Draft Environmental Assessment

for

Thurston Energy Operating Company Proposed Ouray National Wildlife Refuge 2-Well Development Program in Uintah County, Utah

U.S. Department of Interior
Fish & Wildlife Service
Region 6, Mountain Prairie Region
Division of Refuge Planning
134 Union Boulevard, Suite 300
Lakewood, Colorado 80228

Ouray National Wildlife Refuge
HC 69 Box 232
Randlett, Utah 84063

February 2014

TABLE OF CONTENTS

ACRONYMS & ABBREVIATIONS VII

1.0 INTRODUCTION 1
1.1 Ouray National Wildlife Refuge 1
1.2 Background 2
1.3 Purpose and Need 4
1.4 Decision Framework 4
1.5 Relation to Statutes, Regulations, and Other Plans 5
1.5.1 Service Regulations 5
1.5.2 Other Laws Relating to Oil and Gas Activity on NWRS Lands 7
1.5.3 Other Federal Regulations 8
1.5.4 State Regulations and Rules 8
1.6 Public Scoping 9

2.0 PROPOSED ACTION AND ALTERNATIVES 11
2.1 Alternative A – Proposed Action 11
2.1.1 Construction Activities 15
2.1.2 Well Drilling 21
2.1.3 Well Completion and Testing 23
2.1.4 Interim Reclamation 23
2.1.5 Production and Maintenance Operations 24
2.1.6 Final Reclamation and Abandonment 25
2.1.7 Water Use and Supply 26
2.1.8 Hazardous Materials and Solid Waste 26
2.1.9 Workforce Requirements and Schedule 27
2.1.10 Applicant-Committed Environmental Protection Measures 28
2.1.11 Service Terms and Conditions for Thurston Ouray NWR 2-Well Development Project 30
2.2 Alternative B - No Action Alternative 41
2.3 Alternatives Considered but Dismissed from Analysis 42
2.3.1 Alternative C – 4-Well Development 42
2.3.2 Alternative D – Alternative Pipeline Route 1 45
2.3.3 Alternative E – Alternative Pipeline Route 2 45
2.3.4 Alternative F – Directional Drilling Alternative 46

3.0 AFFECTED ENVIRONMENT 49
3.1 Air Quality and Greenhouse Gas Emissions 50
3.1.1 Air Quality 50
3.1.2 Greenhouse Gas 53
3.2 Soils 53
3.2.1 Erosion and Restoration Potential of Project Area Soils 54
3.3 Water Resources Including Floodplains, Wetlands, and Waters of the U.S. 56
3.3.1 Regional Overview 56
3.3.2 Surface Water 57
3.3.3 Groundwater 64
3.3.4 Floodplains, Wetlands, and Waters of the U.S. 65

3.4 Biological Resources 67
3.4.1 General Vegetation 67
3.4.2 Invasive and Noxious Weeds 73
3.4.3 Fish and Wildlife 76
3.4.4 Special Status Plant and Animal Species 88
3.5 Paleontological Resources 99
3.5.1 Regulatory Setting 99
3.5.2 Known Paleontological Resources within the Project Area 99
3.6 Cultural Resources 101
3.6.1 Regulatory Setting 101
3.6.2 Historical Background 102
3.6.3 Known Cultural Resources within the Project Area 103
3.6.4 Section 106 Consultation 104
3.7 Transportation 104
3.8 Recreation 105
3.9 Visual Resources 105

4.0 ENVIRONMENTAL CONSEQUENCES 107

4.1 Air Quality and Greenhouse Gas Emissions 109
4.1.1 Alternative A – Proposed Action 109
4.1.2 Alternative B – No Action Alternative 114
4.1.3 Cumulative Impacts 114
4.1.4 Mitigation 116
4.2 Soils 117
4.2.1 Alternative A – Proposed Action 117
4.2.2 Alternative B – No Action Alternative 120
4.2.3 Cumulative Impacts 120
4.2.4 Mitigation 121
4.3 Water Resources Including Floodplains, Wetlands, and Waters of the U.S. 122
4.3.1 Alternative A – Proposed Action 122
4.3.2 Alternative B – No Action Alternative 126
4.3.3 Cumulative Impacts 126
4.3.4 Mitigation 127
4.4 Biological Resources 129
4.4.1 General Vegetation 129
4.4.2 Invasive and Noxious Weeds 131
4.4.3 Wildlife and Wildlife Habitats 133
4.4.4 Special Status Plant and Animal Species 139
4.5 Paleontological Resources 157
4.5.1 Alternative A – Proposed Action 158
4.5.2 Alternative B – No Action Alternative 158
4.5.3 Cumulative Impacts 158
4.5.4 Mitigation 159
4.6 Cultural Resources 159
4.6.1 Alternative A – Proposed Action 159
4.6.2 Alternative B – No Action Alternative 160
4.6.3 Cumulative Impacts 160
4.6.4 Mitigation 161

4.7 Transportation 161
4.7.1 Alternative A – Proposed Action 161
4.7.2 Alternative B – No Action Alternative 162
4.7.3 Cumulative Impacts 162
4.7.4 Mitigation 163
4.8 Recreation 164
4.8.1 Alternative A – Proposed Action 164
4.8.2 Alternative B – No Action Alternative 165
4.8.3 Cumulative Impacts 165
4.8.4 Mitigation 165
4.9 Visual Resources 166
4.9.1 Alternative A – Proposed Action 166
4.9.2 Alternative B – No Action Alternative 166
4.9.3 Cumulative Impacts 166
4.9.4 Mitigation 167

5.0 CONSULTATION AND COORDINATION 169
5.1 Introduction 169
5.2 Persons, Groups, and Agencies Consulted 169
5.3 List of Preparers 170

6.0 REFERENCES 173

TABLES

Table 1-1. Proposed Well Locations and Mineral Leases 2
Table 2-1. Estimated Disturbance of Project Facilities under the Proposed Action 15
Table 2.2. Table of Well Depths, Elevations, and Screen Intervals 43
Table 3-1. Ambient Air Quality Background Values 51
Table 3-2. Additional Ozone Background Values * 52
Table 3-3. Soils Map Units within Project Area 54
Table 3-4. Stream Flow Data for USGS Gauging Stations 59
Table 3-5. Summary of Water Quality Analyses for the Green River at Ouray, USGS Gauging Station 09307000 (1950-1966) 62
Table 3-6. Summary of Water Quality Analysis for Green River near Ouray, UDEQ Station 4937020 (1976-2006) 63
Table 3-7. National Vegetation Classification Standard Recognized Vegetation Communities within the Project Area 69
Table 3-8. Noxious Weeds Known to Occur on the Ouray NWR 74
Table 3-9. Waterfowl Species Known to Occur on the Ouray NWR 81
Table 3-10. Federally Listed Species Considered for Evaluation in the EA/BA 90
Table 3-11. UNHP Species of Concern Considered for Evaluation in the EA 95
Table 3-12. AADT for Federal and State Highways Providing Access to Project Area 104
Table 3-13. Public Use on Ouray NWR (Oct. 2011 – Sept. 2012) 105
Table 4-1. Cumulative Impact Assessment Areas 108
Table 4-2. Estimated Maximum Surface Disturbance Associated with Past, Present, and Reasonably Foreseeable Energy Development within Ouray NWR 109
Table 4-3. Estimate of Annual Emissions *(tons per year)*[1] for Well Development and Production under the Proposed Action 110
Table 4-4. Estimate of Annual Emissions *(Tons per Year)* [1] for Well Development under the Proposed Action 111
Table 4-5. Estimate of Annual Emissions *(Tons per Year)* [1] for Well Production under the Proposed Action 111
Table 4-6. Uinta Basin Oil and Gas Operations Emissions Summary (2006) 114
Table 4-7. Soil Disturbance by Major Soil Map Units under the Proposed Action 118
Table 4-8. Vegetative Communities Affected by the Proposed Action 129
Table 4-9. Common Noise Levels Associated with Activities and Natural Events 141
Table 4-10. Estimated Noise Attenuation Associated with an Increase in Distance 141
Table 5-1. Persons, Groups, and Agencies Consulted 169
Table 5-2. U.S. Fish and Wildlife Service 170
Table 5-3. Non-U.S. Fish and Wildlife Service Preparers 171

FIGURES

Figure 1-1. Project Location 3
Figure 2-3. Typical Well Pad Layout 17
Figure 2-4. Typical Roadway Cross-section with Width Specifications 18
Figure 2-5. Alternatives Dismissed from Analysis 47
Figure 3-1. Uintah County Soil Survey 55
Figure 3-2. Surface Water Features 58

Figure 3-3. Hydrograph for USGS Gauging Station 0926100 Green River near Jensen, Utah (USGS 2013) 60
Figure 3-4. 100-Year Floodplain 66
Figure 3-5. Vegetation Cover Types 68
Figure 3-6. Noxious Weeds 75
Figure 3-7. Pronghorn Seasonal Ranges 79
Figure 3-8. Mule Deer Seasonal Ranges 80
Figure 3-9. Monthly Waterfowl Usage of Leota Bottom, 2007–2011 83
Figure 3-10. Number of Raptors Observed in Leota Bottom by Month, 2007 – 2011 86
Figure 3-11. Prairie Dog Colonies 98
Figure 3-12. Location of Cultural/Paleontological Survey Area 100
Figure 4-1. 2012-2013 Cactus Survey Results 145

APPENDICES

Appendix A Thurston Energy, LLC's Surface Use Plan of Operations
Appendix B U.S. Army Corps of Engineers Wetland and Waters of the U.S. Impact Determination
Appendix C Ouray National Wildlife Refuge Species List
Appendix D Special Status Plant Survey Reports
Appendix E Air Quality Emissions Inventory
Appendix F Thurston Energy LLC's Draft Reclamation Plan
Appendix G Thurston Energy LLC's Draft Spill Prevention, Control and Countermeasure (SPCC) Plan and Thurston Spill Response Plan Supplement
Appendix H Draft Biological Assessment (BA) Memorandum
Appendix I State Historic Preservation Office (SHPO) Consultation

This page intentionally left blank.

ACRONYMS & ABBREVIATIONS

-A-	
AADT	Annual Average Daily Traffic
ACEPM	Applicant Committed Environmental Protection Measures
AHPA	Archaeological and Historic Preservation Act
AIRFA	American Indian Religious Freedom Act
AMSL	Above Mean Sea Level
AO	Authorized Officer
APD	Application for Permit to Drill
APE	Area of Potential Effect
AQRV	Air Quality Related Values
ARPA	Archaeological Resources Protection Act of 1979
AST	Aboveground Storage Tank
ATV	All-terrain Vehicle
-B-	
BA	Biological Assessment
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BHCA	Bird Habitat Conservation Area
BLM	United States Bureau of Land Management
BMP	Best Management Practices
BOD	Biological Oxygen Demand
BOP	Blowout Preventer
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene isomers
-C-	
°C	Degrees Celsius
ca	Circa
CAA	Clean Air Act
$CaCO_3$	Calcium Carbonate
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CH_4	Methane
CIAA	Cumulative Impact Assessment Area
CO	Carbon Monoxide
COA	Conditions of Approval
CS	Species receiving special management under a Conservation Agreement
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy

-D-	
DOT	Department of Transportation
DR	Decision Record
dV	Deciview
-E-	
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
ESO	Ecological Services Office
-F-	
°F	Degrees Fahrenheit
FEIS	Final Environmental Impact Statement
FONSI	Finding of No Significant Impact
FY	Fiscal Year
-G-	
g/bhp-hr	Grams per Brake Horsepower per Hour
GIS	Geographic Information System
GLO	General Land Office
GNB	Greater Natural Buttes
gpm	Gallons per Minute
GWP	Global Warming Potential
-H-	
HAP	Hazardous Air Pollutants
HDPE	High-density Polyethylene
-K-	
K_w	Whole Soil Erosion Potential
-L-	
LOP	Life of Project
-M-	
Manual	The Service Manual, Land Use Series, 612 FW 2, Oil and Gas
MBCA	Migratory Bird Conservation Act
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
mg/L	Milligrams per Liter
MOU	Memorandum of Understanding
MSDS	Material Safety and Data Sheets
-N-	
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NAGPRA	Native American Grave Protection and Reparation Act

NASA	National Aeronautical and Space Administration
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
n-Hexane	Normal-Hexane
NHPA	National Historic Preservation Act of 1966
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NO_X	Nitrogen Oxide
NPS	United States National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NVCS	National Vegetation Class Standard
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NWRSAA	National Wildlife Refuge System Administration Act
-O-	
O_3	Ozone
OSHA	Occupational Health and Safety Administration
-P-	
pH	Hydrogen Ion Concentrations
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 Microns in Diameter
$PM_{2.5}$	Particulate Matter less than 2.5 Microns in Diameter
ppb	Parts per Billion
ppm	Parts per Million
PVMRM	Plume Volume Molar Ratio Method
-R-	
RCRA	Resource Conservation Recovery Act on 1976
Recovery Program	Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin
RIPRAP	Recovery Implementation Program Recovery Action Plan
ROW	Right-of-way
-S-	
Sagebrush	Sagebrush Consultants, LLC
SAR	Sodium Absorption Ratio
Service	U.S. Fish and Wildlife Service, Refuge Planning Division
SH	State Highway
SHPO	State Historic Preservation Office
SITLA	School and Institutional Trust Land Administration
SMCL	Secondary Maximum Contaminant Level
SO_2	Sulfur Dioxide

SO_X	Sulfur Oxides
SPC	Wildlife Species of Concern
SPCC	Spill Prevention, Control and Countermeasure
spp.	Species
SUP	Special Use Permit
SUPO	Surface Use Plan of Operations
SWMP	Stormwater Management Plan
SWReGAP	Southwest Regional Gap Analysis Project
-T-	
TDS	Total Dissolved Solids
Thurston	Thurston Energy, LLC
TSL	Toxic Screening Level
TSS	Total Suspended Solids
TVD	True Vertical Depth
-U-	
µg/L	Micrograms per Liter
µg/m3	Micrograms per Cubic Meter
µnhos/cm	Micromhos per Centimeter
µS/cm	Microsiemens per Centimeter (Specific Conductance)
U.S.C.	United States Code
UDAQ	Utah Division of Air Quality
UDEQ	Utah Division of Environmental Quality
UDNR	Utah Division of Natural Resources
UDOGM	Utah Division of Oil, Gas and Mining
UDOT	Utah Department of Transportation
UDWQ	Utah Department of Water Quality
UDWR	Utah Division of Wildlife Resources
UNHP	Utah Natural Heritage Program
USACE	United States Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USFWS-ESO	U.S. Fish and Wildlife Service, Ecological Services Office
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
US-NVCS	U.S. National Vegetation Classification System
-V-	
VOC	Volatile Organic Compound
-Y-	
YOY	Young-of-Year

1.0 INTRODUCTION

The U.S. Fish and Wildlife Service (USFWS) Refuge Planning Division (Service) has prepared this Environmental Assessment (EA) and Biological Assessment (BA) in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations to analyze proposed oil and natural gas development by Thurston Energy, LLC (Thurston) within the Ouray National Wildlife Refuge (NWR or Refuge) boundary. The proposed oil and gas exploration and development project constitutes an externally initiated proposal for a federal action that is subject to analysis by the Service under NEPA. This EA discloses the direct, indirect, and cumulative environmental impacts that would result from the Proposed Action and Alternatives, including the No Action Alternative. The EA also provides evidence for determining whether a statement of "Finding of No Significant Impact" (FONSI) will be prepared or whether an Environmental Impact Statement (EIS) will be required. A FONSI is a document that briefly presents the reasons why implementation of the Proposed Action or an Alternative would not result in "significant" environmental impacts. If the Service decision maker determines that this project has no "significant" impacts following the analysis in the EA, a Decision Record (DR) and FONSI would be prepared that approve the selected alternative or combination of alternatives. If the project is found to have "significant" impacts, an EIS would be prepared.

1.1 Ouray National Wildlife Refuge

The Ouray NWR was established on May 25, 1960, under authority of the Migratory Bird Conservation Act of 1929 and Public Land Order 2730. Land acquisition was initiated in 1961 using Duck Stamp funding. The Refuge covers some 11,987 acres and includes 12 miles of the Green River. Most of the surface acreage is owned in fee title (5,032 acres), in which 3,110 acres was transferred from the Bureau of Land Management (BLM), 2,692 acres is leased from the Ute Tribe, and 1,153 are leased from the State of Utah. Approximately 559 acres of private in-holdings exist within the Refuge boundary (USFWS 2000a). The minerals underlying the Refuge are owned by various entities including the State of Utah, the federal government, the Ute Tribe, and numerous private or fee owners.

The Refuge was originally established to provide prime breeding, resting, and feeding areas for migratory waterfowl traveling along the Green River corridor. Early in its history, much of the Refuge's floodplain and wetland habitats were altered with the construction of dikes and levees to gain control over seasonal water flow from the Green River. Impounded marsh units were created to provide secure water, food, and nesting cover for waterfowl. Since the construction of Flaming Gorge Dam upstream, the Green River system has changed dramatically resulting in long-term loss and degradation of riparian habitats and wildlife species dependent on them. The current management strategy of the Refuge takes into account new biological information and insight into the importance of western riparian and floodplain systems. It also de-emphasizes waterfowl production and shifts management emphasis toward enhancement of riparian and wetland habitat for waterfowl, other migratory birds, and endangered fish species. The Refuge's wetland and riparian habitat is now critically important to protect declining fish and migratory bird species using the Green River corridor.

Management strategies today are focused on managing water to mimic the natural floodplains that existed before dams were erected along the river. Portions of protective levees throughout the Refuge have been removed to allow more frequent flooding. The Refuge includes approximately 19 square miles of bottomland and river surface along the Green River. Five bottomlands within the river floodplain - Johnson Bottom, Leota Bottom, Wyasket Lake, Sheppard Bottom, and Woods Bottom - are all fed by the river as it winds through an otherwise arid landscape. When natural flooding occurs in the spring, ponds

are formed in the bottomland areas, spurring the growth of semi-aquatic plants that provide food and cover for ducks and other wildlife. In addition, these ponds serve as nurseries for the endangered fish species of the Colorado River system.

The Refuge provides food and nesting cover for some 26 species of migratory waterfowl as well as a resting area and food for many additional species of migrating waterfowl. Approximately 237 species of birds use Ouray NWR, along with a variety of mammals such as elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), river otters (*Lontra canadensis*), and white-tailed prairie dogs (*Cynomys leucurus*). The proposed threatened yellow-billed cuckoo (*Coccyzus americanus*) and several endangered fish such as the bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) also use portions of the Green River within the Refuge.

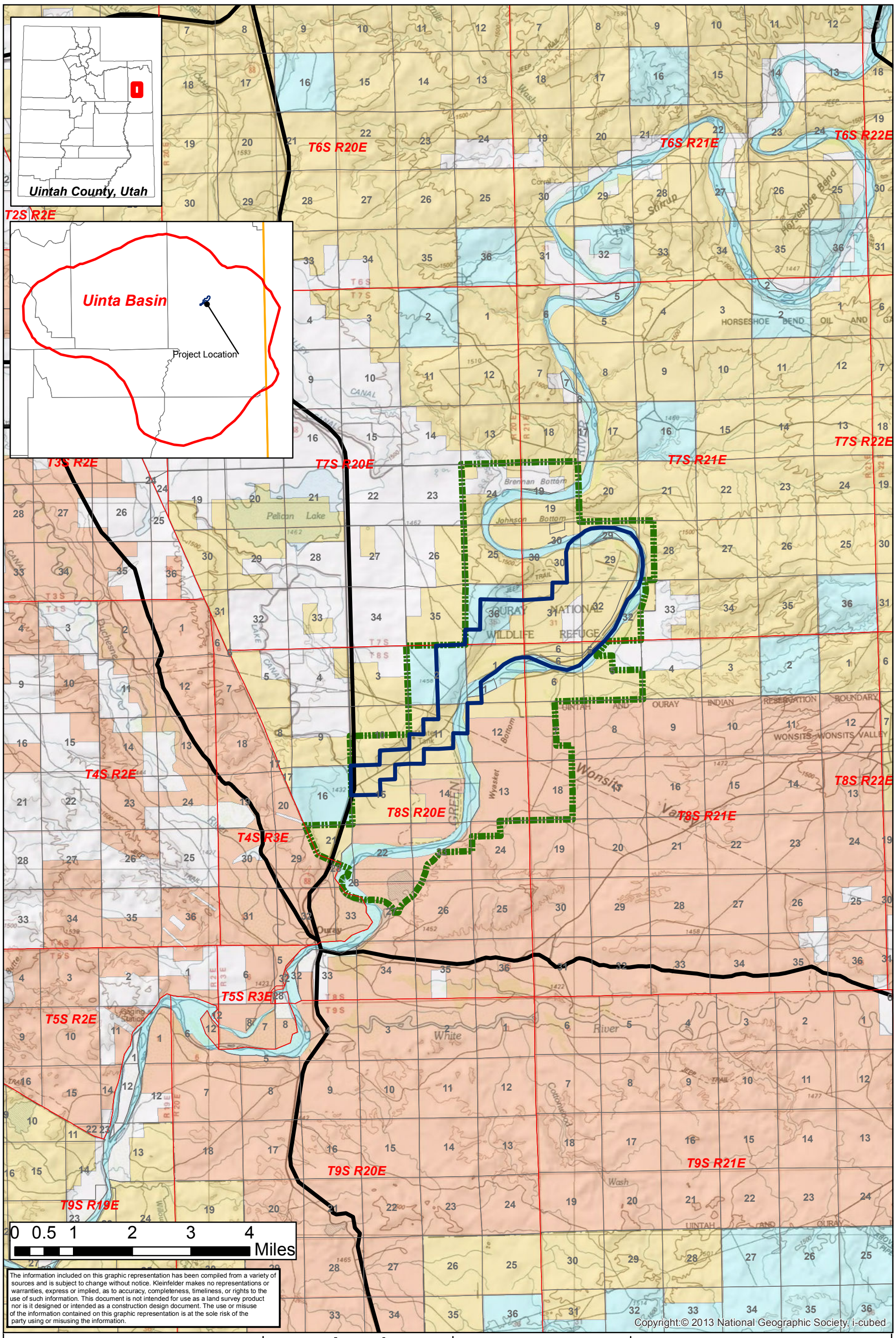
1.2 Background

The Service is evaluating a proposal from Thurston to drill and operate two exploratory oil and natural gas wells, construct associated well pads, pipelines and access roads, and upgrade and maintain existing access roads within Ouray NWR. The project is located approximately 32 miles southwest of Vernal in northeastern Utah. The Project Area consists of approximately 3,684 acres on federal lands administered by the Service. Mineral rights for the proposed project underlying Refuge lands are owned by the State of Utah, which is administered by the School and Institutional Trust Land Administration (SITLA). Well locations and mineral leases are listed in **Table 1-1**. This proposal is referred to as the Ouray NWR 2-Well Development Program (see **Figure 1-1**).

The federal government owns the surface estate of the Refuge (including all surface and subsurface natural resources not considered to be minerals), and it is administered by the Service as part of the National Wildlife Refuge System (NWRS) pursuant to the NWRS Administration Act (NWRSAA) of 1997, and other applicable laws and regulations. As the surface owner, the Service has a responsibility to protect the surface estate of the Refuge and its associated resources. The Service policy (612 FW 2.7(c), USFWS 2012a) requires that the Refuge is protected from all unnecessary damage resulting from oil and gas activities. Thus, the Service has the responsibility to require protective measures to ensure that the surface estate (including all surface and subsurface natural resources not considered to be minerals) of the Refuge and associated cultural, socioeconomic, and aesthetic resources are not unreasonably impacted by Thurston's proposed activities.

Table 1-1. Proposed Well Locations and Mineral Leases

Well	Surface Location	Mineral Lease	Lease Stipulations
Thurston 11-31-7-21	LOT 7 SEC 31,T7S, R21E 2295' FLS, 1722' FWL	52015 (state)	Standard terms and conditions
Thurston 12-31-7-21	LOT 8 SEC 31, T7S, R21E 1995' FSL, 639' FWL	52015 (state)	Standard terms and conditions



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Major Road
- Ouray National Wildlife Refuge Boundary

Surface Ownership
- Federal
- Private
- State
- Tribal

N

PROJECT NO.	126694
DRAWN:	2/6/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig1_1ProjectLocation.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Project Location
Uintah County, Utah

FIGURE
1-1

1.3 Purpose and Need

The Purpose and Need Statement "shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action" (40 Code of Federal Regulations [CFR] §1502.13). Because the Proposed Action is an externally generated action, the Purpose and Need statement addresses the purpose of and need for the action proposed by Thurston and the necessity of a response from the Service.

The purpose of the Proposed Action is to provide Thurston access to and allow for the exploration of leased mineral rights and commence construction and operations to ascertain whether sufficient oil and gas resources exist to commence commercial production of those resources; and if so, to proceed with production. The need for the Proposed Action allows Thurston to exercise its rights under the Mineral Leasing Act (MLA) of 1920 to explore for and develop minerals on federal lands. The Service is required to respond to the Proposed Action and develop a range of "reasonable alternatives" and/or mitigation measures that would meet the Service's requirements for environmental protection under NEPA and the Ouray NWR Comprehensive Conservation Plan (CCP) (USFWS 2000a), while at the same time recognizing a mineral owner's vested right to access and explore the oil and gas mineral estate.

The Service prepared this EA to evaluate potential impacts resulting from the Proposed Action and Alternatives and to assess whether Thurston's proposed oil and gas exploration and development is conducted in a manner most protective to the surface estate while recognizing the mineral owners right to access. By preparing this EA, the Service is fulfilling its responsibilities under federal law to protect the surface estate and associated resources of the Refuge from unreasonable damage by Thurston in their Plan of Operations. The Service has included specific conservation measures that will protect the surface estate and associated resources from unreasonable damage, while still recognizing Thurston's vested rights to access and explore the oil and gas mineral estate underlying Refuge lands. This EA will facilitate the Service's decision-making process as to whether to issue a Special Use Permit (SUP) granting Thurston access to Refuge lands and the terms and conditions of the SUP based on an evaluation of the expected impacts. A decision to issue an access agreement/permit would authorize Thurston to exercise the rights of their mineral lease, subject to specific Conditions of Approval (COAs) and additional site-specific review and approval, as necessary.

1.4 Decision Framework

This EA has been prepared to comply with NEPA, the Council on Environmental Quality (CEQ) regulations 40 CFR 1500-1508. This EA discloses the potential environmental consequences associated with Thurston's proposal to drill and operate up to two oil and natural gas wells and construct associated infrastructure on federal surface and state mineral leases in the Ouray NWR.

This EA provides the Service responsible official, federal and state agencies, local governments, and the public with information on the Proposed Action and No Action Alternatives and the likely environmental consequences on the human environment. This EA has been prepared for a 30-day public review and comment period. The Service will need to make two decisions based on this EA: (1) select an alternative for implementation based on review of environmental consequences analysis, mitigation measures, and public comments; and (2) determine if the selected alternative is a major federal action significantly affecting the quality of the human environment, thus requiring preparation of an EIS, per CEQ regulations.

A Biological Assessment (BA) has also been prepared for the project and is incorporated into this EA by reference. The BA was prepared pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (Title 16, United States Code, Section 1531 et seq. [16 U.S.C. §§ 1531 et seq.]), to address potential effects of the proposed oil and gas development on federally listed threatened and endangered species, species proposed for listing, candidate species and, where applicable, their designated critical habitat. A draft of the BA Memorandum for the Thurston Ouray NWR 2-Well Development Program is included in **Appendix H**.

The BA is intended to fulfill the compliance requirements of pertinent environmental laws, regulations, and policies in accordance with the requirements of Section 7(b) of the ESA of 1973, as amended, and implementing regulations [16 United States Code (U.S.C.) 1536 (c), 50 Code of Federal Regulations (CFR) 402.12 (f) and 402.14 (c)], and ESA guidance contained in the Endangered Species Consultation Handbook (USFWS and National Marine Fisheries Service 1998).

Federal agencies, in consultation with the U.S. Fish and Wildlife Service, Ecological Services Office (USFWS-ESO), are required to ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of a federally listed or proposed threatened or endangered species. As the federal lead agency for the EA, the Service is responsible for Intra-Service Section 7 consultation with the USFWS-ESO. It is Service policy to consider candidate species when making natural resource decisions and thus, candidate species will be included for consideration in the BA.

The Utah Department of Natural Resources, Division of Oil, Gas and Mining (UDOGM) has regulatory authority for applications for permit to drill (APDs) on state mineral leases. Because Thurston's proposed development accesses state minerals, UDOGM would be responsible for all downhole and regulatory permitting. The Service has consulted with UDOGM in the preparation of this EA to ensure mutual management goals and objectives for oil and gas exploration and development are achieved. The Service will defer to UDOGM regulations for baseline standards, but retains planning and decision-making authority over activities occurring on surface lands within the Ouray NWR boundary, including the authority to add additional conservation stipulations to protect the Refuge's natural resources.

1.5 Relation to Statutes, Regulations, and Other Plans

1.5.1 Service Regulations

The Service has managed oil and gas operations on approximately one quarter of the 558 NWRs in the NWRS. Under the NWRSAA of 1966, as amended, the Service is responsible for managing all activities on Refuges including oil and gas operations on non-federally owned (private) mineral rights. It is the policy of the Service "to protect Service resources to the maximum extent possible without infringing on the rights of sub-surface owners". The following sections describe the legal framework under which the Service regulates oil and gas exploration that takes place on Refuge lands when the Service does not own the subsurface rights. In addition to Service regulations concerning oil and gas activities, other statutes and regulations are cited.

1.5.1.1 Excepted Mineral Rights

The Service Manual, Land Use Series, 612 FW 2, Oil and Gas (Manual) (USFWS 2012a) provides standard policy guidance and background information on management of oil and gas activities on NWRS lands (USGAO 2003). In this Manual, the Service provides for the exercise of non-federally owned

mineral rights while protecting Service resources to the maximum extent possible. The provisions of the Service Manual are applicable to Thurston's oil and gas mineral interest that are discussed below.

On a portion of the Refuge, the mineral owner holds "excepted rights" that also are referred to as "outstanding rights" (USFWS 2012a). Excepted rights occur when oil and gas rights are owned by third parties at the time the Service acquires title to the lands. The "owner of excepted (outstanding) oil and gas rights has the right to sell, lease, explore for, and remove those minerals subject to the terms of the instrument by which that interest was acquired or reserved and to the State laws governing protection of the surface and the rights of the surface owner." Section 2.9.B of the Manual provides the procedural requirements for permitting oil and gas activities on Service lands at 612 FW 2.9 (USFWS 2012a).

In addition to the Manual, reserved and excepted rights are addressed in the NWRSAA of 1966 and addressed by the regulation in Title 50 CFR 29.32 (Mineral Rights Reserved and Excepted). This regulation provides general rules governing the exercise of reserved and excepted mineral rights on NWRS lands. 50 CFR 29.32 states the following:

- Persons holding mineral rights in wildlife refuge lands by reservation in the conveyance to the United States and persons holding mineral rights in such lands which rights vested prior to the acquisition of the lands by the United States shall, to the greatest extent practicable, conduct all exploration, development, and production operations in such a manner as to prevent damage, erosion, pollution, or contamination to the lands, waters, facilities and vegetation of the area. So far as is practicable, such operations also must be conducted without interference with the operation of the Refuge or disturbance to the wildlife.
- Physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations. Persons conducting mineral operations on refuge areas must comply with all applicable federal and state laws and regulations for the protection of wildlife and the administration of the area. Oil field brine, slag, and all other waste and contaminating substances must be kept in the smallest practicable area, must be confined so as to prevent escape as a result of rains and high water or otherwise, and must be removed from the area as quickly as practicable in such a manner as to prevent contamination, pollution, damage, or injury to the lands, waters, facilities, or vegetation of the refuge or to wildlife. Structures and equipment must be removed from the area when the need for them has ended. Upon the cessation of operations, the area shall be restored as nearly as possible to its condition prior to the commencement of operations. Nothing in this section shall be applied so as to contravene or nullify rights vested in holders of mineral interests on refuge lands.

1.5.1.2 Compatible Uses Policy

The NWRSAA of 1966, Policy 603 FW 2 Compatible Uses Policy (USFWS 2000b) and the NWRS Improvement Act, set forth general rules and provides guidelines for determining compatibility of proposed and existing uses of Refuge. However, provisions of 603 FW 2, as they relate to the compatibility standard of the NWRSAA to the exercise of reserved and excepted mineral rights on NWRS lands, state the following:

- The Service must recognize and allow owners' property rights that are not vested in the federal government, such as reserved or excepted rights, to explore and develop minerals or oil and gas beneath a refuge, regardless of whether the use is compatible. In these situations, a compatibility

determination is not required and should not be completed. Therefore, the compatibility standard of the NWRSAA does not apply to Thurston's development program on the Refuge.

1.5.1.3 Appropriate Refuge Use Policy

The NWRSAA of 1966, Policy 603 FW 1 Appropriate Refuge Uses Policy (USFWS 2006), sets forth general rules and provides guidelines for determining appropriate uses of NWRs. The Appropriate Refuge Use Policy of the NWRSAA does not apply because exercise of the subsurface mineral holder's rights is not at the Service's discretion and jurisdiction.

1.5.2 Other Laws Relating to Oil and Gas Activity on NWRS Lands

1.5.2.1 National Historic Preservation Act of 1966, as Amended

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires federal agencies to assess the effects of an undertaking on historical and cultural resource sites. This is accomplished by inventorying proposed disturbance areas or area of potential effect (APE), evaluating site importance and eligibility to the National Register of Historic Places (NRHP), assessing the effect of the undertaking on NRHP-eligible sites, and consulting with appropriate historic preservation agencies. Compliance with section 106 of NHPA was followed for the oil and gas exploration activities described in this EA.

1.5.2.2 Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act (ARPA) of 1979 (16 USC 470aa-470mm) and amendments provide for the protection of archaeological resources on public and Native American lands as well as the exchange of information between governmental entities and academic or private archaeological researchers. An archaeological resource under this Act is defined as material remains of past human life or activities that are of archaeological interest and includes, but is not limited to, pottery, basketry, bottles, weapons, tools, structures, rock paintings or carvings, intaglios, graves, and human skeletal materials.

1.5.2.3 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (MBTA) of 1918 (16 USC 703-712) implements various treaties between the United States and other nations of the MBTA and provides for the protection of migratory birds and specifies penalties for harming or unlawfully killing migratory birds. Section 715e of the MBTA provides statutory authority for regulation of reserved mineral rights on NWRs (it subordinates oil and gas interests to such rules and regulations as may be prescribed by the Secretary of the Interior from time-to-time).

1.5.2.4 Endangered Species Act of 1973, as Amended

The ESA of 1973, as amended (16 USC 1531-1544), provides for the protection of endangered and threatened species and the habitats upon which they depend. Section 7 of the Act requires federal agencies to consult with the Secretary of the Interior or the Secretary of Commerce in cases where the agencies' action may affect a listed species to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species. Compliance with Section 7 of the ESA was followed for the oil and gas exploration activities and preparation of a BA was performed in conjunction with this EA. The Service will complete an intra-service Section 7 evaluation on the Proposed Action.

1.5.2.5 Bald and Golden Eagle Protection Act of 1940, as Amended

The Bald and Golden Eagle Protection Act (BGEPA), as amended (16 USC 668-668c), provides for the protection of bald and golden eagles and prohibits the "taking" of either species, including their parts, nests, or eggs, without a permit issued by the Department of the Interior. The term "take" under the Act is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb". The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import" bald or golden eagles and is punishable by fines and/or imprisonment.

1.5.3 Other Federal Regulations

The proposed Thurston development activities also are governed by all applicable federal regulatory programs that include, but are not necessarily limited to, the following:

- Clean Water Act (CWA)
- Clean Air Act (CAA)
- American Indian Religious Freedom Act (AIRFA)
- Native American Grave Protection and Repatriation Act (NAGPRA)
- Resource Conservation Recovery Act (RCRA)
- Occupational Health and Safety Administration (OSHA) regulations
- Department of Transportation (DOT) regulations

1.5.4 State Regulations and Rules

1.5.4.1 Utah Code – Statutes and Constitution

Utah Code Ann §23-21-6: Wildlife Resources, Lands and Waters for Wildlife Purposes
Utah Code Title 23: Wildlife Resources, Chapter 21: Lands and Waters for Wildlife Purposes provide for the establishment of migratory waterfowl refuges in accordance with the Migratory Bird Conservation Act (MBCA). As such, mining and oil and gas exploration and development on these lands are subject to "rules and regulations prescribed from time-to-time by the Secretary of the Interior for the occupation, use, operation, protection, and administration of these areas as refuges for migratory birds." Ouray NWR is considered a migratory waterfowl refuge by the U.S. government.

Utah Code Ann §53C-2-409: Mineral Leases, Cancellation, Use of Surface Land, Liability for Damage
Utah Code Title 53C: School and Institutional Trust Lands Management Act, Chapter 2: Activities on Trust Lands establishes policy for mineral lease surface use and liability for damage. Accordingly, lease holders of SITLA administered minerals have the right to reasonable use of surface land but may not injure, damage, or destroy improvements of the surface owner and are liable to the surface owner for all damages to the surface of the land, except for reasonable use.

1.5.4.2 Utah Division of Oil, Gas and Mining

The Utah Division of Oil, Gas and Mining (UDOGM) has developed and implemented rules for regulating oil and gas exploration and production activities (R649). Section 649-2-2 of the Rules provides authority over "all state lands in Utah including lands of the United States and lands subject to the jurisdiction of the United States to the extent lawfully subject to the state's power" (UDOGM 2005). UDOGM regulations cover all phases of oil and gas drilling operations, address pollution prevention, and provide for penalties and fines for non-compliance. The oil and gas rules give UDOGM staff latitude when developing conditions of approval for APDs depending on specific site concerns or conditions.

1.6 Public Scoping

The Service conducted public and internal scoping to solicit input from the public, interested organizations, and federal, state and local agencies to help inform the Service of concerns associated with the proposed project.

The formal scoping period began on October 22, 2012, with the publication of a press release and a map of the proposed project on the Refuge website (www.ouray.fws.gov). The notice was also posted on the Refuge's information kiosk and published in the *Vernal Express*, a local weekly newspaper, on October 31, November 7, 14, and 21, 2012. The 30-day public scoping period closed on November 23, 2012. The Service received no response from the general public, special interest groups, or federal and state agencies in response to the public scoping notice. As such, the resources carried forward for analysis in this EA were determined based on input received during internal scoping with the Service and Ouray NWR managers.

This page intentionally left blank.

2.0 PROPOSED ACTION AND ALTERNATIVES

Alternative approaches to satisfy the purpose and need described in **Chapter 1.0** are briefly identified and described in this chapter. These alternatives have been chosen to provide a reasonable range of options for consideration by decision makers in terms of their capacity to meet project objectives. NEPA requires that a practical range of reasonable alternatives be considered and evaluated. Such alternatives must meet the project's purpose and need while minimizing or avoiding environmental impacts. This range of reasonable alternatives is formulated to address issues and concerns raised by agencies during scoping and the public.

Reasonable alternatives are defined by CEQ as those that are technically, economically, and environmentally practical and feasible, and meet the project proponent's stated purpose and need for the project. NEPA also requires the analysis of a No Action Alternative for comparison to the other alternatives in the EA. If alternatives are proposed or suggested during the EA process and those alternatives are not reasonable or do not otherwise meet the project proponent's purpose and need of the project, a detailed analysis is not required. Rather, the rationale for eliminating them from detailed analysis must be briefly explained.

Alternative A is Thurston's Proposed Action for oil and gas development. The Service has identified Alternative A as the agency preferred alternative because it best addresses issues raised in scoping about potential impacts to resources while meeting the purpose and need for the Project. Alternative A also incorporates additional mitigation measures to protect Refuge resources. Alternative B is the No Action Alternative.

Four additional action alternatives were initially identified. However, after preliminary screening, all four were eliminated from further consideration because they clearly were incapable of meeting the needs of the proposed project.

2.1 Alternative A – Proposed Action

Thurston proposes to drill, complete, produce, and reclaim two oil and gas wells located within the Ouray NWR. The proposed wells would target the Green River and Wasatch formations and would require construction and maintenance of associated access roads and natural gas pipelines. Thurston understands that access to Refuge lands will be contingent upon the Service's issuance of a SUP, subject to approval of Service terms and conditions (i.e., approval of Plan of Operations, mitigation plans, road maintenance agreement, etc.). A copy of Thurston's Surface Use Plan of Operations (SUPO) is provided in **Appendix A.**

Specifically, Thurston's Proposed Action includes the following primary components:

- Construction of two (2) well pads, each averaging approximately 1.6 acres in size;
- Construction of approximately 513.1 feet of new access road;
- Installation of 15,710 feet of 3-inch surface HDPE gas pipeline laid by hand from the trunk line on top of the bluff to the well pads;
- Construction of approximately 9,768 feet of overhead electric power lines; and
- Well testing to evaluate the development potential of the lease.

Figure 2-1 depicts the proposed locations of the wells and infrastructure associated with the proposed project. The proposed wells would be drilled vertically to total depths of approximately 7,000 feet. Although actual operations are subject to change as conditions warrant, Thurston plans to drill the two wells over a one-year period. The anticipated life of an individual well is 30- to 40-years, and the anticipated time needed for field abandonment and final reclamation is three years. Therefore, the anticipated life of the project (LOP) under the SUPO would be 33- to 43-years.

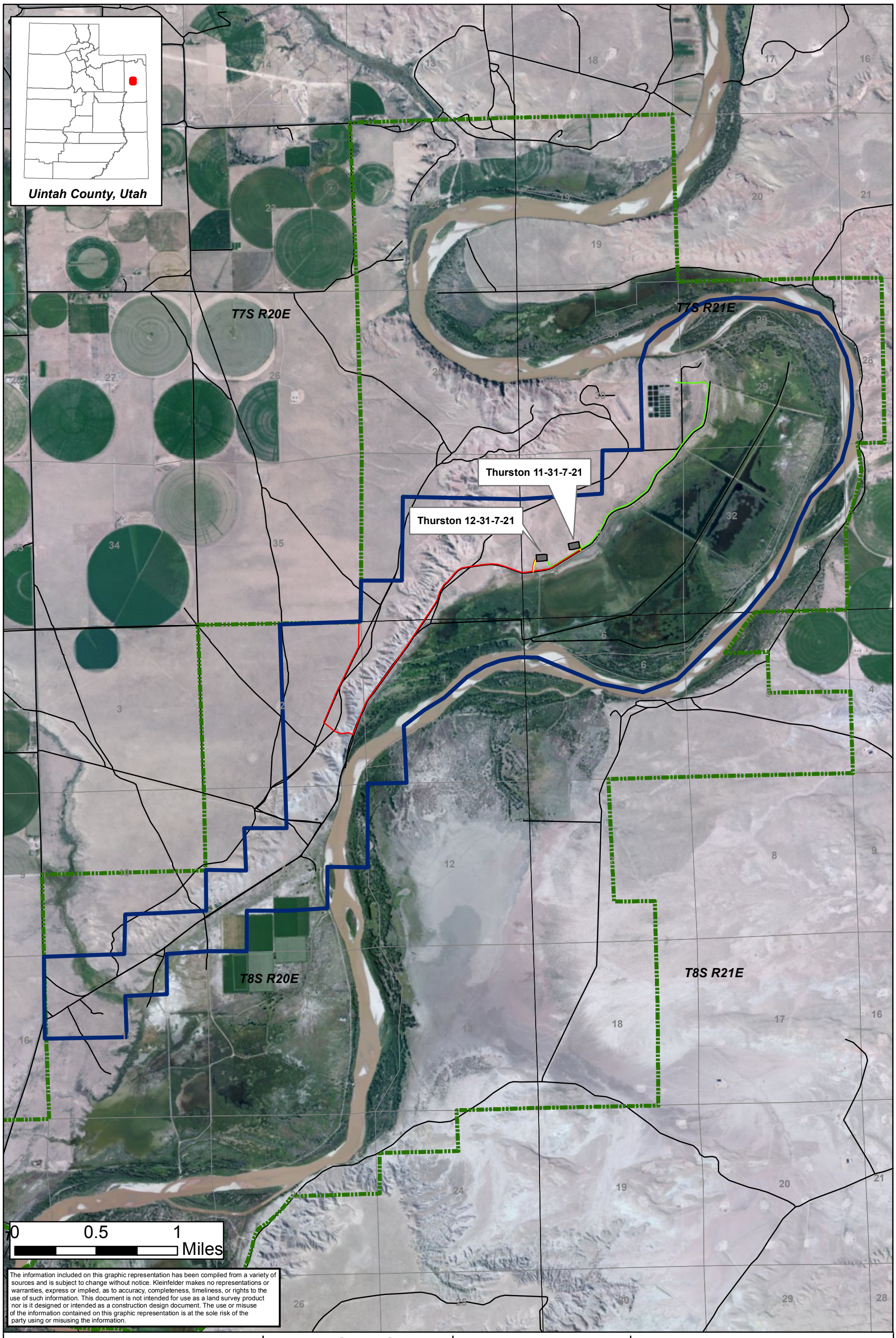
The timeframe for annual construction, drilling, and completion activities would depend on permit approval and compliance with relevant seasonal restrictions.

Included in the Proposed Action are a range of Best Management Practices (BMPs) and Applicant Committed Environmental Protection Measures (ACEPMs) that would be implemented to avoid, minimize, or offset potential adverse impacts to surface and subsurface resources (see **Section 2.1.10**). Service-prescribed environmental protection measures implemented as conservation stipulations can be found in **Section 2.1.11**.

The proposed location of the new well pads reflects the results of an onsite visit conducted by Thurston and representatives from the Service on September 17, 2013. The primary purpose of the onsite inspection was to assess potential resource impacts associated with the construction of the well pads, access roads, and pipeline corridor(s).

Figure 2-2 identifies project activities, components of the Proposed Action including well pads, access roads, surface pipeline routes, power lines, the completed cactus surveys delineated and identified by date, and habitat locations for cacti, Yellow-billed cuckoo, and two of the Colorado River Fish species.

Proposed surface locations depicted in **Figure 2-1** were chosen with consideration of factors such as topography, subsurface geologic conditions, sensitive wildlife and vegetation habitat, and other site-specific conditions. Surface disturbance anticipated under the Proposed Action is shown in **Table 2-1**. Short-term surface disturbance would occur during and immediately after the construction, drilling, completion, and testing activities. Prior to interim reclamation, short-term surface disturbance for well pads and new access roads would equal approximately 3.6 acres. Those portions of the well pads and access road ROWs not needed for production operations would be reclaimed within one to two growing seasons. The remaining surface disturbance would be long-term disturbance of approximately 2.8 acres for the 33- to 43-year LOP. Long-term disturbance from the well pads and new access roads equates to approximately 0.08 percent of the total acreage within the Project Area.



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

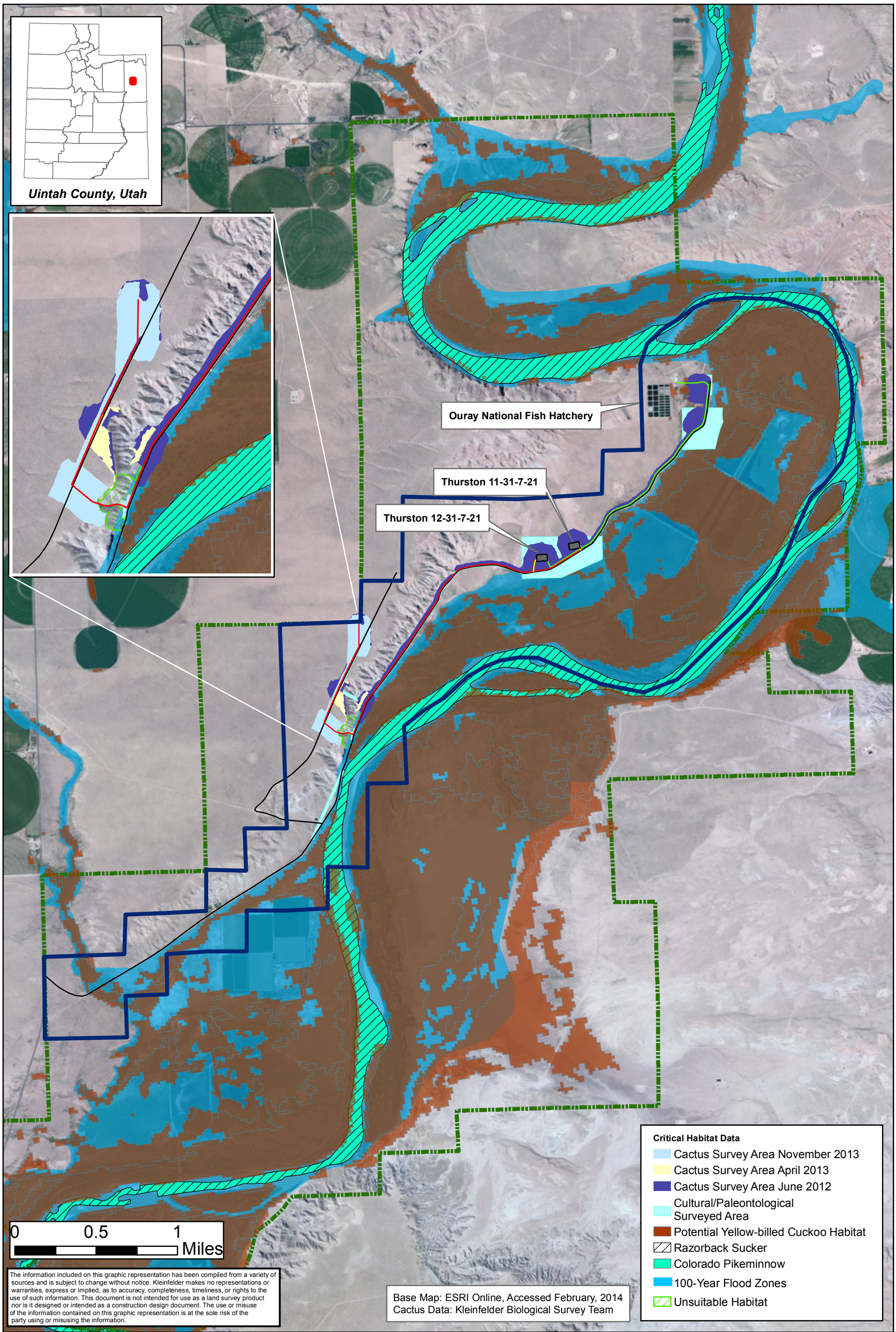
PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig2_1ProposedAction.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

Proposed Action
Uintah County, Utah

FIGURE
2-1



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/13/2014
DRAWN BY:	B. McDavid
CHECKED BY:	C. Wharry
FILE NAME:	Fig2_2CriticalHabitat.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

Critical Habitat Map
Uintah County, Utah

FIGURE
2-2

Table 2-1. Estimated Disturbance of Project Facilities under the Proposed Action

Project Feature	Quantity or Feet	Short-term (disturbance width[feet] or acres/facility)	Short-term Surface Disturbance (acres)	Long-term (disturbance width[feet] or acres/facility)	Long-term Surface Disturbance (acres)
Well Pads					
Thurston 11-31-7-21	1	1.6 acres	1.6	1	1.2
Thurston 12-31-7-21	1	1.6 acres	1.6	1	1.2
Subtotal	***2***	***3.2 acres***	***3.2***	***2***	***2.4***
Access Roads					
New Roads	513.1 feet	36 feet	0.42	36 feet	0.42
Subtotal	***513.1 feet***	***--***	***0.42***	***--***	***0.42***
Pipelines					
3-inch Surface HDPE Gas Pipeline	15,710 feet	30 feet	10.8	20 feet	7.2
Subtotal	***15,710 feet***	***--***	***10.8***	***--***	***7.2***
Power Line					
Overhead Electric Power Line	9,768 feet	--	--	--	--
Subtotal	9,768 feet	**--**	**--**	**--**	**--**
Total New Disturbance	**--**	**--**	**14.4**	**--**	**10.0**

Assumptions: The working area for installation of a surface pipeline of similar diameter is typically 30' in width and permanent ROW width of 20'. The access roads for the well sites are typically designed with a finished running surface 18' in width in a total disturbed width of 36'.

The life cycle of an individual well and its associated facilities/required infrastructure (e.g., roads and pipelines) is composed of six primary phases: (1) construction, (2) well drilling, (3) well completion and testing, (4) interim reclamation, (5) production and maintenance, and (6) final reclamation and abandonment. Specific details of these six primary phases are described in the following sections.

2.1.1 Construction Activities

Construction activities would follow procedures specified by the Service, as well as other applicable industry standards and governmental guidelines, such as the BLM/U.S. Forest Service (USFS) publication, Surface Operating Standards for Oil and Gas Exploration and Development, the "Gold Book" (USDI-USDA 2007 as revised). All surface disturbing activities would be supervised by a qualified Thurston representative who is familiar with the environmental protection and mitigation measures defined in the SUPO and DR for this EA, APDs, and right-of-way (ROW) permit with the Service Realty Division. The Service could implement additional site-specific mitigation measures as necessary.

2.1.1.1 Well Pads

Prior to well pad construction or surface disturbing activities, Thurston would obtain approval of an APD by the appropriate UDOGM Authorized Officer (AO) for the lease. The APD would contain site-specific COAs that would apply to construction and well operations.

Well pad construction would typically begin with stripping and stockpiling topsoil. The top 4- to 6-inches of topsoil material suitable for plant growth would be removed from areas to be disturbed and stockpiled for eventual use in reclamation. Vegetation removed from the disturbed area would be re-spread to provide protection, nutrient recycling, and a seed source for reclamation.

Following vegetation and topsoil removal, each well pad would be constructed using standard cut-and-fill techniques to create a level pad for the drill rig and graded surface for the support equipment. Thurston would employ the use of erosion control measures, including proper grading to minimize slopes, diversion terraces and ditches, mulching, terracing, riprap, fiber matting, temporary sediment traps, and broad-based drainage dips or low water crossings as necessary and appropriate to minimize erosion and surface runoff during pad construction and operation activities. Earthen berms approximately 12-inches in height would be constructed using excess material from pad construction around each well pad. Each berm would be lined with an impermeable liner. Runoff from undisturbed areas around the well pad would be directed into ditches and energy dissipaters (if needed) around the site and then released to grade, which is consistent with Utah Division of Water Quality (UDWQ) BMPs for stormwater. Stormwater management efforts may include additional engineering measures such as the installation of culverts to divert water flow away as needed. With associated cut-and-fill slopes, each well would be constructed to average dimensions of approximately 210 x 345 feet (1.6 acres in size).

Once the pad has been leveled and graded, it would be compacted to establish a level and solid foundation for the drilling rig. Completing the site preparation process will require approximately 3- to 4-days on average.

Primary surface equipment to be installed at each well pad would include a drilling rig, mud tank, dog house flare pit, pipe racks, pump house, trailers, water storage tanks, and generators. The typical layout for a single well pad is illustrated in **Figure 2-3**. If the well is productive, interim reclamation would occur within 90 days of completion of the last well drilled on the well pad. Topsoil reserved for interim reclamation and previously stockpiled along the edges of the well pad would be re-spread across the disturbed area. The area would then be seeded with a seed mixture prescribed by the Service. Interim reclamation would result in an estimated 40-60 percent reduction in well pad size to about 1.2 acres over the productive LOP (approximately 33- to 35-years).

The two proposed wells to be drilled would use a closed-loop mud and drill cuttings system that would eliminate the need for a reserve pit.

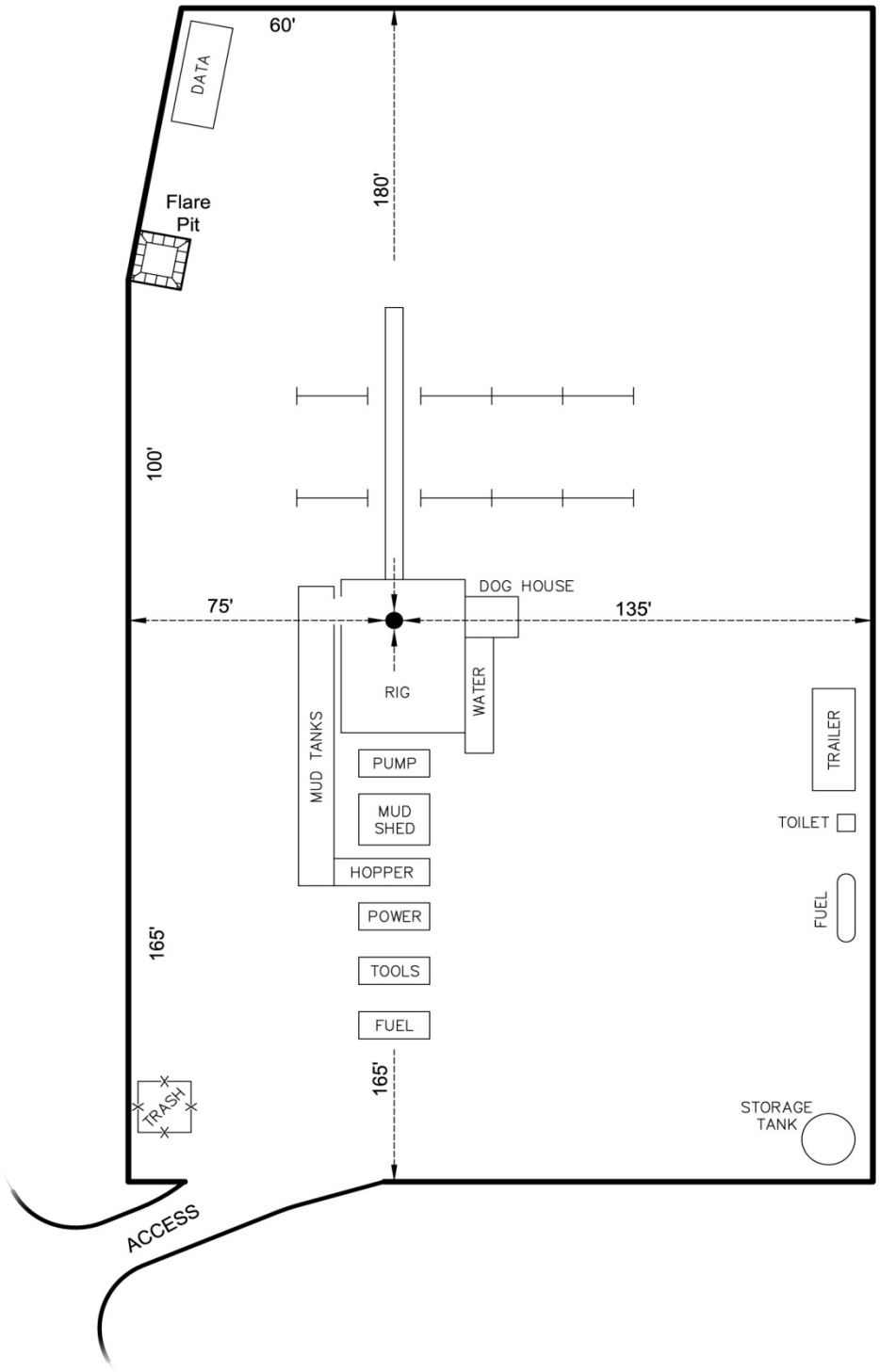
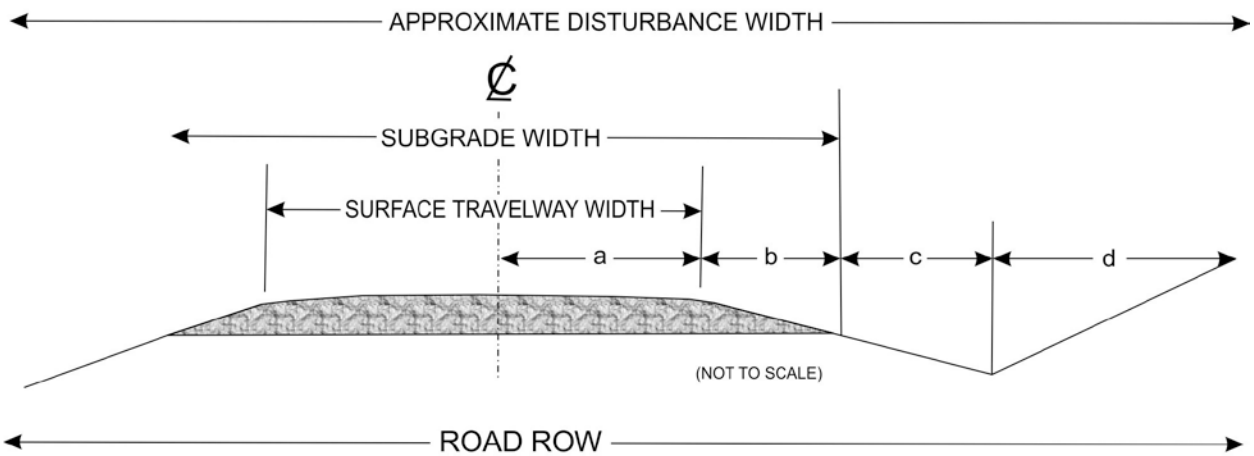


Figure 2-3. Typical Well Pad Layout

2.1.1.2 Access Roads

A network of roads already exists within the Project Area. These roads would be used as-is or upgraded where acceptable for access to well pads. New roads would be constructed only where necessary because they have been sited and designed to minimize disturbances and maximize transportation efficiency. New roads would be built and maintained to provide year-round access, as needed. Bulldozers, graders, and other types of heavy equipment would be used to construct and maintain the access road and Refuge roads.

All new access roads would be constructed out of native material and to the standards outlined in the "*Gold Book*." .This publication provides practices and standards to guide compliance with all applicable agency policies, operating guidelines, and BMPs. After APD approval, standard cut-and-fill construction methods and construction equipment (such as crawler tractors, graders, and scrapers) would be used to construct new roads. A typical roadway cross-section with width specifications is shown in **Figure 2-4.**



a: half-width of surface travel-way b: shoulder c: drainage ditch foreslope d: drainage ditch backslope

	Minimum Subgrade Width (ft.)	Minimum Surfaced Travelway Width (ft.)	a (ft.)	b (ft.)	c (ft.)	d (ft.)	Approximate Disturbance Width (ft.)	Total ROW Width (ft.)	Design Speed (mph)
Resource Road	16	12	6	2	4	8	40	50	15-30
Local Road	24	20	10	2	4	8	48	55	20-50
Collector Road	28	24	12	2	4	8	52	60	30-50

Figure 2-4. Typical Roadway Cross-section with Width Specifications

The standard methodology for building new roads involves the use of a crawler tractor or track hoe to clear vegetation and topsoil materials from the road surface. Both materials would be windrowed for future redistribution during reclamation. All roads would be constructed with appropriate and adequate drainage and erosion control features where appropriate (e.g., cut-and-fill slope and drainage ditch stabilization, relief and drainage culverts, wing ditches, and rip-rap). Where needed, road base or gravel would be placed on upgraded and newly-constructed roads to provide a stable travel-way surface. Aggregate for road surfacing would be obtained from existing permitted sources. Aggregate would be weed free and of sufficient size, type, and amount to allow all weather access and to help minimize fugitive dust.

Safety, sight distance, grade, topography, anticipated traffic flow, and visual resource management concerns would be considered in determining the optimal road width of specific road segments. Roads would be crowned (two to three percent), ditched, and constructed to meet the anticipated traffic flow and provide a well-constructed and safe travel-way surface in all weather conditions. New roads would be constructed to a width of 36 feet including a finished 18-foot running surface.

Revegetation of road edges, drainage ditches, and cut-and-fill slopes would help stabilize exposed soil and reduce sediment loss, growth of noxious weeds, and maintenance costs while minimizing impacts to scenic quality, water quality, and wildlife forage and cover. To ensure successful growth of seeded plants, topsoil would be stripped and stockpiled during road construction and re-spread on cut slopes, fill slopes, and borrow ditches prior to seeding.

Under the Proposed Action, approximately 513 feet of new road would be constructed to provide access to the proposed well pads, which would result in a short-term surface disturbance of about 0.42 acres.

Existing roads would be upgraded as necessary to accommodate anticipated traffic loads and all-weather road requirements. Thurston would enter into a Road Maintenance Agreement with the Service to upgrade and maintain existing roads that would be used for project access. Upgrading would include ditching, drainage, graveling, crowning, and capping of the roadbed as necessary.

2.1.1.3 Power Lines

Under the Proposed Action, Thurston would install electricity to provide power for separators and pump jacks on the two proposed well pads to reduce the level of noise for both wildlife and visitors. Approximately 9,768 feet of overhead distribution lines would be installed along a 15-foot wide power line ROW corridor and extended to the well pads. The electric distribution lines would be built on single wood utility poles approximately 65 feet in height. The span between poles would be approximately 200 feet and poles would be installed in the same 15 foot-wide ROW corridor that is used for the existing Refuge road (see **Figure 2-1**). The 3-inch surface HDPE gas pipeline and the overhead power line would share the 15 foot-wide ROW corridor that falls between the well pads. Therefore, no additional surface disturbance would be anticipated from installation of the electric distribution line. The proposed distribution line would tie into an existing power source at the Ouray National Fish Hatchery (NFH). Construction of the power line to the associated infrastructure would be in compliance with raptor protection requirements. Thurston would agree to meet APLIC standards for the new overhead power line as discussed in **Section 2.1.11**.

2.1.1.4 Pipelines

Natural gas would be transported from the well head through a 3-inch surface HDPE gas pipeline to an existing Ultra Resources, Inc. pipeline in the area. Natural gas gathering pipelines for all wells would be installed parallel and immediately adjacent to the proposed well access roads. Installing the gathering lines aboveground would be necessary to reduce surface disturbance. One of the two proposed well pads would be used as a staging area for gathering line assembly. The amount of surface required to install gathering lines is based upon a temporary use width of 15 feet, which corresponds to the width of land required by pipeline installation equipment.

From the well access roads, the pipeline route would follow Wildlife Refuge Road southwest where it would terminate from the road and travel uphill and over the bluffs to an existing lateral and main line west of the Project Area (see **Figure 2-1**). The pipeline would be approximately 15,710 feet in length and be laid by hand from the trunk line on top of the bluff to the well pad with 3-inch surface HDPE gas pipe. The majority of the 3-inch surface HDPE gas pipeline would follow Wildlife Refuge Road and would be placed adjacent to the road within a 15-foot right-of-way (ROW) easement on the west side of the road. All 3-inch surface HDPE gas pipeline would be co-located with existing roads or proposed access roads.

Two sections of 3-inch surface HDPE gas pipeline totaling approximately 1,815 feet in length would be installed “cross-country”, as shown on **Figure 2-1**. All pipeline installation would occur within a 15-foot wide ROW. Construction of the “cross country” segment of the surface pipeline would begin near the top of the bluffs area at the tie-in point and proceed east to Wildlife Refuge Road. The 3-inch surface HDPE gas pipeline would be laid by hand from the well pads to the Ultra Resources, Inc. gas service line. Each segment of 3-inch HDPE pipe will be joined together and tested prior to completion of construction. Upon installation, portions of the “cross-country” surface pipeline would be anchored in place to prevent lateral movement and subsequent disturbance to soils on steeper slopes.

Pipelines would be constructed of HDPE gas pipe (black) and would meet all applicable American Petroleum Institute (API) and industry standards. Each proposed pipeline would be pressure tested with air to locate any leaks for 100 percent Maximum Allowable Working Pressure (MAWP). After testing, site-specific stabilization barriers, water bars, silt fences or other erosion control devices would be installed in the disturbed areas. Erosion blankets and hand seeding may also be used in these areas.

Surface disturbances resulting from pipeline installation under the Proposed Action would primarily be limited to the crushing of vegetation and minor soil disturbances related to assembly and placement of the pipeline. Thus, no appreciable surface disturbance associated with installation of the surface pipeline is expected. Under this alternative, the 3-inch surface HDPE gas pipeline would follow Wildlife Refuge Road and would be laid by hand alongside the road ROW within a 15-foot easement on the uphill side of the road.

Standard construction techniques for a hand laid surface pipeline would be used along the pipeline route, which typically involves the following sequential operations: (1) preconstruction survey, (2) vegetation preparation, (3) pipe alignment and joining, (4) anchoring, (5) testing, and (6) cleanup and restoration. Construction of the pipeline would begin after all required federal, state, and local approvals have been obtained. Company personnel, construction contractors, and the Service AO would discuss procedures and permit approvals prior to construction.

Prior to pipeline construction, a preconstruction survey would be conducted to delineate the centerline and outside ROW boundaries of the pipeline corridor. The limits of disturbance would be clearly marked/staked prior to construction including the construction ROW and temporary use areas. Any

sensitive areas to be protected from disturbance or that require monitoring would also be marked. Flagging, signs, and other markings identifying the limits of disturbance would be maintained through all phases of pipeline construction. Erosion and sediment control would be installed as outlined in the approved SUPO.

Construction activity would be limited to approved-staked areas. Brush would generally be cut by hand as needed and would be cut as close to the ground as possible. Vegetative material would typically be shredded and scattered back across the surface to increase roughness, facilitate seeding establishment, and protect the construction ROW.

The surface disturbance associated with installation of the new 3-inch surface HDPE gas pipeline assumes that the portions of the 15-foot wide ROW would be disturbed for the pipeline co-located with Wildlife Refuge Road. Thus, the short-term surface disturbance associated with installation of the new 3-inch surface HDPE gas pipeline would be approximately 10.8 acres and long-term surface disturbance would be 7.2 acres.

Individual joints of pipe would be would be aligned, joined together, and laid by hand on the surface. All joints would be visually inspected and tested by a qualified inspector. Non-destructive radiographic inspection methods would be conducted in accordance with current requirements. A specialized contractor would be employed to perform this work. Any joint defects would be repaired or cut out as required under the specified regulations and standards.

Cleanup and restoration would occur after the pipeline is installed completed. Cleanup of the surface along the construction ROW would include removal of construction debris. Permanent erosion control measures would be installed and seeding would occur in accordance with Service requirements.

2.1.1.5 Rights-of-Way

In accordance with Service Manual 105, Part 340: Real Property Management, a ROW covers “uses that will encumber real property by granting a right to use and alter the landscape through construction of a facility such as a road, pipeline, power line, or building. Generally, such uses are for a relatively long period of time (i.e., 10 years or longer)” (USFWS 1993). Thurston would apply for a ROW permit with the Service Realty Division for proposed access roads, well pads, and pipelines in the proposed SUPO and would acquire a SUP for any activities that would result in temporary disturbance or land use.

2.1.2 Well Drilling

Once construction of a well pad is complete, drilling equipment would be moved on-site. All drilling operations would be conducted in compliance with all Federal Onshore Oil and Gas Orders, all applicable rules and regulations, and COAs applied by UDOGM. The proposed wells would target the Green River and Wasatch Formation, which is present approximately 7,000 feet below the ground surface. No abnormal pressures, temperatures, or other hazards are anticipated. Wells that have been previously drilled in the vicinity of the Proposed Action have not encountered over-pressured zones or hydrogen sulfide gas. Each well would require approximately 10 days to drill and 15 days for completion and production testing operations. Drilling activities typically occur around the clock, 24-hours per day, 7-days per week.

The drilling operation would be conducted in three primary phases using three specialized drilling rigs for each wellbore. In the first phase, a drill rig would drill the conductor hole and set the conductor pipe. In the second phase, a conventional mechanically-powered mobile drilling rig would be transported to the

well site and erected on the well pad by tractor-trailer trucks to drill the surface hole and run and cement surface casing. The well would be initially drilled with air and/or freshwater to approximately 3,000 feet below ground surface and below the base of any freshwater aquifers encountered. Beyond approximately 3,000 feet, drilling fluids would consist of a water and gel mixture, with water being the main constituent. Non-toxic chemicals such as a potassium chloride substitute and commercial clay stabilizer may be added to the mud to maintain borehole stability, minimize possible damage to the formations, provide adequate viscosity to carry the drill cuttings out of the wellbore, and reduce downhole fluid losses. Prior to drilling the production hole, the surface hole would be cased with steel casing and cemented in place entirely from the total depth of the surface hole up to ground level. The surface casing and its design would provide protection for freshwater aquifers and contain pressure that may be encountered while drilling the production hole. UDOGM would be notified in advance of running surface casing and cement to observe these operations if so desired. This part of the drilling operation would normally take two to three days to complete.

Prior to drilling below the surface casing, a Blowout Preventer (BOP) would be installed on the surface casing and a flow control manifold consisting of manual and hydraulically operated valves would be installed below the rig floor. Both the BOP and surface casing would be tested for pressure integrity in order to meet the minimum standards of BLM *Onshore Oil and Gas Order No. 2, Drilling Operations.* UDOGM would be notified in advance of all pressure tests in order to be present and witness the tests, if desired. The BOP would be mechanically checked daily during drilling operations. During this phase the rig would pump fresh water as a circulating fluid to drive the mud motor, cool the drill bit, and remove cuttings from the wellbore. To achieve borehole stability and minimize possible damage to the hydrocarbon producing formations, a potassium chloride substitute and commercial clay stabilizer may be added to the drilling fluid. From time to time, other materials may be added to the fluid system, such as sawdust, natural fibers, or paper flakes, to reduce downhole fluid loss.

The final stage of drilling includes drilling the production hole, running and cementing the casing. Prior to setting production casing, well logs would be run to evaluate a well's potential. If the evaluation concludes that sufficient hydrocarbons are present and recoverable, then steel production casing would be run and cemented in place in accordance with the well design, as specified in the APD and COAs. Cementing the production casing back to the bottom of the surface casing would prevent damage to the wellbore from the targeted formation pressure, retard corrosion, and prohibit pressure communication or fluid migration between productive zones. After drilling operations are completed, the drilling rig would be dismantled and demobilized from the location.

Freshwater used for drilling would be contained in above ground storage tanks (ASTs) located on site. Additional ASTs would be used during drilling and testing operations to hold non-flammable materials such as cuttings, salt, drilling fluids, chemicals, produced fluids, etc. All drilling fluids used for each well would be recycled using a closed-loop drilling system, thereby eliminating the need for a reserve pit. The closed-loop drilling method involves removing and treating drilled soils from the system and collecting solid and liquid waste in modified steel catch tanks rather than open reserve pits. The method includes a mud de-watering system that separates the soils from the liquids. The soils (natural rock cuttings) would be processed to remove excess drilling fluids and stored on location in segregated piles or within a cutting storage area. The recovered drilling fluid would be stored in ASTs to be re-used at the next drilling site or removed and disposed of at an approved offsite disposal facility.

Any additives to the mud system would conform to *Subtitle C of the Resource Conservation and Recovery Act* (RCRA) of 1976 as amended 1996. Material Safety and Data Sheets (MSDS) would be located onsite and readily available at all times. Drill cuttings from each wellbore (consisting of mainly

shale, sand, and miscellaneous rock materials) would be transported to an approved offsite disposal facility.

2.1.3 Well Completion and Testing

If drilled wells indicate economic productivity, completion operations would commence after drilling is complete. After the production casing has been cemented in place, completion equipment would be mobilized into the well pad location. Well completion would consist of running a cement bond log to evaluate the cement integrity, perforating the casing across the hydrocarbon-bearing zones, and stimulating the formation to enhance the production of oil and gas. The typical method used for stimulation consists of hydraulic fracture treatment of the reservoir, in which water with relatively small concentrations of sand and stimulation fluids are pumped down the well through perforations in the casing and into the formation. Pumping pressures would be increased to the point at which fractures occur in the rock formations and radiate outward from the perforations into the target formation. The slurry flows into the fractures and the sand in the slurry mix serves as a proppant to keep the created fracture open after the fracture treatment, thereby allowing reservoir fluids to move more readily into the well.

Post-stimulation flow tests would allow for recovery of stimulation fluids and evaluation of well productivity. The duration of flow testing would vary according to individual well performance and would typically be conducted only long enough for fluid rates to drop to a level to ensure safe operation of permanent production equipment. During completion operations, gas may be vented to the atmosphere from the flowback tank prior to installing production equipment; however, Thurston does not anticipate the need to flare gas.

Depending on the concentration of water and proppant in the flow from the well and the availability of a gas transportation pipeline, “test” gas would be vented, flared, or sold down the pipeline.

Typical equipment and vehicles used during completion activities would include: sand transport trucks; water trucks; oil service trucks to transport pumps and equipment for hydraulic fracturing; flat beds and gin trucks to move water tanks, rigs, tubing and hydraulic fracturing chemicals; logging trucks (cased hole wireline trucks); and pickup trucks to haul personnel and miscellaneous small materials.

Completion activities on individual wells would occur 24-hours per day, 7-days per week, and would generally take approximately three weeks, depending on conditions at the individual well.

2.1.4 Interim Reclamation

Upon well completion, the well locations and surrounding area(s) would be cleared of all unused tubing, materials, trash, and debris not required for production. All pits, cellars, rat holes, and other bore holes unnecessary for further well operations would be promptly backfilled. In accordance with UDOGM regulations, drilling fluids and cuttings contained within the closed system tank would be hauled from the site and disposed of at an approved facility.

In accordance with BLM *Oil and Gas Onshore Order Number 1, Approval of Operations*, after completion activities have been finalized for all planned wells, Thurston would reduce the size of the well pad to the minimum surface area needed for production facilities and adequate room for trucks to turn around, while providing for reshaping and stabilization of cut-and-fill slopes. Interim reclamation would be accomplished by grading, leveling, and seeding, as required by the Service, and would reduce the

disturbed area at each of the well pads to approximately 1.2 acres or less. Interim reclamation of areas disturbed along portions of the access road cuts and shoulders would also be conducted.

Initial reclamation would establish a vegetative cover sufficient to maintain a biologically active soil, control erosion, and minimize habitat and forage loss during production operations. Reclamation activities would commence within 90 days of well completion, weather permitting per the Reclamation Plan included in **Appendix F**. Earthwork would be completed within six months of well completion.

Under the SUPO, approximately 4.4 acres of short-term disturbance associated with construction of proposed well pads, pipeline corridors, and access road ROWs not needed for operational purposes would be reclaimed. This would reduce the long-term disturbance associated with implementation of the SUPO to approximately 10 acres.

Thurston would monitor interim reclamation operations on an annual basis to ensure timely achievement of its reclamation goals by documenting the progress of reclamation and weed control to baseline data collected prior to commencing operations. Thurston would modify its reclamation procedures as necessary to achieve the reclamation outcomes mutually agreed-upon with the Service AO.

2.1.5 Production and Maintenance Operations

Well production facilities, including gas gathering lines, would be installed after drilling and completion operations. Facilities on each well pad would include a well head, valves and piping, separator, dehydrator, and meter that would either be housed in a small building or enclosed by a fence. The 3-inch surface HDPE gas line would be anchored down as necessary from the well head to the Ultra Resources, Inc. trunk line. Wells would likely be fitted with a pump jack, Roto-flex unit, or gas lift to assist liquid production in liquid volumes and/or as low formation pressures require it. Plunger lift systems do not require outside sources of energy; however, a pump jack or Roto-flex unit would require the installation of electrical service to run the electric motors.

Each location would use two 300-barrel tanks for storing oil and water condensate and one additional tank for heated produced liquids. The tanks would be approximately 12-feet in diameter and 15-feet high. They would be surrounded by a secondary containment berm of sufficient capacity to contain 110 percent storage capacity of the largest tank and sufficient freeboard to contain precipitation. All loading lines and valves would be placed inside the berm surrounding the tank battery or would use catch basins to contain spills. Thurston would maintain the integrity of the dike throughout the production lifetime of the well.

