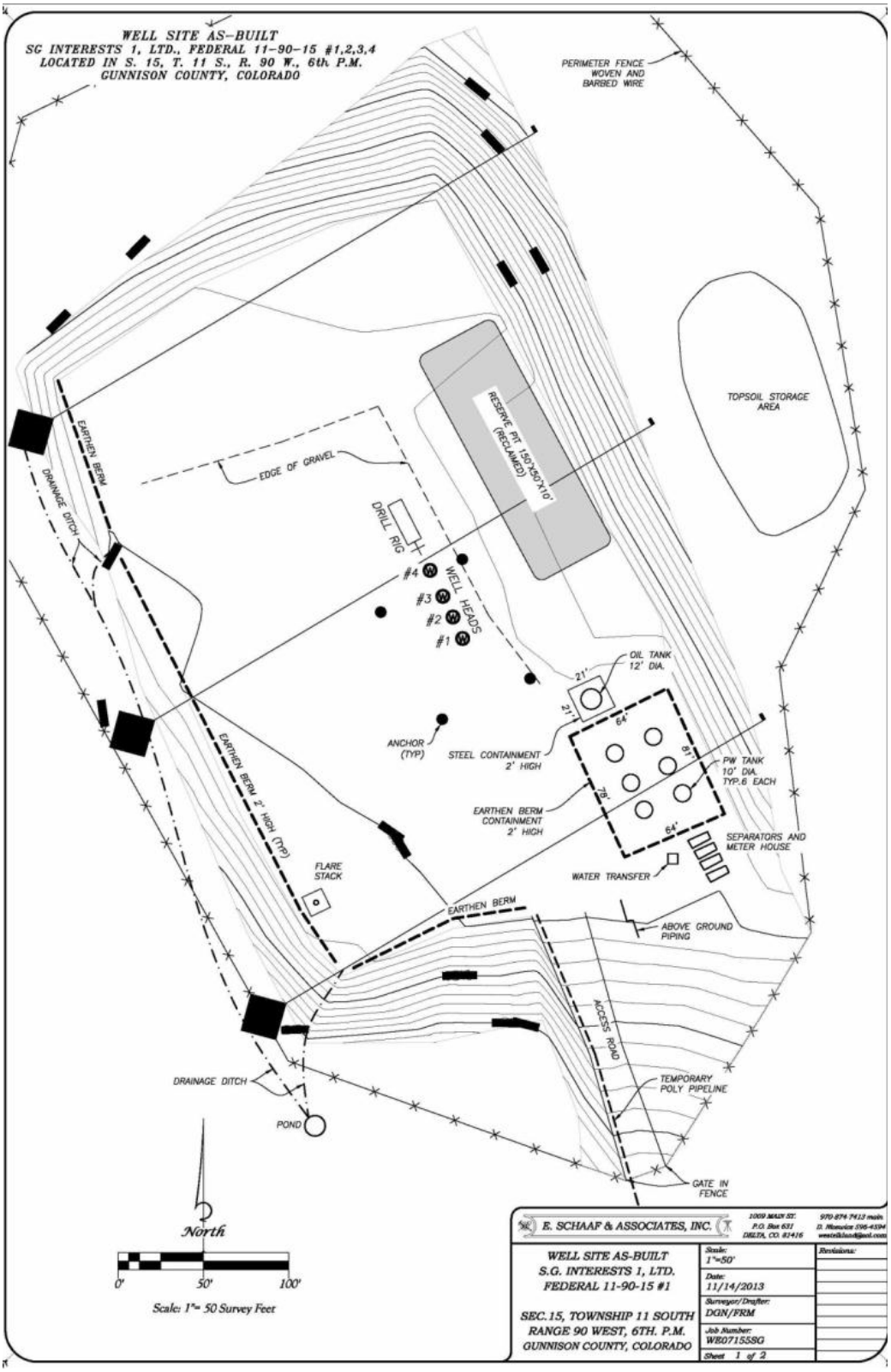

TYPICAL DITCH
TEMPORARY ROCK CHECK DAM NOTES:
1. MAXIMUM HEIGHT OF DAM AT CENTER SHOULD NOT EXCEED 2' OR ONE-HALF THE DEPTH OF THE DITCH.
2. CHECK DAM SHOULD BE WIDE ENOUGH TO REACH FROM BANK TO BANK OF THE SWALE OR DITCH.
ROCK CHECK DAM
NOT TO SCALE
2 STAKES PER BALE (TYP)
TYPICAL DIMENSIONS
EROSION BALE, CERTIFIED WEED FREE STRAW OR HAY, EMBEDDED AT LEAST 4" INTO GROUND WITH NO GAPS, STAKED AND BACKFILLED (TYP)
STRAW / HAY CHECK DAM
NOT TO SCALE
WATTLE / EROSION LOG ABUTS GROUND WITH NO GAPS
STAKE TOP AND TOE OF SLOPE EVERY 3 (TYP)
TYPICAL SWALE
STAKE AT 90 DEG TO EACH OTHER
WETLANDS OR FEATURES REQUIRING PROTECTION
WATTLE / EROSION LOG
NOT TO SCALE
FABRIC STAPLED TO POSTS
SILT FENCE FABRIC ANCHORED IN "TRENCH AND ATTACHED FIRMLY" TO POST
COMPACTED BACKFILL
FLOW
6"X6" TRENCH
SILT FENCE
NOT TO SCALE
TOP OF ROADWAY
ROADWAY EMBANKMENT (SLOPE VARIES)
PROVIDE MIN 1' DEEP DEPRESSION
RIPRAP
RIPRAP OUTLET PROTECTION
NOT TO SCALE
ROAD SIDE DITCH, AS REQUIRED
14.0' MIN
2H:1V CATCH SLOPE, AS REQUIRED
1.0' (TYP)
3% ±
TYPICAL ROAD SECTION
NOT TO SCALE
N
FOREST SERVICE ROAD 704
0 200 400 600
SCALE IN FEET
18" CULVERT OUTLET TO HAVE FLARED END SECTION AND RIPRAP OUTLET PROTECTION
18" CULVERT LENGTH = 24' FIELD FIT
BLADE AND RE-CROWN APPROXIMATELY 4,160 LF OF THE EXISTING FOREST SERVICE ROAD 704
18" CULVERT INLET TO HAVE SLIGHT DEPRESSION WITH FLARED END SECTION AND WATTLE PROTECTION
18" CULVERT LENGTH = 24' FIELD FIT
18" CULVERT OUTLET TO HAVE FLARED END SECTION AND RIPRAP OUTLET PROTECTION
18" CULVERT LENGTH = 24' FIELD FIT
18" CULVERT INLET TO HAVE SLIGHT DEPRESSION WITH FLARED END SECTION AND WATTLE PROTECTION
18" CULVERT OUTLET TO HAVE FLARED END SECTION AND RIPRAP OUTLET PROTECTION
18" CULVERT LENGTH = 24' FIELD FIT
18" CULVERT LENGTH = 24' FIELD FIT
18" CULVERT OUTLET TO HAVE FLARED END SECTION AND RIPRAP OUTLET PROTECTION
18" CULVERT INLET TO HAVE SLIGHT DEPRESSION WITH FLARED END SECTION AND WATTLE PROTECTION
18" CULVERT LENGTH = 24' FIELD FIT

H.2. SG 11-90-9

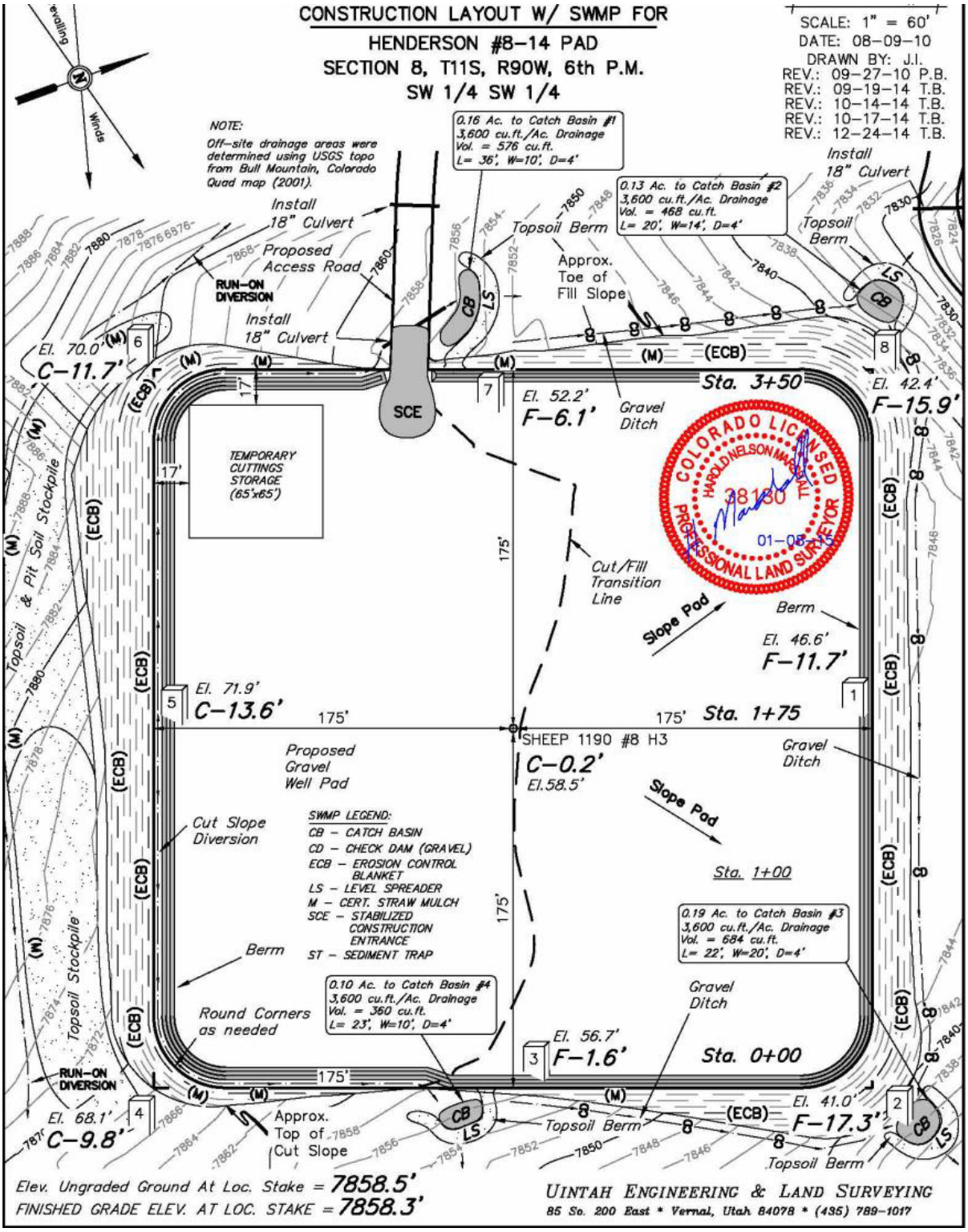

GAS WELL LOCATION
SG INTERESTS 1, LTD.
FED 11-90-09 #3
1764' FNL & 1027' FWL
LOCATED IN S. 9, T. 11 S., R. 90 W., 6th P.M.
GUNNISON COUNTY, COLORADO
C 17.7'
ELEV. - 7697.7'
A'
C 8.5'
ELEV. - 7688.5'
250'
C 18.4'
ELEV. - 7698.4'
B'
350'
A
C 8.3'
ELEV. - 7688.3'
7679.2' GROUND
7680.0' DESIGN
C'
C 6.6'
ELEV. - 7686.6'
350'
B
F 6.7'
ELEV. - 7673.3'
250'
F 12.8'
ELEV. - 7667.2'
C
F 22.2'
ELEV. - 7657.8'
COLORADO REGISTERED
24963
11/30/11
PROFESSIONAL LAND SURVEYOR
N
0'
100'
200'
A-A'
Vert: 1" = 30' Horiz.: 1" = 50'
7690
7680
7670
0
125
250
B-B'
7690
7680
7670
0
125
250
C-C'
7680
7670
7660
0
125
250

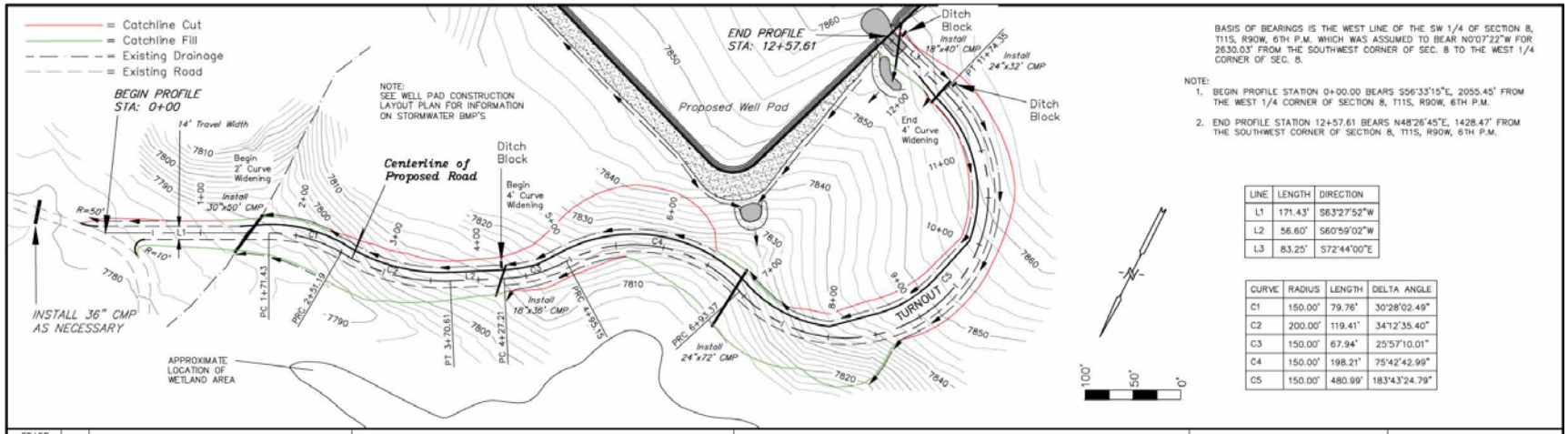

Rock Check Dam
Silt Fence
Straw / Hay Check Dam.
Typical Road Section.
Wattle / Erosion Log.
Vegetation Reference Area
HORIZONTAL GRAPHIC SCALE IN FEET