All measurement facilities would conform to American Petroleum Institute (American Gas Association) standards for gas and liquid hydrocarbon measurement. Thurston would adhere to all site security guidelines and regulation identified in 43 CFR 3126.7. A gas meter would be initially calibrated and tested periodically thereafter with measurement results provided to the UDOGM as required. If feasible, telemetry equipment would also be installed at the well pad location to remotely monitor well conditions and reduce traffic to and from the well pad.

All permanent (onsite for six months or longer) structures either constructed or installed would be painted a flat, non-reflective, earth-tone color using one of the standard environmental colors, as determined by the Service AO. All facilities would be painted within six months of installation.

Periodically, a workover or recompletion on a well may be required to ensure that efficient production is maintained. Workovers can include repairs to the well bore equipment (casing, tubing, rods, or pump), the wellhead, or the production facilities. These repairs would usually be completed in seven days per well,

during daylight hours. The frequency for this type of work cannot be accurately projected because workovers vary by well; however, an average work time may be one workover per well per year after about five years of production. In the case of a recompletion, where the wellbore casing is worked on or valves and fittings are replaced to stimulate production, all byproducts would be stored in tanks and hauled from the location. For workover operations, it may be necessary to rework the surface location to accommodate equipment. Thurston would notify the Refuge staff prior to any workover activities. At the completion of the work, the surface location would be re-graded and reclaimed to pre-existing conditions.

2.1.6 Final Reclamation and Abandonment

Thurston would perform final reclamation of a well pad and access road, not including existing Wildlife Refuge Road and county roads, consistent with the Reclamation Plan and well-specific COAs. Prior to abandonment of any well location, Thurston would file a Notice of Intent (NOI) to abandon with UDOGM, detailing the proposed procedures. During plugging and abandonment, all other surface equipment, including tanks, pumping unit, three-phase separator, and aboveground flow lines, gas system pipelines, and water pipelines, would be removed from the site. The 3-inch surface HDPE gas pipeline would be removed by hand. Wellbores would be plugged with cement to prevent fluid or pressure migration and to protect mineral and water resources. Wellheads would be removed, both the surface casing and production casing would be cut off below ground level, and an appropriate dry hole marker would be set in compliance with UDOGM regulations.

A monitoring plan would be implemented to provide quantifiable data to assess interim reclamation operations, including annual site visits to ensure timely achievement of reclamation goals and weed control. Thurston would modify reclamation procedures as necessary to achieve reclamation success as determined by the Service. For more information regarding the monitoring strategy and success criteria, refer to the Reclamation Plan included in **Appendix F** of this EA.

Thurston would restore the well pad location and access roads to approximately their original contours. During reclamation of these sites, fill material would be pushed into cuts and up over the back slope. No depressions would be left that would trap water or form ponds. Upon completion of backfilling, leveling, and recontouring, the remaining topsoil would be evenly spread over the reclaimed areas. All disturbed surfaces would be reseeded with a seed mixture prescribed by the Service. The seedbed would then be prepared by disking and roller packing following the natural contours. Seed would be drilled on contours at an appropriate depth depending on soil condition and plant requirements. In areas that cannot be drilled, seed would be broadcast at double the seeding rate and harrowed into the soil. Seeding should occur within 24 hours following completion of final seedbed preparation to reduce the potential for establishment of weeds and before crusting of the soil, which can impede germination. If the seeding is unsuccessful, Thurston would be required to conduct reseeding in subsequent years.

Thurston would monitor final reclamation operations on an annual basis to ensure timely achievement of its reclamation goals by documenting the progress of reclamation and weed control against baseline data collected prior to commencing operations. Thurston would modify its reclamation procedures as necessary to achieve the reclamation outcomes mutually agreed-upon with the Service AO. Unreclaimed areas or reclaimed areas that do not meet the objective of three to four years of sustained progress toward reclamation success (known as “operator complete”) would undergo the reclamation retreatment measures described in the SUPO (see **Appendix A**), which is referenced with each APD. Thurston would also be required to meet the UDOGM bonding requirements of at least $30,000 for each well (UDOGM 2005 R649-3-1-5.3).

2.1.7 Water Use and Supply

Drilling operations would be responsible for most of the water consumed during the project. Water for use during drilling operations would be obtained from existing permitted water supply sources, including but not necessarily limited to, J.D. Field Services (State Water Right No. 49-2307) and RNI (State Water Right No. 49-2367).

No water would be used or taken from Refuge impoundments or from the Green River inside the Refuge boundary. The Refuge's water right will not be used for any of this project. Approximately 0.5 acre-feet (3,879 barrels, or 162,925 gallons) of water would be needed for the drilling of each well, using mud as the circulation medium. Thus, a maximum of one acre-foot of water would be required to drill the two proposed wells. Approximately 2.3 acre-feet (18,000 barrels, or 756,000 gallons) of additional water would be used per well for completion purposes, for a total of approximately 4.6 acre-feet of water for the two proposed wells. Approximately 0.1 acre-feet of water would be used on Wildlife Refuge Road for dust control. The total amount of water required for drilling, completion, and dust control operations is anticipated to be approximately 5.7 acre-feet over the LOP. Water used for completion and dust control purposes would be obtained from the Vernal City municipal water supply and transported to the well pads by truck. Water would be transported to the well pad by licensed haulers, and the appropriate water permits would be filed by the licensed haulers. An estimated 84-137 truck round trips (assuming the truck volumes will be between 5,500 and 9,000 gallons) would be required for drilling and completion operations per well.

2.1.8 Hazardous Materials and Solid Waste

A variety of chemicals (i.e., lubricants, paints, and additives) is used to drill, complete, and operate a well. Some of these substances may contain constituents that are hazardous. Hazardous materials can include some greases or lubricants, solvents, acids, paint, and herbicides, among others. Even though these materials would not be stored at well locations, they may be kept in limited quantities on drilling sites and at production facilities for short periods of time. Eventually these hazardous substances would need to be stored, transported, and disposed of according to applicable requirements.

None of the chemicals that would be used during drilling, completion, or production operations meet the criteria for being an acutely hazardous material/substance or meet the quantities criteria per the BLM *Instruction Memorandum No. 93-344*. Wastes that would be generated at project locations are excluded from regulation by the RCRA under the exploration and production exemption in Subtitle C (40 CFR 261.4[b][5]) and are considered to be solid wastes. These wastes include those generated at the wellhead, through the production stream, and through the inlet of the gas plant. Exempt wastes include produced water, production fluids such as drilling mud or well stimulation flowback, and crude oil impacted soils. During drilling operations, Thurston could potentially store and use diesel fuel, sand (silica), described as hazardous substances in 40 CFR Part 302, Section 302.4, in quantities exceeding 10,000 pounds. In addition, small quantities of retail products (i.e., paint, spray paint, solvents [e.g., WD-40], and lubrication oil containing non-reportable volumes of hazardous substances) may be stored and used on site at any time.

Any release of oil, gas, saltwater, or other such fluids would be cleaned up and removed to an approved disposal site. The spills would be reported to the Service AO and other appropriate authorities. In accordance with U.S. Environmental Protection Agency (EPA) regulation, Thurston would prepare and implement a site-specific Spill Prevention, Control and Countermeasure (SPCC) Plan within six months of commencing operations (40 CFR Part 112.3.3[b]). A Draft SPCC Plan is provided in **Appendix G**. An

approved SPCC plan will be reviewed and certified by a licensed Professional Engineer when the final SUP and APD are approved. The SPCC plan describes spill prevention, control, reporting, and cleanup procedures to help prevent impacts to surface waters and subsurface waters and to address potential threats to Colorado River endangered fish species and designated critical habitat. A copy of the drilling company's SPCC plan will be kept on site during drilling operations. In addition, Thurston has provided a spill response plan supplement in **Appendix G** that includes information about spill avoidance and management.

All produced liquid hydrocarbons would be stored in tanks surrounded by a secondary containment berm of sufficient capacity to contain 110 percent of the total capacity of the largest tank within the tank battery and sufficient freeboard to contain precipitation. All loading lines and valves would be placed inside the berm surrounding the tank or would use catchment basins to contain spills. The tanks would be emptied as necessary to prevent overflow, and the liquids transported to market through trucks and/or pipelines.

Portable toilets and trash containers would be located on active construction sites throughout the Project Area. A commercial supplier would install and maintain portable toilets and equipment and would be responsible for removing sanitary waste. Sanitary waste facilities (i.e., toilet holding tanks) would be regularly pumped and their contents disposed of at approved sewage disposal facilities in Uintah County, in accordance with applicable rules and regulations regarding sewage treatment and disposal.

Accumulated trash and nonflammable waste materials would be hauled to an approved landfill once a week or as often as necessary. All debris and waste materials not contained in the trash containers would be cleaned up, removed from the construction ROW or well pad, and disposed of at an approved landfill. Sanitary waste equipment and trash bins would be removed from the Project Area upon completion of the construction of well pads, access roads, and other surface facilities, and following drilling and completion operations at well pads.

2.1.9 Workforce Requirements and Schedule

Drilling of each well would commence following issuance of a SUP from the Service and APD approval from the UDOGM. Personnel would commute to the Project Area from Vernal or the surrounding area.

Construction of access roads and well pads would be completed by local contractors during daylight hours and would require approximately seven days. Construction crews would be made up of two to six individuals who would access the project location using an average of three light trucks. During construction, two to three pieces of heavy equipment (i.e., bulldozers and motor graders) would be used to perform earth moving operations.

When drilling commences, the operation would become a continuous 24-hour operation until the well is drilled to total projected depth. Following road and pad construction, the following personnel would be on site for any given shift: rig hands, well pusher, mud logger, and a Thurston representative. The rig crew would work one 12-hour shift per 24-hour day. Drilling and completion crews would be allowed access to the project location outside of normal refuge hours through use of a lockbox at the Refuge entrance. Overnight personnel would be restricted to the drilling site and ingress and egress roads during Refuge off-hours. Approximately 40 truckloads of equipment would be required to transport the drilling rig and associated equipment to a location for assembly. During drilling operations, up to 10 light trucks would transport one to four crew members, service personnel, materials and equipment. Approximately five trailers would remain on location for the duration of drilling operations for staff use and equipment storage.

Completion and testing operations would require approximately 15 days for each well. During completion operations, fracture stimulation would be required and approximately 15 large trucks would access each well location twice. Trucks would also be required to deliver water to each location and remove fracturing fluids to an approved disposal facility. Up to 10 pickup trucks transporting a total of 7 to 10 crew members as well as other service personnel, materials, and equipment would access the drilling location daily.

2.1.10 Applicant-Committed Environmental Protection Measures

Thurston would voluntarily implement the following ACEPMs to reduce the potential short-term, long-term, and cumulative impacts to existing resources as a result of implementation of the Proposed Action.

2.1.10.1 General

- Thurston will annually monitor its facilities to ensure that normal operations will be in compliance with the Federal Onshore Oil and Gas Orders; its SUPO (as contained in each APD); other rules and regulations that apply to the Proposed Action; the Thurston Reclamation and Weed Plan; commitments proposed by Thurston (as contained in this EA); and any conditions that may result from approval of the Proposed Action. Thurston will provide an annual report to the Service describing the progress of its reclamation operations until the Service agrees that reclamation has been successful.
- Thurston will secure all required permits and approvals from the Service, State of Utah, and Uintah County prior to construction. Thurston will adhere to all applicable federal, state, county, regulations while performing all operations associated with the Proposed Action.
- Thurston will instruct its employees and contractors not to exceed 20 miles per hour on any well access road during construction, drilling/completion, or normal daily activities to discourage the generation of fugitive dust.
- Thurston will use BMPs for control of nonpoint sources of water pollution to prevent erosion, allow year-round traffic, and ensure safe conditions in its general operating procedures.
- Thurston will implement hiring policies that would encourage the employment of area residents and will purchase equipment and materials from local area merchants to the extent feasible.
- Thurston's drug and alcohol policies will be rigorously enforced.

2.1.10.2 Construction and Drilling

- Construction operations would be conducted in consideration of the *Surface Operating Standards for Oil and Gas Exploration and Development, 4th Edition* (Gold Book) (USDI-USDA 2007 as revised).
- During drilling and completion operations, Thurston will perform dust abatement measures on proposed access roads and/or well pads as necessary. Dust control measures will be performed on access roads as needed during normal daily operations.
- Thurston has conducted a Class III cultural resource survey on lands that would be affected by surface-disturbing activities and will avoid all sites determined to be eligible to the NRHP or will

perform mitigation as recommended by the cultural resource consultant and directed by the AO. The results of the survey were submitted to the Service.

- If the proposed surface disturbance will affect an NRHP-eligible site, data recovery will be performed. Data recovery will include detailed recordation and archival research. The gathered information will be analyzed and described in a report that details the results of the investigation. The report will be submitted to the Service and the State Historic Preservation Office (SHPO) in Salt Lake City.
- Thurston will educate its contractors and employees about the relevant federal regulations intended to protect cultural resources. All vehicular traffic, personnel movement, construction and restoration activities will be confined to existing roads and to areas cleared by the site inventory unless mitigation measure are undertaken. In the event historic or archeological resources are uncovered during construction, work will stop immediately and the Service AO will be notified.
- Thurston will conduct preconstruction surveys, as needed.
- Thurston has conducted paleontological surveys on lands that would be affected by surface-disturbing activities. The results of the survey were submitted to the Service with the APD for each well.
- Thurston will educate its contractors and employees about the relevant federal regulations intended to protect paleontological resources. All vehicular traffic, personnel movement, construction, and restoration activities will be confined to existing roads and to areas cleared by the site inventory unless mitigation measure are undertaken. If any potential paleontological resources are uncovered during construction, work will stop immediately in the area and the AO will be notified.
- Thurston will educate staff and contractors regarding illegal collection or destruction of cultural resources.

2.1.10.3 Production and Maintenance Operations

- Thurston will maintain existing and new roads and well pads in consideration of Gold Book standards.
- Thurston will monitor the growth of noxious and invasive species resulting from surface disturbance caused by project activities and will control weeds according to procedures contained in the Reclamation Plan (see **Appendix F**).
- Thurston will paint all permanent (onsite 6 months or longer) structures either constructed or installed a flat, non-reflective, earth-tone color (Covert Green), as determined by the Service AO.
- Thurston will develop and implement SPCC plans for the wells (see Draft SPCC Plan in **Appendix G**). In addition, Thurston has provided a spill response plan supplement in **Appendix G** that includes information about spill avoidance and management.
- Thurston will construct a secondary containment berm of sufficient capacity to contain 110 percent storage capacity of the largest tank in the tank battery and sufficient freeboard to contain precipitation. Thurston will install containment for the chemical injection tanks.
- Thurston would sample any known water wells located within a 0.25 mile radius up-gradient or immediately down-gradient of the oil extraction wells.

2.1.10.4 Reclamation

- Thurston has developed a Reclamation Plan that will be used to direct reclamation and monitoring operations and to ensure that the results meet acceptable standards (see **Appendix F**).
- Thurston will develop vegetation baselines for the proposed well sites or will implement other methods to determine reclamation success, in cooperation with the Service AO.
- Thurston will provide the Service with an annual report detailing reclamation status.
- Thurston will reclaim as much of a well pad as possible after the well is drilled and completed.

2.1.11 Service Terms and Conditions for Thurston Ouray NWR 2-Well Development Project

Under the Proposed Action, Thurston would be required to implement the following conservation stipulations. Specific references to federal and state laws are not intended to be all inclusive. Therefore, all applicable federal and state laws (in addition to those highlighted) would still apply to the proposed exploration activities. These measures would represent the Service's specific terms and conditions for the issuance of the SUP.

- Thurston will install electricity to provide power for separators and pump jacks on the two proposed well pads to reduce the level of noise for both wildlife and visitors. An aboveground distribution line would be built on single wood utility poles located within the proposed road ROW. The proposed distribution line would tie into an existing power source at the Ouray NFH.
- All vehicles and equipment used in construction must be decontaminated prior to arriving at the Refuge per Service procedures to prevent the introduction of noxious weeds to the Refuge. It is recommended that the operator consult with the local weed control agency or other weed control authority if weed infestation occurs. It is the responsibility of the operator to monitor affected and reclaimed lands for noxious weed infestations. The Refuge will require a weed control plan.
- Impacts on sensitive habitat (e.g., wetlands, riparian areas), wildlife, plants, and other natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the footprint devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Existing high resolution aerial imagery of the Project Area will be provided pre- and post-construction. Aerial photography must be in color and procured from a reputable source (e.g., ESRI, National Aerial Photography Program [NAPP], National Agricultural Imagery Program [NAIP], etc.). Preconstruction imagery shall be submitted within 10 days of initiation of drilling; post-survey imagery shall be provided as soon as updated imagery becomes available. All imagery will become the property of the Refuge.
- Thurston must provide the Refuge Manager or the Service AO a copy of the wetland determination/delineation that was issued by the U.S. Army Corps of Engineers (USACE) for the Project Area showing that none of the well pad locations or roads will impact wetland areas.

- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- All construction of roads and pads will occur in a manner that best facilitates their subsequent complete removal and reclamation once Thurston activities have ceased at these sites. This includes separating, stockpiling, and covering topsoil layers onsite to be replaced during reclamation. All disturbed areas must be reclaimed with Service input at the time reclamation occurs. Only endemic plants and seed mixtures are to be used in reclamation. Thurston shall separate and store the topsoil horizon or the top six-inches, whichever is deeper, and mark or document stockpile locations to facilitate subsequent reclamation. When separating the topsoil layers, the operator shall segregate the horizon based upon noted changes in physical properties such as organic content, color, texture, density, or consistency. All stockpiled soils shall be protected from degradation due to contamination, compaction and, to the extent practicable, from wind and water erosion during drilling and production operations. BMPs to prevent weed establishment and to maintain soil microbial activity shall be implemented. Final reclamation of all disturbed areas shall be considered complete as follows:

    a) When all activities disturbing the ground have been completed and;

    b) When all disturbed areas have been either built upon, compacted, covered, paved, or otherwise stabilized in such a way as to minimize erosion, or;

    c) When a uniform vegetative cover has been established that reflects pre-disturbance or;

    d) When reference area forbs, shrubs, and grasses with total percent plant cover of at least 80 percent of pre-disturbance or reference area levels (excluding noxious weeds) or equivalent permanent, physical erosion reduction methods have been employed. Re-seeding alone is not sufficient.

- Thurston shall implement and maintain BMPs at all oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation. BMPs shall be maintained until the facility is abandoned and final reclamation is achieved. Operators shall employ BMPs, as necessary, to comply with this rule, at all oil and gas locations, including, but not limited to, well pads, soil stock piles, access roads, tank batteries, and pipeline ROWs. BMPs shall be selected based on site-specific conditions, such as slope, vegetation cover, and proximity to water bodies, and may include maintaining in-place some or all of the BMPs installed during the construction phase of the facility. Where applicable, based on site-specific conditions, operators shall implement BMPs in accordance with good engineering practices.
- In accordance with EPA regulations (40 CFR Part 112), Thurston must prepare and implement a SPCC plan within six months of beginning operations. Copies of the SPCC plans shall be provided to the Refuge Manager within six months of commencing production operations. A Draft SPCC Plan, which illustrates the types of spill prevention measures that will be installed, is included in **Appendix G**. This plan will be reviewed by the Service and should include a listing of secondary containment and/or diversionary structures or equipment for all oil handling containers, equipment, and transfer areas. It should also include a table identifying tanks and containers at the facility with the potential for an oil discharge, the mode of potential

failure, and the likely flow direction and potential quantity of the discharge, as well as provide the secondary containment method and containment capacity. In addition, the SPCC Plan should include the physical layout of the facility and a facility diagram, which must mark the location and contents of each container. The facility diagram must also include all transfer stations and connecting pipes.

- All cuttings and drilling fluids will be removed from the Refuge and disposed of off-site in an approved disposal facility.
- A lockbox or similar security system will be provided to Thurston for after-hours access to the project site during drilling and completion operations. No unauthorized entry of non-project related personnel will be permitted on the Refuge after normal operating hours.
- Construction and drilling operations conducting during the Refuge's seasonal closure period must be coordinated and authorized with the Refuge Manager or the Service AO to avoid conflicts with wildlife. At the discretion of the Refuge Manager or the Service AO, additional wildlife monitoring or mitigation may be required during this closure period based on site-specific conditions.
- Project activities would comply with applicable requirements of the MBTA, BGEPA, and ESA, as amended.
- Should the project schedule construction activities between March 1st and August 31st, all areas within 0.5 miles of the proposed project would be surveyed for the presence of raptor nests by a Service-approved biologist. If occupied raptor nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- Burrowing owl surveys would be conducted concurrently with the raptor surveys within 0.25 miles of the proposed project if the project schedule occurs between March 1st and August 31st. If occupied burrowing owl nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- To avoid and minimize impacts to birds during construction and operations and to ensure ground-disturbing activities do not result in the "take" of an active nest or migratory bird protected under the MBTA, the Service requires the following of Thurston:

    a) Any groundbreaking activities or vegetation treatments should be performed before migratory birds begin nesting or after all young have fledged to avoid take;

    b) Time tree and shrub removal and ground disturbing activities should occur during the non-nesting season (approximately September 1st to February 28th). If this is not possible, surveys should be conducted prior to disturbance to determine whether active nests are present; active nests found in the area should be left untouched until the young have fledged;

    c) If activities must be scheduled to start during the migratory bird breeding season, appropriate steps to prevent migratory birds from establishing nests in the potential impact area should be taken. These steps could include covering equipment and structures and use of various excluders (e.g., noise). Birds can be harassed to prevent them from nesting on the site;

d) If activities must be scheduled during the migratory bird breeding season, a site-specific survey for nesting birds should be performed starting at least two weeks prior to vegetation treatments. Established nests with eggs or young cannot be moved, and the birds cannot be harassed (see item b above), until all young have fledged and are capable of leaving the nest site; and

e) If nesting birds are found during the survey, appropriate spatial buffers should be established around nests. Vegetation treatments within the buffer areas should be postponed until the birds have left the nest. Confirmation that all young have fledged should be made by a qualified biologist.

- The Refuge Manager or the Service AO may require drill pads to be fenced and signed if problems arise as a result of refuge visitors and wildlife at these sites.
- To protect special status species such as, but not limited to, the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), the Service requires the following of Thurston. In order to minimize effects to the federally threatened Uinta Basin hookless cactus, the BLM in coordination with the Service, developed the following avoidance and minimization measures. Integration of and adherence to these measures will help ensure the activities carried out during oil and gas development (including, but not limited to, drilling, production, and maintenance) are in compliance with the ESA. The following avoidance and minimization measures should be included in the POD:

a) Pre-project habitat assessments will be completed across 100% of the project disturbance area within potential habitat[1] prior to any ground disturbing activities to determine if suitable Uinta Basin hookless cactus habitat is present.

b) Within suitable habitat[2], site inventories will be conducted to determine occupancy. Inventories:

1. Must be conducted by qualified individual(s) and according to the USFWS and Service-accepted survey protocols;

2. Will be conducted in suitable and occupied habitat[3] for all areas proposed for surface disturbance prior to initiation of project activities and within the same growing season, at a time when the plant can be detected, and during appropriate flowering periods:

a. *Sclerocactus brevispinus* surveys should be conducted March 15th to June 30th, unless extended by the USFWS.

b. *Sclerocactus wetlandicus* surveys can be done any time of the year, provided there is no snow cover;

[1] *Potential habitat* is defined as areas which satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment.
[2] *Suitable habitat* is defined as areas which contain or exhibit the specific components or constituents necessary for plant persistence; determined by field inspection and/or surveys; may or may not contain Uinta Basin hookless cactus. Habitat descriptions can be found in the U.S. Fish and Wildlife Service's 1990 Recovery Plan and Federal Register Notices for the Uinta Basin hookless cactus (http://www.fws.gov/endangered/wildlife.html).
[3] *Occupied habitat* is defined as areas currently or historically known to support Uinta Basin hookless cactus; synonymous with "known habitat."

3. Will occur within the ROW and 50 feet from the outside edge of the ROW on one side of the road only (the side on which the pipeline will be laid); applies to buffers for roadside surface pipelines;

   Will occur within the ROW and 50 feet from both sides of the ROW edge; applies to buffers for hand laid cross-country surface pipelines;

   Will occur within the ROW and 300 feet from both sides of the ROW edge; applies to buffers for access roads; and

   Will occur out to a distance of 300 feet from the edge of disturbance for the proposed well pads; applies to buffer distances (avoidance).
4. Will include, but is not be limited to, plant species lists and habitat characteristics; and
5. Will be valid until March 15th the following year for *Sclerocactus brevispinus* and one year from the survey date for *Sclerocactus wetlandicus*.

c) Design project infrastructure to minimize impacts within suitable habitat:

1. Reduce well pad size to the minimum needed, without compromising safety;
2. Limit new access routes created by the project;
3. Roads and utilities should share common ROWs where possible;
4. Reduce width of ROWs and minimize the depth of excavation needed for the road bed and where feasible, use the natural ground surface for the road within habitat;
5. Place signing to limit off-road travel in sensitive areas;
6. Stay on designated routes and other cleared/approved areas;
7. All disturbed areas will be re-vegetated with native species comprised of species indigenous to the area and non-native species that are not likely to invade other areas; and
8. A biological monitor will be onsite during facility installation.

d) Within occupied habitat, project infrastructure will be designed to avoid direct disturbance and minimize indirect impacts to populations and to individual plants:

1. Follow the above (#c) recommendations for project design within suitable habitats;
2. Buffers of 300 feet minimum between the edge of the ROW (roads and surface pipelines) or surface disturbance (well pads) and plants and populations will be incorporated;
3. Surface pipelines will be laid such that a 300-foot buffer exists between the edge of the ROW and the plants and use stabilizing and anchoring techniques when the pipeline crosses the habitat to ensure the pipelines do not move towards the population;

4. Before and during construction, areas for avoidance should be visually identifiable in the field, e.g., flagging, temporary fencing, rebar, etc.;
5. Where technically and economically feasible, use directional drilling or multiple wells from the same pad;
6. Designs will avoid concentrating water flows or sediments into occupied habitat;
7. Place produced oil, water, or condensate tanks in centralized locations, away from occupied habitat; and
8. Minimize the disturbed area of producing well locations through interim and final reclamation. Reclaim well pads following drilling to the smallest area possible.
9. Occupied Uinta Basin hookless cactus habitats within 300 feet of the edge of the surface pipelines' ROWs, 300 feet from the edge of the roads' ROWs, and 300 feet from the edge of the well pad shall be monitored for a period of three years after ground disturbing activities. Monitoring will include annual plant surveys to determine plant and habitat impacts relative to project facilities. Annual reports shall be provided to the BLM and the Service. To ensure desired results are being achieved, minimization measures will be evaluated and may be changed after a thorough review of the monitoring results and annual reports during annual meetings between the BLM and the Service.
10. Re-initiation of Section 7 consultation with the Service will be sought immediately if any loss of plants or occupied habitat for the Uinta Basin hookless cactus is anticipated as a result of project activities.

e) Additional site-specific measures may also be employed to avoid or minimize effects to the species. These additional measures will be developed and implemented in consultation with the Service to ensure continued compliance with the ESA.

- As necessary, Thurston will notify the appropriate authorities (UDOT on highways and UDWR or USFWS on county and Refuge roads) of the presence of roadside carrion and ask that they remove the carrion as soon as possible. Carcasses may be covered in the interim to discourage scavenging by bald eagles and other raptors. However, only authorized personnel may touch or remove the carcasses.
- Thurston would not commence construction, drilling, or completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st).
- To avoid the potential for mortality and harassment of wildlife, all firearms and dogs will be prohibited from the project site, and all workers will be required to check under their vehicles prior to departing the project site.
- Trash and food items will be disposed of promptly in containers with resealable lids. Trash containers will be removed regulatory (at least once per week). This effort will reduce the attractiveness of the area to opportunistic wildlife.

- The Operator must provide detailed maps or plats of the proposed project layout (as required by the Refuge Manager or the Service AO) that shows routes, staging areas, construction areas, and work locations. The map should include the following minimum information:
    - a) Dimensions on adjacent exterior section lines sufficient to completely describe the quarter section that contains the proposed well shall be indicated. If dimensions are not field measured, state how the dimensions were determined.
    - b) The latitude and longitude of the proposed well location shall be provided on the drawing with a minimum of five (5) decimal places of accuracy and precision using the North American Datum (NAD) of 1983 (e.g.; latitude 37.12345 N, longitude 104.45632 W).
    - c) For irregular, partial or truncated sections, dimensions will be furnished to completely describe the entire section containing the proposed well.
    - d) The field-measured distances from the nearer north/south and nearer east/west section lines shall be measured at ninety (90) degrees from said section lines to the well location and referenced on the plat.
    - e) A map legend.
    - f) A north arrow.
    - g) A scale expressed as an equivalent (e.g. - 1” = 1000’).
    - h) A bar scale.
    - i) The ground elevation.
    - j) The basis of the elevation (how it was calculated or its source).
    - k) The basis of bearing or interior angles used.
    - l) Complete description of monuments and/or collateral evidence found; all aliquot corners used shall be described.
    - m) The legal land description by section, township, range, principal meridian, baseline and county.
    - n) Operator name.
    - o) Well name and well number.
    - p) Date of completion of scaled drawing.
    - q) A line designating the 100-year floodplain for the Green River relative to pad and well placement.
- Any materials brought into the Refuge as fill material for construction must be authorized by the Refuge Manager or the Service AO. To minimize the spread of invasive species, no top soils will be brought in from outside the Refuge.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.

- Prior to rig-up, Thurston must provide operational contacts to the Refuge Manager in the form of a telephone list that names key contacts for emergency operations and activation.
- The Operator must upgrade and maintain all access routes, roads, and bridges designated for its use across the Refuge in accordance with acceptable specifications and standards. The Operator must have road maintenance equipment and operator(s) readily available to perform road repairs and maintenance as needed, or as directed by the Refuge Manager or the Service AO**.**
- Dust levels on regularly traveled access routes must be kept to a minimum. The Operator must have a water truck and operator(s) readily available to perform dust abatement as needed, or as directed by the Refuge Manager or the Service AO. Magnesium water or an approved equivalent may be used as needed with prior approval from the Refuge Manager or the Service AO. Dust control measures must be implemented throughout the traveled areas of the Project Area.
- The drill site and immediate access roads must be constructed of Refuge-approved material for all drilling locations. All existing drainage patterns within roads to be constructed must be maintained uninterrupted by the use of culverts, bridges, or other applicable techniques as specified and authorized by the Refuge Manager or the Service AO.
- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both the state requirements and Federal *Oil and Gas Onshore Order No. 2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to near original site conditions. All costs shall be borne by the Operator.
- All open-top oil, condensate, or produced water tanks, dehydration unit tubs, secondary containment tubs, and any other open tub, tank, pan, or similar item will be netted or screened to prevent entrapment and mortality of migratory birds. Where there are open-top tanks which do not contain harmful substance, such as, stock water tire tanks, we recommend the use of escape ramps in these tanks to minimize the potential drowning of migratory birds and possible violations of MBTA.
- Pits, ponds, and/or open tanks are prohibited. Aboveground storage tanks must be used in circulating operations for the temporary storage of all drilling fluids, cuttings, mud, and contaminants. All drilling fluids, cuttings, mud, contaminants, portable tanks, and other equipment must be transported off Refuge to a state-approved facility upon cessation of drilling activity. Onsite disposal of drilling fluids is prohibited.
- Onsite disposal of produced water is prohibited. Produced water may only be disposed of at an offsite State-approved facility.
- All toxic construction and equipment supplies and refuse (oil, grease, gasoline, diesel, paint, and other petrochemical derivatives) must be centrally stored. Wastes must be removed from the Refuge immediately following completion of drilling operations and disposed of properly. In the event of an accidental spill or discharge of oil, brine, or any other petrochemical substance, the Operator must immediately notify the Refuge Manager or authorized representative. The Operator must remove contaminated soils for proper disposal off Refuge and replace them with the same type soils or one specified and approved by the Refuge Manager or the Service AO. A site reclamation plan may be required by the Refuge Manager or the Service AO.

- Secondary containment (i.e., catch pans or other liner systems consistent with industry standards) are required for equipment and locations such as mud pumps, bulk mud additive tanks, fuel tanks, mixing sheds, generators, accumulator and lines, and under the entire rig floor. The catch pans must cover the entire surface area under the equipment. The rig floor catch pan (collector) must be properly secured to allow for wash down and mud drainage from the drill pipe. The catch pans must be kept free of accumulated debris and spill materials must be emptied on a regular basis.
- The Operator will be responsible for providing all water needed for drilling operations. No wastewater will be discharged onto Refuge lands, ditches, or water bodies. The Operator will provide a containerized or temporary septic system for domestic sewage disposal during drilling operations, which must be removed upon completion of drilling. Use of portable toilets at the drill site or the installation of a temporary septic system, or similar treatment system or tanks, will be required for any trailer or quarters onsite. No surface discharge of septic system or portable toilet water is permitted. Septic tanks must be inspected weekly during operations and pumped as necessary. Upon completion of operations, the septic tanks must be pumped out, removed, and all material hauled away.
- All disposable type materials and trash brought onto the Refuge or generated at the drill site must be removed from the Refuge on a biweekly basis and upon completion of the drilling activities. The drill site and operational area must be kept free of debris and trash at all times. Trash must be contained securely at the drill site in such a manner (fully enclosed trash cages) as to prevent trash from being spread by wind or wildlife. No trash may be disposed of or buried on the Refuge.
- During all phases of this project, noise levels must be kept to a minimum and should not exceed the established industry standard above ambient day and nighttime noise levels. Thurston should make every effort to use electric pumping equipment (most quiet) during the production phase of this operation.
- Thurston must implement the following conditions to reduce the impacts on daytime and nighttime visual resources:
    - a) The production equipment and associated infrastructure must be painted a flat, non-reflective, earth-tone color to blend with the natural landscape background.
    - b) During pad construction and when erecting or disassembling the drilling rig, outdoor lighting should be kept to a minimum and turned off when not needed.
    - c) Whenever possible, each series of lights must be either on a separate switch, timer, or motion sensor to allow the operator to tailor their use to activity in a specific area of the drill pad.
    - d) All area lights must be downward pointing and fully shielded. All lighting focused on a particular apparatus must be laterally shielded so that all light falls upon the intended work area and a minimum amount of light is emitted sideways or upward.
    - e) Lights that are required by OSHA for emergencies must be linked to alarms so that they are only operational when an emergency situation arises.
    - f) No light shall exceed 400 watts.
    - g) All lamps must be $\leq$ 3500 ° Kelvin color temperature to reduce blue-rich light, which causes greater sky glow and is typically more attractive to wildlife.

h) A Service designee will observe the facility from critical angles and distances. Excessively glaring lights must be shielded, re-aimed, or otherwise mitigated with an adaptive approach without compromising worker safety requirements.

i) Lighting will be minimized where applicable unless safety is an issue.

- The following measures would be implemented for new power lines:
  - Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). In addition, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012). Depending on the alternative selected, specific standards to be followed will be identified in the Decision Record for the EA.
- General Refuge access conditions:

a) Thurston and/or its contractors shall be allowed access to portions of the Refuge for the purpose of carrying out drilling of oil and gas exploration wells previously identified (50 CFR 26.22).

b) The Refuge Manager is the coordinating official having immediate jurisdiction and administrative responsibility for oil and gas operations on Refuge lands and property; all entry upon the Refuge must be coordinated with the Refuge Manager or the Service AO. The Refuge Manager must be advised at least 48 hours prior to initiation of construction (50 CFR 26.22).

c) The failure of the United States to require strict performance of the terms, conditions, covenants, agreements, or stipulations of this permit for access to conduct exploration activities on NWR lands shall not constitute a waiver or relinquishment of the right of the United States to strictly enforce thereafter such terms, conditions, covenants, agreements, or stipulations, which shall, at all times, continue in full force and effect.

d) Thurston and/or its contractors shall save, hold harmless, defend, and indemnify the United States, its agents and employees for loss, damages, or judgments and expenses on account of bodily injury, death, or property damage, or claims for bodily injury, death or property damage of any nature whatsoever, and by whomever made, arising out of the Operator, their employees, subcontractors, or agents with respect to the exploration of any and all mineral rights within the lands administered by the Refuge.

e) All applicable federal and state regulations apply and will be in force. Operator shall be responsible for the actions of all exploration and support personnel. Violations of applicable laws or regulations will subject the Operator and/or their employees to prosecution under state and/or federal laws. Individuals using the Refuge under the Operator's authorization are subject to inspections of vehicles and their contents by federal and state law enforcement officers.

f) Proof of general liability insurance as required by State law must be furnished to repair/mitigate any damages. This does not limit the liability for damages to this amount.

g) Operators will act in a manner that is respectful of Refuge habitats, wildlife, and property. Gates are to be locked or unlocked as they are found (50 CFR 27.21; 50 CFR 27.51).

h) All vehicle access will be restricted to developed roads and two-tracks. All-terrain vehicle (ATV) use and deviations to vehicle use must be pre-approved by the Refuge Manager in writing prior to any action taken (50 CFR 27.31).

i) To reduce potential impacts to air quality, all equipment associated with drilling and completion activities, as well as, service equipment used for fracing and cementing, would be with Tier-1 grade engines and emissions at a minimum.

j) Vehicle speed limits will be set at the discretion of Refuge Manager and limits will be strictly adhered to (50 CFR 27.31).

k) No pets will be allowed on the Refuge.

l) Person(s) entering or remaining on the Refuge when under the influence of alcohol is prohibited (50 CFR 27.81).

m) Possession of drugs or controlled substances is strictly prohibited on the Refuge (50 CFR 27.82.

n) Possession, transportation, or discharge of firearms, fireworks, or explosives on the Refuge is prohibited unless specifically authorized (50 CFR 27.41; 50 CFR 27.42).

o) Open fires are strictly prohibited in any areas of the Refuge (50 CFR 27.95).

p) Operators will not be considered agents of the Service and will not represent the Service in any matters (50 CFR 27.84).

q) Operators will perform all work in accordance with the highest standards of the industry and to the satisfaction of the Service.

r) Operators will perform all work in accordance with all applicable laws and regulations and will obtain all necessary permits or licenses when required to do so (50 CFR 25.13; 50 CFR 29.32).

s) All personnel and activities shall be restricted to the immediate drilling area and the direct access road to the drill site (50 CFR 26.22).

t) Feeding wildlife species is prohibited. Molesting or destroying the home or dens of wildlife is prohibited. If dens are found during the normal course of operations, distinctive flagging will be used to alert all personnel of the den location. Adverse impacts on fish, wildlife, and the environment shall be kept to an absolute minimum. All road kills will be reported to the Refuge Manager or the Service AO (50 CFR 27.51).

u) Littering is prohibited. All cans, bottles, lunch papers, and operations trash must be removed. Cigarette butts are considered litter. All vehicles must be equipped with a container to carry out trash (50 CFR 27.94).

v) Thurston must complete or obtain all necessary permits, contacts and clearances prior to the start of the activity (50 CFR 25.13).

w) No overnight quarters will be permitted on the Refuge unless authorized by the Refuge Manager (50CFR 27.92).

- In the event that unanticipated cultural resources are uncovered during surface-disturbing activities, procedures outlined in the Service's 614 FW 2, Survey and Identification Manual (USFWS 1992c) and other applicable regulations would be followed. Thurston would suspend operations at the site and immediately contact the Service, who will arrange for a determination of eligibility in consultation with the State Historic Preservation Office (SHPO) and if necessary, will recommend a recovery or avoidance plan.
- Thurston is responsible for informing all persons in the area who are associated with this project that they may be subject to prosecution for knowingly disturbing historic or archaeological sites or for collecting artifacts. All vehicular traffic, personnel movement, and construction and restoration activities would be confined to the areas evaluated in the pre-disturbance survey.
- Earthen berms and storage tank containment areas would be lined with a non-permeable liner in order to reduce the risk of groundwater and soil contamination. These liners will be maintained and replaced per manufacturer guidelines.
- Thurston shall provide a detailed topographic map, using established map making practices, showing the location of the 100-year floodplain along the Green River inside the Ouray NWR boundary.
- A brief Worker Environmental Awareness Program (WEAP) will be implemented for construction and drilling crews prior to the commencement of the project activities. Training materials and briefings will include, but are not be limited to, discussion of the federal and state ESAs, the consequences of noncompliance with these acts, identification and values of wildlife and natural plant communities, threatened and endangered species within the Project Area, hazardous substance spill prevention and containment measures, and review of all required and recommended mitigation measures.
- Per consultation with the Utah SHPO, a contracted paleontologist will be onsite when construction occurs.

2.2 Alternative B - No Action Alternative

Under the No Action Alternative, a SUP for access to construct and develop the two wells associated with the Proposed Action would be denied. The Proposed Action affects state subsurface minerals on Ouray NWR lands. Thurston has purchased these state leases granting them a right to explore and develop oil and gas on the leased areas. The No Action Alternative constitutes denial of the Proposed Action and could be used to prevent unnecessary and undue degradation of Ouray NWR resources. Absent a non-discretionary statutory prohibition against drilling, the Service cannot deny the right to drill and develop the leasehold. Only the U.S. Congress can completely prohibit development activities (Western Colorado Congress, 130 IBLA 244, 248 [1994], citing Union Oil Company of California v. Morton 512 F.2d 743, 750-51 [9th Cir. 1975]). However, while Thurston has a legal right to develop minerals somewhere on their lease, analysis of the No Action Alternative is required by CEQ regulation.

Under the No Action Alternative, current management plans for the Ouray NWR would continue to guide management of the Project Area. The proposed wells and well pads as well as associated access roads and pipelines would not be implemented to accomplish Thurston's purpose and need. The Wildlife Refuge Road that would be used to access the Project Area would continue to be used for wildlife viewing, hunting, and other forms of dispersed recreational activities on Ouray NWR lands. Future mineral development in the Project area would be considered on a case-by-case basis and would be subject to separate NEPA analysis.

2.3 Alternatives Considered but Dismissed from Analysis

The provisions of NEPA require that a range of reasonable alternatives be explored and evaluated. NEPA also requires that the reasons for eliminating certain alternatives from detailed study be briefly explained. In addition to the Proposed Action described above, four other action alternatives were identified in this EA. These alternatives include Alternative C – 4-Well Development; Alternative D - Alternate Pipeline Route 1; Alternative E - Alternative Pipeline Route 2; and Alternative F - Directional Drilling. Each alternative is described in more detail below with rationale for dismissal.

2.3.1 Alternative C – 4-Well Development

A 4–Well Development Alternative was considered that included the following primary components (see **Figure 2-5**):

- Construction of four (4) well pads, each averaging approximately 2.1 acres in size;
- Construction of approximately 581 feet of new access road;
- Upgrades to approximately 413 feet of Wildlife Refuge Road and realignment of approximately 2,366 feet of Wildlife Refuge Road;
- Installation of up to 17,948 feet of co-located surface pipeline and 3,296 feet of "cross-country pipeline." All pipeline installation would occur within a 15-foot wide ROW. Construction of the "cross country" segment of the surface pipeline would begin near the top of the bluffs area near the tie-in point and proceed south then east to Wildlife Refuge Road.

2.3.1.1 Consideration of Ouray National Fish Hatchery (NFH)

The Ouray National Fish Hatchery (Ouray NFH) was established in May 1996 as a fish refuge and technology development facility to assist in the recovery of the four listed Colorado River endangered fish: razorback sucker, Colorado pikeminnow, humpback chub, and bonytail chub (USFWS 2013g). The mission of the Ouray NFH is to serve as a genetic refuge for priority endangered Colorado River fishes (USFWS 1995a).

The primary goal of the Ouray NFH is to preserve a genetically sound captive razorback sucker broodstock of approximately 500 adults and maintain a propagation program adequate to produce ample larvae needed for floodplain wetland studies as well as hatchery production. The goal will be modified in 2013 to include the production of bonytail chub (USFWS 2013g). The Ouray NFH is the primary source of genetic material that is needed to maintain a large genetic pool and work towards a viable reproduction population (USFWS 1995a).

The end product of the Ouray NFH is to maintain endangered fish in Ouray NWR to prevent extinction; develop genetically sound broodstocks for production of young fish for stocking to stabilize or enhance wild stocks; and to produce captive reared endangered fish for priority laboratory and field experiments (USFWS 2013e).

Refuge populations and broodstocks are often the 'last line of defense' to prevent species extinction or population extirpation. Therefore, they are irreplaceable components that are essential for recovery of these species. Similarly, successful stocking programs are often the first action that must be undertaken for species' recovery. The razorback sucker stocking program (including the Ouray NFH) is a great

example of how hatchery programs can avert the extinction of an endangered species (USFWS 2013f).

2.3.1.2 Summary of the Ouray NFH Well Field

The existing Ouray NFH Well Field (groundwater aquifer) consists of seven wells arranged in a roughly triangular pattern on the Leota Bottom of the Green River within the Ouray NWR. The water supply wells are all located within the northwest ¼ of Section 29, Township 7 South, Range 21 East of Uintah County, Utah (USFWS 2001a). Other components of the well field include distribution piping; 12, clay-lined, 0.2-acre ponds; an effluent water dispersal basin; and chain link fence surrounding the pond area (USFWS 1992b). The wells in the groundwater aquifer are the primary freshwater source for the Ouray NFH. **Table 2.2** shows the depths and elevations of the seven wells in the Ouray NFH well field.

Table 2.2. Table of Well Depths, Elevations, and Screen Intervals

Well #	#1	#2	#3	#4	#5	#6	#7
Ground Elev.	4666.10	4667.60	4667.20	4666.00	4661.10	4667.40	4665.60
Depth to Bedrock	52.20	53.00	55.70	56.00	52.00	52.00	53.00
Bedrock Elev.	4613.90	4614.60	4611.50	4610.00	4609.10	4615.40	4612.60
Top of Screen	42.20	40.80	43.20	36.50	40.00	34.90	42.00
Bottom of Screen	52.20	50.80	53.20	46.50	50.00	50.30	52.00
Screen Elev-Top	4623.90	4626.80	4624.00	4629.50	4621.10	4632.50	4623.60
Screen Elev-Bot	4613.90	4616.80	4614.00	4619.50	4611.10	4617.10	4613.60

Source: USFWS 2001a

The final well field configuration consists of four pumping wells of equal capacity, supplying an average of 1,300 gpm of continuous flows within the limits of the existing well field. Any three of the four wells have the capacity to supply the entire 1,300 gpm in the event that any one well is offline. The configuration within the existing well field boundaries that best meets the criteria established by the FWS and the principles of good well design is having pumping wells located at or near the existing wells #2, #5, #6, and #7. Under normal designed operating conditions with four wells operating, and each discharging 325 gpm, there will be minimal interference between adjacent wells. The maximum drawdowns projected within the well field do not exceed five feet (USFWS 2001a).

2.3.1.3 Risk Factors

The Service prefers a low-risk threshold approach. Hatchery facilities and endangered fish species are an irreplaceable resource. Because the Ouray NFH contains irreplaceable resources for endangered fish recovery, protection of the facility is of the utmost importance. Water quality contamination, aquatic disease inoculation, facility breakdowns, and other problems can destroy years of work, cost millions of dollars, and slow the recovery process. As a result, protection of the Ouray NFH's water source and facilities are essential to the recovery of razorback sucker, bonytail, and humpback chub (USFWS 2013f).

Due to the location of two well pads (Thurston 12-29-7-21 is 747' southwest and Thurston 13-29-7-21 is 853' northwest of the Ouray NFH), the Service is concerned that the 4-Well Alternative would impact the hatchery recovery program as well as the Colorado River fish species and their habitat. As a whole, implementation of the 4-Well Alternative poses increased risk of spills near the Ouray NFH and groundwater contamination in the floodplain over the anticipated life of the project (LOP) (33- to 43-years). These risk factors include:

- Drilling operations for the four proposed wells would generate approximately 450 truck trips, while completion operations would require about 620 vehicle trips. In total, traffic generated during the construction, drilling, and completion phase would average 10 vehicles per day. These activities would increase level of risk of spills or groundwater contamination in the floodplain for the two wells near the fish hatchery and the freshwater aquifers that supply water to the Ouray NFH.
- The storage, transport, disposal of hazardous substances including greases or lubricants, solvents, acids, paint, and herbicides stored near the hatchery drilling sites and production areas would increase level of risk of spills or groundwater contamination in the floodplain for the two wells near the fish hatchery and the freshwater aquifers that supply water to the Ouray NFH.
- Construction activities associated with road upgrades and realignment for the two wells near the Ouray NFH would generate additional surface disturbances and displace soils and vegetation. For example, approximately 413 feet of upgrades to Wildlife Refuge Road and 2,366 feet of realignment of Wildlife Refuge Road would be needed to provide suitable access for equipment and vehicles to Thurston 12-29-7-21 near the northern edge of the Project boundary. These road improvements alone would result in 5.8 acres of additional short-term disturbance.
- Short-term impacts from nighttime or artificial lighting at the drilling sites for Thurston 12-29-7-21 and Thurston 13-29-7-21 would be within 747' and 853' of the Ouray NFH, respectively.
- Long-term impacts from visibility of well production operations for Thurston 12-29-7-21 and Thurston 13-29-7-21 would be within 747' and 853' of the Ouray NFH, respectively.
- Short-term noise impacts due to drilling and well completion activities.
- Although the surface casing and its design would provide protection for freshwater aquifers and contain pressures that may be encountered while drilling the production hole, the location of the well in relative to the hatchery or freshwater well field poses to great of risk.

If resources were developed at their current proposed well pad locations under the 4-well Alternative, it is likely that the Service would need to consider relocating the entire hatchery facility at the expense of Thurston Energy (USFWS 2013f). Thurston would be responsible for the following actions:

- Completing baseline monitoring of hatchery water supply before development proceeds;
- Undertaking long-term monitoring of the hatchery water supply during resource extraction;
- Making potential improvements of the hatchery water supply and purification system;
- Lining all well pads in a synthetic liner to protect groundwater resources;
- Constructing berms around all well pads to contain spills and runoff;
- Conducting a groundwater risk analysis study to determine potential effects of nearby drilling operations;

- Developing BMPs and a quick response action plan for a surface spill to protect floodplain nursery habitats;
- Replicating or moving the Ouray NFH broodstock and refuge populations, and holding those resources at an alternative location;
- Providing a safer source of hatchery water, such as constructing a river water infiltration gallery upstream of the proposed action;
- Replicating or moving all Ouray NFH facilities and production capabilities to a site with a protected location and water supply system; and
- Ensuring that the Recovery Program stocking goals are met during facility transfer (USFWS 2013f).

The 4-Well Development Alternative would also require further hydrologic risk assessment studies to better understand alluvial aquifer and groundwater hydrology.

2.3.1.4 Rationale for Eliminating Alternative C from Further Consideration

The 4-Well Development Alternative was dismissed for biological reasons due to the location of two well pads in proximity to the Ouray NFH and the floodplains; namely, Thurston 12-29-7-21 is a distance of 747' southwest of the hatchery and Thurston 13-29-7-21 is a distance of 853' northwest of the hatchery. The risks associated with the implementation of the 4-Well Alternative could lead to increased potential for spills from the two wells near the Ouray NFH and groundwater contamination in the floodplain over the LOP; thus, it would not be considered a preferable alternative to the Proposed Action. Portions of the Utah Ecological Services Field Office (Utah FO) memorandum (USFWS 2013f) were incorporated into the discussion under **Sections 2.3.1.1** and **2.3.1.3** above to further explain the rationale for excluding the two wells near the Ouray NFH from any future oil and gas development activity.

2.3.2 Alternative D – Alternative Pipeline Route 1

An alternate surface pipeline route was considered that would connect to the southwest portion of an existing mainline. This alternative would entail the installation of approximately 969 linear feet of surface pipeline northwest of Wildlife Refuge Road in Section 2, Township 8 S, Range 20 E (see **Figure 2-5**). Based on additional soil and vegetation, the potential disturbance associated with installation and increased visual impacts resulting from this alternative, it was not considered to be a preferred alternative to the Proposed Action and the No Action Alternative.

2.3.3 Alternative E – Alternative Pipeline Route 2

A second alternate surface pipeline tie-in route was considered in Sections 1 and 2, Township 8 S, Range 20 E, and Section 11, Township 9 S, Range 20 E. This alternative would entail the installation of approximately 12,524 linear feet (2.4 miles) of surface pipeline, which would travel southwest along Wildlife Refuge Road, turn northwest for approximately 0.75 miles, and then north for approximately one mile (see **Figure 2-5**). This alternate pipeline route would travel through *Sclerocactus* Level 1 and Level 2 Core Conservation Areas. The USFWS' working *Sclerocactus* management guidelines model current cactus population data into Level 1 (highest concentration of known cacti, highest level of protection) or Level 2 (pollinator buffer, highly restricted surface disturbance guidelines) areas throughout the species currently known and occupied ranges. Under these guidelines, no new surface disturbance would occur in Level 1 areas and a disturbance cap of five percent would be applied to Level 2 areas. This alternate pipeline route was eliminated because it was determined not to be economically practical and would

impact protected *Sclerocactus* habitat under the USFWS' current management guidelines; thus, it would not be considered environmentally preferable to the Proposed Action or Agency Preferred Alternative.

2.3.4 Alternative F – Directional Drilling Alternative

The Service considered the alternative of directionally drilling all four proposed wells from a single pad (one vertical and three directional wells) to limit surface disturbance to one site. Dismissal of this alternative requires an understanding of the limitations of directional drilling associated with oil and gas development in the Project Area.

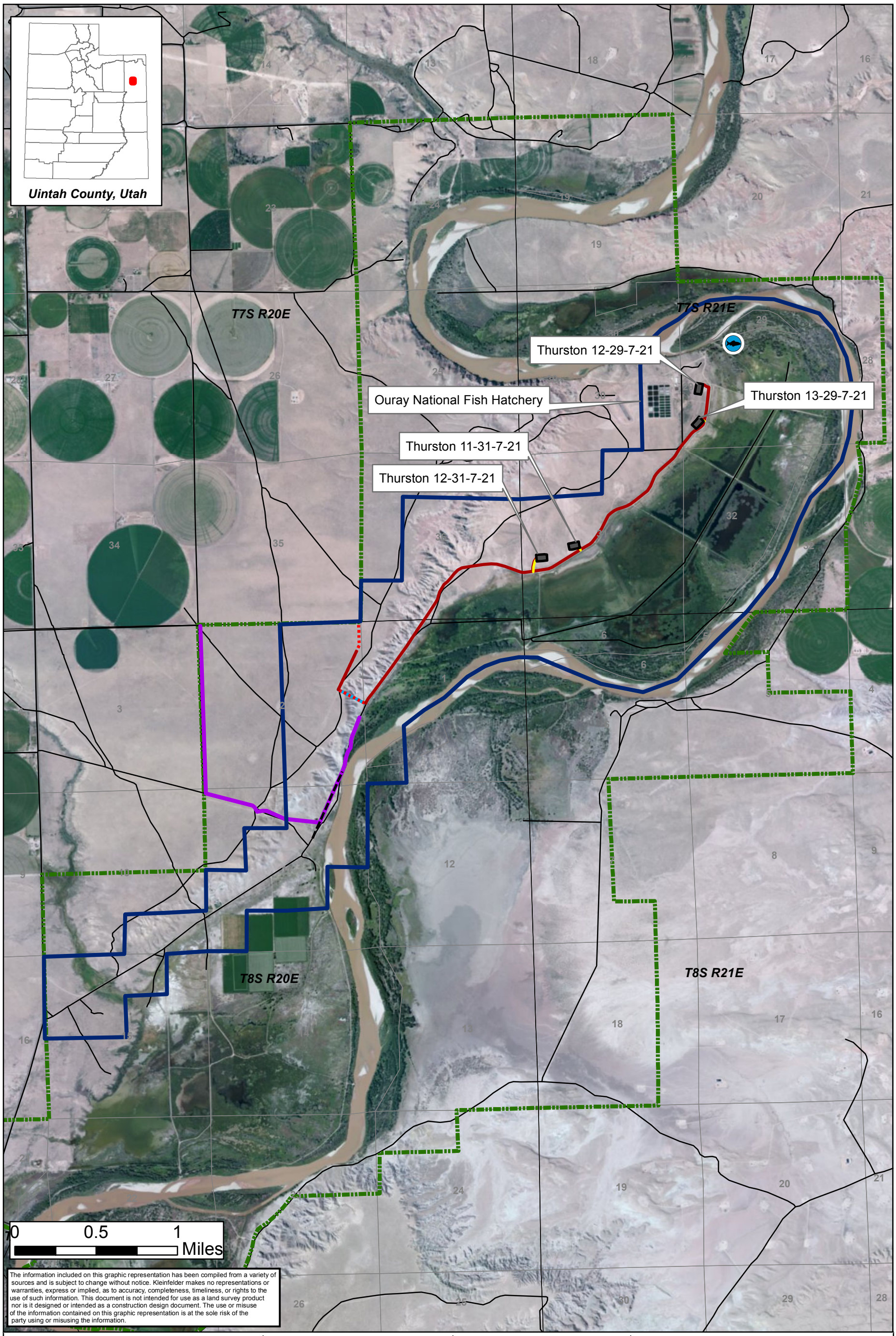
Actual borehole configuration of several directionally drilled wells on a single pad would be complex and require larger drill rigs, a larger drilling pad, and higher potential for hole problems (i.e., sticking drill pipe and drilling tools, inadequate ability to test potential zones, losing the hole, etc.).

Additionally, due to the distances required for effective drainage and spacing between wells, it is not technically feasible to rod pump the four wells from one surface location due to the angles required in this directional drilling scenario. Additional information on the technical challenges of drilling the two exploratory wells from one well pad is described below. Specifically:

- Thurston's commence build depth for the proposed surface casing depth is 900 feet. Based on Thurston's knowledge of the Project Area, it is desirable to have 800 – 1,000 feet below surface of vertical section to reduce rod wear and to effectively rod pump the wells. Thus, 900-foot depth is currently the earliest point for Thurston to commence build on these wells.
- The proposed wells have a build and drop angle of three degrees (doglegs) to our maximum inclination and "back to vertical". Based on Thurston's experience and industry standards, build and drop angles over four degrees causes significant rod wear when rod pumping the wells.
- The Green River formation is Thurston's primary target and completion interval in the Project Area. For this project, the average top of the Green River for the two proposed wells is 2,459 feet true vertical depth (TVD). Based on UDOGM-required 40-acre spacing for the wells, it is necessary to be 'back to vertical' by 2,459 feet to adequately drain the resource within the Green River formation.

Based on the information above, the maximum inclination for the proposed exploration wells is 24.1 degrees, with a vertical section or total maximum reach of approximately 333 feet.

For these reasons, directionally drilling the two exploratory wells from a single pad is not technically feasible. As such, the Service has determined that requiring additional directional drilling is not a feasible alternative because it would not meet the purpose and need of the project and would not offer greater protection for the resources of the Refuge. Therefore, this alternative has been dismissed from further analysis.



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Alt. C Proposed Pad
- Alt. C Realigned Road
- Alt. C Proposed Access Road
- Alt. C Proposed Co-located Surface Pipeline
- Alt. C Proposed Cross-country Surface Pipeline
- Alt. D Proposed Pipeline (Route 1)
- Alt. E Proposed Pipeline (Route 2)
- Ouray National Wildlife Refuge Boundary
- Fish Hatchery Water Supply Wells

N

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig2_1ProposedAction.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

Alternatives Dismissed from Analysis
Uintah County, Utah

FIGURE

2-5

This page intentionally left blank.

3.0 AFFECTED ENVIRONMENT

This chapter describes the existing human environment including biological, physical, and social resources that may be affected by the Proposed Action or No Action Alternative as described in **Chapter 2**. Resources and resource values analyzed in the EA were identified as issues by the Service and/or public during the public scoping process. Where no measureable effects are anticipated, resource descriptions are limited in order to focus the analysis on the principle issues to be considered in the decision making process.

The following resources/elements (while critical) are not present in the Project Area or would not be affected. Therefore, they were dismissed from further analysis for the reasons identified below.

- **Geology/Minerals:** Compliance with existing Service and UDOGM oil and gas guidelines and regulations would make the possibility of project-initiated landslides, other mass movement, or flooding unlikely. In addition, current state-of-the-art drilling and well completion techniques and UDOGM siting and spacing regulations would make the possibility of adverse degradation to energy resources (i.e., oil, natural gas, tar sand, oil shale, etc.) or mineral deposits negligible.
- **Socioeconomics:** The Proposed Action would have negligible impact on socioeconomic conditions within and adjacent to the Project Area.
- **Livestock/Range Management:** The Project Area does not contain rangeland or designated livestock grazing allotments.
- **Wilderness:** There are no designated Wilderness or Wilderness Study Areas within or adjacent to the Project Area.
- **Noise/Light:** The Project Area and surrounding region is in a remote setting with no areas nearby where dwellings or other fixed developed sites would be subject to significant levels of noise and light as a result of the proposed project.

Resources Brought Forward for Analysis

The resources that were considered for analysis in the EA include environmental elements identified by the Service that could potentially be affected by the Proposed Action and Alternatives. These resources are discussed further below with respect to their status in the Project Area.

- Air Quality and Greenhouse Gas Emissions
- Soils
- Water Resources including Surface Water, Groundwater, Floodplains, Wetlands, and Waters of the U.S.
- Biological Resources including Vegetation, Invasive and Noxious Weeds, Fish and Wildlife and their Habitat, and Special Status Plant and Animal Species and their Habitat
- Paleontological Resources
- Cultural Resources
- Transportation
- Recreation
- Visual Resources

3.1 Air Quality and Greenhouse Gas Emissions

3.1.1 Air Quality

The Project Area is located in the Uinta Basin. The Uinta Basin is a physiographic section of the larger Colorado Plateaus province, which in turn is part of the larger Intermontane Plateaus physiographic division. It is also a geologic structural basin in eastern Utah, east of the Wasatch Mountains and south of the Uinta Mountains. The Uinta Basin is fed by creeks and rivers flowing south from the Uinta Mountains. Many of the principal rivers (Strawberry River, Currant Creek, Rock Creek, Lake Fork River, and Uinta River) flow into the Duchesne River which feeds the Green River—a tributary of the Colorado River. The Uinta Mountains forms the northern border of the Uinta Basin. They contain the highest point in Utah, Kings Peak, with a summit 13,528 feet above sea level. The Uinta Basin is a semiarid, mid-continental climate regime typified by dry windy conditions, limited precipitation, and wide seasonal temperature variations. The Uinta Basin is subject to abundant sunshine and rapid nighttime cooling. Existing point and area sources of air pollution within the Uinta Basin include the following:

- Exhaust emissions (primarily carbon monoxide [CO], nitrogen oxide [NO_X], particulate matter less than 2.5 microns in diameter [$PM_{2.5}$], and hazardous air pollutants [HAPs]) from natural gas fired compressor engines used in transportation of natural gas and pumpjack engines used to mechanically lift liquid out of the well;
- Gasoline and diesel-fueled vehicle tailpipe emissions of volatile organic compounds (VOCs), NO_X, CO, sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM_{10}), and $PM_{2.5}$;
- Natural gas dehydrator still-vent and reboiler emissions of VOC, CO, NO_X, $PM_{2.5}$, and HAPs;
- Sulfur oxides (SO_X), NO_X, and fugitive dust emissions from coal-fired power plants and coal mining and processing;
- Fugitive dust (in the form of PM_{10} and $PM_{2.5}$) from vehicle traffic on unpaved roads, wind erosion in areas of soil disturbance, and road sanding during winter months; and
- Long-range transport of pollutants from distant sources.

The Uinta Basin is currently designated as unclassified or attainment for all criteria pollutants by the EPA under the Clean Air Act (CAA). This classification indicates that the concentration of criteria pollutants in the ambient air is below the National Ambient Air Quality Standards (NAAQS), or adequate air monitoring is not available to determine attainment. NAAQS are standards that have been set for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which standards have been set include ground-level ozone (O_3), SO_2, nitrogen dioxide (NO_2), CO, and PM_{10} or $PM_{2.5}$. Airborne particulate matter (PM) consists of tiny coarse-mode (PM_{10}) or fine-mode ($PM_{2.5}$) particles or aerosols combined with dust, dirt, smoke, and liquid droplets. $PM_{2.5}$ is derived primarily from the incomplete combustion of fuel sources and secondarily formed aerosols, whereas PM_{10} is primarily derived from crushing, grinding, or abrasion of surfaces. **Table 3-1** lists ambient air quality background values for the Uinta Basin and NAAQS standards.

Two year-round air quality monitoring sites were established in summer 2009 near Redwash (southeast of Vernal, Utah) and Ouray (southwest of Vernal). The monitors were certified as Federal Reference Monitors in the fall of 2011. These monitors can be used to make NAAQS compliance determinations (EPA AQS 2012). There are additional monitors at Dinosaur National Monument, Meeker, Colorado, and Rangely, Colorado, that also provide an indication as to the air quality in the Uinta Basin.

Since 2010 and in the winter of 2013, several of the monitoring sites have recorded exceedances of the current NAAQS 8-hour ozone standard of 75 parts per billion (ppb). These exceedances occurred during the winter months (January through March). **Table 3-2** presents the maximum and fourth-highest monitored ozone values at the regional monitoring stations. Note that there were no exceedances of the NAAQS observed in the 2012 monitoring season with the highest fourth-high 8-hour observation being 75 ppb at Dinosaur National Monument and the highest maximum value in the Uinta Basin (as reported by the Redwash and Ouray monitors) being 74 ppb with the highest fourth-high of 70 ppb. The relatively lower values in the winter of 2011/2012 are speculated to be due to the lack of sufficient snow cover during the winter of 2011/2012.

The ozone standard is a three-year average, not a single maximum value. Accordingly, although there have been exceedances of the numerical value of the standard, the region is currently (as of November 2013) still considered attainment or unclassifiable for ozone. It is possible that the Uinta Basin will be declared non-attainment after the monitoring data are quality assured and evaluated. Should the area become a nonattainment area, the EPA will require the Utah Division of Air Quality (UDAQ) to prepare and implement a State Implementation Plan (SIP) that will require additional emission controls on the sources of emissions causing the ozone exceedances such that the area will reach attainment by federally-specified dates. The SIP could require future emission controls or other restrictions on the Proposed Action and Alternatives, but the nature of such requirements is not known at this time.

Table 3-1. Ambient Air Quality Background Values

Pollutant	Averaging Period(s)	Uinta Basin Background Concentration (μg/m^3)	NAAQS (μg/m^3)
SO_2	Annual	---	--[1]
	24-hour	---	--[1]
	3-hour	16.7[2]	1,300
	1-hour	21.7[2]	197
NO_2	Annual	9.0[3]	100
	1-hour	69.9[3]	188
PM_{10}	Annual	---	--[6]
	24-hour	18.0[4]	150
$PM_{2.5}$	Annual	12.3[3]	15
	24-hour	21.6[3]	35
CO	8-hour	3,910[4]	10,000
	1-hour	6,325[4]	40,000
O_3	8-hour	See Text	75 ppb

[1] The 24-hour and annual SO_2 NAAQS have been revoked by EPA.
[2] Based on 2009 data from Wamsutter Monitoring Station Data (EPA AQS Database).
[3] Annual value based on 2010/2011 data from Redwash Monitoring Station (EPA AQS Database). The value for $PM_{2.5}$ 24-hour is 2-year average from the Ouray monitor.
[4] Based on 2006 data disclosed in the Greater Natural Buttes FEIS (BLM 2012a).

Table 3-2. Additional Ozone Background Values *

Site	Year	8 hour Average Maximum (ppb)	8-hour Average Fourth High (ppb)	8-Hour Average Three Year Fourth High (ppb)
Dinosaur National Monument	2010	71	68	77.7
	2011	106	90	
	2012	83	75	
Redwash, UT	2010	105	98	88.3
	2011	125	100	
	2012	68	67	
Ouray, UT	2010	123	117	101
	2011	139	116	
	2012	74	70	
Meeker, CO	2010	73	66	64.3
	2011	65	63	
	2012	68	64	
Rangely, CO	2010	67	58	66.7
	2011	88	73	
	2012	71	69	

* US EPA Air Data: http://www.epa.gov/airdata/ (accessed April 16, 2013)

It is thought that relatively high concentrations of ozone in the region are being formed under a "cold pool" process. This process occurs when stagnant air conditions form with very low mixing heights under clear skies, snow-covered ground, and abundant sunlight. These conditions, combined with area precursor emissions (NO_X and VOCs), can create ozone episodes. This phenomenon has also been observed in similar locations in Wyoming. Because the ozone exceedances are occurring in areas where there is extensive oil and gas exploration and production, it is likely that the causes of the exceedances are related to emissions from oil and gas operations in the Basin rather than transport from other regions, although the quantitative cause and effect relationship is still unknown.

Winter ozone formation is a newly recognized issue, and the methods of analyzing and managing this problem are still being developed. Although it is well documented how ozone precursors (VOCs and NO_X) interact in the atmosphere to create ozone, the existing photochemical models are currently unable to reliably replicate winter ozone formation. This is due to the very low mixing heights associated with the unique meteorology of the ambient conditions. Further research is needed to definitively quantify the precise relative contribution of ozone precursor emissions with respect to winter time ozone concentrations. Photochemical models that replicate summer time ozone formation show that the relationship between emissions of ozone precursors and ozone concentrations is non-linear and in some cases ozone formation is driven by NOx emissions while in others it is driven by VOC emissions.

It is possible that the interaction of VOC and NOx emissions with each other may be different for winter time ozone formation than for summer ozone formation and it is not yet known if the winter time ozone formation in the Uinta Basin is VOC limited or NOx limited. Although winter time ozone formation may be different than summer time, the existing photochemical models have demonstrated that if both NOx and VOC emissions are reduced, the potential for ozone formation is also reduced. Although the relative

magnitude of emissions compared to ozone concentrations is not known for winter time ozone formation, it is expected that the same overall relationship (i.e. reduction in both NOx and VOC will reduce the potential for ozone exceedances) is expected to hold in the Uinta Basin. The potential effects of the Proposed Action and Alternatives on ozone formation are discussed in **Chapter 4** of this EA.

The UDAQ conducted limited monitoring of $PM_{2.5}$ in Vernal, Utah in December 2006. During the 2006-2007 winter season, $PM_{2.5}$ levels were higher than the $PM_{2.5}$ health standard that became effective in December 2006. The $PM_{2.5}$ levels recorded in Vernal were similar to other areas in northern Utah that experience wintertime inversions. The most likely causes of elevated $PM_{2.5}$ at the Vernal monitoring station are probably those common to other areas of the western United States (combustion and dust) plus nitrates and organics from oil and gas activities in the Uinta Basin. $PM_{2.5}$ monitoring that has been conducted in the vicinity of oil and gas operations in the Uinta Basin by the Redwash and Ouray monitors beginning in summer 2009 have not recorded any exceedances of either the 24-hour or annual NAAQS.

HAPs are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified 187 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde, benzene, toluene, ethylbenzene, isomers of xylene (BTEX) compounds, and normal-hexane (n-Hexane). There are no applicable federal or State of Utah ambient air quality standards for assessing potential HAP impacts to human health. However, the State of Utah has published toxic screening levels (TSLs) that are used to assess potential health impacts of HAPs.

3.1.2 Greenhouse Gas

Greenhouse gases keep the planet's surface warmer than it would be otherwise. However, as the concentrations of these gases increase the Earth's temperature is climbing above past levels. The eight warmest years on record (since 1850) have all occurred since 1998, with the warmest year being 1998. However, according to the British Meteorological Office's Hadley Centre (BMO 2009), the United Kingdom's foremost climate change research center, the mean global temperature has been relatively constant for the past nine years after the warming trend from 1950 through 2000. Predictions of the ultimate outcome of global warming remain to be seen.

The analysis of the Regional Climate Impacts prepared by the U.S. Global Change Research Program (USGCRP) suggests that recent warming in the region (including the Project Area) was nationally among the most rapid (Karl et al. 2009). Past records and future projections predict an overall increase in regional temperatures, largely in the form of warmer nights and effectively higher average daily minimum temperatures. They conclude that this warming is causing a decline in spring snowpack and reduced flows in the Colorado River. The USGCRP projects a region-wide decrease in precipitation, although with substantial variability in inter-annual conditions. For eastern Utah, the projections range from an approximate five percent decrease in annual precipitation to decreases as high as 40 percent of annual precipitation (Karl et al. 2009).

3.2 Soils

The Soil Survey of the Uinta Area, Utah – Parts of Daggett, Grand, and Uintah Counties, published by the U.S. Department of Agriculture (USDA) Soil Conservation Service, is the primary source of information concerning soils in the Project Area (USDA-NRCS 2003). This survey has been supplemented by additional information available on the Natural Resource Conservation Service (NRCS) soils survey website (USDA-NRCS 2012).

The development of soils is governed by many factors, including climatic conditions (e.g., the amount and timing of precipitation, temperature, and wind), the parent material that the soil is derived from, topographic position (e.g., slope, elevation, and aspect), geomorphic processes, and vegetation type and cover. Soils textures in the Project Area include stony fine sandy loam, gravelly sandy loam, fine sandy loam, very fine sandy loam, clay loam, and loamy fine sand. Badland-Rock outcrops are also present. Soils within the Project Area belong to the Badland, Green River, Greybull, Utaline, Jenrid, Ohtog, Parohtog, Shotnick, Walkup, Stygee, Tipperary, Blackston, and Turzo general soil series. Soil map units contain one or more of these soil series and are depicted in **Figure 3-1**. **Table 3-3** summarizes the 14 soil map units present in the Project Area as well as their whole soil erosion factors and restoration potentials.

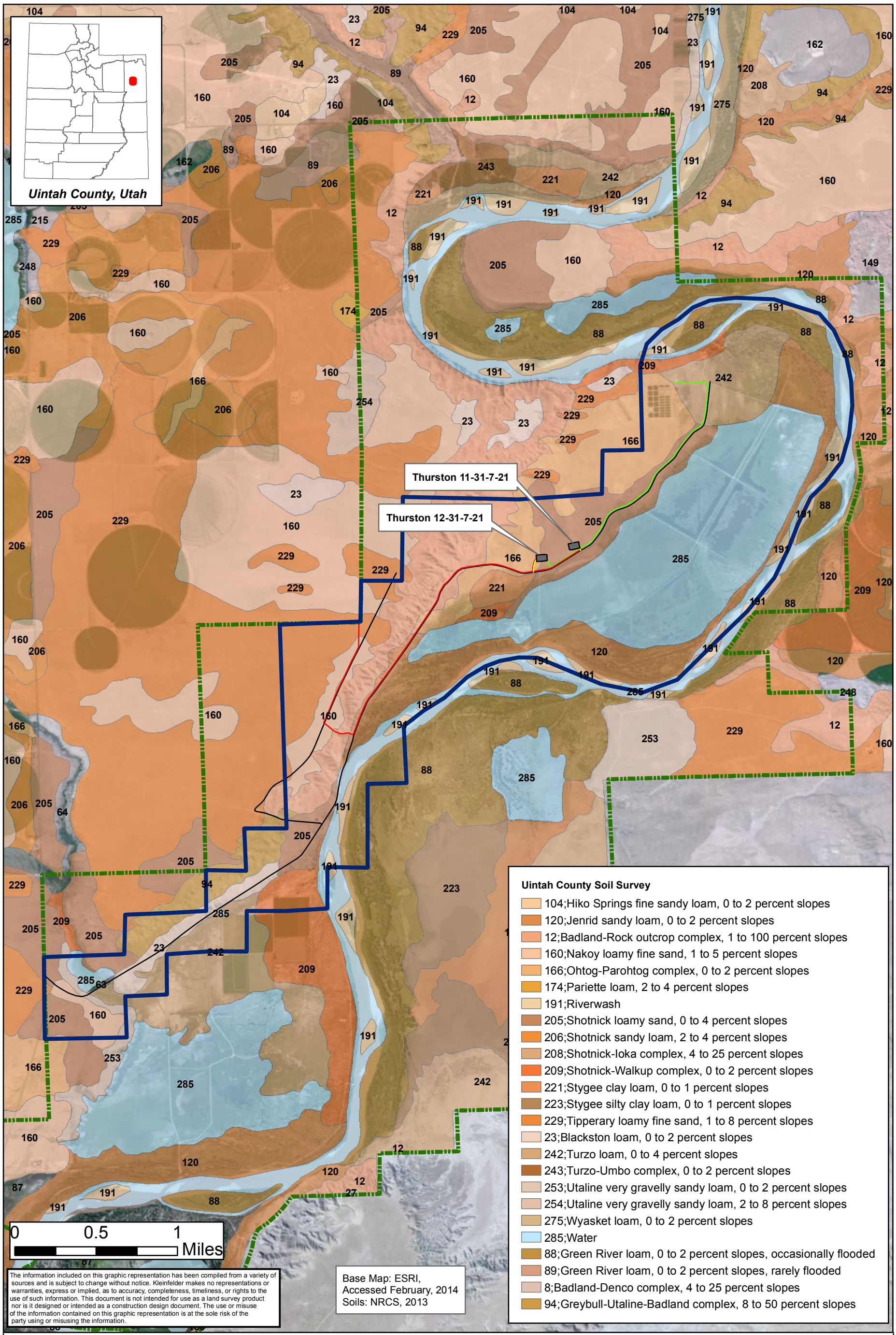
3.2.1 Erosion and Restoration Potential of Project Area Soils

To evaluate potential environmental impacts to Project Area soils, key attributes including whole soil erosion potential and soil restoration potential were identified. Soil mapping conducted by the NRCS provides information about each soil type and can be used to evaluate key attribute data and potential impacts for each soil unit.

Table 3-3. Soils Map Units within Project Area

Soil Map Unit	Acres within Project Area	Whole Soil Erosion Factor (Kw)	Restoration Potential
Badland-Rock outcrop complex, 1 to 100 percent slopes (12)	324	0.10	Not Rated
Green River loam, 0 to 2 percent slopes, occasionally flooded (88)	188	0.37	Low
Greybull-Utaline-Badland complex, 8 to 50 percent slopes (94)	91	0.10	Low
Jenrid sandy loam, 0 to 2 percent slopes (120)	421	0.28	Low
Nakoy loamy fine sand, 1 to 5 percent slopes (160)	157	0.28	Low
Ohtog-Parohtog complex, 0 to 2 percent slopes (166)	245	0.37	Low
Riverwash (191)	94	0.20	Not Rated
Shotnick loamy sand, 0 to 4 percent slopes (205)	332	0.24	Low
Shotnick-Walkup complex, 0 to 2 percent slopes (209)	96	0.32	Low
Stygee clay loam, 0 to 1 percent slopes (221)	38	0.32	Low
Tipperary loamy fine sand, 1 to 8 percent slopes (229)	176	0.43	Low
Turzo loam, 0 to 4 percent slopes (242)	285	0.37	Low
Blackston loam, 0 to 2 percent slopes (23)	76	0.37	Low
Utaline very gravelly sandy loam, 0 to 2 percent slopes (253)	19	0.10	Low
Unclassified (open water, water structures)	1,142	N/A	N/A
Total	**3,684**	**--**	**--**

Source: USDA – NRCS 2012



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_1Soils.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Uintah County Soil Survey

FIGURE **3-1**

3.2.1.1 Erosion Potential

Erosion potential can vary widely among soil units within a given geographic boundary. It is dependent upon particle size distribution, slope and aspect, and the amount and type of vegetation cover. The NRCS typically rates each of the soil units according to its whole soil erosion potential (Kw). The erosion potential indicates the general susceptibility of a soil to sheet and rill erosion. The value of Kw ranges from 0.02 to 0.69. The higher the Kw value of a soil type, the more susceptible the soil is to sheet and rill erosion.