H.3. SG Aspen Leaf



H.4. GE Henderson





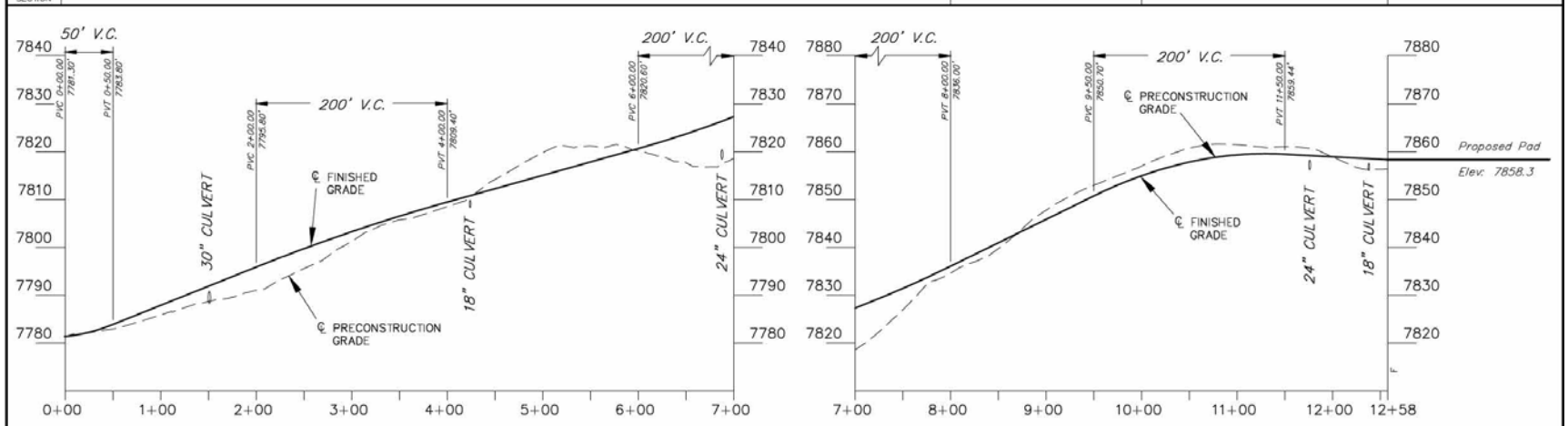
BASIS OF BEARINGS IS THE WEST LINE OF THE SW 1/4 OF SECTION 8, T11S, R90W, 6TH P.M. WHICH WAS ASSUMED TO BEAR N0°07'22"W FOR 2630.03' FROM THE SOUTHWEST CORNER OF SEC. 8 TO THE WEST 1/4 CORNER OF SEC. 8.

NOTE:
1. BEGIN PROFILE STATION 0+00.00 BEARS S56°33'15"E, 2055.45' FROM THE WEST 1/4 CORNER OF SECTION 8, T11S, R90W, 6TH P.M.
2. END PROFILE STATION 12+57.61 BEARS N48°26'45"E, 1428.47' FROM THE SOUTHWEST CORNER OF SECTION 8, T11S, R90W, 6TH P.M.

LINE	LENGTH	DIRECTION
L1	171.43'	S63°27'52"W
L2	56.60'	S60°59'02"W
L3	83.25'	S72°44'00"E

CURVE	RADIUS	LENGTH	DELTA ANGLE
C1	150.00'	79.76'	30°28'02.49"
C2	200.00'	119.41'	34°12'35.40"
C3	150.00'	67.94'	25°57'10.01"
C4	150.00'	198.21'	75°42'42.99"
C5	150.00'	480.99'	183°43'24.79"

GRADE %	+2.0	+8.0	−5.6	+9.8	−1.1	PROPOSED WELL PAD
TYP. SECTION		"A"		TURNOUT	"A"	



GUNNISION ENERGY CORPORATION
HENDERSON PAD

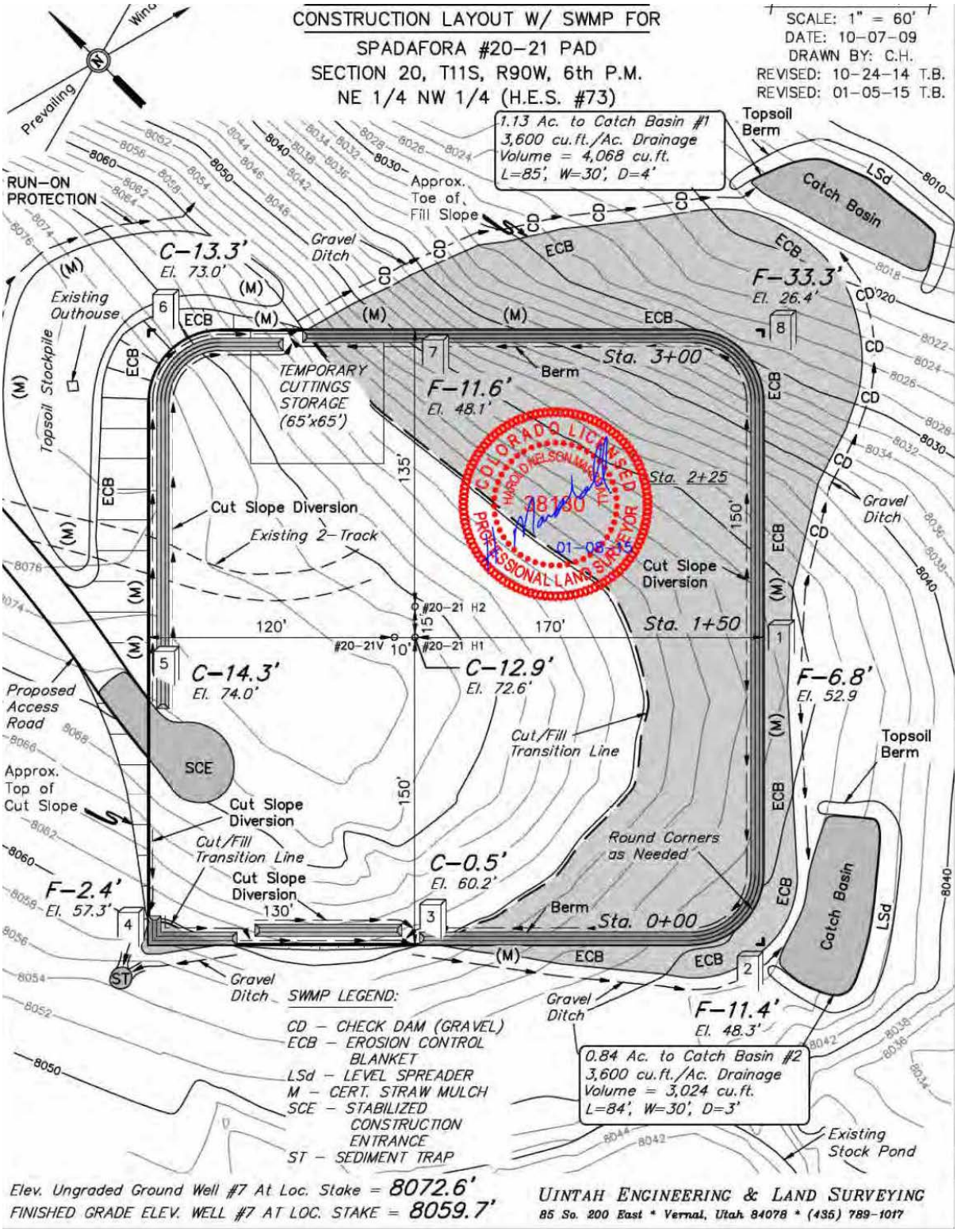
DATE	BY	REVISIONS

SCALE: 1"=100'
DRAWN BY: P.M.B.
E-FILE: ROAD.DWG

85 SOUTH 200 EAST
VERNAL, UTAH 84078
(435)789-1017

P1

H.5. GE Spadafora



This page intentionally left blank

APPENDIX I. AIR QUALITY NEAR FIELD IMPACTS MODELING ANALYSIS

A near-field ambient air quality impact assessment was performed to quantify and evaluate maximum incremental air quality related value (AQRV) impacts at nearby Class I and sensitive Class II areas and cumulative air pollutant concentration impacts at nearby residence ambient receptors within the vicinity of the project area resulting from proposed oil and gas development (drilling, etc.) and production (operation phase) related emissions for the proposed project. The analysis was performed using EPA-approved version of the CALPUFF modeling system (Version 5.8.4) with Mesoscale Model Interface Program (MMIF) extracted four kilometer resolution Weather Research Forecast Model (WRF) 2008 meteorology.

The modeling analysis includes predicted maximum incremental changes in visibility and nitrogen deposition at nearby United States Forest Service (USFS) Class I and sensitive Class II areas and 1-hour average ambient concentrations for nitrogen dioxide (NO_2), benzene, formaldehyde and n-hexane; 24-hour average concentrations of PM_{10} and $PM_{2.5}$; and annual $PM_{2.5}$, benzene, formaldehyde and n-hexane concentrations at nearby residences in the modeling domain.