Erosion hazards become critical issues when protective vegetation is removed from the soil surface. Typically, soils found on steeper slopes have a higher erosion hazard factor than those found on gentler slopes. Soils with more fine particles are at a greater risk of wind erosion, and conversely, soils with more gravel and/or stones are at a lower risk of wind erosion. The Kw values for soils within the Project Area ranges from 0.10 to 0.43, indicating a range of low to moderately-high whole soil erosion potential across the Project Area (refer to **Table 3-3**).

3.2.1.2 Restoration Potential

Restoration potential (also referred to as soil resilience) estimates a soil's inherent ability to restore functional and structural integrity after a disturbance and is measured in terms of the rate and degree of the recovery (USDA-NRCS 2003). Key attributes that factor into a soil's restoration potential include: sustaining biological activity; maintaining diversity and productivity; capturing, storing, and releasing water; storing and cycling nutrients and other elements; filtering, buffering, degrading, immobilizing, and detoxifying contaminants; providing support for plant and animal life; and protecting archaeological sites. Soil resilience is dependent upon adequate stores of organic matter, soil structure, low salt and sodium levels, nutrient levels, microbial biomass and diversity, adequate precipitation for recovery, and other soil properties. A high potential rating indicates that the soil has features that are very favorable for recovery and high restoration performance can be expected. Conversely, a low potential indicates that a soil has one or more features that are unfavorable for recovery, and poor restoration potential can be expected. As indicated in **Table 3-3**, 12 of the 14 soil types identified within the Project Area have low potential for restoration. Reclamation and remediation in this soil types would likely be difficult and may be unsuccessful in some instances. Soil resilience ratings are not provided by the NRCS for the remaining two soil map units in the Project Area.

3.3 Water Resources Including Floodplains, Wetlands, and Waters of the U.S.

3.3.1 Regional Overview

The Project Area lies within an arid to semi-arid region in the Uinta Basin of northeastern Utah. The Uinta Basin covers 6,969,600 acres (10,890 square miles) and is divided into two drainages – the North Slope and the South Slope of the Uinta Mountains. The North Slope is bounded by the Wyoming border to the north, the Uinta Mountains to the south, the Colorado border to the east, and the Bear River Basin to the west. The South Slope is bounded by the Uinta Mountains to the north, the Tavaputs Plateau and the Book Cliffs to the south, Diamond Mountain and the Colorado border to the east, and the Wasatch Mountains to the west. Kings Peak in the Uinta Mountains is the highest point in the basin (13,528 feet above mean sea level [amsl]). The lowest point in the basin (4,150 feet amsl) lies where the Green River exits in the basin above its confluence with the White River.

The North Slope of the Uinta Basin is drained by the Green River. Its primary tributary, the Duchesne River, drains the south slope. The eastern portion of the Uinta Basin, including part of Colorado, is

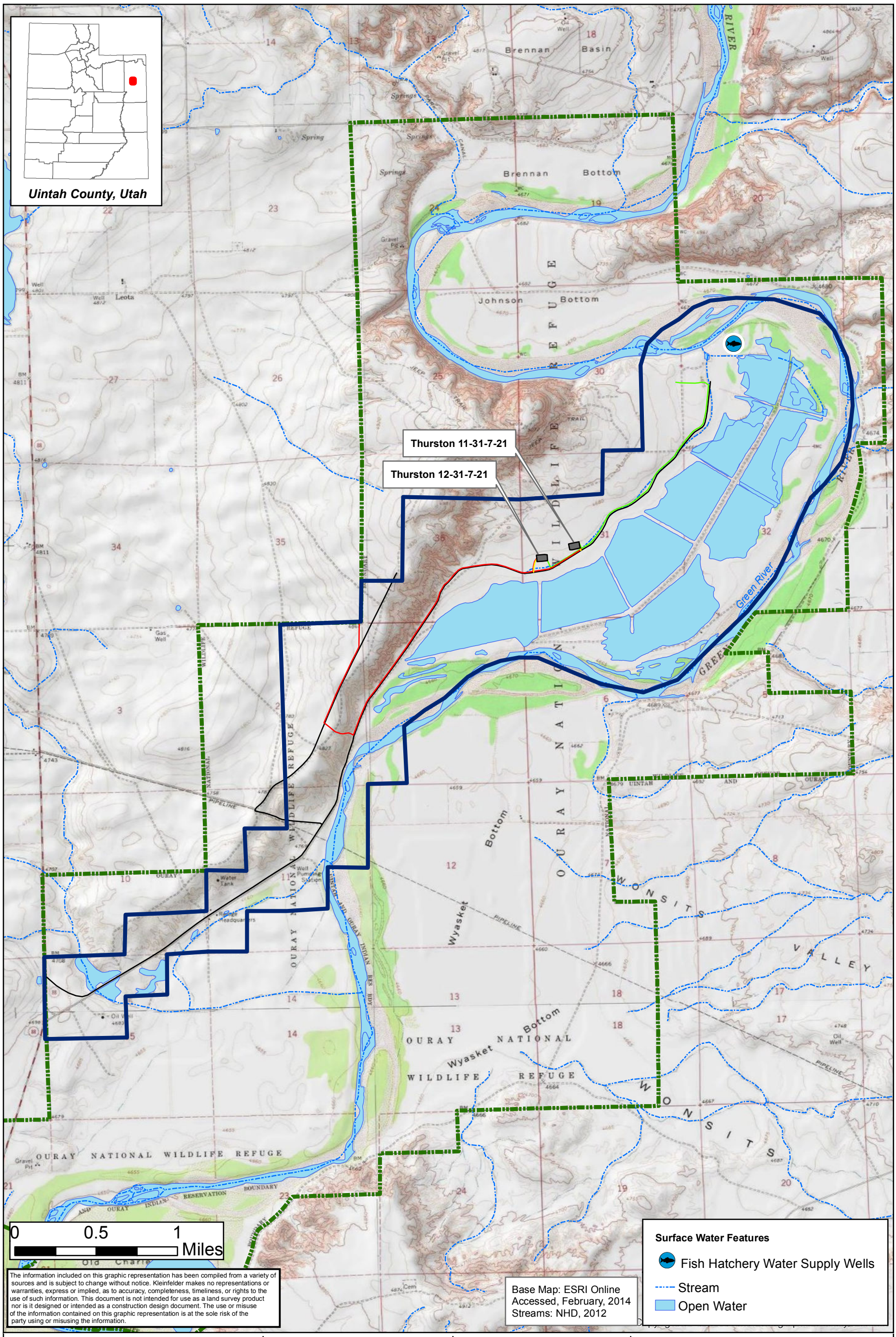
drained by the White River, which is also a tributary to the Green River. The Utah Division of Water Resources (UDWR) has divided the Uinta Basin into five subunits: Upper Green River, Ashley/Brush, Duchesne/Strawberry, Green River (middle and lower), and White River (UDWaR 1999). The proposed Project Area lies in the Green River watershed.

Water resources within the Project Area include the surface water features, alluvial and bedrock groundwater, floodplains, and wetlands and Waters of the U.S.

3.3.2 Surface Water

Figure 3-2 shows the surface water features in the vicinity of the Project Area. The proposed project facilities would lie on nearly level ground adjacent to the 100-year floodplain of the Green River on the Leota Bottom, one of five bottomlands located within the Ouray NWR. The Green River is a major river in the western United States. It originates in Wyoming at the Continental Divide, flows through the Uinta Basin, and joins the Colorado River about 110 miles south of Green River, Utah. Major tributaries to the Green River in the Uinta Basin include the Duchesne and the White Rivers.

As previously discussed, surface water flow on the Leota Bottom has been altered with the construction of dikes and levees that control seasonal flooding of the bottomlands along the Green River within the Ouray NWR. Since construction of the Flaming Gorge Dam, the flow regime of the Green River has changed dramatically resulting in the loss of riparian habitats. In response, portions of the levees have been removed to allow for more frequent flooding of the bottomlands.



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_2SurfaceWaterFeatures.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

Surface Water Features
Uintah County, Utah

FIGURE
3-2

3.3.2.1 Stream Classification

The Utah Water Quality Board classifies Utah surface water resources according to quality and degree of protection (UDEQ 2008). All streams and water bodies in Utah are assigned to one or more of five classes. The Green River is classified as Class 1C, 2B, and 3B. Class 1C streams are protected for domestic use with prior treatment by treatment processes as required by the Utah Division of Drinking Water. Class 2B streams are protected for secondary contact recreation such as boating, wading, or similar uses. Class 3B streams are protected for warm water species of game fish and other warm water aquatic life.

3.3.2.2 Stream Flow

Two United States Geological Survey (USGS) gauging stations are located on the Green River in the vicinity of the Project Area, including one located just downstream near Ouray, Utah (USGS 2013). This station was only monitored for stream flow discharge until 1966. A second gauging station near Jensen, Utah, has been monitored continuously since 1947 and provides a longer period of flow records. **Table 3-4** presents summary flow data for the two USGS stations.

Table 3-4. Stream Flow Data for USGS Gauging Stations

USGS Gauging Station Name and Number	Range of Monthly Mean Discharge (cfs)	Peak Daily Discharge (cfs)	Mean Annual Discharge (cfs)	Period of Record
Green River near Ouray, UT 09307000	1,925 (January) to 17,000 (June)	14,100 (June 11, 1952)	5,614	October 1947 – September 1966
Green River near Jensen, UT 09261000	1,900 (September) to 11,200 (May and June)	40,000 (May 18, 1984)	3,138	October 1946 – September 2012

Source: USGS 2013

Mean monthly stream flows on the Green River at Ouray range from 1,925 cubic feet per second (cfs) to 17,000 cfs, and peak in June and July. Fifty percent of all flows in the Green River are less than 2,760 cfs and 90 percent are less than 14,100 cfs at this location. Mean monthly stream flow for the Green River near Jensen ranges from 1,900 cubic feet per second (cfs) in September to 11,200 cfs in both the months of May and June (USGS 2013). **Figure 3-3** shows the hydrograph for the Green River near Jensen, Utah, for the period of March 1988 to March 2013. Flow patterns during this time period display a pattern of a rising limb, peak, and falling limb for each water year.

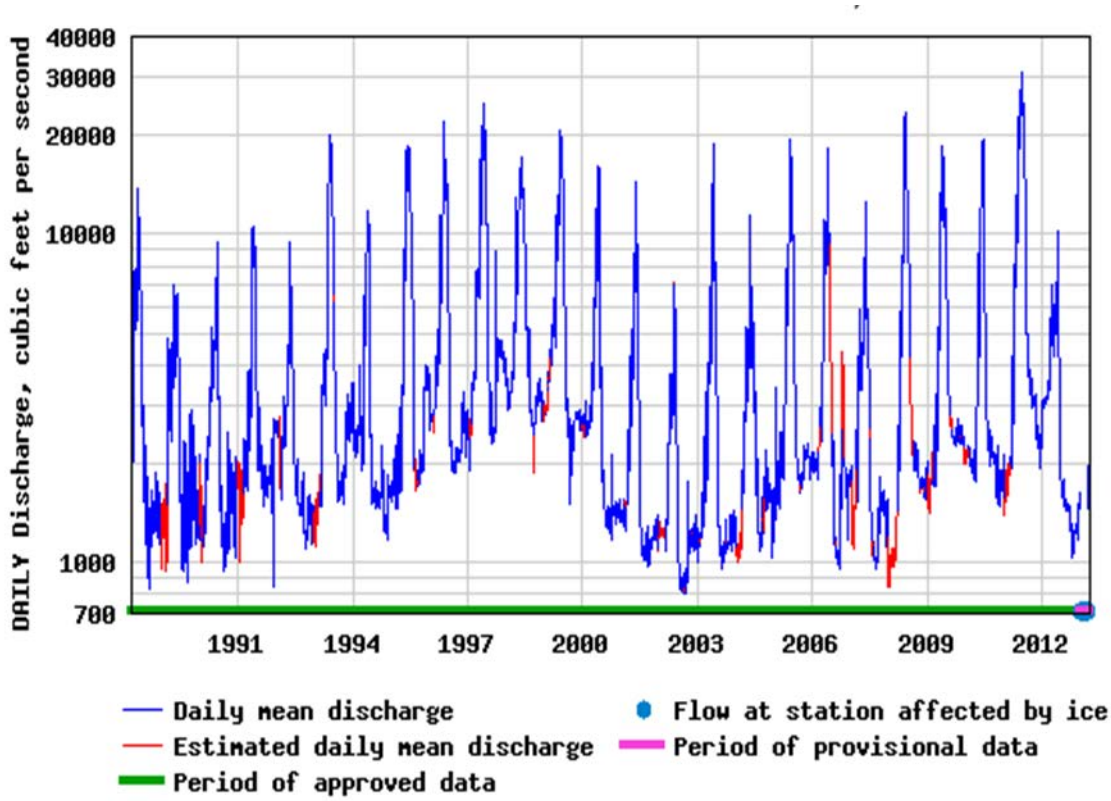


Figure 3-3. Hydrograph for USGS Gauging Station 0926100 Green River near Jensen, Utah (USGS 2013)

3.3.2.3 Surface Water Quality

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

The EPA has established primary and secondary drinking water standards (EPA 2009) for approximately 90 water contaminants as required by the Safe Drinking Water Act, as amended in 1996, and CWA of 1987, as amended. These regulations specify maximum contaminant levels (MCLs) and secondary standards for specific contaminants. The MCLs are health-based. Although these MCLs legally apply only to public drinking water supplies, they are also useful as general indicators of water quality. The secondary standards are for constituents that cause cosmetic effects (such as skin or tooth discoloration) or esthetic effects (such as taste, odor, or color) in drinking water. The CWA delegated the administration of these standards to cooperating States and Tribes, so long as the State standards are at least as stringent

as the federal standards. Most States, including Utah, now have primacy for the administration of the CWA and have also adopted State water-quality standards (UDEQ 2008), including numeric standards protective of aquatic biota.

Salinity refers to the total amount of salts in solution in surface waters, including sodium. The sodium hazard of irrigation water can be estimated by the sodium adsorption ratio (SAR), which is the proportion of sodium to calcium plus magnesium in the water. Waters with SARs in the range zero to six can generally be used on all soils with little problem of a sodium buildup. When SAR's range from six to nine, chances for soil permeability problems increase (Hergert and Knudson 1997). Water with an SAR greater than nine should not be used for irrigation, even if the total salt content is relatively low. Continued use of water having a high SAR can lead to a breakdown in the physical structure of the soil, called dispersion. Dispersion causes the soil to become hard and compact when dry and increasingly impervious to water penetration.

Salinity of surface waters is of concern within the Uinta Basin and other portions of the Colorado River Basin. The 1974 Colorado River Basin Salinity Control Act, Public Law 93-320, authorized the construction, operation, and maintenance of works in the Colorado River Basin to control the salinity of water delivered to Mexico. In 1994, Public Law 98-569 amended the Colorado River Basin Salinity Control Act and directed the Secretary (or Secretary of Agriculture) to develop a comprehensive program for minimizing salt contributions from lands administered by federal agencies. The Colorado River Basin Salinity Control Program is designed to provide the best management of the resource base and minimize increased salinity in the Colorado River System. Water quality standards for the salinity program are reviewed at least every three years with the most recent review occurring in 2011 (CRBSCF 2011).

Table 3-5 provides a summary of water quality analyses for samples collected from the Green River near Ouray from December 1950 to September 1951 and from October 1958 to September 1966 (USGS 2013). Waters in the Green River are described as calcium-sodium bicarbonate-sulfate type waters with moderate to very high hardness (110 – 640 mg/L as $CaCO_3$). Total dissolved solids (TDS) are variable and ranges from 168 mg/L to 1,380 mg/L, with an average of 525 mg/L. The waters are generally alkaline with pH ranging from 7.30 to 8.60 units, with an average of 7.91. Sulfate exceeded to secondary maximum contaminant level (SMCL) of 250 mg/L for 45 of 164 samples (27.4 percent). Values for all other parameters reported are less than the associated water quality standards, except for nitrate and iron. Nitrate exceeded the aquatic water standard of 4 mg/L for three samples out of 59, and iron exceeded the SMCL of 300 ug/L for one of 34 samples. Specific conductance ranges from 323 to 1,890 microsiemens per centimeter (uS/cm) with an average of 789 uS/cm. These values fall within the moderate to high salinity classes (USDA-George E. Brown, Jr., Salinity Laboratory 1954). The SAR of the waters ranges from 0.7 to 5.0 and averages 1.9. These are considered to be safe values for SAR. Total suspended solids (TSS) concentrations are quite variable, ranging from 87 mg/L to 52,300 mg/L, with an average of 4,900 mg/L. These high values are reflective of the high sediment loading to the Green River from sources in the Uinta Basin, Wyoming, and Colorado.

Table 3-5. Summary of Water Quality Analyses for the Green River at Ouray, USGS Gauging Station 09307000 (1950-1966)

Parameters	Standards		Summary Statistics		
	Drinking Water[1]	Aquatic Biota[3]	No. of Samples	Range	Mean
General Water Quality Indicators					
Temperature (°C)	-	-	182	0.6 – 28.3	16.7
Specific Conductance (uS/cm)	-	-	177	323 – 1,890	789
pH (standard units)	6.5-8.5[2]	6.5-9.0	167	7.60 – **8.60**	7.91
Total Hardness (mg/L)	-	-	167	110 – 640	267
Sodium Adsorption Ratio	-	-	156	0.7 – 5	1.90
Total Dissolved Solids (mg/L)	500[2]	1,200	174	168 – **1,380**	**525**
Total Suspended Solids (mg/L)	-	90	194	87 – **52,300**	**4,900**
Ionic Constituents					
Calcium (mg/L)	-	-	107	34 – 191	73.2
Magnesium (mg/L)	-	-	107	8.3 – 66	25.2
Sodium (mg/L)	-	-	157	19 – 250	73.5
Potassium (mg/L)	-	-	58	1.5 – 6.4	2.93
Chloride (mg/L)	250[2]	-	167	7.5 – 197	37.3
Sulfate (mg/L)	250[2]	-	164	50 – **621**	204
Fluoride (mg/L)	4[1], 2[2]	1.2 - 2.4[4]	57	0.2 – 0.8	0.39
Bicarbonate (mg/L)	-	-	168	112 – 320	195
Nitrate, total (mg/L)	10[1]	4	59	0.3 – **4.3**	1.66
Silica (mg/L)	-	-	78	7.3 – 21	12.3
Trace Metals					
Boron (ug/L)	-	-	58	50 – 300	143
Iron, total (ug/L)	300[2]	1,000	42	<0.1 – **330**	29.3

All samples are dissolved (filtered) unless otherwise noted.
Bold values exceed standards.
Average values calculated using one-half the detection limit for non-detect values
[1] Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2] Federal Drinking Water Secondary Standard
[3] Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code)
[4] Value is dependent on temperature and pH
Source: USGS 2013

The Utah Division of Environmental Quality (UDEQ) also monitors and assesses the Green River on a regular basis to determine if the river is supporting beneficial uses. Water quality data have been collected from the Green River at UDEQ station 4937020 located downstream of the Project Area near Ouray, Utah. These data are stored in the EPA STORET database, which reports all non-detect values simply as "Non-detect". Calculation of any central tendency (mean or median) using non-detect values requires that the instrument detection limit is known for each parameter and individual analysis. Non-detect values cannot simply be assumed to be zero. Therefore, for the STORET stations, a mean was calculated only for parameters with less than 20 percent of the available values reported as non-detect.

Table 3-6 provides a summary of water quality analyses for samples collected from UDEQ station 4937020 from February 1976 to June 2006 (EPA 2012). Values for general water quality parameters are generally lower than those recorded at the USGS station. TDS ranged from 158 to 618 mg/l with an average of 413 mg/l, pH ranged from 6.60 to 9.16, and TSS ranged from 1 to 5,768 mg/l with an average of 344 mg/l. Specific conductance ranged from 222 to 866 µmhos/cm with an average of 624 µmhos/cm. These values fall within the moderate to high salinity classes. Dissolved oxygen, pH, TDS, TSS, ammonia, sulfate, aluminum, copper, silver, and zinc exceeded standards for one or more samples each.

Table 3-6. Summary of Water Quality Analysis for Green River near Ouray, UDEQ Station 4937020 (1976-2006)

	Standards		Summary Statistics			
Parameters	**Drinking Water**	**Aquatic Biota[3]**	**No. of Samples**	**No. of Detects**	**Range of Detects**	**Mean**
General Water Quality Indicators						
Dissolved Oxygen (mg/L)	–	> 6.5	183	183	**3.8** – 14.6	8.79
pH	6.5 to 8.5[2]	6.5 to 9.0	316	316	6.60 – **9.16**	8.22
Hardness (mg/L)	–	–	159	159	88.2 – 298.1	229
Spec. Cond. (umhos/cm)	–	–	364	364	222 – 866	624
Temperature (^{o}C)	–	–	175	175	-0.15 – 28.5	11.8
Total Dissolved Solids (mg/L)	500[2]	1,200	176	176	158 – **618**	413
Total Suspended Solids (mg/L)	–	90	174	174	1 – **5,768**	**344**
Ionic Constituents						
Bicarbonate (mg/L)	–	–	183	183	31 – 280	171
Calcium (mg/L)	–	–	183	183	23 – 82	54.4
Chloride (mg/L)	250[2]	–	181	175	0.85 – 60.1	18.7
Fluoride	2[1], 4[2]	–	17	17	0.11 – 0.34	0.26
Magnesium (mg/L)	–	–	183	183	7 – 33	22.2
Ammonia (mg/L)	–	0.11 to 0.49[4]	176	55	0.047 – **0.7**	NC
Nitrite + Nitrate, total (mg/L)	10(1[5])	4	62	54	0.02 – 1.13	0.28
Phosphate, total (mg/L)	–	–	178	168	0.02 – 4.08	0.24
Potassium (mg/L)	–	–	183	182	1.0 – 5.5	2.70
Sodium (mg/L)	–	–	183	183	13 – 110	50.3
Sulfate (mg/L)	250[2]	–	183	183	40.8 – **417**	168
Trace Metals (Dissolved)						
Aluminum (ug/L)	50 to 200[2]	750	33	14	30 – **220**	NC
Arsenic (ug/L)	10[1]	190	51	8	0.9 – 4	NC
Barium (ug/L)	2,000[1]	1,000	49	44	5.6 – 203	69.0
Boron			20	20	36 – 200	121
Cadmium (ug/L)	5	250	49	1	3	NC
Chromium (ug/L)	100[1]	74	48	1	5.2	NC
Copper (ug/L)	1300[1], 1000[2]	9	50	3	5 – **49**	NC
Iron (ug/L)	300[2]	1,000	50	28	0.4 – 190	NC
Lead (ug/L)	15[1]	2.5	49	1	1	NC
Manganese (ug/L)	50[2]	–	49	15	5 – 39	NC
Mercury	–	0.012	45	0	--	--
Nickel	–	52	3	0	--	--
Selenium (ug/L)	50[1]	5	50	32	0.5 – 5	NC
Silver (ug/L)	100[2]	1.6	49	1	**10**	NC
Zinc (ug/L)	5,000[2]	120	50	9	6 – **210**	NC

Bold values exceed standards NC = Mean not calculated due to undefined non-detect values in database
[1] Federal Drinking Water Primary Maximum Contaminant Level (MCL)
[2] Federal Drinking Water Secondary Standard (SMCL)
[3] Aquatic life (Utah Water Quality Standards, R317-2 Utah Administrative Code).
[4] Value is dependent on temperature and pH
[5] Federal Drinking Water Quality Standard is 1 mg/L for Nitrite and 10 mg/L for Nitrate
Source: EPA 2012

3.3.3 Groundwater

Groundwater in the southern Uinta Basin is contained in a complex system of shallow unconsolidated, perched, and deep confined aquifers. The principal aquifers in the Project Area include unconsolidated alluvial deposits along the Green River and deeper sandstone zones within the Uinta Formation and Green River Formation (Hood and Fields 1978; Schlotthauer et al. 1981).

Unconsolidated materials present in the valley fill beneath Leota Bottom form the principal aquifer in the Project Area. This alluvial aquifer is recharged by direct precipitation and infiltration of stream flow from the Green River. The average thickness of alluvium along the Green River has been reported to be about 30 feet. The hydraulic conductivity of these deposits ranges from about 1 to 25 feet/day (Price and Miller 1975; Holmes and Kimball 1987).

The Uinta Formation contains water-bearing zones within confined sandstone layers surrounded by fine-grained siltstones and mudstones. The Green River Formation is often considered an aquiclude and generally prevents downward movement of groundwater; however, two zones within the formation are considered to be regional aquifers. The Bird's Nest Aquifer, which may be present beneath the Project Area, lies between the upper part of the Parachute Creek Member and the Mahogany Zone. The aquifer is generally 90 to 205 feet thick, with an average thickness of about 115 feet. The hydraulic conductivity of the aquifer is enhanced by the dissolution of the nahcolite and fracturing. The Bird's Nest Aquifer contains an estimated 1.9 million acre-feet of water in storage (Holmes and Kimball 1987). The Douglas Creek Aquifer underlies much of the southern Uinta Basin and is generally about 500 feet thick. The Douglas Creek Member of the Green River Formation also produces water to some wells from fine- to medium-grained sandstone beds (Howells et al. 1987). Aquifer tests conducted in the Douglas Creek aquifer show that transmissivity ranges from about 16 to 170 feet squared per day, and the storage coefficient ranges from about 7×10^{-4} to 2.5×10^{-4}. The Douglas Creek aquifer contains an estimated 16 million acre-feet in storage (Holmes and Kimball 1987).

3.3.3.1 Groundwater Quality

There is limited information concerning the quality of groundwater in the Project Area. Groundwater in unconsolidated alluvial aquifers in the southern Uinta Basin generally reflects the overall water quality of nearby streams, rivers, or recharge sources (Matthew Fry, personal communication, October 20, 2012). Away from outcrop areas, water quality generally is poorer and becomes much higher in dissolved solids with depth.

The Ouray NFH maintains a water supply well field within the Project Area, as shown on **Figure 3-2**. This well field produces about 630 gallons per minute (gpm) from the shallow alluvium beneath the Leota Bottom. The water from this well shows an average TDS of 396 mg/l, similar to the average value recorded for the Green River. Alkalinity (240 mg/l), ammonia (0.009 to 0.015 mg/l), pH (7.70), and hardness (324 mg/l) are also similar to the River water. The alluvial groundwater contains higher average concentrations of iron (1,500 µg/l) and manganese (900 µg/l) than the River water.

The TDS concentrations in the Uinta Formation are reported to range from 3,260 mg/L to 64,300 mg/L (Schlotthauer et al. 1981). The Bird's Nest Aquifer generally produces water with TDS between 3,000 and 10,000 mg/L, but some water from the zone is unusable (TDS more than 10,000 mg/L). The TDS of water in the Douglas Creek aquifer is also generally between 3,000 and 10,000 mg/L. Use of groundwater from the Uinta and Green River Formations is limited to livestock watering and industrial uses because of its poor quality in terms of TDS and hardness.

3.3.4 Floodplains, Wetlands, and Waters of the U.S.

3.3.4.1 Floodplains

Floodplains are typically dry lands that are susceptible to inundation by adjacent rivers or streams. The extent of floodplain inundation depends in part on the flood magnitude. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream or river, which consists of accumulations of sand, gravel, silt, and clay formed by deposition of sediment carried by runoff from the mesa tops and canyon walls during storm and snowmelt events (USFWS 1979a). These floodplains support riparian vegetation and wetlands and are often underlain by alluvial groundwater aquifers. Floodplains typically support rich ecosystems, both in quantity and diversity. Nutrient levels, primary productivity, and macro invertebrate populations are highest in the floodplain depressions following a flood event. The Green River floodplains also serve as important nursery and forage habitat for the endangered razorback sucker and bonytail chub.

Currently, floodplains are protected by Executive Order 11988, which requires that all federal agencies take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

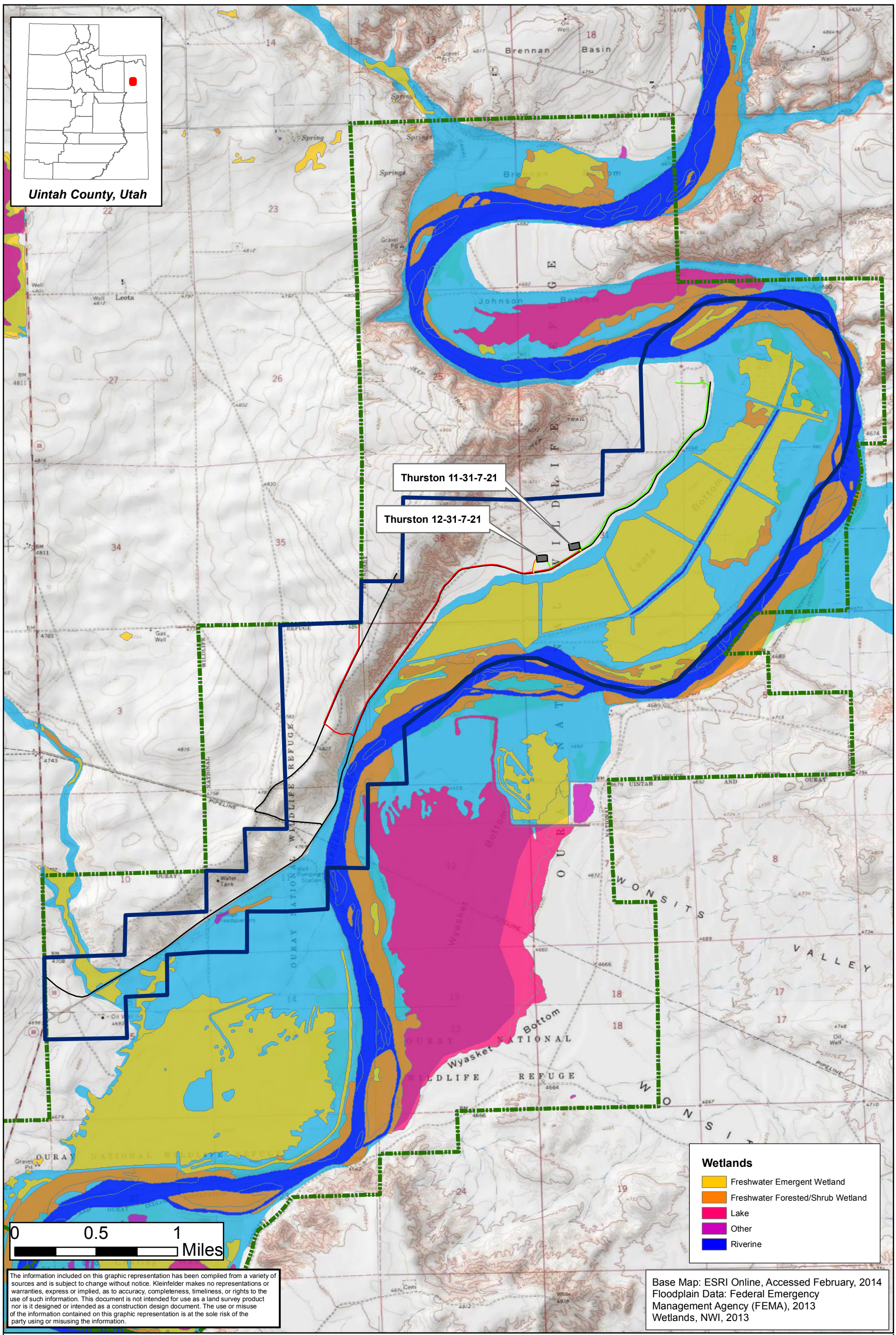
Within the Project Area, zones likely to be inundated from a 100-year, 24-hour event are indicated on **Figure 3-4**.

3.3.4.2 Wetlands and Waters of the U.S.

Under Section 404 of the CWA, the USACE has authority to regulate the discharge of dredged and fill material into waters of the U.S. including non-navigable tributaries that typically flow year-round or have flow at least seasonally (e.g., typically three months). Wetlands can be jurisdictional under Section 404 as a subset of Waters of the U.S. Wetlands, as defined by the EPA and the USACE in the Wetland Delineation Manual are “those areas that are inundated or saturated by surface or groundwater at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (USACE, Environmental Laboratory 1987).

Wetland areas can generally be identified in the Project Area during the spring and summer months by the green belt of vegetation adjacent to the Green River or in marsh areas where ground water is close to the soil surface. Drought conditions can make identification of riparian and wetland habitat problematic.

Wetlands can be distinguished from other vegetative communities by the unique combination of hydrology, soils, and vegetation. A location’s hydrology is typically the determining characteristic distinguishing wetlands from adjacent upland habitat. The hydrology of any site is linked in part to precipitation, but the development and propagation of wetland habitat is dependent on the long-term presence of available water. As discussed in **Section 1.1** and **Section 3.3.2,** the flow regime of the Green River has changed dramatically since the construction of Flaming Gorge Dam, resulting in loss of wetland and riparian habitat. As a result, surface water flow on the Leota Bottom has been altered with the construction of dikes and levees to control seasonal flooding along the Green River within the Refuge.



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

N

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary
- 100 Year Flood Zones

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_4Floodplain.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

100-Year Floodplains
Uintah County, Utah

FIGURE
3-4

As shown in **Figure 3-4**, wetlands comprise approximately 1,183 acres or 32 percent of the Project Area. The USFWS National Wetlands Inventory (NWI) has identified two primary wetland vegetation types: Freshwater Emergent Wetland and Freshwater Forested/Shrub Wetland. These wetlands occur east and south of Wildlife Refuge Road and abut the Green River.

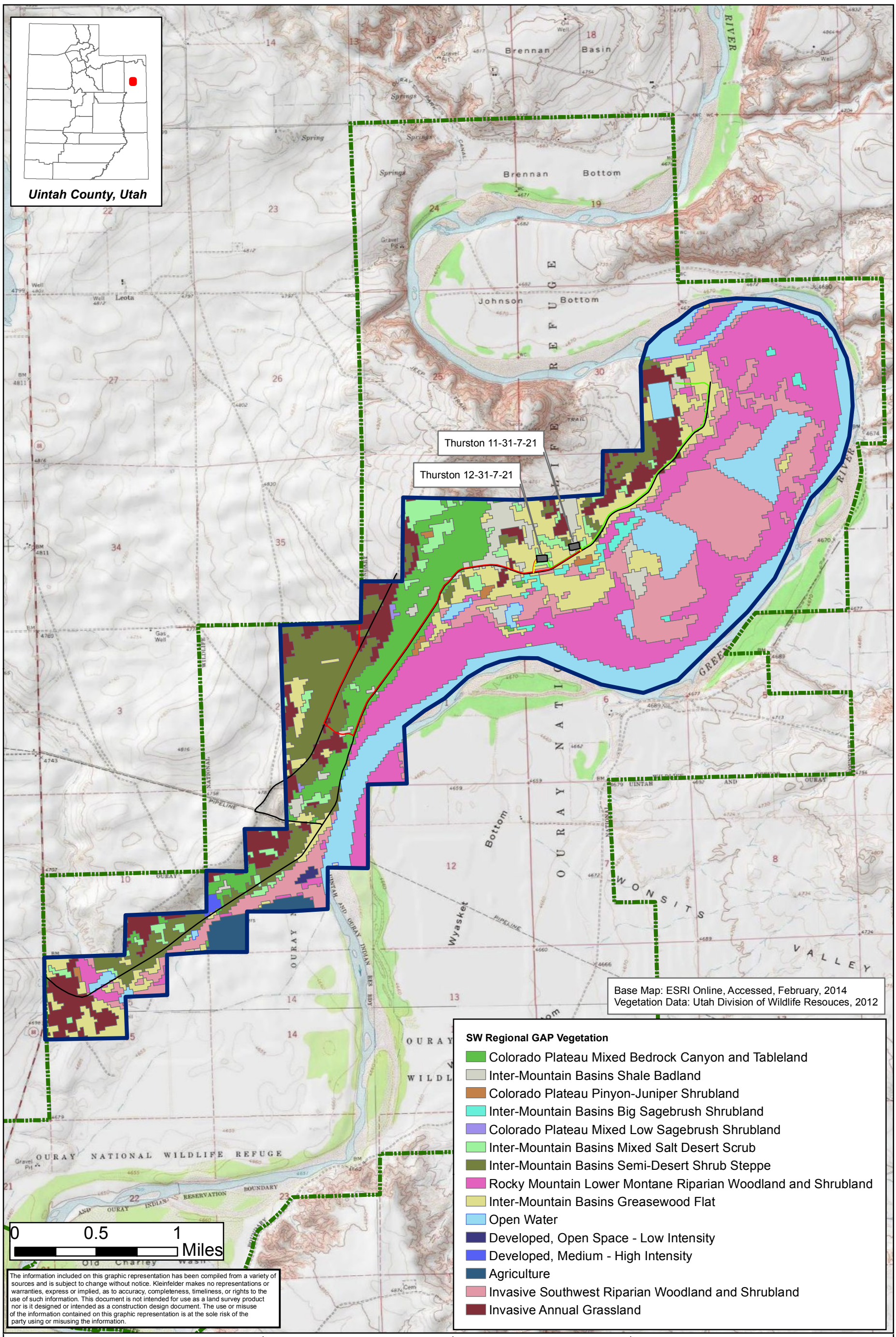
The USACE has established a series of Nationwide Permits (NWP) that authorize certain activities in Waters of the U.S., provided that a proposed activity can demonstrate compliance with standard conditions. Generally, USACE requires an individual permit for an activity that will affect an area equal to or in excess of 0.5 acre of Waters of the U.S. However, the USACE, Utah Regulatory Office verified on February 27, 2012, that none of the project facilities were located within Waters of the U.S., including wetlands (see **Appendix B,** Hollis Jencks, personal communication, May 7, 2012). As such, no USACE Section 404 permit will be required for the Project.

3.4 Biological Resources

3.4.1 General Vegetation

The Project Area is located within the intermountain semi-desert region of the Colorado Plateau Floristic Province. This region mixes an array of geographic substrates, topographic features, climatic regimes, soil types, and other physical factors, which have combined to produce a mosaic of floristic components and associated natural habitats. The plant communities encountered in the Project Area consist of typical inter-mountain basin shrubland associations. These communities are often mixed, transitional, or widely distributed.

The vegetation communities identified in this analysis are derived from data obtained from the Southwest Regional Gap Analysis Project (SWReGAP) as well as vegetation land cover descriptions provided by the USGS Gap Analysis Program (USGS-NGAP 2005). The SWReGAP data provides land cover and vegetation characterization for the southwestern United States (Arizona, Colorado, New Mexico, Nevada and Utah) and encompasses 560,000 square miles within these states. Data on wetlands were supplemented with interpretation of aerial photographs and information from USFWS NWI maps (USFWS-NWI 1983). In this effort, a total of 14 vegetation communities are recognized and mapped within the Project Area, as depicted in **Figure 3-5**.



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_5Vegetation.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Vegetation Cover Types
Uintah County, Utah

FIGURE
3-5

Table 3-7 summarizes acreage of vegetation communities within the Project Area. These 13 vegetation types can be grouped into five general land cover types. These include Scrub/Shrub, Grasslands/Herbaceous, Riparian, Barren Lands, and Altered or Disturbed Land.

Table 3-7. National Vegetation Classification Standard Recognized Vegetation Communities within the Project Area

Land Cover Type	Vegetation Community	Acres Within the Project Area[1]	Percent Within the Project Area
Scrub/Shrub	Colorado Plateau Mixed Low Sagebrush Shrubland	3	0.1
	Inter-Mountain Basin Mixed Salt Desert Shrubland	109	3.0
	Colorado Plateau Pinyon-Juniper Shrubland	14	0.4
	Inter-Mountain Basins Big Sagebrush Shrubland	33	0.9
Total		**159**	**4.4**
Grasslands/ Herbaceous	Inter-Mountain Basins Semi-Desert Shrub Steppe	347	9.4
Total		**347**	**9.4**
Riparian	Inter-Mountain Basins Greasewood Flat	398	10.8
	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	878	23.8
Total		**1,276**	**34.6**
Barren Lands	Colorado Plateau Mixed Bedrock Canyon and Tableland	275	7.5
	Inter-Mountain Basins Shale Badland	101	2.7
Total		**376**	**10.2**
Open Water	Open Water	572	15.5
Total		**572**	**15.5**
Altered or Disturbed Land	Invasive Annual Grassland	321	8.7
	Invasive Southwest Riparian Woodland and Shrubland	574	15.6
	Agricultural Lands	48	1.3
	Existing Development	11	0.3
Total		**954**	**25.9**
Grand Total		**3,684**	**100.0**

[1] Total acreage estimates are based on GIS-software calculations and may not equal total acreage by soil map unit due to rounding, removal of overlapping development, and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore, will be used throughout this document.

*Note: Individual acreages may not equal totals due to rounding.

Source: Lowry et al. 2007.

3.4.1.1 Scrub/Shrub

The Scrub/Shrub land cover type covers approximately 159 acres (4.4 percent) within the Project Area and includes four vegetation cover types: Colorado Plateau Mixed Low Sagebrush Shrubland, Inter-mountain Basins Mixed Salt Desert Shrubland, Colorado Plateau Pinyon-Juniper Shrubland, and Inter-Mountain Basins Big Sagebrush Shrubland. These vegetation types are found on the western half of the Project Area outlining the North American Warm Desert Badlands. The four scrub/shrub vegetation types that occur in the Project Area are described briefly below.

Colorado Plateau Mixed Low Sagebrush Shrubland

This vegetation cover type occurs in the Colorado Plateau, Tavaputs Plateau, and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 6,000 feet amsl. Soils are often rocky, shallow, and alkaline. It includes open shrublands and steppe dominated by black sagebrush (*Artemisia nova*) or Bigelow sagebrush (*Artemisia bigelovii*), and sometimes with Wyoming big sagebrush (*Artemisia tridentata spp. wyomingensis*). The Colorado Plateau Mixed Low Sagebrush Shrubland type covers approximately 3 acres (0.1 percent) within the Project Area.

Inter-Mountain Basins Mixed Salt Desert Shrubland

This widespread shrub-steppe system is dominated by perennial grasses and forbs and occurs throughout much of the northern Great Basin and Wyoming. Soils are typically deep and nonsaline, often with a microphytic crust. Shrubs may increase following heavy grazing and/or with fire suppression. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more saltbush species such as shadscale saltbush (*Atriplex confertifolia*), fourwing saltbush (*Atriplex canescens*), cattle saltbush (*Atriplex polycarpa*), or spiny saltbush (*Atriplex spinifera*). Other shrubs present to codominate may include Wyoming big sagebrush, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush (*Ericameria nauseosa*), Mormon tea (*Ephedra nevadensis*), spiny hopsage (*Grayia spinosa*), winterfat (*Picrothamnus desertorum*), bud sagebrush (*Picrothamnus desertorum*), or shortspine horsebrush (*Tetradymia spinosa*). These shrublands and steppe habitats are the most prevalent vegetation community in the Project Area, covering approximately 109 acres (3.0) percent of the Project Area.

Colorado Plateau Pinyon-Juniper Woodland and Shrubland

This cover type is present in the dry mountains and foothills of the Colorado Plateau region along the Western Slope of Colorado through to the Wasatch Range. Typically found at lower elevations ranging from 5,000 to 8,000 feet amsl, this community is dominated by dwarfed (usually less than 10 feet tall) two-needle pinyon (*Pinus edulis*) and/or Utah juniper (*Juniperus osteosperma*) trees that form extensive tall shrublands. These trees occur in a mosaic with taller (usually greater than 10 feet tall), more dense woodland associations of two-needle pinyon and/or Utah juniper. These stands may be solely dominated by Utah juniper (*Juniperus osteosperma*) or may be co-dominated by other Juniperus species. Other shrubs that may occur in this vegetation community may include black sagebrush (Artemisia nova), Wyoming big sagebrush or yellow rabbitbrush. This vegetation type is present within 14 acres (0.4 percent) of the Project Area.

Inter-Mountain Basins Big Sagebrush Shrubland

Located in basins between mountain ranges, plains, and foothills, this vegetation cover type occurs throughout much of the western U.S., at elevations between 5,000 and 7,500 feet amsl. Soils are typically deep, well drained, and non-saline. These shrublands are dominated by Basin big sagebrush (*Artemisia tridentata ssp. tridentata*) and/or Wyoming big sagebrush. Scattered juniper (*Juniperus spp.*), greasewood (*Sarcobatus vermiculatus*) and saltbush (*Atriplex spp.*) may be present in some stands. Rubber rabbitbrush

(*Ericameria nauseosa*), yellow rabbitbrush, antelope bitterbrush (*Purshia tridentata*), or mountain snowberry (*Symphoricarpos oreophilus*) may co-dominate altered/disturbed stands. This vegetation type covers about 33 acres (0.9 percent) within the Project Area.

3.4.1.2 Grasslands/Herbaceous

The Grasslands/Herbaceous land cover type covers approximately 347 acres within the Project Area and encompasses one vegetation cover type, the Inter-Mountain Basins Semi-Desert Shrub Steppe. Grasslands/Herbaceous is found throughout the Project Area and is most common around wetland and agricultural areas. The description of an Inter-Mountain Basins Semi-Desert Shrub Steppe can be found below.

Inter-Mountain Basins Semi-Desert Shrub Steppe

This cover type includes shrublands of typically saline basins, alluvial slopes, and plains across the intermountain western U.S. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but they can include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more saltbush species, with a sparse to moderately dense herbaceous layer dominated by perennial grasses. Characteristic grasses include Indian ricegrass, blue grama, saltgrass (*Distichlis spicata*), needle-and-thread grass, James' galleta, Sandberg bluegrass (*Poa secunda*), and alkali sacaton (*Sporobolus airoides*). Characteristic shrub species include fourwing saltbush, sand sagebrush (*Artemisia filifolia*), Greene's rabbitbrush (*Chrysothamnus greenei*), yellow rabbitbrush, rubber rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), and winterfat. Scattered Basin big sagebrush species may be present but does not dominate. This vegetation type covers approximately 347 acres (9.4 percent) of the Project Area.

3.4.1.3 Riparian

The Riparian land cover type is the most abundant, covering approximately 1,276 acres within the Project Area, and includes two vegetation cover types: Inter-mountain Basins Greasewood Flat and Rocky Mountain Lower Montane Riparian Woodland and Shrubland. These areas are the most abundant in the Project Area and are primarily in the central, northwest, and southwest regions. The descriptions of each of the two cover types can be found below.

Inter-Mountain Basins Greasewood Flat

This vegetation cover type occurs throughout much of the western United States in intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils and a shallow water table. They may flood intermittently but remain dry for most growing seasons. This vegetation cover type usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by greasewood (*Sarcobatus vermiculatus*), fourwing saltbush, shadscale saltbush, or mulefat may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. This woody vegetation community covers approximately 398 acres (10.8 percent) of the Project Area.

Rocky Mountain Lower Montane Riparian Woodland and Shrubland

This vegetation cover type is found in the foothills, canyon slopes, and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. These shrublands occur between 5,000 and 9,500 feet amsl in elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, all of which limit tree growth. Dominant trees may include boxelder (*Acer*

negundo), narrowleaf cottonwood (*Populus angustifolia*), balsam poplar (*Populus balsamifera*), eastern cottonwood (*Populus deltoids*), Fremont cottonwood (*Populus fremontii*), Douglas-fir (*Pseudotsuga menziesii*), blue spruce (*Picea pungens*), peachleaf willow (*Salix amygdaloides*), or Rocky Mountain juniper (*Juniperus scopulorum*). Dominant shrubs include Rocky Mountain maple (*Acer glabrum*), speckled alder (*Alnus incana*), water birch (*Betula occidentalis*), red osier dogwood (*Cornus sericea*), river hawthorn (*Crataegus rivularis*), stretchberry (*Forestiera pubescens*), chokecherry (*Prunus virginiana*), skunkbush sumac (*Rhus trilobata*), park willow (*Salix monticola*), Drummond's willow (*Salix drummondiana*), narrowleaf willow (*Salix exigua*), sandbar willow (*Salix irrorata*), shining willow (*Salix lucida*), or silver buffaloberry (*Shepherdia argentea*). The Rocky Mountain Lower Montane Riparian Woodland and Shrubland type occurs on approximately 878 acres (23.8 percent) of the Project Area.

3.4.1.4 Barren Lands

The Barren Lands land cover type covers approximately 376 acres (10.2 percent) within the Project Area and includes two vegetation cover types, which include Colorado Plateau Mixed Bedrock Canyon and Tableland as well as the Inter-Mountain Basins Shale Badland. This cover type is prevalent along a western steep elevation gradient and along the Green River in arid sediment deposits. A description of these cover types can be found below.

Inter-Mountain Basins Shale Badland

This widespread vegetation cover type of the intermountain western U.S. is composed of barren and sparsely vegetated substrates typically derived from marine shales; however, this vegetation community also includes substrates that are derived from siltstones and mudstones (clay) with a high rate of erosion and deposition. Landforms are typically rounded hills and plains that form a rolling topography. Environmental variables that lead to sparse dwarf-shrubs are harsh soil properties and the high rate of erosion and deposition. Species in this category include mat saltbush, Gardner's saltbush, birdfoot sagebrush, and herbaceous vegetation. The Inter-Mountain Basins Shale Badland type covers approximately 101 acres (2.7 percent) within the Project Area.

Colorado Plateau Mixed Bedrock Canyon and Tableland

The distribution of this vegetation cover type is centered on the Colorado Plateau where it is composed of barren and sparsely vegetated landscapes on steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common varieties include two-needle pinyon, Ponderosa pine (*Pinus ponderosa*), Juniper species, littleleaf mountain mahogany (*Cercocarpus intricatus*), and other short-shrub and herbaceous species. These species have adapted to using moisture from cracks and pockets where soil accumulates as habitat. The Colorado Plateau Mixed Bedrock Canyon and Tableland type covers approximately 275 acres (7.5 percent) within the Project Area.

3.4.1.5 Altered or Disturbed Land

Altered or Disturbed Land accounts for approximately 954 acres (25.9 percent) within the Project Area and includes four vegetation cover types: Invasive Annual Grassland, Invasive Southwest Riparian Woodland and Shrubland, Agricultural Lands, and Existing Development. While not a necessarily a vegetation cover type, the Existing Development category includes all scraped or excavated bare land which is, or has been, in transition to a developed state. The four categories of altered or disturbed vegetation communities that occur in the Project Area are described below.

Invasive Annual Grassland and Invasive Southwest Riparian Woodland and Shrubland

The Invasive Annual Grassland type covers approximately 321 acres (8.7 percent) of the Project Area and is concentrated around the Refuge and North American Warm Desert Badlands within the Project Area. These areas are dominated by introduced annual grass species such as cheatgrass (*Bromus tectorum*) and California brome (*Bromus carinatus*). The Invasive Southwest Riparian Woodland and Shrubland type covers approximately 574 (15.6 percent) and is dominated by tamarisk (*Tamarix spp*.). This vegetation cover type is found along the Green River and intermixed with Rocky Mountain Lower Montane Riparian Woodland and Shrublands.

Agricultural Lands

The agricultural vegetation type includes areas used for the production of alfalfa and barley. There are also areas of fallowed and disked land that are used for agriculture. The agricultural vegetation community accounts for approximately 48 acres (1.3 percent) of the Project Area and is located in the southwest-most region of the Project Area along near the Green River.

Existing Development

This category, which covers an estimated 11 acres (0.3 percent) of the Project Area, includes all scraped or excavated bare land which is currently in, or has previously been in, transition to a developed state. Included in this category are all lands covered by urban development, including residential, transportation and utility infrastructure, well pads, mines, quarries, and other surface features. Isolated structures such as farmsteads and low density residential areas are also included in this category. Included in this category is an existing Ouray NFH facility which has developments in the northernmost and southernmost portions of the Project Area.

3.4.2 Invasive and Noxious Weeds

A “noxious weed” is legally defined under both federal and state laws and is often used interchangeably with the term “invasive weed”. The Federal Plant Protection Act of 2000 (formally the Noxious Weed Act of 1974 [7 U.S.C. §2801-2814]) states that a noxious weed is defined as “any plant or plant product that that can directly or indirectly injure or cause damage to crops, livestock poultry or other interests to agriculture, irrigation, navigation, the natural resources of the United States, the public health or the environment” (USDA- Animal Plant and Health Inspection Service 2010; Institute of Public Law 1994). Every state is federally mandated to support and enforce the rules and regulations stipulated under the Federal Plant Protection Act and manage their lands accordingly. In addition to federal legislation regarding noxious weeds, the Utah Department of Agriculture and Food (2010) has crafted the Utah Noxious Weed Act. Under this act, the Commissioner of Agriculture and Food defines a noxious weed as any plant that is especially injurious to public health, crops, livestock, land or other property (Utah State Legislature 2007). The term “invasive weeds” may include plants not listed as noxious weeds, but are not native to their particular area.

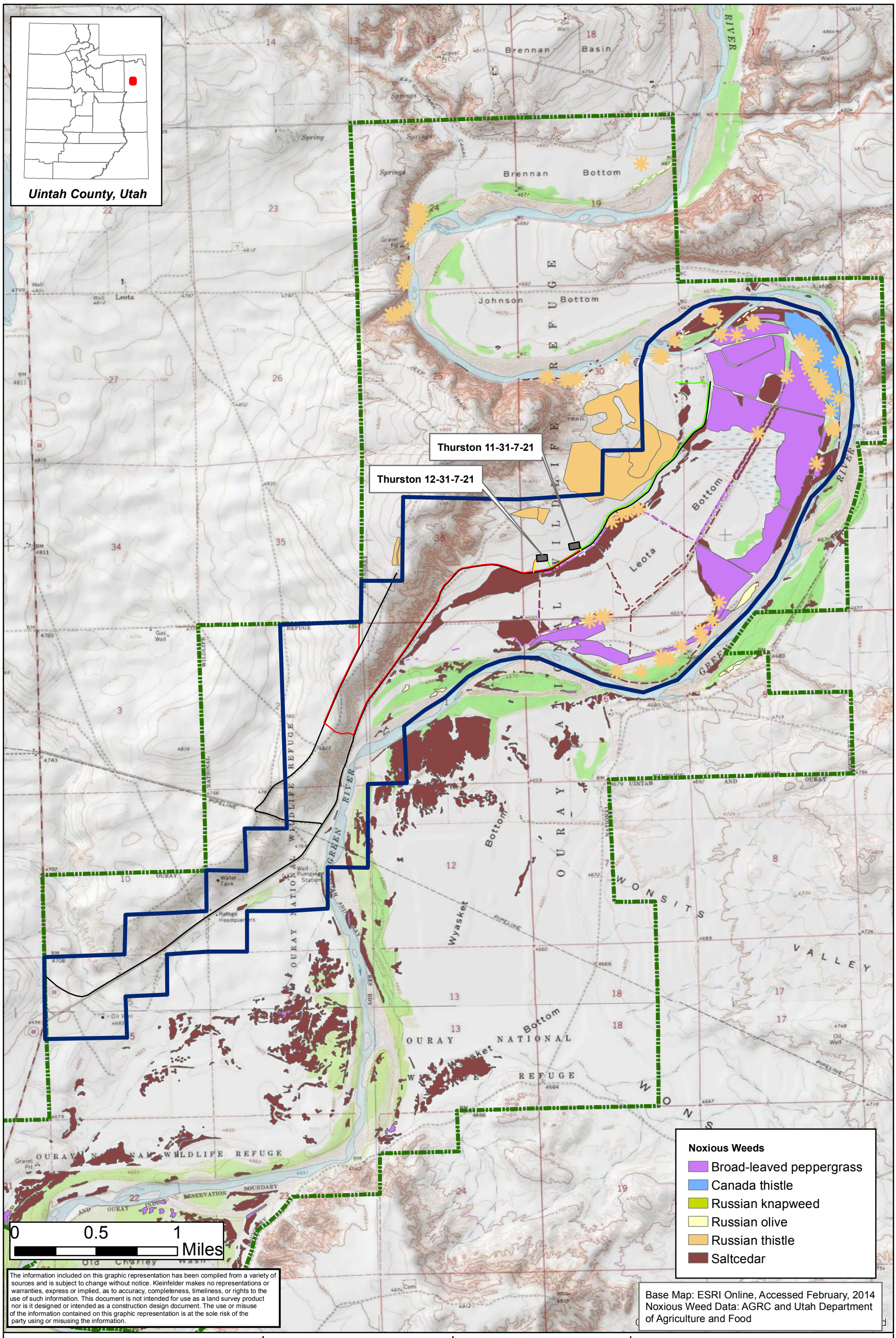
In areas of disturbance, vegetation communities may have a heightened susceptibility to the introduction of noxious weeds. Noxious weeds are most abundant in areas of prior surface disturbance such as roadsides, agricultural lands, utility ROW, areas of grazing, well pads, and adjacent washes. The prevention of introduction of noxious weeds is a priority to federal, state, and county agencies. Under Executive Order (EO) 13112 of February 3, 1999 – Invasive Species, federal agencies shall not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the U.S. or elsewhere, unless it has been determined that the benefits of such actions outweigh the potential harm caused by invasive species and that all feasible and prudent measures to minimize the risk of harm will be taken in conjunction with the actions.

Some 13 species of noxious weeds are known to occur within the Refuge (see **Table 3-8**). The most abundant within the Project Area is saltcedar (*Tamarix ramosissima*), which occurs on approximately 529 acres (14.3 percent) of the Project Area along the Green River and along the road edges of Refuge Road. Kochia (*Kochia scoparia*) and Cheatgrass (*Bromus tectorum*) are also abundant and each occurs on approximately 2,000 acres of the Refuge. Other noxious weeds found on the Refuge include Russian olive (*Elaeagnus angustifolia*), Russian thistle (*Salsola tragus*), Russian knapweed (*Centaurea repens*), broad-leaved peppergrass (*Lepidium latifolium*), and Canada thistle (*Cirsium arvense*). These species are most commonly found along the Green River and other disturbed areas within the Refuge. The distributions of mapped noxious weeds that are known to occur on the Ouray NWR are depicted in **Figure 3-6.**

Table 3-8. Noxious Weeds Known to Occur on the Ouray NWR

Common Name	Scientific Name	State or County Noxious Weed List
Musk Thistle	*Cardus Nutans*	State List Class B
Broad-leaved Peppergrass*	*Lepidium latifolium*	State List Class B
Russian Knapweed*	*Centaurea repens*	State List Class B
Scotch Thistle	*Onopordum acanthium*	State List Class B
Canada Thistle*	*Cirsium arvense*	State List Class C
Field Bindweed	*Convolvulus arvensis*	State List Class C
Saltcedar*	*Tamarix ramosissima*	State List Class C
Russian Olive*	*Elaeagnus angustifolia*	Uintah County List C
Russian Thistle*	*Salsola tragus*	N/A
Bull Thistle	*Cirsium vulgare*	N/A
Siberian Elm	*Ulmus pumila*	N/A
Kochia	*Kochia scoparia*	N/A
Cheatgrass	*Bromus tectorum*	N/A

Source: USFWS 2013b *Known to occur within the Project Area



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_6NoxiousWeeds.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Noxious Weeds
Uintah County, Utah

FIGURE
3-6

3.4.3 Fish and Wildlife

3.4.3.1 Wildlife Habitats

The Project Area and surrounding region support a variety of natural vegetation communities and landscape features that offer a diversity of wildlife habitat types. While these habitat types correspond with the vegetation community types discussed in **Section 3.4.1** above, they are also defined by a number of distinct landscape features such as washes and gullies, rock outcrops and hillsides, cliffs and badlands. All contribute to the diversity and abundance of wildlife in the area as they generally provide a microhabitat for wildlife uniquely adapted to or dependent on these features. Habitats for numerous wildlife species, including small mammals, game species, various species of rodents and bats, migratory birds, raptors, herptiles, and aquatic species occur in the Project Area. These species occupy the area on a year-round or seasonal basis. Species' occurrences are typically dependent on habitat availability, carrying capacities, and the degree of existing habitat quality.

3.4.3.2 General Wildlife

Small mammals potentially found within the Project Area and surrounding region include the white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), northern river otter (*Lutra canadensis*), American beaver (*Castor canadensis*), and various species of rodents, foxes, and bats. Large non-game mammals include moose (*Alces alces*), bison (*Bos bison*), black bear (*Ursus americanus*), mountain lion (*Felis concolor*), and lynx (*Lynx spp.*). Bird species that may be present include the black-throated sparrow (*Amphispiza bilineata*), Say's phoebe (*Sayornis saya*), ferruginous hawk (*Buteo regalis*), Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), grasshopper sparrow (*Ammodramus savannarum*), and horned lark (*Eremophila alpestris*). Herptiles potentially found in the region include the wandering garter snake (*Thamnophis elegans vagrans*), Great Basin gopher snake (*Pituophis catenifer deserticola*), western rattlesnake (*Crotalus viridis*), northern leopard frog (*Rana pipiens*), western whiptail (*Cnemidophorus tigris*), sagebrush lizard (*Sceloporus graciosus*), and short-horned lizard (*Phymosoma douglassii*) (USFWS 2000a).

Although all of these species are important members of wildland ecosystems and communities, most are common and have wide distributions within the region. Consequently, the relationship of most of these species to the proposed project is not discussed in the same depth as species that are threatened, endangered, sensitive, of special economic interest, or are otherwise of high interest or unique value.

3.4.3.3 Big Game

Three resident big game species are known to occur in the Project Area and surrounding region: pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and American elk (*Cervus elaphus*). Habitats and management prescriptions for these species as well as their distribution within the Project Area and surrounding region are described below.

Pronghorn

Pronghorn typically inhabit grasslands and semi-desert shrublands of the western and southwestern United States. The species is common in Utah, where it can be found in desert, grassland, and sagebrush habitats (UDWR 2009). Of these habitats, nearly all pronghorn populations in Utah occur in shrub steppe habitat, where large expanses of low rolling or flat terrain characterize the topography. Pronghorn are typically less abundant in xeric habitats because the abundance of water is important to long-term population viability. Pronghorn habitat in Utah often shows a scarcity of naturally available water

(UDWR 2009). Pronghorn are commonly found in small groups and tend to be most active during the day (UDWR 2009). Typically, daily movements do not exceed six miles. Some pronghorn make seasonal migrations between summer and winter ranges, but these migrations are often tied to the availability of succulent plants and not local weather conditions such as snow accumulations (Fitzgerald et al. 1994).

The UDWR manage pronghorn, along with other big game herds within the State, at the Herd Unit level. Pronghorn that occur within the Ouray NWR and surrounding region are considered to be a part of the Vernal and Bonanza subunits of the South Slope Herd Unit (Herd Units #9B and #9D). Trend counts of pronghorn and other big game populations are conducted annually with fixed-wing aircraft between February and April. Those are supplemented with pre-season classification counts from the ground in August and September to determine fawn production and buck:doe ratios. The historic statewide population trend for pronghorn from 1999 to 2011 has trended upwards from a population estimate just below 10,000 in 1999 to just below 13,000 in 2011 (UDWR 2012c).

The latest (2011) population estimate for the Vernal subunit was approximately 126 individuals (UDWR 2012c). Pre-hunt production ratios in 2011 were estimated at 51 fawns and 43 bucks per 100 does (UDWR 2012c). A total of 41 individuals were successfully harvested from the herd in 2011, including 27 bucks and 14 does. The harvest history for this subunit generally reflects a fluctuating pronghorn population.

The latest (2011) population estimate for the Bonanza subunit is approximately 298 total animals; a 33 percent increase from 2010's estimate of 223 (UDWR 2012c). Pre-hunt production ratios in 2011 were estimated to be 49 fawns and 64 bucks per 100 does (UDWR 2012c). According to spring trend data this subunit, the population has declined from approximately 836 adults in 2003 to 475 adults in 2009 (UDWR 2011b).

Pronghorn occupy portions of the Project Area on a year-round basis and are found in low numbers in a variety of upland habitats that are characterized by low rolling, wide-open, expansive areas within scrub and shrub vegetation communities. The UDWR has designated approximately 420 acres (11 percent) of the Project Area as year-long substantial habitat for pronghorn. The remaining 3,264 acres (89 percent) of land within the Project Area is unclassified (see **Figure 3-7**). Although there is no year-long crucial habitat for pronghorn within the Project Area, it does occur immediately adjacent to the Project Area on the east side of the Green River.

Mule Deer

Mule deer are common statewide in Utah, where the species can be found in many types of habitat, ranging from open deserts to high mountains to urban areas (UDWR 2012a). Typical habitats include short-grass and mixed-grass prairies, sagebrush and other shrublands, coniferous forests, and shrubby riparian areas. Mating occurs in late fall, and females may produce a litter of one or two fawns in late spring or early summer (UDWR 2012d). Fawn production is closely tied to the abundance of succulent green forage during the spring and summer months, whereas deer are especially reliant on shrubs for forage during the winter (UDWR 2012a). Thick-treed habitats may offer shelter from severe weather, but offer little in the way of forage (UDWR 2012a).

Mule deer that occupy the Project Area are considered to be part of the Vernal and Bonanza subunits of the South Slope Herd Unit (Units #9B and #9D). The Vernal subunit (Unit #9B) had a winter population estimate of 11,600 mule deer (winter population estimates for Unit #9D were not available), which is approximately 11 percent below the 13,000 population objective for this subunit (UDWR 2012a). Pre-

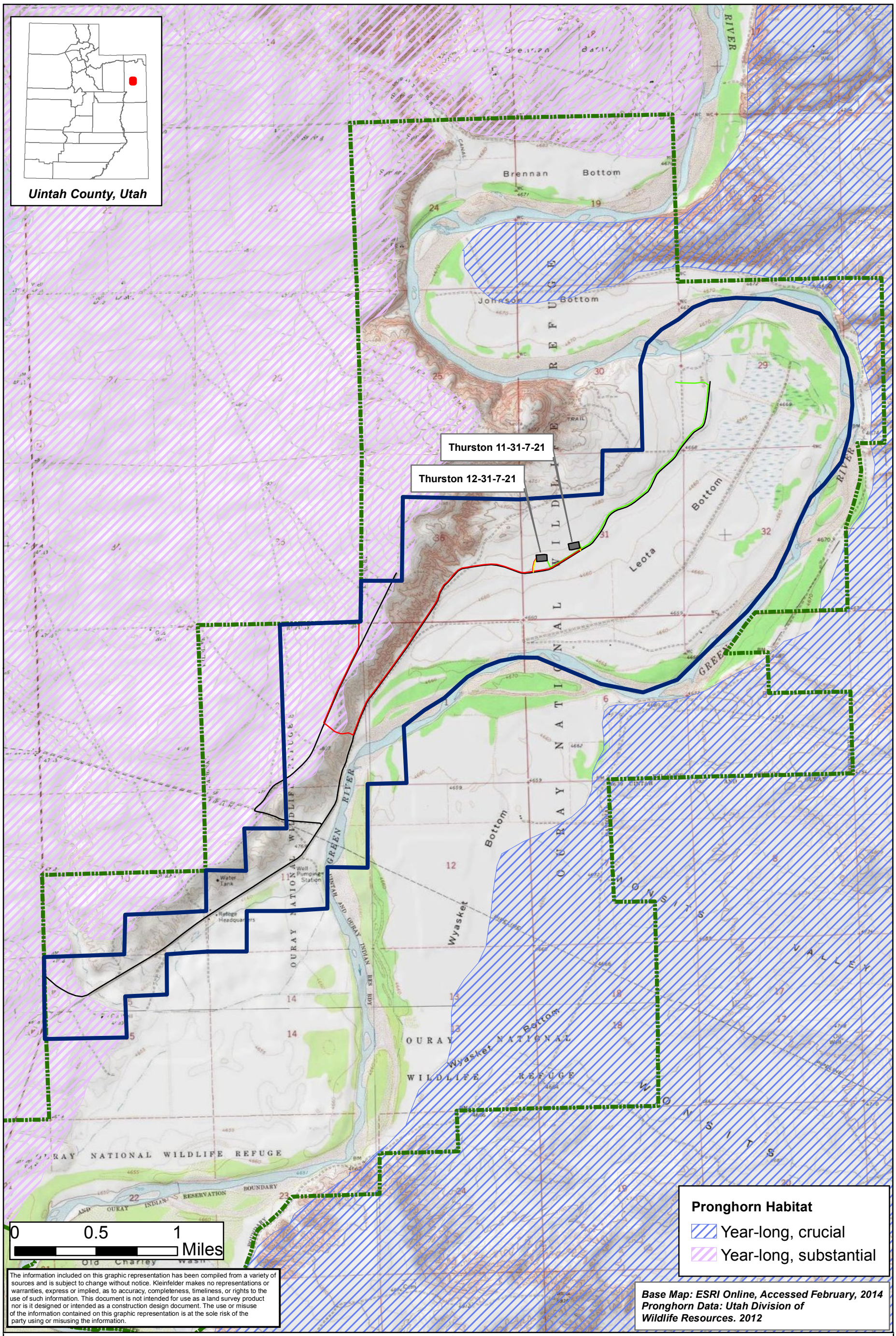
hunt production ratios for Units # 9B and 9D in 2011 were 61 fawns per 100 does, which was slightly below the three year average of 66 from 2009 to 2011 (UDWR 2012a).

Mule deer occupy portions of the Project Area on a year-round basis. The UDWR has identified approximately 2,966 acres (81 percent) of the Project Area as year-long, crucial value fawning habitat and about 24 acres (less than 1 percent) as year-long, substantial. The remaining 694 acres (19 percent) of land within the Project Area is unclassified (see **Figure 3-8**).

Elk

Elk have an extremely variable diet and occupy a variety of habitats in Utah (UDWR 2005). Elk are common in most mountainous regions of Utah, where they can be found in mountain meadows and forests during the summer and in foothills and valley grasslands during the winter (UDWR 2010). The species can also be found in the low deserts of Utah (UDWR 2005). Like other members of the deer family, this species relies on a combination of grasses, forbs, and woody plants depending on their availability throughout the year (UDWR 2010). Elk consume mostly grasses and forbs during the summer and browse during the winter (UDWR 2005).

Currently, there are no UDWR-designated seasonal ranges for elk within the Project Area; however, elk have become a significant big game animal of interest within the Ouray NWR. As of 2011, the Project Area has been opened to limited elk hunting for the first time. Elk that occupy the Project Area and surrounding region are considered to be part of the South Slope-Vernal/Diamond Mountain Unit (USFWS 2011b). This herd had a 2011 population estimate of 2,700 animals, which is approximately eight percent above objective for this population (UDWR 2011b). Pre-hunt production ratios for Herd Unit #9B was 43 calves and 8 bulls per 100 cows. No recent information was provided for Herd Unit #9D.



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

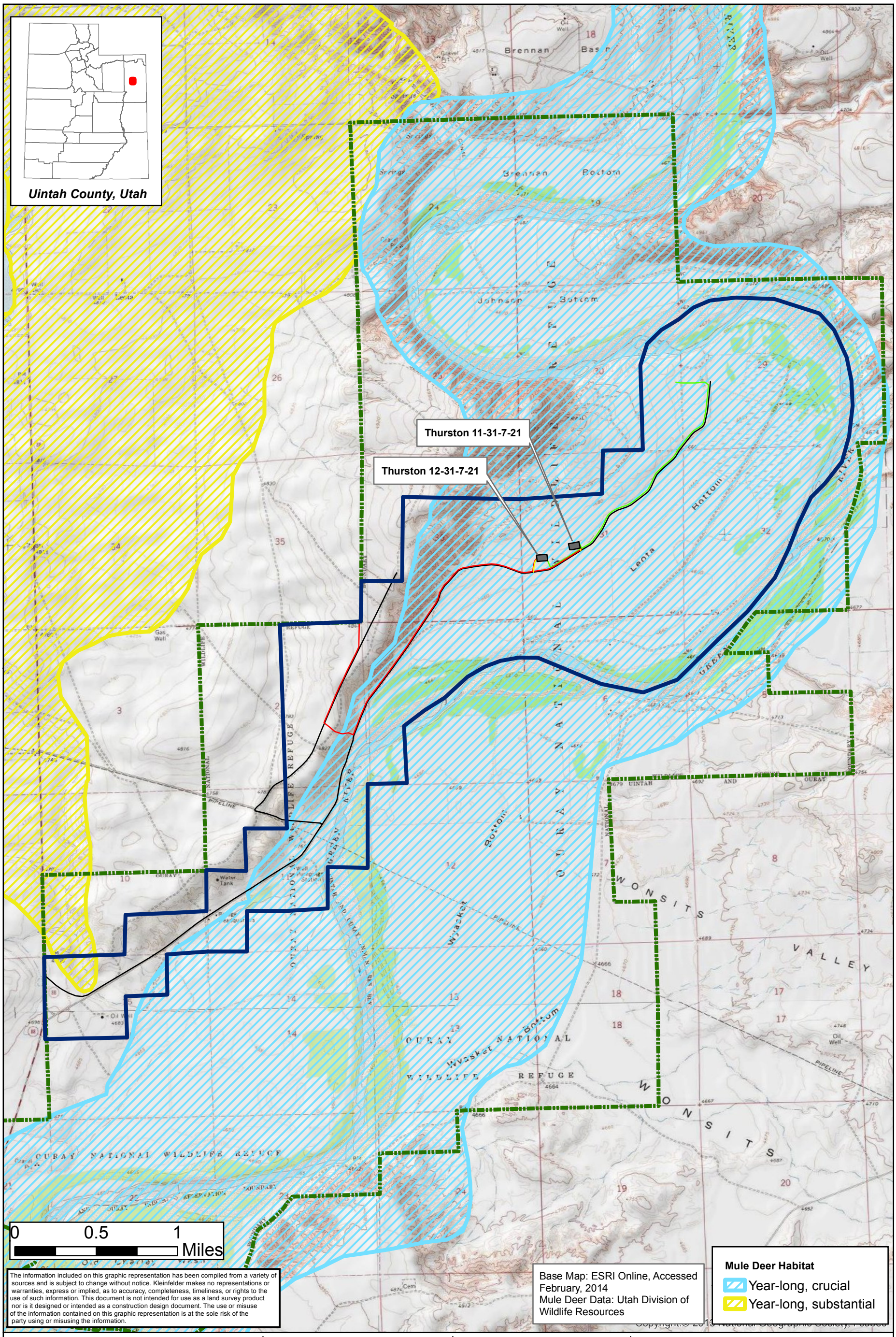
Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_7Pronghorn.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Pronghorn Seasonal Ranges
Uintah County, Utah

FIGURE
3-7



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Road
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_8MuleDeer.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Mule Deer Seasonal Ranges Uintah County, Utah

FIGURE **3-8**

3.4.3.4 Upland Game

Upland game with the potential to occur in the Project Area include populations of ring-necked pheasant (*Phasianus colchicus*), California quail (*Callipepla californica*), wild turkey (*Meleagris gallopavo*), mourning dove (*Zenaida macroura*), rock dove (*Columba livia*), band-tailed pigeon (*Columba fasciata*), white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail rabbit (*Sylvilagus audubonii*). Habitat for these species can be found throughout the Project Area. Annual fluctuations for most upland game populations closely correlate with annual climatic patterns. Mild winters and early precipitation during the spring are associated with increases in upland game populations. Warm, dry weather during the early summer is generally considered vital for the survival of newly born young of many upland game species. Annual surveys are conducted to measure the production, trend, and harvest of each upland game population (UDWR 2012b). Many upland game species (e.g., cottontail rabbits and mourning doves) easily adapt to human disturbance and can often be found near disturbed/built areas such as well sites and along roadsides.

3.4.3.5 Waterfowl

The Ouray NWR was originally established to provide prime breeding, resting, and feeding areas for migratory waterfowl (USFWS 2000a). Some 26 species of migratory waterfowl are known to occur within the Ouray NWR, and at least 12 of these species were documented to nest on the Refuge (see **Table 3-9**). Waterfowl habitat within the Project Area is present within emergent wetlands, open water sites, and along the along the Green River. Pelican Lake, located southeast of the Ouray NWR, is an important wintering area for waterfowl because the Green River serves as a migratory corridor for much of the waterfowl in eastern Utah.

Table 3-9. Waterfowl Species Known to Occur on the Ouray NWR

Common Name	Scientific Name	Confirmed Nesting on Ouray NWR (Yes/No)
Greater White-fronted Goose	*Anser albifrons*	No
Snow Goose	*Chen caerulescens*	No
Canada Goose	*Branta canadensis*	Yes
Trumpeter Swan	*Cygnus buccinator*	No
Tundra Swan	*Cygnus columbianus*	No
Wood Duck	*Aix sponsa*	No
Gadwall	*Anas strepera*	Yes
American Wigeon	*Anas americana*	No
Mallard	*Anas platyrhynchos*	Yes
Blue-winged Teal	*Anas discors*	Yes
Cinnamon Teal	*Anas cyanoptera*	Yes
Northern Shoveler	*Anas clypeata*	Yes
Northern Pintail	*Anas acuta*	Yes
Green-winged Teal	*Anas crecca*	Yes
Canvasback	*Aythya valisineria*	Yes
Redhead	*Aythya americana*	Yes
Ring-necked Duck	*Aythya collaris*	No
Greater Scaup	*Aythya marila*	No
Lesser Scaup	*Aythya affinis*	No
Bufflehead	*Bucephala albeola*	No

Common Name	Scientific Name	Confirmed Nesting on Ouray NWR (Yes/No)
Common Goldeneye	*Bucephala clangula*	No
Barrow's Goldeneye	*Bucephala islandica*	No
Hooded Merganser	*Lophodytes cucullatus*	No
Common Merganser	*Mergus merganser*	Yes
Red-breasted Merganser	*Mergus serrator*	No
Ruddy Duck	*Oxyura jamaicensis*	Yes

Source: USFWS 2013d

Annual surveys of migratory waterfowl are conducted on the Ouray NWR to describe general trends in the number of waterfowl resting and feeding on the Refuge through the years. Survey results for Leota Bottom for years 2007 through 2011 are presented in **Figure 3-9** (USFWS 2011a). Dabbling ducks were the most common, showing a peak in numbers during April and during the late summer months, followed by diving ducks that often showed a peak in April. Migratory waterfowl use of the Refuge is largely influenced by off-refuge factors, such as annual variations in weather conditions and food resources throughout the Central Flyway. On the Refuge, food availability and the extent of human disturbance, such as hunting and boating, greatly influence the number of birds present.