The following sections of this modeling report provide details for the modeling analysis that was conducted for the proposed action environmental assessment.

MODELING INPUTS AND METHODOLOGY

Meteorology

The year 2008 WRF meteorological model 4-kilometer resolution output produced as part of the WRAP WestJumpAQMS (WRAP 2013) was used as the meteorological dataset for the CALPUFF modeling. A subset of the large WestJumpAQMS modeling domain output was extracted and reformatted into an annual CALPUFF-ready dataset using the MMIF (Version 3.0) meteorological data processor.

Modeling Domain

The near-field modeling domain was established to include nearby existing and reasonable foreseeable (future) emissions sources and sensitive receptors (residences) out to 12 kilometers in all directions from the approximate center of the proposed project area. In addition to the residence receptors, receptors were included for Maroon Bells-Snowmass Wilderness (Class I – USFS), Raggeds Wilderness (sensitive Class II – USFS) and West Elk Wilderness (Class I – USFS). The two following plots show the near-field modeling domain boundary with locations of sensitive residence receptors (purple/pink pentagon), nearby Class I / sensitive Class II areas (small black dot) and criteria pollutant (yellow box) and hazardous air pollutants (orange box) nearby existing and future projected emissions sources included in the cumulative analysis. The proposed project area is approximately in the center of the modeling domain circle with blue triangles for drilling / completion / development activities (production activities were also modeled at these locations) and green boxes for sites with only production activities modeled.

The second plot zooms into the near-field modeling domain for clearer view of residence receptors, nearby existing and future projected sources and proposed project sources.

Note that all receptors for the Class I / sensitive Class II areas were included in CALPUFF analysis.

Figure 1. Modeling Domain

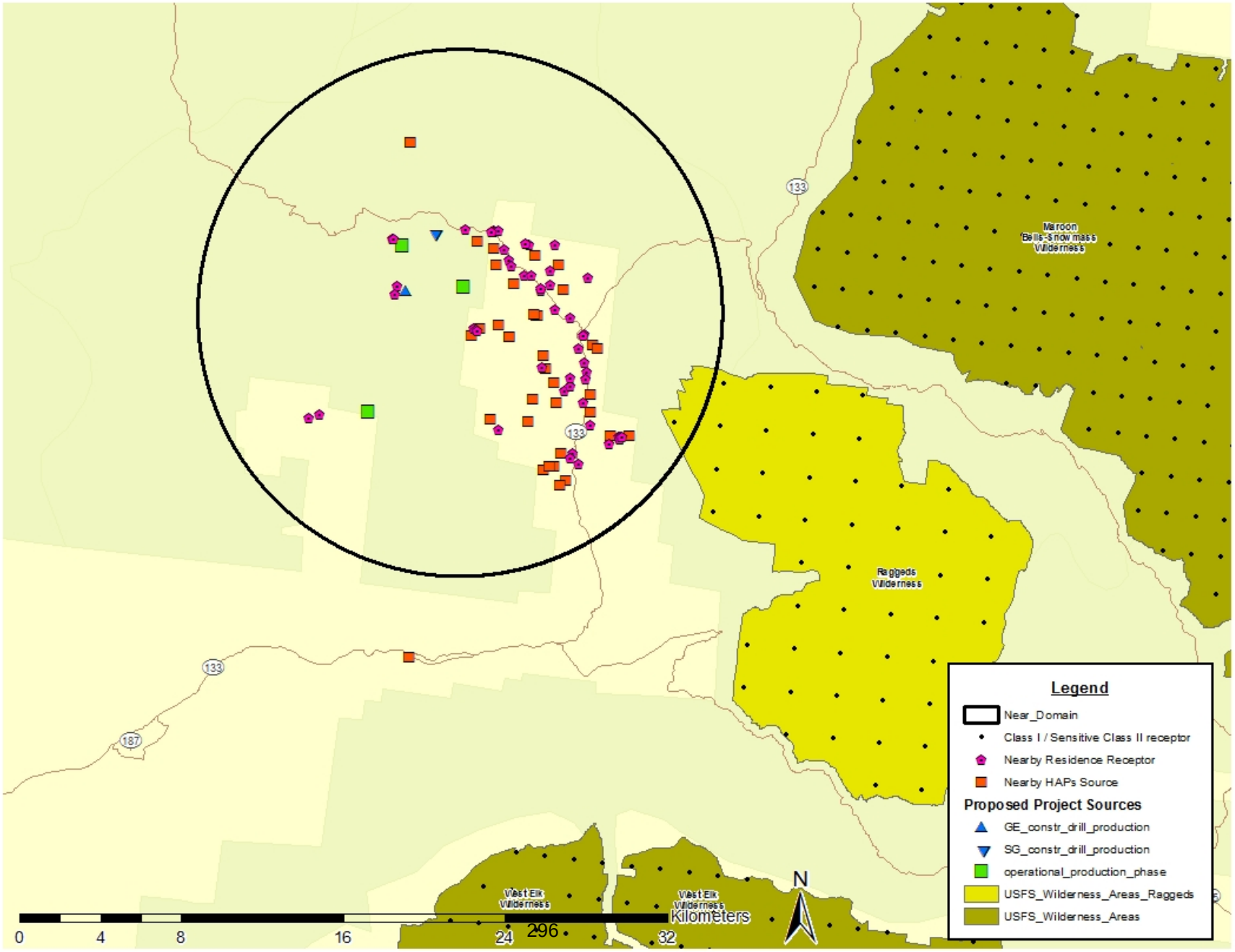
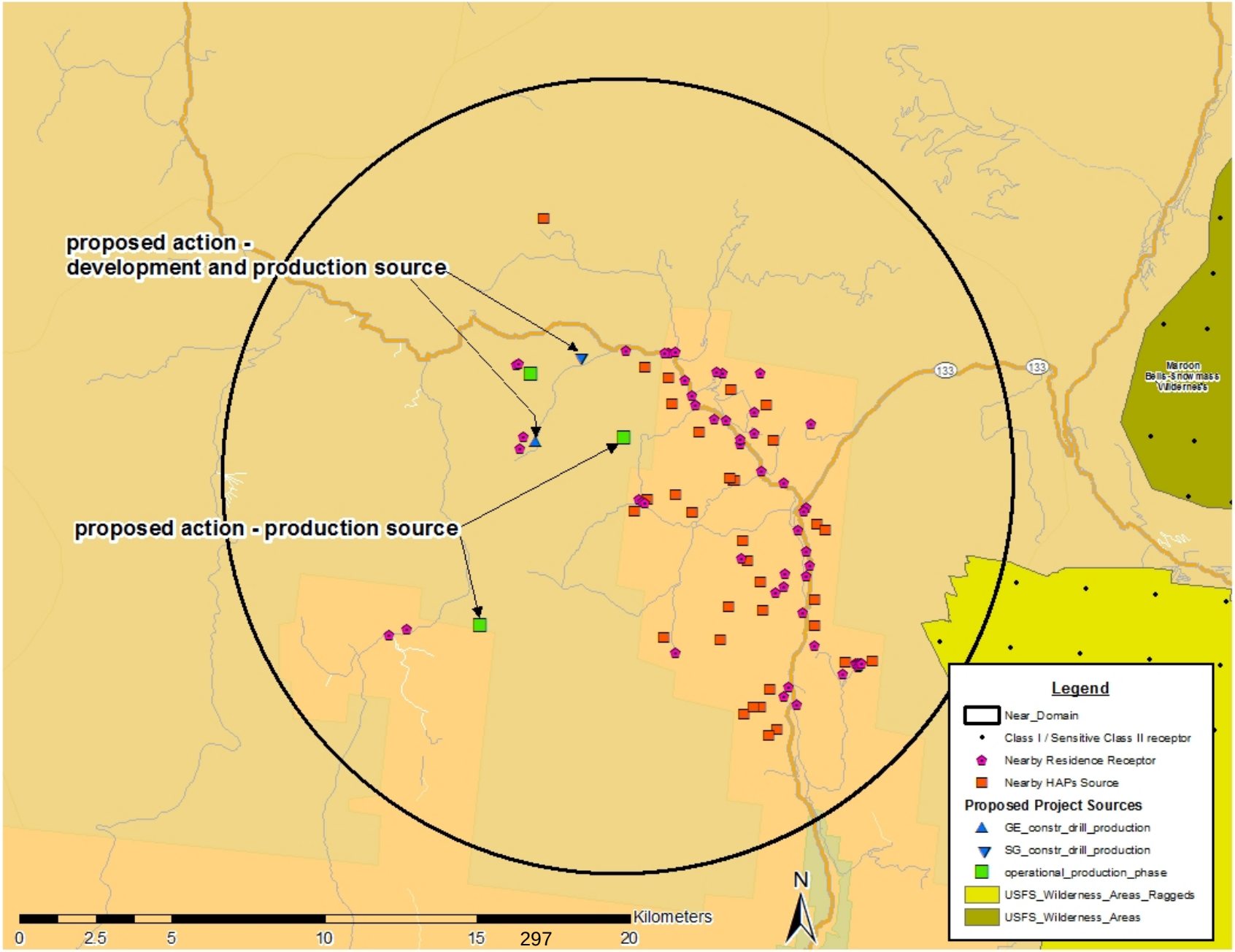