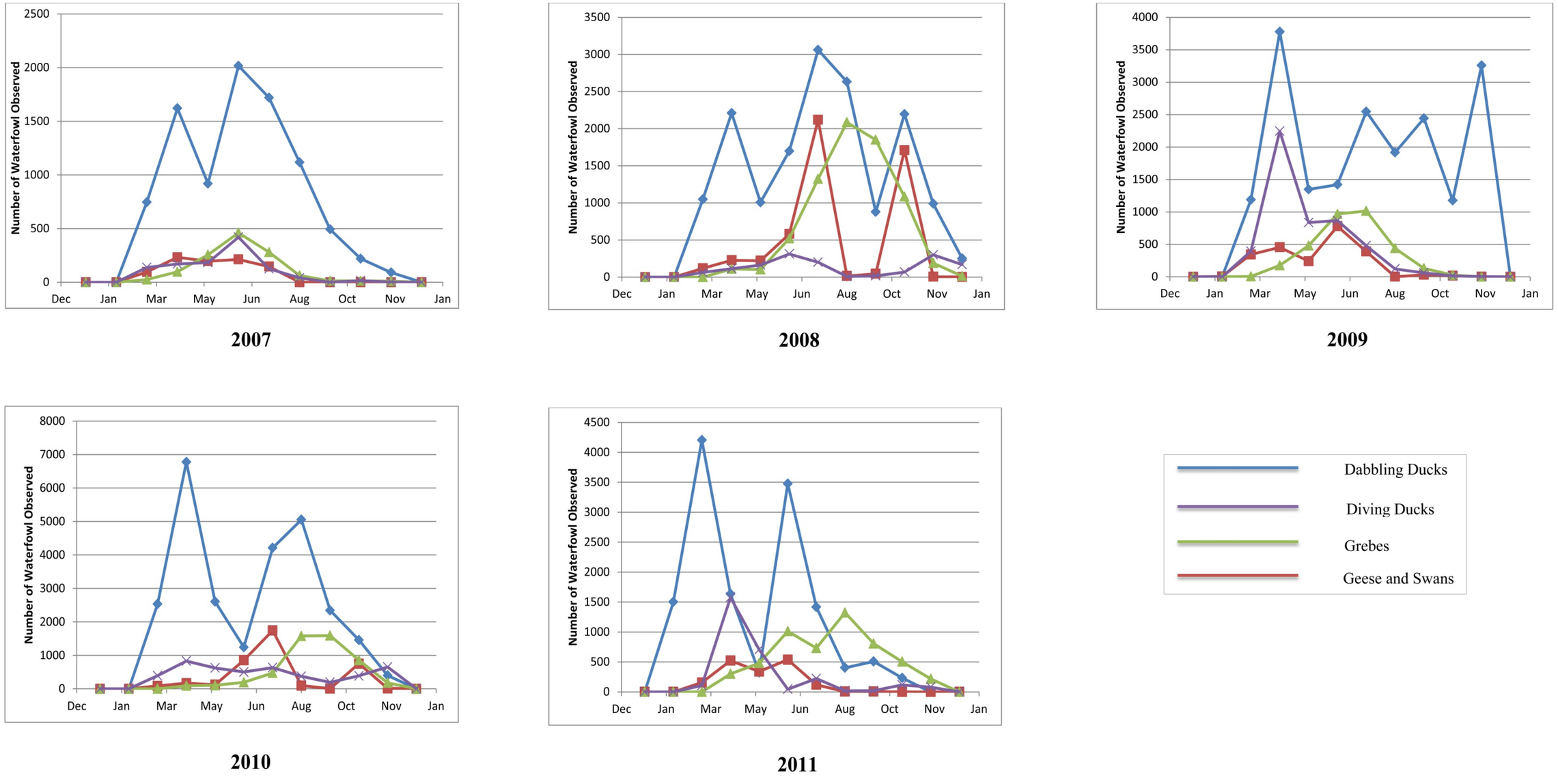


Figure 3-9. Monthly Waterfowl Usage of Leota Bottom, 2007–2011

Source: USFWS 2011a

This page intentionally left blank.

3.4.3.6 Migratory Birds

Migratory birds are protected under the MBTA of 1918 (16 USC 703-711) and Executive Order (EO) 13186 (66 Federal Register 3853). Executive Order 13186 sets forth the responsibilities of federal agencies to implement provisions of the MBTA by integrating bird conservation principles and practices into agency activities and by ensuring that federal actions evaluate the effects of actions and agency plans on migratory birds.

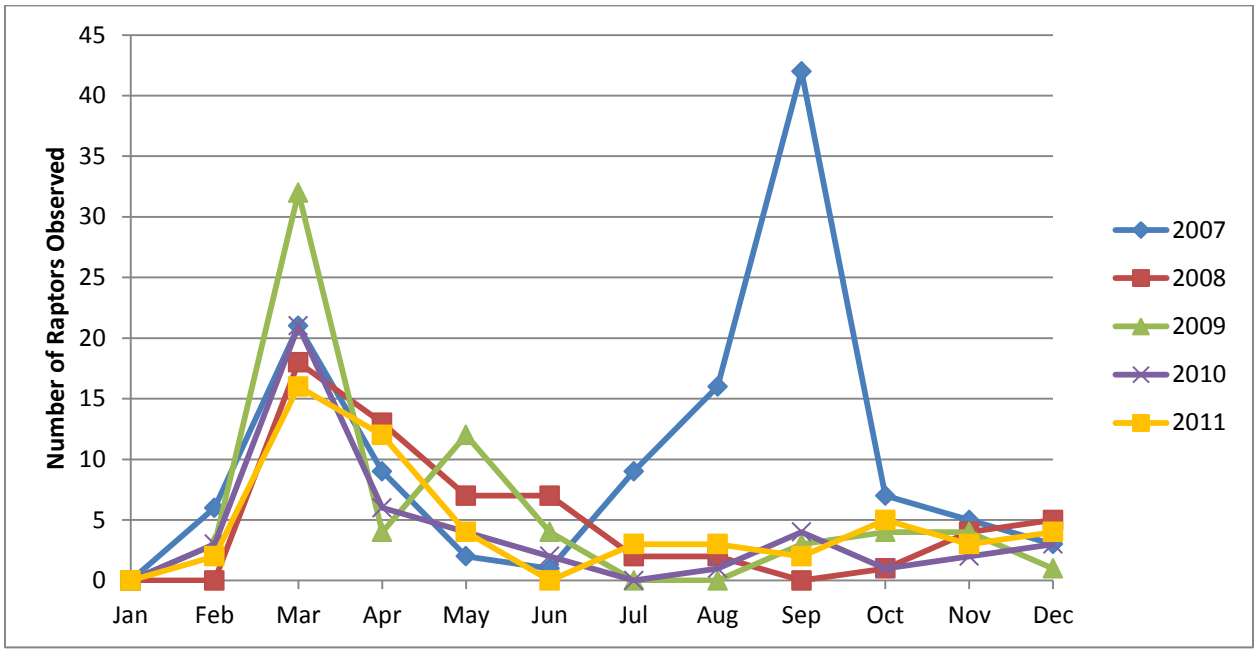
A list of Birds of Conservation Concern (BCC) was developed as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This Act mandated that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973." The goal of the BCC list is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions to ensure that these species would be consulted on in accordance with EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. The Project Area is located within BCC Region 16 (Southern Rockies/Colorado Plateau).

The Project Area and surrounding region has been designated by the Utah Partners in Flight program as a Bird Habitat Conservation Area (BHCA). The southern-most portion of the Upper Green River BHCA (#25) contains the entire Project Area and is located near the juncture of BHCA #25, #21 (Duchesne River) and #37 (Green River) (IWJV 2007). BHCAs are intended to identify areas where bird habitat conservation projects may take place, predicated on concurrence, collaboration, and cooperation with all landowners involved; however, BHCAs have no official status (IWJV 2007).

Some 237 species of migratory birds have been documented to occur on the Ouray NWR as seasonal residents or migrants, 114 of which are known to nest within the Refuge (USFWS 2005) (see **Appendix C** for details). Potential occurrence is based on habitat (vegetation) types occurring across the Project Area (see **Table 3-7**) and the bird species that tend to use these habitat types (UDWR 2003). (Note: Most species use more than one habitat.) Migrating birds often have special habitat needs. The UDWR (2012d) has identified that many migrants rely on riparian corridors for nesting and migration purposes in arid country.

3.4.3.7 Raptors

Twenty-two species of raptors are known to occur within the Project Area and surrounding region year-round or on a seasonal basis (USFWS 2005, 2013d). These include the bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), osprey (*Pandion haliaetus*), northern goshawk (*Accipiter gentilis*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*), turkey vulture (*Cathartes aura*), American kestrel (*Falco sparverius*), great-horned owl (*Bubo virginianus*), burrowing owl (*Athene cunicularia*), short-eared owl (*Asio flammeus*), long-eared owl (*Asio otus*), western screech-owl (*Otis kennicottii*), northern saw-whet owl (*Aegolius acadius*), and rough-legged hawk (*Buteo lagopus*) (USFWS 2005). Most raptor species using the area migrate each fall and return to the region again the following spring. Exceptions include the golden eagle, bald eagle, rough-legged hawk and great horned owl which are year-round residents **Figure 3-10** shows the number of raptors observed in Leota Bottom by month for years 2007 through 2011.



Source: USFWS 2011a

Figure 3-10. Number of Raptors Observed in Leota Bottom by Month, 2007 – 2011

Twelve raptor species have the potential to nest in the Ouray NWR. These include the golden eagle, turkey vulture, Swainson's hawk, American kestrel, red-tailed hawk, Cooper's hawk northern harrier, prairie falcon, burrowing owl, long-eared owl, short-eared owl and great-horned owl (USFWS 2005, 2013d). Most identified nest sites within the Ouray NWR are located in trees along riparian areas within the Green River floodplain. Additionally, there are a significant amount of bald eagle roosting sites within the Project Area and in the adjacent tree stands surrounding the Project boundary.

All raptor species and their nests are protected from take or disturbance under the MBTA (16 USC, § 703 et seq.). The bald eagle and golden eagle are also afforded additional protection under the Bald and Golden Eagle Protection Act, amended in 1973 (16 USC, § 669 et seq.). Because golden eagles, bald eagles, ferruginous hawks, and burrowing owls are considered to be special status raptor species, they are discussed in further detail in **Section 3.4.4**.

3.4.3.8 Fish

The Green River immediately upstream and downstream of the Project Area is host to approximately nine fish species: roundtail chub (*Gila robusta*), bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), speckled dace (*Rhinichthys osculus*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), razorback sucker (*Xyrauchen texanus*), mottled sculpin (*Cottus biardi*), and brook stickleback (*Culaea inconstans*). Representative nonnative species in the Green River in the vicinity of the Project Area include the green sunfish (*Lepomis cyanellus*), smallmouth bass (*Micropterus dolomieui*), walleye (*Stizostedion vitreum vitreum*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ictalurus melas*), northern pike (*Esox lucius*), fathead minnow (*Pimephales promelas*), common carp (*Cyprinus carpio*), and red shiner (*Notropis lutrensis*) (USFWS 2000a). A complete list of fish species found on the Ouray NWR is provided in **Appendix C.**

3.4.3.9 Ouray National Fish Hatchery (NFH)

The Ouray National Fish Hatchery (Ouray NFH) was established in May 1996 as a fish refuge and technology development facility to assist in the recovery of the four listed Colorado River endangered fish: razorback sucker, Colorado pikeminnow, humpback chub, and bonytail chub (USFWS 2013g).

The Ouray NFH is located 35.2 miles southwest of Vernal, Utah, on the Ouray NWR. The facility consists of a 30,116-gallon indoor recirculation hatchery with 27, 7.9-foot circular fiberglass tanks and 30, 3.9-foot circular fiberglass tanks. The isolation room consists of twelve, 9.7-ft^2 circular fiberglass tanks that can be operated as single pass cold water tanks or as a separate re-use system (USFWS 2013e). There are a 24, 0.2-acre fish ponds and 12, 0.5-acre fish ponds. The 1.2-acre clarification reservoir has been successfully used as a production pond that increases the total surface area of ponds space available for fish production at the Ouray NFH. The water source consists of seven shallow wells (49.2 feet deep) located near the Green River approximately 0.5 miles from the hatchery (USFWS 2013g). Other facilities associated with the Ouray NFH include an effluent basin; a 60’ x 120’ hatchery office building; a shop garage; a 4-bedroom, 2-bath, double-wide modular home serving as a bunkhouse; a domestic water supply and sewage disposal system; and a chain link fence surrounding the ponds (USFWS 1992b).

The primary goal of the Ouray NFH is to maintain endangered fish in the Ouray NWR to prevent extinction; develop genetically sound broodstocks for production of young fish for stocking to stabilize or enhance wild stocks; and to produce captive reared endangered fish for priority laboratory and field experiments (USFWS 2013e). The goal will be modified in 2013 to include the production of bonytail chub (USFWS 2013g). The Ouray NFH is the primary source of genetic material that is needed to maintain a large genetic pool and work towards a viable reproductive population (USFWS 1995a).

In January 1988, the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) started establishing captive fish propagation facilities to assist in the recovery of the Colorado River fish species. The primary focus of the Ouray NFH has been the propagation of the razorback sucker. However, beginning in 2007, the Recovery Program started capturing humpback chubs, which were transferred to the Ouray NFH to be maintained as a Refuge population and a potential source of future broodstock (USFWS 2013g). The Recovery Implementation Plan for the Endangered Fish Species in the Upper Colorado River Basin includes activities to restore habitat and control non-native fish. The Ouray NFH is the primary refuge for the Middle Green River Subbasin (USFWS 1995a). The Recovery Program is also part of a multi-state organization that forms the basis for water recovery.

The Ouray NFH is a critical component of the Recovery Program. The facility offers a protected location for refuge populations and broodstock of three endangered fish species (razorback sucker, bonytail, and humpback chub), and it produces large numbers of endangered fish that are stocked into native habitats. The Ouray NFH harbors a collection of specimens that includes:

- A broodstock of razorback sucker with irreplaceable genetic makeup;
- Over 25,000 razorback suckers of various life stages at all times, and up to as many as 50,000 individuals during some timeframes;
- Approximately 39,000 bonytail of various life stages; and
- A Refuge population of 36 humpback chub from Yampa Canyon to support a possible broodstock for that population.

The Ouray NFH is one of only two facilities to produce razorback sucker for the Recovery Program. In 2012 the Ouray NFH produced over 16,000 razorback sucker averaging 14.7 inches and these fish were stocked in the middle (at Ouray, UT) and lower (at Green River, UT) Green River. In 2013, the Ouray NFH plans to stock 10,000 bonytail averaging 9.8 inches. In addition, it will continue to house the razorback sucker broodstock and the humpback chub Refuge population.

In response to dramatically declining wild populations of razorback sucker, the Recovery Program sporadically captured the few remaining wild fish in the Green River between 1980 and 2000 to create a broodstock and a hatchery program. Wild populations were so depleted at the time that the first management action to achieve recovery was to reestablish populations with hatchery-produced fish. An integrated stocking plan was implemented in 2003, and was updated subsequently to improve fish survival. Over the years, the stocking program has been successful, with adult fish surviving, expanding their range, and reproducing.

River and floodplain habitats found on the Ouray NWR are designated as critical habitat and crucial to the recovery of the endangered fish of the Green River, especially the razorback sucker. Adult razorback suckers (stocked hatchery fish) are currently exhibiting significant survival and natural reproduction rates that are encouraging for a future recovery scenario of the species (USFWS 2013f). However, despite high levels of reproduction, very few hatchery-reared razorback suckers recruit (defined as young individuals growing to an age and condition to reproduce) from the larval stage to sexual maturity. Successful recruitment of wild produced razorback sucker is therefore a significant demographic characteristic needed for potential recover of the species.

Successful recruitment of young-of-year (YOY) razorback sucker requires off-channel floodplain nursery habitats that the YOY can reside in before returning to the main channel. These off-channel nurseries offer higher biological productivity and lower levels of large bodied predators. Availability of these high-quality floodplain nursery habitats is supported by high spring peak flows. In order to attempt to entrain large numbers of naturally produced larval fish into these floodplain habitats, the Bureau of Reclamation (in partnership with other agencies) has altered its spring operations at the Flaming Gorge Dam to provide river connection to floodplain habitats when larval razorback suckers are present.

Floodplain habitats on the Ouray NWR are a substantial subset of the floodplain habitats targeted under Flaming Gorge operations. Specifically, Leota Bottom contains two key areas (Leota 4 and Leota 7) that are targeted by Flaming Gorge Dam operations. Because suitable floodplain habitats are limited in number (especially those easily accessible to biologists), preserving the habitat quality in Leota Bottom is crucial for the recovery of the razorback sucker, including the success of fish stocking programs and reservoir operations (USFWS 2013f).

3.4.4 Special Status Plant and Animal Species

Special status plant and animal species include those listed as threatened or endangered under the ESA of 1973, as amended, species proposed for listing, species of special concern and other species identified either by the USFWS, UDWR, or Utah Natural Heritage Program (UNHP) as unique or rare, and which have the potential to occur within the Project Area and surrounding region.

Based on examination of USFWS, UDWR, and UNHP data, a total of 32 special status plant and animal species were identified as potentially occurring within the Project Area. Of the 32 special status species that were evaluated, 11 species were eliminated from further consideration in this EA because either the geographic or elevational range of the species is located outside of the Project Area and/or the Project Area does not provide suitable habitat for the species. The remaining 21 species that have the potential to

occur within the Project Area and were retained for further evaluation include seven federally listed species and 14 UNHP Wildlife Species of Concern (SPC). These species are described below.

3.4.4.1 Federally Threatened, Endangered, or Proposed Species

Federally listed threatened, endangered, or proposed species identified as potentially occurring within the Project Area are presented in **Table 3-10**. A total of seven species or subspecies of plants and animals are addressed in the EA, four of which are federally listed as endangered, two of which are federally listed as threatened, and one federally listed proposed threatened species. Critical habitat has been designated for four of the seven species (all fish), as indicated in **Table 3-10**.

The evaluation of federally listed threatened and endangered species in this document is intended to fulfill the compliance requirements of pertinent environmental laws, regulations, and policies in accordance with the requirements of Section 7(b) of the ESA of 1973, as amended, and implementing regulations [16 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14 (c)], and ESA guidance contained in the Endangered Species Consultation Handbook (USFWS and National Marine Fisheries Service 1998).

Federal agencies, in consultation with the USFWS-ESO, are required to ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of a federally listed or proposed threatened or endangered species. As the federal lead agency for the EA, the Service is responsible for Intra-Service Section 7 consultation with the USFWS-ESO. It is Service policy to consider candidate species when making natural resource decisions and thus, candidate species will be included for consideration in this document. Biological information on the above mentioned species is presented below and the impacts associated with the Proposed Action and Alternatives are analyzed in **Section 4.5.4**.

Table 3-10. Federally Listed Species Considered for Evaluation in the EA/BA

Species	Status	Species Listing		Critical Habitat		Abundance	Primary Refuge Habitat Use
		Date Listed	Federal Register No.	Date Designated	Federal Register No.		
Birds							
Yellow-billed cuckoo (*Coccyzus americanus*)	PT	October 3, 2013	78 FR 78321	N/A	N/A	Uncommon Summer	Riparian Habitats
Fish							
Colorado pikeminnow (*Ptychocheilus lucius*)	E	March 11, 1967	32 FR 4001	March 21, 1994	59 FR 13374	Rare; Ouray reach is an important nursing area	Riverine & Wetlands/ Bottomlands
Bonytail chub (*Gila elegans*)	E	April 23, 1980	45 FR 27713	March 21, 1994	59 FR 13374	Rare; No wild caught in several years	Riverine
Razorback sucker (*Xyrauchen texanus*)	E	October 23, 1991	56 FR 54957	March 21, 1994	59 FR 13374	Rare; Severely reduced in numbers	Riverine & Wetlands/ Bottomlands
Humpback chub (*Gila cypha*)	E	March 11, 1967	32 FR 4001	March 21, 1994	59 FR 13374	Rare; Severely reduced in numbers	Riverine
Plants							
Uinta Basin hookless cactus (*Sclerocactus wetlandicus*)	T	October 11, 1979	44 FR 58869	N/A	N/A	Uncommon	Dry Gravel Terraces
Ute ladies'-tresses (*Spiranthes diluvialis*)	T	January 17, 1992	57 FR 2048	N/A	N/A	Uncommon	Floodplains and Perennial Stream Terraces

E = Endangered, T = Threatened, PT = Proposed Threatened

Yellow-Billed Cuckoo

The yellow-billed cuckoo (*Coccyzus americanus*) is a proposed threatened bird under the ESA. This species is a neotropical migratory species that breeds in the U.S. and Canada and winters in South America (USFWS 2001b). Currently, the range of the cuckoo is limited to disjunct fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho, southward into northwestern Mexico, and westward into southern Nevada and California. Cuckoos are long-range migrants that winter in northern South America in tropical deciduous and evergreen forests (Ehrlich et al. 1988).

Historically, cuckoos were probably common to uncommon summer residents in Utah and across the Great Basin (Ryser 1985, Hayward et al. 1976). The current distribution of yellow-billed cuckoos in Utah is poorly understood, though they appear to be an extremely rare breeder in lowland riparian habitats statewide (Walters and Sorenson 1983, Behle 1981, Benton 1987).

Yellow-billed cuckoos are one of the latest migrants to arrive and breed in Utah. They arrive in extremely late May or early June and breed in late June through July. Nesting season on the Refuge is considered June 15th to August 31st. Cuckoos typically start their southerly migration by late August or early September. Yellow-billed cuckoos feed almost entirely on large insects that they glean from tree and shrub foliage. They feed primarily on caterpillars, including tent caterpillars. They also feed frequently on grasshoppers, cicadas, beetles, and katydids, occasionally on lizards, frogs, and eggs of other birds and rarely on berries and fruits (Ehrlich et al. 1988, Kaufman 1996).

The cuckoo is a riparian obligate bird that feeds in cottonwood groves and nests in willow thickets. Nesting habitat is classified as dense lowland riparian that is characterized by a dense sub-canopy or shrub layer (regenerating canopy trees, willows, or other riparian shrubs) within 300 feet of water. Overstory in these habitats may be either large, gallery-forming trees (30-90 feet) or developing trees (10-30 feet), usually cottonwoods. Nesting habitats are found at low to mid-elevations (2,500-6,000 feet) in Utah. Laymon and Halterman (1989) concluded that sites larger than 200 acres and wider than 1,950 feet were optimal for breeding; sites 101 to 200 acres and wider than 650 feet were suitable breeding habitat; sites 50 to 100 acres and 325 to 650 feet in width were marginal breeding habitat; and sites less than 38 acres and less than 325 feet in width were unsuitable breeding habitat (BLM 2003). Cuckoos are not strongly territorial and home ranges may overlap during the breeding season. Nests are usually 4-8 feet above the ground on the horizontal limb of a deciduous tree or shrub, but nest heights may range from 3-20 feet and higher. In Utah, this species nests in riparian areas and has been documented in cottonwood habitat along the Green River. The yellow-billed cuckoo has been confirmed to nest within the Refuge (Howe and Hanberg 2000).

Colorado Pikeminnow

The Colorado pikeminnow (*Ptychocheilus lucius* [formerly the Colorado squawfish]) is a federally endangered fish species under the ESA. This species is endemic to the Colorado River Basin habitat that is characteristic of variable flow, turbulent water, and high silt loads. Within the Colorado River Basin the Colorado pikeminnow is known to inhabit the Colorado, Green, Duchesne, Price, San Rafael, Gunnison, San Juan, White, and Dolores Rivers and numerous associated streams. Today, the species is most abundant in the Green River below the confluence with the Yampa River; the White River from Taylor Draw Dam near Rangely, Colorado, downstream to the confluence with the Green River; and the main stem of the Colorado River from Palisade, Colorado, to Lake Powell. The Gray Canyon and the Yampa River of the lower Green River hold the two critical spawning sites of this species (USFWS 2002a). The species is not known to occur in the direct vicinity of the Project Area.

Some 726 total miles of river and its associated 100-year floodplain in Utah have been designated by the USFWS as critical habitat for the Colorado pikeminnow. The Project Area contains approximately 6.6 miles of critical habitat along the Green River, not inclusive of associated floodplains (USFWS 2007a).

Bonytail Chub

The bonytail chub (*Gila elegan*) is a federally endangered fish under the ESA. The bonytail chub has historically been a common species along the Colorado River system but the population has dwindled in recent years (USFWS 1994). This may be due to the introduction of 40 nonnative species of riverine fish such as the green sunfish, smallmouth bass, and channel catfish. The bonytail chub has adapted to major river habitats where it has been observed in slow moving pools and eddies. Flooded bottomland habitat is important for growth and conditioning for young bonytail chub and acts as a nursery or transitioning habitat. There are currently no self-sustaining wild populations of bonytail chub. While very few individuals have been caught in the Upper Colorado River Basin, there have been several individuals caught in the Green River at Hideout Canyon and Gray Canyon, as well as at the confluence of the Colorado and Green Rivers. The release of hatchery-born bonytail chub into the Upper Colorado River Basin has resulted in low survival reproduction and recruitment to the population (USFWS 2002b).

A total of 139 river miles and their associated 100-year floodplains in Utah have been designated by the USFWS as critical habitat for the bonytail chub in portions of the Green River and Colorado River. The portion of the Green River within the boundaries of Ouray NWR is not listed as critical bonytail chub habitat. However, adult bonytail chub have been found to use the Refuge floodplains for foraging habitat. These flooded areas are also used for stocking of bonytail chub.

Razorback Sucker

The razorback sucker (*Xyrauchen texanus*) is a federally endangered fish species under the ESA. The razorback sucker currently populates the Green River, upper Colorado River, and San Juan River sub-basins in the Upper Colorado River Basin. The general population consists of mostly aged adults with minimal recruitment; however, in the middle Green River, where there are juveniles and young adults, there is a low degree of recruitment. The largest population of razorback sucker exists in low-gradient, flat-water reaches of the middle Green River between the confluences of the Duchesne River and Yampa River (USFWS 2002c). Razorback suckers tend to occupy habitat types such as impounded and riverine areas, eddies, gravel pits, flooded mouths and tributary streams, backwaters, flooded bottoms, and sandy riffles. Adults move into flooded areas in spring to begin spawning migrations as they become reproductively active. Spawning typically occurs over rocky runs and gravel bars (USFWS 2002c).

A total of 688 river miles and their associated 100-year floodplains have been designated by the USFWS as critical habitat for the razorback sucker. The entire length of the Green River within the Project Area is designated as critical razorback habitat. This accounts for approximately 6.6 miles of river within the Project Area, not inclusive of 100-year floodplains (USFWS 2007a).

Humpback Chub

The humpback chub (*Gila cypha*) is listed as a federally endangered fish species under the ESA. In Utah, humpback chub are now confined to a few white-water areas in the Colorado, Green, and White Rivers. Humpback chub are found in river canyons where they occupy habitats such as river pools, riffles, eddies, rocky runs, and travertine dams. The densest concentrations of humpback chub are in the Westwater Canyon and Grand Canyon reaches of the Colorado River. Humpback chub in the Desolation and Gray Canyons of the Green River hold the third most abundant population of this species (USFWS 2002d). The species is not known to occur in the immediate vicinity of the Project Area.

Some 139 river miles and their associated 100-year floodplains have been designated as critical habitat for the humpback chub by the USFWS in portions of the Colorado and Green Rivers. There is no critical humpback chub habitat within the Project Area. The nearest critical habitat occurs approximately 22 miles north and 28 miles south of the Project Area.

Uinta Basin Hookless Cactus

The Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) is federally listed as threatened (USFWS 1979b, 2009) under the ESA. The Uinta Basin hookless cactus was formerly included in the *Sclerocactus glaucus* "complex" (Hochstätter 1989), but is now considered a distinct species by the USFWS and retains its status as federally threatened (USFWS 2007b, 2009). The USFWS-ESO (2010) published a recovery outline for the Uinta Basin hookless cactus in April 2010. The original recovery criteria for the *S. glaucus* species complex are no longer sufficient to address the recovery of the now separated species that require different ecological requisites. Revised recovery plans for the Uinta Basin hookless cactus are currently in development to meet the specific needs of the species.

This member of the cactus family is a perennial that occurs as a solitary, unbranched, round-to-elongate/cylindric succulent stem usually 1.25–3.5 inches in diameter by 2–5 inches tall that produces pink to violet flowers from late April to May (Heil and Porter 2004). Observed pollinators include bees, beetles, ants, and flies. Seed dispersal vectors include gravity, ants, birds, rodents, precipitation, and surface water flows. It is theorized that seed dispersal is a limiting factor in the distribution of the species (USFWS 1990). Very little is known about the factors affecting the distribution and long-term population dynamics of the Uinta Basin hookless cactus.

Information on the habitat requirements and distribution of this species has been rapidly changing as more studies and surveys are conducted in the Uinta Basin. Currently, it is known to occur on Quaternary and Tertiary alluvium soils overlain with cobbles and pebbles of the Duchesne River, Green River, and Uinta Formations between 4,500 to 6,600 feet amsl (BLM 2008, UNPS 2006). It is found on gravelly hills and terraces, river benches, valley slopes, and rolling hills along the Green, White, and Duchesne Rivers. Preferred habitat is generally associated with Pleistocene outwash terraces with coarse-textured, alkaline soils overlain by a surficial pavement of large, smooth, rounded cobble. It can be found in a range of vegetative communities including clay badlands, salt desert shrub, and pinyon-juniper. Associated species include black sagebrush, shadscale saltbush, James' galleta, and Indian ricegrass.

Within designated potential habitat for the Uinta Basin hookless cactus, the USFWS has proposed core conservation areas and management recommendations in response to the ongoing energy development in the Uinta Basin. The purpose of the proposed core conservation areas and management recommendations is to protect the most important populations or sub-populations, and reduce threats to *Sclerocactus*. Two levels of core conservation areas were developed based on pollinator travel distance and habitat connectivity between populations and individuals. The core areas are centered on the densest known areas of *Sclerocactus* within a 400 m (Level 1) and 1,000 m (Level 2) buffer that was developed using kernel density analysis found in geographic information systems (GIS) software.

The distances used to develop core conservation areas were based on travel distances of common bee species that visit individual plants. These bees are in the small and medium size range and travel approximately 400 meters to 1,000 meters between plants and nests (Tepedino et al. 2010). Level 1 polygons were developed using a 400-meter buffer around plants to allow for pollinator travel. They include the densest concentrations of cactus locations and the most restrictive management recommendations as proposed by USFWS. Level 2 polygons were developed using a 1,000-meter buffer around plants while incorporating less-dense cactus areas and less restrictive management

recommendations as proposed by USFWS. It is important to note that at the time this document was developed, these proposed measures are interim management recommendations that have not been finalized or formally adopted as standard mitigation practices by federal land management agencies.

In 2010, the USFWS developed a potential habitat polygon for *S. wetlandicus* to better assess possible impacts to the species within its range. Although *S. wetlandicus* and populations can be found outside of these areas, they tend to occur at greater numbers and at higher densities within these polygons. This polygon is updated annually and was last updated in March 2013 (USFWS 2013c).

The total area of potential habitat for *S. wetlandicus* within its range is currently 442,000 acres and includes federal, tribal, state, and private lands. The most recent geographic data for *S. wetlandicus* includes over 18,400 points representing approximately 40,528 individual cacti. The entire Project Area (3,684 acres) is within USFWS-designated potential habitat for *S. wetlandicus*. Approximately 1,154 and 380 acres of Level 1 and 2 Core Conservation Areas occur in the Project Area, respectively.

Surveys for Uinta Basin hookless cactus were conducted during June 11-14, 2012, April 1-3, 2013, and November 4, 2013, in accordance with USFWS and BLM survey requirements for *Sclerocactus spp.* (USFWS 2012c, 2013c). Surveys were conducted in areas proposed for well pad, access road, and pipeline development under the Proposed Action as well as areas proposed for alternative pipeline routes. Results of the survey effort identified two populations of Uinta Basin hookless cactus, which were located along the ridgeline of the bluffs. All populations were located outside of Level 1 and 2 Core Conservation Areas. An updated version of the Special Status Plant Survey Report for the Thurston Ouray NWR 2-Well Development Program is included in **Appendix D**.

Ute ladies'-tresses

Ute ladies'-tresses (*Spiranthes diluvialis*) is a federally listed threatened species. This member of the orchid family is a perennial herb that occurs on seasonally flooded river terraces, spring-fed stream channels, lakeshores, and in human-modified and disturbed wetlands, such as canals, gravel pits, and irrigated meadows (Fertig et al. 2005). The species occurs primarily in areas where vegetation is relatively open and not overgrown or overgrazed, generally in sandy or loamy soils that are typically mixed with gravels (USFWS 1992a). Within the Uinta Basin, Ute ladies'-tresses occurs along the Green River near the confluence with the Yampa River, and along Ashley Creek, Big Brush Creek, and the upper Duchesne River and its tributaries (BLM 2005) above 4,300 feet elevation (BLM 2006). Ute ladies'-tresses populations require recurrent disturbance, such as seasonal flooding, grazing, or mowing, for establishment and persistence, and often occur in recently created riparian habitats such as sand bars and backwaters (USFWS 1995b).

There are no known occurrences of Ute ladies'-tresses on the Refuge and the species has not been found south of Highway 40. Potential habitat occurs within the Project Area in the floodplains and riparian areas of the Green River.

3.4.4.2 Utah Natural Heritage Program Species of Concern

Table 3-11 presents UNHP species of concern that were identified as potentially occurring within the Project Area. A total of 14 wildlife species are addressed in the EA. This includes nine species of birds, one mammal, three species of fish, and one reptile species.

Table 3-11. UNHP Species of Concern Considered for Evaluation in the EA

Species	Status	Abundance	Primary Refuge Habitat Use
Birds			
Bald Eagle (*Haliaeetus leucocephalus*)	SPC	Rare Spring; Occasional Fall; Common Winter	Riparian Habitats & Wetland/Bottomlands
Golden Eagle (*Aquila chrysaetos*),	SPC	Common Year-Round	Semi-desert Shrubland, Riparian Habitats
Ferruginous Hawk (*Buteo regalis*)	SPC	Occasional Summer	Semi-desert Shrubland
Northern Goshawk (*Accipiter gentilis*)	CS	Uncommon	Riparian and woodland habitats
Burrowing Owl (*Athene cunicularia*)	SPC	Uncommon Spring, Summer, and Fall	Grassland
Short-eared Owl (*Asio flammeus*)	SPC	Uncommon Spring, Summer, Fall, and Winter	Grassland
American White Pelican (*Pelecanus erythrorhynchos*)	SPC	Occasional Spring and Summer; Common Fall	Wetland/Bottomlands
Long-billed Curlew (*Numenius americanus*)	SPC	Rare Spring, Summer, and Fall	Grassland & Wetland/ Bottomlands
Lewis's Woodpecker (*Melenerpes lewis*)	SPC	Common Spring and Summer; Uncommon Fall	Riparian Habitats
Mammals			
White-tailed Prairie Dog (*Cynomys leucurus*)	SPC	Common	Grassland
Fish			
Bluehead Sucker (*Catostomus discobolus*)	CS	Common	Aquatic Habitats
Flannelmouth Sucker (*Catostomus latipinnis*)	CS	Common	Aquatic Habitats
Roundtail Chub (*Gila robusta*)	CS	Rare	Aquatic Habitats
Reptiles			
Smooth Green Snake (*Opheodrys vernalis*)	SPC	Uncommon	Wetlands/Bottomlands

SPC = Wildlife species of concern;
CS = Species receiving special mgmt. under a Conservation Agreement to preclude the need for federal listing
Source: UDWR-UNHP 2011, UDWR 2011a

Bald and Golden Eagle

The bald eagle (*Haliaeetus leucocephalus*) was previously listed as a federally endangered species, but as of August 8, 2007, has been removed from the Federal List of Endangered and Threatened Wildlife (72 FR 37346, Federal Register 2007). However, the bald eagle will continue to be protected under the Bald and Golden Eagle Protection Act, governed by the MBTA, and is listed as a UDWR SPC (UDWR-UNHP 2011). Similarly, the golden eagle (*Aquila chrysaetos*) is protected under the MBTA because of its similar appearance to juvenile bald eagles. No active bald eagle nesting sites were recorded with the Project Area or surrounding region. Golden eagle nests have been documented on the Ouray NWR and surrounding region, but none within the Project Area. Bald and golden eagles are known to roost all along the Green River with higher numbers found during winter months. Winter roosting generally occurs anytime between early November through late March, and bald eagles may also use the area as foraging habitat during this period.

Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is listed as a UDWR SPC (UDWR-UNHP 2011). Ferruginous hawk inhabit grassland, sagebrush/saltbrush/greasewood shrublands, and the boundary of pinyon-juniper woodlands. Breeding season for this species is between March 1 and August 1. Nests for the ferruginous hawk are usually found on cliffs, hills and knolls, trees, and buttes that provide access to prey such as small mammals (Johnsgard 1990). Nesting sites generally are in areas of high visibility, which makes the ferruginous hawk sensitive to human development. Nesting areas within close proximity to human development are characterized by lower productivity during reproductive periods (Collins and Reynolds, 2005). Although the ferruginous hawk is listed as "present" on the Ouray NWR, it was not found to have any nesting sites within or around the Project Area.

Northern Goshawk

The northern goshawk (*Accipiter gentilis*) is listed as a species receiving special management under a Conservation Agreement to preclude the need for federal listing (UDWR-UNHP 2011). The species occurs as a permanent resident throughout Utah (but is not common in the state) and prefers mature mountain forest and riparian zone habitats (UDWR 2012d). In the western United States, northern goshawks typically nest in old growth forests and generally select larger tracts of forest over smaller tracts (Parrish et al. 2002). Although northern goshawks are listed as "present" and known to occur on the Ouray NWR, no nesting sites have been identified within or around the Project Area (USFWS 2012b).

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is classified as a UDWR SPC. The burrowing owls migrate to the plains of Utah between March and mid-April for breeding and remain residents throughout the summer (Johnsgard 2002). Burrowing owls typically make nests in mammal-burrows (i.e., prairie dog, badger, and ground squirrel) and are relatively tolerant to human disturbance as they have been seen to occupy areas surrounding farm land, highways, and airports. If an existing burrow is not available, an owl may excavate their own for nesting. Burrowing owls primarily eat terrestrial invertebrates and small vertebrates such as birds, reptiles, and small mammals. They also serve as a prey species for large raptors and canids (Kaufman 1996). There are several prairie dog colonies northeast of the Project Area that may serve as suitable nesting habitat for burrowing owls (USFWS 2000a). This species is a confirmed nester on the Ouray NWR (USFWS 2012b).

Short-Eared Owl

The short-eared owl (*Asio flammeus*) is listed as a UDWR SPC. This owl is a resident of grasslands, shrublands, and other open habitats. Its nesting sites vary from year-to-year and are often dependent on foraging capability. The short-eared owl consumes mostly rodents and small vertebrates. It is a ground-nesting bird that typically builds its nest in early April using a small depression in the soil. While some individuals are known to migrate to Mexico during the winter months, most short-eared owls remain within range of their breeding grounds (UDWR 2012d). This species is not commonly observed in northern Utah; as such, no confirmed nesting sites are present within the Project Area or in the Ouray NWR. However, because a short-eared owl may be present in the Ouray NWR during the nesting season, it is considered a nesting species in the region (USFWS 2000a).

American White Pelican

The American white pelican (*Pelecanus erythrorhynchos*) is listed as a UDWR SPC (UDWR-UNHP 2011). The American white pelican migrates north during the summer months, usually not reaching Utah until March. Breeding areas can be found on islands in a range that extend from northern Mexico and Texas to as far north as Canada. Pelicans begin to leave Utah between October and December, which coincides with the waterfowl hunting season, lower access to fisheries, and icing of open water. This species primarily eats fish and is highly cooperative in foraging. The species is social and is often found in flocks (UDWR 2012d). This species is commonly observed in the Ouray NWR (USFWS 2000a).

Long-Billed Curlew

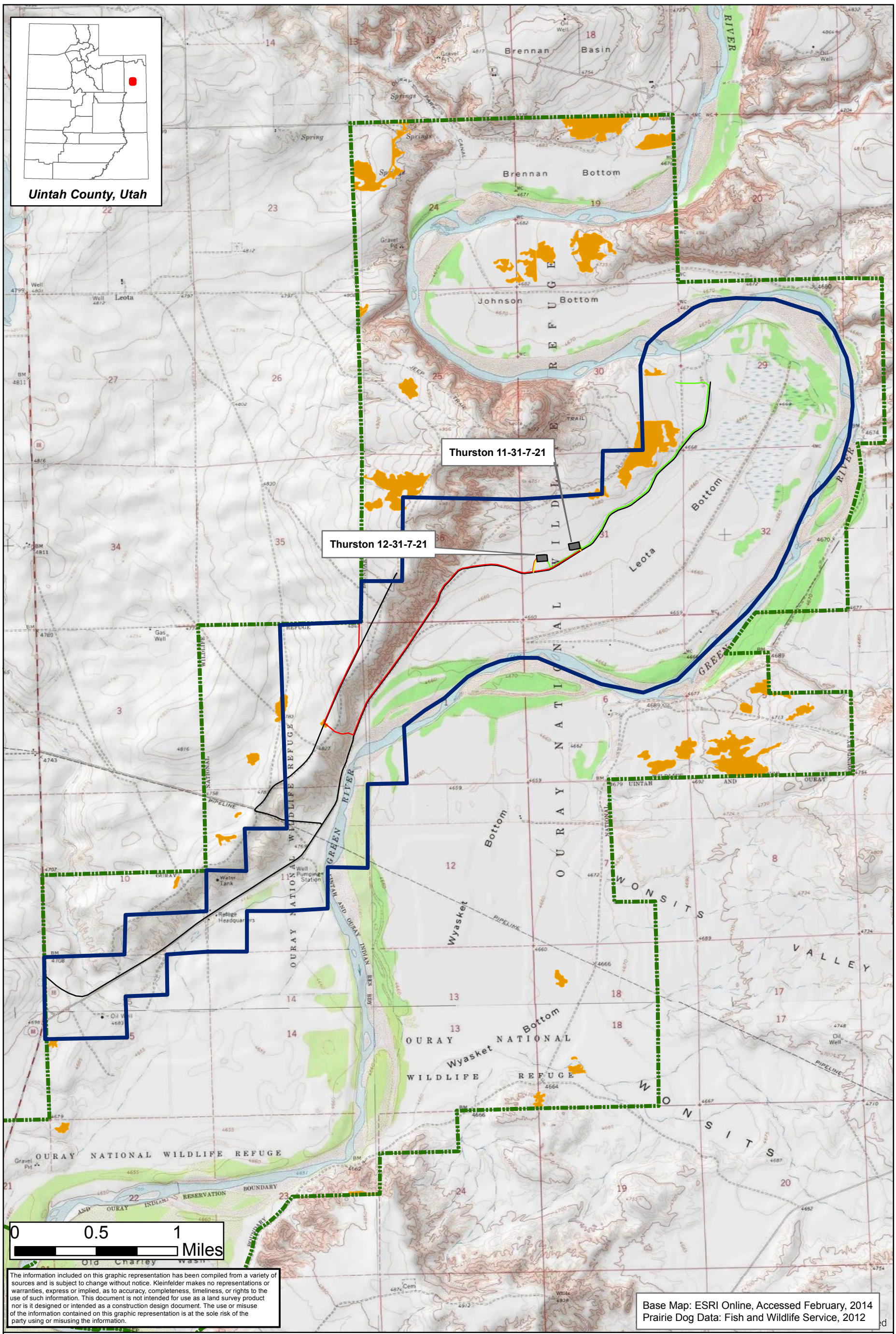
The long-billed curlew (*Numenius americanus*) is listed as a UDWR SPC. This species is known to migrate through Utah during the summer months to breed and continue south towards California, Texas, Northern Mexico, and Florida during the colder winter months. It is common in central and northern Utah valleys but is less common along the Colorado River drainage. Long-billed curlews arrive in Utah in late March and nest in areas surrounding the Great Salt Lake. They prefer nesting habitat in short grass and shade with bare ground components and adequate vertebrate prey. The long-billed curlew diet consists of mollusks, worms, crustaceans, toads, insects, and berries (UDWR 2012d). This species is known to nest on the Ouray NWR (USFWS 2012b).

Lewis's Woodpecker

Lewis's woodpecker (*Melanerpes lewis*) is listed as a UDWR SPC. The Lewis's woodpecker is a permanent resident of western North America. It is listed as a wildlife species of concern because of recent population declines and limited distribution in the state of Utah. This species is primarily found along the Green River in the Uinta Basin and other riparian habitats. The species is a confirmed nester on the Refuge and is known to breed from mid-May to mid-August in cottonwood and ponderosa woodlands (Kingery 1998).

White-tailed Prairie Dog

The white-tailed prairie dog (*Cynomys leucurus*) is listed as a UDWR SPC (Tier II species in the Utah Comprehensive Wildlife Conservation Strategy [CWCS]). Colonies of the species occur primarily in mountain valleys, semi-desert grasslands, and open shrublands. In Utah, the white-tailed prairie dog occurs predominantly in the Uinta Basin and the northern part of the Colorado Plateau. This species is the main food source of the endangered black-footed ferret (Fitzgerald et al. 1994). Approximately 43 acres of Prairie dog colonies (occupied habitat) exist within the Project Area along the roads west of the Leota Bottom. **Figure 3-11** depicts the distribution and size of the known colonies.



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

Base Map: ESRI Online, Accessed February, 2014
Prairie Dog Data: Fish and Wildlife Service, 2012

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary
- Prairie Dog Colony

N

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	3_12PrairieDogs.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Mapped White-Tailed Prairie Dog Colonies
Uintah County, Utah

FIGURE
3-11

Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

The bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and roundtail chub (*Gila elegans*) are all listed as species receiving special management under a Conservation Agreement to preclude the need for federal listing (UDWR-UNHP 2011) and are all found within the Upper Colorado River Basin. The bluehead sucker occurs in a variety of habitat within the Basin, ranging from headwater streams to large rivers, and generally prefers moderate to high velocity waters and rocky substrates. The flannelmouth sucker is a large river sucker that inhabits a variety of areas including riffles, eddies, and backwaters. The roundtail chub can be found in warm streams and larger rivers, usually in habitats with slow-flowing, murky water adjacent to areas of faster water (UDWR 2012d). The roundtail chub has been described as varying from sedentary to mobile, depending on life stage and habitat conditions (Sigler and Sigler 1996). All three fish currently occupy approximately 45 to 50 percent of their historical habitat in the Colorado River Basin (UDWR 2006).

Smooth Green Snake

The smooth green snake (*Opheodrys vernalis*) is listed as a UDWR SPC. This species is located across the western United States, southern Canada, and northern Mexico. This species is uncommon in Utah, but is a resident of the Abajo, La Sal, Uinta, and Wasatch Mountain Ranges. The smooth green snake prefers moist areas such as grasses and meadows. The smooth green snake relies on small invertebrates as a food source and mainly consumes insects and spiders. Female snakes reproduce in the late summer months and typically have brood sizes of four to six individuals. Following the reproductive period this species hibernates during the winter months and becomes active again the following spring (UDWR 2012d).

3.5 Paleontological Resources

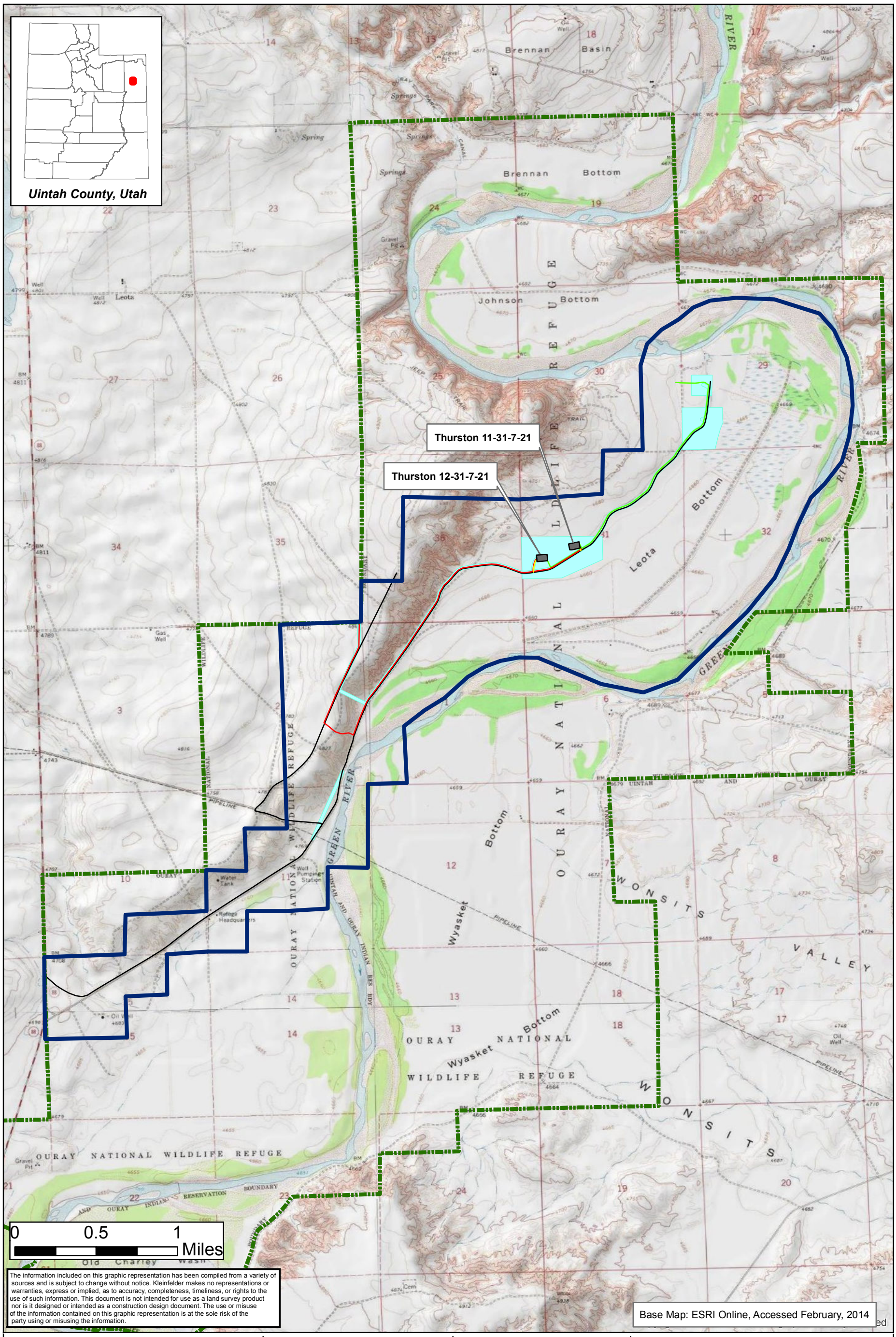
Unless otherwise noted, information for the following discussion was taken from three cultural resources technical reports (Sagebrush Consultants, LLC [Sagebrush], 2011; 2012; 2013). This source is included in the Service project file for this EA but may not be available for public distribution due to sensitive material contained within.

3.5.1 Regulatory Setting

Federal legislation and programs provide a legal environment for documentation, evaluation, and protection of paleontological resources that may be affected by federal undertakings or by private undertakings operating under federal license, with federal funding, or on federally managed lands. These include the Antiquities Act of 1906 (16 USC 431-433), Paleontological Resources Preservation Act (Public Law 111-011. P.L. 111-011, Title VI, Subtitle D), and the National Natural Landmarks Program (established in 1962 under the authority of the Historic Sites Act of 1935, and are administered by the National Park Service [(NPS]). The Ouray NWR 2-Well Development Program is subject to compliance with these laws.

3.5.2 Known Paleontological Resources within the Project Area

Two paleontological resources investigations were conducted for this project: the first was conducted in November 2011, for the well pads, and the second in September 2012, for the pipeline and access roads (see **Figure 3-12**).



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Ouray National Wildlife Refuge Boundary
- Existing Roads
- Cultural/Paleontological Surveyed Area

N

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig3_13Cultural.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Location of Cultural/ Paleontological Survey Area Uintah County, Utah

FIGURE **3-12**

On November 23, 2011, Martha Hayden, State of Utah Department of Natural Resources (UDNR) paleontological assistant, conducted a Paleontological File Search for the area within one mile of each of the four proposed well pads. This investigation found that quaternary and recent alluvial deposits that are exposed near the well pads have a low potential for yielding significant fossil localities, and no prior paleontological localities have been recorded in the Project Area.

The second paleontological resources investigation was conducted on September 26, 2012, by Martha Hayden, UDNR paleontological assistant. This investigation found one previously known paleontological locality near the pipelines and access roads and recommended additional paleontological consultation with a permitted paleontologist. Therefore, a paleontology survey was conducted on November 16, 2012, and two new fossil localities were discovered. Based on the records search and survey, there is a potential for paleontological resources to exist near several locations of along the proposed pipelines and access roads.

3.6 Cultural Resources

Unless otherwise noted, information for the following discussion was taken from three cultural resources technical reports (Sagebrush, 2011; 2012; 2013). This source is included in the Service project file for this EA but may not be available for public distribution due to sensitive material contained within.

3.6.1 Regulatory Setting

Federal historic preservation legislation provides a legal environment for documentation, evaluation, and protection of cultural resources that may be affected by federal undertakings, or by private undertakings operating under federal license, with federal funding, or on federally managed lands. These include the NHPA of 1966, as amended; the AHPA of 1974; and the ARPA, as amended. EO 11593 also provides necessary guidance on protection and enhancement of cultural resources.

The Ouray NWR 2-Well Development Program is subject to compliance with Section 106 of the NHPA, as amended (16 USC 470 *et seq*.). Section 106 (36 CFR 800) requires federal agencies to take into account the effects of their undertakings on historic properties, and consult with the Utah SHPO.

The terms cultural resource and historic properties refer to a broad category of resources, which include prehistoric and historic archaeological sites, buildings, districts, structures, locations, or objects considered important to a culture or community for scientific, traditional, religious, or other reasons. Resources deemed significant for their contribution to broad patterns of history, prehistory, architecture, engineering, and culture are eligible for listing on the NRHP and require specific considerations under the NHPA. Regardless of age, resources listed on or eligible for listing on the NRHP are termed historic properties.

In order to be eligible for inclusion on the NRHP, a property must be significant under one or more of the four evaluation criteria:

- Criterion A: Associated with events that have made a significant contribution to the broad patterns of our history; or
- Criterion B: Associated with the lives of persons significant in our past; or

- Criterion C: 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
- Criterion D: Yielded, or may be likely to yield, information important in prehistory or history.

In addition, a property must be able to convey its significance through the retention of specific aspects of integrity, such as location, design, setting, materials, workmanship, feeling, and association. In general, properties less than 50 years of age, unless of exceptional importance, are not eligible for the NRHP.

As outlined in 40 CFR 1508.8, effects to historic properties can include direct effects and indirect effects, as well as adverse and beneficial effects. Additionally, in accordance with 36 CFR Part 800.16(d), an APE has been established within which direct and indirect effects on historic properties resulting from the Proposed Action and Alternatives could occur. The APE for the project includes the 3,684-acre Project Area (see **Figure 1-1**).

3.6.2 Historical Background

3.6.2.1 Prehistoric Period

The prehistory of the current Project Area is complex and poorly understood because of the area's location near the contact zone between the Great Basin, Colorado Plateau, and Northern Plains cultures. The prehistory of the Uinta Basin is a meld of these traditions that has resulted in the identification of many enigmatic archaeological sites. The cultural changes in these areas are classified into the following four general chronological periods: Paleo-Indian, Desert Archaic, Formative, and Post-Formative. The following is a brief description of each period (some of which may overlap in time) and their distinct phases.

Also known as the Clovis Period, the Paleo-Indian Period (ca. 12,000 B.C. to 9,000 B.C.) is poorly understood in the eastern Great Basin and northwestern Colorado Plateau. What little is known about this period comes from a limited number of surface sites and isolated finds of Clovis, Folsom, and Lake Mojave projectile points, which suggest a possible lake edge-marsh adaptation. The Desert Archaic Period (ca. 9,000 B.C. to A.D. 500) is marked by broad range movement and diminished hunting of big game by the native peoples. It also includes a time of climatic change associated with the end of the Pleistocene Epoch and with the subsequent cultural adaptations.

The Formative Period (ca. A.D. 400 to 1300) is characterized by a shift from a hunting and gathering way of life to a more sedentary one based on horticulture. The native peoples associated with this period, the Fremont, were roughly contemporaneous with the Anasazi of southern Utah and the Four Corners region. The Post-Formative Period (ca. A.D. 1200 to 1776) is marked by the apparent replacement of the Fremont peoples by a migratory group of Shoshonean/Numic-speaking people from the southwest. This period also includes the arrival of the direct ancestors of modern-day Ute Indians and their use of the Uinta Basin's resources.

3.6.2.2 Historical Period

The first explorations by Europeans and European-Americans into the Uinta Basin occurred over 200 years ago when the Spanish friars Francisco Atanasio Dominguez and Silvestre Velez de Escalante made their way through the Uinta Basin during their search for an overland route from Santa Fe, New Mexico, to the missions of Monterey, California. Subsequent forays and settlements undertaken by exploratory

campaigns, fur trappers, and Mormon pioneers eventually forced the Utes onto a reservation established by President Lincoln in 1861. Unfulfilled promises by the government and unrest among the different bands of Utes forced to cohabitate on the reservation led to a series of uprisings in 1866 known as the Black Hawk War. Many Utes left the reservation at this time to join Chief Black Hawk in his raids on Mormon settlements in the area. The Black Hawk War continued until 1868, at which point Chief Black Hawk agreed to cease hostilities and move onto the Uinta Valley Reservation.

Following the Black Hawk War, between 1869 and 1885 several small communities were established in the area and rudimentary canal systems were set up to irrigate the farms of the new settlers. Water development became an increasingly important and tense issue as more and more settlers made their way into the arid Uinta Basin. Water right arguments resulted in the construction of various canal systems throughout the area. In 1886, a rich gilsonite vein was discovered in the Uinta Basin and additional discoveries of minable ores prompted the government to reopen sections of the Uinta Valley Reservation for leasing to white miners and homesteaders. Road networks and railroads were developed to support the growing mining industry and eventually the reservation was opened in 1905 to allow whites access to the natural resources in the area. Water resources continued to be a source of tension, and by the late 1910s and early 1920s, water development was in full swing in the Uinta Basin with the development of additional canals and reservoirs. The Great Depression greatly affected residents of the Uinta Basin, and it was not until the start of World War II and the accompanying demand for the mineral resources that the economy of the area began to recover. Because of oil discoveries in the post-World War II period, this area has remained prosperous into modern day, though water resources continued to be an issue.

One of the most significant developments in the Uinta Basin in recent years concerns the argument over legal jurisdiction of Ute tribal lands. The argument, which is being settled in a number of current court cases, is debating the exact boundaries of tribal lands, and more importantly for the Utes, determining who have legal jurisdiction over said lands. It is unclear as to what the outcome of these hearings will be and how that outcome will affect future development in the area.

3.6.3 Known Cultural Resources within the Project Area

Two cultural resources investigations were conducted for this project: the first occurred in November 2011 for the well pads, and the second in September 2012 for the pipeline and access roads.

On November 21, 2011, the Utah SHPO conducted a GIS file search of the area within one mile of each well pad. On November 22, 2011, a records search was conducted at the SHPO, Division of State History, Antiquities Section. The records showed that a total of 11 cultural resource projects have been previously conducted and two cultural resource sites have been previously identified within one mile of the well pads. On September 3, 2012, the Utah SHPO conducted a GIS file search of the area within one mile of the pipelines and access roads. The records showed that a total of 18 cultural resource projects have been previously conducted and three cultural resource sites have been previously identified within one mile of the pipelines and access roads. The NRHP and General Land Office (GLO) plat maps for the area were also consulted in 2011 and 2012. One GLO plat map depicts the alignment of a canal in the APE.

Two intensive cultural resources field surveys were also conducted within the APE and included the well pads, pipelines, and access roads (see **Figure 3-12**). The first survey was carried out for the four proposed wells on November 22, 2011. A total of 121.5 acres were surveyed by walking in parallel transects spaced no more than 50 feet apart. The second survey was conducted for the proposed pipelines and access roads on September 20, 2012. A total of 56.17 aces were surveyed by walking in parallel transects spaced no more than 50 feet apart. One historic site (42UN7913) and two isolated finds were located during the surveys.

Based on the nature of the isolated finds, they were not evaluated for inclusion to the NRHP. Site 42UN7913 represents an historic irrigation system that was fundamental to settlement and farming in the Leota Bottom region and may have association with Depression Era programs. This site is associated with events that have made a significant contribution to the broad pattern of the history of the region, specifically irrigation, agriculture, Depression Era resettlement, and, possibly, Depression Era relief programs. Therefore, site 42UN7913 as a whole is recommended as eligible to the NRHP under Criterion A. However, the portion of this site within the APE has lost integrity due to flooding, road construction, etc. and therefore is not significant or eligible to the NRHP.

3.6.4 Section 106 Consultation

Final consultation with Utah SHPO will be initiated and completed prior to the issuance of a Decision Record for this EA. Preliminary consultation with the Utah SHPO concurred with Service determinations of eligibility and effects regarding the Thurston Energy, LLC's Proposed Ouray National Wildlife Refuge 2-Well Development Program. See **Appendix I** for details.

3.7 Transportation

U.S. Highway 40 (US 40) and State Highway 88 (SH 88) provide access to the Ouray NWR and Project Area from Vernal and Roosevelt, Utah. Use of these transportation corridors is monitored by the Utah Department of Transportation (UDOT). **Table 3-12** provides a summary of the average annual daily traffic (AADT) on the highway segments providing access to the Ouray NWR and the Project Area from Vernal (traveling west on US 40), Roosevelt (traveling east on US 40), and SH 88 (traveling south from US 40 junction). AADT represents traffic traveling in both directions.

US 40 is a two- to three-lane all weather highway in Utah's primary highway system. The road provides access to the Project Area from the population centers of Roosevelt and Vernal, Utah, which would serve as the primary service centers for project-related activity. SH 88 is a two-lane all weather state highway providing access to the town of Ouray and the Ouray NWR from US 40.

An existing network of gravel roads is maintained by the Service within the Ouray NWR. Wildlife Refuge Road provides access to the Refuge and the Ouray NFH from SH 88 and will be the primary transportation route used within the Project Area. The current transportation network within the Refuge is used by USFWS employees for Refuge management and maintenance, Ouray NFH employees, and visitors for various recreation uses.

Table 3-12. AADT for Federal and State Highways Providing Access to Project Area

Road Name	Road Segment	Segment Distance	2011 AADT[1]	2010 AADT[1]	2009 AADT[1]
US 40	200 N Roosevelt to 7500 E (road to Fort Duchesne)	6.8 miles	12,578	11,056	10,946
	7500 E (road to Fort Duchesne) to SR 88 (road to Ouray)	19.6 miles	8,222	7,125	6,952
	SR 88 (road to Ouray) to SR 45 Naples	8.3 miles	15,923	15,912	15,837
SH 88	US 40/SH 88 junction to Ouray	16.9 miles	2,300	2,305	2,262

[1] AADT represents average traffic traveling in both directions for route section
Source: UDOT 2011

3.8 Recreation

The Ouray NWR is a popular outdoor recreation destination for local residents, wildlife enthusiasts, anglers and hunters. Most public use occurs April through November. The Refuge received approximately 4,800 visitors in fiscal year (FY) 2012 (October 2011 – September 2012, [USFWS 2012d unpub. data]). **Table 3-13** summarizes public and recreation use on the Refuge for FY12. Due to flooding and high water conditions in 2011, public use and recreation opportunities on the Refuge were limited and below target.

Table 3-13. Public Use on Ouray NWR (Oct. 2011 – Sept. 2012)

Public Use	2012 Target	2012 Actual
Environmental education	50	55
General visitation (visitation to visitor center/contract station)	300	290
Fishing	40	35
Waterfowl hunting	150	155
Upland Game hunting	20	25
Big Game hunting	40	50
Wildlife observation: hiking/pedestrian	100	15
Wildlife observation: auto-tour	1,000	250
Wildlife observation: boating, canoeing, rafting	30	25
Wildlife photography	100	90
Volunteers *Total Volunteer Hours (wildlife/habitat, maintenance)*	18 *710*	30 *1,420*

Source: USFWS 2012d unpublished data

Hunting and fishing are popular activities on the Refuge and harvest is permitted for mule deer, elk, ducks, geese, coots, pheasant, and turkey in designated areas. The Leota, Wyasket, and Johnson Bottoms are open to deer and pheasant hunting, and the Leota Bottom is open for waterfowl hunting during all State prescribed seasons. Season and weapon restrictions apply to elk and turkey hunts (USFWS 2012e). Fishing is allowed on the Green River year-round. Endangered fish species (i.e., razorback suckers, Colorado pikeminnow, humpback chub, and bonytail) must be returned to the river unharmed in accordance with ESA regulations if caught.

3.9 Visual Resources

The Ouray NWR lies within the Uinta Basin section of the Colorado Plateau physiographic province. The general visual characteristics of the Uinta Basin topography west of the Green River can be described as relatively flat wide shallow valleys that are not more than a few hundred feet below the surrounding county (Stokes 1986).

The landscape is composed of scenery that is typical of the central Uinta Basin: a predominance of shallow, gently rolling hills and drainages; shale-colored bluffs and steeply incised drainages near the Green River and Nine Mile Canyon; and distant views of the Uinta Mountains to the north, the Roan Cliffs and Book Cliffs to the south, and the Wasatch foothills to the west.

There is no human habitation within the Project Area and oil and gas activities, structures, and surface disturbances are present in much of the region. Modifications of the landform and vegetation, as well as placement of structures on the land are prevalent throughout most of the Project Area.

Public visitation within the proposed Project Area is not high; however, areas adjacent to the Project Area (Green River corridor) are high-quality recreational and scenic destinations.

4.0 ENVIRONMENTAL CONSEQUENCES

This Chapter summarizes and analyzes the potential impacts or environmental consequences that would result from implementation of Alternative A – Proposed Action, and Alternative B – No Action Alternative. The impact analysis describes the effects of implementing the alternatives on the physical, biological, and the human environment that were discussed in **Chapter 3**. The resource-specific effects of the alternatives are evaluated both quantitatively and qualitatively, depending on available data and the nature of the resources analyzed. Mitigation measures and long-term impacts are discussed, where appropriate, to further minimize impacts.

An environmental consequence or impact is defined as a modification in the existing environment resulting from the Proposed Action or an Alternative. Impacts can be a primary result of the action (direct) or a secondary result (indirect), and can be temporary and of short duration (short-term) or permanent or long-lasting (long-term). Impacts can vary in degree from only a slight discernible change to a total change in the environment.

Direct effects are caused by the action and generally occur at the time the action is implemented and within the Project Area (e.g., removal/loss of vegetation). Indirect effects are caused by the action and occur later in time or further removed from the Project Area (e.g., sediment yield impacts downstream from the Project Area). Short-term impacts are effects on the environment that occur during and immediately after well pad construction, drilling, completion, testing, and/or production facility installation, and can last for several years, or until completion of interim reclamation. Although short in duration, such impacts can be obvious and disruptive. For this Project, short-term impacts are defined as lasting four years or less. Long-term impacts are changes made in the environment during construction and operation of the project that remain longer than four years and perhaps for the LOP (approximately 25- to 33-years) and beyond.

For the purposes of the environmental consequences analysis of this EA, the term “Proposed Action” represents the construction footprint (area of disturbance), while the term “Project Area” also includes the 3,684 acres of surrounding lands outside but adjacent to the proposed project. The term “surrounding region” includes surrounding lands (outside but adjacent to the Project Area) and denotes a more expansive landscape context. Where appropriate, the analysis of impacts considers effects to resources in the surrounding region outside the immediate Project Area (e.g., air quality impacts, transportation, etc.).

As defined by CEQ regulations, cumulative impacts result from the incremental impacts of an action when added to past, present, and reasonably foreseeable future actions, regardless of who takes the action (40 CFR 1508.7). Concurrently, the ESA defines cumulative impacts as effects of future state or private activities (not involving federal activities) that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR §402.02). The ESA definition only applies to Section 7 analysis and should not be confused with the broader use of this term in NEPA or other environmental laws.

Cumulative impact analysis is presented for each resource following the direct and indirect effects discussion and provides a framework for forecasting and evaluating future environmental changes that may affect the quality and extent of the natural and human environment. Although the Ouray NWR boundary may be considered a generalized cumulative impact assessment area (CIAA), cumulative impacts in this EA were analyzed using CIAAs with spatial boundaries that vary by resource. **Table 4-1** defines the CIAA for each resource examined in this EA and provides rationale for selecting each CIAA boundary.

Table 4-1. Cumulative Impact Assessment Areas

Resource	Cumulative Impact Assessment Areas	Assessment Area Rationale
Air Quality	Uinta Basin	Construction, development, and production activities from implementation of the Proposed Action would cumulatively contribute to changes in air quality occurring immediately adjacent to the Project Area and within the greater Uinta Basin.
Soils	Ouray NWR Boundary	Project activities impacting soils would only affect soil types present within the Ouray NWR boundary and would not cause additive effects to those occurring elsewhere.
Water Resources[1]	Ouray NWR Boundary	Project activities impacting water resources would only affect those present within the Ouray NWR boundary and would not cause additive effects to those occurring elsewhere.
Biological Resources[2]	Ouray NWR Boundary	Project activities impacting biological resources would only affect those present within the Ouray NWR boundary and would not cause additive effects to those occurring elsewhere. Furthermore, proposed conservation measures would reduce impacts to special status plant and animal species and their potential habitat within the Ouray NWR boundary.
Paleontological Resources	Project Area Boundary	Project activities impacting paleontological resources would only affect those present in the Project Area and would not cause additive effects to those occurring elsewhere.
Cultural Resources	Project Area Boundary	Construction activities impacting cultural resources would only affect those present in the Project Area and would not cause additive effects to those occurring elsewhere.
Transportation	Project Area Boundary and primary access roads to the area	Impacts to transportation would be most pronounced within the Project Area; however, less noticeable impacts may be realized on primary, public transportation corridors (i.e., US 40 and SH 88) leading to the Refuge.
Recreation	Ouray NWR Boundary	Project activities impacting recreation would be limited to the Ouray NWR boundary and would not cause additive effects elsewhere.
Visual Resources	Ouray NWR Boundary	Project activities impacting visual resources would only affect those present within the Ouray NWR boundary and would not cause additive effects elsewhere.

[1] Includes Floodplains, Wetlands, and Waters of the U.S.
[2] Includes Vegetation, Invasive and Noxious Weeds, Fish and Wildlife, and Special-Status Plant and Animal Species

As stated previously, cumulative impacts are derived from past, present, and reasonably foreseeable future actions. Reasonably foreseeable future actions are those for which there are existing decisions, funding, formal proposals, or which are highly probable and based on known opportunities or trends. For purposes of assessment in this EA, it is reasonably assumed that energy-related actions would have the greatest effect within the previously defined CIAAs. All other actions that could affect the CIAAs are assumed to remain at current trends, with only minor deviations.

The following discussion for present and reasonably foreseeable energy development (RFD) is based on UDOGM data and pending NEPA documents with the Service within the Ouray NWR boundary. As of April 2013, there are seven well pads, six active wells, and two pending APDs on State-owned lands within the Refuge boundary, and nine wells proposed for development under an ongoing EA with the Service. **Table 4-2** provides the estimated surface disturbance for the past, present, and reasonably foreseeable future energy development within the Ouray NWR.

Table 4-2. Estimated Maximum Surface Disturbance Associated with Past, Present, and Reasonably Foreseeable Energy Development within Ouray NWR

	No. of Wells [2]	No. of Well Pads[2]	Estimated Surface Disturbance[1]			
			Well Pads (acres)	Access Roads, Pipelines, and/or Power Lines (acres)	Other Supporting Infrastructure (acres)	Total (acres)
Past	--	--	--	--	--	--
Present	6	7	14.7	10.5	--	25.2
RFD	9	5	11.8	18.1	--	29.9
Proposed Action[3**]	2	2	3.2	11.2	--	14.4
Total	**17**	**14**	**29.7**	**39.8**	**0**	**69.5**

[1] Surface disturbance is the short-term disturbance value for each of the defined project components. (Note: Projects without a designated surface disturbance rate were assigned a total equivalent of 3.6 total acres per well pad (BLM 2012b)).
[2] Number of proposed wells for each project was compiled from NEPA documents and UDOGM data.
[3] Estimated short-term surface disturbance set out in the Proposed Action, **Section 2.1.1**.
[**] Includes 9,768.1 feet of proposed above ground power line.

As shown in **Table 4-2,** surface disturbance associated with implementation of the Proposed Action, when added to past, present, and other reasonably foreseeable actions, would incrementally increase the total cumulative disturbance within the Ouray NWR to 69.5 acres, or 0.6-percent of the total acreage within the Refuge.

4.1 Air Quality and Greenhouse Gas Emissions

4.1.1 Alternative A – Proposed Action

Emissions under the Proposed Action are considered to be a minor source under the CAA. The Proposed Action would result in different types of emission sources associated with two project phases: well development and well production. Under the Proposed Action the pumpjack engines and wellsite heaters

would be powered by commercial electricity rather than hydrocarbon fuel from the wells. This will reduce emissions of NO_x, CO, and Greenhouse gas. Annual estimated emissions from the Proposed Action are summarized in **Table 4-3.** A more detailed overview of emissions calculations are presented in **Appendix E.**

Table 4-3. Estimate of Annual Emissions *(tons per year)*[1] for Well Development and Production under the Proposed Action

Pollutant	Development	Production	Total
Criteria Pollutants			
NO_X	2.99	0.32	3.31
CO	1.42	0.32	1.73
VOC	0.51	11.48	12.00
SO_2	0.058	0.00027	0.058
PM_{10}	0.90	19.03	19.93
$PM_{2.5}$	0.22	1.93	2.15
Greenhouse Gases			
Carbon Dioxide (CO_2)	260.4	31.63	292.1
Methane (CH_4)	0.20	6.60	6.80
Nitrous Oxide (N_2O)	0.0020	0.00018	0.0022
Global Warming Potential (GWP)[2]	265.3	170.2	435.5
Hazardous Air Pollutants			
Benzene	0.0012	0.39	0.39
Toluene	0.00049	0.68	0.68
Ethylbenzene	0.00067	0.027	0.027
Xylene	0.0019	0.39	0.39
n-Hexane	0.0019	0.31	0.31
Formaldehyde	0.00034	---	0.00034

[1] Emissions include development and production from 2 wells and associated operations traffic during the year in which the project is developed.
[2] Global Warming Potential (GWP) = $CO_2 + 21 \times CH_4 + 310 \times N_2O$

Well Development includes NO_X, SO_2, and CO tailpipe emissions from earth-moving equipment, vehicle traffic, drilling, and completion activities. Fugitive dust emissions would occur from vehicle traffic on unpaved roads and from wind erosion where soils are disturbed. Drill rig and fracturing pump engine operations would result mainly in NO_X and CO emissions, with lesser amounts of SO_2 and $PM_{2.5}$. These emissions would be short-term during the drilling and completion phases and would not be expected to cause or contribute to an exceedance of the NAAQS.

Drilling operations are the main contributor to well development emissions as shown in **Table 4-4**. These emissions are summarized from **Appendix E** and are calculated based on the average time needed for the drilling of a single well multiplied by the total number of wells (two) assuming Tier 2 drill rig engines are used.

Table 4-4. Estimate of Annual Emissions *(Tons per Year)* [1] for Well Development under the Proposed Action

Pollutant	Construction	Drilling	Well Completion	Interim Reclamation	Wind Erosion	Total Well Development Emissions
NO_X	0.49	1.70	0.79	0.0026	---	2.99
CO	0.16	0.94	0.32	0.0029	---	1.42
VOC	0.041	0.35	0.12	0.00021	---	0.51
SO_2	0.0000024	0.033	0.025	0.0000024	---	0.058
PM_{10}	0.17	0.43	0.16	0.11	0.027	0.90
$PM_{2.5}$	0.052	0.09	0.062	0.011	0.0041	0.22

[1] Emissions include construction, drilling, and well completion from two wells and associated operations traffic during the year in which the project is developed. Summations may not precisely add due to round off differences.

During well production, continuous NO_X, CO, VOC, and HAP emissions (plus relatively small amounts of SO_2, PM_{10}, and $PM_{2.5}$) will be produced from well pad dehydration units with emission control combustion units, condensate storage tanks, pneumatics, and tailpipe and fugitive dust emissions from operations traffic. Well production emissions are summarized in **Table 4-5.**

Table 4-5. Estimate of Annual Emissions *(Tons per Year)* [1] for Well Production under the Proposed Action

Pollutant	Stock Tanks	Truck Loading	Dehydrator Units	Operations Vehicle	Pneumatics	Total Well Production Emissions
NO_X	---	---	---	0.32	---	0.32
CO	---	---	---	0.32	---	0.32
VOC	8.49	0.37	2.48	0.018	0.13	11.48
SO_2	---	---	---	0.00027	---	0.00027
PM_{10}	---	---	---	19.03	---	19.03
$PM_{2.5}$	---	---	---	1.93	---	1.93

[1] Emissions include production and operation of two wells using commercial electricity rather than fuel combustion. Summations may not precisely add due to round off differences.

Potential impacts of oil and gas well development and production emissions in the region have been extensively analyzed in the Greater Natural Buttes Final Environmental Impact Statement (FEIS) (BLM, 2012a). The Greater Natural Buttes (GNB) Project was approved for a total of 3,675 producing wells, with 336 wells developed per year. Despite the fact that the GNB Project has a substantially

greater number of wells, the GNB analysis found that the annual NAAQS for criteria pollutants would not be exceeded as a result of implementation of the GNB Project. Therefore, development of the Proposed Action would not cause an exceedance of the annual NAAQS.

Potential 1-hour, 3-hour, 8-hour, and 24-hour impacts are not based on the total number of wells being developed or operated, but rather are a function of a single or small number of wells. The GNB FEIS analyzed a worst case scenario where four wells were drilled simultaneously at the four corners of a square 400 meters on a side (i.e., the wells were 400 meters apart). All of the short-term and annual potential impacts were evaluated, including the 1-hour NO_2 and 1-hour SO_2 standards. For the 1-hour NO_2 standard, the GNB analysis used the Plume Volume Molar Ratio Method (PVMRM) to account for NO to NO_2 conversion, assuming initial in-stack NO_2 was 10 percent of the total NO_X emissions, Tier 2 drill rig engines, and the AERMOD dispersion model. The GNB analysis also accounted for seasonal and diurnal variation in ozone concentrations (since ozone is needed for the conversion of NO to NO_2). The GNB FEIS found that the 1-hour NO_2 standard would not be exceeded even at receptors located as close as 100 meters to the drill rig engines. The GNB analysis assumed at a minimum that Tier 2 drill rig engines (4.8 grams per brake hp hour [g/bhp-hr]) be used. Therefore, Tier 2 engines are recommended as a mitigation measure for potential air quality impacts associated with the Proposed Action. Since the GNB FEIS indicated that none of the NAAQS would be exceeded with the four drill rig scenario, the Proposed Action would also not result in an exceedance of the NAAQS since only one drill rig will be operating at a time. While Tier 4 engines are not being evaluated in this analysis, emissions would be decreased if Tier 4 engines were used instead of Tier 2.

The GNB 1-hour NO_2 analysis was conducted prior to the EPA issuing extended guidance on how to conduct such analyses. However, although the analysis does not precisely match the guidance, it is similar to the most recent guidance. For example, the EPA guidance suggests a default in-stack NO to NO_2 ratio of 0.5 if no project-specific stack testing data are available. Although the GNB analysis did not have project specific stack testing data available, the 10 percent assumption is consistent with stack testing data that are available for large diesel-fueled engines as presented by the EPA on its In Stack Ratio (ISR) database of actual stack test results, available at www.epa.gov/scram001/no2_isr_database.htm. This database was designed specifically to address the default ISR problem. As the EPA states on the web site for the ISR database:

> " … *the recommended default ISR may still be too conservative for many applications such that there remains a significant need for a widely available and well-documented database of ISRs, which is the impetus for the current data collection effort*."

The database supports use of the 10 percent ISR used in the GNB analysis. In addition, the use of PVMRM for atmospheric conversion of NO to NO2 is what is specified in the EPA guidance. Therefore, as long as the 10 percent assumption made by GNB is valid, the GNB analysis should yield a reasonable assessment of potential 1-hour NO2 impacts. Because the GNB FEIS indicated that none of the NAAQS would be exceeded with the four drill rig scenario, the Proposed Action would also not result in an exceedance of the NAAQS because only one drill rig will be operating at a time.

Under the Proposed Action, total emissions of NO_X and VOC ozone precursors, from both well development and well production are estimated at 3.31 tons per year for NO_X, and 12.00 tons per year for VOCs (**Table 4-6**). It should be noted that these are extremely small amounts of ozone precursor emissions. For example, the GNB Project alone has NO_X emissions on the order of 2,000 tons per year and VOC emissions on the order of 7,000 tons per year with total emissions in the region reaching a magnitude of 12,000 tons per year for NO_X and 200,000 tons per year for VOCs. **Section 4.1.3** discusses the potential ozone formation.