Figure 2. Near-Field Modeling Domain



Terrain and Base Elevations
ArcGIS and 10 meter resolution terrain data were used to determine base elevations and topography for the existing and projected nearby and proposed project emissions sources and sensitive residence receptors included in the modeling analysis.

Proposed Action Modeling Setup and Emissions
Ambient air models were created with CALPUFF to assess potential air quality impacts from oil and gas development and production related activities. To realistically estimate potential cumulative air quality impacts within ~ 12 kilometers of the proposed project area, proposed project and existing and projected nearby source activities were modeled together for the CALPUFF modeling analysis. AQRV visibility change and nitrogen deposition were modeled for proposed project sources only. The proposed project operators provided emissions estimates and proposed action information to the BLM to use for developing the modeling inputs. The following provides details for the proposed action sources that were modeled:

- Gunnison Energy (GE): four (4) new wells being developed on Spadafora well-pad in one year time period. Construction activities for the new Spadafora well-pad and access road and pipeline were modeled. The modeling analysis assumes that four (4) new GE wells were already developed on the Henderson well-pad at the temporal point in the modeling analysis and therefore, production phase emissions for eight (8) new GE wells were modeled from the two (2) well-pads; fifty percent (50%) of the total GE proposed production emissions from each of the Spadafora and Henderson well-pads.
- SG Interests (SG): five (5) new wells being developed on 11-90-9 well-pad in one year time period. Construction activities for the new 11-90-9 well-pad and access road and pipeline were modeled. The modeling analysis assumes that 12 new SG wells were already developed on the Aspen Leaf and Allen well-pads at the temporal point in the modeling analysis and therefore, production phase emissions for 17 new SG wells were modeled from the three (3) well-pads; ~ thirty percent (30%) of production emissions from 11-90-9 well-pad and ~ 35% of total SG proposed production emissions from each of the other two well-pads (Aspen Leaf and Allen).

The following tables show the emissions rates modeled for each point or volume source for each GE emissions source activity:

Table 1a. Criteria Pollutants Emissions Rates (Tons / Year) Modeled – GE Project Sources

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
Development Point Source - Spadafora	**63.539**	**2.128**	**2.0645**
Development Volume Source - Spadafora	**0.353**	**3.4495**	**2.467**
Production Point Source – Both Well-pads	**2.088**	**0.04**	**0.04**
Production Volume Source – Both Well-pads	**0.068**	**0.47**	**0.3885**

*development emissions released from Spadafora well-pad sources only
*production related emissions released from each GE well-pad (Spadafora and Henderson)

Table 1b. HAPs Emissions Rates (Tons / Year) Modeled - GE Project Sources

Emissions Source Activity	Formaldehyde	Benzene	n-Hexane
Development Point Source - Spadafora	**0.004**	**---**	**---**
Development Volume Source - Spadafora	**---**	**---**	**---**
Production Point Source – Both Well-pads	**0.464**	**---**	**---**
Production Volume Source – Both Well-pads	**---**	**0.153**	**0.779**

*"---" means negligible emissions estimated for activity
*development emissions released from Spadafora well-pad sources only
*production related emissions released from each GE well-pad (Spadafora and Henderson)

The following tables show the emissions rates modeled for each point or volume source for each SG emissions source activity:

Table 2a. Criteria Pollutants Emissions Rates (Tons / Year) Modeled – SG Project Sources

Emissions Source Activity	NO_x	PM_{10}	$PM_{2.5}$
Development Point Source – 11-90-9	**93.452**	**3.108**	**3.014**
Development Volume Source – 11-90-9	**0.20**	**1.35**	**0.966**
Production Point Source – 11-90-9	**2.03**	**0.036**	**0.036**
Production Volume Source – 11-90-9	**0.01**	**0.16**	**0.144**
Production Point Source – Other Well-pads	**2.436**	**0.043**	**0.043**
Production Volume Source – Other Well-pads	**0.012**	**0.192**	**0.172**

*development emissions released from 11-90-9 well-pad sources only
*production related emissions for "other well-pads" released from each Aspen Leaf and Allen well-pad

Table 2b. HAPs Emissions Rates (Tons / Year) Modeled - SG Project Sources

Emissions Source Activity	Formaldehyde	Benzene	n-Hexane
Development Point Source - Spadafora	**0.005**	**---**	**---**
Development Volume Source - Spadafora	**---**	**---**	**---**
Production Point Source - Spadafora	**0.459**	**---**	**---**
Production Volume Source - Spadafora	**---**	**0.067**	**0.387**
Production Point Source – Other Well-pads	**0.551**	**---**	**---**
Production Volume Source – Other Well-pads	**---**	**0.080**	**0.464**

*"---" means negligible emissions estimated for activity
*development emissions released from 11-90-9 well-pad sources only
* production related emissions for "other well-pads" released from each Aspen Leaf and Allen well-pad

Figure 2 above shows the proposed project emissions source layout. The layout is based on project operator provided information for the proposed project. The closest sensitive receptors in the vicinity of the proposed project are also shown in the plot.

More Information Regarding Emissions Source Setup for the Proposed Project

The following provides more details about the proposed project-related emissions sources that were included in the near-field modeling and any additional information about how the emissions were calculated or released / modeled within the near-field modeling domain:

- Well-pad drill rig or completion engine emissions were modeled from point sources with stack height: 6.2 meters, exhaust temperature: 675 K, exit velocity: 30 meters/second and stack tip diameter: 0.2 meters. One development related point source at Spadafora (GE) and 11-90-9 (SG) well-pads. Production related emissions (process heaters and stationary engines) for each of these two pads were modeled from same point source as development emissions for each well-pad.
- Well-pad, access road and pipeline construction activities (surface disturbance and equipment) were modeled from volume sources with a release height: 2.29 meters, sigma-y: 1.42 meters and sigma-z: 2.13 meters. One development related volume source at Spadafora (GE) and 11-90-9 (SG) well-pads. Production related emissions (tanks, product loadout, equipment leaks, pneumatics and traffic) for each of these two pads were modeled from same volume source as development emissions for each well-pad.
- Well-pads modeled without construction activities (i.e. production operations only) were modeled using point and volume sources with same dimensions as described above.
- Project specific design features accounted for in the modeling analysis include: 50% dust control for construction phase surface disturbance and traffic, Tier-2 drilling / completion engine technology, low-bleed pneumatic devices, green well completion practices and operation phase stationary engines will meet CDPHE Regulation 7 Standards.

Nearby Existing Emissions Sources and Background Concentrations
An existing and projected (reasonable foreseeable actions) nearby HAPs emissions inventory was included in the cumulative HAPs near-field analysis (sources were explicitly modeled in CALPUFF) to account for current and future HAPs concentrations not associated with the proposed project. Projected year 2021 modeled criteria pollutant concentrations for the project area were used to represent all criteria pollutant impacts not explicitly associated with the proposed project so no nearby existing and projected emissions sources were included in CALPUFF for criteria pollutants. For this analysis, HAPs monitored concentrations and regional modeling study predicted future year 2021 criteria pollutant concentrations are used to represent all emissions sources impacts not explicitly modeled using CALPUFF and were added to the near-field modeled concentrations to produce cumulative predicted near-field concentrations at ambient receptors for comparison to applicable air quality impact thresholds.

Nearby Existing Emissions Sources
In addition to the proposed project sources, a HAPs inventory was developed for existing and projected nearby emissions sources to include in the cumulative near-field HAPs impacts analysis. CDPHE provided HAPs emissions inventories for current permitted activities were compiled and processed, and nearby existing and projected HAPs emissions sources within 12 kilometers of the proposed project area were included in the cumulative CALPUFF runs. Figure 2 shows locations of nearby existing and projected emissions sources included in the cumulative HAPs near-field modeling analysis.

A total of 15 existing nearby HAPs emissions sources made up mostly of engines (modeled using point sources) and tanks (modeled using volume sources) were included in the cumulative CALPUFF runs. Existing SG and GE oil and gas sources at well-pads, product storage facilities (Hotchkiss Water Storage Facility) and compressor stations (Ragged Mtn. CS) and West Elk Mine were among the existing facilities included in the cumulative near-field modeling analysis HAPs inventory.

A total of 22 projected nearby HAPs emissions sources made up of future well-pad (engines, fugitive and product storage) and compressor stations (engines, fugitive and product storage) were included in the cumulative CALPUFF runs to account for reasonable foreseeable oil and gas emissions projected to occur within the modeling domain not associated with the project or existing emissions sources.

Ambient Background Concentrations
HAPs concentration data collected at a regional monitoring site and provided in the EPA Air Quality System (AQS) database (EPA 2015) are used for HAPs ambient background monitored concentrations for this cumulative near-field air quality modeling analysis. The regional monitoring site for HAPs is located in a Colorado-based high oil and gas development area.

Projected year 2021 Colorado Air Resource Management Modeling Study (CARMMS [BLM 2015]) NO_2 and PM concentrations for a set of 4 kilometer resolution CARMMS grid cells points (37 grid points spaced at 4 kilometers apart) that intersect the near-field modeling domain were used to develop projected year NO_2 and PM "background" concentrations. These CARMMS "High Scenario" (based on upper-end of the potential oil and gas development range for the region ~ based on Reasonable Foreseeable Development [RFD] for most areas) projected year 2021 modeled concentrations are for the CARMMS total year 2021 cumulative emissions inventory (i.e. not just for a particular BLM planning area, source apportionment area or emissions source group for modeling) and represent projected concentrations for all emissions sources including mobile source, biogenic / natural, oil and gas, EGUs, farming and fires. The cumulative year 2021 emissions inventory for CARMMS was developed using the EPA's year 2020 emissions inventory for $PM_{2.5}$ NAAQS analysis with Three-State Air Quality Study (3SAQS) year 2020 updates and the BLM Colorado's year 2021 oil and gas projections.

A CDPHE criteria pollutant emissions inventory for existing permitted activities in the near-field modeling domain was obtained from CDPHE in March, 2015. This dataset was processed by BLM and the existing nearby emissions source inventory annual emissions totals for NO_2, $PM_{2.5}$,

PM_{10} and VOC were approximately 139 TPY, ~ 1 TPY, ~ 1 TPY and 105 TPY, respectively. The CARMMS year 2021 cumulative (all sources – not just oil and gas) NO_2, $PM_{2.5}$, PM_{10} and VOC annual emissions totals for the 37 grid points (intersecting the near-field modeling domain) are 1,441 TPY, 83 TPY, 306 TPY and 3,413 TPY, respectively. For the intersecting grid cells, the percentages of total CARMMS year 2021 NO_2, $PM_{2.5}$, PM_{10} and VOC emissions associated with oil and gas emissions sources are 75%, 77%, 85% and 34%, respectively. As shown, the CARMMS High Scenario projected year 2021 modeled emissions rates for sources within the near-field modeling domain are much larger than the current year CDPHE permitted emissions rates and the CARMMS emissions inventory accounts for oil and gas growth in the project area as well as emissions sources not readily permitted by CDPHE. The projected year 2021 CARMMS concentrations also account for future year emissions reductions for mobile sources and EGUs to provide a more look at realistic future concentrations than current baseline conditions. As described earlier, year 2021 CARMMS modeled concentrations are added to CALPUFF modeled concentrations to determine cumulative air quality concentrations for criteria pollutants. Note that there would be some double-counting of the total cumulative air quality impacts associated with the proposed project related oil and gas sources since some of the emissions for these sources would be accounted for in both sets (explicitly modeled with CALPUFF and in CARMMS) of values being added together.

Table 3 shows HAP concentrations for the regional monitor and CARMMS predicted year 2021 concentrations that are used to represent all emissions sources impacts not explicitly modeled using CALPUFF. Pollutant concentrations are in units micrograms per cubic meter ($\mu g/m^3$) for all pollutants.

Table 3. Ambient Background Concentrations

Pollutant / Units	**Background Monitored Concentrations**		**Monitoring Station Information**
	1-Hour / 24-Hour *	**Annual Average ***	
Benzene ($\mu g/m^3$)	**28.75**	**9.11**	Garfield County, Colorado (Rifle, Colorado). Monitor ID: 08-045-0007. 1-hour value is maximum for all reported concentrations in year 2013 dataset. Annual average value is average of all values in the year 2013 dataset.
Formaldehyde ($\mu g/m^3$)	**4.37**	**1.38**	
n-Hexane ($\mu g/m^3$)	**80.01**	**20.46**	
NO_2 ($\mu g/m^3$)	**31.09**	**NA**	Background concentration is the overall maximum (of all grid cells) 1st high daily 1-hour value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).

PM_{10} (	**34.07**	**NA**	Background concentration is the overall maximum (of all grid cells) 1st high 24-hour average value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).
$PM_{2.5}$ (	**12.52**	**5.52**	Background concentrations are the average (for all grid cells) 1st high 24-hour average and overall maximum (of all grid cells) annual average value for all CARMMS grid cells processed (grid cells intersecting near-field modeling domain).

$\mu g/m^3$ = micrograms per cubic meter
* NA ~ averaging time was not modeled for this assessment
*1-hour concentrations shown for all pollutants except PM species which are 24-hour average values

Ozone and Ammonia Background Concentrations for CALPUFF

Representative ozone and ammonia data is required for use in the chemical transformation of primary pollutant emissions. Hourly ozone is used by CALPUFF to oxidize NO_x and sulfur dioxide (SO_2) emissions within the modeling domain to nitric acid and sulfuric acid, respectively. The predicted nitric acid and sulfuric acid are then partitioned in CALPUFF between the gaseous and particulate nitrate and sulfate phases based on the available ammonia, and ambient temperature and relative humidity. Year 2008 hourly ozone data from EPA AQS and Clean Air Status and Trends Network (CASTNET) ozone sites within the region were used in the analysis. The background ammonia value used in the CALPUFF modeling was 1.0 parts per billion (ppb) for cooler months January – March and October – December and 5.0 ppb for warmer months April – September.

NEAR-FIELD ASSESSMENT OF AIR QUALITY IMPACTS – CRITERIA POLLUTANTS

NO_2 and PM Impacts

The following Table 4 shows results for near-field cumulative NO_2 and PM impacts analysis for proposed project and projected future emissions sources. As shown in the Table, modeled impacts when added to background concentrations are below air quality standards / thresholds.