The primary sources of HAPs are from condensate storage tanks and dehydration units, with smaller amounts from other production equipment. Small amounts of HAPs are emitted by construction equipment. These emissions are extremely small compared to emissions from other projects in the surrounding region, especially the GNB Project. The GNB FEIS found that the GNB Project (3,675 wells) would not cause an adverse health effect as the result of HAPs emissions. Consequently, implementation of the Proposed Action will not likewise cause adverse health impacts.

Amendments to the CAA stipulate requirements to prevent significant deterioration of air quality and, in particular, to preserve air quality in national parks, national wilderness areas, national monuments and national seashores (42 U.S.C. 7470). These amendments also established Class I, II and III areas, where emissions of particulate matter and sulfur dioxide are to be restricted. The restrictions are most severe in Class I areas and are progressively more lenient in Class II and III areas. In addition to the CAA classifications, the Federal Land Managers have established sensitive Class II areas that also require additional AQRV evaluation as part of the NEPA process. The Ouray National Wildlife Refuge has been determined by the Fish and Wildlife Service to be a sensitive Class II area.

Because the Proposed Action would occur within a sensitive Class II area, potential impacts on visual air quality have to be analyzed near the emission source. The VISCREEN model used for visibility impact screening analyses calculates the contrast of a potential plume of pollutants against terrain and sky backgrounds. As a default criteria, a value of 2 for the color difference, Delta-E, is used as the threshold for a plume being “just noticeable”.

Maximum emissions from a single drill rig were input into the VISCREEN model along with the default hypothetical worst case meteorological conditions for dispersion. For an observer standing near the drill rig emission source, the plume may be visible out to approximately 3 km. However, this impact has been determined not to be an issue according to Fish and Wildlife Service guidance. **Appendix E** contains the VISCREEN model input and output tables.

Additionally, the GNB FEIS analyzed the potential impact of the GNB Project on visual air quality and acid deposition at distant Class I and sensitive Class II areas. The GNB FEIS analysis was conducted consistent with the Federal Land Managers Air Quality Related Work Group Phase I Report dated December 2000 (FLAG 2000). Potential visual air quality impacts were analyzed with both Method 2 and Method 6 using the CALPUFF set of dispersion models and post-processors, but Method 2 is no longer used. Although Method 6 is consistent with the EPA’s final regional haze rule, for purposes of evaluating impacts at Class I and sensitive Class II areas, it has recently been replaced by the Federal Land Managers with Method 8 (FLAG 2010). The main difference between Method 8 and Method 6 is that Method 8 treats small sulfate, nitrate, and organic carbon particles differently from larger particles. This generally results in a slightly more conservative (i.e., larger) regional haze impact. For example, at 70 percent relative humidity and a sulfate concentration of 0.4 ug/m^3, Method 8 yields a 13 percent greater sulfate light extinction than Method 6. However, the changes are not linear and are a function of both the particle concentrations and relative humidity.

The GNB FEIS compared modeled impacts to both 0.5 deciview (dV) and 1.0 dV 98th percentile change in light extinction evaluation criteria. The 0.5 dV change criteria is defined as the threshold for concern by the Federal Land Managers (FLAG 2010) and is used by the EPA as a threshold for a source contributing to regional haze impairment, while the 1.0 dV change is used by EPA as a threshold for a source causing regional haze impairment. The FEIS found that the GNB Project alone would not cause a change greater than 0.5 dV at any of the Class I and sensitive Class II areas. The GNB FEIS also found that the Project would not cause adverse acid deposition. However, the GNB analysis only used one year

of meteorological data for its analysis, while FLAG 2010 recommends a minimum of three years and five years preferred. Nevertheless, considering that emissions from implementation of the Proposed Action are so much smaller than the 3,675-well GNB Project, the Proposed Action alone is also not anticipated to cause a significant impact on visual air quality, nor acid deposition.

The assessment of greenhouse gas emissions and climate change remains in its earliest stages of formulation. The lack of scientific models that predict climate change on a regional or local level prohibits the project-specific quantification of potential future impacts on climate change. Potential greenhouse gas impacts are global and cumulative in nature only and are discussed in **Section 4.1.3**.

4.1.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed gas wells would not be drilled and there would be no incremental increase in emissions. Effects on ambient air quality would continue at present levels from existing oil and gas development in the region and other emission producing sources. Since the Proposed Action does not cause nor contribute to a significant ambient air quality impact, then the No Action Alternative would not change the significance of potential air quality impacts either.

4.1.3 Cumulative Impacts

The CIAA for air quality resources is the Uinta Basin. The GNB FEIS summarized past, present, and reasonably foreseeable development in the Uinta Basin. While, the Ouray NWR 2-Well Development Project was not explicitly listed in the GNB FEIS as one of the anticipated future projects, emissions under the Proposed Action are included in the scaling factors used by the GNB FEIS to estimate reasonably foreseeable development in the region. **Table 4-6** shows the total emissions projected in the GNB FEIS compared to those under the Proposed Action. In **Table 4-6**, "2006 Baseline" represents existing emissions, "2018 Projected" represents the total of existing emissions plus reasonably foreseeable future development, and "2017 GNB Project" is the additional emissions as the result of the GNB Project (i.e., the GNB Proposed Action). As shown in **Table 4-6**, the Proposed Action comprises a very small percentage of the total emissions in the Uinta Basin.

Table 4-6. Uinta Basin Oil and Gas Operations Emissions Summary (2006)

Emissions Category	NO_X (tons/year)	CO (tons/year)	SO_X (tons/year)	PM_{10} (tons/year)	VOC (tons/year)
2006 Baseline	10,754	7,800	391	592	70,226
2018 Projected	10,138	9,732	30	565	184,262
2017 GNB Project	2,213	1,300	25	1,011	6,617
Uinta Basin Future Total (i.e., 2018 Projected plus GNB Project)	**12,351**	**11,032**	**55**	**1,576**	**190,879**
Ouray NWR 2-Well Development Project (Proposed Action)	3.31	1.73	0.058	19.93	12.00

The GNB FEIS explicitly analyzed cumulative impacts with respect to NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, ozone, HAPs, visual air quality, and acid deposition at sensitive Class I and II areas. The FEIS found that the cumulative impacts of NO_2, CO, SO_2, PM_{10}, and $PM_{2.5}$ emissions would not cause an exceedance of

the NAAQS in the region. Therefore, it is assumed that implementation of the Proposed Action will also not contribute to an exceedance.

The GNB FEIS analyzed the potential impact of cumulative emissions of ozone precursors on regional ozone concentrations. The GNB FEIS regional ozone modeling did not show an exceedance of the ozone NAAQS caused by the cumulative emissions in the region. As discussed in **Chapter 3**, although the current photochemical models do show the effect of ozone precursor emissions on summer time ozone concentrations, they have not yet been developed to represent winter time ozone formation in detail. Emissions of ozone precursors from the Proposed Action are less than 0.01 percent of the regional total assessed in the GNB analysis (i.e., sum of the Proposed Action NO_x and VOC compared to the sum of the Uinta Basin future total NO_x and VOC).

Based on the magnitude of the projected increase in ozone precursors in the Uinta Basin, whether or not the proposed project is built, and the contribution that would be emitted from implementation of the Proposed Action, a precise numerical analysis of potential ozone impacts from the action alternatives is not feasible. Any cumulative ozone impacts from implementation of the Proposed Action would be indistinguishable from, and insignificant in comparison to, the margin of uncertainty associated with the regional cumulative VOC and NO_X emission inventory and ozone impact modeling methodology. Whether or not emissions from the Proposed Action were included in any regional ozone modeling, there would be no difference in the results.

On the other hand, photochemical models have demonstrated that reductions in NOx and VOC emissions will reduce the potential for ozone exceedances. Considering the fact that the region may be declared nonattainment, ozone exceedances have been observed, and oil and gas operations are the only major source of emissions in the region, the possible contribution of the Proposed Action to potential ozone formation cannot be ignored and a reduction in emissions will result in a reduced potential for visibility impairment, even if not detectable, quantifiable, or measureable.

The State of Utah has expressed interest in participating in the USEPA Ozone Advance Program that encourages the reduction of ozone precursor emissions and participants may receive preferred status when applying for federal grants and/or receive a State Implementation Plan (SIP) credit for reduction measures undertaken as part of the Program. Thurston will consider participating in the Ozone Advance Program should a reasonable plan be promulgated in the future and will also consider participating in the BLM Adaptive Management Program for ozone precursor emission reductions. In the interim, Thurston will comply with all applicable air emission regulations that are designed to ensure that ozone levels do not exceed the NAAQS.

In addition, in the future the Uinta Basin may be declared non-attainment for ozone by the USEPA. If this occurs, the State of Utah will be required to develop a SIP to achieve attainment status and the SIP may require emission reductions from existing or new sources of ozone precursor emissions. Thurston will abide by the SIP process and all emission reduction requirements that may be included in the SIP.

The GNB FEIS also modeled potential visual air quality and acid deposition impacts at distant Class I and sensitive Class II areas. The GNB FEIS found that cumulative emissions in the Uinta Basin would not have a significant impact on acid deposition. As discussed in **Section 4.1.1**, the GNB FEIS found that the 3,675-well GNB Project alone would not cause an exceedance of the 0.5 dV threshold. On the other hand, the GNB FEIS found that cumulative emissions from all current and future development could cause an exceedance of the 1.0 dV threshold on 223 to 365 days per year at several of the Class I areas. The lowest value, 223 days per year, was for Canyonlands National Park. Similar results were found for the sensitive Class II areas, with the lowest number of days (206) being at the Browns Park NWR. The

GNB FEIS analysis used Method 6 to assess visual air quality impacts. Recent guidance uses Method 8, and thus the cumulative visual air quality impacts with Method 8 could be different than reported in the GNB FEIS.

However, as in the case of ozone, the emissions that could potentially affect visual air quality from implementation of the Proposed Action are less than 0.02 percent of the future total. Any cumulative visual air quality impacts from implementation of the action alternatives would be indistinguishable from, and insignificant in comparison to, the margin of uncertainty associated with the regional cumulative emissions related to potential visual air quality impacts. Whether or not emissions from the Proposed Action were included in the cumulative visual air quality impact modeling, regardless of the method used to perform the analysis (i.e., Method 2, 6, or 8), there would be no difference in the results. But as noted above, a reduction in emissions will result in a reduced potential for visibility impairment, even if not detectable, quantifiable, or measureable. Under the Proposed Action, implementation of ACEPMs (**Section 2.1.10**) and Service Terms and Conditions (**Section 2.1.11**) would also reduce impacts to air quality by minimizing fugitive dust.

Under the No Action Alternative, there would be no contribution to cumulative emissions in the region. However, the potential impacts of the cumulative emissions would not essentially change because the Proposed Action emissions are such a small portion of the total. As a result, there would be no detectable or observable change in cumulative impacts whether or not the Proposed Action or No Action Alternative is implemented.

4.1.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service Terms and Conditions (**Section 2.1.11**) would be applied to reduce impacts to air quality under the Proposed Action:

- Thurston will secure all required permits and approvals from the Service, State of Utah, and Uintah County prior to construction. Thurston will adhere to all applicable federal, state, county, regulations while performing all operations associated with the Proposed Action.
- Thurston will instruct its employees and contractors not to exceed 20 miles per hour on any well access road during construction, drilling/completion, or normal daily activities to discourage the generation of fugitive dust.
- During drilling and completion operations, Thurston will perform dust abatement measures on proposed access roads and/or well pads as necessary. Dust control measures will be performed on access roads as needed during normal daily operations.
- Thurston will install electricity to provide power for separators and pump jacks on the two proposed well pads to reduce the level of noise for both wildlife and visitors. An aboveground distribution line would be built on single wood utility poles located within the proposed road ROW. The proposed distribution line would tie into an existing power source at the Ouray NFH.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.

- Dust levels on regularly traveled access routes must be kept to a minimum. The Operator must have a water truck and operator(s) readily available to perform dust abatement as needed, or as directed by the Refuge Manager or the Service AO. Magnesium water or an approved equivalent may be used as needed with prior approval from the Refuge Manager or the Service AO. Dust control measures must be implemented throughout the traveled areas of the Project Area.
- To reduce potential impacts to air quality, all equipment associated with drilling and completion activities, as well as, service equipment used for fracing and cementing, would be with Tier-1 grade engines and emissions at a minimum.

4.2 Soils

As described in **Section 3.2**, soils in the Project Area are generally rated low in reclamation potential. Impacts to soils are typically described in terms of short-term and long-term impacts. In disturbed areas where interim reclamation is implemented, ground cover by herbaceous species could potentially re-establish within 5- to 7-years following seeding of native plant species and diligent weed control efforts, thereby reducing soil erosion. These reclaimed areas have often been referred to as short-term disturbance. However, it is important to note that all surface disturbances could remain as long-term (or even permanent) impacts on the landscape if reclamation efforts are not successful.

4.2.1 Alternative A – Proposed Action

Construction and operation of the proposed project would result in short- and long-term impacts to soils within the Project Area. Impacts would result from the clearing of vegetation, excavation, salvage, stockpiling, and the redistribution of soils during construction and reclamation activities that are associated with well pads, access roads, and pipelines.

Implementation of the Proposed Action would result in the direct disturbance of approximately 14.4 acres of soils within the Project Area. Following construction, approximately 4.4 acres of short-term disturbance (31 percent) associated with construction of proposed well pads and portions of the access roads and pipeline ROWs not needed for operational purposes would be reclaimed. This would reduce the long-term disturbance associated with implementation of the Proposed Action to approximately 10.0 acres. **Table 4-7** provides a summary of short-term and long-term surface disturbance associated with each soil mapping unit within the Project Area.

Blading or excavation to achieve desired grades could result in slope steepening of exposed soils in cut-and-fill areas, mixing of topsoil and subsoil materials, and the breakdown of soil aggregates into loose particles. The mixing of physical characteristics of the soils, including structure, texture, and rock content could potentially lead to a loss of soil productivity and reduced reclamation potential. Topsoil and subsoil would be stockpiled separately along the sides of the well pads and access roads. Soil structural aggregates would also be broken down by compaction from vehicular traffic. Removal and stockpiling of topsoil for revegetation purposes could reduce the natural fertility of the soil, and cause a loss of soil profiles by mixing soil horizons. These activities could potentially result in the subsequent breakdown of the soil structure.

Table 4-7. Soil Disturbance by Major Soil Map Units under the Proposed Action

Soil Map Unit	Acres within Project Area	Short-term Surface Disturbance (acres)	Long-term Surface Disturbance (acres)
Badland-Rock outcrop complex, 1 to 100 percent slopes (12)	324	2.2	1.5
Green River loam, 0 to 2 percent slopes, occasionally flooded (88)	188	0.0	0.0
Greybull-Utaline-Badland complex, 8 to 50 percent slopes (94)	91	0.0	0.0
Jenrid sandy loam, 0 to 2 percent slopes (120)	421	2.8	1.9
Nakoy loamy fine sand, 1 to 5 percent slopes (160)	157	2.0	1.3
Ohtog-Parohtog complex, 0 to 2 percent slopes (166)	245	3.3	2.3
Riverwash (191)	94	0.0	0.0
Shotnick loamy sand, 0 to 4 percent slopes (205)	332	3.8	2.8
Shotnick-Walkup complex, 0 to 2 percent slopes (209)	96	0.0	0.0
Stygee clay loam, 0 to 1 percent slopes (221)	38	0.0	0.0
Tipperary loamy fine sand, 1 to 8 percent slopes (229)	176	0.3	0.2
Turzo loam, 0 to 4 percent slopes (242)	285	0.0	0.0
Blackston loam, 0 to 2 percent slopes (23)	76	0.0	0.0
Utaline very gravelly sandy loam, 0 to 2 percent slopes (253)	19	0.0	0.0
Unclassified (open water, water structures)	1,142	0.0	0.0
Total	**3,684**	**14.4**	**10**

[1] Total acreage estimates are based on GIS-software calculations and may not equal the total summation when using mathematic equation due to rounding, removal of overlapping development and minute boundary discrepancies.

4.2.1.1 Erosion and Sedimentation

The whole soil erosion potential (K_w) for the soils that would be disturbed under the Proposed Action range from 0.24 – 0.37, indicating a moderate potential for erosion. In addition, the reclamation source materials rating for these soils are low, indicating that the presence of soil factors would inhibit the growth of vegetation. Upon completion of construction activities, re-vegetation, and 5- to 7-growing seasons, erosion rates would be expected to decrease to near baseline conditions for the reclaimed portions of the well pads, access roads, and pipeline ROW. However, erosion rates would likely remain at slightly elevated levels for the new access roads even in the absence of high traffic volumes.

Exposed soils would also be susceptible to heightened wind and soil erosion. The removal of vegetative cover, steepening of slopes, and the breakdown of aggregates would increase the potential for channelized runoff and accelerated soil erosion. Wind erosion could also increase with removal of vegetation and exposure of soils. Erosion would result in the formation of more rills and gullies and would increase sedimentation of surface water. Erosion would be particularly evident if project related activities are conducted during periods of high precipitation or during drought conditions. The increased erosion of soils could potentially lead to increased loss of vegetative cover and increased sedimentation in ephemeral drainages, the Green River, and/or other unnamed drainages within Ouray NWR. The actual amount of

additional sedimentation that would reach the drainages within or downstream adjacent to the Project Area would depend of the effectiveness of reclamation and erosion control measures as well as natural factors including the water available for overland flow; the texture of the eroded material and the amount and kind of ground cover; the shape, gradient, and length of the slopes; and surface roughness (Barfield et al. 1981).

Under the Proposed Action, topsoil would be conserved. Topsoil removed during project activities would be stockpiled for interim and final reclamation. During interim reclamation, all areas not needed for production would be returned to their natural contour using stockpiled topsoil and then seeded. At the completion of the project, or if a well is not productive, the well pads would be completely reclaimed. In addition, implementation of the additional Service-prescribed environmental protection measures detailed in **Section 2.1.11** would further minimize soil erosion and sedimentation impacts under the Proposed Action. Ground disturbing activities would be limited during periods of low precipitation to minimize wind erosion and fugitive dust deposition. Greater care and maintenance of topsoil would enhance reclamation success for soils with poor reclamation potential. This includes separating, stockpiling, covering, and documenting topsoil stockpiles on-site, in accordance with the Refuge's environmental terms and conditions.

4.2.1.2 Soil Contamination

Sources of potential soil contamination include leaks or spills of natural gas condensate liquids from wellheads, gas and water lines, produced water sumps, and condensate storage tanks. To reduce the potential for hydrocarbon contamination of soils, gas lines, and water lines would be designed to minimize the potential for spills and leaks. Storage tanks would be surrounded by berms capable of holding at least 110 percent of the largest single tank volume. Leaks or spills of saline water, hydraulic fracturing chemicals, fuels, and lubricants could also result in soil contamination. Depending on the size and type of spill, the effect on soils would primarily consist of the potential loss of soil productivity. The Project would minimize the risk of such spills by providing safeguards against spills and making sure that detailed reporting and cleanup measures are performed in the event of a spill. Thus, the potential for impacts to soils from spills would be considered minor.

Implementation of the Service-prescribed environmental protection measures as conservation stipulations (see **Section 2.1.11**) would further minimize the direct and indirect impacts to soils assessed under the Proposed Action (see **Section 4.2.1**). Construction of containment structures and use of catch pans or other liner systems to capture any and all leaked substances from storage tanks and/or production facilities would further minimize risks to the soil resources from possible contamination. In the event of an accidental spill or discharge, Thurston would be required to remove contaminated soils for proper disposal off-site and replace them with the same soil type or one specified and approved by the Refuge Manager. To further protect soils from contamination, Thurston or a Service-approved laboratory will be required to test the soils at the Project site to determine levels of heavy metals, chemical pollutants, or other contaminants prior to rig-up operations and before completion or at abandonment. Ground disturbance activities will be limited during periods of low precipitation to minimize impacts to soils. Greater care and maintenance of topsoil would enhance reclamation success on soils having poor reclamation potential. This includes separating, stockpiling, covering, and documenting topsoil stockpiles on-site in accordance with Refuge protection measures.

4.2.2 Alternative B – No Action Alternative

Under the No Action Alternative, the applicant would be denied access to USFWS refuge lands and exploratory drilling would not occur within Ouray NWR. As such, no changes to the existing environment would occur. No impacts to soil resources are anticipated.

4.2.3 Cumulative Impacts

The CIAA for soil resources is defined as the Ouray NWR. Any surface disturbing activity that removes native vegetation and topsoil from land within the Refuge may cumulatively and incrementally affect soil resources by increasing erosion and sediment yield, thereby reducing soil productivity and stability as measured by the amounts and types of vegetative cover and forage. Past, present, and reasonably foreseeable actions that could result in increased erosion and sediment yield within the CIAA include: prescribed burns; habitat enhancement projects; road, trail, and various other travel-way development; and oil and gas exploration and production. Of these actions, impacts related to road construction are the highest concern. As active roadways and trails would not be reclaimed for the long term, it is assumed sediment yield from existing and proposed road and trail construction (including those roads used for oil and gas development) would continue at rates two to three times above background rates into the indefinite future, as compared to other authorized actions.

As previously shown in **Table 4-2**, surface disturbance associated with the Proposed Action, when added to past, present, and other reasonably foreseeable actions, would cumulatively and incrementally result in minor negative cumulative impacts to soil resources within the CIAA. Approximately 55.1 acres have been or will be disturbed in the past, present, and reasonably foreseeable future from oil and gas activities on the Refuge. Under the Proposed Action, the proposed Ouray NWR 2-Well Development Project would incrementally increase the total cumulative soil disturbance in Ouray NWR to 69.5 acres. Throughout the CIAA, disturbed soil acreage and reduced soil productivity would last for the lifetime of oil and gas development or until final reclamation is deemed successful.

The incremental increase within the CIAA would increase under the Proposed Action because the 3-inch surface HDPE gas pipeline and power line within the ROW would result in more surface disturbance. Since the pipeline would be laid by hand along an existing road corridor, it would only represent an increase in short-term disturbance.

Soil compaction due to construction activities at well pads, along access roads, and in other disturbed areas would result in a small increase in surface runoff. This increased runoff could in turn cause increased sheet, rill, and gully erosion. The construction and operation of each well would also incrementally increase the potential for soil contamination within the CIAA. Spills, leaks, or discharges could increase the loss of soil productivity within the area.

Under Proposed Action, implementation of certain design features (see **Section 2.1**), ACEPMs (see **Section 2.1.10**), and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**) including berms, proper grading of well pads and access roads, and spill prevention and containment measures, would reduce impacts to soil resources by minimizing soil erosion and reducing the potential for soil contamination.

No cumulative impacts to soil resources are expected under the No Action Alternative.

4.2.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to soils under the Proposed Action:

- Impacts on sensitive habitat, (e.g., wetlands, riparian areas) wildlife, plants, and other sensitive natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- All construction of roads and pads will occur in a way that best facilitates their subsequent complete removal and reclamation once Thurston activities have ceased at these sites. This includes separating, stockpiling, and covering topsoil layers on site to be replaced during reclamation. All disturbed areas must be reclaimed with Service input at the time reclamation occurs. Only endemic plants and seed mixtures are to be used in reclamation. Thurston shall separate and store the topsoil horizon or the top six-inches, whichever is deeper, and mark or document stockpile locations to facilitate subsequent reclamation. When separating the soil horizons, the operator shall segregate the horizon based upon noted changes in physical characteristics such as organic content, color, texture, density, or consistency. All stockpiled soils shall be protected from degradation due to contamination, compaction and, to the extent practicable, from wind and water erosion during drilling and production operations. Best management practices to prevent weed establishment and to maintain soil microbial activity shall be implemented. Final reclamation of all disturbed areas shall be considered complete when all activities disturbing the ground have been completed, and all disturbed areas have been either built upon, compacted, covered, paved, or otherwise stabilized in such a way as to minimize erosion, or a uniform vegetative cover has been established that reflects pre-disturbance or reference area forbs, shrubs, and grasses with total percent plant cover of at least 80 percent of pre-disturbance or reference area levels, excluding noxious weeds, or equivalent permanent, physical erosion reduction methods have been employed. Re-seeding alone is not sufficient.
- Thurston shall implement and maintain BMPs at all oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation. BMPs shall be maintained until the facility is abandoned and final reclamation is achieved. Operators shall employ BMPs, as necessary, to comply with this rule, at all oil and gas locations, including, but not limited to, well pads, soil stock piles, access roads, tank batteries, and pipeline rights-of-way. BMPs shall be selected based on site-specific conditions, such as slope, vegetation cover, and proximity to water bodies, and may include maintaining in-place some or all of the BMPs installed during the construction phase of the facility. Where applicable, based on site-specific conditions, operators shall implement BMPs in accordance with good engineering practices.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.

- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both the state requirements and federal *Oil and Gas Onshore Order No. 2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to original site conditions. All costs shall be borne by the Operator.
- Pits, ponds, and/or open tanks are prohibited. Above ground storage tanks must be used in circulating operations for the temporary storage of all drilling fluids, cuttings, mud, and contaminants. All drilling fluids, cuttings, mud, contaminants, portable tanks, and other equipment must be transported off Refuge to a state-approved facility upon cessation of drilling activity. Onsite disposal of drilling fluids is prohibited.
- All toxic construction and equipment supplies and refuse (oil, grease, gasoline, diesel, paint, and other petrochemical derivatives) must be centrally stored. Wastes must be removed from the Refuge immediately following completion of drilling operations and disposed of properly. In the event of an accidental spill or discharge of oil, brine, or any other petrochemical substance, the Operator must immediately notify the Refuge Manager or the Service AO. The Operator must remove contaminated soils for proper disposal off Refuge, and replace such soils with the same type soils or of a type specified and approved by the Refuge Manager or the Service AO. A site reclamation plan may be required by the Refuge Manager or the Service AO.
- Catch pans or other liner systems consistent with industry standards are required for equipment and locations such as mud pumps, bulk mud additive tanks, fuel tanks, mixing sheds, generators, accumulator and lines, and under the entire rig floor. The catch pans must cover the entire surface area under the equipment. The rig floor catch pan must be tied to allow for wash down and mud drainage from the drill pipe. The catch pans must be kept free of accumulated debris and spill materials must be emptied on a regular basis.
- Earthen berms and storage tank containment areas would be lined with a non-permeable liner in order to reduce the risk of groundwater and soil contamination. These liners will be maintained and replaced per manufacturer guidelines.

4.3 Water Resources Including Floodplains, Wetlands, and Waters of the U.S.

4.3.1 Alternative A – Proposed Action

Construction and operation of the proposed project could potentially result in direct and indirect impacts to water resources. The principal impacts to water resources associated with the Proposed Action include: (1) increased sediment loading to the Green River, potentially increasing salinity levels in the Colorado River system; (2) depletion of stream flows in the Green River from the removal of water for drilling activities; (3) increased runoff; (4) impacts to water quality (i.e., potential contamination of surface water resources and shallow groundwater with drilling fluids or other wastes generated by natural gas drilling and production activities); and (5) direct and indirect impacts to floodplains.

4.3.1.1 Surface Water

The magnitude of potential project-related impacts to surface water resources would depend on a number of factors, including the proximity of surface disturbances to the Green River; slope aspect and gradient; soil type; the duration and timing of the construction activity; and the success or failure of reclamation and erosion control measures. The potential for adverse impacts to surface water resources would be greatest during project construction activities and would likely decrease in time due to natural stabilization of disturbed surfaces, the reduction in the amount of surface disturbance from interim and final reclamation, and successful revegetation efforts.

Increased Sedimentation

Much of the Project Area, including land where the well pads would be constructed, is nearly flat and increased erosion from these areas would likely be negligible. The potential for increased erosion would be greatest in the area where the Wildlife Refuge Road would be re-aligned. The actual amount of sediment that would be transported to the Green River would depend on natural factors and the effectiveness of BMPs employed to control erosion, but is expected to be minimal. Potential increases in construction-related erosion and sedimentation would be minimized by implementing BMPs (e.g., silt fencing).

During construction, especially along the re-aligned portions of Wildlife Refuge Road, erosion control measures would be implemented to avoid or minimize soil erosion and sedimentation. All roads would be constructed with appropriate and adequate drainage and erosion control features (e.g., cut-and fill-slope and drainage ditch stabilization, relief and drainage culverts, wing ditches, and rip-rap). The Refuge Manager will specify the erosion control methods to be used on a site-specific basis. Revegetation of road edges, drainage ditches, and cut-and-fill slopes would help stabilize exposed soil and reduce sediment loss.

Water Use

Water for use during drilling operations would be obtained from the Green River at the Green River Bridge on State Highway 88. Approximately 0.5 acre-feet (5,256 barrels, or 162,925 gallons) of water would be needed for the drilling of each well. Thus, a maximum of one acre-foot of water would be required to drill two wells. Approximately 2.3 acre-feet (24,176 barrels, or 749,458 gallons) of additional water would be used per well for completion purposes, for a total of approximately 4.6 acre-feet of water for two wells. Approximately 0.1 acre-feet (1,051 barrels, or 32,585 gallons) of water would be used on Wildlife Refuge Road for dust control. Water used for dust control purposes would be obtained from the Vernal City municipal water supply. The total amount of water required for drilling, completion, and dust control operations is anticipated to be approximately 5.7 acre-feet over the LOP. In comparison, the average annual flow in the Green River at Ouray is about 4,064,290 acre-feet (based on flow data from the USGS gauging station at Ouray). Therefore, the use of water for drilling will deplete the Green River by only 0.0001 percent, a hydrologically insignificant amount.

Increased Runoff

Soils compacted on well pads and roads would contribute to slightly greater runoff than undisturbed sites. The increased erosion could subsequently lead to slightly increased turbidity in the adjacent floodplain during major storm events. However, this effect would likely be negligible due to the low amount of runoff that would potentially be generated from the proposed facilities. In addition, surface water flow within the Refuge is controlled by a series of dikes and levees that regulate the discharge of floodwaters to the surrounding floodplain and ultimately into the Green River.

Runoff from undisturbed areas around each well pad would be directed into ditches and energy dissipaters (if needed) around the site and then released to grade. Stormwater management efforts may include additional engineering measures such as the installation of culverts to divert water flow around the well pads. As a result of these measures, the increased runoff would likely have no appreciable impact on the adjacent floodplain.

Water Quality

Contamination of surface water can occur in oil and gas fields. Sources of potential contamination include leaks of fuels, petroleum products, and produced water from wellheads, conveyance pipelines, storage tanks, and tanker trucks; leaching of contaminants from impacted soils near these facilities; and accidental spills. A spill of natural gas condensate that enters the adjacent floodplain or the Green River would have the greatest potential environmental impact on surface water. Potential effects from a spill of natural gas condensate could include an increase in biological oxygen demand (BOD) that results in the depletion of oxygen in the water and sediments during the short-term. This depletion of oxygen could have deleterious effects on aquatic organisms.

Produced water would be stored in steel tanks at each well pad. The contents of the tanks would be pumped out as needed and transported by tanker truck to licensed disposal sites. A spill of produced water into the adjacent floodplain or Green River could also result in negative impacts, including an increase of sodium, chloride, and other constituents, and aquatic organism mortality. In addition, significant leaks of produced water from routine loading operations on the well pads could potentially enter and impact surface water.

The Proposed Action has been designed to minimize the potential for spills. Should well logs determine that a well is economically viable, steel production casing would be run from the bottom of the wellbore through to the surface casing. The steel production casing would be cemented in place. Cementing the production casing would prevent damage to the wellbore that could potentially occur from targeted formation pressure or retard corrosion, and would prohibit pressure communication or fluid migration between productive zones. This would prevent protection to freshwater aquifers within the Project Area. Prior to drilling below the surface casing, a BOP would be installed on the surface casing and a flow control manifold consisting of manual and hydraulically operated valves would be installed below the rig floor. Both the BOP and the steel casing would be pressure tested to verify well integrity and to comply with *BLM Onshore Oil and Gas Order No. 2, Drilling Operations*. Additionally, a cement bond log would be run as part of completion operations to ensure that the production casing is properly protected from non-target formations. All drilling fluids used for each well would be contained within a closed-loop drilling system and no reserve pits would be constructed or used. All condensate and water tanks would be surrounded by a dike of sufficient capacity to contain 110 percent of the storage capacity of the largest tank in the battery and sufficient freeboard to contain precipitation.

Thurston would prepare and implement a final site-specific SPCC plan within six months of commencing operations. The SPCC plan describes spill control, reporting, and cleanup procedures to help prevent impacts to surface and subsurface waters. Any release of oil, gas, salt water, or other such fluids would be cleaned up immediately and removed to a permitted disposal site. Thurston would develop a storm water management plan and design well locations divert storm water drainages around the proposed well pads to reduce the amount of on pad erosion and the potential for small quantities of hazardous material from accidental spills to be washed into the drainage.

4.3.1.2 Groundwater

Potential impacts to groundwater resources from the Proposed Action include contamination of shallow groundwater underlying the Leota Bottom with produced water, drilling fluids, and petroleum constituents. Spills of fuels or produced fluids have the potential to contaminate shallow groundwater resources, including water used by the Ouray NFH from its production well. Potential effects from contamination of groundwater with natural gas condensate or produced water are similar to the potential effect to surface water, and include an increase in BOD, depletion of dissolved oxygen, and an increase of sodium, chloride, and other constituents. In addition, cleanup of groundwater contaminated with these substances can be considerably more difficult than cleanup of surface water.

The Proposed Action has been designed to minimize the potential for contamination of shallow aquifers. The well would be lined with steel casing that would be cemented in place. The steel casing would be pressure tested to ensure that the well would not leak production fluids into non-target or water bearing formations. The steel casing would then be cemented in place down to the producing zones and a cement bond log would be run. This would prevent damage to the wellbore that could potentially occur from targeted formation pressure, retard corrosion, and prohibit pressure communication or fluid migration between productive zones. If a spill is detected, the SPCC plan would be implemented to minimize, control, and cleanup the affected area. The measures provided in the SPCC plan would minimize the chance that spilled material would enter the groundwater by providing a rapid response to any spill events.

Hydraulic fracturing would be conducted as part of the Proposed Action. Hydraulic fracturing is commonly used to enhance the recovery of natural gas from relatively impermeable “tight” sandstones. This process involves the injection of water or other fluids, which may contain some petroleum constituents, and sand or some other “proppant” into the formation. Hydraulic fracturing would occur at depths that are at least 7,000 feet or more below the surface within isolated sections of the completion casing. Therefore, because of the great depth at which Hydraulic fracturing would be conducted, groundwater resources would not be affected.

4.3.1.3 Floodplains and Wetlands and Waters of the U.S.

Floodplains are protected by EO 11988 which requires that all federal agencies take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. Wetlands and Waters of the U.S. are protected under Section 404 of the CWA. Potential impacts to floodplains from the Proposed Action include damage to or loss of riparian vegetation from increased sedimentation; removal of vegetation for road and well pad construction; and pollution of surface water ponds or wetlands on the Leota Bottom due to accidental spills or loss of containment of petroleum products, fuels, and other chemicals. Per USACE verification, no direct impacts resulting from implementation of the Proposed Action would occur to wetlands or Waters of the U.S. See **Appendix B** for details.

The implementation of the environmental protection measures described above for surface water resources (e.g., BMPs and SPCC) would also be protective of floodplains, Waters of the U.S. and wetlands in the Project Area. Therefore, the potential for adverse direct or indirect impacts to floodplains and wetlands is expected to be minimal. Additionally, Service-prescribed environmental protection measures listed in **Section 2.1.11** would further minimize potential direct and indirect impacts assessed under the Proposed Action (see **Section 4.3.1**). Implementation of secondary containment structures to capture any and all leaked substances from storage tanks, production facilities, and drilling equipment would reduce the potential for contamination of water resources due to accidental spills. The well

development timing limitations would limit construction activities during potentially wet conditions in the spring, thereby potentially reducing damage to floodplains vegetation from construction activities.

4.3.2 Alternative B – No Action Alternative

Under the No Action Alternative, the applicant would be denied access to USFWS refuge lands and exploratory drilling would not occur within the Ouray NWR. As such, no impacts to water resources would occur.

4.3.3 Cumulative Impacts

The CIAA for water resources, including floodplains, wetlands, and waters of the U.S., is defined as the Ouray NWR. Any surface disturbing activity that removes native vegetation and topsoil from land within the Refuge may cumulatively and incrementally affect water resources by increasing erosion and sediment yield, as well as by introducing produced fluids and other physical and chemical constituents to area drainages and surface water features. Past, present, and reasonably foreseeable actions that could result in increased erosion rates, sediment yield, and contamination within the CIAA include: oil and gas development, prescribed burns, Refuge management activities, recreation, and road and trail construction. Of these actions, surface disturbing activities such as construction of oil and gas facilities and associated infrastructure would likely have the greatest potential impact on water resources due to increased erosion and sedimentation rates.

Surface disturbing activity that removes native vegetation and topsoil within the Refuge may cumulatively and incrementally impact surface water resources from increasing erosion and subsequent sedimentation. Implementation of the Proposed Action may introduce produced fluids and other physical and chemical constituents to area drainages and surface water features. Past, present, and reasonably foreseeable actions that could result in increased erosion, sediment yield, and contamination within the CIAA include: oil and gas development, prescribed burns, Refuge management activities, recreation, and road and trail construction.

As previously shown in **Table 4-2**, surface disturbance associated with the Proposed Action would cumulatively and incrementally result in minor negative cumulative impacts to water resources within the CIAA when added to past, present, and other reasonably foreseeable actions. Approximately 55 acres have been or will be disturbed in the past, present, and reasonably foreseeable future from oil and gas activities on the Refuge. The proposed project would incrementally increase the total cumulative soil disturbance in Ouray NWR to approximately 69.5 acres. Throughout the CIAA, increased erosion and sediment yield, and the risk of spills, would last for the lifetime of oil and gas development and production until final reclamation is deemed successful. Depending on reclamation requirements, drought conditions and other factors may affect reclamation success in the CIAA.

Soils compacted on existing roads, new access roads, and well pads would contribute to slightly higher runoff than at undisturbed sites. The increased runoff could lead to slightly higher peak flows in the CIAA drainage system, potentially increasing erosion of the channel banks. Such increased erosion, when combined with increased erosion from other authorized actions, could have negative impacts on aquatic habitat within affected drainages and on the proper functioning condition of floodplains. These impacts include increased turbidity and salinity; the covering of stream substrates with fine sediment and clogging of the interstitial pores of the substrate; increased transport of pollutants, including trace metals, herbicides, and petroleum constituents, and increased down-cutting of channel and bank destabilization. The construction and operation of each well would also incrementally increase the potential for leaks or

spills of saline water, hydraulic fracturing chemicals, fuels, and lubricants within the CIAA. Spills of this nature could contaminate surface water or shallow alluvial groundwater within the Refuge.

Under the Proposed Action, implementation of design features (see **Section 2.1**), ACEPMs (see **Section 2.1.10**), and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**) including construction of secondary containment structures around the proposed facilities and limiting construction activities during wet conditions, thereby reducing impacts to floodplain vegetation, would minimize cumulative impacts to water resources within the Refuge.

No cumulative impacts to water resources are expected under the No Action Alternative.

4.3.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to water resources under the Proposed Action:

- Impacts on sensitive habitat, (e.g., wetlands, riparian areas) wildlife, plants, and other sensitive natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Thurston must provide the wetland determination/delineation that was done by the U.S. Army Corps of Engineers (USACE) for the Project Area to the Refuge showing that none of the well pad locations or roads will impact wetland areas.
- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- In accordance with EPA regulations (40 CFR Part 112), Thurston must prepare and implement a SPCC plan within six months of beginning operations. Copies of the SPCC plans shall be provided to the Refuge Manager within six months of commencing production operations. A Draft SPCC Plan, which illustrates the types of spill prevention measures that will be installed, is included in **Appendix G**. This plan will be reviewed by the Service and should include a listing of secondary containment and/or diversionary structures or equipment for all oil handling containers, equipment, and transfer areas. It should also include a table identifying tanks and containers at the facility with the potential for an oil discharge, the mode of potential failure, and the likely flow direction and potential quantity of the discharge, as well as provide the secondary containment method and containment capacity. In addition, the SPCC Plan should include the physical layout of the facility and a facility diagram, which must mark the location and contents of each container. The facility diagram must also include all transfer stations and connecting pipes.
- All cuttings and drilling fluids will be removed from the Refuge and disposed of off-site in an approved disposal facility.

- Thurston shall provide a detailed topographic map, using established map making practices, showing the location of the 100-year floodplain along the Green River inside the Ouray NWR boundary.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- The drill site and immediate access roads must be constructed of Refuge-approved material for all drilling locations. All existing drainage patterns within roads to be constructed must be maintained uninterrupted by the use of culverts, bridges, or other applicable techniques as specified and authorized by the Refuge Manager or the Service AO.
- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both the state requirements and Federal *Oil and Gas Onshore Order No. 2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to original site conditions. All costs shall be borne by the Operator.
- Pits, ponds, and/or open tanks are prohibited. Above ground storage tanks must be used in circulating operations for the temporary storage of all drilling fluids, cuttings, mud, and contaminants. All drilling fluids, cuttings, mud, contaminants, portable tanks, and other equipment must be transported off Refuge to a state-approved facility upon cessation of drilling activity. Onsite disposal of drilling fluids is prohibited.
- Onsite disposal of produced water is prohibited. Produced water may only be disposed of at an offsite State-approved facility.
- Catch pans or other liner systems consistent with industry standards are required for equipment and locations such as mud pumps, bulk mud additive tanks, fuel tanks, mixing sheds, generators, accumulator and lines, and under the entire rig floor. The catch pans must cover the entire surface area under the equipment. The rig floor catch pan must be tied to allow for wash down and mud drainage from the drill pipe. The catch pans must be kept free of accumulated debris and spill materials must be emptied on a regular basis.
- The Operator will be responsible for providing all water needed for drilling operations. No waste water will be discharged onto Refuge lands, ditches, or water bodies. The Operator will provide a containerized or temporary septic system for domestic sewage disposal during drilling operations, which must be removed upon completion of drilling. Use of portable toilets at the drill site or the installation of a temporary septic system, or similar treatment system or tanks, will be required for any trailer or quarters on site. No surface discharge of septic system or portable toilet water is permitted. Septic tanks must be inspected weekly during operations and pumped as necessary. Upon completion of operations, the septic tanks must be pumped out, removed, and all material hauled away.
- Earthen berms and storage tank containment areas would be lined with a non-permeable liner in order to reduce the risk of groundwater and soil contamination. These liners will be maintained and replaced per manufacturer guidelines.

4.4 Biological Resources

4.4.1 General Vegetation

4.4.1.1 Alternative A – Proposed Action

Construction and operation under the Proposed Action would result in direct and indirect impacts to vegetation communities within the Project Area. Direct effects to vegetation (i.e., modification of structure, species composition, and extent of cover types) would occur from disturbance or removal of vegetation associated with construction of well pad sites, access roads or improvements to Wildlife Refuge Road. Indirect effects may include the short-term and long-term increased potential for noxious weed invasion, exposure of soils to accelerated erosion, soil compaction, and shifts in species composition and/or changes in plant density.

Table 4-8 shows that implementation of the Proposed Action would result in the direct disturbance of 14.3 acres of vegetation. This includes approximately 1.3 acres of scrub/shrub; 2.2 acres of grasslands/herbaceous; 2.4 acres of riparian vegetation types; 7.4 acres of barren land; and 1.0 acre of altered or disturbed vegetation cover types. Following construction, approximately 4.3 acres of short-term disturbance (30 percent) associated with construction of proposed well pads, portions of the access road, and pipeline ROW not needed for operational purposes would be reclaimed. This would reduce the long-term disturbance associated with implementation of the Proposed Action to approximately 10 acres.

Table 4-8. Vegetative Communities Affected by the Proposed Action

Land Cover Type	Vegetation Community	Short-Term Disturbance	Long-Term Disturbance
Scrub/Shrub	Colorado Plateau Mixed Low Sagebrush Shrubland	0.0	0.0
	Inter-Mountain Basin Mixed Salt Desert Shrubland	1.3	0.9
	Colorado Plateau Pinyon-Juniper Shrubland	0.0	0.0
	Inter-Mountain Basins Big Sagebrush Shrubland	0.0	0.0
Total		**1.3**	**0.9**
Grasslands/ Herbaceous	Inter-Mountain Basins Semi-Desert Shrub Steppe	2.2	1.5
Total		**2.2**	**1.5**
Riparian	Inter-Mountain Basins Greasewood Flat	2.4	1.8
	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.0	0.0
Total		**2.4**	**1.8**
Barren Lands	Colorado Plateau Mixed Bedrock Canyon and Tableland	4.6	3.1
	Inter-Mountain Basins Shale Badland	2.8	2.0
Total		**7.4**	**5.1**
Open Water	Open Water	0.0	0.0
Total		**0.0**	**0.0**

Land Cover Type	Vegetation Community	Short-Term Disturbance	Long-Term Disturbance
Altered or Disturbed Land	Invasive Annual Grassland	0.7	0.5
	Invasive Southwest Riparian Woodland and Shrubland	0.3	0.2
	Agricultural Lands	0.0	0.0
	Existing Development	0.0	0.0
Total		**1.0**	**0.7**
Grand Total		**14.3**	**10.0**

[1] Total acreage estimates are based on GIS-software calculations and may not equal total acreage by soil map unit due to rounding, removal of overlapping development, and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore, will be used throughout this document.

*Note: Individual acreages may not equal totals due to rounding.

*No USACE-designated wetlands are located within the proposed disturbance area.

The duration of impacts to vegetation would depend, in part, on the success of mitigation and revegetation efforts and the time needed for natural succession to return revegetated areas to pre-disturbance conditions. Following interim reclamation, ground cover would likely begin to re-establish within 2- to 3-years following seeding using native plant species. An estimated 7- to 10-years would be needed for shrub species to successfully re-vegetate the disturbed portions of the Project Area. Long-term disturbance would remain for the estimated 25- to 33-year LOP or until such time as the abandoned well pads and roads would be restored to near existing conditions.

Interim reclamation for portions of the well pads and access roads not needed for production facilities/operations would be completed within six months following completion of the last well planned. Seeding of temporarily disturbed areas along roads and pipelines would be completed within 30 days following completion of construction.

Implementation of the Proposed Action also would increase the potential for the occurrence of indirect effects. Additional construction related impacts could include soil compaction, an increased potential for wind and water erosion of disturbed surfaces prior to reclamation, and the potential for shifts in species composition and/or changes in plant density.

Service-prescribed environmental protection measures implemented as conservation stipulations would further reduce environmental impacts through greater care and maintenance of topsoil to enhance reclamation success (see **Section 2.1.11**). In addition, actions would be taken to limit the spread and introduction of noxious weeds through decontamination of vehicles and equipment entering the Refuge.

4.4.1.2 Alternative B – No Action Alternative

Under the No Action Alternative, the two proposed well pads, associated access roads, and surface pipeline would not be implemented. As such, there would be no direct or indirect impacts to vegetation or wetlands. Existing conditions for vegetation and wetlands resulting from recreation use and maintenance of Refuge resources would continue at current levels.

4.4.1.3 Cumulative Impacts

The CIAA for general vegetation is defined as the Ouray NWR boundary. Any surface disturbing activity that removes native vegetation and topsoil may cumulatively and incrementally affect general vegetation by fragmenting plant communities and increasing competition from invasive and noxious weeds. Surface-disturbing activities that compact soil, increase erosion and sediment yield, and increase fugitive dust may also cumulatively and incrementally affect general vegetation. Consequently, change to the landscape may decrease plant productivity and composition in the CIAA. Past, present, and reasonably foreseeable actions that could result in adverse impacts to vegetation within the CIAA include oil and gas development; prescribed burns; habitat enhancement projects and regular Refuge management activities; invasive species control and eradication efforts; and general recreation activities.

As shown in **Table 4-2,** surface disturbance associated with the Proposed Action, when added to past, present, and other reasonably foreseeable energy development activities would cumulatively and incrementally affect vegetation communities across the CIAA. Approximately 55.1 acres have been or will be disturbed in the past, present, and reasonably foreseeable future from oil and gas activities. Implementation of the Proposed Action would incrementally increase the total cumulative disturbance in the CIAA to approximately 69.5 acres. Throughout the CIAA, disturbed vegetation communities and reduced plant productivity would last for the lifetime of oil and gas development and production, until such time that final reclamation is deemed successful. Depending on reclamation requirements, drought conditions and other factors may affect reclamation success in the CIAA.

Under the No Action Alternative, no additional surface disturbance would occur within the CIAA as a result of the proposed project.

4.4.1.4 Mitigation

No additional mitigation beyond what is proposed under the ACEPMs is recommended in **Sections 2.1.10** and **2.1.11**for vegetation under the Proposed Action.

4.4.2 Invasive and Noxious Weeds

4.4.2.1 Alternative A – Proposed Action

Disturbances from construction would increase the potential for the establishment and spread of noxious weeds. Noxious weeds tend to be aggressive colonizers of disturbed areas where the native vegetation has been removed. Therefore, disturbances associated with construction of well pad sites, access roads, and other project facilities would provide opportunities for invasive and noxious weeds to become established. Once established, weeds could contribute to a reduction in the overall visual character of the area and add to the reduction or elimination of native plant species, wildlife habitat, and/or habitat for special status plant species.

In order to minimize the potential for adverse effects from invasive and noxious weed establishment, monitoring for invasive and noxious weeds would be necessary and if found, control and eradication measures would be implemented as outlined in the COAs for the SUP for the Project. The implementation of these measures along with ACEPMs listed in **Sections 2.1.10** and **2.1.11** would minimize the potential for adverse impacts from noxious weeds. Under the No Action Alternative, the applicant would be required to decontaminate all construction vehicles and equipment, prior to entering the Refuge. Any materials brought into the Refuge for the construction or reclamation of well pads must be authorized by the Refuge Manager, and no topsoil from outside the refuge would be allowed. In

addition, Thurston will also be required to have a Reclamation Plan that includes weed management (see **Appendix F**) to monitor affected and reclaimed lands for noxious weed infestations.

4.4.2.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented. As a result, there would be no direct or indirect impacts associated with the spread of invasive species and/or noxious weeds. Existing conditions promoting the continuation and spread of noxious weeds (for example, recreation and regular Refuge maintenance activities) would continue at current levels.

4.4.2.3 Cumulative Impacts

The CIAA for invasive and noxious weeds is defined as the Ouray NWR. Any surface disturbing activities that remove native vegetation and topsoil from the Refuge may cumulatively and incrementally contribute to the introduction and/or spread of invasive and noxious species. Cumulative effects to vegetation from noxious weeds are many and stem from a variety of past, present, and reasonably foreseeable land management and development activities including prescribed fire, wildfire, habitat enhancement projects, developed and motorized recreation, invasive species control and eradication efforts, and future oil and gas development. Specific negative impacts associated with the introduction and/or spread of invasive and noxious weed species include: 1) a reduction in the overall visual character of an area; 2) competition with, or elimination of native plants; 3) a reduction or fragmentation of native vegetation for wildlife use; and 4) increased soil erosion. Weed infestations may enter previously undisturbed areas or increase the size or density of existing weed populations within the Refuge. These impacts would likely be greatest along road corridors, which often provide a major conduit for the spread of weeds into natural areas.

Surface disturbance associated with the Proposed Action would cumulatively and incrementally affect vegetation communities across the CIAA when added to past, present, and reasonably foreseeable actions. Approximately 55.1 acres have been or will be disturbed in the past, present, and reasonably foreseeable future from oil and gas activities. Implementation of the Proposed Action would incrementally increase the total cumulative disturbance in the CIAA to approximately 69.5 acres (see **Table 4-2**). Under the Proposed Action, interim and final reclamation, in combination with ACEPMs (see **Section 2.1.10**), and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**) would reduce the potential for introduction or spread of invasive and noxious species into native vegetation communities within the Refuge. Throughout the CIAA, disturbed areas associated with the construction of well pads and access roads would last for the lifetime of oil and gas development and production until final reclamation is deemed successful. Depending on reclamation requirements, drought conditions and other factors may affect reclamation success and timelines within the CIAA.

Under the No Action Alternative, the potential for the spread and/or introduction of invasive and noxious weeds resulting from Refuge management activities and recreational use would continue at current levels and incrementally add to the cumulative impacts within the Refuge.

4.4.2.4 Mitigation

No additional mitigation beyond what is proposed under the ACEPMs (**Section 2.1.10**) and the Service-prescribed environmental protection measures (**Section 2.1.11**) are recommended for invasive and noxious weeds under the Proposed Action or other alternatives.

4.4.3 Wildlife and Wildlife Habitats

4.4.3.1 Alternative A – Proposed Action

Under the Proposed Action, construction and operation of the proposed project would result in direct and indirect impacts to wildlife and wildlife habitat. The principal impacts to terrestrial wildlife associated with implementation of the Proposed Action would likely include: (1) the loss of certain wildlife habitats due to construction activities such as earth-moving associated with proposed well pads, access roads, and 3-inch surface HDPE gas pipeline; (2) habitat fragmentation; (3) vehicle-related mortality; (4) displacement of some wildlife species; and (5) an increased potential for illegal take and harassment of wildlife. The magnitude of impacts to wildlife and wildlife habitats would depend on a number of factors including the type and duration of disturbance, the species of wildlife present, time of year, and implementation of recommended and required mitigation measures.

Table 4-8 shows that implementation of the Proposed Action would result in the direct disturbance of 14.3 acres of vegetation. This includes approximately 1.3 acres of scrub/shrub; 2.2 acres of grasslands/herbaceous; 2.4 acres of riparian vegetation types; 7.4 acres of barren land; and 1.0 acre of altered or disturbed vegetation cover types. Direct disturbance to wildlife habitat includes activities such as ground surface grading and excavation, tree and shrub removal, and/or scraping of road surfaces that disturbs surface and subsurface soils. Each of these activities could effectively remove and/or degrade existing habitat, thereby reducing its availability to local wildlife populations.

Following construction, approximately 4.3 acres of short-term disturbance (30 percent) associated with construction of the two proposed well pads, portions of the access road, and pipeline ROW not needed for operational purposes would be reclaimed. These areas would be revegetated with seed mixes approved by the Refuge Manager, most of which are specifically oriented to enhance wildlife use. The duration of impacts to vegetation would depend, in part, on the success of mitigation and reclamation efforts and the time needed for natural succession to return revegetated areas to pre-disturbance conditions. Grasses and forbs are expected to become established within the first several years following reclamation; however, an estimated 7- to 10-years would be required for shrub establishment and production of useable forage. Thus, under the Proposed Action, total habitat disturbance to vegetation would be reduced from approximately 14.3 acres to 10 acres.

Permanent and temporary loss of habitat as a result of construction activities could affect some small mammal, bird, reptile, and/or amphibian species with very limited home ranges and mobility. Although there is no way to accurately quantify these effects, the impact is likely to be moderate in the short-term and be reduced over time as reclaimed areas produce suitable habitats. Since most of these wildlife species are common and widely distributed throughout the Project Area, the loss of some individuals as a result of habitat removal would have a negligible impact on populations of these species throughout the region.

Indirect effects due to displacement of wildlife also would occur as a result of construction activities associated with the proposed project. In response to the increase in human activity (e.g., equipment operation, vehicular traffic, noise, and lighting), wildlife may avoid or move away from the sources of disturbance to other habitats. This avoidance or displacement could result in underutilization of the physically unaltered habitats adjoining the disturbances. The net result would be that the value of habitats near the disturbances would be decreased and previous distributional patterns would be altered. The habitats would not support the same level of use by wildlife as before the onset of the disturbance. Additionally, some wildlife would be displaced to other habitats leading to some degree of overuse and degradation to those habitats.

Public vehicle use of roads can have an additive, or possibly a synergistic influence on reducing wildlife use of adjacent habitats, as well as causing additional impacts. Public access and increased truck traffic associated with construction, drilling, and production operations in the Project Area would increase the potential for mortality and general harassment of wildlife.

4.4.3.1.1. Big Game

Mule Deer, Pronghorn, and Elk

Surface disturbances associated with the Proposed Action would result in the direct short-term loss of approximately 11.5 acres of crucial, year-long habitat for mule deer. Following construction, approximately 3.4 acres of short-term disturbance (30 percent) associated with construction of proposed well pads, portions of the re-aligned Wildlife Refuge Road, and access road ROWs not needed for operational purposes would be reclaimed. This would reduce the long-term disturbance of substantial, year-long habitat for mule deer associated with the Proposed Action to approximately 8.1 acres. Approximately 2.8 acres of substantial year-long pronghorn habitat would be lost as a result of the Proposed Action. However, interim reclamation would reduce the overall disturbance to this range to approximately 1.9 acres for the remainder of the LOP.

No surface disturbance to elk seasonal ranges would occur under the Proposed Action because these areas do not occur in close proximity to the disturbance footprint. No adverse impacts to elk are expected as a result of direct habitat disturbance under the Proposed Action because no designated crucial habitats will be affected and a relatively small total area is involved, and habitats similar to those impacted are readily available in surrounding areas.

Activities associated with the construction phase of the project are likely to temporarily displace pronghorn, mule deer, or elk from adjacent habitats, lowering the overall habitat effectiveness within the Project Area (D'Eon and Serrouya 2005; Sawyer et al. 2006). This could be caused by noise effects related to drilling equipment or through increased human presence. These zones are not likely to be completely abandoned by these species, but the effective use of these areas could be reduced depending on a number of factors such as time of year, social structure of individual herds, and whether populations are resident or migratory. However, once construction is complete, facilities are put into operation, and subsequent human activities are reduced, big game are likely to return to pre-disturbance activity patterns because most resident animals would have already been acclimated to the relatively high level of human activity. The displacement of a few individual big game species from their summer range is considered a short-term, non-adverse impact because of the temporary nature of the displacement and the availability of comparable habitats in adjacent areas.

The potential for vehicle collisions with big game during the spring, summer, and fall months would be increased by a commensurate increase in vehicle traffic during construction and would continue (although at a much reduced rate) throughout all phases of the well operations. In addition, the short-term influx of temporary construction workers and the long-term use of the area by gas field employees would increase the potential for poaching and general harassment of big game. Although such activities are not likely to reach significant proportions, proposed ACEPMs (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) that include measures to protect big game from harassment and/or poaching would reduce potential impacts associated with the Proposed Action.

4.4.3.1.2. Upland Game

Permanent and temporary loss of habitat as a result of construction activities could affect some upland game bird and mammal species within the Project Area. Approximately 12.7 acres of crucial year-long wild turkey habitat would be disturbed under the Proposed Action. Additionally, 14.4 acres of proposed disturbance occurs within year-long crucial habitat for ring-necked pheasant. Interim reclamation would reduce the long-term disturbance to these areas down to approximately 8.9 and 10 acres respectively. Although there is no way to accurately quantify impacts for other upland game species, the impact is likely to be moderate in the short-term and be reduced over time as reclaimed areas produce suitable habitats. Most of these game species would be common and widely distributed throughout the Project Area and surrounding region. The displacement of some individuals as a result of habitat removal would have a negligible impact on populations of these species throughout the region.

4.4.3.1.3. Waterfowl and Migratory Birds

The intensity of impacts from the Proposed Action on waterfowl and migratory birds that use the Ouray NWR and the surrounding region would be dependent upon the seasons of construction and the drilling of each well. If construction and drilling are completed in the late summer or early fall months (i.e., August to October), some of the migratory bird species would have left the immediate Project Area, or at least will have fledged and left their nests. Disturbance during this time would be temporary, and project-related impacts would not likely have an appreciable impact on migratory bird populations as a whole or individual species in general. However, if the proposed well construction and drilling were to occur during the peak nesting months in spring/summer, the Proposed Action could increase the potential for nest abandonment, reduce fecundity, displacement of birds in habitats adjacent to the proposed disturbance areas. These impacts would vary depending on species specific sensitivity to human activity, increased noise and light, and habitat fragmentation.

Construction, drilling, and completion activities, as well as production and maintenance activities would result in the fragmentation of habitat and associated edge avoidance by migratory birds, which have been documented as leading to lower levels in productivity (Renfrew et al. 2005). Associated noise, lighting, and increased human presence could cause displacement from foraging and nesting habitats. If displaced, birds could move to less suitable habitats that could cause an increase in competition and deteriorated physical condition. Increased vehicle traffic levels could also lead to the increased potential for collisions between migratory birds and vehicles. Thurston has committed to conducting drilling and completion activities outside the nesting season for yellow-billed cuckoo (June 15th to August 31st). This would reduce construction, drilling, and completion related impacts to migratory birds that may utilize of nest in the Project Area during this period. Given the relatively short period of time in which construction, drilling, and completion activities would occur, impacts related to noise, light, and increased human presence would be minor. The implementation of design features such as electrification of production facilities, along with ACEPMS (**Section 2.1.10**) and Service terms and conditions (**Section 2.1.11**) would reduce the long term impacts to migratory birds resulting from noise, lighting, electrification risk, and human activity.

4.4.3.1.4. Raptors

The principal impacts of the Proposed Action on raptors are: (1) nest desertions and/or reproductive failure caused by project-related disturbances, (2) increased public access and subsequent human disturbance resulting from new road and well pad construction, (3) increased risk of electrocution from installation of power lines and (4) temporary reductions in prey populations. Based on Refuge data, 12 raptor species are known to nest within the Refuge. Most of these nest sites are located in trees along the

riparian corridor and in the Green River floodplain. In addition, there are three known bald eagle roosting sites located within the Project Area and eight located adjacent to the Project Area along the Green River.

Direct impacts to raptors could result from surface-disturbing activities or areas with concentrated human activity that is in close proximity to an active raptor nest. This could lead to temporary displacement from nesting sites, avoidance of affected areas, and deterrence from establishing other nesting sites. Steidl and Anthony (2000) suggest that the greatest energetic costs from disturbance occur in nestlings, potentially decreasing overall reproductive success. Displacement could also lead to increased use of adjacent habitats, which could lead to increased inter- and intra-specific competition for resources. Because increased noise levels and visual disturbances associated with construction and drilling activities would be localized and short-term, displacement to adjacent habitats would likely be temporary in nature and would not likely alter the productivity of current raptor populations within the Project Area.

The newly constructed access roads under the Proposed Action may increase public access to areas within the Project Area and Leota Bottom. As workers and recreationists increase use of or activities in the Project Area, the potential for encounters between raptors and humans would also increase and could result in increased disturbance to nests and foraging areas, vehicle collisions, and incidences of general harassment.

New power lines used to serve wells under the Proposed Action would pose an increased risk of electrocution and collision hazard to raptors. Electrocution is a well-documented source of mortality for raptors and the vast majority of electrocutions involve electric distribution lines rather than high voltage transmission lines (APLIC 2006). Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). In addition, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012).

The development of proposed well pads and associated roads and pipelines would initially disturb an estimated 14.4 acres of potential habitat for several species of small mammals that serve as prey items for raptors. It is not likely to be the determining factor in the level of use by raptors within the Project Area because the small amount of short-term change in prey base populations created by the construction associated with the Proposed Action is minimal in comparison to the overall status of the rodent and lagomorph cycles, which is controlled over the region and State by natural forces. While prey populations on the Project Area would likely sustain some stress during the initial phase of the project, prey numbers would be expected to soon rebound to pre-disturbance levels following reclamation of approximately 31 percent of the short-term disturbance area involving unused portions of well pads and roads. Once reclaimed, these areas will likely promote an increased density and biomass of small mammals that is comparable to those of undisturbed areas (Hingtgen and Clark 1984). For these reasons, implementation of the Proposed Action is not expected to produce any appreciable long-term negative changes to the raptor prey base within the Project Area.

Both successful interim reclamation of areas not used for production activities and final reclamation efforts could re-establish some raptor and prey habitat over time. Measures to reduce speeding and remove carrion on area roads could reduce direct impacts associated with the Proposed Action.

4.4.3.1.5. Fisheries

Under the Proposed Action, habitat for native and/or recreational fish species inhabiting the Green River within and adjacent to the Project Area may be degraded by increased erosion, sediment yield, and the potential for exposure to hazardous substances in the case of an accidental spill that would result in condensate and hydrocarbon material entering the Green River. However, degradation of habitat related to increased erosion and sedimentation would be minimized by actions set out in the Proposed Action, including ACEPMs (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**), which include provisions to implement reclamation and utilization of BMPs to reduce or minimize the potential for erosion and sedimentation within the Project Area. In addition, impacts related to exposure of hazardous substances would be minimized by implementation of and adherence to items of the SPCC plan. Water depletions associated with implementation of the Proposed Action may reduce the ability of the Green River and its tributaries to create and maintain the physical habitat required by fish species and the supporting biological environment; however, water depletions under the Proposed Action would be minor and would not likely contribute to long-term impacts. While individual common native and/or recreational fish may be affected by the Proposed Action, population or species-level impacts are not anticipated.

4.4.3.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed surface disturbing activities would not occur. Future mineral development in the Project Area would be considered on a case-by-case basis and would be subject to separate NEPA analysis. As a result, the No Action Alternative would not have an adverse or beneficial effect on fish and wildlife.

4.4.3.3 Cumulative Impacts

The CIAA for fish and wildlife and their associated habitat is defined as the Ouray NWR boundary. This analysis assumes that: (1) human use of the CIAA would increase with implementation of the Proposed Action; and (2) the overall region has been previously affected by past and present (existing and ongoing) oil and gas development.

Past, present, and reasonably foreseeable surface disturbance from oil and gas activities within Ouray NWR has and will continue to reduce wildlife habitat, contribute to habitat fragmentation, disrupt seasonal patterns or migration routes, displace individual wildlife species, result in collisions between wildlife and vehicles, and potentially contribute to poaching and harassment of animals. Other permitted activities, such as recreation, refuge management operations, and prescribed burns have and will also continue to contribute to cumulative impacts to fish and wildlife, but the incremental contribution of these activities is difficult to quantify. As such, this analysis assumes future disturbance in the CIAA would primarily result from oil and gas development; however, it is understood that recreation, development of dedicated recreational and educational facilities, and ongoing Refuge management activities may also contribute to the disturbance of wildlife species and their habitat.

As shown in **Table 4-2,** approximately 55.1 acres have been or will be disturbed in the past, present, and reasonably foreseeable future from oil and gas activities within the Refuge. Implementation of the Proposed Action would incrementally increase the total cumulative disturbance in the CIAA to approximately 69.5 acres. While surface disturbance does correspond to associated wildlife impacts, accurate calculations of cumulative wildlife habitat loss are not determinable because the direct impacts are species-specific and depend on the following: status and condition of the population(s) or individual animals being affected; seasonal timing of the disturbances; value or quality of the Project Area habitats

as well as adjacent habitats; physical parameters of the affected and nearby habitats (e.g., extent of topographical relief and vegetative cover); and type of surface disturbance.

Surface disturbance associated with the Proposed Action would have minimal impacts on wildlife habitat across the CIAA (0.6 percent) when added to past, present, and reasonably foreseeable actions. Yet, in the context of cumulative impact analysis, each acre of vegetation and wildlife habitat disturbance in the Refuge would be additive to other losses of habitat, foraging areas, breeding areas, ground cover, and increased habitat fragmentation within the Uinta Basin. Additional development activities could temporarily displace wildlife or preclude wildlife species from using areas of more intense human activity. Other impacts could increase disruption of migratory routes and seasonal ranges, general distress, or deteriorated physical condition, decreased reproductive success, and nutritional condition due to increased energy expenditure.

Under the Proposed Action, implementation of design features (see **Section 2.1**), ACEPMs (see **Section 2.1.10**), and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**) including avoidance of sensitive wildlife habitat (i.e., floodplains/riparian area), preconstruction surveys, adherence to speed limits, implementation of a SPCC plan, and minimizing noise during construction, drilling and completion activities would reduce impacts to wildlife and wildlife habitat, thus reducing long-term cumulative impacts within the Refuge.

No cumulative impacts are anticipated under the No Action Alternative as no project activity would occur within the Ouray NWR.

4.4.3.4 Mitigation

The following recommended mitigation measures would be applied to reduce impacts to wildlife species and wildlife habitat:

- To avoid the potential for mortality and harassment of wildlife, all firearms and dogs will be prohibited from the project site, and all workers will be required to check under their vehicles prior to departing the project site.
- Trash and food items will be disposed of promptly in containers with resealable lids. Trash containers will be removed regulatory (at least once per week). This effort will reduce the attractiveness of the area to opportunistic wildlife.
- A maximum speed limit of 20 miles per hour, unless otherwise posted, will be maintained while traveling on unpaved access roads on the project site. This effort will reduce the potential for vehicle-wildlife related collisions and decrease fugitive dust associated with truck traffic.
- A brief Worker Environmental Awareness Program (WEAP) will be implemented for construction and drilling crews prior to the commencement of the project activities. Training materials and briefings will include, but are not be limited to, discussion of the federal and state ESAs, the consequences of noncompliance with these acts, identification and values of wildlife and natural plant communities, threatened and endangered species within the Project Area, hazardous substance spill prevention and containment measures, and review of all required and recommended mitigation measures.

- Should the project schedule construction activities between March 1st and August 31st, all areas within 0.5 miles of the proposed project would be surveyed for the presence of raptor nests by a Service-approved biologist. If occupied raptor nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- Burrowing owl surveys would be conducted concurrently with the raptor surveys within 0.25 miles of the proposed project if the project schedule occurs between March 1st and August 31st. If occupied burrowing owl nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- To avoid and minimize impacts to birds during construction and operations and to ensure ground-disturbing activities do not result in the "take" of an active nest or migratory bird protected under the MBTA, the Service requires the following of Thurston:

    a) Any groundbreaking activities or vegetation treatments should be performed before migratory birds begin nesting or after all young have fledged to avoid take;

    b) Time tree and shrub removal and ground disturbing activities should occur during the non-nesting season (approximately September 1st to February 28th). If this is not possible, surveys should be conducted prior to disturbance to determine whether active nests are present; active nests found in the area should be left untouched until the young have fledged;

    c) If activities must be scheduled to start during the migratory bird breeding season, appropriate steps to prevent migratory birds from establishing nests in the potential impact area should be taken. These steps could include covering equipment and structures and use of various excluders (e.g., noise). Birds can be harassed to prevent them from nesting on the site;

    d) If activities must be scheduled during the migratory bird breeding season, a site-specific survey for nesting birds should be performed starting at least two weeks prior to vegetation treatments. Established nests with eggs or young cannot be moved, and the birds cannot be harassed (see item b above), until all young have fledged and are capable of leaving the nest site; and

    e) If nesting birds are found during the survey, appropriate spatial buffers should be established around nests. Vegetation treatments within the buffer areas should be postponed until the birds have left the nest. Confirmation that all young have fledged should be made by a qualified biologist.

4.4.4 Special Status Plant and Animal Species

In general, construction and operational impacts on special status fish and wildlife species and their habitats would be similar to those discussed in the preceding sections for vegetation communities (**Section 4.4.1**) and wildlife (**Section 4.4.3**). However, these impacts can be more severe for special status plant, fish, and wildlife species, if present, since the distribution and abundance of many of these species are limited in the Project Area and surrounding region. An adverse impact to special status species will have occurred if construction and/or operation of any component of the proposed project

would cause substantial changes to the existing abundance, distribution, or habitat value for a special status fish and wildlife species.

4.4.4.1 Alternative A – Proposed Action

Species Listed as Federally Threatened, Endangered, or Proposed

The following section describes the anticipated effects of various project components and activities associated with the Proposed Action on federally listed, proposed, and candidate species carried forward for evaluation. The magnitude and nature of effects of the Proposed Action is assessed for the species relative to existing conditions in terms of whether these effects are expected to appreciably reduce the likelihood of species survival and recovery. Conclusions regarding the effects of the Proposed Action on the species, as well as a determination of effect (***no effect; may affect, is not likely to adversely affect; may affect, is likely to adversely affect; is likely to jeopardize proposed species/adversely modify proposed critical habitat;*** and ***is not likely to result in a trend towards federal listing of the species***) is presented in the conclusions and determination section at the end of the analysis for the species.

Although not specifically required by the ESA, the USFWS encourages the formation of partnerships to conserve candidate species because these species by definition may warrant future protection under the ESA. Under Intra-Service Section 7 consultations, candidate species are treated as if they are proposed for listing for purposes of conducting internal FWS conferencing. FWS units consult or confer with the appropriate FWS Ecological Services field office on actions they authorize, fund, or carry out that may affect listed, proposed, or candidate species or designated or proposed critical habitat. In the event that yellow-billed cuckoo becomes listed in the future, Thurston would conduct preconstruction surveys to determine the likely effects of the Proposed Action and findings of effect on the species and its habitat.

Yellow-Billed Cuckoo

The yellow-billed cuckoo is known to use riparian habitat that occurs north and east, but outside, of the disturbance footprint for the Project along the Green River. Therefore, the Proposed Action would not have direct impacts to this habitat. Potential effects of the Proposed Action on the western yellow-billed cuckoo would likely be in the form of direct noise disturbance or lighting. Noise and/or lighting may arise from construction, drilling, and production activities associated with the proposed project, which could affect cuckoos, if present in the immediate vicinity of these activities. This could lead to avoidance of affected areas (Goodwin and Shriver 2010). Displacement could also lead to increased use of adjacent habitats, which could lead to increased inter- and intra-specific competition for resources.

Existing studies on noise indicate that the response of wildlife to noise disturbance is complex; that is, it is neither uniform nor consistent. Delaney et al. (1997) reviewed literature on the response of raptors and other birds to noise and concluded the following: (1) birds are more susceptible to disturbance-caused nest abandonment early in the nesting season, (2) birds generally flush in response to disturbance when distances to the source are less than approximately 200 feet and when sound levels are in excess of 95 dB(A), and (3) the tendency to flush from a nest declines with experience or habituation to the noise, although the alert response (i.e., head movements or agitated behavior) cannot be completely eliminated by habituation.

Elevated ambient daytime noise from the proposed project during the western yellow-billed cuckoo breeding season could result in decreased utilization within an indeterminate number of acres north and east of the current Wildlife Refuge Road along the floodplain. The magnitude of impacts would depend on the specific type of activity, the noise level generated by various types of equipment, the distance between the activity and individual cuckoos, and whether local barriers and topography provide shielding

effects. Noise analysis completed for the Montebello Hills Specific Plan Environmental Impact Report revealed that use of electric pumpjack equipment and transformers similar in size to what would be installed on the Refuge would generate noise levels at distances greater than 150 feet that are considered ambient conditions in a rural residential area (i.e., noise levels near or below 40 dB[A]) (BridgeNet International 2009). Topographic screening between the area of disturbance and the birds' location creates a noise buffer and could assist in the reduction of noise disturbance (Knight and Cole 1995).

Table 4-9 lists noise levels associated with common activities and events.

Table 4-9. Common Noise Levels Associated with Activities and Natural Events

Source	Sound Level
Threshold of Hearing	0 dB(A)
Wind in Deciduous Trees (2-14 mph)	36-61 dB(A)
Falling Rain (Variable Rainfall Rates)	41-63 dB(A)
Light Traffic (at 100 feet)	50 dB(A)
Average Residence	50 dB(A)
Loud Automobile Horn (at 1 meter)	115 dB(A)
Oil Drilling Rig (at 50 feet)	90-115 dB(A)

Source: EPA 1974

Table 4-10 shows the attenuation of noise levels in association with distance from the receptor. .

The influences of vegetation, topography, and atmospheric conditions on noise reduction factors can vary greatly and are often impossible to quantify. Therefore, these factors are generally not taken into account in environmental noise analysis, which generally results in predicted noise levels that are higher than actual noise levels. For example, a break in the line of sight between a noise source and receptor can result in a 5 dB(A) reduction. Dense vegetation can reduce noise levels by 5 dB(A) for every 100 feet of vegetation, up to a maximum reduction of 10 dB(A) (USDOT 1995). Wind can reduce noise levels by as much as 20 dB(A) to 30 dB(A) at long distances (USDOT 1995).

Table 4-10. Estimated Noise Attenuation Associated with an Increase in Distance

Distance to Receptor (Feet)	Sound Level at Receptor (Decibels)
50	92
100	86
200	80
400	73
600	69
800	67
1,000	64
1,500	60
2,000	57
2,500	54
3,000	51
4,000	47

Source: California State Water Resources Control Board (2002).

Thurston would not conduct construction, drilling, and completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st); therefore, intensive noise, light, and human related impacts to nesting cuckoos during these project phases are not anticipated. Due to the distance the proposed well pads would be from the nearest area that contains riparian vegetation, the use of electrified pump-jacks, and the buffering effects of vegetation, topography, and atmospheric conditions, the magnitude of project-related noise impacts on the yellow-billed cuckoo are not expected to reach adverse levels.

Potential indirect impacts to potential yellow-billed cuckoo habitat could result under the Proposed Action from increased soil erosion and potential for spills and leaks. These impacts would be reduced with interim reclamation, recommended mitigation measures for erosion control to avoid or minimize soil erosion and off-site deposition, and spill containment measures. Further, while the yellow-billed cuckoo is known to occur and nest within the Ouray NWR, they are considered as uncommon to rare summer residents within the Refuge. Based on this information, the Proposed Action ***may affect, is not likely to adversely affect*** the yellow-billed cuckoo within the Project Area.

Colorado River Fish Species

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

Total water needed for the proposed project would be approximately 5.7 acre-feet (see **Section 2.1.7**). The estimated total freshwater needed for the proposed project (5.7 acre-feet) could result in depletion to the Green River, thus directly affecting the Colorado River fish and their habitat. Water depletions can reduce the ability of the Green River and its tributaries to create and maintain the physical habitat required by these fish and the supporting biological environment. Water depletions can also contribute to alterations in flow regimes that favor increased forage and habitat competition for, and predation on, the Colorado River fish from non-native fish species.

In order to address depletion and other direct and indirect impacts on the Colorado River fish, a Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) was initiated in January 22, 1988. Under the Recovery Program, any water depletions from tributary waters within the Colorado River drainage are considered to "jeopardize the continued existence" of these fish. To further define and clarify the recovery processes in the Recovery Program, a Section 7 agreement was implemented on October 15, 1993, by the recovery program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP). The RIPRAP identifies actions currently required to recover the endangered fish species in the most expeditious manner. Included in the RIPRAP was the requirement that a one-time depletion fee would be paid to help support the recovery program for all non-historic water depletions (i.e., occurring after January 1988) from the Upper Colorado River Basin. The depletion fee ($19.82 per acre-foot as of October 1, 2012, and updated annually) was intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions to the Upper Colorado River Basin (USFWS 2013a). In 1995, the USFWS eliminated these fees for non-historical water depletions (permitted after January 1988) from the Upper Colorado River Basin of 100 acre-feet or less (USFWS 1994). For this EA, it is assumed that all water depletions from fresh water sources would be considered non-historical.

Local floodplain areas to the project (i.e., Leota Bottom) are important nursery habitats for razorback sucker. As part of the newly implemented *Study Plan to Examine the Effects of Using Larval Razorback*

Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam Peak Releases (LTSP) (Larval Trigger Study Plan ad hoc committee 2012), the Upper Colorado River Endangered Fish Recovery Program plans to use floodplains in the Leota Bottom area as nursery habitat under various hydrologic conditions. Specifically, Leota 7 would be targeted for larval razorback in all average and wetter years, and Leota 7a and 4 would be targeted in moderately wet and wet years. These floodplain units located within the Project Area lie directly east of Wildlife Refuge Road and the proposed disturbance. More specifically, units 4, 7 and 9 are those most likely to suffer from indirect impacts associated with project activities. Potential indirect effects to the floodplains in the Leota Bottom and their associated fish habitat are described below.

Implementation of the Proposed Action could also degrade USFWS-designated critical habitat for the Colorado River fish species in major tributaries and floodplains of Green River by increasing erosion, sediment yield, and the potential for exposure to hazardous substances in the case of an accidental spill that would result in condensate and hydrocarbon material to enter the Green River. However, degradation of habitat related to increased erosion and sedimentation would be minimized by actions set out in the Proposed Action, including ACEPMs (**Section 2.1.10**) and Service prescribed environmental protection measures (**Section 2.1.11**), which include provisions to implement reclamation, implement and adhere to a stormwater management plan (SWMP), and use BMPs to reduce or minimize erosion from the Project Area. In addition, impacts related to the increased potential for exposure to hazardous substances would be minimized by implementation of and adherence to the specific action items of a SPCC plan that would contain and/or control contaminated water.

The Proposed Action would not result in any direct impacts to the Ouray NFH. The proposed well pads, access road, and pipeline corridor would occur approximately 7,571.5 feet southeast of the hatchery. The hatchery could be indirectly impacted by the construction of the proposed above ground power line running from the hatchery to the proposed well sites. These impacts could include increased noise and human presence within the vicinity of the facility. However, these impacts are considered negligible as they would be short in duration and minor in scope.

As discussed in **Section 4.3.1.1**, the use of water for drilling under the Proposed Action will result in a small depletion to the Green River, 0.0001 percent. While this amount may be minor to the flow of the Green River, any loss of water from the Upper Colorado River Basin represents a measurable loss of habitat for fish species; therefore, implementation of the Proposed Action ***may affect, is likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River.

This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin and the potential for the Colorado River fish and their designated critical habitat to be exposed to hazardous substances originating from an accidental spill, which could result in the release or discharge of condensate or hydrocarbon materials into the Green River and its associated 100-year floodplain.

Uinta Basin Hookless Cactus

Implementation of the Proposed Action would directly result in the disturbance of approximately 14.4 acres of potential habitat for Uinta Basin hookless cactus within the Project Area, which represents approximately 0.003 percent of the total potential habitat for Uinta Basin hookless cactus across their entire range. Following construction, approximately 4.4 acres (31 percent) of land associated with the construction of the well pads, access roads, and pipeline ROWs not needed for operation purposes would be reclaimed. This would reduce the long-term disturbance to Uinta Basin hookless cactus habitat associated with the Proposed Action to approximately 10 acres. None of the proposed well pads or

project infrastructure would be constructed within Level 1 and 2 Core Conservation Areas for the Uinta Basin hookless cactus.

Figure 4-1 shows the results of cactus areas surveyed in June 2012, April 2003, and November 2013. As identified in **Appendix D**, the proposed cross-country 3-inch surface HDPE gas pipeline would be located approximately 87 feet from the nearest identified *Sclerocactus* individual. However, this route would be subgrade to the identified cactus populations and would have minimal indirect impacts. No appreciable surface disturbance associated with installation of this surface pipeline would be expected.

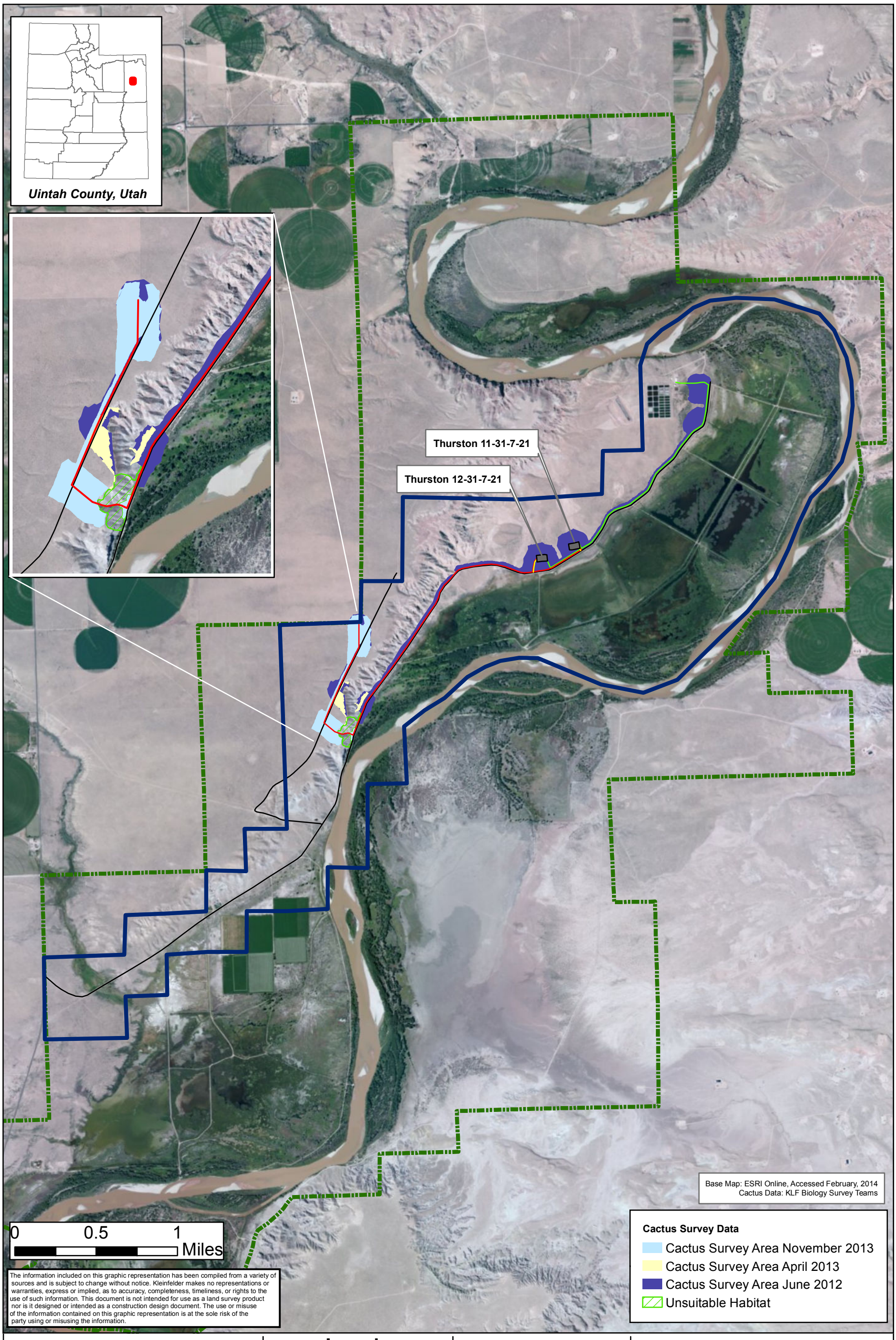
Implementation of the Proposed Action would increase the potential for occurrence of indirect and dispersed direct effects to the Uinta Basin hookless cactus, if present. Disturbances from construction could increase the potential for the invasion and establishment of noxious weed species. Invasion by non-native species is particularly problematic because they are capable of effective competition with native species for space, water, light, nutrients, and subsequent survival. Over time, the successful establishment of non-native species can out-compete native vegetation and eventually dominate large areas. An increase in weedy annual grasses also increases the potential for fire by increasing the density and flammability of available fuels. Grasses are more flammable and establish in denser populations than woody and non-woody native vegetation.

Additional indirect construction-related impacts could include an increased potential for wind erosion of disturbed areas creating airborne dust that could be transported into suitable habitat for these species. Airborne dust generated by vehicles could inhibit photosynthesis and transpiration in the Uinta Basin hookless cactus. Inhibited and reduced rates of photosynthesis could affect the rate of growth, the reproductive capacity of individual plants, and ultimately the ability of these individuals to persist in adjacent areas. Thompson et al. (1984) and Farmer (1993) have indicated that varying amounts of dust settling on vegetation can block stomata, increase leaf temperature, and reduce photosynthesis.

Other indirect impacts to Uinta Basin hookless cactus in the Project Area would include an increased risk of crushing by off-road vehicles due to an expanded road network, impacts from herbicides used to control invasive plants, and possible reductions in pollination or seed dispersal due to a larger road network and resulting habitat fragmentation and dust. Because the Uinta Basin hookless cactus requires insect pollinators for successful reproduction (Tepedino et al. 2010), impacts to pollinator nesting and foraging habitats can negatively affect the cactus by reducing the diversity and abundance of pollinators and, thereby, the plant's ability to successfully reproduce. The expanded road network also will increase the risk of illegal collecting of cacti.

Design features outlined under the Proposed Action would reduce the impacts to *Sclerocactus spp.* Actions outlined include: noxious weed and invasive species monitoring, use of existing roads where possible, minimizing new surface disturbance, dust abatement techniques, preconstruction surveys in potential habitat and adherence to species-specific conservation measures. The species-specific conservation measures for the Uinta Basin hookless cactus include provisions to avoid occupied habitat, employ the use of spatial buffers between surface activities and known populations of plants, limit off-road travel, and monitor the effectiveness of these measures.

Although these measures will minimize the impacts of the action to *Sclerocactus spp.*, larger landscape-level changes such as increased habitat fragmentation and habitat loss, pollinator disturbance, changes in erosion and water runoff, and increased weed invasion cannot be entirely negated. These disturbances will continue to negatively impact the Uinta Basin hookless cactus throughout the Project Area. Therefore, the Proposed Action ***may affect, is likely to adversely affect*** the Uinta Basin hookless cactus.



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	C. Wharry
FILE NAME:	Fig4_1Cactus.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

2012-2013 Cactus Survey Results
Uintah County, Utah

FIGURE
4-1

Ute ladies'-tresses

No disturbance to wetlands, riparian areas, or floodplains would likely occur under implementation of the Proposed Action. Therefore, no loss of Ute ladies'-tresses is anticipated as a result of the proposed project. Additionally, no Ute ladies'-tresses have been observed south of Highway 40 (Fertig et al. 2005). For the same reasons, the potential for occurrence of indirect and dispersed direct effects to this species from the Proposed Action would be unlikely to occur. Therefore, the Proposed Action ***may affect, is not likely to adversely affect*** the Ute ladies'-tresses.

Utah Natural Heritage Program Species of Concern

The following section describes the anticipated effects of project components and activities associated with the Proposed Action on UNHP species of concern identified as potentially occurring within the Project Area. The magnitude and nature of effects resulting from implementation of the Proposed Action is assessed for the species relative to existing conditions in terms of whether these effects are expected to appreciably impact species population viability and/or result in a trend towards federal listing.

Bald and Golden Eagle

Although no bald or golden eagle nesting has been reported to occur within the Project Area, there are several bald eagle roosting sites within the Project Area and adjacent lands. Impacts associated with the implementation of the Proposed Action on roosting bald and golden eagles would be similar to those discussed in **Section 4.4.3.1.4** for raptors. These impacts include temporary displacement caused by elevated human activity, increased public access and subsequent human disturbance as a result of construction of new access roads and reduction in prey population due to habitat fragmentation alteration.

Increased noise levels, lighting, and visual disturbances associated with construction and drilling activities would be localized and short-term, and would not be likely alter the current use of cottonwood trees and elevated areas along the Green River as roosting sites for eagles. In addition, the cliffs and trees that occur along the Green River would provide a moderate level of topographic screening and increased insulation from facilities, human activity, and altered habitat throughout the Project Area.

In addition to fish taken along the Green River, bald eagles would likely feed on carrion during the winter, including mule deer and pronghorn that use winter range within portions of the Project Area. The potential for vehicle collisions with big game could increase as a result of increased vehicular traffic associated with the presence of construction crews and operation under the Proposed Action. Measures to control speed limits and the removal of big game carcasses from roadways would be implemented to reduce the potential for vehicle-related collisions with bald eagles.

New power lines used to serve facilities and wells under the Proposed Action would pose an increased risk of electrocution and collision hazard to bald and golden eagles. Electrocution is a well-documented source of mortality for eagles and other raptor species and the vast majority of electrocutions involve electric distribution lines rather than high voltage transmission lines (APLIC 2006). Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). Furthermore, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012).

Similar to the raptors, should the project timeline include construction during the raptor nesting season (March 1st to August 31st), all areas within 0.5 miles of the proposed project would be surveyed for the presence of eagle nests by a Service-approved biologist. If an occupied nest is identified, all construction activities would be postponed until the young have fledged and left the nest (see **Section 2.1.11**) (Romin

and Muck 2002). Other ACEPMs pertaining to bald and golden eagle protection and mitigation include interim and final reclamation, adherence to speed limits, and procedures to contact the county for carrion removal. Based on adherence to these measures, the Proposed Action would not likely result in a trend toward re-listing of this species, nor would it result in an appreciable loss of bald eagle or golden eagle populations or density within the Project Area.

Ferruginous Hawk

Implementation of the Proposed Action could result in both direct and indirect impacts to the ferruginous hawk and would resemble the impacts identified in **Section 4.4.3.1.4** for raptors in general. These impacts include temporary displacement caused by elevated human activity, increased public access and subsequent human disturbance as a result of construction of new access roads, and reduction in prey population due to habitat fragmentation alteration.

Ferruginous hawks are particularly susceptible to human-caused disturbances during courtship and incubation periods, and the species will abandon nests if disturbed prior to the eggs hatching (Wheeler 2003). Construction, drilling, or completion activities plus increased traffic could potentially disrupt breeding and nesting activities in the Project Area. Such disturbance could result in displacement from nesting sites and reduce nesting success. A reduction in reproductive success could continue throughout the LOP, particularly near heavy traffic roads or areas with intense human activity. Displacement could lead to increased use of adjacent habitats, which could cause increased inter- and intra-specific competition for resources.

Surface disturbances associated with the Proposed Action would result in the short-term direct loss of and fragmentation of approximately 14.4 acres of prey species habitat such as ground squirrels, prairie dogs, jackrabbits, rabbits, small rodents, and birds. The direct habitat loss and reduced habitat values in foraging areas, loss of prey and prey habitat, and increased potential for collisions with vehicles traveling in the Project Area may limit foraging opportunities for individual ferruginous hawks.

New power lines used to serve facilities and wells under the Proposed Action would pose an increased risk of electrocution and collision hazard to ferruginous hawks. Electrocution is a well-documented source of mortality for raptors and the vast majority of electrocutions involve electric distribution lines rather than high voltage transmission lines (APLIC 2006). Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). Furthermore, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012).

Similar to the raptors, should the project timeline include construction during the ferruginous hawk nesting season (March 1st to August 1st), all areas within 0.5 miles of the proposed project would be surveyed for the presence of raptor nests by a Service-approved biologist. If an occupied nest is identified, all construction activities would be postponed until the young have fledged and left the nest (see **Section 2.1.11**) (Romin and Muck 2002). Other ACEPMs pertaining to ferruginous hawk protection and mitigation include interim and final reclamation, adherence to speed limits, and procedures to contact the county for carrion removal. Based on adherence to these measures, the Proposed Action would not likely result in an appreciable loss of ferruginous hawk populations or density within the Project Area.

Northern Goshawk

Implementation of the Proposed Action could result in both direct and indirect impacts to the northern goshawk and would resemble the impacts identified in **Section 4.4.3.1.4** for raptors in general. These impacts include temporary displacement caused by elevated human activity, increased public access and subsequent human disturbance as a result of construction of new access roads, and reduction in prey population due to habitat fragmentation alteration.

New power lines used to serve facilities and wells under the Proposed Action would pose an increased risk of electrocution and collision hazard to northern goshawks. Electrocution is a well-documented source of mortality for raptors and the vast majority of electrocutions involve electric distribution lines rather than high voltage transmission lines (APLIC 2006). Potential impacts from increased risk of electrocution would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). Furthermore, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012).

No northern goshawk nests or roosting sites exist within or around the Project Area, and the northern goshawk is listed as an uncommon species within the Ouray NWR. Therefore, implementation of the proposed action would likely have minimal effects on the northern goshawk.

Similar to the raptors, should the project timeline be delayed to include construction within the March 1st to August 31st window, all areas within 0.5 miles of the proposed project would be resurveyed for the presence of raptor nests by a Service-approved biologist. If an occupied nest is identified, all construction activities would be postponed until the young have fledged and left the nest (see **Section 2.1.11**) (Romin and Muck 2002). Other ACEPMs pertaining to northern goshawk protection and mitigation include interim and final reclamation, adherence to speed limits, and procedures to contact the county for carrion removal. Based on adherence to these measures, the Proposed Action would not likely result in a trend toward an appreciable loss of northern goshawk populations or density within the Project Area.

Burrowing Owl

The primary effect of the Proposed Action on burrowing owls would be the direct loss and fragmentation of potential foraging habitat. While no prairie dog colonies would be directly disturbed, increased human activity and development in close proximity to nesting sites in the Project Area could lead to nest abandonment, which would lower the annual productivity of breeding pairs. Since burrowing owls alternate between nesting sites within their breeding boundary, any surface facilities that have ongoing traffic and human presence in or near prairie dog colonies could prevent burrows from being used as nest sites in the future.

Construction, drilling, and completion activities would also result in visual disturbances (lighting) on the landscape, increased noise from equipment use, and increased vehicle traffic, all of which could cause burrowing owls to avoid disturbed areas. Such displacement and avoidance could lead to an increased use of adjacent habitat, which could cause increased inter-specific and intra-specific competition for resources in these areas.

Based on Service biologists' determination, any prairie dog towns located within 0.25 miles of the proposed construction would be surveyed for the presence of ground-nesting burrowing owls. If an occupied nest is identified, all construction activities would cease between March 1st and August 31st (**Section 2.1.11**) (Romin and Muck 2002). Other ACEPMs pertaining to burrowing owl protection and mitigation include interim and final reclamation, adherence to speed limits, and procedures to contact the

county for carrion removal. In addition, implementation of recommended mitigation measures that include provisions to avoid active white-tailed prairie dog colonies during construction could further reduce impacts related to the loss of potential nesting habitat in the Project Area.

Short-eared Owl

Implementation of the Proposed Action could directly impact short-eared owls through loss and fragmentation of foraging and nesting habitat. Indirect effects on short-eared owls include displacement from foraging areas and loss of prey species' habitat as a result of habitat fragmentation and alteration.

Temporary displacement or avoidance of habitats could affect short-eared owls potentially nesting on the ground in the vicinity of construction activities. As established in the Vernal RMP and included in **Section 2.1.11**, surface disturbing activities are not to occur within 0.25 miles of identified short-eared owl nests from March 1st through August 1st (BLM 2008). However, short-eared owl nests are often located on the ground and are difficult to see in areas of dense vegetation. Active nests could potentially be missed during aerial or ground surveys that could result in impacts on breeding, nesting, and fledgling success and may also be subject to mortality from collisions with construction vehicles or equipment. Other ACEPMs pertaining to short-eared owl protection and mitigation include interim and final reclamation, adherence to speed limits, and procedures to contact the county for carrion removal. Based on adherence to these measures, the Proposed Action would not likely result in a trend toward an appreciable loss of short-eared owl populations or density within the Project Area.

American White Pelican

The American white pelican may use riparian habitat that is found along the eastern border of the Project Area. This habitat within the Project Area is away from the footprint of the development and would not be subject to direct impacts from the implementation of the Proposed Action. However, indirect impacts to the American white pelican could result from increased levels of human activity and noise within the Project Area. These disturbances could cause displacement of individuals from the riparian corridor adjacent east of the proposed development and deter the American white pelican from establishing nesting sites within the Project Area in the future. Indirect impacts to potential American white pelican habitat could result under the Proposed Action from increased soil erosion and potential for spills and leaks. These impacts would be reduced with interim reclamation, recommended mitigation measures for erosion control to avoid or minimize soil erosion and off-site deposition, and spill containment measures. Based on adherence to these measures, the Proposed Action would not likely result in a trend toward an appreciable loss of American white pelican populations or density within the Project Area.

Long-billed Curlew

Potential direct effects to the long-billed curlew are loss of potential nesting habitat and foraging habitat. Since this species is a known nester on the Refuge and requires dry grassland as nesting habitat, it is likely that surface disturbance as a result of the Proposed Action will reduce the total available nesting habitat for the long-billed curlew within the Ouray NWR. Additionally, the long-billed curlew may use riparian habitat as foraging habitat, which is found along the eastern border of the Project Area. Indirect impacts such as increase sediment loads and potential spills and leaks could affect habitat for invertebrate riparian species. These impacts would be reduced with interim reclamation, recommended mitigation measures for erosion control to avoid or minimize soil erosion and off-site deposition, and spill containment measures. Based on adherence to these measures and given that the long-billed curlew is not a common species to this area, the Proposed Action would not likely result in a trend toward an appreciable loss of long-billed curlew populations or density within the Project Area.

Lewis's Woodpecker

While no habitat for the Lewis's woodpecker would be directly disturbed by the Proposed Action, direct impacts may stem from the timing of surface disturbing actions and increased human presence during sensitive breeding and nesting periods. These impacts could cause individual breeding pairs to abandon the area and/or abandon nest and young, choosing other areas. Indirect impacts extend these direct impacts to include increased inter- and intra-species competition for suitable breeding and foraging sites elsewhere along the riparian corridors. Displacement to other, possibly less suitable habitat areas could result in lowered overall physical conditioning of the birds, which could affect breeding success and survivability of young. Suitable reproduction and foraging habitat for the Lewis's woodpecker occurs along the Green River on the eastern border of the Project Area. The Proposed Action would not likely affect the species at the population level or lead in a trend towards federal listing of this species.

White-tailed Prairie Dog

No surface disturbance would occur on habitat occupied by white-tailed prairie dog colonies under the Proposed Action. Potential impacts to the white-tailed prairie dog may include direct mortalities of individuals as a result of crushing from construction activities, vehicles, and equipment. Additional impacts may result from increased habitat fragmentation, human presence, and noise which may cause prairie dogs to underutilize habitat adjacent to disturbance. Disturbance in areas adjacent to white-tailed prairie dog colonies would not likely result in significant impacts to the populations present. Given the colony's behavior despite current disturbance from the existing road and the Ouray NFH, additional disturbance in the vicinity of these areas is not expected to result in underutilization of adjacent habitats. Habitat disturbance in surrounding areas may encourage future colonization in the short-term, based on the availability of disturbed soils that would occur within the Project Area subsequent to the Project-related construction. Weed control would reduce habitat degradation. Overall, the Proposed Action may indirectly impact the white-tailed prairie dog, but would not likely result in a trend towards federal listing of this species.

Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Based on the similarity of affected habitat within the Green River and potential impacts associated with the alternatives, impact analyses for the bluehead sucker, flannelmouth sucker, and roundtail chub (collectively known as Utah State Sensitive Fish Species) are discussed together within this EA. Impacts to the Utah state sensitive fish species would be similar in nature to those previously discussed for the Colorado River fish species including potential water depletion to the Green River, which would directly affect the Utah state sensitive fish and their habitat. Implementation of the Proposed Action may also result in increased erosion, sediment yield, and the potential for exposure to hazardous substances due to an accidental discharge or release of condensate or hydrocarbon material into the Green River. ACEPMs identified under the Proposed Action would minimize habitat degradation resulting from increased sedimentation or erosion to the Green River through the implementation of a SWMP and interim reclamation. In addition, impacts associated with the increased potential for exposure to hazardous substances would be minimized through implementation of and adherence to the specific guidelines of a SPCC plan. Implementation of the Proposed Action may directly affect the habitat of the Utah state sensitive fish species, but would not likely result in a trend towards federal listing of the species.

Smooth Green Snake

While the smooth green snake is generally uncommon in the Uinta Basin, it is possible that the species has been observed within the Refuge's boundary. Implementation of the Proposed Action may result in permanent and temporary loss of smooth green snake habitat as a result of construction activities, although the impact is likely to be moderate in the short term and be reduced over time as the Project

Area is returned to its preexisting condition. Increased human activity (e.g., equipment operations, vehicular traffic, and noise), can cause temporary displacement or avoidance of affected areas. ACEPMs identified under the Proposed Action, including interim and final reclamation and management of noxious weeds, would reduce impacts to potential smooth green snake habitat. Based on this information and the fact that the smooth green snake is generally uncommon within the Project Area, implementation of the Proposed Action would not likely result in a trend toward federal listing of the species.

4.4.4.2 Alternative B – No Action Alternative

Under the No Action Alternative, Thurston would be denied access to Service refuge lands and the proposed well pads, associated access roads, and pipeline would not occur within Ouray NWR. Future mineral development in the Project Area would be considered on a case-by-case basis and would be subject to separate NEPA analysis. As a result, the No Action Alternative would have no adverse or beneficial effects on special status species.

4.4.4.3 Cumulative Impacts

The CIAA for special status plant and animal species and their associated habitat is defined as the Ouray NWR boundary. It is assumed that cumulative impacts to special status plant and wildlife species would be similar to those discussed for general vegetation and wildlife (see **Sections 4.4.1.4** and **4.4.3.4**, respectively). However, given ongoing habitat losses, sensitivity to disturbance, and declining overall population numbers, special status plant and wildlife species would likely be more sensitive to impacts related to development within the Refuge than other more common species. Based on these sensitivities, existing and reasonably foreseeable development land uses have reduced and would likely continue to reduce the quality and quantity of habitats within the Ouray NWR and surrounding region for special status species.

On federally administered lands, surveys are required in potential or known habitats of threatened, endangered or otherwise special status species prior to project implementation. These surveys help determine the presence of any special status plant and wildlife species or extent of their habitat. Furthermore, protective measures such as seasonal and/or spatial and temporal buffers would generally be implemented to avoid or minimize direct disturbance or impacts. As such, the additive impacts of the Proposed Action to past, present, and reasonably foreseeable actions could affect but would not likely adversely affect special status species populations within the Refuge. Given the status of the Uinta Basin hookless cactus and the Colorado River endangered fish, cumulative impacts may be more pronounced than other special status species and they are discussed in more detail below.

Yellow-Billed Cuckoo

As the Proposed Action does not result in the loss of any riparian woodlands or other vegetation communities that may provide habitat for the yellow-billed cuckoo, the proposed project would not provide an incremental contribution to the loss of nesting habitat within the CIAA. Implementation of the Proposed Action along with past, present, reasonably foreseeable development within the CIAA could degrade available riparian woodland habitat through indirect impacts such increased erosion and ambient noise levels. Adherence to project design features, ACEPMs in **Section 2.1.10**, and Service-specified environmental terms and conditions in **Section 2.1.11** would further reduce the impacts of the proposed project on yellow-billed cuckoo within the CIAA.

Colorado River Endangered Fish

Water depletions associated with the Proposed Action in combination with depletions from other activities in the CIAA would result in small but incremental impacts to the Upper Colorado River Basin and the biological environment for the Colorado River Endangered Fish species. Implementation of the Proposed Action in combination with other activities in the CIAA could degrade USFWS-designated critical habitat for the Colorado River Endangered Fish Species using the Green River by increasing erosion, sediment yield, and the potential for leaks or spills. Implementation of certain design features (see **Section 2.1**), ACEPMs (see **Section 2.1.10**), and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**), including appropriate erosion control measures and use of closed-loop drilling techniques, would reduce impacts to the Colorado River Endangered Fish species. Many of the aforementioned impacts would be minimized and/or monitored.

Uinta Basin Hookless Cactus

Cumulative effects to the Uinta Basin hookless cactus would be similar to those discussed for general vegetation within the Ouray NWR boundary (see **Section 4.4.3.1**). Direct cumulative impacts would result from potential crushing of individual cacti, the temporary or permanent loss of suitable habitat, soil compaction (as the result of construction), Refuge management activities, and recreational use. Indirect cumulative impacts include habitat fragmentation; increased dust effects; introduction and spread of invasive species; temporary or permanent loss of suitable habitat; and changes to the composition of the native vegetative community from surface disturbance activities such as oil and gas development, road construction, and other human activities. Changes in land use patterns or increased human encroachment also would adversely impact occupied and suitable habitats. Recovery and reclamation of suitable habitats could be compounded by limiting reclamation conditions (e.g., drought).

Cumulative impacts to the Uinta Basin hookless cactus resulting from the Proposed Action would be minimized through implementation of ACEPMs (see **Section 2.1.10**) and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**). In addition, implementation of recommended mitigation measures would further reduce impacts related to the loss of potential habitat and accidental loss of individual species resulting from construction and/or operation activities.

Ute Ladies'-Tresses

As no habitat for the Ute ladies'-tresses would be disturbed by the proposed project, no incremental increase in direct cumulative impacts to the CIAA resulting from the Proposed Action are anticipated. Indirect cumulative impacts such as increased erosion and subsequent sedimentation into wetland, floodplain, river terrace, and shoreline habitats, along with the increased potential for the introduction of hazardous substances through accidental release. These impacts could further reduce the quality and overall available habitat for Ute ladies'-tresses within the CIAA. Cumulative impacts to Ute ladies'-tresses resulting from the Proposed Action would be minimized through implementation of ACEPMs described in **Section 2.1.10** and the additional Service-prescribed environmental terms and conditions detailed in **Section 2.1.11** of the EA.

4.4.4.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to biological resources under the Proposed Action:

- Thurston would be required to install electricity to provide power for separators and pump jacks on the two proposed well pads to reduce the level of noise for both wildlife and visitors. An above ground distribution line would be built on single wood utility poles located within the proposed road ROW. The proposed distribution line would tie into an existing power source at the Ouray NFH.
- Thurston will develop the two southern wells. Thurston originally proposed to develop four wells, two of which were located near the Ouray NFH. However, to limit impacts of the well development on the Refuge, the two wells near the hatchery were eliminated.
- All vehicles and equipment used in construction must be decontaminated prior to arriving at the Refuge per Service procedures to prevent the introduction of noxious weeds to the Refuge. It is recommended that the operator consult with the local weed control agency or other weed control authority if weed infestation occurs. It is the responsibility of the operator to monitor affected and reclaimed lands for noxious weed infestations. The refuge will require a weed control plan.
- Impacts on sensitive habitat, (e.g., wetlands, riparian areas) wildlife, plants, and other sensitive natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- All construction of roads and pads will occur in a way that best facilitates their subsequent complete removal and reclamation once Thurston activities have ceased at these sites. This includes separating, stockpiling, and covering topsoil layers on site to be replaced during reclamation. All disturbed areas must be reclaimed with Service input at the time reclamation occurs. Only endemic plants and seed mixtures are to be used in reclamation. Thurston shall separate and store the topsoil horizon or the top six inches, whichever is deeper, and mark or document stockpile locations to facilitate subsequent reclamation. When separating the soil horizons, the operator shall segregate the horizon based upon noted changes in physical characteristics such as organic content, color, texture, density, or consistency. All stockpiled soils shall be protected from degradation due to contamination, compaction and, to the extent practicable, from wind and water erosion during drilling and production operations. Best management practices to prevent weed establishment and to maintain soil microbial activity shall be implemented. Final reclamation of all disturbed areas shall be considered complete when all activities disturbing the ground have been completed, and all disturbed areas have been either built upon, compacted, covered, paved, or otherwise stabilized in such a way as to minimize erosion, or a uniform vegetative cover has been established that reflects pre-disturbance or reference area forbs, shrubs, and grasses with total percent plant cover of at least 80 percent of

pre-disturbance or reference area levels, excluding noxious weeds, or equivalent permanent, physical erosion reduction methods have been employed. Re-seeding alone is not sufficient.

- Construction and drilling operations conducted during the Refuge's seasonal closure period must be coordinated and authorized with the Refuge Manager or the Service AO to avoid conflicts with wildlife. Additional wildlife monitoring or mitigation may be required during this closure period, at the discretion of the Refuge Manager or the Service AO, based on site-specific conditions.
- Should the project schedule construction activities between March 1st and August 31st, all areas within 0.5 miles of the proposed project would be surveyed for the presence of raptor nests by a Service-approved biologist. If occupied raptor nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- Burrowing owl surveys would be conducted concurrently with the raptor surveys within 0.25 miles of the proposed project if the project schedule occurs between March 1st and August 31st. If occupied burrowing owl nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- The Refuge Manager or the Service AO may require drill pads to be fenced and signed if problems are created from refuge visitors and wildlife at these sites.
- Any materials brought into the Refuge as fill material for construction must be authorized by the Refuge Manager or the Service AO. To minimize the spread of invasive species, no top soils will be brought in from outside the Refuge.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both the state requirements and federal *Oil and Gas Onshore Order No.2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to original site conditions. All costs shall be borne by the Operator.
- All disposable type materials and trash brought onto the Refuge or generated at the drill site must be removed from the Refuge on a biweekly basis and upon completion of the drilling activities. The drill site and operational area must be kept free of debris and trash at all times. Trash must be contained securely at the drill site in such a manner (fully enclosed trash cages) as to prevent trash from being spread by wind or wildlife. No trash may be disposed of or buried on the Refuge.

- During all phases of this project, noise levels must be kept to a minimum and should not exceed the established industry standard above ambient day and nighttime noise levels. Thurston would make every effort to utilize electric pumping equipment (most quiet) during the production phase of this operation.
- The following measures would be implemented for new power lines: Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Power Lines: the State of the Art in 2006* (APLIC 2006). In addition, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Power Lines: the State of the Art in 2012* (APLIC 2012). Depending on the action selected, specific standards to be followed will be identified in the Decision Record for the EA.
- To protect special status species such as, but not limited to, the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), the Service requires the following of Thurston. In order to minimize effects to the federally threatened Uinta Basin hookless cactus, the BLM in coordination with the Service, developed the following avoidance and minimization measures. Integration of and adherence to these measures will help ensure the activities carried out during oil and gas development (including, but not limited to, drilling, production, and maintenance) are in compliance with the ESA. The following avoidance and minimization measures should be included in the POD:

    a) Pre-project habitat assessments will be completed across 100% of the project disturbance area within potential habitat[4] prior to any ground disturbing activities to determine if suitable Uinta Basin hookless cactus habitat is present.

    b) Within suitable habitat[5], site inventories will be conducted to determine occupancy. Inventories:

        1. Must be conducted by qualified individual(s) and according to the USFWS and Service-accepted survey protocols;

        2. Will be conducted in suitable and occupied habitat[6] for all areas proposed for surface disturbance prior to initiation of project activities and within the same growing season, at a time when the plant can be detected, and during appropriate flowering periods:

            a. *Sclerocactus brevispinus* surveys should be conducted March 15th to June 30th, unless extended by the USFWS.

            b. *Sclerocactus wetlandicus* surveys can be done any time of the year, provided there is no snow cover;

[4] *Potential habitat* is defined as areas which satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment.
[5] *Suitable habitat* is defined as areas which contain or exhibit the specific components or constituents necessary for plant persistence; determined by field inspection and/or surveys; may or may not contain Uinta Basin hookless cactus. Habitat descriptions can be found in the U.S. Fish and Wildlife Service's 1990 Recovery Plan and Federal Register Notices for the Uinta Basin hookless cactus (http://www.fws.gov/endangered/wildlife.html).
[6] *Occupied habitat* is defined as areas currently or historically known to support Uinta Basin hookless cactus; synonymous with "known habitat."

3. Will occur within the ROW and 50 feet from the outside edge of the ROW on one side of the road only (the side on which the pipeline will be laid); applies to buffers for roadside surface pipelines;

   Will occur within the ROW and 50 feet from both sides of the ROW edge; applies to buffers for hand laid cross-country surface pipelines;

   Will occur within the ROW and 300 feet from both sides of the ROW edge; applies to buffers for access roads; and

   Will occur out to a distance of 300 feet from the edge of disturbance for the proposed well pads; applies to buffer distances (avoidance).

4. Will include, but is not be limited to, plant species lists and habitat characteristics; and

5. Will be valid until March 15th the following year for *Sclerocactus brevispinus* and one year from the survey date for *Sclerocactus wetlandicus*.

c) Design project infrastructure to minimize impacts within suitable habitat:

1. Reduce well pad size to the minimum needed, without compromising safety;
2. Limit new access routes created by the project;
3. Roads and utilities should share common ROWs where possible;
4. Reduce width of ROWs and minimize the depth of excavation needed for the road bed and where feasible, use the natural ground surface for the road within habitat;
5. Place signing to limit off-road travel in sensitive areas;
6. Stay on designated routes and other cleared/approved areas;
7. All disturbed areas will be re-vegetated with native species comprised of species indigenous to the area and non-native species that are not likely to invade other areas; and
8. A biological monitor will be onsite during facility installation.

d) Within occupied habitat, project infrastructure will be designed to avoid direct disturbance and minimize indirect impacts to populations and to individual plants:

1. Follow the above (#c) recommendations for project design within suitable habitats;
2. Buffers of 300 feet minimum between the edge of the ROW (roads and surface pipelines) or surface disturbance (well pads) and plants and populations will be incorporated;
3. Surface pipelines will be laid such that a 300-foot buffer exists between the edge of the ROW and the plants and use stabilizing and anchoring techniques when the pipeline crosses the habitat to ensure the pipelines do not move towards the population;

4. Before and during construction, areas for avoidance should be visually identifiable in the field, e.g., flagging, temporary fencing, rebar, etc.;
5. Where technically and economically feasible, use directional drilling or multiple wells from the same pad;
6. Designs will avoid concentrating water flows or sediments into occupied habitat;
7. Place produced oil, water, or condensate tanks in centralized locations, away from occupied habitat; and
8. Minimize the disturbed area of producing well locations through interim and final reclamation. Reclaim well pads following drilling to the smallest area possible.
9. Occupied Uinta Basin hookless cactus habitats within 300 feet of the edge of the surface pipelines' ROWs, 300 feet from the edge of the roads' ROWs, and 300 feet from the edge of the well pad shall be monitored for a period of three years after ground disturbing activities. Monitoring will include annual plant surveys to determine plant and habitat impacts relative to project facilities. Annual reports shall be provided to the BLM and the Service. To ensure desired results are being achieved, minimization measures will be evaluated and may be changed after a thorough review of the monitoring results and annual reports during annual meetings between the BLM and the Service.
10. Re-initiation of Section 7 consultation with the Service will be sought immediately if any loss of plants or occupied habitat for the Uinta Basin hookless cactus is anticipated as a result of project activities.

h) Additional site-specific measures may also be employed to avoid or minimize effects to the species. These additional measures will be developed and implemented in consultation with the Service to ensure continued compliance with the ESA.

- As necessary, Thurston will notify the appropriate authorities (UDOT on highways and UDWR or USFWS on county and Refuge roads) of the presence of roadside carrion and ask that they remove the carrion as soon as possible. Carcasses may be covered in the interim to discourage scavenging by bald eagles and other raptors. However, only authorized personnel may touch or remove the carcasses.
- Thurston would not commence construction, drilling, or completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st).

4.5 Paleontological Resources

Direct adverse impacts to paleontological resources in the Project Area include physically altering, damaging, or destroying all or a part of the paleontological resource; altering characteristics of the surrounding environment that contribute to the paleontological resource's significance; and, neglecting the paleontological resource to the extent that it deteriorates or is destroyed. Direct impacts can be assessed by identifying the types and locations of proposed activities and determining the location of resources that could be affected.

4.5.1 Alternative A – Proposed Action

Under the Proposed Action, known (surface) or potentially unknown (buried) paleontological resources could be directly affected and irreversibly damaged or destroyed by surface-disturbing activities related to well pad and road construction activities. The opportunity for increased human presence in the area could result in increased incidences of vandalism and/or theft of such resources. All of these impacts could contribute to the alteration of the Project Area as well as the possible loss of interpretation possibilities and research potential.

Based on current paleontological records search and survey, one previously known paleontological locality occurs near the pipelines and access roads and two new fossil localities were discovered in the same general location. Thurston has committed to suspend all operations that would further disturb paleontological material if such resources are uncovered during ground-disturbing activities (refer to **Section 2.1.10**). Such a commitment would mitigate impacts to paleontological resources in the Project Area.

4.5.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed surface disturbing activities would not occur. Future mineral development in the Project Area would be considered on a case-by-case basis and would be subject to separate NEPA analysis. As a result, the No Action Alternative would have no adverse or beneficial effects on paleontological resources.

4.5.3 Cumulative Impacts

The CIAA for paleontological resources is defined as the Project Area boundary. Cumulative impacts to paleontological resources are defined as any damage to, or destruction of, paleontological resources which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions (40 CFR 1508.7). The magnitude of impacts may be greater or lesser depending on 1) the paleontological resource site densities present in the areas of project-related activity; 2) the importance of the paleontological resources present; and 3) the final magnitude and scope of reasonably foreseeable actions over the next 20 years. However, it is important to remember that destruction to, or damage of, paleontological resources is often site-specific and not additive in nature.

Impacts to paleontological resources in the CIAA would primarily result from past, present, and reasonably foreseeable activities associated with surface and subsurface disturbance of fossiliferous rocks for oil and gas development. These activities could damage or destroy fossils. Destruction of scientifically-important fossils would irreversibly and irretrievably damage the paleontological information base, and destroyed fossils would not be available for future analysis. In addition, increased vandalism and theft of fossils could result from improved vehicle and pedestrian access to fossil localities and increased visitation to the area.

Specific direct impacts to presently unknown paleontological resources in the CIAA would not be known until surveys are completed for all areas proposed for surface disturbance. While the potential for direct impacts to fossils is likely to increase with increased surface disturbance in the CIAA, these impacts would be mitigated by preparation and execution of appropriate mitigation measures that have been approved by the Refuge Manager or appropriate Service AO. Surface-disturbing activities could also have a beneficial effect on paleontological resources by drawing the attention of a qualified paleontologist to areas that are not currently being researched, and may result in the collection of specimens and data

that would not be recovered otherwise. Therefore, neither the Proposed Action nor the No Action Alternative would incrementally contribute to cumulative impacts to paleontological resources from oil and gas exploration and development in the Project Area.

4.5.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to paleontological resources under the Proposed Action:

- Impacts on sensitive habitat, (e.g., wetlands, riparian areas) wildlife, plants, and other sensitive natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.

4.6 Cultural Resources

4.6.1 Alternative A – Proposed Action

During the cultural resource inventory that was conducted for the Project, only one site was identified. Though site 42UN7913 has been recommended eligible to the NRHP as a whole, the portion of this site within the APE has lost integrity and is not eligible to the NRHP. Therefore, the Project is unlikely to have an adverse or beneficial effect on the site.

Indirect impacts to cultural resources in the Project Area from implementation of the Proposed Action could result from atmospheric, visual, and auditory intrusions; increased visitation and traffic during construction, drilling and completion operations; vandalism; erosion; and unknown impacts to unidentified cultural landscapes, all of which may contribute to an alteration of the overall setting and feeling of the Project Area. Such changes could lead to the damage, destruction, or removal of scientific information, the loss of research potential, the loss of interpretation possibilities, and the destruction of the character or setting of a site.

The ACEPMs identified in **Section 2.1.10** of this EA will also further minimize effects to site 42UN7913. Therefore, the Proposed Action would not have an adverse or beneficial effect on historic properties.

4.6.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed surface disturbing activities would not occur. Future mineral development in the Project Area would be considered on a case-by-case basis and would be subject to separate NEPA analysis. As a result, the No Action Alternative would not have an adverse or beneficial effect on historic properties.

4.6.3 Cumulative Impacts

The CIAA for cultural resources is defined as the Project Area boundary because impacts are not additive across a landscape. Impacts to the cultural resources in the CIAA would primarily result from past, present, and reasonably foreseeable activities associated with surface and subsurface disturbance. Impacts to cultural resources in the CIAA may also result from specific cultural resource management decisions and from non-surface-disturbing activities that create atmospheric changes, visual obstructions, noise levels, and/or lighting impingement effects. These latter impacts would apply to sites or locations that together comprise the overall cultural experience for all visitors to the area, especially those areas deemed sacred or traditionally important by Native American Tribes and used by these groups. These types of impacts cumulatively affect not only the historic setting, visitor experience, and viewshed of cultural properties, but also their eligibility potential for nomination to the NRHP.

As previously stated, no eligible cultural resource sites were found during the cultural resource inventory for the proposed project. Specific direct impacts to presently unknown cultural resources as a result of reasonably foreseeable actions in the CIAA would not be known until surveys are completed for any areas proposed for surface disturbance and cultural resource properties are evaluated for their eligibility for listing on the NRHP. While the potential for direct impacts to eligible cultural resources is likely to increase with increased surface disturbance, these impacts can be mitigated by preparation and execution of appropriate mitigation measures that have been approved by the Refuge Manager or appropriate Service AO. As cultural resource surveys would occur prior to any surface-disturbing activities in the Project Area, and as all NRHP eligible cultural resources would be avoided or appropriately mitigated, direct cumulative impacts to these resources are expected to be minimal.

Although archaeological sites located within disturbance areas would be avoided or mitigated, sites located outside of and adjacent to disturbance areas would be vulnerable to indirect impacts. When considered in addition to other past, present, and reasonably foreseeable actions, implementation of the Proposed Action could cumulatively affect unknown cultural resources in the Project Area by introducing atmospheric, visual, and auditory intrusions; increased visitation and pedestrian traffic during well development and operation; and unknown impacts to unidentified cultural resources and cultural landscapes. It is anticipated that there would be a cumulative increase in vandalism, illegal collection, and dust due to the increase in roads throughout the CIAA, and increased erosion at sites located in the vicinity of well pads, roads, and pipelines where vegetation cover has been reduced or eliminated. All of these impacts may contribute to an alteration of the overall historic setting and visitor experience of the CIAA. Beneficial cumulative impacts would also likely occur as undocumented cultural resources could be discovered and preserved.

No cumulative impacts to cultural resources are expected under the No Action Alternative.

4.6.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to cultural resources under the Proposed Action:

- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- Impacts on sensitive habitat, (e.g., wetlands, riparian areas) wildlife, plants, and other sensitive natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the land area devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- Per consultation with the Utah SHPO, a contracted paleontologist will be onsite when construction occurs.

4.7 Transportation

4.7.1 Alternative A – Proposed Action

Under the Proposed Action, short-term increases in the volume of both heavy and light traffic would occur on US 40, SH 88, and along Wildlife Refuge Road. Traffic operations may be affected by additional traffic volumes including heavy trucks, tractor trailers, and passenger transport vehicles and may result in temporary traffic delays. Unpaved road surfaces may be degraded due to heavy equipment traffic during the construction and drilling phases of the project, and fugitive dust would be generated in association with travel along these roads.

The largest increase in traffic would occur during the construction, drilling, and completion phases of the project. Construction of the well pads and associated access roads would require three light trucks to transport construction crews for duration of up to seven days. Two to three pieces of heavy equipment, such as bull dozers and motor graders, would also be used to perform earth moving operations. Drilling operations would generate approximately 225 truck trips, and completion operations for the two proposed wells would require approximately 360 vehicle trips. In total, traffic generated during the construction, drilling, and completion phase (107 days) would be an average of from 5 to 6 vehicles per day, although some days would experience higher than average traffic volumes depending on the specific work activity conducted.

Once the wells are complete, the volume of traffic would decrease substantially and would be limited to routine production and maintenance operations. Tanker trucks would remove condensate from onsite storage tanks on the well pads at rates ranging from twice per day to once per week. The wells may be

recompleted once per year (after about five years of production) that would require approximately three to five truck trips per day for approximately seven days.

ROW permits for road improvements and access road construction will be required and obtained from the USFWS Realty Division prior to beginning work on any USFWS managed roads.

Per the Service-prescribed environmental protection measures implemented as conservation stipulations, the Operator would be required to upgrade and maintain all access routes and roads within the Refuge and must have road maintenance equipment and Operator(s) readily available to perform road repairs and maintenance, as needed, or as directed by the Refuge Manager. Vehicles speed limits within the Refuge area boundary would also be set at the discretion of the Refuge Manager and will be strictly adhered to.

4.7.2 Alternative B – No Action Alternative

Under the No Action Alternative, no improvements to the existing transportation infrastructure would occur. Traffic volumes on US 40 and SH 88 would continue to reflect background levels and trends resulting from regional land use, recreational use, other approved energy development projects, and related traffic. No impacts to traffic patterns or volumes would result from the No Action Alternative.

4.7.3 Cumulative Impacts

The analysis area for cumulative effects to transportation includes the US 40 corridor between Vernal and Roosevelt, SH 88 between US 40 and the Town of Ouray, and the existing transportation infrastructure within the Project Area. Past, present, and reasonably foreseeable development activities that contribute to transportation-related impacts include oil and gas development, agriculture, recreation, and upgrades to the existing transportation infrastructure within the region.

Implementation of the Proposed Action would result in minor cumulative impacts to the transportation analysis area. Adverse cumulative impacts primarily would consist of small incremental increases in traffic delays, increased traffic volumes, potential road closures, and road damage associated with construction, drilling, and production of the proposed wells. Traffic volumes generated by the project would incrementally add to existing and future background traffic volumes from residential, recreation, and industrial uses. On roadways where adequate capacity exists and traffic volumes are low, the addition of project-related traffic would not substantially affect traffic operations or safety. On roadways such as US 40 where traffic volumes are high, the cumulative effect of project-related traffic may be noticeable during periods of increased use such as during worker commuting hours or during wet conditions. A potential benefit associated with implementation of the Proposal Action would include a better maintained road network in the southern portion of the Refuge that could cater to recreational use and Refuge management activities.

No cumulative impacts to transportation are expected under the No Action Alternative.

4.7.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to transportation under the Proposed Action:

- The Operator must provide detailed maps or plats of the proposed project layout (as required by the Refuge Manager or the Service AO) that shows routes, staging areas, construction areas, and work locations. The map should include the following minimum information:
    - a) Dimensions on adjacent exterior section lines sufficient to completely describe the quarter section that contains the proposed well shall be indicated. If dimensions are not field measured, state how the dimensions were determined.
    - b) The latitude and longitude of the proposed well location shall be provided on the drawing with a minimum of five (5) decimal places of accuracy and precision using the North American Datum (NAD) of 1983 (e.g.; latitude 37.12345 N, longitude 104.45632 W).
    - c) For irregular, partial or truncated sections, dimensions will be furnished to completely describe the entire section containing the proposed well.
    - d) The field-measured distances from the nearer north/south and nearer east/west section lines shall be measured at ninety (90) degrees from said section lines to the well location and referenced on the plat.
    - e) A map legend.
    - f) A north arrow.
    - g) A scale expressed as an equivalent (e.g. - 1” = 1000’).
    - h) A bar scale.
    - i) The ground elevation.
    - j) The basis of the elevation (how it was calculated or its source).
    - k) The basis of bearing or interior angles used.
    - l) Complete description of monuments and/or collateral evidence found; all aliquot corners used shall be described.
    - m) The legal land description by section, township, range, principal meridian, baseline and county.
    - n) Operator name.
    - o) Well name and well number.
    - p) Date of completion of scaled drawing.
    - q) A line designating the 100-year floodplain for the Green River relative to pad and well placement.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.

- The Operator must upgrade and maintain all access routes, roads, and bridges designated for its use across the Refuge in accordance with acceptable specifications and standards. The Operator must have road maintenance equipment and operator(s) readily available to perform road repairs and maintenance as needed, or as directed by the Refuge Manager or the Service AO.
- The drill site and immediate access roads must be constructed of Refuge-approved material for all drilling locations. All existing drainage patterns within roads to be constructed must be maintained uninterrupted by the use of culverts, bridges, or other applicable techniques as specified and authorized by the Refuge Manager or the Service AO.
- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both the state requirements and federal *Oil and Gas Onshore Order No. 2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to original site conditions. All costs shall be borne by the Operator.

4.8 Recreation

4.8.1 Alternative A – Proposed Action

The Proposed Action is not likely to appreciably impact recreation activities within or adjacent to the Project Area. Except for short periods of time associated with the construction of the proposed well pads, access roads, and/or pipeline installation, most recreational activities on the Refuge would continue uninhibited in the Project Area. Increased traffic, fugitive dust, and noise during construction, drilling, and completion activities would likely discourage hunting and wildlife viewing within the immediate vicinity (i.e., approximately 0.25 miles or less) of the proposed well pads, and possibly diminish the quality of the recreation experience. However, activities associated with well pad and road construction and drilling and completion are only expected to take approximately four weeks per pad. These activities would not likely interfere with the hunting season, thereby eliminating the majority of impacts to recreational users of the area during the active rifle hunting season.

If the proposed well are not productive and the disturbed areas are reclaimed, no impacts to recreation will occur in the long-term. If the wells are productive over the operational life of the project, the presence of the well pads, access roads, and surface pipeline may slightly diminish the quality of the experience of some recreational users. These potential impacts would occur because the relatively undisturbed character of the area would be altered by the presence of industrial facilities. Since most recreational users generally prefer a natural unaltered setting, the attractiveness of the area and its surroundings would be somewhat reduced as a recreational resource. As a result, recreational users who use the Project Area, particularly for wildlife viewing and/or hunting where the proposed well pads, pipeline, and access roads would be located could be displaced to other undisturbed settings within the Refuge or elsewhere.

Per the Services-prescribed environmental protection measures implemented as conservations stipulations, the Operator would be required to do the following: 1) fence and provide appropriate signage on all well pads to prevent Refuge visitors from gaining access; 2) provide a Service approved gate guard for after-hour entry to the Refuge during the construction and drilling phase; and 3) modify drilling operations, as necessary, to reduce conflicts with regular Refuge management and public use activities.

4.8.2 Alternative B – No Action Alternative

Under the No Action Alternative, development of the Project Area would not occur and recreational opportunities and resources would remain in their present condition.

4.8.3 Cumulative Impacts

The analysis area for cumulative effects to recreation is the entire Ouray NWR. Under both Proposed Action, the short-term disruption of recreational opportunities and access to the Leota Bottom resulting from the construction of the well pads and associated access roads would contribute to minor, short-term adverse cumulative impacts. In addition, the proposed development may also decrease opportunities for recreationists seeking a more primitive setting or experience. No cumulative impacts are anticipated under the No Action Alternative.

4.8.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to recreation under the Proposed Action:

- Thurston would be required to install electricity to provide power for separators and pump jacks on the four proposed well pads to reduce the level of noise for both wildlife and visitors. An above ground distribution line would be built on single wood utility poles located within the proposed road ROW. The proposed distribution line would tie into an existing power source at the Ouray NFH.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- A lockbox or similar security system will be provided to Thurston for after-hours access to the project site during drilling and completion operations. No unauthorized entry of non-project related personnel will be permitted on the Refuge after normal operating hours.
- The Refuge Manager or the Service AO may require drill pads to be fenced and signed if problems are created from refuge visitors and wildlife at these sites.
- Any materials brought into the Refuge as fill material for construction must be authorized by the Refuge Manager or the Service AO. To minimize the spread of invasive species, no top soils will be brought in from outside the Refuge.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- During all phases of this project, noise levels must be kept to a minimum and should not exceed the established industry standard above ambient day and nighttime noise levels. Thurston should make every effort to utilize electric pumping equipment (most quiet) during the production phase of this operation.

4.9 Visual Resources

4.9.1 Alternative A – Proposed Action

The potential direct impacts to visual resources would include the visual contrasts created by construction equipment, pipelines, well pads, temporary and permanent access roads, and other forms of infrastructure associated with oil and gas exploration and development within Ouray NWR. In general, drilling rigs and equipment, construction and maintenance vehicles, development infrastructure, and surface disturbance, including roads, would impact an area's scenic quality and appearance of naturalness with human-made color, form, and linear contrasts. The visual impacts from producing wells (including permanent access roads, well pads, pipelines, maintenance vehicles, and related infrastructure, such as generators and storage tanks) would have similar visual contrasts with the natural landscape and would persist throughout the active production lifetime of the wells.

Long-term fugitive dust that would be generated by production well maintenance vehicles and short-term well-drilling activities could impact long-distance scenic quality because these fugitive dust-producing activities would continue throughout the LOP. However, ACEPMs for dust abatement along access roads would reduce the effects of long-term dust-related haze to long-distance scenic quality (see **Section 2.1.10**).

Additional impacts may include artificial light and associated sky flow from night lighting required for night-time drilling. Night lighting could degrade scenic quality in relatively undeveloped areas by introducing intrusive artificial lighting into an otherwise unlit natural landscape. This could have detrimental impacts on nocturnal species such as bats and insects and how they use the surrounding landscape. Short-term visual impacts from horizontal and vertical lighting at the well-pad locations would occur during the drilling period of 30 to 40 days. The locations of these temporary impacts would move across the Project Area as each individual well is drilled and completed. Short-term impacts would also include drilling rig visibility at site-specific drilling locations during the day and night because the rigs would be moved weekly or monthly, depending on amount of time needed to drill each well. Long-term impacts (for the LOP) would include pipeline, infrastructure, well-pad visibility, and surface disturbances from the well-pad and access road construction.

The applicant would minimize impacts resulting from artificial light by shielding lighting and using switches, timers or motion sensors. In addition, artificial lighting needed for night operations would be kept to a minimum and shielded to the extent practicable. All lights must be less than 3500° Kelvin color temperature to reduce blue-rich light, which increases sky glow and can be a wildlife attractant (see **Section 2.1.11**). All production equipment and associated infrastructure will be painted a standard environmental color to blend with the natural landscape background, thus further reducing long-term visual impacts.

4.9.2 Alternative B – No Action Alternative

Under the No Action Alternative, the proposed oil and gas exploration project would not occur. As such, the No Action Alternative would have no adverse or beneficial effects on visual resources.

4.9.3 Cumulative Impacts

The CIAA for visual resources is defined as the Ouray NWR. This CIAA accounts for impacts to visual resources that are collectively affected by ongoing Refuge management activities and energy extraction,

given that this land is commonly managed by the Service under the Refuge's CCP. The most visible effects from past activities within the Refuge have generally been caused by the removal of tamarisk and other vegetation in patterns that contrast with the natural forms, lines, colors, and textures of the natural landscape and the alteration of waterflow within the bottomlands along the Green River caused by construction of dikes and levees. Further, development of oil and gas including the construction of roads, well pads, pipelines, and power lines has transformed the landscape, although to a lesser extent.

Past, present, and reasonably foreseeable future oil and gas development has disturbed approximately 55.1 acres within the CIAA (**see Table 4-2**). Other public land use and Refuge management activities have resulted in unknown disturbance acreages within the Refuge and have also affected the character of the landscape. Implementation of the Proposed Action would incrementally increase the total cumulative surface disturbance resulting from energy development in the Ouray NWR to approximately 69.5 acres and would result in minor cumulative impacts to visual resources. Cumulative impacts would consist of small incremental modifications to the natural landscape resulting from the removal of vegetation and the degree of deviation from the landscape's natural condition. Impacts to visual resources would be minimized under the Proposed Action by implementation of ACEPMs (see **Section 2.1.10**) and additional Service-prescribed environmental terms and conditions (see **Section 2.1.11**).

No cumulative impacts to transportation are expected under the No Action Alternative.

4.9.4 Mitigation

The following ACEPMS (**Section 2.1.10**) and Service-prescribed environmental protection measures (**Section 2.1.11**) would be applied to reduce impacts to recreation under the Proposed Action:

- Existing high resolution aerial imagery of the Project Area will be provided pre- and post-construction. Aerial photography must be in color and procured from a reputable source (e.g., ESRI, National Aerial Photography Program [NAPP], National Agricultural Imagery Program [NAIP], etc.). Pre-construction imagery shall be submitted within 10 days of initiation of drilling; post-survey imagery shall be provided as soon as updated imagery becomes available. All imagery will become the property of the Refuge.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- Pits, ponds, and/or open tanks are prohibited. Above ground storage tanks must be used in circulating operations for the temporary storage of all drilling fluids, cuttings, mud, and contaminants. All drilling fluids, cuttings, mud, contaminants, portable tanks, and other equipment must be transported off Refuge to a state-approved facility upon cessation of drilling activity. Onsite disposal of drilling fluids is prohibited.

- Thurston must implement the following conditions to reduce the impacts on day- and nighttime visual resources:
    - The production equipment and associated infrastructure must be painted to blend with the natural landscape background.
    - During pad construction and when erecting or disassembling the drilling rig, outdoor lighting should be kept to a minimum and turned off when not needed.
    - Whenever possible, each series of lights must be either on a separate switch, timer, or motion sensor to allow the operator to tailor their use to activity in a specific area of the drill pad.
    - All area lights must be downward pointing and fully shielded. All lighting focused on a particular apparatus must be laterally shielded so that all light falls upon the intended work area and a minimum amount of light is emitted sideways or upward.
    - Lights that are required by OSHA for emergencies must be linked to alarms, so that they are only operational when an emergency situation arises.
    - No light shall exceed 400 watts.
    - All lamps must be ≤ 3500 ° Kelvin color temperature to reduce blue-rich light, which causes greater sky glow and is typically more attractive to wildlife.
    - The facility will be observed by a Service designee from critical angles and distances, and excessively glaring lights must be shielded, re-aimed, or otherwise mitigated with an adaptive approach, without compromising worker safety requirements.
    - Lighting will be minimized where applicable unless safety is an issue.

5.0 CONSULTATION AND COORDINATION

5.1 Introduction

The beginning of **Chapter 3** identifies issues/resources that the Service and/or the public during the public scoping process decided to bring forward to analyze in detail in **Chapter 4** and provides rationale for issues that were considered but not analyzed further in the EA. CEQ regulations under NEPA require an "early and open process for determining the scope of issue to be addressed and for identifying significant issues related to a Proposed Action" (40 CFR 1501.7). In order to satisfy this CEQ requirement, announcement of the Proposed Action was posted on the Refuge website (www.ouray.fws.gov), posted on the Refuge's information kiosk, and published weekly in the *Vernal Express* from October 31st through November 21st. The Service resource specialists reviewed Thurston's proposed POD and conferred with the USFWS-ESO and Refuge personnel to assess the type and magnitude of potential impacts to the natural and human environment from implementation of the proposed project. A 30-day public comment period was established for the EA to allow for public participation and input.

5.2 Persons, Groups, and Agencies Consulted

Table 5-1 lists those persons, groups, and agencies that participated and/or provided input during the internal scoping meeting.

Table 5-1. Persons, Groups, and Agencies Consulted

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
U.S. Fish & Wildlife Service (USFWS) – Ecological Services Office	Information on Consultation, under Section 7 of the ESA (16 USC 1531)	Consultation with the U.S. Fish and Wildlife Service will be completed prior to the issuance of a Decision Record for this project.
U.S. Fish & Wildlife Service (USFWS) – Air Quality Branch	Coordination on methodology for analyzing and mitigating air quality impacts.	Emissions inventory and draft air quality sections of the EA were provided for review prior to the public comment period. Comments were addressed.
U.S. Fish & Wildlife Service (USFWS) – Ouray National Wildlife Refuge	Coordination with Ouray National Wildlife Refuge on wildlife use, water quality, and historical public use data for the Refuge.	Data and analysis regarding biological resources, water quality and recreation incorporated in **Chapters 3** and **4** of the EA.
Utah State Historic Preservation Office (SHPO)	Consultation for undertakings, as required by the National Historic Preservation Act (NHPA) (16 USC 470)	Final Consultation with Utah SHPO will be initiated and completed prior to the issuance of a Decision Record for this EA. Preliminary consultation with the Utah SHPO concurred with Service determinations of eligibility and effects regarding Thurston Energy, LLC's Proposed Ouray National Wildlife Refuge 2-Well Development Program.

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
		See **Appendix I** for details.
U.S. Army Corps of Engineers (USACE), Utah Regulatory Office	Coordination on impacts to wetlands and waters of the U.S.	USACE, Utah Regulatory Office verified on a site visit dated February 27, 2012, and in an email dated May 07, 2012, that none of the project facilities would directly impact waters of the U.S., including wetlands. See **Appendix B**.

5.3 List of Preparers

Tables 5-2 and **5-3** lists the people who participated in initial scoping, offered technical review, and/or provided data, direction, or assistance during the preparation of this EA.

Table 5-2. U.S. Fish and Wildlife Service

Name	Title	Responsible for the Following Section(s) of this Document
Kelly Hogan	Region 6 Oil & Gas Coordinator	Project Lead
David Lucas	Refuge Planning Division Chief	Project Lead/Liaison with Ouray NWR staff
Cris Dippel	Lower Green River NWR Complex Manager	Project Lead
Dan Schaad	Ouray NWR Manager	Project Liaison, Invasive and Noxious Weeds and Vegetation including T&E Plant Species
Louise (L.E.) Galiher	Reality Specialist	Rights-of-Way
Catherine Collins	Air Quality Branch – Environmental Engineer	Air Quality
Tim Allen	Air Quality Branch – Meteorologist/Modeler	Air Quality
Matthew Fry	Ouray National Fish Hatchery – Fish Biologist	Water Quality
Diane Penttila	Ouray National Wildlife Refuge Biologist	Wildlife including Special Status Animal Species
Margaret (Meg) Van Ness	Regional Historic Preservation Officer/Archaeologist	Cultural Resources, Paleontology
Tina Dobrinsky	Refuge Public Use Specialist	Recreation, Visual Resources
Amy Defreese	Ecological Services, Terrestrial Biologist	Special status species – Yellow-billed cuckoo
Melissa Burns	Ecological Services, Ecologist/Migratory Bird Coordinator	Migratory Birds, Raptors
Kevin McAbee	Ecological Services, Aquatics Ecologist	Special status species - Fish

Name	Title	Responsible for the Following Section(s) of this Document
Brad Rogers	Ecological Services, Fish and Wildlife Biologist	Colorado River Fish Species
Tova Spector	Ecological Services, Botanist	Cactus Plants
Sonja Jahrsdoerfer	Refuge Manager, Lower Green River NWR Complex	Lower Green River NWR Complex, Project Leader

Table 5-3. Non-U.S. Fish and Wildlife Service Preparers

Name	Affiliation	Title	Responsible for the Following Section(s) of this Document
Bill Sparks	Beatty & Wozniak, P.C.	Attorney	Thurston Energy Legal Counsel
Louis Bridges	Kleinfelder	NEPA Project Manager	Project Manager, Alternative Development, Wildlife, Special Status Species, Wetlands
Brad Norling	Kleinfelder	NEPA Project Manager	Project Manager, Vegetation, Noxious Weeds, Wildlife, Special Status Species, Wetlands
Ralph Curton	Thurston Energy	Chairman and CEO	Project Proponent
Ashley Smith	Kleinfelder	NEPA Resource Specialist	Document Preparation
Lauren MacMillan	Kleinfelder	Deputy Project Manager / NEPA Resource Specialist	Deputy Project Manager, Soils, Transportation, Recreation, Visual Resources
Russ Erbes	Kleinfelder	Sr. Air Quality Specialist	Air Quality
Dustin Collins	Kleinfelder	Air Quality Specialist	Air Quality
Michele Steyskal	Kleinfelder	Air Quality Specialist	Air Quality
Estee Lafrenz	Kleinfelder	Air Quality Specialist	Air Quality
David Allin	Consultant to Thurston Energy	Petroleum Consulting/Geologist	Proposed Action
Dave Nicholson	Consultant	Sr. Hydrogeologist	Water Resources
Elyssa Figari	Kleinfelder	Environmental Planner	Paleontology, Cultural Resources
Lindsey Hockert	Kleinfelder	GIS Analyst	GIS Mapping
Briana McDavid	Kleinfelder	GIS Analyst	GIS Mapping

Name	Affiliation	Title	Responsible for the Following Section(s) of this Document
Cale Wharry	Kleinfelder	NEPA Resource Specialist	Vegetation, Wildlife, Special Status Species, Revised Special Status Plant Survey Report; Document Production
Jim Habiger	Kleinfelder	NEPA Resource Specialist	Document Review, Resource Analysis
Scott Florin	Kleinfelder	Natural Resource Specialist	Project Leader, Revised Special Status Plant Survey Report
Chad Incorvia	Kleinfelder	Natural Resource Specialist	Survey Crew Leader, Revised Special Status Plant Survey Report
Sandy Chynoweth Pagano	Sagebrush Consultants, L.L.C.	Archaeologist	Cultural resource and paleontology inventory/report for four proposed wells
Sandy Chynoweth Pagano	Sagebrush Consultants, L.L.C.	Archaeologist	Cultural resource inventory/report for proposed pipeline and access road widening
Stephen Sandau	Intermountain Paleo-Consulting	Paleontologist	Paleontology inventory/report for proposed pipeline and access road widening

6.0 REFERENCES

Avian Power Line Interaction Committee (APLIC). 2006. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006*. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, CA.

_____. 2012. *Reducing Avian Collisions with Power Lines: The State of the Art in 2012*. Edison Electric Institute and APLIC. Washington, D.C. Barfield, B.J., R.C. Warner, and C.T. Hann. 1981. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. Stillwater, Oklahoma.

Barfield, B.J., R.C. Warner, and C.T. Hann. 1981. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. Stillwater, Oklahoma.

Behle, W.H. 1981. The Birds of Northeastern Utah. Occasional Publication No. 2. Utah Museum of Natural History. University of Utah, Salt Lake City, Utah.

Benton, R. 1987. The Yellow-Billed Cuckoo. Utah Birds. V.3(1). pp. 7-11.

BridgeNet International. 2009. Appendix Q. EIR Noise Analysis for *Montebello Hills Specific Plan*, Montebello, California. Report #2008-040. Prepared by: Justin W. Cook, Acoustics Division. Prepared for: Cook Hill Properties, LLC. March 24, 2009.

British Meteorological Office (BMO). 2009. Hadley Center for Climate Change Research- Global Surface Temperature. Accessed October 2012 at: http://www.metoffice.gov.uk/climatechange/science/monitoring.

California State Water Resources Control Board. 2002. State Water Resources Control Board and Sierra Pacific Power Company. Farad Diversion Dam Replacement Project, DEIS Report. Access online at http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/farad/deir/ch11_noise.pdf.

Collins, C.P. and T.D. Reynolds. 2005, September 2. Ferruginous Hawk (Buteo regalis): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/ferruginoushawk.pdf.

Colorado River Basin Salinity Control Forum (CRBSCF). 2011. Water Quality Standards for Salinity, Colorado River System – 2011 Review. October 2011. Available online at http://coloradoriversalinity.org/docs/2011%20REVIEW-October.pdf.

Delaney, D.K., T.G. Grubb, and L.L. Pater. 1997. Effects of Helicopter Noise on Nesting Mexican Spotted Owls. The Journal of Wildlife Management. Vol. 63, No. 1, pgs. 60-76.

D'eon, R.G. and R. Serrouya. 2005. Mule Deer Seasonal Movements and Multiscale Resource Selection Using Global Positioning System Radiotelemetry. Journal of Mammalogy, 86(4):736–744.

Ehrlich, P.R., D.S. Dobkins, and D. Wheye. 1988. The Birder's Handbook. Simon and Schuster, Fireside Books. New York.

Farmer, A.M. 1993. The effects of dust on vegetation – a review. Environmental Pollution. 79(1): 63-75.

Federal Land Managers Air Quality Related Values Workgroup (FLAG). 2000. Phase I Report. U.S. Forest Service – Air Quality Program, National Park Service – Air Resources Division, U.S. Fish and Wildlife Service – Air Quality Branch, December 2000.

_____. 2010. Phase I Report—Revised (2010), Natural Resource Report NPS/NRPC/NRR—2010/232. U.S. Forest Service – Air Quality Program, National Park Service – Air Resources Division, U.S. Fish and Wildlife Service – Air Quality Branch.

Fertig, W., R. Black, and P. Wolken. 2005. Rangewide Status Review of Ute Ladies'-tresses (Spiranthes diluvialis). Prepared for the U.S. Fish and Wildlife Service and Central Utah Water Conservancy District. 101 pp. September 30, 2005.

Fitzgerald, J.P., C.A. Meaney, and D.M. Armstrong. 1994. Mammals of Colorado. Denver Museum of Natural History and University Press of Colorado. Niwot, Colorado.

Goodwin, S.E. and Shriver, W.G. 2010. Effects of Traffic Noise on Occupancy Patterns of Forest Birds. Conservation Biology, Volume 25, No. 2, 406–411.

Hayward, C.L., C. Cottam, A.M. Woodbury, and H.H. Frost. 1976. Birds of Utah. Great Basin Nat. Memoirs No. 1. Brigham Young University, Provo, UT.

Heil, K. D. and J. M. Porter. 1994. Sclerocactus (Cactaceae): A revision. Haseltonia Yearbook of the Cactus and Succulent Society of America, Number 2.

Hergert, G.W., D. Knudsen. 1997. Irrigation Water Quality Criteria NebGuide. University of Nebraska, Lincoln.

Hingtgen, T. M., and W. R. Clark. 1984. Small mammal recolonization of reclaimed coal surface-mined land in Wyoming. Journal of Wildlife Management 48:1255-1261.

Hochstätter, F. 1989. Nieubeschrijving Sclerocactus wetlandicus species nova-Een nieuwe Sclerocactus uit Uintah County, Utah, USA (English reprint in Hochstätter1993). Succulenta (Netherlands) 68: 123-124.

Hollis Jencks (U.S. Army Corps of Engineers - Utah State Office), personal communication with D. Allison. Email to D. Allison dated May 7, 2012.

Holmes, W.F., and Kimball, B.A. 1987. Groundwater in the Southeastern Uinta Basin, Utah and Colorado: U.S. Geological Survey Water-Supply Paper 2248, 47p.

Hood, J.W. and F.K. Fields, 1978. Water Resources on the Northern Uinta Basin Area, Utah and Colorado, with Special Emphasis on Ground-Water Supply. State of Utah, Department of Natural Resources, Technical Publication No. 62.

Howe, F.P. and M. Hanberg. 2000. Willow Flycatcher and Yellow-billed Cuckoo Surveys Along the Green and San Juan Rivers in Utah, 2000. Utah Division of Wildlife Resources Publication Number 00-31.

Howells, L., M.S. Longson, G.L. Hunt. 1987. Base of Moderately Saline Ground Water in the Uinta Basin, Utah, with an Introductory Section Describing the Methods Used in Determining its Position. State of Utah, Department of Natural Resources, Technical Publication No. 92. U.S. Geological Survey Open-File Report 87-397.

Institute of Public Law. 1994. Federal Noxious Weed Act of 1974. University of New Mexico School of Law.http://ipl.unm.edu/CWI/fedbook/fedweed.html.

Intermountain West Joint Venture (IWJV). 2007. Utah Bird Habitat Conservation Areas with Ownership, Utah. Access Online at http://iwjv.org/sites/default/files/ut_bhca_map_w_own.pdf.

Johnsgard, P. A. 1990. Hawks, Eagles & Falcons of North America. Smithsonian Institute Press, Washington, D.C., USA

_____. 2002. North American Owls: Biology and Natural History, Second Edition. Smithsonian Institution Press, Washington, D.C. 215 pp.

Karl, T.R., J.M. Melillo, T.C. Peterson (eds). 2009. United States Global Climate Research Project (USGCRP): Global Climate Change Impacts in the United States. Cambridge University Press. Full report can be found at: www.globalchange.gov/usimpacts.

Kaufman, K. 1996. Lives of North American Birds. New York: Houghton Mifflin Company.

Kingery, H.E. (ed.). 1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership, Durango, and Colorado Division of Wildlife, Denver, Colorado.

Knight, R. L., and D. N. Cole. 1995. Factors that influence wildlife responses to recreationists. Pages 71-79 *in* R. L. Knight and K. J. Gutzwiller, editors. Wildlife and recreationists: coexistence through management and research. Island Press, Washington, D.C.

Larval Trigger Study Plan ad hoc Committee. 2012. Study plan to examine the effects of using larval razorback sucker occurrence in the Green River as a trigger for Flaming Gorge Dam peak releases. Upper Colorado River Endangered Fish Recovery Program, Lakewood, Colorado.

Laymon, S.A. and M.D. Halterman. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. USDA Forest Service Gen. Tech. Rep. PSW-110 p 272-277.

Lowry, J.H., Jr., R.D. Ramsey, K.A. Thomas, D. Schrupp, W. Kepner, T. Sajwaj, J. Kirby, E. Waller, S. Schrader, S. Falzarano, L. Langs, G. Manis, C. Wallace, K. Schulz, P. Comer, K. Pohs, W. Rieth, C. Velasquez, B. Wolk, K. Boykin, L. O'Brien, J. Prior-Magee, D. Bradford and B. Thompson, 2007. Land Cover Classification and Mapping. Chapter 2 *in* J.S. Prior-Magee, ed. Southwest Regional Gap Analysis Final Report. U.S. Geological Survey, Gap Analysis Program, Moscow, Idaho. Available at http://fws-nmcfwru.nmsu.edu/swregap.

Matthew Fry (Ouray National Fish Hatchery), personal communication with L. MacMillan. Email to L. MacMillan dated October 20, 2012.

Parrish, J.R., F.P. Howe, R.E. Norvell. 2002. Utah Partners in Flight Avian Conservation Strategy Version 2.0. Utah Partners in Flight Program, Utah Division of Wildlife Resources, 1594 West North Temple, Salt Lake City, UT 84116. UDWR Publication Number 02-27. i-xiv + 302 pp.

Renfrew, R.B., C.A. Ribic, J.L. Knack. 2005. Edge avoidance by nesting grassland birds: a futile strategy in a fragmented landscape. The Auk 122(2): 618-636.

Romin L. and J. Muck. 2002. Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. U.S. Fish and Wildlife Service. Salt Lake City, Utah. pp. 42.

Ryser, Jr., Fred A. 1985. Birds of the Great Basin. University of Nevada Press, Reno.

Price, D., and L.L. Miller. 1975. Hydrologic Reconnaissance of the Southern Uinta Basin, Utah and Colorado. State of Utah – Department of Natural Resources, Technical Publication No. 49.

Sagebrush Consultants, L.L.C. (Sagebrush). 2011. A Class III Cultural and Paleontological Resource Inventory for Thurston Energy Operating Company's Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, #12-31-7-21, Uintah County, Utah. December 21, 2011.

_____. 2012. Letter Report Regarding A Class III Cultural and Paleontological Resources Inventory of a Proposed Pipeline and Access Road Widening for the Four Proposed Thurston Ouray National Wildlife Refuge Wells #12-29-7-21, #11-31-7-21, and #12-31-7-21, Uintah County, Utah. December 19, 2012.

_____. 2013. A Class III Cultural and Paleontological Resource Inventory for Thurston Energy Operating Company's Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, #12-31-7-21, and their Associated Access Roads and Pipelines, Uintah County, Utah. January 2, 2013.

Sawyer, H.R., M. Nielson, F. Lindzey and L.L. McDonald. 2006. Winter Habitat Selection of Mule Deer Before and During Development of a Natural Gas Field. The Journal of Wildlife Management. 70(2). 396-408.

Schlotthauer, W.E., B.W. Nance, J.D. Olds. 1981. Identification and Characteristics of Aquifers in Utah. Utah Division of Water Rights. July 1981.

Sigler, W.F., and J.W. Sigler. 1996. Fishes of Utah: A Natural History. Salt Lake City: University of Utah Press.

Steidl, R.J. and R.G. Anthony. 2000. Experimental Effects of Human Activity on Breeding Eagles. Ecological Applications. 10(1): 258-268.

Stokes, W.L. 1986. *Geology of Utah*. Salt Lake City: University of Utah.

Tepedino V.J., T.L. Griswold, and W.R. Bowlin. 2010. Reproductive biology, hybridization and flower visitors of rare *Sclerocactus* taxa in Utah's Uinta Basin. Western North American Naturalist 70(3): 377-386.

Thompson, J. R., Mueller, P. W., Fluckiger, W., and Rutter, A. J. 1984. The effects of dust on photosynthesis and its significance for roadside plants. *Environmental Pollution 34* (2): 171-190. www.sciencedirect.com

United States Bureau of Land Management (BLM). 2003. Species Assessment for Yellow-Billed Cuckoo (*Coccyzus americanus*) in Wyoming. Prepared by Bennet, J. and Douglas, A.K. Wyoming State Office Cheyenne, Wyoming.

_____. 2005. Final Environmental Impact Statement and Record of Decision, Castle Peak and Eightmile Flat Oil and Gas Expansion Project, UT-080-2002-168. United States Department of the Interior, Bureau of Land Management, Vernal Field Office. Vernal, Utah.