Table 4. Near-Field NO_2 and PM Impacts

Criteria Pollutant	Avg. Period	Modeled Year	Concentration (ug/m^3)			Ambient Standard (ug/m^3)		Percent of NAAQS
			Modeled	Back-ground	Total	NAAQS	CAAQS	
NO_2	1-hour	2008	117.99	31.09	**149.08**	188	NA	79%
PM_{10}	24-hour	2008	2.58	34.07	**36.65**	150	150	24%
$PM_{2.5}$	24-hour	2008	1.98	12.52	**14.50**	35	NA	41%
$PM_{2.5}$	Annual	2008	0.16	5.52	**5.68**	12	NA	47%

CAAQS = Colorado Ambient Air Quality Standards

NAAQS = National Ambient Air Quality Standards

μg/m^3 = micrograms per cubic meter

The modeled concentration values shown in the Table above ("Modeled" column) are the maximum concentrations for all receptors for the full of meteorology that was used for modeling impacts; high 1st high daily maximum for NO_2 1-hour, high 1st high 24-hour average for $PM_{2.5}$ and PM_{10} 24-hour average concentrations and highest annual average for $PM_{2.5}$ annual average value shown in the Table above.

The NO_2 1-hour and $PM_{2.5}$ NAAQS are calculated as 3-year (consecutive years) average values. The maximum modeled values shown in Table 4 above are predicted concentrations that could occur in any one year and are associated with proposed project full well-pad and infrastructure build-out. These modeled values would not occur for 3 years at any one ambient residence receptor for the proposed project.

NEAR-FIELD ASSESSMENT OF AIR QUALITY IMPACTS – HAZARDOUS AIR POLLUTANTS

Short-term (1-hour) HAP concentrations are compared to acute Reference Exposure Levels (RELs). RELs are defined as concentrations at or below which no adverse health effects are expected. No REL is available for n-hexane; instead, the available Immediately Dangerous to Life or Health divided by 10 (IDLH/10) values are used. These IDLH values were determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from USEPA's Air Toxics Database (EPA 2011). These values approximate pollutant concentrations likely to produce mild effects during 1-hour exposures.

Long-term maximum potential exposures to HAPs are compared to Reference Concentrations for Chronic Inhalation (RfCs). An RfC is defined by USEPA as the daily inhalation concentration at which no long-term adverse health effects are expected. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (EPA, 2012). Annual modeled HAP concentrations for each modeled HAP were compared directly to the non-carcinogenic RfCs.

Of the above HAPs, only benzene and formaldehyde are suspected to be carcinogenic. RfCs for these HAPs are expressed as unit risk factors (URFs). Accepted methods for risk assessment were used to evaluate the incremental cancer risk for these pollutants. Based on the Superfund

National Oil and Hazardous Substances Pollution Contingency Plan, a cancer risk range of 1 in a million to 100 in a million (10^{-6} to 10^{-4} risk) is generally acceptable (EPA 1990). Cancer risks are calculated for each individual HAP and for combined exposure to aggregated HAPs for both the maximally exposed individual (MEI) and most likely exposure (MLE). A detailed explanation of this determination is provided below.

Annual total concentrations (modeled plus background) were multiplied by USEPA's URF (based on 70-year exposure) for those pollutants, and then the product was multiplied by an adjustment factor that represents the ratio of projected exposure time to 70 years. The adjustment factors represent two scenarios: a MLE scenario and one reflective of the MEI.

The MLE duration was assumed to be 9 years, which corresponds to the mean duration that a family remains at a residence (EPA 1993). This duration corresponds to an adjustment factor of 9/70 = 0.13. The duration of exposure for the MEI was assumed to be 20 years (i.e., the LOP), corresponding to an adjustment factor of 20/70 = 0.29.

A second adjustment was made for time spent at home versus time spent elsewhere. For the MLE scenario, the at-home time fraction is 0.64 (EPA 1993), and it was assumed that during the rest of the day the individual would remain in an area where annual HAP concentrations would be one-quarter as large as the maximum annual average concentration. Therefore, the MLE adjustment factor was (0.13) × [(0.64 × 1.0) + (0.36 × 0.25)] = 0.095. The MEI scenario assumed that the individual is at home 100 percent of the time, for a final adjustment factor of (0.29 × 1.0) = 0.29.

HAPs Impacts

As shown in the following Table 5, all HAP maximum 1-hour concentrations (including background concentrations) are well below the REL or IDLH/10 reference concentrations.

Table 5. Acute HAPs Impacts

HAP	Modeled Year	Maximum 1-Hour Modeled ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	REL ($\mu g/m^3$)	Percent of REL (%)
Benzene	2008	1.96	28.75	**30.71**	1,300	2%
Formaldehyde	2008	4.68	4.37	**9.05**	55	16%
n-Hexane	2008	9.65	80.01	**80.01**	390,000	0%

$\mu g/m^3$ = micrograms per cubic meter

REL = Reference Exposure Level

* data source for all pollutants except n-hexane: USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

* No REL available for n-hexane. Values shown are from Immediately Dangerous to Life or Health (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA, 2005a).

The concentration values shown in the Table above are the maximum modeled concentrations (high 1st high) for all receptors for the full year (2008) of meteorology that was used for modeling maximum impacts.

As shown in the following table, the maximum annual modeled HAPs concentrations for all receptors are well below their respective RfCs.

Table 6. Chronic HAPs Impacts

Pollutant	Modeled Year	Annual Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Total Concentration ($\mu g/m^3$)	RfC ($\mu g/m^3$)
Benzene	2008	0.07	9.11	**9.19**	30
Formaldehyde	2008	0.24	1.38	**1.62**	9.8
n-Hexane	2008	0.09	20.46	**20.46**	200

$\mu g/m^3$ = micrograms per cubic meter

RfC = Reference Concentration for Chronic Inhalation

* USEPA Air Toxics Database, Table 1 (USEPA, 2005b).

The concentration values shown in the Table above are the maximum (highest annual average (modeled concentrations for the full year of meteorology that was used for modeling maximum impacts.

Cancer risk from benzene, formaldehyde, and the combined HAPs (benzene plus formaldehyde) are shown in Table 7. As previously described, these values are calculated using annual average modeled and background concentrations. As shown in the previous Table 6, the Garfield County annual “background” concentrations are much higher than the annual modeled concentrations and are the primary contribution to the overall predicted long-term exposure impacts. For the MLE, an individual could encounter a maximum cancer risk due to benzene of up to ~ 7 in one million. The MLE risk due to formaldehyde is ~ 2 in a million. The combined HAPs MLE risk is approximately 9 in one million. Cancer risks are greater for an MEI, with a risk of up to ~ 21 (in one million) due to benzene exposure and ~ 6 (in one million) for formaldehyde exposure.

Table 7. Long-Term Cancer Risk

HAP	Modeled Year	Analysis	Carcinogenic RfC URF 1/(μg/m^3)	Exposure Adj. Factor	Cancer Risk (per million)
Benzene	2008	MLE	7.8×10^{-6}	0.095	6.81E-06
		MEI	7.8×10^{-6}	0.29	2.08E-05
Formaldehyde	2008	MLE	1.3×10^{-5}	0.095	2.00E-06
		MEI	1.3×10^{-5}	0.29	6.10E-06
Total Combined		**MLE**			**8.81E-06**
		MEI			**2.69E-05**

MEI = maximally exposed individual

μg/m^3 = micrograms per cubic meter

MLE = most likely exposure

URF = unit risk factor

* USEPA Air Toxics Database, Table 1 (EPA 2012).

ASSESSMENT OF AQRV IMPACTS – VISIBILITY CHANGES AND NITROGEN DEPOSITION

In addition to modeling criteria air pollutant and HAPs concentrations at near-field ambient receptors, modeling was also performed for AQRVs including nitrogen (N) deposition and visibility changes associated with proposed project emissions.

The maximum modeled annual N deposition rates were estimated for the annual CALPUFF run. The POSTUTIL program (CALPUFF utility) was used to estimate total N fluxes from CALPUFF predicted wet and dry fluxes of NO_x, NO_3, HNO_3, SO_2, and SO_4. CALPOST (CALPUFF post-processor) was then used to summarize annual N deposition values from the POSTUTIL program. Modeled project only impacts are compared to the NPS screening deposition analysis threshold (DAT), which is defined as 0.005 kilogram per hectare per year (kg/ha/yr) in the western United States for N (FLAG 2010). A DAT is the additional amount of N deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered to be insignificant.

The visibility impacts assessment for this modeling analysis followed the recommendations in the FLAG Phase I Report - Revised guidelines (FLAG 2010). Specifically, this analysis compared daily modeled primary ($PM_{2.5}$ and PM_{10}) and secondary (sulfate and nitrate) particulate matter concentrations, as well as NO_2 concentrations, to calculated natural and 20% cleanest background conditions utilizing monthly RH adjustment values. To account for the various fine particulate matter components (elemental carbon [EC], organic carbon [OC], etc.) associated with fuel (natural gas and diesel) combustion, the CALPOST light extinction coefficient for PM fine was replaced with a new weighted average fine PM light extinction coefficient ~ 2.3 (default ~ 1.0) since EC and OC were not modeled with CALPUFF. FLAG background conditions data for the West Elk Wilderness and Maroon Bells – Snowmass Wilderness Areas (Class I) were used as background conditions for those areas and the FLAG background data for Maroon Bells – Snowmass Wilderness was used as background conditions for nearby Raggeds Wilderness Area (sensitive Class II).

Tables 8 and 9 provide a summary for the CALPUFF modeled AQRV impacts for this analysis. As shown in the Tables, CALPUFF modeled N deposition rates are below the applicable DAT at each Class I / sensitive Class II area and there are no predicted days of visibility threshold exceedances at these areas as well. As shown in Table 8, the maximum visibility deciview change for the three Class I / sensitive Class II areas is approximately 0.35, which is below the

FLAG 0.5 delta-deciview threshold. Table 9 shows that the maximum annual N deposition associated with the proposed project emissions is ~ 0.004 kg/ha/yr which is below the DAT (0.005 kg/ha/yr).

Table 8. Visibility Change

Largest Delta-Deciview in Class I or Sensitive Class II Areas From Project Sources

Air Quality Related Value: Visibility Change

Area	2008	
	FLAG 2010 (Annual Avg.)	FLAG 2010 (20% Best)
Class I or Sensitive Class II Areas		
Maroon Bells Snowmass Wilderness	**0.15**	**0.20**
Raggeds Wilderness	**0.25**	**0.35**
West Elk Wilderness	**0.08**	**0.11**

Visibility calculation methods include the following:

FLAG 2010 Annual Average: Uses Annual Average Natural background conditions shown in the Federal Land Air Gr*oup (FLAG)* 2010 Report (FLAG 2010).

FLAG 2010 20% Best: Uses 20% Best Natural background conditions shown in the Federal Land Air Gr*oup (FLAG)* 2010 Report (FLAG 2010).

Table 9. Nitrogen Deposition

Maximum Predicted Nitrogen Deposition From Project Sources

Air Quality Related Value: Nitrogen Deposition

Area	Maximum Modeled Deposition (kg/ha/yr)	DAT [1] (kg/ha/yr)
Class I or Sensitive Class II Areas		
Maroon Bells Snowmass Wilderness	**0.0029**	**0.005**
Raggeds Wilderness	**0.0040**	**0.005**
West Elk Wilderness	**0.0018**	**0.005**

The Deposition Analysis Threshold (DAT) is a significance threshold. If the modeled deposition rate (without adding the background concentration) is below the DAT, predicted impacts associated with a project are considered to be insignificant.

ASSUMPTIONS FOR MODELING AND IMPACTS EVALUATION

The following provides information for modeling impacts evaluation and / or was assumed for this analysis:

- Full NO_x to NO_2 conversion for estimating NO_2 1-hour and visibility impacts and therefore, NO_2 impacts are likely overestimated for this analysis.
- Assumes full build-out of well-pads in one year even though that is highly unlikely based on project operator proposed plans. Likely an overestimate based on previous statement alone, but near-field NO_2 1-hour and PM modeling was completed for full build-out of the proposed well-pad with closest proximity to residence for this modeling analysis.
- As previously stated, the NO_2 1-hour and $PM_{2.5}$ NAAQS are calculated as 3-year (consecutive years) average values. The maximum modeled values shown in Table 4 of this report are predicted concentrations that could occur in any one year and are associated with proposed project full well-pad and infrastructure build-out. These modeled values would not occur for 3 years at any one ambient residence receptor for the proposed project.
- The CARMMS High Scenario year 2021 predicted concentrations were used as “background” concentrations for near-field NO_2 and PM. These future year concentrations account for substantial oil and gas growth in the project area and could be overestimates of future conditions.
- Background HAPs concentrations for this cumulative modeling analysis are for an air quality monitor located in a much higher oil and gas environment than the proposed project location and could be an overestimate of background HAP conditions in the proposed project area.

Information Sources / References:

BLM, 2015. Colorado Air Resource Management Modeling Study (CARMMS). BLM Colorado Air Resources. http://www.blm.gov/co/st/en/BLM_Information/nepa/air_quality/carmms.html

CDPHE, 2011. Colorado Modeling Guidelines for Air Quality Permits. Colorado Department of Public Health and Environment. Air Pollution Control Division. May. http://www.colorado.gov/airquality/permits/guide.pdf

EPA, 1990. National Oil and Hazardous Substances Contingency Plan Final Rule. U.S. Environmental Protection Agency (55 FR 8669, 40 CFR 300.340(e)(2)(i)(A)(2). March 8.

EPA, 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Preliminary Review Draft.

EPA, 2005. Revision to the Guidelines for Air Quality Models. Environmental Protection Agency. November. http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

EPA, 2010. Guidance Concerning the Implementation of the 1-hour NO2 NAAQS for the Prevention of Significant Deterioration Program. Environmental Protection Agency. June. http://www.epa.gov/nsr/documents/20100629no2guidance.pdf

EPA, 2011. Air Toxics Database, Table 2, Acute Dose-Response Values for Screening Risk Assessments (12/19/2011). Office of Air Quality Planning and Standards (OAQPS). Technology Transfer Network Air Toxics Website. http://www.epa.gov/ttn/atw/toxsource/summary.html

EPA, 2012. Air Toxics Database, Table 1, Prioritized Chronic Dose-Response Values (5/21/2012). Office of Air Quality Planning and Standards (OAQPS). Technology Transfer Network Air Toxics Website. http://www.epa.gov/ttn/atw/toxsource/summary.html

EPA, 2013. NO2/NOx In-Stack Ratio (ISR) Database. Office of Air Quality Planning and Standards (OAQPS). Technology Transfer Network, Support Center for Regulatory Atmospheric Modeling Website. http://www.epa.gov/ttn/scram/no2_isr_database.htm

EPA, 2015. Technology Transfer Network Website. Air Quality System (AQS). Year 2013 PVOC data downloaded: 05/2015. Years 2011, 2012 and 2013 Ozone data downloaded: 05/2015. http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm

FLAG, 2010. Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report – Revised (2010). U.S. Forest Service-Air Quality Program, National Park Service-Air Resources Division, U.S. Fish and Wildlife Service-Air Quality Branch. November, 2010. http://www.nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf

WRAP, 2013. Western Regional Air Partnership. Regional Technical Center and West-wide Jump Start Air Quality Modeling Study (WestJumpAQMS) WRF Application / Evaluation. ENVIRON Corp, Alpine Geophysics and University of North Carolina. http://www.wrapair2.org/WestJumpAQMS.aspx