_____. 2006. Chapita Wells/Stagecoach Area Draft Environmental Impact Statement. UTU-080-2005-0010. Vernal, Utah: U.S. Department of the Interior, Bureau of Land Management, Vernal Field Office.

_____. 2008. Record of Decision and Approved Resource Management Plan. Vernal Field Office. Vernal, Utah.

_____. 2012a. Greater Natural Buttes Final Environmental Impact Statement FEIS 12-8, EIS No. UT-080-07-807. Published March 2012.

_____. 2012b. Greater Uinta Basin Oil and Gas Cumulative Impacts Technical Support Document. United States Department of the Interior, Bureau of Land Management. Dated March 2012.

United States Department of Agriculture (USDA) – Animal and Plant Health Inspection Service. 2010. Federal Noxious Weed List. http://aphis.gov/plant_health/permits/organism/federal_noxious_weeds.shtml

United States Department of Agriculture, Natural Resource Conservation Center (USDA-NRCS). 2003. Soil Survey of Uinta Area, Utah – Parts of Daggett, Grand, and Uintah Counties.

_____. 2012. Web Soil Survey. Accessed October 8, 2012 at http://websoilsurvey.nrcs.usda.gov/app/.

USDA-George E. Brown, Jr. Salinity Laboratory. 1954. Diagnosis and Improvement of Saline and Alkali Soils. Agriculture Handbook No. 60. U.S. Government Print Office, Washington, D.C.

United States Department of Army, Corps of Engineers (USACE), Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. 92 pp. plus appendices.

United States Department of the Interior (USDI) and the United States Department of Agriculture (USDA). 2007. Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development (The Gold Book). United States Department of the Interior, Bureau of Land Management and the United States Department of Agriculture, Forest Service. Access online at http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/best_management_practices/gold_book.html.

United States Department of Transportation (USDOT), Federal Highway Administration. 1995. Highway Traffic Noise Analysis and Abatement Policy and Guidance. Office of Environment and Planning, Noise and Air Quality Branch. Washington, D.C.

United States Environmental Protection Agency (EPA). 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. The U.S. Environmental Protection Agency, Office of Noise Abatement and Control.

_____. 2009. National Drinking Water Primary Regulations, List of Contaminants and their Maximum Contaminant Level (MCLs), accessed at http://water.epa.gov/drink/contaminants/index.cfm#List.

_____. 2012. STORET and WQX, EPA's Repository and Framework for Sharing Water Monitoring Data, available at http://www.epa.gov/storet. Accessed on November 2, 2012.

United States Environmental Protection Agency (EPA) Air Quality System (AQS). 2012 Data Mart Monitor Values. Available at http://www.epa.gov/airquality/airdata/ad_rep_mon.html.

United States Fish and Wildlife Service (USFWS). 1979a. Classification of Wetlands and Deepwater Habitats of the United States, FWS/OBS-79/31. Authored by L.M. Cowardin, V. Carter, F.C. Golet, E.T. LaRoe. pp. 131.

_____. 1979b. Endangered and Threatened Wildlife and 22 Plants; Determination That *Sclerocactus glaucus* is a Threatened Species. 50 CFR Part 17. 23 Federal Register Vol. 44, No. 198: 58868-58870.

_____. 1983. National Wetlands Inventory (NWI). U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Available online at http://www.fws.gov/wetlands/. Accessed September – October 2012.

_____. 1990. Uinta Basin hookless cactus (*Sclerocactus glaucus*) recovery plan. Prepared for U.S. Fish and Wildlife Service, Region 6, Denver, Colorado.

_____. 1992a. Endangered and Threatened Wildlife and Plants: Final Rule to List the Plant *Spiranthes diluvialis* (Ute Ladies'-Tresses) as a Threatened Species. Federal Register, Vol. 57, No. 12:2048-2054.

_____. 1992b. Ouray National Fish Hatchery Proposed Facilities Site Map.

_____. 1992c. 614 FW 2, Survey and Identification, Natural and Cultural Resources Management Series. November 18, 1992.

_____. 1993. Service Manual 105, Part 340: Real Property Management, Rights-of-Way and Road Closings. USFWS Division of Realty. July 28, 1993. Access online at http://www.fws.gov/policy/340fw3.html.

_____. 1994. Endangered and Threatened Wildlife and Plants. Determination of critical habitat for the Colorado River endangered fishes: razorback sucker, Colorado squawfish, humpback chub, and bonytail chub. Federal Register 59:13374–13400.

_____. 1995a. FY 1996 Umbrella Scope of Work for Construction of Propagation Facilities Memorandum from John Hamill, Director to Management Committee. Propagation of Endangered Fishes for the Upper Colorado River Basin. U.S. Department of the Interior, Fish and Wildlife Service. Denver, Colorado. July 26.

_____. 1995b. Ute ladies'-tresses (*Spiranthes diluvialis*) agency review draft recovery plan. U.S. Fish and Wildlife Service, Region 6, Denver, CO.

_____. 2000a. Ouray National Wildlife Refuge Comprehensive Conservation Plan. Prepared by U.S. Fish and Wildlife Service, Ouray National Wildlife Refuge, Randlett, Utah. July 2000. pp. 125.

_____. 2000b. Service Manual. 603 FW 2, Compatibility. http://www.fws.gov/policy/603fws.html. Site updated November 17, 2000.

_____. 2001a. Ouray National Fish Hatchery Well Field Expansion: Design Specifications. U.S. Department of the Interior, Fish and Wildlife Service. Vernal, Utah. February 10, 2001.

_____. 2001b. Genetics Study for Western Yellow-billed Cuckoo Now Available. Document Number 01-76. Released June 7, 2001. United States Department of the Interior, Fish and Wildlife Service. Available Online at http://www.fws.gov/pacific/news/2001/2001-76.htm.

_____. 2002a. Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals: Amendment and Supplement to the Colorado Squawfish Recovery Plan. Prepared for U.S. Fish and Wildlife Service, Region 6, Denver, Colorado.

_____. 2002b. Bonytail (*Gila elegans*) Recovery Goals: Amendment and Supplement to the Bonytail Chub Recovery Plan. Prepared for U.S. Fish and Wildlife Service, Region 6, Denver, Colorado.

_____. 2002c. Razorback Sucker (*Xyrauchen texanus*) Recovery Goals: Amendment and Supplement to the Razorback Sucker Recovery Plan. Prepared for U.S. Fish and Wildlife Service, Region 6, Denver, Colorado.

_____. 2002d. Humpback Chub (*Gila cypha*) Recovery Goals: Amendment and Supplement to the Humpback Chub Recovery Plan. Prepared for U.S. Fish and Wildlife Service, Region 6, Denver, Colorado.

_____. 2005. Ouray National Wildlife Refuge, Wildlife List. U.S. Fish and Wildlife Service.

_____. 2006. Service Manual. 603 FW 1, Appropriate Refuge Uses. http://www.fws.gov/policy/603fw1.html. Site updated July 26, 2006.

_____. 2007a. Critical Habitat Portal. Available online at http://criticalhabitat.fws.gov/crithab/.

_____. 2007b. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. 50 CFR Part 17. Vol. 72, No. 130, p. 37346-37371. Access online at http://www.gpo.gov/fdsys/pkg/FR-2007-07-09/pdf/07-4302.pdf#page=1.

_____. 2009. Taxonomic change of *Sclerocactus glaucus* to three separate species. Federal Register, 74: 47112-47117. September 15, 2009.

_____. 2011a. Ouray National Wildlife Refuge Bird Use in Leota Bottom. Unpublished data.

_____. 2011b. U.S Fish and Wildlife Service Announces Opening of Ouray National Wildlife Refuge to Limited Elk Hunting. U.S. Fish and Wildlife, Mountain-Prairie Region. Available online at http://www.fws.gov/mountain-prairie/pressrel/11-67.html

_____. 2012a. Service Manual, 612 FW, Oil and Gas. Available at: http://www.fws.gov/policy/612fw2.html. Site updated June 26, 2012.

_____. 2012b. Endangered, Threatened, Proposed, and Candidate Species; Utah Counties. USFWS Ecological Services, Utah Field Office, West Valley City, Utah. January 2012. Retrieved October 31, 2012, from http://www.fws.gov/utahfieldoffice/Documents/Species%20by%20County.pdf

_____. 2012c. USFWS *Scelerocactus wetlandicus* Polygon.

_____. 2012d. FY 2012 Refuge Annual Performance Plan (RAPP), Ouray National Wildlife Refuge Station Report. Unpublished data.

_____. 2012e. Ouray National Wildlife Refuge Hunting and Fishing Regulations. Revised August 16, 2012. Available online at: http://www.fws.gov/ouray/Ouray_NWR_Hunting_and_Fishing_Regs_2012.pdf. Accessed October 22, 2012.

_____. 2013a. Colorado River Recovery Program. FY 2013 Depletion Charge and Annual Budget Adjustments. Dated October 17, 2012. Available online at http://www.coloradoriverrecovery.org/documents-publications/budget-documents/cpitbl/cpitbl13rev.pdf.

_____. 2013b. Environmental Conservation Online System. U.S. Fish and Wildlife Service. Accessed on January 14, 2013 at http://ecos.fws.gov/ecos/indexPublic.do.

_____. 2013c. USFWS *Sclerocactus* polygon. March.

_____. 2013d. Ouray National Wildlife Refuge Website. Available online2013 at http://www.fws.gov/ouray/birds.html. Last updated March 4, 2013.

_____. 2013e. Ouray National Fish Hatchery Budget Detail Requirements for Recovery Program FY 2014-2015 Scope of Work. Submitted by Karl “Dave” Schnoor, Project Leader. U.S. Department of the Interior, Fish and Wildlife Service. Vernal, Utah. May.

_____. 2013f. Status Memorandum from Kevin McAbee to Chris Dippel regarding Thurston Energy’s Proposed Development of Four Oil and Gas Wells at Ouray National Wildlife Refuge (Ouray NWR). U.S. Department of the Interior, Fish and Wildlife Service. Denver, Colorado. June 13, 2013.

_____. 2013g. FY 2012 Annual Project Report, Colorado River Recovery Program, Project Number: 29B. Operation and Maintenance of Ouray National Fish Hatchery. Principal Investigators: Karl “Dave” Schnoor, Project Leader and Matt Fry, Fish Biologist. U.S. Department of the Interior, Fish and Wildlife Service. Vernal, Utah. August.

United States Fish and Wildlife Service, Ecological Services Office (USFWS-ESO). 2010. Recovery outline for the *Sclerocactus wetlandicus* (Uinta Basin hookless cactus). Utah Ecological Services Field Office. April 14, 2010.

United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Access online at http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf.

United States General Accounting Office (USGAO). 2003. National Wildlife Refuges: Opportunities to improve the management and oversight of oil and gas activities on federal lands. GAO-03-517.

United States Geological Survey (USGS). 2013. National Water Information System – Web Interface, USFS Water Data for the Nation, accessed March 26, 2013 at http://waterdata.usgs.gov/nwis.

United States Geological Survey – National Gap Analysis Program (USGS-NGAP). 2005. Southwest Regional GAP Analysis Project – Land Cover Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University.

Utah Department of Agriculture and Food. 2010. Utah Noxious Weed List. Utah State Government, Department of Agriculture and Food. Available online at http://ag.utah.gov/divisions/plant/noxious/documents/noxUtah.pdf.

Utah Department of Environmental Quality (UDEQ). 2008. Standards of Quality for Waters of the State, Rule 317-2. February 2008.

Utah Department of Transportation (UDOT). 2011. Traffic on Utah Highways. UDOT Systems Planning and Programming Division, Traffic Analysis Section. Retrieved from http://www.udot.utah.gov/main/uconowner.gf?n=10717515279209789. Accessed on October 20, 2012.

Utah Division of Oil, Gas and Mining (UDOGM). 2005. Utah Oil and Gas Conversation General Rules: R649- Natural Resources; Oil, Gas and Mining; Oil and Gas. Available at http://oilgas.ogm.utah.gov/Rules/Rules_Page.htm.

Utah Division of Water Resources (UDWaR). 1999. Utah Department of Natural Resources. Utah State Water Plan, Uinta Basin. Utah Board of Water Resources, Salt Lake City, Utah. December 1999.

Utah Division of Wildlife Resources (UDWR). 2003. Vertebrate information compiled by the Utah Natural Heritage Program: A Progress Report. Publication number 03-45. State of Utah Department of Natural Resources, UDWR Salt Lake City, Utah. 336 pp.

_____. 2005. Rocky Mountain Elk (*Cervus elaphus nelsoni*), Wildlife Notebook series No. 12. Amy Adams, Project Wild. Access online at http://wildlife.utah.gov/publications/pdf/2010_elk.pdf.

_____. 2006. Range-wide Conservation Agreement and Strategy for Roundtail Chub *Gila robusta*, Bluehead sucker *Catostomus discobolus*, and Flannelmouth Sucker *Catostomus latipinnis*. Utah Department of Natural Resources, Division of Wildlife Resources. Available online at http://wildlife.state.co.us/SiteCollectionDocuments/DOW/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf.

_____. 2009. Utah Pronghorn Statewide Management Plan. Utah Division of Wildlife Resources, Department of Natural Resources. Available online at http://wildlife.utah.gov/hunting/biggame/pdf/Statewide_prong_mgmt_2009.pdf.

_____. 2010. Utah Elk Statewide Management Plan. Utah Division of Wildlife Resources, Department of Natural Resources. Access online at http://wildlife.utah.gov/hunting/biggame/pdf/elk_plan.pdf.

_____. 2011a. Utah Sensitive Species List, Last Updated March 29, 2011. Department of Natural Resources Division of Wildlife Resources. Access Online at http://dwrcdc.nr.utah.gov/ucdc/viewreports/SSLAppendices20110329.pdf.

_____. 2011b. Utah Big Game Annual Report 2010. Bernales, H.H., Hersey, K.R., and A. Aoude. Utah Department of Natural Resources, Division of Wildlife Resources. Publication No. 11-23. Available online at http://wildlife.utah.gov/hunting/biggame/pdf/annual_reports/11_bg_report.pdf.

_____. 2012a. Statewide Management Plan for Mule Deer. Utah Division of Wildlife Resources, Department of Natural Resources. Access online at http://wildlife.utah.gov/hunting/biggame/pdf/mule_deer_plan.pdf. Amended May 3, 2012.

_____. 2012b. Utah Upland Game Annual Report 2011-12. Bernales, H.H., Robinson, J.D., Stringham, B., and J. Dolling. Publication No. 12-25. Utah Department of Natural Resources, Division of Wildlife Resources. Available online at http://wildlife.utah.gov/uplandgame/annualreports/2011.pdf .

_____. 2012c. Utah Big Game Annual Report 2011. Bernales, H.H., Hersey, K.R., and A. Aoude. Utah Department of Natural Resources, Division of Wildlife Resources. Publication No. 12-27. Available online at http://wildlife.utah.gov/hunting/biggame/pdf/annual_reports/11_bg_report.pdf.

_____ 2012d. Utah Conservation Data Center. State of Utah, Department of Natural Resources, Division of Wildlife Resources. Available online at http://dwrcdc.nr.utah.gov/ucdc.

Utah Division of Wildlife Resources – Utah Natural Heritage Program (UDWR-UNHP). 2011. Utah Conservation Data Center, Utah Sensitive Species List by County. Last updated March 29, 2011 Accessed online at http://dwrcdc.nr.utah.gov/ucdc.

Utah Native Plant Society (UNPS). 2006. *Utah Rare Plant Guide*. Salt Lake City, Utah: Utah Rare Plant Guide Home Page. Accessed May 31, 2007 at http://www.utahrareplants.org.

Utah State Legislature. 2007. Utah Noxious Weed Act, Title 4, Chapter 17. Available at http://le.utah.gov/~code/TITLE04/04_17.htm.

Walters, R.E., and E. Sorenson. 1983. Utah bird distribution: latitude-longitude study. Utah Division of Wildlife Resources Publication No. 83-10, Salt Lake City, UT.

Wheeler, B.K. 2003. Raptors of Western North America. The Wheeler Guide. Princeton University Press, New Jersey. 544 pp.

APPENDIX A

Thurston Energy, LLC's Surface Use Plan of Operations (SUPO)

Thurston Energy LLC

Ouray National Wildlife Refuge 2-Well Development Program

Proposed Surface Use Plan of Operations

Name of Owner(s)
Thurston Energy LLC
Address
P| xxx.xxx.xxxx

Table of Contents

1) Proof of Mineral Rights 1

2) Location of Mineral Rights 2

3) Proposed Project Location 3

4) Well-Specific Plan of Operations / Surface Use Plan 4

Thurston 11-31-7-21 4
11-31-7-21 Legal Plat
Thurston 12-31-7-21 10
12-31-7-21 Legal Plat

5) Reclamation and Weed Plan 16

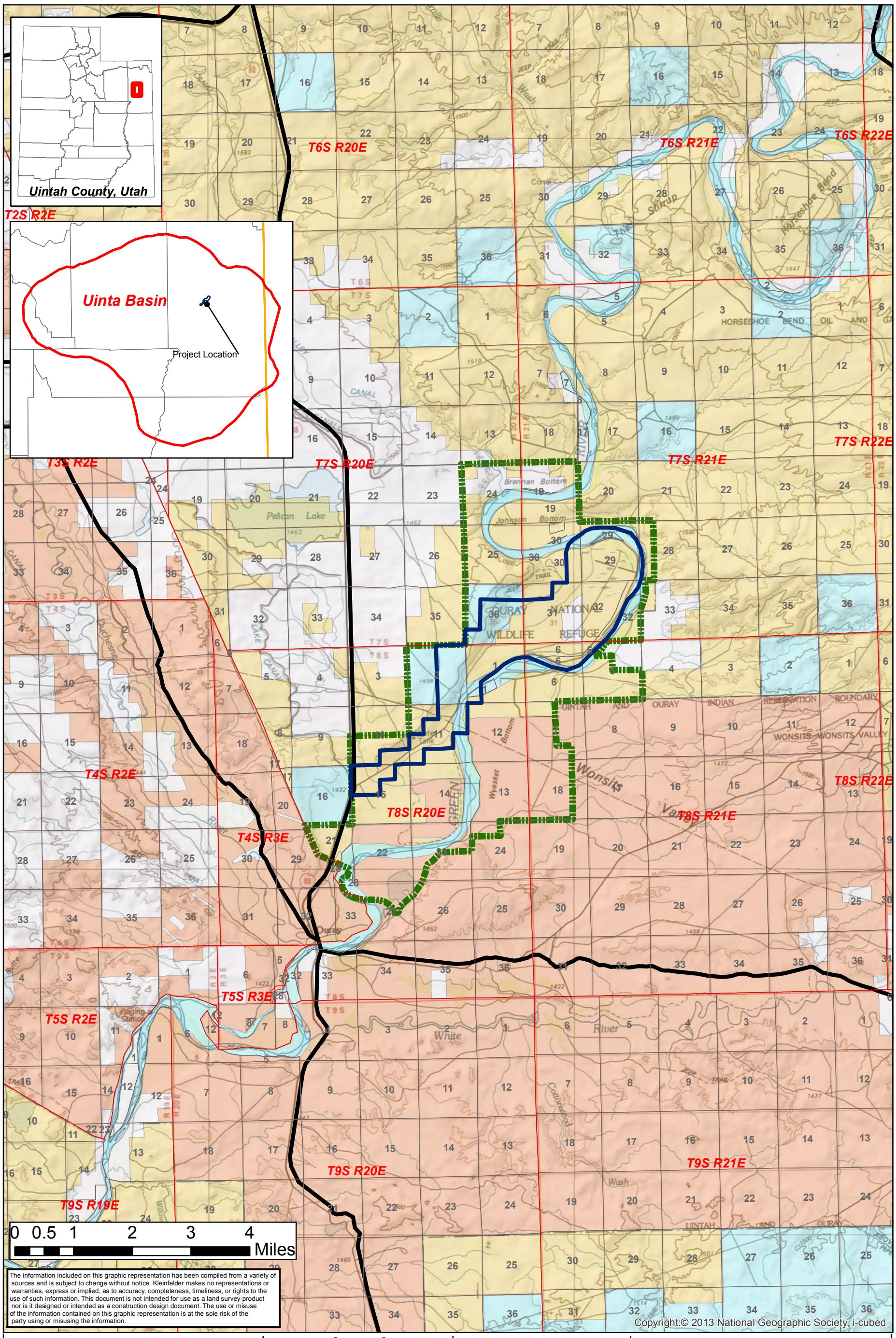
Thurston Energy LLC Reclamation Plan ..... See **Appendix F** in EA
Preconstruction/Baseline Weed Inventory Report 17

1) Proof of Mineral Rights

[In the form of a copy of the lease, deed, designation of operator, or assignment of rights]

2) Location of Mineral Rights

[Map(s) showing location of mineral rights]



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Major Road
- Ouray National Wildlife Refuge Boundary

Surface Ownership
- Federal
- Private
- State
- Tribal

N

PROJECT NO.	126694
DRAWN:	2/6/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig1_1ProjectLocation.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Project Location
Uintah County, Utah

4) Well-Specific Plan of Operations / Surface Use Plan

THURSTON 11-31-7-21

Location: Section 31, Township 7 South, Range 21 East, S.L.B. & M.
County: Uintah County, Utah
Lease Number: ML 52016
Surface Ownership: Federal

1. Estimated Timetable for Completion & Periods of Activity

2. Existing Roads

Starting in Vernal, Utah:
Proceed in a southwesterly direction from Vernal, Utah along U.S. Highway 40 approximately 13.9 miles to the junction of State Highway 88. Exit left and then proceed in a southerly direction along SH 88 approximately 7.1 miles to the intersection of 5500 South Street. Continue along SR 88 approximately 6.7 miles to the Ouray NWR entrance and exit left and continue approximately 4.7 miles. Follow flags for the proposed access road approximately 80' to the proposed location.

Total Distance from Vernal, Utah to the proposed well location is approximately 32.4 miles.

All existing roads to the proposed location are State of Utah or Uintah County Class B roads.

3. Planned Access Road

Access road will be constructed.

A) Approximate length	80'
B) Access width	36'
C) Running surface	18'
D) Surface material	Natural
E) Maximum grade	Flat
F) Fence crossing	NO
G) Culvert	Yes
H) Turnouts	NO
I) Major cuts and fills	NO
J) Road flagged	YES
K) Access road surface ownership	Federal
L) All new construction on lease	YES
M) Pipeline crossing	None
N) Construction time	1 DAY
O) Road crowned and ditched	YES

Please see the location plats on the following pages for additional details.

An access permit will be required. All surface disturbances for the road and location will be within the lease boundary. The equipment used for road construction will be the same as used for location construction.

4. Location of existing wells

See SHEET 10 of attached Plats for well locations. There are no monitoring or observation wells.

5. Location of tank batteries, production facilities, production gathering pipelines

All production facilities are to be contained within the proposed location site. Please see SHEET 5 of attached plats for the gas well separator installation and well site piping.

All permanent (on site for six months or longer) structures constructed or installed will be painted a Covert Green color. Facilities required to comply with OSHA will be excluded.

All tanks will be surrounded by a dike of sufficient capacity to contain 110 percent of the total storage capacity of the largest tank in the battery and sufficient freeboard to contain precipitation. The integrity of the dike will be maintained.

The operator will adhere to all site security guidelines and regulation identified in 43 CFR 3126.7.

All off lease storage, off lease measurement, comingling on lease or off lease, of production, will have prior written approval from the authorized officer.

If the well is capable of economic production a surface gas line will be required.

<u>Pipeline:</u>
The pipeline would consist of 15,710 feet of 3-inch surface HDPE pipe laid by hand from the trunk line on top of the bluff to the well pad. The majority of the surface pipeline would follow Wildlife Refuge Road and would be placed adjacent to the road within a 15-foot right-of-way (ROW) easement on the west side of the road. The pipeline will be strung and boomed to the south of the location and parallel to the access road and county Class D road. It will continue southerly along the County road to a point where it enters Sec 2, Twp 7, Rng 20E then Northwest to the County Class D road then northerly to the northeast corner of Sec 2 where it will tie into an existing Ultra Resources, Inc. collector line.

The location will be utilized as the staging area.

A) Staging area	None
B) Construction	1 week
C) Additional equipment required	None
D) Stringing method	Boomed
E) Wash crossing	YES
F) Road crossing	YES

An off lease Right-of-Way will be required.

Please see the attached location diagrams for pipeline location.

There will be no additional surface disturbances required for the installation of gathering line.

The gas meter run will be located within 500' of the wellhead. The gas line will be anchored down from the wellhead to the meter. Meter runs will be housed and/or fenced.

The gas meter will be calibrated and the tank strapped in place prior to any deliveries. Tests for meter accuracy will be conducted monthly for the first three months on new meter installations and at least quarterly thereafter. The authorized officer will be provided with a date and time for the initial meter-proving schedules. A copy of the meter calibration report will be submitted to the BLM's Vernal District office and State of Utah, Division of Oil, Gas, and Mining. All measurement facilities will conform to API (American Gas Association) standards for gas and liquid hydrocarbon measurement.

6. Location of overhead power line

Approximately 9,768 feet of overhead distribution lines would be installed along a 15-foot-wide power line ROW corridor. The electric distribution lines would be built on single wood utility poles approximately 65 feet in height. The span between poles would be approximately 200 feet and poles would be installed in the same 15-foot-wide ROW corridor as the 3-inch surface HDPE gas pipeline and existing refuge roads. Therefore, no additional surface disturbance would be anticipated from installation of the electric distribution line.

The proposed distribution line would tie into an existing power source at the Ouray National Fish Hatchery (NFH). Construction of the power line to the associated infrastructure would be in compliance with raptor protection requirements.

7. Location and type of water supply

Water for drilling and cementing will come from the Green River on SR88.

8. Source of construction materials

All construction material for this location site and access road shall borrow material accumulated during construction of the location site and access road. Additional road gravel or pit lining material, if required, will be obtained from private resources.

9. Potential hazards to persons and/or the environment

Description of potential hazards to

10. Methods for handling waste disposal

A) Drilling operations
A closed system will be used to drill the well. All fresh water for drilling will come from tanks placed on location and from the rig tank. Non-flammable materials such as cuttings, salt, drilling fluids, chemicals, produced fluids, etc. will be held in tanks.

B) Drilling mud
XXX

C) Produced fluids
Produced water will be confined to storage tanks for a period not to exceed 90 days after initial production. During the 90-day period an application for approval for permanent disposal method and location will be submitted to the authorized officer.

D) Garbage
A trash cage fabricated from expanded metal will be used to hold trash on location and will be removed to an authorized landfill location.

E) Sewage
A portable chemical toilet will be supplied for human waste. A sewage gathering system will be used for all affluent from camp building on location. All affluent will be disposed of at the Ashley Valley water treatment plant.

F) Site clean-up
After the rig is moved off the location, the well site area will be cleaned and all refuse removed.

11. Ancillary facilities

There are no ancillary facilities planned at this time and none are foreseen in the future.

12. Well-site layout

Location dimensions are as follows:

A) Pad length	345 ft
B) Pad width	210 ft
C) Pit depth	N/A
D) Pit length	N/A
E) Pit width	N/A
F) Max cut	2.7 ft
G) Max fill	0.6 ft
H) Total cut yds	4,140 cu yds
I) Pit location	N/A
K) Access road location	Southwest
L) Flare pit	Corner 6

Please see the location plats for additional details.

All pits will be fenced according to the following minimum standards:

A) Thirty-nine inch net wire shall be used with at least one strand of wire on top of the net wire. Barbed wire is not necessary if pipe or some type of reinforcement rod is attached to the top of the entire fence.

B) The net wire shall be no more than two inches above the ground. The barbed wire shall be three inches above the net wire. Total height of the fence shall be at least 42 inches.

C) Corner posts shall be cemented and/or braced in such a manner to keep the fence tight at all times.

D) Standard steel, wood or pipe posts shall be used between the corner braces. Maximum distance between any two posts shall be no greater than 16 ft.

E) All wire shall be stretched by using a stretching device before it is attached to the corner posts.

13. Surface restoration

Reclamation activities will be accomplished as provided in the **Thurston Energy Operating Company LLC Ouray National Wildlife Refuge Reclamation and Weed Plan.** (The plan and plat of the Interim Reclamation Diagram and Site Specific Plan are enclosed.)

14. Surface ownership

Access road	Federal
Location	Federal
Pipeline	Federal and State

15. Other information

A) Vegetation
See Site Specific Plan

B) Dwellings
There are no dwellings or other facilities within a one-mile radius of the location.

C) Weed Control Plan
Weed control will be accomplished as provided in the attached **Thurston Energy Operating Company LLC Ouray National Wildlife Refuge Reclamation and Weed Plan.**

D) Archaeology
The location has been surveyed. The cultural and paleontological report is included in the USFWS project file but may not be available for public distribution due to sensitive material contained within.

E) Water
Nearest water is in the Green River approximately 1.2 miles to the north.

F) Chemicals
No pesticides, herbicides or other possible hazardous chemicals will be used without prior application and approval.

G) Proper Notification
a) Will occur at least 48-hours prior to construction of location and access roads.
b) Will occur prior to moving on the drilling rig.
c) Will occur at least 24 hours prior to spudding the well.
d) Will occur at least 24 hours prior to running casing and cementing all casing strings.
e) Will occur at least 24 hours prior to initial pressure tests of BOP and related equipment.
f) First production notice will be submitted within five business days after the new well begins or resumes production if the well has been shut-in for more than 90 days.

H) Flare pit
The flare pit will be located on Corner 6, 100 feet from the bore hole on the south side of the location. All fluids will be removed from the pit within 48 hours of occurrence.

I) Paleontology
The location has been surveyed. The cultural and paleontological report is included in the USFWS project file but may not be available for public distribution due to sensitive material contained within.

THURSTON 12-31-7-21

Location: Section 31, Township 7 South, Range 21 East, S.L.B. & M.
County: Uintah County, Utah
Lease Number: ML 52016
Surface Ownership: Federal

1. Estimated Timetable for Completion & Periods of Activity

2. Existing Roads

Starting in Vernal, Utah:
Proceed in a southwesterly direction from Vernal, Utah along U.S. Highway 40 approximately 13.9 miles to the junction of State Highway 88. Exit left and then proceed in a southerly direction along SH 88 approximately 7.1 miles to the intersection of 5500 South Street. Continue along SR 88 approximately 6.7 miles to the Ouray NWR entrance and exit left and continue approximately 4.7 miles. Follow flags for the proposed access road approximately 80' to the proposed location.

Total Distance from Vernal, Utah to the proposed well location is approximately 32.4 miles.

All existing roads to the proposed location are State of Utah or Uintah County Class B roads.

3. Planned Access Road

Access road will be constructed.

A) Approximate length	433'
B) Access width	36'
C) Running surface	18'
D) Surface material	Native
E) Maximum grade	Flat
F) Fence crossing	N/A
G) Culvert	Yes
H) Turnouts	None
I) Major cuts and fills	None
J) Road flagged	YES
K) Access road surface ownership	Federal
L) All new construction on lease	YES
M) Pipeline crossing	None
N) Construction time	1 DAY
O) Road crowned and ditched	YES

Please see the location plats on the following pages for additional details.

An access permit will be required. All surface disturbances for the road and location will be within the lease boundary. The equipment used for road construction will be the same as used for location construction.

4. Location of existing wells

See SHEET 10 of attached Plats for well locations. There are no monitoring or observation wells.

5. Location of tank batteries, production facilities, production gathering pipelines

All production facilities are to be contained within the proposed location site. Please see SHEET 5 of attached plats for the gas well separator installation and well site piping.

All permanent (on site for six months or longer) structures constructed or installed will be painted a Covert Green color. Facilities required to comply with OSHA will be excluded.

All tanks will be surrounded by a dike of sufficient capacity to contain 110 percent of the total storage capacity of the largest tank in the battery and sufficient freeboard to contain precipitation. The integrity of the dike will be maintained.

The operator will adhere to all site security guidelines and regulation identified in 43 CFR 3126.7.

All off lease storage, off lease measurement, comingling on lease or off lease, of production, will have prior written approval from the authorized officer.

If the well is capable of economic production a surface gas line will be required.

<u>Pipeline:</u>
The pipeline would consist of 15,710 feet of 3-inch surface HDPE pipe laid by hand from the trunk line on top of the bluff to the well pad. The majority of the surface pipeline would follow Wildlife Refuge Road and would be placed adjacent to the road within a 15-foot right-of-way (ROW) easement on the west side of the road. The pipeline will be strung and boomed to the south of the location and parallel to the access road and County Class D road. It will continue southerly along the County road to a point where it enters Sec 2, Twp 8S, Rng 20E then northerly to the Northeast corner of Sec 2 where it will tie into an existing Ultra Resources, Inc. collection line.

The location will be utilized as the staging area.

A) Staging area	None
B) Construction	1 week
C) Additional equipment required	None
D) Stringing method	Boomed
E) Wash crossing	YES
F) Road crossing	YES

An off lease Right-of-Way will be required.

Please see the attached location diagrams for pipeline location.

There will be no additional surface disturbances required for the installation of gathering line.

The gas meter run will be located within 500' of the wellhead. The gas line will be anchored down from the wellhead to the meter. Meter runs will be housed and/or fenced.

The gas meter will be calibrated and the tank strapped in place prior to any deliveries. Tests for meter accuracy will be conducted monthly for the first three months on new meter installations and at least quarterly thereafter. The authorized officer will be provided with a date and time for the initial meter-proving schedules. A copy of the meter calibration report will be submitted to the BLM's Vernal District office and State of Utah, Division of Oil, Gas, and Mining. All measurement facilities will conform to API (American Gas Association) standards for gas and liquid hydrocarbon measurement.

6. Location of overhead power line

Approximately 9,768 feet of overhead distribution lines would be installed along a 15-foot-wide power line ROW corridor. The electric distribution lines would be built on single wood utility poles approximately 65 feet in height. The span between poles would be approximately 200 feet and poles would be installed in the same 15-foot-wide ROW corridor as the 3-inch surface HDPE gas pipeline and existing refuge roads. Therefore, no additional surface disturbance would be anticipated from installation of the electric distribution line.

The proposed distribution line would tie into an existing power source at the Ouray NFH. Construction of the power line to the associated infrastructure would be in compliance with raptor protection requirements.

7. Location and type of water supply

Water for drilling and cementing will come from the Green River on SR88.

8. Source of construction materials

All construction material for this location site and access road shall borrow material accumulated during construction of the location site and access road. Additional road gravel or pit lining material, if required, will be obtained from private resources.

9. Potential hazards to persons and/or the environment

Description of potential hazards

10. Methods for handling waste disposal

A) Drilling operations
A closed system will be used to drill the well. All fresh water for drilling will come from tanks placed on location and from the rig tank. Non-flammable materials such as cuttings, salt, drilling fluids, chemicals, produced fluids, etc. will be held in tanks.

B) Drilling mud
XXX

C) Produced fluids
Produced water will be confined to storage tanks for a period not to exceed 90 days after initial production. During the 90-day period an application for approval for permanent disposal method and location will be submitted to the authorized officer.

D) Garbage
A trash cage fabricated from expanded metal will be used to hold trash on location and will be removed to an authorized landfill location.

E) Sewage
A portable chemical toilet will be supplied for human waste. A sewage gathering system will be used for all affluent from camp building on location. All affluent will be disposed of at the Ashley Valley water treatment plant.

F) Site clean-up
After the rig is moved off the location, the well site area will be cleaned and all refuse removed.

11. Ancillary facilities

There are no ancillary facilities planned at this time and none are foreseen in the future.

12. Well-site layout

Location dimensions are as follows:

A) Pad length	345 ft
B) Pad width	210 ft
C) Pit depth	N/A
D) Pit length	N/A
E) Pit width	N/A
F) Max cut	2.7 ft
G) Max fill	0.6 ft
H) Total cut yds	4,140 cu yds
I) Pit location	N/A
K) Access road location	Southwest
L) Flare pit	Corner 6

Please see the location plats for additional details.

All pits will be fenced according to the following minimum standards:

A) Thirty-nine inch net wire shall be used with at least one strand of wire on top of the net wire. Barbed wire is not necessary if pipe or some type of reinforcement rod is attached to the top of the entire fence.

B) The net wire shall be no more than two inches above the ground. The barbed wire shall be three inches above the net wire. Total height of the fence shall be at least 42 inches.

C) Corner posts shall be cemented and/or braced in such a manner to keep the fence tight at all times.

D) Standard steel, wood or pipe posts shall be used between the corner braces. Maximum distance between any two posts shall be no greater than 16 ft.

E) All wire shall be stretched by using a stretching device before it is attached to the corner posts.

13. Surface restoration

Reclamation activities will be accomplished as provided in the **Thurston Energy Operating Company LLC Ouray National Wildlife Refuge Reclamation and Weed Plan.** (The plan and plat of the Interim Reclamation Diagram and Site Specific Plan are enclosed.)

14. Surface ownership

Access road	Federal
Location	Federal
Pipeline	Federal and State

15. Other information

A) Vegetation
See Site Specific Plan

B) Dwellings
There are no dwellings or other facilities within a one-mile radius of the location.

C) Weed Control Plan
Weed control will be accomplished as provided in the attached **Thurston Energy Operating Company LLC Ouray National Wildlife Refuge Reclamation and Weed Plan.**

D) Archaeology
The location has been surveyed. The cultural and paleontological report is included in the USFWS project file but may not be available for public distribution due to sensitive material contained within.

E) Water
Nearest water is in the Green River approximately 1.2 miles to the north.

F) Chemicals
No pesticides, herbicides or other possible hazardous chemicals will be used without prior application and approval.

G) Proper Notification
a) Will occur at least 48-hours prior to construction of location and access roads.
b) Will occur prior to moving on the drilling rig.
c) Will occur at least 24 hours prior to spudding the well.
d) Will occur at least 24 hours prior to running casing and cementing all casing strings.
e) Will occur at least 24 hours prior to initial pressure tests of BOP and related equipment.
f) First production notice will be submitted within five business days after the new well begins or resumes production if the well has been shut-in for more than 90 days.

H) Flare pit
The flare pit will be located on corner 6, 100 feet from the bore hole on the south side of the location. All fluids will be removed from the pit within 48 hours of occurrence.

I) Paleontology
The location has been surveyed. The cultural and paleontological report is included in the USFWS project file but may not be available for public distribution due to sensitive material contained within.

5) Thurston Energy Ouray National Wildlife Refuge Reclamation and Weed Plan

[See **Appendix F** of the EA]

PRECONSTRUCTION/BASELINE WEED INVENTORY FOR THURSTON ENERGY'S OURAY NATIONAL WILDLIFE REFUGE PROJECT:

Well Name
11-31-7-21
12-31-7-21

Prepared for

Thurston Energy, LLC
P. O. Box 749
Vernal, Utah 84078

and

US Fish and Wildlife Service
HC 69 Box 232
Randlett, UT 84063

Survey Date: June 11-14, 2012
Report Date: June 28, 2012
Report Number: KLF-12-110

Introduction

In May 2012, Thurston Energy (Thurston) in Vernal, Utah, requested that Kleinfelder (KLF) conduct a baseline weed inventory for two proposed wells and associated infrastructures located in the Ouray National Wildlife Refuge. Proposed wells Thurston 11-31-7-21 and Thurston 12-31-7-21 are located in Uintah County, Utah approximately 30 miles southwest of Vernal, UT. The project area is located in Leota Bottom, adjacent to the Green River. The purpose of this inventory was to identify any invasive weed species within the proposed Project Area.

Proposed Development

Thurston proposes to drill two well pads located in Section 31 of Township 7 South, Range 21 East in the Ouray National Wildlife Refuge, Utah (see **Figure 1**). Surface disturbance associated with this proposed development includes constructing new well pads and site-specific access roads, and installing surface pipelines. A total of 3.2 acres of disturbance is proposed for the construction of two well pads (**Table 1**). A total of 513 feet of access roads is proposed to connect proposed well pads to existing roads. The proposed pipeline connecting the well pads and the gathering line would consist of a 15,710-foot, 3-inch surface HDPE pipe laid by hand (**Table 2**). The majority of the surface pipeline would follow Wildlife Refuge Road and would be placed adjacent to the road within a 15-foot right-of-way (ROW) easement on the west side of the road.

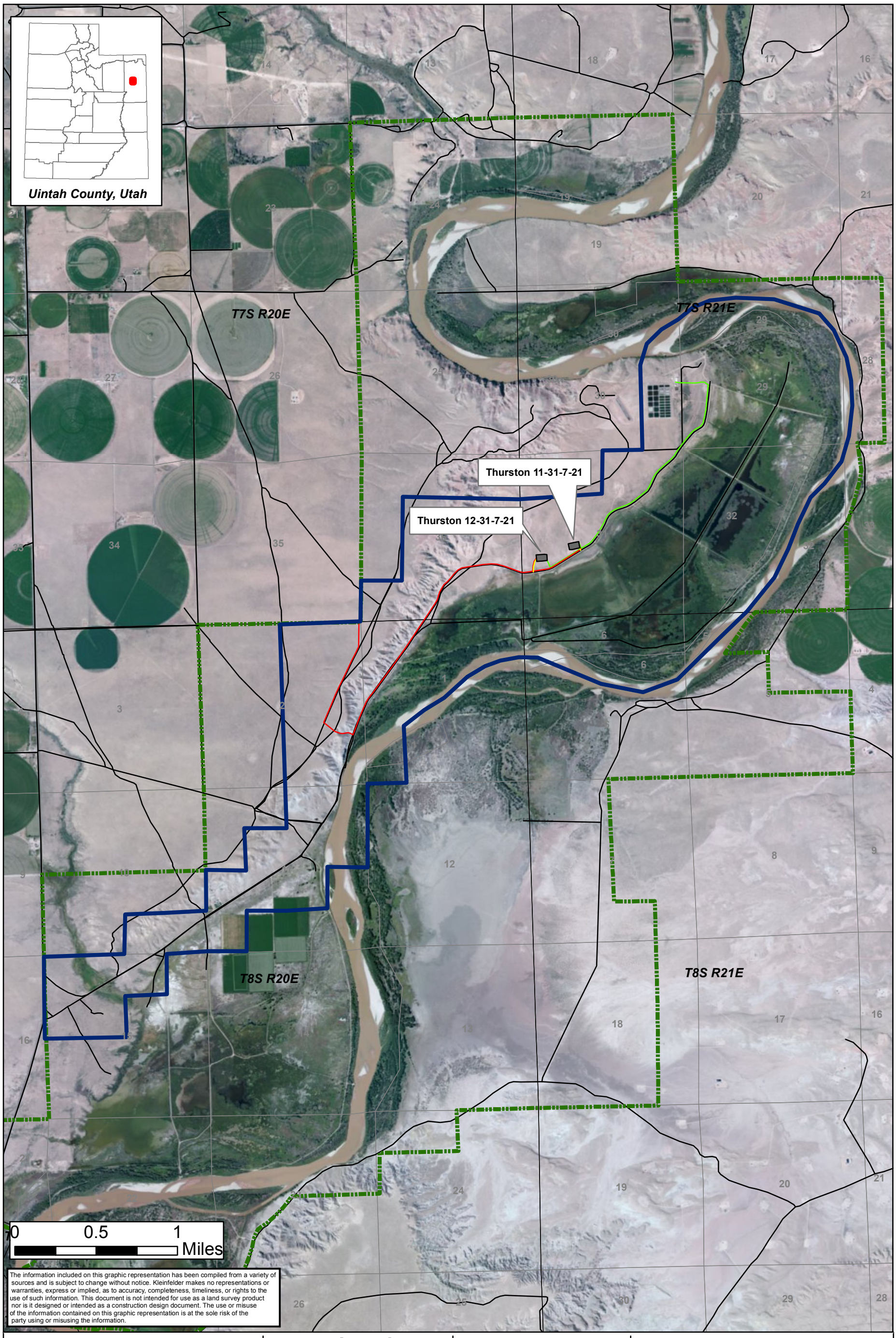
Surface ownership for the proposed development and associated infrastructure is managed by the US Fish and Wildlife Service (USFWS). **Figure 1** shows the general locations of the proposed wells. None of the existing well pads are located within the Pariette ACEC.

Table 1: Proposed Well Pad Development (Acres)

Well Name	Legal Location	Proposed Disturbance
Thurston 11-31-7-21	LOT 7 SEC31, T7S, R21E	1.6
Thurston 12-31-7-21	LOT 8 SEC31, T7S, R21E	1.6

Table 2: Proposed Associated Infrastructure Development (Feet)

Infrastructure Name	Proposed Disturbance
Thurston 12-31-7-21 Access Road	433
Thurston 11-31-7-21 Access Road	80
3-inch Surface HDPE Pipeline	15,710



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend
- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/7/2014
DRAWN BY:	B. McDavid
CHECKED BY:	J.Habiger
FILE NAME:	Fig2_1ProposedAction.mxd

Thurston Energy
Ouray NWR 2-Well Development Program

Proposed Action
Uintah County, Utah

FIGURE
1

Survey Methodology and Results

Survey Methodology

On June 11-14, 2012, Kleinfelder (KLF) conducted a preconstruction weed inventory using the survey protocol outlined in the 2009 BLM Vernal Field Office Surface Disturbing Weed Policy (Weed Policy). All areas proposed for disturbance were assessed, including proposed well pads, access roads and pipeline right-of-ways (ROWs). Existing staking and hand-held GPS units (Trimble JunoSB unit 1-3 meter accuracy) were used for navigation during surveys. The presence or absence of noxious weeds, as defined by the Weed Policy, was documented.

Survey Results

Several noxious weeds were documented during the 2012 surveys. The following tables summarize the results of the surveys.

Table 3: Proposed Thurston 12-31-7-21 Well Pad and Access Road

Common Name	Scientific Name	% Cover	Pattern	Infestation Size
Cheatgrass	*Bromus tectorum*	5-10 %	Patchy but dense where found	½ - 1 acre
Halogeton	*Halogeton glomeratus*	1-5 %	Patchy	Less than 1 acre
Russian Thistle	*Salsola tragus*	< 1 %	Rare	Less than 1 acre

Table 4: Proposed Thurston 11-31-7-21 Well Pad and Access Road

Common Name	Scientific Name	Cover Class	Pattern	Infestation Size
Cheatgrass	*Bromus tectorum*	5-10 %	Patchy but dense where found	½ - 1 acre
Halogeton	*Halogeton glomeratus*	1-5 %	Patchy	Less than 1 acre
Russian Thistle	*Salsola tragus*	< 1 %	Rare	Less than 1 acre

Table 5: Proposed Surface Pipeline

Common Name	Scientific Name	Cover Class	Pattern	Infestation Size
Cheatgrass	*Bromus tectorum*	1-5 %	Patchy and thin	Less than 1 acre
Halogeton	*Halogeton glomeratus*	< 1%	Patchy along disturbance	Less than 1 acre
Russian Thistle	*Salsola tragus*	< 1 %	Rare	Less than 1 acre

Conclusion

Three species of noxious weeds (cheatgrass, halogeton, and Russian thistle) were documented in low densities throughout the landscape. At a minimum, Thurston would be responsible for controlling weed species and densities to these baseline conditions.

Limitations

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services were provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data as agreed upon in the scope of services. It is possible that field conditions could vary in the future and results may not be fully repeatable. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of services provided.

This report may be used only by Thurston and designated agencies, and only for the purposes stated for this specific engagement within a reasonable and acceptable time from its issuance.

This page intentionally left blank.

APPENDIX B

U.S. Army Corps of Engineers Wetland and Waters of the U.S. Impact Determination

-----Original Message-----
From: David Allison [mailto:dlallison@ubtanet.com]
Sent: Tuesday, June 26, 2012 7:55 AM
To: Bradley Norling
Subject: FW: Wetlands Report

-----Original Message-----
From: Jencks, Hollis G SPK [mailto:Hollis.G.Jencks@usace.army.mil]
Sent: Monday, May 07, 2012 12:34 PM
To: David Allison
Subject: RE: Wetlands Report

David-

After meeting with you on site February 27, 2012. It was verified by this office that there were no water of the U.S. including wetland located within the access roads or pads of 12-31, 11-31, 13-29 and 12-29. If you need any further information send me an e-mail.

Thanks,
Hollis Jencks
Project Manager, Utah Regulatory Office
533 West 2600 South, Suite 150
Bountiful, Utah 84010
Phone: 801-295-8380 X 18
Fax: 801-295-8842

-----Original Message-----
From: David Allison [mailto:dlallison@ubtanet.com]
Sent: Monday, May 07, 2012 12:18 PM
To: Jencks, Hollis G SPK
Subject: FW: Wetlands Report

Hollis: on 3/15/12 I sent Hollis: on 3/15/12 I sent you the maps you requested for the proposed wells on the Ouray Wild life Refuge so you could
prepare a report on your findings. To-date we have not received that
report. This Friday we are meeting with Refuge management and the EA contractor to kick of the EA development and would like to have the report
for that meeting. I would appreciate a copy of the report. Thanks

APPENDIX C

Ouray National Wildlife Refuge Species List

Ouray National Wildlife Refuge Species List (Including Birds, Mammals, Reptiles, Amphibians, Fish, and Plants)

Common Name	Scientific Name
BIRDS (*indicates confirmed nester on Refuge)	
Loons	
Common Loon	*Gavia immer*
Grebes	
Pied-billed Grebe*	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe*	*Podiceps nigricollis*
Western Grebe*	*Aechmophorus occidentalis*
Clark's Grebe*	*Aechmophorus clarkii*
Pelicans	
American White Pelican	*Pelecanus erythrorhynchos*
Cormorants	
Double-crested Cormorant*	*Phalacrocorax auritus*
Bitterns, Herons, and Egrets	
American Bittern*	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great Blue Heron*	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret*	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Green Heron*	*Butorides virescens*
Black-crowned Night-Heron*	*Nycticorax nycticorax*
Ibises	
White-faced Ibis*	*Plegadis chihi*
New World Vultures	
Turkey Vulture*	*Cathartes aura*
Swans, Geese, and Ducks	
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Canada Goose*	*Branta canadensis*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Wood Duck*	*Aix sponsa*
Gadwall*	*Anas strepera*
American Wigeon*	*Anas americana*
Mallard*	*Anas platyrhynchos*

Common Name	Scientific Name
Blue-winged Teal*	*Anas discors*
Cinnamon Teal*	*Anas cyanoptera*
Northern Shoveler*	*Anas clypeata*
Northern Pintail*	*Anas acuta*
Green-winged Teal*	*Anas crecca*
Canvasback*	*Aythya valisineria*
Redhead*	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck*	*Oxyura jamaicensis*
Osprey, Kites, Hawks, and Eagles	
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier*	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk*	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Swainson's Hawk*	*Buteo swainsoni*
Red-tailed Hawk*	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle*	*Aquila chrysaetos*
Falcons and Carcaras	
American Kestrel*	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Prairie Falcon*	*Falco mexicanus*
Rails	
Virginia Rail*	*Rallus limicola*
Sora*	*Porzana carolina*
Common Moorhen	*Gallinula chloropus*
American Coot*	*Fulica americana*

Common Name	Scientific Name
Cranes	
Sandhill Crane	*Grus canadensis*
Plovers	
American Golden-Plover	*Pluvialis dominica*
Snowy Plover	*Charadrius alexandrinus*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer*	*Charadrius vociferus*
Black-bellied Plover	*Pluvialis squatarola*
Stilts and Avocets	
Black-necked Stilt*	*Himantopus mexicanus*
American Avocet*	Recurvirostra Americana
Sandpipers and Phalaropes	
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted Sandpiper*	*Actitis macularia*
Long-billed Curlew*	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Semipalmated Sandpiper	*Charadrius semipalmatus*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
White-rumped Sandpiper	*Calidris fuscicollis*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt Sandpiper	*Calidris himantopus*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe*	*Gallinago gallinago*
Wilson's Phalarope*	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Skuas, Jaegers, Gulls, and Terns	
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus philadelphia*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Caspian Tern	*Sterna caspia*

Common Name	Scientific Name
Common Tern	*Sterna hirundo*
Forster's Tern*	*Sterna forsteri*
Black Tern*	*Chlidonias niger*
Pigeons and Doves	
Rock Dove	*Columba livia*
Band-tailed Pigeon	*Columba fasciata*
Mourning Dove*	*Zenaida macroura*
Cuckoos and Anis	
Yellow-billed Cuckoo*	*Coccyzus americanus*
Typical Owls	
Western Screech-Owl	*Otis kennicottii*
Great Horned Owl*	*Bubo virginianus*
Burrowing Owl*	*Athene cunicularia*
Long-eared Owl*	*Asio otus*
Short-eared Owl*	*Asio flammeus*
Northern Saw-whet Owl	*Aegolius acadicus*
Nightjars	
Common Nighthawk*	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Swifts	
White-throated Swift	*Aeronautes saxatalis*
Hummingbirds	
Black-chinned Hummingbird	*Archilochus alexandri*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Rufous Hummingbird	*Selasphorus rufus*
Kingfishers	
Belted Kingfisher	*Ceryle alcyon*
Woodpeckers	
Lewis' Woodpecker*	*Melanerpes lewis*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Red-naped Sapsucker*	*Sphyrapicus nuchalis*
Downy Woodpecker*	*Picoides pubescens*
Hairy Woodpecker*	*Picoides villosus*
Northern Flicker*	*Colaptes auratus*
Tyrant Flycatchers	
Olive-sided Flycatcher	*Contopus cooperi*
Western Wood-Pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Least Flycatcher	*Empidonax minimus*

Common Name	Scientific Name
Hammond's Flycatcher	*Empidonax hammondii*
Gray Flycatcher	*Empidonax wrightii*
Dusky Flycatcher	*Empidonax oberholseri*
Say's Phoebe*	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western Kingbird*	*Tyrannus verticalis*
Eastern Kingbird*	*Tyrannus tyrannus*
Shrikes	
Loggerhead Shrike*	*Lanius ludovicianus*
Northern Shrike	*Lanius excubitor*
Vireos	
Plumbeous Vireo*	*Vireo plumbeus*
Warbling Vireo*	*Vireo gilvus*
Crows, Jays, and Magpies	
Western Scrub-Jay	*Aphelocoma californica*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Black-billed Magpie*	*Pica pica*
American Crow*	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Larks	
Horned Lark*	*Eremophila alpestris*
Swallows	
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow*	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Cliff Swallow*	*Petrochelidon pyrrhonota*
Barn Swallow*	*Hirundo rustica*
Titmice and Chickadees	
Black-capped Chickadee*	*Poecile atricapillus*
Mountain Chickadee	*Poecile gambeli*
Bushtits	
Bushtit	*Psaltriparus minimus*
Nuthatches	
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
Creepers	
Brown Creeper	*Certhia Americana*

Common Name	Scientific Name
Wrens	
Rock Wren*	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
Bewick's Wren	*Thryomanes bewickii*
House Wren*	*Troglodytes aedon*
Marsh Wren*	*Cistothorus palustris*
Kinglets	
Ruby-crowned Kinglet	*Regulus calendula*
Old World Warblers	
Blue-gray Gnatcatcher	*Polioptila caerulea*
Thrushes	
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Swainson's Thrush*	*Catharus ustulatus*
Hermit Thrush*	*Catharus guttatus*
American Robin*	*Turdus migratorius*
Mimic Thrushes	
Gray Catbird*	*Dumetella carolinensis*
Northern Mockingbird*	*Mimus polyglottos*
Sage Thrasher*	*Oreoscoptes montanus*
Starlings	
European Starling*	*Sturnus vulgaris*
Wagtails and Pipits	
American (Water) Pipit	*Anthus rubescens*
Waxwings	
Bohemian Waxwing	*Bombycilla garrulus*
Cedar Waxwing	*Bombycilla cedrorum*
Wood Warblers	
Orange-crowned Warbler*	*Vermivora celata*
Virginia's Warbler*	*Vermivora virginiae*
Lucy's Warbler	*Oreothlypis luciae*
Yellow Warbler*	*Dendroica petechia*
Yellow-rumped Warbler*	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
American Redstart	*Setophaga ruticilla*
Ovenbird	*Seiurus aurocapillus*
MacGillivray's Warbler	*Oporornis tolmiei*

Common Name	Scientific Name
Northern Waterthrush	*Parkesia noveboracensis*
MacGillivray's Warbler*	*Oporornis tolmiei*
Common Yellowthroat*	*Geothlypis trichas*
Wilson's Warbler*	*Wilsonia pusilla*
Yellow-breasted Chat*	*Icteria virens*
Tanagers	
Summer Tanager	*Piranga rubra*
Western Tanager*	*Piranga ludoviciana*
Sparrows and Towhees	
Green-tailed Towhee*	*Pipilo chlorurus*
Spotted Towhee*	*Pipilo maculatus*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Black-throated Sparrow	*Amphispiza bilineata*
Sage Sparrow*	*Amphispiza belli*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow*	*Passerculus sandwichensis*
Fox Sparrow	*Passerelia iliaca*
Song Sparrow*	*Melospiza melodia*
Lincoln's Sparrow*	*Melospiza lincolnii*
Harris' Sparrow	*Zonotrichia querula*
White-crowned Sparrow*	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Snow Bunting	*Plectrophenax nivalis*
Cardinals, Grosbeaks, and Allies	
Black-headed Grosbeak*	*Pheucticus melanocephalus*
Blue Grosbeak*	*Guiraca caerulea*
Indigo Bunting	*Passerina cyanea*
Lazuli Bunting*	*Passerina amoena*
Blackbirds and Orioles	
Red-winged Blackbird*	*Agelaius phoeniceus*
Western Meadowlark*	*Surnella neglecta*
Yellow-headed Blackbird*	Xanthocephalus xanthocephalus
Brewer's Blackbird*	*Euphagus cyanocephalus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird*	*Molothrus ater*

Common Name	Scientific Name
Bullock's Oriole*	*Icterus galbula*
Scott's Oriole	*Icterus parisorum*
Finches	
Gray-crowned Finch	*Leucosticte tephrocotis*
Black Rosy-finch	*Leucosticte atrata*
Cassin's Finch	*Carpodacus cassinii*
House Finch	*Carpodacus mexicanus*
Pine Siskin	*Carduelis pinus*
Lesser Goldfinch	*Carduelis psaltria*
American Goldfinch*	*Carduelis tristis*
Evening Grosbeak	*Coccothraustes vespertinus*
Old World Sparrows	
House Sparrow* Introduced	*Passer domesticus*
MAMMALS	
Bears	
Black Bear	*Ursus americanus*
Raccoons	
Raccoon	*Procyon lotor*
Otters, Badgers, and Weasels	
Northern River Otter	*Lutra canadensis*
American Badger	*Taxidea taxus*
Short-tailed Weasel	*Mustela ermine*
Long-tailed Weasel	*Mustela frenata*
Skunks	
Western Spotted Skunk	*Spilogale gracilis*
Striped Skunk	*Mephitis mephitis*
Dogs and Foxes	
Coyote	*Canis latrans*
Red Fox	*Vulpes vulpes*
Kit Fox	*Vulpes macrotis*
Common Gray Fox	*Urocyon cinereoargenteus*
Cats	
Mountain Lion	*Felis concolor*
Bobcat	*Lynx rufus*
Squirrels	
Yellow-bellied Marmot	*Marmota flaviventris*
White-tailed Prairie Dog	*Cynomys leucurus*
White-tailed Antelope Squirrel	*Ammospermophilus leucurus*
Least Chipmunk	*Tamias minimus*
Rock Squirrel	*Spermophilus variegatus*

Common Name	Scientific Name
Kangaroo Rats	
Ord's Kangaroo Rat	*Dipodimys ordii*
Plains Pocket Mouse	*Perognathus flavescens*
Great Basin Pocket Mouse	*Perognathus parvus*
Beaver	
American Beaver	*Castor Canadensis*
Mice	
Deer Mouse	*Peromyscus maniculatis*
White-footed Mouse	*Peromyscus leucopus*
Western Harvest Mouse	*Reithrodontomys megalotis*
Brush Mouse	*Peromyscus boylii*
Canyon Mouse	*Peromyscus crinitus*
Northern Grasshopper Mouse	*Onychomys leucogaster*
Bushy-tailed Woodrat	*Neotoma cinerea*
Sagebrush Vole	*Lemmiscus curtatus*
Common Muskrat	*Ondatra zibethicus*
Jumping Mice	
Western Jumping Mouse	*Zapus Princeps*
Porcupine	
Porcupine	*Erithizon dorsatum*
Hares and Rabbits	
White-tailed Jackrabbit	*Lepus townsendii*
Black-tailed Jackrabbit	*Lepus californicus*
Desert Cottontail	*Sylvilagus audubonii*
Shrews	
Merriam's Shrew	*Sorrex merriami*
Vesper Bats	
California Myotis	*Myotis californicus*
Western Small-footed Myotis	*Myotis ciliolabrum*
Long-eared Myotis	*Myotis evotis*
Little Brown Myotis	*Myotis lucifugus*
Fringed Myotis	*Myotis thysanodes*
Long-legged Myotis	*Myotis volans*
Yuma Myotis	*Myotis yumanensis*
Hoary Bat	*Lasiurus cinereus*
Silver-haired Bat	*Lasionycteris noctivagans*
Western Pipistrelle	*Parastrellus hesperus*
Big Brown Bat	*Eptesicus fuscus*
Spotted Bat	*Euderma maculatum*
Townsend's Big-eared Bat	*Corynorhinus townsendii*

Common Name	Scientific Name
Pallid Bat	*Antrozous pallidus*
Free-tailed Bats	
Brazilian Free-tailed Bat	*Tadarida Brasiliensis*
Big Free-tailed Bat	*Nyctimops macrotis*
Deer	
American Elk	*Cervus elaphus*
Mule Deer	*Odocoileus hemionus*
Moose	*Alces alces*
Pronghorn	
Pronghorn	*Antilocapra Americana*
REPTILES & AMPHIBIANS	
Spiny Lizards	
Eastern Fence Lizard	*Sceloporous undulates*
Side-blotched Lizard	*Uta stansburiana*
Short-horned Lizard	*Phrynosoma douglassii*
Northern Plateau Lizard	*Sceloporus tristichus*
Western Fence Lizard	*Sceloporus occidentalis*
Tree Lizard	*Urosaurus ornatus*
Collared Lizards	
Long-nosed Leopard Lizard	*Gambelia wislizenii*
Small-spotted Leopard Lizard	*Crotaphytus wislizeni punctatus*
Common Collared Lizard	*Crotaphytus collaris*
Pit Vipers	
Midget Faded Rattlesnake	*Crotalus oreganus concolor*
Whiptail	
Western Whiptail	*Cnemidophorus tigris*
Garter	
Wandering Garter Snake	*Thamnophis elegans vagrans*
Racers	
Yellow-bellied Racer	*Coluber constrictor*
Smooth Green Snake	*Opheodrys vernalis*
Great Basin Gopher Snake	*Pituophis melanoleucus*
Striped Whipsnake	*Masticophis taeniatus*
Great Plains Rat Snake	*Elaphe emoryi*
Utah Milk Snake	*Lampropeltis triangulum taylori*
Wandering Garter Snake	*Thamnophis elegans vagrans*
Black-necked Garter Snake	*Thamnophis cyrtopsis*
Night Snake	*Hypsiglena torquata*
True Toads	
Western Toad	*Bufo Boreas*

Common Name	Scientific Name
Tree Frogs	
Boreal Chorus Frog	*Pseudacris triseriata maculate*
Woodhouse's Toad	*Bufo woodhousei*
True Frogs	
Northern Leopard Frog	*Rana pipiens*
Spadefoot Toads	
Great Basin Spadefoot	*Spea intermontana*
Mole Salamanders	
Western Toad	*Ambystoma tigrinum*
FISH	
Trout	
Rainbow Trout*	*Oncorhynchus mykiss*
Brown Trout*	*Salmo trutta*
Pike	
Northern Pike*	*Esox Lucius*
Carp and Minnows	
Common Carp*	*Cyprinus carpio*
Utah Chub*	*Gila atraria*
Roundtail Chub	*Gila robusta*
Bonytail	*Gila elegans*
Humpback Chub	*Gila cypha*
Sand Shiner*	*Notropis stramineus*
Fathead Minnow*	*Pimephales promelas*
Colorado Pikeminnow	*Ptychocheilus lucius*
Speckled Dace	*Rhinichthys osculus*
Redside Shiner*	*Richardsonius balteatus*
Red Shiner*	*Notropis lutrensis*
Grass Carp*	*Ctenopharyngodon idella*
Suckers	
White Sucker*	*Catostomus commersoni*
Bluehead Sucker	*Catostomus discobolus*
Flannelmouth Sucker	*Catostomus latipinnis*
Razorback Sucker	*Xyrauchen texanus*
Bullhead Catfishes	
Black Bullhead*	*Ictalurus melas*
Channel Catfish*	*Ictalurus punctatus*
Sunfishes	
Green Sunfish*	*Lepomis cyanellus*
Bluegill*	*Lepomis macrochirus*
Smallmouth Bass*	*Micropterus dolomieui*

Common Name	Scientific Name
Black Crappie*	*Pomoxis nigromaculatus*
Perches	
Yellow Perch*	*Perca flavescens*
Walleye	*Stizostedion vitreum vitreum*
Sculpins	
Mottled Sculpin	*Cottus bairdi*
Sticklebacks	
Brook stickleback	*Culaea inconstans*
PLANTS	
Grasses	
Crested Wheatgrass	*Agropyron cristatum*
Western Wheatgrass	*Agropyron smithii*
Slender Wheatgrass	*Agropyron trachycaulum*
Creeping Bentgrass	*Agrostis stolonifera*
Purple Three-awn	*Aristida purpurea*
American Sloughgrass	*Beckmannia syzigachne*
Cheatgrass	*Bromus tectorum*
Inland Saltgrass	*Distichlis spicata*
Barnyard Grass	*Echinochloa crusgalli*
Nodding Wildrye	*Elymus canadensis*
Low Creeping Wildrye	*Elymus simplex*
Sixweeks Fescue	*Festuca octoflora*
Galleta	*Hilaria jamesii*
Foxtail Barley	*Hordeum jubatum*
Scratchgrass	*Muhlenbergia asperifolia*
Indian Ricegrass	*Oryzopsis hymenoides*
Old Witchgrass	*Panicum capillare*
Common Reed	*Phragmites australis*
Sandberg Bluegrass	*Poa secunda*
Rabbitfoot Grass	*Polypogon monspeliensis*
Squirreltail	*Sitanion hystrix*
Alkali Sacaton	*Sporobolus airoides*
Sand Dropseed	*Sporobolus cryptandrus*
Needle-and-Thread Grass	*Stipa comata*
Forbs and Weeds	
Lowland Purslane	*Sesuvium sessile*
Redroot Amaranth	*Amaranthus retroflexus*
Springparsley	*Cymopterus acaulis*
Onion Springparsley	*Cymopterus bulbosus*
Uinta Basin Springparsley	*Cymopterus duchesnensis*

Common Name	Scientific Name
Purple Springparsley	*Cymopterus purpurascens*
Hemp Dogbane	*Apocynum cannabinum*
Pallid Milkweed	*Asclepias cryptoceras*
Labriform Milkweed	*Asclepias labriformis*
Showy Milkweed	*Asclepias speciosa*
Bur Ragweed	*Ambrosia tomentosa*
Leafy Aster	*Aster frondosus*
Nodding Beggarticks	*Bidens cernua*
Russian Knapweed	*Centaurea repens*
Douglas Chaenactis	*Chaenactis douglasii*
False Yarrow	*Chaenactis stevioides*
Creeping Thistle	*Cirsium arvense*
Bull Thistle	*Cirsium vulgare*
Dandelion Hawksbeard	*Crepis runcinata glauca*
Enceliopis	*Enceliopsis nutans*
Fleabane	*Erigeron bellidiastrum typicus*
Low Fleabane	*Erigeron pumilus*
Lowland Cudweed	*Gnaphalium palustre*
Curlycup Gumweed	*Grindelia squarrosa*
Broom Snakeweed	*Gutierrezia sarothrae*
Orange Sneezeweed	*Helenium autumnale*
Wild Sunflower	*Helianthus annuus*
Sunflower	*Helianthus petiolaris*
Showy Goldeneye	*Heliomeris multiflora*
Fineleaf Hymenopappus	*Hymenopappus filifolius luteus*
Poverty Sumpweed	*Iva axillaris*
Chicory Lettuce	*Lactuca tatarica*
Heath Aster	*Leucelene ericoides*
Skeleton Plant	*Lygodesmia grandiflora*
Purple Aster	*Machaeranthera canescens*
Discoid Tansyaster	*Machaeranthera grindelioides*
Desert Dandelion	*Malacothrix sonchoide*
	Platyschkuhria integrifolia
	Prenanthella exigua
Canada Goldenrod	*Solidago canadensis*
Missouri Goldenrod	*Solidago missouriensis*
Western Goldenrod	*Solidago occidentalis*
Field Sowthistle	*Sonchus arvensis*
Prickly Sowthistle	*Sonchus asper*
Wirelettuce	*Stephanomeria paucifloria*

Common Name	Scientific Name
Wirelettuce	*Stephanomeria runcinata*
Nuttall Horsebrush	*Tetradymia nuttallii*
Cottonthorn Horsebrush	*Tetradymia spinosa*
Towndsendia	*Townsendia grandiflora*
Towndsendia	*Townsendia incana*
Yellow Salsify	*Tragopogon dubius*
Rough Cocklebur	*Xanthium strumarium*
Desert Daisy	*Xylorhiza venusta*
Cryptantha	*Cryptantha ambigua*
Yellow Cryptantha	*Cryptantha flava*
Cryptantha	*Cryptantha paradoxa*
Desert Stickseed	*Lappula redowskii*
Persoon	*Tiquilia nuttallii*
Beauty Rockcress	*Arabis pulchra*
Rough Wallflower	*Erysimum asperum*
Prairie Pepperweed	*Lepidium densiflorum*
Giant Whitetop	*Lepidium latifolium*
Mountain Pepperweed	*Lepidium montanum*
African Mustard	*Malcolmia africana*
Common Twinpod	*Physaria acutifolia*
Blunt-leaf Yellowcress	*Rorippa curvipes*
Marsh Yellowcress	*Rorippa islandica*
Cress	*Rorippa lyrata*
Flaxleafed Plainsmustard	*Schoencrambe linifolia*
Tall Tumble Mustard	*Sisymbrium altissimum*
	Thelypodiopsis elegans
Yellow Bee-plant	*Cleome lutea*
Rocky Mountain Bee-plant	*Cleome serrulata*
Fendler Sandwort	*Arenaria fendleri eastwoodiae*
	Chenopodium atrovirens
Fremont Goosefoot	*Chenopodium fremontii*
Oakleaf Goosefoot	*Chenopodium glaucum*
Green Molly	*Kochia americana*
Kochia Weed	*Kochia scoparia*
Povertyweed	*Monolepis nuttalliana*
Russian Thistle	*Salsola iberica*
Halogeton	*Halogeton glomeratus*
Field Bindweed	*Convolvulus arvensis*
Dodder	*Cuscuta spp.*
Spurge	*Euphorbia albomarginata*

Common Name	Scientific Name
Fendler Euphorbia	*Euphorbia fendleri*
Locoweed	*Astragalus amphioxys*
Cicada Milkvetch	*Astragalus chamaeleuce*
Lesser Rushy Milkvetch	*Astragalus convallarius*
Duchesne Milkvetch	*Astragalus duchesnensis*
Yellow Milkvetch	*Astragalus flavus*
Geyer Milkvetch	*Astragalus geyeri*
	Astragalus hamiltonii
Woolly Locoweed	*Astragalus mollissimus*
Draba Milkvetch	*Astragalus spatulatus*
American Wild Licorice	*Glycyrrhiza lepidota*
Dwarf Lupine	*Lupinus pusillus*
Yellow Sweetclover	*Melilotus officinalis*
Silvery Sophora	*Sophora stenophylla*
Tall Centaury	*Mentaurium exaltatum*
	Nama densum
Scorpionweed	*Phacelia crenulata*
Scorpionweed	*Phacelia ivesiana*
Geyer Onion	*Allium geyeri*
Wild Onion	*Allium textile*
Asparagus	*Asparagus officinalis*
Sego Lily	*Calochortus nuttallii*
False Solomon's Seal	*Smilacina stellata*
Whitestem Mentzelia	*Mentzelia albicaulis*
Brushy Mentzelia	*Mentzelia dispersa*
Wingseed Mentzelia	*Mentzelia pterosperma*
Purple Ammannia	*Ammannia robusta*
Alkali-mallow	*Malvella leprosa*
Scarlet Globemallow	*Sphaeralcea coccinea*
Nelson Globemallow	*Sphaeralcea parvifolia*
Sandverbena	*Abronia elliptica*
Narrowleaf Umbrellawort	*Mirabilis linearis*
	Tripterocalyx micranthus
Barestem Camissonia	*Camissonia scapoidea*
Small-flowered Gaura	*Gaura parviflora*
Tufted Evening-primrose	*Oenothera caespitosa*
Evening-primrose	*Oenothera elata*
Pale Evening-primrose	*Oenothera pallida*
Plantain	*Plantago asiatica*
Broadleaf Plantain	*Plantago major*

Common Name	Scientific Name
Woolly Plantain	*Plantago patagonica*
Ballhead Gilia	*Gilia congesta*
Gilia	*Gilia congesta*
Gilia	*Gilia polycladon*
Dwarf Gilia	*Gilia pumila*
Common Prickly Phlox	*Lepodactylon pungens*
Hood Phlox	*Phlox hoodii*
Wild Sweet William	*Phlox longifolia*
	Eriogonum batemanii
	Nodding Eriogonum
	Eriogonum cernuum
Big Wild Buckwheat	*Eriogonum corymbosum*
	Eriogonum flexum
Gordon's Umbrella Plant	*Eriogonum gordonii*
	Eriogonum hookeri
Desert Trumpet Eriogonum	*Eriogonum inflatum*
Slenderbush Eriogonum	*Eriogonum microthecum*
	Eriogonum salsuginosum
Shockley Wild Buckwheat	*Eriogonum shockleyi*
Green Eriogonum	*Eriogonum viridulum*
Western Virgin-bower	*Clematis ligusticifolia*
Nuttall Larkspur	*Delphinium nuttallianum*
Biennial Cinquefoil	*Potentilla biennis*
Brook Cinquefoil	*Potentilla rivalis*
Desert Paintbrush	*Castilleja chromosa*
Marsh Paintbrush	*Castilleja exilis*
Black Nightshade	*Solanum nigrum*
Prostrate Verbena	*Verbena bracteata*
Aquatic and Wetland Plants	
Narrowleaf Water-plantain	*Alisma gramineum*
Bur-head	*Echinodorus berteroi*
Upright Burhead	*Echinodorus rostratus*
Arrowhead	*Sagittaria cuneata*
Salt Heliotrope	*Heliotropium curassavicum*
Saltmarsh Sandspurry	*Spergularia marina*
	Chara spp
Awned Flatsedge	*Cyperus aristatus*
Needle Spikerush	*Eleocharis acicularis*
Common Spikerush	*Eleocharis palustris*
Dwarf Spikerush	*Eleocharis parvula*

Common Name	Scientific Name
Hardstem Bulrush	*Scirpus acutus*
Alkali Bulrush	*Scirpus maritimus*
Bulrush	*Scirpus saximontanus*
Softstem Bulrush	*Scirpus validus*
Smooth Scouring-rush	*Equisetum laevigatum*
Alpine Rush	*Juncus alpinus*
Wiregrass	*Juncus arcticus*
Toad Rush	*Juncus bufonius*
Torrey Rush	*Juncus torreyi*
Marsh Hedgenettle	*Stachys palustris pilosa*
Water Smartweed	*Polygonum amphibium*
Dooryard-grass	*Polygonum aviculare*
Pale Smartweed	*Polygonum lapathifolium*
Curly Dock	*Rumex crispus*
Canaigre	*Rumex hymenosepalus*
Golden Dock	*Rumex maritimus*
Bitter Dock	*Rumex obtusifolius*
Western Dock	*Rumex occidentalis*
Longleaf Pondweed x	*Rumex occidentalis*
Sago Pondweed	*Potamogeton pectinatus*
Hairleaf Water-buttercup	*Ranunculus aquatilis*
Rocky Mtn. Buttercup	*Ranunculus cymbalaria*
Pennsylvania Buttercup	*Ranunculus pennsylvanicus*
Meadowrue	*Thalictrum spp*
Hedge Hyssop	*Gratiola neglecta*
Mudwort	*Limosella aquatica*
Water Speedwell	*Veronica anagallis-aquatica*
Common Cattail	*Typha latifolia*
Fogfruit	*Phyla cuneifolia*
Woody Plants	
Squaw Bush	*Rhus trilobata*
Biennial Wormwood	*Artemisia biennis*
Tarragon	*Artemisia dracunculus*
Prairie Sage	*Artemisia ludoviciana var. ludoviciana*
Black Sagebrush	*Artemisia nova*
Bud Sagebrush	*Artemisia spinescens*
Big Sagebrush	*Artemisia tridentata*
Mohave Brickellbush	*Brickellia oblongifolia*
Rubber Rabbitbrush	*Chrysothamnus nauseosus*
Low Rabbitbrush	*Chrysothamnus viscidiflorus*

Common Name	Scientific Name
Silverscale	*Atriplex argentea*
Fourwing Saltbush	*Atriplex canescens*
Shadscale	*Atriplex confertifolia*
Mat Saltbush	*Atriplex corrugata*
Castle Valley Saltbush	*Atriplex gardneri cuneata*
	Atriplex heterosperma
Fivehook Bassia	*Bassia hyssopifolia*
Winterfat	*Ceratoides lanata*
Spiny Hopsage	*Grayia spinosa*
Black Greasewood	*Sarcobatus vermiculatus*
Russian-olive	*Elaeagnus angustifolia*
Silver Buffaloberry	*Shepherdia argentea*
Torrey Mormon Tea	*Ephedra torreyana*
Woods Rose	*Rosa woodsii*
Fremont Cottonwood	*Populus fremontii*
Peach-leaf Willow	*Salix amygdaloides*
Narrow-leaf Willow	*Salix exigua*
Whiplash Willow	*Salix lasiandra*
Tamarisk	*Tamarix ramosissima*
Cacti	
Ball Cactus	*Coryphantha vivipara*
Plains Pricklypear	*Opuntia polyacantha*
Uinta Basin Hookless Cactus	*Sclerocactus glaucus*

APPENDIX D

Special Status Plant Survey Reports

SPECIAL STATUS PLANT SURVEY REPORT:

THURSTON ENERGY LLC'S PROPOSED OURAY NATIONAL WILDLIFE REFUGE 2-WELL DEVELOPMENT PROGRAM

Prepared for

Thurston Energy LLC
P. O. Box 749
Vernal, Utah 84078
&

U.S. Department of Interior
Fish & Wildlife Service
Ecological Services Field Office
Vernal, UT 84078

Ouray National Wildlife Refuge
HC 69 Box 84063
Randlett, Utah 84063

Prepared by

KLEINFELDER
Bright People. Right Solutions.

Survey Dates: June 11-14, 2012; April 1-3, 2013; and November 4, 2013
Report Date: November 18, 2013 (Revised February 5, 2014)
Report Number: KLF-13-034

Survey Crew Leader: Chad Incorvia (cincorvia@kleinfelder.com)
Project Leader: Louis Bridges (lbridges@kleinfelder.com)

Introduction

This report has been prepared by Kleinfelder at the request of Thurston Energy, LLC., (Thurston). The purpose of this report is to document the results of a protocol-level clearance survey conducted for the federally-listed Pariette cactus (*Sclerocactus brevispinus*) and Uinta Basin hookless cactus (*S. wetlandicus*) which have the potential to occur within the Project Area. Information contained in this report will be used in obtaining the necessary regulatory agency approvals for project implementation.

Proposed Development

Thurston proposes to install two well pads and their associated pipeline, access roads, and electrical lines within the Ouray National Wildlife Refuge (NWR) (**Table 1** & **Appendix A**). The proposed project is located approximately 32 miles southeast of Vernal, Utah, on Federal lands administered by the United States Fish and Wildlife Service (USFWS). The proposed development would initially disturb 14.4 acres of soils and vegetation; however, interim reclamation would reduce the overall disturbance to 10 acres for the production phase of the development until final reclamation is completed. The proposed disturbance occurs within USFWS designated potential habitat for *Sclerocactus* species and therefore requires a clearance level survey.

Table 1 – Proposed Surface Facilities and Project Disturbance

Project Feature	Quantity or Feet	Short-term (disturbance width[feet] or acres/facility)	Short-term Surface Disturbance (acres)	Long-term (disturbance width[feet] or acres/facility)	Long-term Surface Disturbance (acres)
Well Pads					
Thurston 11-31-7-21	1	1.6 acres	1.6	1.2 acres	1.2
Thurston 12-31-7-21	1	1.6 acres	1.6	1.2 acres	1.2
Subtotal	***2***	***3.2 acres***	***3.2***	***2.4 acres***	***2.4***
Access Roads					
New Roads	513.1 feet	36 feet	0.42	36 feet	0.42
Subtotal	***513.1 feet***	***--***	***0.42***	***--***	***0.42***
Pipelines					
3-inch Surface HDPE Gas Pipeline	15,710 feet	30 feet	10.8	20 feet	7.2
Subtotal	***15,710 feet***	***--***	***10.8***	***--***	***7.2***
Power Line					
Overhead Electric Power Lines	9,768 feet	--	--	--	--
Subtotal	***9,768 feet***	***--***	***--***	***--***	***--***
Total	**--**	**--**	**14.4**	**--**	**10.0**

Special Status Plant Background Information

The Uinta Basin hookless cactus was federally listed as threatened under the ESA in 1979. Recently, the Uinta Basin hookless cactus complex has been reclassified into three species, are now recognized separately as the Colorado hookless cactus (*Sclerocactus glaucus*), Pariette cactus (*S. brevispinus*), and Uinta Basin hookless cactus (*S. wetlandicus*). Of these three species, *S. brevispinus* has the potential to occur in the Project Area.

In the spring of 2009, the Spanish bayonet (*Yucca sterlis*) was one of 26 taxa identified as "extremely high" priority by the Utah Native Plant Society. The Spanish bayonet is not federally listed, but the Bureau of Land Management (BLM) requests any sightings of the plant be reported. No other protected or species of interest are likely to occur in the Project Area.

Pariette Cactus

According to current studies and data available on the Pariette cactus, there is a potential geographical limit for the growth of this species. The Pariette cactus is known to occur in small scattered populations in badlands near Myton, Utah, occupying an area approximately 10 miles long and three miles wide astride the Duchesne and Uintah County line. Currently, the majority of the Pariette cactus habitat is contained within the Pariette Wetlands Area of Critical Environmental Concern (ACEC) (UES 2010).

The Pariette cactus grows in fine clay soils derived from the Uinta Formation. An important indicator of suitable Pariette cactus habitat is the presence of desert pavement, which is typically a thin layer of centimeter-thick rock fragments set on top of a layer of finer material. Associated vegetation include shadscale (*Atriplex confertifolia*), globemallow (*Sphaeralcea spp.*), snakeweed (*Gutierrezia sarothrae*), desert parsley horsebrush (*Tetradymia canescens*), bud sagebrush (*Artemisia spinescens)*, and Mormon tea (*Ephedra spp.*). The Pariette cactus can vary in size from a dime-diameter to slightly larger than a baseball.

Uinta Basin Hookless Cactus

Information on the habitat requirements and distribution of this species has been rapidly changing as more studies and surveys are conducted in the Uinta Basin. Currently, it is known to occur on Quaternary and Tertiary alluvium soils overlain with cobbles and pebbles of the Duchesne River, Green River, and Mancos Formations between 4,500 and 6,600 feet above mean seal level (amsl) (BLM 2008; UNPS 2006). It is found on the gravelly hills and terraces on river benches, valley slopes, and rolling hills along the Green, White, and Duchesne rivers. Preferred habitat is generally associated with Pleistocene outwash terraces with coarse-textured, alkaline soils overlain by a surficial pavement of large, smooth, rounded cobble. It can be found in a range of vegetative communities including clay badlands, salt desert shrub, and pinyon-juniper.

This species often grows to a larger size than the Pariette cactus, potentially reaching football size individuals. Additionally, the central spine of the Uinta Basin hookless cactus is generally

much larger than that found in the Pariette cactus, which can be used as an identifying factor in the field.

Spanish Bayonet

Spanish bayonet *(Yucca sterilis)* is a perennial shrub/subshrub in the *Agavaceae* family. The species is a BLM sensitive plant species, and is also known as a rhizomatous variant of the *Yucca harrimaniae*, which is also commonly known as Spanish bayonet. *Y. sterilis* has been collected while in flower, but is not known to produce fruit. *Y. sterilis* grows in the lower elevations of Duchesne and Uintah Counties in salt and mixed desert shrub vegetation communities. The species is known to occur in in areas near the Ouray NWR.

Survey Methodology and Results

Survey Methodology

During June 11-14, 2012 Kleinfelder conducted *Sclerocactus* clearance surveys for both well pads and the initial access road and pipeline alignment that was proposed by Thurston. Additional, cactus surveys were conducted in April of 2013 to address changes in the pipeline alignment in order to mitigate potential cactus conflicts. The April 2013 survey identified several *Sclerocactus spp.* within the current survey buffer; these individuals are shown in **Appendix A**.

An additional clearance survey was conducted on November 4, 2013 and was designed to identify if the and *Sclerocactus* occur within the new proposed pipeline route identified in **Appendix A**.

The survey completed on November 4, 2013 incudes the sections of surface pipeline located in Sections 1 and 2 of Township 8 South, Range 20 East, and did not include the well pads and access roads that were subject to a clearance survey in June of 2012. Should construction of these facilities occur prior to June 14th of 2016, the USFWS would require a spot check survey.

The November 4, 2013 survey was conducted according to the *Sclerocactus* survey protocol, as distributed during the March 2013 US Fish and Wildlife Service (USFWS) and BLM rare plant webinar. The survey locations fall inside the 2013 *Sclerocactus* Suitable Habitat Boundary (also supplied by the USFWS and BLM during the rare plant workshop). The clearance surveys were conducted with 100-percent visual coverage. The survey was conducted by a crew of 8-10 individuals walking parallel transects spaced approximately three feet apart within the survey buffer. The locations of all transect lines and any cacti encountered were mapped using a Trimble Juno SB Model GPS (1-3 meter accuracy). The surveys were conducted out to 300 feet from the edge of disturbance, where possible. Areas containing unsuitable habitat for *Sclerocactus spp.* was not surveyed (**Appendix B**).

All survey personnel were trained prior to the start of the 2013 *Sclerocactus* survey season, and were fully knowledgeable of the established protocols and expectations. Surveyors gained a visual representation of *Sclerocactus* by visiting known populations and discussing identification techniques and habitat evaluations.

In conjunction with the *Sclerocactus* survey and using the same methodologies, Kleinfelder also surveyed for the presence of *Y. sterilis* at the request of the Vernal, UT BLM office.

Survey Results

The November 4, 2013 survey identified two new *Sclerocactus spp.* populations on a bluff near the cross country portion of the pipeline route (**Appendix A**). No *Y. sterilis* were identified. Some areas along the cross country pipeline route were not surveyed out to 50 feet as unsuitable habitat was present. However, a 10 foot corridor was surveyed where the hand laid 3" HDPE gas pipeline would be placed within the unsuitable habitat to verify the presence or absence of any potential sensitive cactus.

Unsuitable habitat either contained extremely fine sediment and steep grades, or did not contain cobble and gravel surfaces and lacked sufficient vegetative cover. Following the initial surveys Kleinfelder, Thurston, and the USFWS have coordinated a route and developed a set of best management practices that would allow a pipeline to traverse between the two identified *Sclerocactus* populations with minimal impacts to the habitat. The pipeline within this area will be approximately 87 feet from the nearest cacti; however, the pipeline will be hand laid on the surface to minimize habitat loss and surface disturbance and will be subgrade to the cactus communities to reduce indirect impacts such as erosion, sedimentation, and potential for spills of hazardous materials.

As two populations of *Sclerocactus wetlandicus* were identified near the 50 foot survey buffer for the hand laid cross country 3"-HDPE gas pipeline, an Intra-service Section 7 consultation will be required. No surface disturbance activities (i.e. trenching or grading) are located within 300 feet of a *Scelerocactus spp.* under the proposed action. Should any ground disturbing activities occur, a 300 foot buffer between the disturbance and any occupied *Sclerocactus* habitat would be required. In an effort to minimize impacts to *Sclerocactus* species the USFWS recommends the following conservation measures:

- Reduce cross-country impacts by collocating surface pipelines with existing roads.
- Provide detailed drawings for the above ground cross-country pipeline.
- Coordinate with the USFWS to reduce installation disturbances for the cross-country pipeline.
- Stabilize of all surface pipelines.
- Flag identified *Sclerocactus* immediately prior to the start of construction. Flagging will be removed immediately following the completion of construction in order to minimize the opportunity of theft.
    - A qualified botanist will be required to monitor activity during construction.
- Implement erosion and water flow control measures.
- Annual monitoring and reporting on the status of *Sclerocactus* populations within the construction buffers.

Additional conservation measures may be required at the discretion of the USFWS.

Conclusion

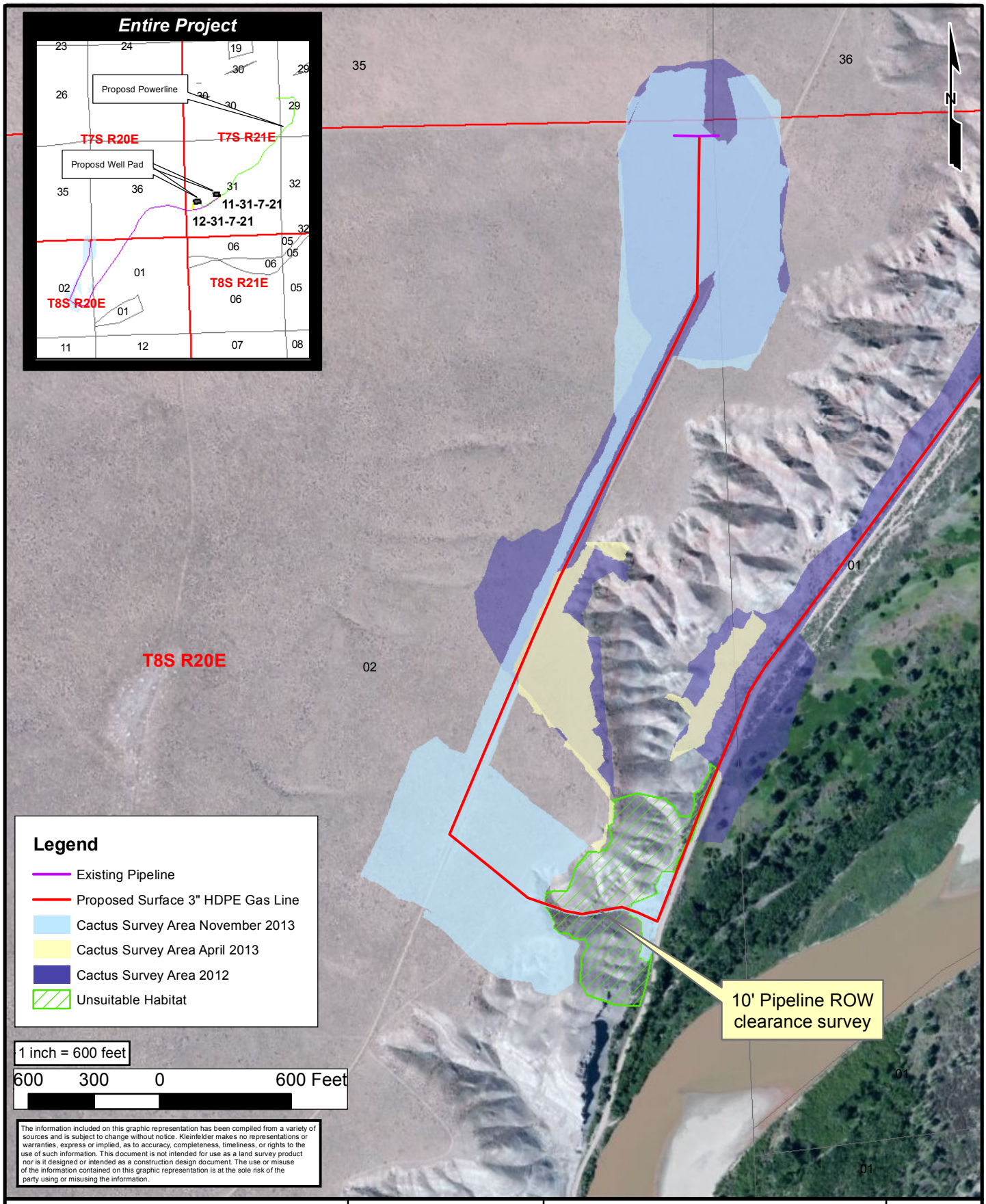
In accordance with existing USFWS *Sclerocactus* survey protocol, 100-percent clearance surveys are valid for 1-year. All construction activities beginning between 1-4 years after the initial 100-percent clearance survey would require a less intensive spot-check survey prior to ground disturbing activities. Any construction activity occurring between November 4, 2014 and November 4, 2017, would require a spot check survey by a qualified biologist(s) prior to any surface disturbance. A 100 percent clearance survey would be required after November 4, 2017 for any additional construction. This survey does not account for the well pads and access roads that were subject to a clearance survey in June of 2012. Should construction of these facilities occur prior to June 14th of 2016, the USFWS would require a spot check survey before any ground disturbing activities begin.

Limitations

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services were provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data as agreed upon in the scope of services. It is possible that field conditions could vary in the future and results may not be fully repeatable. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of services provided.

This report may be used only by Thurston and designated agencies, and only for the purposes stated for this specific engagement within a reasonable and acceptable time from its issuance.

APPENDIX A
FIGURES



KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	126694
DRAWN:	2/6/2014
DRAWN BY:	L.Hockert
CHECKED BY:	L.Bridges
FILE NAME:	CactusReport_wPoints.mxd

Thurston Energy

Proposed Ouray National Wildlife Refuge
2-Well Development Program
Cactus Survey
Sec. 1 & 2, T8S, R20E
Uintah County, Utah

FIGURE
1

APPENDIX B
PHOTOLOG

A. Facing North

B. Facing East

C. Facing South

D. Facing West

E.

F.

KLEINFELDER
Bright People. Right Solutions.

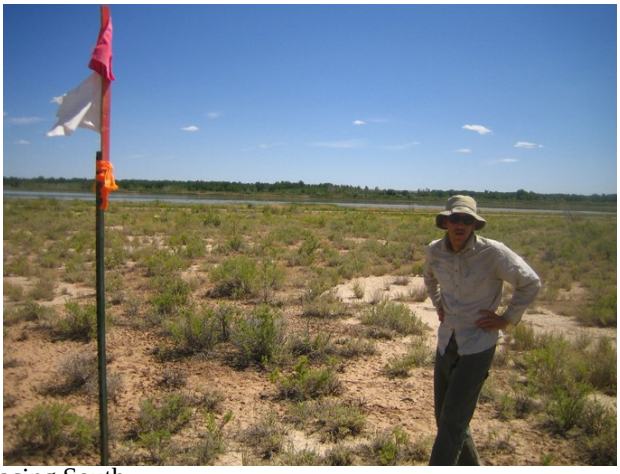
SITE PHOTOGRAPHS
Proposed Well 12-31-7-21
April 1, 2013

PN# 126694

Appendix B

A. Facing North

B. Facing East



C. Facing South

D. Facing West

E.

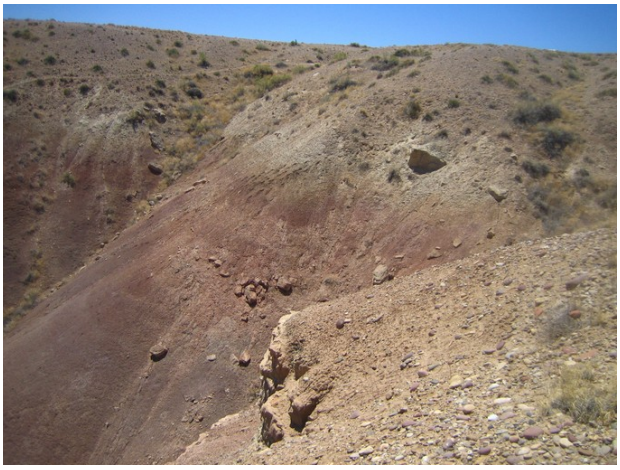
F.

KLEINFELDER
Bright People. Right Solutions.

SITE PHOTOGRAPHS
Proposed Well 11-31-7-21
April 1, 2013

PN# 126694

Appendix B



A. Unsuitable Habitat

B. Unsuitable Habitat

C. Unsuitable Habitat

D. Unsuitable Habitat

E.

F.

KLEINFELDER
Bright People. Right Solutions.

SITE PHOTOGRAPHS
Unsuitable Habitat
April 1, 2013

PN# 126694

Appendix B

UINTA BASIN HOOKLESS CACTUS SECONDARY SURVEY REPORT FOR THURSTON ENERGY'S OURAY NATIONAL WILDLIFE REFUGE 4-WELL DEVELOPMENT PROJECT:

Prepared for

Thurston Energy LLC.
P. O. Box 749
Vernal, Utah 84078

and

U.S. Fish and Wildlife Service
Ecological Services Field Office
Vernal, UT 84078

Prepared by

KLEINFELDER
Bright People. Right Solutions.

Survey Dates: June 11-14, 2012 & April 1, 3, 2013
Report Date: May 13, 2013
Report Number: KLF-13-011

Survey Crew Leader: Chad Incorvia (cincorvia@kleinfelder.com)
Project Leader: Scott Florin (sflorin@kleinfelder.com)

DRAFT

1.0 Introduction

This report has been prepared by Kleinfelder at the request of Thurston Energy (Thurston). The purpose of this report is to document the results of U.S. Fish and Wildlife Service (USFWS) mandated procedural clearance surveys for the federally-listed plant species known as the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) which has the potential to occur within the Project Area. Information contained in this report will be used in obtaining the necessary regulatory agency approvals for project implementation and also in the preparation of a Biological Resources section of an Environmental Assessment (EA) that will be prepared for the Project in accordance with National Environmental Policy Act (NEPA) requirements.

1.1 Background

Clearance surveys were conducted by Kleinfelder on June 11, 12, 13 and 14, 2012, for the proposed development area (**Figure 1**). Areas within the survey buffer were initially cleared of *Sclerocactus*; however, a follow up investigation identified several overlooked *Sclerocactus* populations. At the request of the USFWS, a second clearance survey was initiated over portions of the proposed pipeline.

1.2 Project Location and Description

Thurston proposes activities necessary to drill, complete, and produce four oil wells on the Ouray National Wildlife Refuge (NWR) in Uintah County, Utah. The proposed Project is located approximately 32 miles southeast of Vernal, Utah, on Federal lands administered by the USFWS.

Specifically, Thurston's Proposed Action includes the following primary components:

- Construction of four well pads, each averaging approximately 2.1 acres in size;
- Construction of approximately 581 feet of new access road;
- Upgrades to approximately 413 feet of Wildlife Refuge Road and realignment of approximately 0.45 miles (2,366 feet) of Wildlife Refuge Road;
- Installation of up to 3.4 miles (17,948 feet) of co-located surface pipeline and 0.62 miles (3,296 feet) of "cross-country pipeline"; and
- Well testing to evaluate the development potential of the lease.

The proposed wells would be drilled vertically to total depths of approximately 7,000 feet. Although actual operations are subject to change as conditions warrant, Thurston plans to drill the four wells over a period of two years. The anticipated life of an individual well is 30 to 40 years, and the anticipated time needed for field abandonment and final reclamation is three years. Therefore, the anticipated life of the project (LOP) under the SUPO would be between 33 to 43 years.

Included in the Proposed Action are a range of Best Management Practices (BMPs) and Applicant Committed Environmental Protection Measures (ACEPMs) that would be implemented to avoid, minimize, or offset adverse impacts to surface and subsurface resources. The proposed location of the new well pads reflects the results of an onsite visit conducted by Thurston and representatives from the Service on February, 27, 2011. The primary purpose of the onsite inspection was to assess potential resource impacts associated with the construction of the well pads, access roads, and pipeline corridor(s).

Surface disturbance anticipated under the Proposed Action is shown in **Table 1**. Initial surface disturbance would occur during and immediately after the construction, drilling, completion, and testing

DRAFT

activities. Prior to interim reclamation, initial surface disturbance for well pads and access roads would equal approximately 14 acres. Those portions of the well pads and access road ROWs not needed for production operations would be reclaimed within one to two growing seasons. The remaining surface disturbance would be residual or "long-term" disturbance of approximately 7.8 acres for the 33- to 43-year LOP. Residual disturbance from the proposed project equates to approximately 0.2 percent of the total acreage within the Project Area.

Table 1: Estimated Disturbance of Project Facilities Under the Proposed Action

Project Feature	Quantity or Feet	Size (disturbance width [feet] or acres/facility)	Initial (short-term) Surface Disturbance (acres)	Residual (long-term) Surface Disturbance (acres)
Well Pads				
Thurston 12-29-7-21	1	2.0 acres	2.0	1.3
Thurston 11-31-7-21	1	2.4 acres	2.4	1.6
Thurston 13-29-7-21	1	2.1 acres	2.1	1.4
Thurston 12-31-7-21	1	2.3 acres	2.3	1.3
Subtotal	**4**	**8.8 acres**	**8.8**	**5.6**
Access Roads				
New Roads	581 feet	30 feet	0.4	0.4
Realigned Roads	2,366 feet	100 feet	5.6	1.6
Upgraded Roads	413 feet	15 feet	0.2	0.2
Subtotal	**3,360 feet**	--	**6.2**	**2.2**
Surface Pipelines				
Pipelines Co-located with Existing Roads	17,948 feet	--	--	--
"Cross-country" Pipelines	3,296 feet	--	--	--
Subtotal	**21,244 feet**	--	--	--
Total New Disturbance	--	--	**15.0**	**7.8**

2.0 Environmental Background

As previously mentioned, the project study area is located within the Ouray NWR in the northeastern corner of Utah along the Green River, which is part of the Upper Colorado River System and the Colorado Plateau. The Ouray NWR receives less than seven inches of precipitation annually and covers 11,987 acres, including 16 miles of the Green River. Approximately 3,800 acres of the Ouray NWR is leased from the Uintah and Ouray Indian Reservation and the State of Utah. The Ouray NWR includes approximately 19 square miles of bottomlands and river surface in five naturally occurring bottoms along the shallow Green River: Johnson Bottom, Leota Bottom, Wyasket Lake, Sheppard Bottom, and Wood's Bottom. These bottom lands are all fed by the River as it winds through an otherwise arid landscape. With more than 4,000 acres of wetland and riparian habitat, the Ouray NWR is home to a diverse group of birds, mammals, fish, plants, and amphibians and reptiles.

DRAFT

Eight imperiled species including the yellow-billed cuckoo (*Coccyzus americanus*) and several endangered fish such as the bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) also occur on the Ouray NWR. The Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) is a federally threatened species that also occurs within the refuge and is described further below.

2.1 Uinta Basin Hookless Cactus

The Uinta Basin hookless cactus (*S. glaucus*) was listed as threatened under the ESA in 1979. Recently, the Uinta Basin hookless cactus has been reclassified and three species, which were collectively recognized as Uinta Basin hookless cactus during the time of its listing, are now recognized separately; Colorado hookless cactus (*S. glaucus*), Pariette cactus (*S. brevispinus*) and Uinta Basin hookless cactus (*S. wetlandicus*). Of these three species, *S. wetlandicus* and *S. brevispinus* have the potential to occur in the project area.

Information on the habitat requirements and distribution of this species has been rapidly changing as more studies and surveys are conducted in the Uinta Basin. Currently, it is known to occur on Quaternary and Tertiary alluvium soils overlain with cobbles and pebbles of the Duchesne River, Green River, and Mancos Formations between 4,500 to 6,600 feet in elevation (BLM 2008; UNPS 2006). It is found on the gravelly hills and terraces on river benches, valley slopes, and rolling hills along the Green, White, and Duchesne rivers. Preferred habitat is generally associated with Pleistocene outwash terraces with coarse-textured, alkaline soils overlain by a surficial pavement of large, smooth, rounded cobble. It can be found in a range of vegetative communities including clay badlands, salt desert shrub, and pinyon-juniper. Associated species include black sagebrush (*Artemisia nova*), shadscale (*Atriplex confertifolia*), James' galleta (*Pleuraphis jamesii*), and Indian ricegrass (*Achnatherum hymenoides*).

This species often grows to a larger size than the Pariette cactus, potentially reaching football size individuals. Additionally, the central spine of the Uinta Basin hookless cactus is generally much larger than that found in the Pariette cactus, which can be used as an identifying factor in the field.

Within designated potential habitat for the Uinta Basin hookless cactus, the USFWS has proposed core conservation areas and management recommendations in response to the ongoing energy development in the Uinta Basin. The purpose of the proposed core conservation areas and management recommendations is to protect the most important populations or sub-populations, and reduce threats to *Sclerocactus spp*. Two levels of core conservation areas were developed based on pollinator travel distance and habitat connectivity between populations and individuals. The core areas are centered on the densest known areas of *Sclerocactusspp.* within a 400 meter (m) (Level 1) and 1,000 m (Level 2) buffer that was developed using a kernel density analysis performed in GIS.

The distances used to develop core conservation areas were based on travel distances of common bee species that visit individual plants. These bees are in the small and medium size range and travel approximately 400 m to 1,000 m between plants and nests (Tepedino et al. 2010). Level 1 polygons were developed using a 400 m buffer around plants to allow for pollinator travel and include the densest concentrations of cactus locations and the most restrictive management recommendations as proposed by USFWS. Level 2 polygons were developed using a 1,000 m buffer around plants while incorporating less-dense cactus areas and less restrictive management recommendations as proposed by USFWS. It is important to note that at the time this document was developed, these proposed measures are interim management recommendations that have not been finalized or formally adopted as standard mitigation practices by Federal land management agencies including the Bureau of Land Management (BLM) and Bureau of Indian Affairs (BIA).

DRAFT

The total area of potential habitat for *S. wetlandicus* within its range is currently 442,000 acres and includes federal, tribal, state, and private lands. The most recent geographic data for *S. wetlandicus* includes over 18,400 points representing approximately 40,528 individual cacti. The entire Project Area (3,684 acres) is within USFWS designated potential habitat for *S. wetlandicus*. Approximately 1,154 and 380 acres of Level 1 and 2 Core Conservation Areas occur in the Project Area, respectively.

3.0 Survey Methodology

New surveys for Uinta Basin hookless cactus were conducted by Kleinfelder on April 1 & 3, 2013, in accordance with USFWS and BLM survey requirements for *Sclerocactus spp.* (USFWS, 2013). Surveys were conducted only in areas requested by the USFWS for a resurvey.

As stipulated by the USFWS 2013 *Sclerocactus spp*. survey procedure, 100-percent coverage surveys were conducted with 100-percent visual coverage of the project study area. Surveys were conducted by walking parallel transects spaced approximately three feet apart within the disturbance area, including a 300 foot buffer from the edge of all surface disturbance and 80 feet from all pre-existing roads. The locations of all transect lines and cacti encountered were mapped using a Trimble® GPS.

All survey personnel were experienced in the undertaking of field surveys for special-status plant species. In accordance with existing USFWS survey procedures for *Sclerocactus spp.*, 100-percent clearance surveys are valid for 1-year. All construction activities beginning between 1-4 years after the initial 100-percent clearance survey would require a less intensive spot-check survey prior to the initiation of construction

4.0 Survey Results

Several hundred *Sclerocactus spp*. were identified above and below the ridge proposed for a cross-country surface pipeline. Due to the density of the identified cactus, a polygon was drawn around the populations of cactus rather than marking every individual (**Figure 2**).

5.0 Summary

As currently proposed, Section 7 consultation will likely be required where populations of *Sclerocactus wetlandicus* are located within 300 feet of the proposed cross-country edge of the ROW. In an effort to minimize impacts to *Sclerocactus* spp. the USFWS will likely recommend the following conservation measures:

- Reduce cross-country impacts by collocating surface pipelines with existing roads.
- Stabilize of all surface pipelines.
- Flag identified *Sclerocactus spp*. immediately prior to the start of construction. Flagging will be removed immediately following the completion of construction in order to minimize the opportunity of theft.
    - A qualified botanist may be required to monitor activity during construction.
- Implement erosion and water flow control measures.
    - *Sclerocactus spp.* populations located down slope of pipelines may require silt fencing during construction in an effort to prevent sedimentation and/or dust deposition, as well as minimize impacts in the result of a leak or spill. Fencing will be removed immediately following the completion of construction.
- Annual monitoring and reporting on the status of *Sclerocactus spp.* populations within the construction buffers.

DRAFT

Additional conservation measure may be required at the discretion of the USFWS.

6.0 Limitations

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by Thurston and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance.

The work performed was based on project information provided by Thurston. If Thurston does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

DRAFT

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

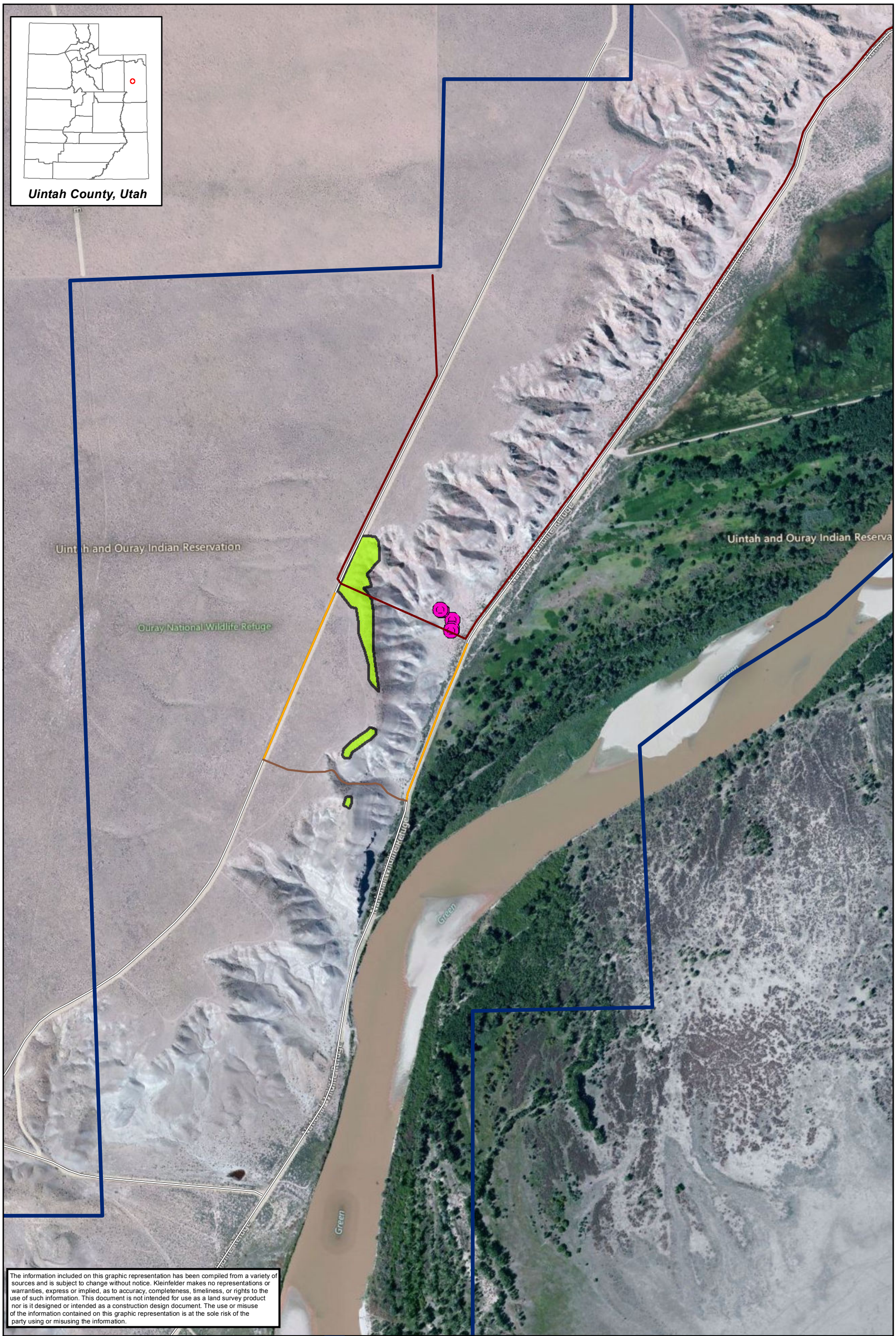
KLEINFELDER
Bright People. Right Solutions.
300 E Mineral Avenue, Suite 7
Littleton, Colorado 80122
o| 303-781-8211
www.kleinfelder.com

PROJECT NO.	126694
DRAWN:	7/5/2012
DRAWN BY:	B. Carlin
CHECKED BY:	S. Florin
FILE NAME:	ThurstonReportMap.mxd

Thurston Energy

Cactus Survey

Figure
1



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

N

- Project Boundary
- Proposed Pad
- Proposed Pipeline
- Co-located Pipeline Extension
- Refuge Preferred Route
- Proposed Access
- Existing Road
- Cactus Locations
- CactusPopulation

PROJECT NO.	126694
DRAWN:	10/11/2013
DRAWN BY:	L.Hockert
CHECKED BY:	L.Bridges
FILE NAME:	Fig2_1ProposedAction.mxd

Thurston Energy

Proposed Action

FIGURE 2

Photo Plates

Photos of Proposed Well 12-31-7-21	
Facing North	Facing East
Facing South	Facing West

Photos of Proposed Well 11-31-7-21

Facing North	Facing East
Facing South	Facing West

Photos of Proposed Well 13-29-7-21

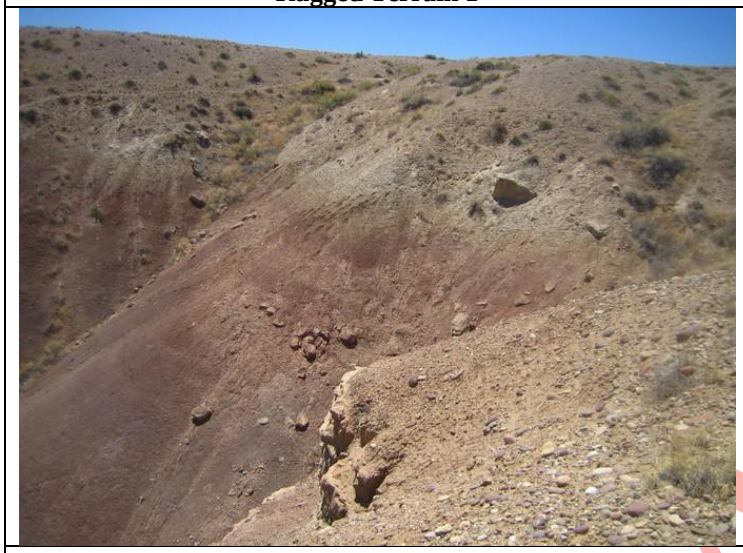
Facing North

Facing East

Facing South

Facing West

Photos of Proposed Well 12-29-7-21	
Facing North	Facing East
Facing South	Facing West

Photos of Areas Not Surveyed	
Rugged Terrain 1	**Rugged Terrain 2**
	
Unsuitable Habitat	**Unsuitable Habitat**

APPENDIX E

Air Quality Emissions Inventory

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

00. Total Project Emissions Summary

Ouray NWR 2-Well EA Annual Emissions Summary (tons/yr)

		Criteria Pollutant Emissions						*Greenhouse Gas Emissions*		
	Source ID	**NO_X**	**CO**	**VOC**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**
Development Emissions	Construction	0.49	0.16	0.04	0.0000024	0.17	0.052	11.35	0.0000087	0.0000029
	Drilling	1.70	0.94	0.35	0.033	0.43	0.09	196.78	0.008	0.0016
	Completion	0.79	0.32	0.12	0.025	0.16	0.062	52.04	0.19	0.0004
	Interim Reclamation	0.0026	0.0029	0.00021	0.0000024	0.11	0.011	0.27	0.0000087	0.0000029
	Wind Erosion	---	---	---	---	0.027	0.0041	---	---	---
	Wellsite Tanks	---	---	8.49	---	---	---	1.23	4.03	---
	Wellsite Truck Loadout	---	---	0.37	---	---	---	0.053	0.17	---
	Pneumatic Controllers	---	---	0.13	---	---	---	0.0093	0.92	---
	Operations Vehicle	0.32	0.32	0.018	0.00027	19.03	1.93	30.35	0.00068	0.00018
	Dehydration Units	---	---	2.48	---	---	---	---	1.46	---
	Total Emissions	**3.31**	**1.73**	**12.00**	**0.058**	**19.93**	**2.15**	**292.07**	**6.80**	**0.0022**

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

1. Road Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	3.00	days per well pad roads
	36.00	hours per well pad roads - Dozer
	10.0	hours per well pad roads - Backhoe
Watering Control Efficiency	85	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98 & 7/98

Emissions (TSP lbs/hr) = $5.7 * (\text{soil silt content } \%)^{1.2} * (\text{soil moisture content } \%)^{-1.3} *$ Control Efficiency

Emissions (PM_{15} lbs/hr) = $1.0 * (\text{soil silt content } \%)^{1.5} * (\text{soil moisture content } \%)^{-1.4} *$ Control Efficiency

Emissions = 0.59 lbs TSP/hour/piece of equipment

Emissions = 0.15 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	tons/well pad	tons/yr [b]	lbs/hr	tons/well pad	tons/yr [b]	tons/yr [b]
TSP	0.59	0.011	0.021	0.59	0.0030	0.0059	0.027
PM_{15}	0.15	0.0027	0.0054	0.15	0.00075	0.0015	0.0069
PM_{10}	0.11	0.0020	0.0041	0.11	0.00056	0.0011	0.0052
$PM_{2.5}$	0.062	0.0011	0.0022	0.062	0.00031	0.0006	0.0029

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to Dozer emissions.

b Assumes maximum development scenario

Copyright 2013 Kleinfelder

2. Road Construction Emissions (Grader Fugitive Dust)

Assumptions:

Hours of Construction	1	day grading per road segment
	12	hours/day
	12	hours per well pad roads
Watering Control Efficiency	85	percent (Assumption)
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
Distance Graded	0.29	miles
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = $0.040 * (\text{Mean Vehicle Speed})^{2.5} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions (PM_{15} lbs) = $0.051 * (\text{Mean Vehicle Speed})^{2.0} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions = 0.23 lbs TSP/well pad

Emissions = 0.11 lbs PM_{15}/well pad

	Grader Construction Emissions			
	lbs/well pad	**lbs/hr/well pad**	**tons/well pad**	**tons/yr [a]**
TSP	0.23	0.020	1.17E-04	2.35E-04
PM_{15}	0.11	0.009	5.62E-05	1.12E-04
PM_{10}	0.07	0.006	3.37E-05	6.74E-05
$PM_{2.5}$	0.007	0.0006	3.64E-06	7.28E-06

a Assumes maximum development scenario

Copyright 2013 Kleinfelder

3. Well Pad Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	3	days per well pad
	36	hours per well pad Dozer
	10	hours per well pad Backhoe
Watering Control Efficiency	85	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = $5.7 * (\text{soil silt content } \%)^{1.2} * (\text{soil moisture content } \%)^{-1.3} *$ Control Efficiency

Emissions (PM_{15} lbs/hr) = $1.0 * (\text{soil silt content } \%)^{1.5} * (\text{soil moisture content } \%)^{-1.4} *$ Control Efficiency

Emissions = 0.59 lbs TSP/hour/piece of equipment

Emissions = 0.15 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	tons/well pad	tons/yr [b]	lbs/hr	tons/well pad	tons/yr [b]	tons/yr [b]
TSP	0.59	0.011	0.021	0.59	0.0030	0.0059	0.027
PM_{15}	0.15	0.0027	0.0054	0.15	0.00075	0.0015	0.0069
PM_{10}	0.11	0.0020	0.0041	0.11	0.00056	0.0011	0.0052
$PM_{2.5}$	0.062	0.0011	0.0022	0.062	0.00031	0.0006	0.0029

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to Dozer emissions.
b Assumes maximum development scenario

Copyright 2013 Kleinfelder

4. Well Pad Construction Emissions (Grader Fugitive Dust)

Assumptions:

Grading Length	1.02	miles on pad
Hours of Construction	2	day grading per well pad
	12	hours/day
	24	hours per well pad
Watering Control Efficiency	85	percent (Assumption)
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
Distance Graded	1.02	miles
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = $0.040 * (\text{Mean Vehicle Speed})^{2.5}$ * Distance Graded * Control Efficiency

Emissions (PM_{15} lbs) = $0.051 * (\text{Mean Vehicle Speed})^{2.0}$ * Distance Graded * Control Efficiency

Emissions = 0.82 lbs TSP/well pad
Emissions = 0.39 lbs PM_{15}/well pad

	Grader Construction Emissions			
	lbs/well	**lbs/hr/well pad**	**tons/well pad**	**tons/yr [a]**
TSP	0.82	0.034	0.00041	0.0008
PM_{15}	0.39	0.016	0.00020	0.00039
PM_{10}	0.23	0.010	0.00012	0.00023
$PM_{2.5}$	0.025	0.0011	0.000013	0.000025

a Assumes maximum development scenario

Copyright 2013 Kleinfelder

5. Pipeline Construction Emissions (Dozer and Backhoe Fugitive Dust)

Assumptions:

Hours of Construction	6.0	days per well pad pipeline
	12	hours/day
	71	hours per well pad pipeline - Dozer
	10	hours per well pad pipeline - Backhoe
Watering Control Efficiency	85	percent (Assumption)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 7/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 7/98)
PM_{10} Multiplier	0.75 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for Bulldozing Overburden Emissions, Western Surface Coal Mining, 7/98

Emissions (TSP lbs/hr) = $5.7 * (\text{soil silt content } \%)^{1.2} * (\text{soil moisture content } \%)^{-1.3} *$ Control Efficiency

Emissions (PM_{15} lbs/hr) = $1.0 * (\text{soil silt content } \%)^{1.5} * (\text{soil moisture content } \%)^{-1.4} *$ Control Efficiency

Emissions = 0.59 lbs TSP/hour/piece of equipment

Emissions = 0.15 lbs PM_{15}/hour/piece of equipment

	Dozer Emissions [a]			Backhoe Emissions [a]			Total
	lbs/hr	tons/well pad	tons/yr [b]	lbs/hr	tons/well pad	tons/yr [b]	tons/yr [b]
TSP	0.59	0.021	0.042	0.59	0.018	0.035	0.077
PM_{15}	0.15	0.0054	0.011	0.15	0.0045	0.009	0.020
PM_{10}	0.11	0.0040	0.0081	0.11	0.0034	0.0067	0.015
$PM_{2.5}$	0.062	0.0022	0.0044	0.062	0.0018	0.0037	0.0081

a Assumes one dozer and one backhoe. Backhoe emissions factors are conservatively estimated as equivalent to Dozer emissions.

b Assumes maximum development scenario

Copyright 2013 Kleinfelder

6. Pipeline Construction Emissions (Grader Fugitive Dust)

Assumptions:

Grading Length	5.95	miles pipeline per pad
Hours of Construction	5.95	days grading per well pad pipeline
	12	hours/day
	71.4	hours per well pad
Watering Control Efficiency	85	percent (Assumption)
Average Grader Speed	7.1	mph (Typical value AP-42 Table 11.9-3, 7/98)
Distance Graded	5.95	miles
PM_{10} Multiplier	0.6 * PM_{15}	(AP-42 Table 11.9-1, 7/98)
$PM_{2.5}$ Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 7/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 7/98

Emissions (TSP lbs) = $0.040 * (\text{Mean Vehicle Speed})^{2.5} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions (PM_{15} lbs) = $0.051 * (\text{Mean Vehicle Speed})^{2.0} * \text{Distance Graded} * \text{Control Efficiency}$

Emissions = 4.80 lbs TSP/well

Emissions = 2.29 lbs PM_{15}/well

	Grader Construction Emissions			
	lbs/well	**lbs/hr/well pad**	**tons/well pad**	**tons/yr [a]**
TSP	4.80	0.067	0.0024	0.0048
PM_{15}	2.29	0.032	0.0011	0.0023
PM_{10}	1.38	0.019	0.00069	0.0014
$PM_{2.5}$	0.15	0.0021	0.000074	0.00015

a Assumes maximum development scenario

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

7. Development Traffic Fugitive Dust Emissions

Unpaved Calculation AP-42, Chapter 13.2.2	$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365)$		Annual
November 2006	$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365)$		Annual
	$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$		Daily
	$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$		Daily
	Silt Content (S)	8.5	AP 42 13.2.2-1 Mean Silt Content Construction Sites
	Round Trip Miles	23	
	Precipitation Days (P)	45	days per year (NCDC data for Ouray, UT 1955-2004)

Paved Calculation AP-42, Chapter 13.2.1	$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$		Annual
January 2011	$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$		Annual
	$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$		Daily
	$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$		Daily
	Silt Loading (sL)	0.6	AP-42 Table 13.2.1-3 baseline low volume roads
	Round Trip Miles	9	From Vernal
	Precipitation Days (P)	45	days per year
	W = average weight in tons of vehicles traveling the road		

Construction (days/pad and road)

Hours per day 12
Days per pad 3

Vehicle Type	Average Weight (lbs)	Round Trips per Well Pad
Haul Trucks: Equipment/Fuel	80,000	1
Pickup Truck: Crew	20,000	1
Mean Vehicle Weight	50,000	2

Unpaved:				
PM_{10} (lb/VMT)	**PM_{10}/Pad (lbs)**	**PM_{10}/Pad (lb/day)**	**$PM_{2.5}$/Pad (lbs)**	**$PM_{2.5}$/Pad (lb/day)**
Daily 2.86	132.3	44.1	13.2	4.4
Annual 2.50	**Unpaved Roads $PM_{10/15}$ Pads (tons)** 0.12		**Unpaved Roads $PM_{2.5/15}$ Pads (tons)** 0.013	

Paved:				
PM_{10} (lb/VMT)	**PM_{10}/Pad (lbs)**	**PM_{10}/Pad (lb/day)**	**$PM_{2.5}$/Pad (lbs)**	**$PM_{2.5}$/Pad (lb/day)**
Daily 0.0369	0.64	0.21	0.16	0.052
Annual 0.04	**Paved Roads PM_{10} Pads (tons)** 0.00062		**Paved Roads $PM_{2.5}$ Pads (tons)** 0.00015	

Drilling (days/well)

Hours per day 24
Days per well 9

Vehicle Type	Average Weight (lbs)	Round Trips per Well
Haul/Semi: Hvy Equip Hauler	80,000	2
Logging/Mud Trucks	70,000	0
Light Haul Trucks	8,000	7
Water Trucks	60,000	0
Mean Vehicle Weight	24,000	9

Unpaved:				
PM_{10} (lb/VMT)	**PM_{10}/Well (lbs)**	**PM_{10}/Well (lb/day)**	**$PM_{2.5}$/Well (lbs)**	**$PM_{2.5}$/Well (lb/day)**
Daily 2.05	427.8	47.5	42.8	4.8
Annual 1.80	**Unpaved Roads PM_{10}/Annual Wells (tons)** 0.38		**Unpaved Roads $PM_{2.5}$/Annual Wells (tons)** 0.038	

Paved:				
PM_{10} (lb/VMT)	**PM_{10}/Pad (lbs)**	**PM_{10}/Pad (lb/day)**	**$PM_{2.5}$/Pad (lbs)**	**$PM_{2.5}$/Pad (lb/day)**
Daily 0.017	1.36	0.15	0.33	0.04
Annual 0.017	**Paved Roads PM_{10}/Annual Wells (tons)** 0.0013		**Paved Roads $PM_{2.5}$/Annual Wells (tons)** 0.00032	

Completion (days/well)

Hours per day 12
Days per pad 6

Vehicle Type	Average Weight (lbs)	Round Trips per Well
Haul/Semi: Hvy Equip Hauler	80,000	1
Light Haul Trucks	8,000	1
Mean Vehicle Weight	44,000	2

Unpaved:				
PM_{10} (lb/VMT)	**PM_{10}/Well (lbs)**	**PM_{10}/Well (lb/day)**	**$PM_{2.5}$/Well (lbs)**	**$PM_{2.5}$/Well (lb/day)**
Daily 2.70	125	20.8	12.5	2.1
Annual 2.36	**Unpaved Roads PM_{10}/Annual Wells (tons)** 0.11		**Unpaved Roads $PM_{2.5}$/Annual Wells (tons)** 0.011	

Paved:				
PM_{10} (lb/VMT)	**PM_{10}/Pad (lbs)**	**PM_{10}/Pad (lb/day)**	**$PM_{2.5}$/Pad (lbs)**	**$PM_{2.5}$/Pad (lb/day)**
Daily 0.032	0.56	0.09	0.14	0.02
Annual **0.03**	**Paved Roads PM_{10}/Annual Wells (tons)** 0.0005		**Paved Roads $PM_{2.5}$/Annual Wells (tons)** 0.00013	

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

7. Development Traffic Fugitive Dust Emissions

Unpaved Calculation AP-42, Chapter 13.2.2	$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365)$		Annual
November 2006	$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365)$		Annual
	$E (PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$		Daily
	$E (PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$		Daily
	Silt Content (S)	8.5	AP 42 13.2.2-1 Mean Silt Content Construction Sites
	Round Trip Miles	23	
	Precipitation Days (P)	45	days per year (NCDC data for Ouray, UT 1955-2004)

Paved Calculation AP-42, Chapter 13.2.1	$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$		Annual
January 2011	$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$		Annual
	$E (PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$		Daily
	$E (PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$		Daily
	Silt Loading (sL)	0.6	AP-42 Table 13.2.1-3 baseline low volume roads
	Round Trip Miles	9	From Vernal
	Precipitation Days (P)	45	days per year
	W = average weight in tons of vehicles traveling the road		

Interim Reclamation (days/well)

Hours per day 10

Days per pad 3

Vehicle Type	**Average Weight (lbs)**	**Round Trips per Well**
Haul/Semi: Hvy Equip Hauler	80,000	1
Light Haul Trucks	8,000	1
Mean Vehicle Weight	44,000	2

Unpaved:				
PM_{10} (lb/VMT)	**PM_{10}/Day (lbs)**	**PM_{10}/Day (lb/day)**	**$PM_{2.5}$/Day (lbs)**	**$PM_{2.5}$/Day (lb/day)**
Daily				
2.70	124.9	41.6	12.5	4.2
Annual	**Unpaved Roads PM_{10}/Annual Wells (tons)**		**Unpaved Roads $PM_{2.5}$/Annual Wells (tons)**	
2.36	0.11		0.011	

Paved:				
PM_{10} (lb/VMT)	**PM_{10}/Pad (lbs)**	**PM_{10}/Pad (lb/day)**	**$PM_{2.5}$/Pad (lbs)**	**$PM_{2.5}$/Pad (lb/day)**
Daily	0.56	0.19	0.14	0.05
0.03	**Paved Roads PM_{10}/Annual Wells (tons)**		**Paved Roads $PM_{2.5}$/Annual Wells (tons)**	
Annual	0.00054		0.00013	
0.03				

Total Annual Traffic Fugitive Dust Emissions (tons/year)

Unpaved Roads PM_{10} (tons)	**Unpaved Roads $PM_{2.5}$ (tons)**
0.71	**0.073**
Paved Roads PM_{10} (tons)	**Paved Roads $PM_{2.5}$ (tons)**
0.0030	**0.00074**

Copyright 2013 Kleinfelder

8. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity (U_t)	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine)
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	15.9	acres total initial disturbance for roads and pipelines (Proposed Action)
	64,345	square meters total initial disturbance for roads and pipelines
	3.2	acres total initial disturbance for well pads (Proposed Action)
	12,950	square meters total initial disturbance for well pads
	19	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Grand Junction (obtained from NCDC website)
Fastest Mile Wind Speed ($U_{10}^{+)}$	20.1	meters/sec (45 mph) reported as fastest 2-minute wind speed for Grand Junction (2002)
Number soil of disturbances	6.00	for well pads (Assumption, disturbance at construction and reclamation) constant for dirt roads
Development Period	2	years (Proposed Action)

Equations (AP-42 13.2.5.2 Industrial Wind Erosion)

Friction Velocity $U^* = 0.053\ U_{10}^{+}$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 µm	**<10 µm**	**<2.5 µm**
1.0	0.5	0.075

Maxium U_{10}^{+} Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well U_t* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
20.12	1.07	1.02	1.28	1.33	0.00

Wind Erosion Emissions

Particulate Species	Wells (tons/year)	Roads/Pipelines (tons/year)
TSP	0.055	0.00
PM_{10}	0.027	0.00
$PM_{2.5}$	0.0041	0.00

Copyright 2013 Kleinfelder

9. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	31.8	miles (Estimated from project area and existing road system)
Hours of Construction	36	hours per site
Number of Heavy Diesel Truck Trips	1	
Number of Pickup Trips	1	
Diesel Fuel sulfur content	0.0015	percent (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{2000 (lb/ton)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [c]	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/pad)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	7.44E-02	0.066	0.0012	7.39E-03	0.007	0.00012	0.072	0.0026
CO	1.98E-02	0.018	0.00032	7.26E-02	0.064	0.0012	0.082	0.0029
VOC	3.16E-03	0.003	0.00005	3.54E-03	0.003	0.00006	0.0059	0.00021
SO_2	4.57E-05	4.04E-05	7.28E-07	2.83E-05	2.50E-05	4.51E-07	0.000065	0.0000024
PM_{10}	4.22E-03	3.73E-03	6.72E-05	1.94E-04	1.72E-04	3.09E-06	0.0039	0.00014
$PM_{2.5}$	4.09E-03	3.62E-03	6.51E-05	1.79E-04	1.58E-04	2.85E-06	0.0038	0.00014
CO_2	6.73E+00	5.95E+00	1.07E-01	1.61E+00	1.42E+00	2.56E-02	7.38	0.27
CH_4	6.56E-05	5.80E-05	1.04E-06	2.08E-04	1.84E-04	3.31E-06	0.00024	0.0000087
N_2O	1.20E-05	1.06E-05	1.91E-07	8.05E-05	7.12E-05	1.28E-06	0.00008	0.0000029

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
c Assumes maximum development scenario

Copyright 2013 Kleinfelder

10. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Development Rate	2	new pads per year (Proposed Action)
Backhoe miles per pad	1.81	miles (Value assumed to be 1/4 of dozer or grader mileage)
Backhoe Hours	30	hours per pad
Backhoe HP	87.17	(Average HP based on NONROAD Population file for Utah, assuming highest population count-Backhoe)
Load Factor	0.21	(Default LF from NONROAD model for Tractors/Loaders/Backhoes)
Dozer miles per pad	7.3	miles
Dozer Hours	143.4	hours per pad
Dozer HP	136.1	(Average HP based on NONROAD Population file for Utah, assuming highest population count-Dozers)
Load Factor	0.59	(Default LF from NONROAD model for Crawler Tractor/Dozers)
Grader miles per pad	7.3	miles
Motor Grader Hours	107.4	hours per pad
Grader HP	231.2	(Average HP based on NONROAD Population file for Utah, assuming highest population count-Graders)
Load Factor	0.59	(Default LF from NONROAD model for Graders)

Equations:

$$\text{Emissions (tons/year/pad)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Horse Power} * \text{Hours} * \text{Load Factor}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Dozer			Grader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr/pad)
NOx	6.9	0.28	0.0042	8.38	1.48	0.11	8.38	2.52	0.14
CO	3.49	0.14	0.0021	2.7	0.48	0.034	2.7	0.81	0.044
VOC [b]	0.99	0.040	0.00060	0.68	0.12	0.0086	0.68	0.20	0.011
PM_{10}	0.722	0.029	0.00044	0.402	0.071	0.0051	0.402	0.12	0.0065
$PM_{2.5}$	0.722	0.029	0.00044	0.402	0.071	0.0051	0.402	0.12	0.0065
CO_2 [c]	188.2	7.59	0.11	188.2	33.31	2.39	188.2	56.59	3.04

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions [d] (tons/yr)
NOx	4.28	0.49
CO	1.43	0.16
VOC	0.36	0.040
PM_{10}	0.22	0.024
$PM_{2.5}$	0.22	0.024
CO_2	97.50	11.08

a From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010.
b Emission Factor represents total Hydrocarbon Emissions
c Converted from emission factor for Distillate Fuel Oil #2 (diesel) as listed in Table C-1 to Subpart C of Part 98 - Default Emission Factors and High Heat Values for Various Types of Fuel.

Listed Factor:	73.96	kg CO_2/mmBtu
	393	hp-hr = mmBtu
	188.2	g CO_2/hp-hr

d Assumes maximum development scenario

Copyright 2013 Kleinfelder

11. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	31.8	miles (Estimated from project area and existing road system)
Hours of Operation	216	hours per site
Number of Heavy Diesel Truck Trips	2	
Number of Pickup Trips	7	
Diesel Fuel sulfur content	0.0015	percent (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{2000 (lb/ton)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [c]	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	7.44E-02	0.022	0.0024	7.39E-03	0.008	0.00082	0.030	0.0064
CO	1.98E-02	0.0058	0.00063	7.26E-02	0.07	0.0081	0.08	0.017
VOC [c]	3.16E-03	0.0009	0.00010	3.54E-03	0.0037	0.00039	0.0046	0.0010
SO_2	4.57E-05	1.35E-05	1.46E-06	2.83E-05	2.92E-05	3.15E-06	4.27E-05	0.000009
PM_{10}	4.22E-03	1.24E-03	1.34E-04	1.94E-04	2.00E-04	2.16E-05	1.44E-03	0.00031
$PM_{2.5}$	4.09E-03	1.21E-03	1.30E-04	1.79E-04	1.85E-04	1.99E-05	1.39E-03	0.00030
CO_2	6.73E+00	1.98E+00	2.14E-01	1.61E+00	1.66E+00	1.79E-01	3.65	0.79
CH_4	6.56E-05	1.93E-05	2.09E-06	2.08E-04	2.15E-04	2.32E-05	2.34E-04	0.000051
N_2O	1.20E-05	3.54E-06	3.82E-07	8.05E-05	8.31E-05	8.97E-06	8.66E-05	0.000019

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
c Assumes maximum development scenario

Copyright 2013 Kleinfelder

12. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	31.8	miles (Estimated from project area and existing road system)
Hours of Operation	72	hours per site
Number of Heavy Diesel Truck Trips	1	
Number of Pickup Trips	1	
Diesel Fuel sulfur content	0.0015	percent (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{2000 (lb/ton)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [c]	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	7.44E-02	0.033	0.0012	7.39E-03	0.0033	0.00012	0.036	0.0026
CO	1.98E-02	0.0088	0.00032	7.26E-02	0.032	0.0012	0.041	0.0029
VOC [c]	3.16E-03	0.0014	0.000050	3.54E-03	0.0016	0.000056	0.0030	0.00021
SO_2	4.57E-05	2.02E-05	7.28E-07	2.83E-05	1.25E-05	4.51E-07	3.27E-05	0.0000024
PM_{10}	4.22E-03	1.87E-03	6.72E-05	1.94E-04	8.58E-05	3.09E-06	1.95E-03	0.00014
$PM_{2.5}$	4.09E-03	1.81E-03	6.51E-05	1.79E-04	7.92E-05	2.85E-06	1.89E-03	0.00014
CO_2	6.73E+00	2.98E+00	1.07E-01	1.61E+00	7.12E-01	2.56E-02	3.69	0.27
CH_4	6.56E-05	2.90E-05	1.04E-06	2.08E-04	9.20E-05	3.31E-06	1.21E-04	0.0000087
N_2O	1.20E-05	5.31E-06	1.91E-07	8.05E-05	3.56E-05	1.28E-06	4.09E-05	0.0000029

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
c Assumes maximum development scenario

Copyright 2013 Kleinfelder

13. Reclamation Tailpipe Emissions

Assumptions:

Average Round Trip Distance	31.8	miles (Estimated from project area and existing road system)
Hours of Operation	30	hours per site
Number of Heavy Diesel Truck Trips	1	
Number of Pickup Trips	1	
Diesel Fuel sulfur content	0.0015	percent (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [c]	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr/well)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	7.44E-02	0.079	0.0012	7.39E-03	0.0078	0.00012	0.087	0.0026
CO	1.98E-02	0.021	0.00032	7.26E-02	0.077	0.0012	0.098	0.0029
VOC [c]	3.16E-03	0.0034	0.000050	3.54E-03	0.0038	0.00006	0.0071	0.00021
SO_2	4.57E-05	4.85E-05	7.28E-07	2.83E-05	3.00E-05	4.51E-07	7.85E-05	2.36E-06
PM_{10}	4.22E-03	4.48E-03	6.72E-05	1.94E-04	2.06E-04	3.09E-06	4.68E-03	1.41E-04
$PM_{2.5}$	4.09E-03	4.34E-03	6.51E-05	1.79E-04	1.90E-04	2.85E-06	4.53E-03	1.36E-04
CO_2	6.73E+00	7.14E+00	1.07E-01	1.61E+00	1.71E+00	2.56E-02	8.85	0.27
CH_4	6.56E-05	6.96E-05	1.04E-06	2.08E-04	2.21E-04	3.31E-06	2.90E-04	8.71E-06
N_2O	1.20E-05	1.27E-05	1.91E-07	8.05E-05	8.54E-05	1.28E-06	9.82E-05	2.95E-06

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, traveling 15 mph onsite in Uintah County, for calendar year 2012.
c Assumes maximum development scenario

Copyright 2013 Kleinfelder

14. Drill Rig Engine Emissions

Assumptions:

Phase I Hours of Operation	72	hours/well
Phase II Hours of Operation	144	hours/well
Development Rate	2.0	Wells per year
Load Factor	0.42	Load Factor based on estimate
Phase I engine	500	estimated hp
Phase II engine	2,400	estimated hp
Diesel Fuel Sulfur Content	0.0015	percent (EPA standard value June 2010)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{\text{2000 (lb/ton)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809 Source: AP-42 Volume I, Large Stationary Diesel Engines Tables 3.4-1 Diesel Fuel, 10/96

Drill Rig Emissions (Tier 2)					
	Phase I - Eng[a]	Phase II - Eng[a]	Ph I Total	Ph II Vert Well	Total
Species	E. Factor	E. Factor	Emissions	Emissions	Emissions [g]
	(lb/hp-hr)	(lb/hp-hr)	(lb/hr)	(lb/hr)	(tons/yr)
Criteria Pollutants & VOC					
NOx [a]	0.011	0.011	2.22	10.67	1.70
CO [a]	0.0057	0.0057	1.20	5.78	0.92
VOC [a]	0.0022	0.0022	0.46	2.22	0.35
PM_{10} [a]	0.00033	0.00033	0.069	0.33	0.053
$PM_{2.5}$ [a]	0.00033	0.00033	0.069	0.33	0.053
SO_2	2.05E-03	1.21E-05	0.43	0.012	0.033
Hazardous Air Pollutants					
Benzene [d]	7.00E-06	5.82E-06	1.47E-03	5.87E-03	9.51E-04
Toluene [d]	3.07E-06	2.11E-06	6.44E-04	2.12E-03	3.52E-04
Xylenes [d]	2.14E-06	1.45E-06	4.49E-04	1.46E-03	2.42E-04
Formaldehyde [d]	8.85E-06	5.92E-07	1.86E-03	5.96E-04	2.20E-04
Acetaldehyde [d]	5.75E-06	1.89E-07	1.21E-03	1.91E-04	1.14E-04
Acrolein [d]	6.94E-07	5.91E-08	1.46E-04	5.96E-05	1.91E-05
Naphthalene [e]	6.36E-07	9.75E-07	1.34E-04	9.83E-04	1.51E-04
Total PAH [e, f]	1.26E-06	1.59E-06	2.65E-04	1.60E-03	2.50E-04
Greenhouse Gases					
CO_2 [b]	1.22	1.22	256.81	1233	196.0
CH_4 [b, c]	4.96E-05	4.96E-05	0.0104	0.050	0.008
N_2O [b, c]	9.92E-06	9.92E-06	0.0021	0.010	0.0016

a. Emission factors for Tier 2 nonroad diesel engine emission standards from dieselnet.com (NO_X, CO, VOC and PM)

b Subpart W - Part 98.233(z)(1) indicates the use of Table C-1 and Table C-2 for fuel combustion of stationary and portable equipment. Table C-1 provides an EF for diesel combustion of 73.96 kg CO_2/mmBtu.

c Table C-2 provides an EF for diesel combustion for CH4 as 3.0E-03 kg/MMBtu and for N2O as 6.0E-04 kg/MMBtu.

d1. AP-42 Table 3.3-2, Emission Factors for Uncontrolled Diesel Industrial Engines, 10/96

d2. AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-4

e AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-4

f PAH (Polycyclic Aromatic Hydrocarbons) includes naphthalene and are a HAP because they are polycyclic organic matter (POM)

g Assumes maximum development scenario

Copyright 2013 Kleinfelder

15. Well Fracturing Pump and Generator Engines

Assumptions:

Average Hours of Operation	72	Hours/Well
Development Rate	2.0	wells per year
Load Factor	0.42	
Frac Pump Engine Horsepower	1,000	estimated hp
Temporary Generator Horsepower	400	estimated hp
Diesel Fuel Sulfur Content	0.0015	percent (typical value)

Equations:

Emission factor conversion: 1b/hp-hr = AP-42 emission factor (lb/MMbtu) * 7500 Average BTU/hp-hr / 1,000,000

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO_2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Frac Pump Engine Emissions		
	E. Factor (lb/hp-hr)	Emissions (lb/hr)	Emissions [i] (tons/yr)
Criteria Pollutants & VOC			
NOx [c]	0.0185	7.76	0.56
CO [c]	5.95E-03	2.50	0.18
VOC [c,b]	1.50E-03	0.63	0.045
PM_{10} [c]	8.86E-04	0.37	0.027
$PM_{2.5}$ [c]	8.86E-04	0.37	0.027
SO_2 [a]	1.21E-05	0.005	0.0004
Hazardous Air Pollutants			
Benzene [e]	5.82E-06	2.44E-03	1.76E-04
Toluene [e]	2.11E-06	8.85E-04	6.37E-05
Xylenes [e]	1.45E-06	6.08E-04	4.38E-05
Formaldehyde [e]	5.92E-07	2.49E-04	1.79E-05
Acetaldehyde [e]	1.89E-07	7.94E-05	5.72E-06
Acrolein [e]	5.91E-08	2.48E-05	1.79E-06
Naphthalene [f]	9.75E-07	4.10E-04	2.95E-05
Total PAH [f]	1.59E-06	6.68E-04	4.81E-05
Greenhouse Gases			
CO_2 [j]	1.22	514	36.98
CH_4 [k]	4.96E-05	0.021	0.0015
N_2O [k]	9.92E-06	0.0042	0.00030

Species	Generator Engine Emissions		
	E. Factor (lb/hp-hr)	Emissions (lb/hr)	Emissions [i] (tons/yr)
Criteria Pollutants & VOC			
NOx [d]	0.0187	3.15	0.23
CO [d]	1.10E-02	1.85	0.13
VOC [b,d]	3.75E-03	0.63	0.045
PM_{10} [d]	1.98E-03	0.33	0.024
$PM_{2.5}$ [d]	1.98E-03	0.33	0.024
SO_2 [g]	2.05E-03	0.34	0.025
Hazardous Air Pollutants			
Benzene [h]	7.00E-06	1.18E-03	8.464E-05
Toluene [h]	3.07E-06	5.15E-04	3.710E-05
Xylenes [h]	2.14E-06	3.59E-04	2.586E-05
Formaldehyde [h]	8.85E-06	1.49E-03	1.070E-04
Acetaldehyde [h]	5.75E-06	9.66E-04	6.958E-05
Acrolein [h]	6.94E-07	1.17E-04	8.392E-06
1,3-Butadiene [h]	2.93E-07	4.93E-05	3.547E-06
Naphthalene [h]	6.36E-07	1.07E-04	7.693E-06
Total PAH [h]	1.26E-06	2.12E-04	1.524E-05
Greenhouse Gases			
CO_2 [j]	1.22	205.4	14.792
CH_4 [k]	4.96E-05	0.0083	0.00060
N_2O [k]	9.92E-06	0.0017	0.00012

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96

b Emission Factor represents total Hydrocarbon Emissions

c From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010, engines greater than 750 hp, Tier 0.

d From Table A-4 of Exhaust and Crankcase Emission Factors for NONROAD Engine Modeling - Compression Ignition, EPA-420-R-10-018, July 2010, engines 16-25 hp, Tier 0.

e AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-3, 10/96

f AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-4, 10/96

g AP-42 Table 3.3-1, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96

h AP-42 Table 3.3-2, Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines, 10/96

i Assumes maximum development scenario

j Subpart W - Part 98.233(z)(1) indicates the use of Table C-1 and Table C-2 for fuel combustion of stationary and portable equipment. Table C-1 provides an EF for diesel combustion of 73.96 kg CO_2/mmBtu.

k Table C-2 provides an EF for diesel combustion for CH_4 as 3.0E-03 kg/MMBtu and for N_2O as 6.0E-04 kg/MMBtu.

Copyright 2013 Kleinfelder

16. Operations Tailpipe Emissions

Assumptions:

Total Annual New Pumper Mileage:	10,728	miles/year
Operation Pickup Trucks	11,622	miles/year
Number of Condensate Haul Truck Round Trips:	0.15	trips per day (Based on Peak Production Proposed Action)
Number of Produced Water Truck Round Trips:	0.77	trips per day (Based on Peak Production Proposed Action)
Average Round Trip Mileage for Condensate Transport:	32	miles (Estimate from Vernal)
Hours of Pumper Operation:	10	hours per day (Assumption)
Hours of Pumper Operation:	3,650	hours per year

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{2000 (lb/ton)}}$$

Operations Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total	
	E. Factor [a] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr)	E. Factor [b] (lb/mile)	Emissions (lb/hr)	Emissions (tons/yr)	Emissions (lb/hr)	Emissions (tons/yr)
Criteria Pollutants & VOC								
NOx	5.36E-02	0.16	0.29	6.05E-03	0.019	0.035	0.18	0.32
CO	1.02E-02	0.030	0.055	4.48E-02	0.14	0.26	0.17	0.32
VOC [c]	1.55E-03	0.0046	0.0083	1.61E-03	0.0051	0.0094	0.010	0.018
SO_2	3.07E-05	0.000090	0.00016	1.84E-05	0.000059	0.00011	0.00015	0.00027
PM_{10}	2.57E-03	0.0076	0.014	1.31E-04	0.00042	0.00076	0.0080	0.015
$PM_{2.5}$	2.50E-03	0.0073	0.013	1.21E-04	0.00039	0.00070	0.0077	0.014
Greenhouse Gases								
CO_2	4.520	13.28	24.24	1.050	3.34	6.10	16.63	30.35
CH_4	2.59E-05	0.000076	0.00014	9.38E-05	0.00030	0.00055	0.00037	0.00068
N_2O	4.01E-06	0.000012	0.000022	2.68E-05	0.000085	0.00016	0.00010	0.00018

a Emission factors developed using EPA MOVES model, assuming Heavy-Heavy Duty Diesel Trucks, running exhaust, traveling 45 mph offsite in Uintah County, for calendar year 2012.

b Emission factors developed using EPA MOVES model, assuming Light Heavy Duty Gasoline Trucks, running exhaust, traveling 45 mph offsite in Uintah County, for calendar year 2012.

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

17. Operations Traffic Fugitive Dust Emissions

Calculation AP-42, Chapter 13.2.2
November 2006

365 operating days per year (Estimate)

Unpaved Roads

Daily $E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$

Daily $E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45}$

Annual $E(PM_{10}) / VMT = 1.5 * (S/12)^{0.9} * (W/3)^{0.45} * (365-p)/365)$

Annual $E(PM_{2.5}) / VMT = 0.15 * (S/12)^{0.9} + (W/3)^{0.45} * (365-p)/365)$

Silt Content (S) 8.5 AP 42 13.2.2-1 Mean Silt Content Construction Sites

Round Trip Miles 23 miles on unpaved roads estimated

Precipitation Days (P) 45 days per year (NCDC data for Ouray, UT 1955-2004)

Calculation AP-42, Chapter 13.2.1
January 2011

Paved Roads

Daily $E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02}$

Daily $E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02}$

Annual $E(PM_{10}) / VMT = 0.0022 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$

Annual $E(PM_{2.5}) / VMT = 0.00054 * (sL)^{0.91} * (W)^{1.02} * (1-(p/(365*4))$

Silt Loading (sL) 0.6 AP-42 Table 13.2.1-2 baseline low volume roads

W = average weight in tons of vehicles traveling the road

Round Trip Miles 9 miles from Vernal on paved roads estimated

Precipitation Days (P) 45 days per year (NCDC data for Ouray, UT 1955-2004)

	Ave.	Round		Daily	Annual				
Vehicle Type	**Weight**	**Trips per**		**PM_{10}**	**PM_{10}**	**Total PM_{10}**	**PM_{10}**	**Total $PM_{2.5}$**	**$PM_{2.5}$**
	(lbs)	**Day**		**(lb/VMT)**	**(lb/VMT)**	**(lbs/yr)**	**(lb/day)**	**(lbs/yr)**	**(lb/day)**
Pickup Truck: Crew	8,000	1.0							
Haul Truck: Oil	80,000	0.2							
Haul Truck: Water	80,000	0.8	Unpaved	2.66	2.33	37,851	118.28	3,785	11.83
Mean Weight	42,560	1.9	Paved	0.031	0.030	185	0.52	45.3	0.13
						PM_{10}		**$PM_{2.5}$**	
						(ton/yr)		**(ton/yr)**	
Annual Traffic Fugitive Dust Emissions			**Unpaved**			**18.93**		**1.89**	
			Paved			**0.092**		**0.023**	
				Total		**19.02**		**1.92**	

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

18. Average Estimated Produced Gas Characteristics
Analysis Referenced from Riverbend EA, January 2013

Gas Heat Value (wet): 1102.2 Btu/scf

C1-C2 Wt. Fraction:	0.87
VOC Wt. Fraction:	0.11
Non-HC Wt. Fraction:	0.01
Total:	1.00

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	89.7593	16.043	14.400	0.781	1,010.0	906.6	910.0	816.8
Ethane	5.7022	30.070	1.715	0.093	1,769.8	100.9	1,618.0	92.3
Propane	2.1706	44.097	0.957	0.052	2,516.2	54.6	2,316.0	50.3
i-Butane	0.4029	58.123	0.234	0.0127	3,252.1	13.1	3,005.0	12.1
n-Butane	0.5285	58.123	0.307	0.0167	3,262.4	17.2	3,013.0	15.9
i-Pentane	0.1965	72.150	0.142	0.0077	4,000.9	7.9	3,698.0	7.3
n-Pentane	0.1572	72.150	0.113	0.0062	4,008.8	6.3	3,708.0	5.8
Hexanes	0.1208	86.177	0.104	0.0056	4,756.2	5.7	4,404.0	5.3
Heptanes	0.0993	100.204	0.099	0.0054	5,502.5	5.5	5,100.0	5.1
Octanes +	0.0269	114.231	0.031	0.0017	6,249.1	0.0	0.0	0.0
Benzene	0.0128	78.120	0.010	0.0005	3,715.5	0.5	0.0	0.0
Toluene	0.0110	92.130	0.010	0.00055	4,444.6	0.5	0.0	0.0
Ethylbenzene	0.0003	106.160	0.000	0.00002	5,191.5	0.0	0.0	0.0
Xylenes	0.0028	106.160	0.003	0.0002	5,183.5	0.1	0.0	0.0
n-Hexane	0.0589	86.177	0.051	0.002752	4,756.2	2.8	0.0	0.0
Nitrogen	0.4190	28.013	0.117	0.0064	0.0	0.0	0.0	0.0
Carbon Dioxide	0.3310	44.010	0.146	0.0079	0.0	0.0	0.0	0.0
TOTAL	100.00		18.44	1.00		1121.7		1010.9

Copyright 2013 Kleinfelder

19. Oil Storage Tank Working, Breathing, and Flashing Emissions

Assumptions:

Average Oil Production Rate :	10.00	bbls oil per day per well
Size of Development:	2	Maximum wellsites with tanks
Quantity of Tanks	6	Maximum number of tanks in operation (3 per wellsite)
Throughput	51,100	gallons per year per tank

Calculations:

Site Specific Emission Factors

Total VOC:	0.424	tons/bbl
Total HAPS:	0.026	tons/bbl
Benzene:	0.0034	tons/bbl
Toluene:	0.0073	tons/bbl
Xylenes:	0.0029	tons/bbl
n-Hexane:	0.012	tons/bbl
Methane:	0.202	tons/bbl
CO2:	0.061	tons/bbl

Uncontrolled Emissions

TANK DESCRIPTION	VOC Emissions (tons/yr)	Benzene Emissions (lbs/yr)	Toluene Emissions (lbs/yr)	Xylenes Emissions (lbs/yr)	n-Hexane Emissions (lbs/yr)	Total HAP Emissions (tons/yr)	Methane Emissions (tons/yr)	CO2 Emissions (tons/yr)
Oil Tanks (2 Wells with 6 tanks)	8.49	136.00	292.00	116.00	496.00	0.52	4.03	1.23

NOTE: Tank emissions are calculated using E&P TANK, using Greater Natural Buttes gas/liquids analysis data.

Copyright 2013 Kleinfelder

Project: Thurston Ouray NWR 2-Well EA

Date: 11/11/2013

20. Wellsite Truck Loadout

AP - 42, Chapter 5.2

$$L_L = 12.46 \times S \times P \times M / T$$

$$\text{Emissions} = L_L * \text{Throughput}$$

TABLE 1. Emission factors are calculated utilizing AP-42 equations and data from EPA TANKS 4.09 L_L is converted to tpy VOC emissions per barrel of production per day: L_L (lbs VOC/1000 gal) * 1000 gal * 42 gal/bbl * 365 days/year / 2000 lbs/ton

L_L = Loading Loss Emission Factor (lbs VOC/1000 gal Loaded)
S = Saturation Factor (0.6 For Submerged Loading - Dedicated Service)
P = True Vapor Pressure of the Loaded Liquid (psi)
M = Vapor Molecular Weight of the Loaded Liquid (lbs/lbmol)
T = Temperature of Loaded Liquid (ºR)

						L_L	Production	VOC
Location	Factors	S	TVP (psi)[1]	M[1]	T (ºR)	lb/1000 gal	bpd	tpy
Truck Loading	12.46	0.6	3.4	50	531	2.3927	20.00	0.37

Notes:
1) Vapor molecular weight and True Vapor Pressure (TVP) of the loaded liquid from AP-42 Chapter 7, Table 7.1-2, assuming the properties of Crude Oil RVP 5.

	tpy
Methane	0.17
CO2	0.053
HAPs	0.022
Benzene	0.0029
Toluene	0.0063
Xylene	0.0025
n-Hexane	0.011

* Calculated using Oil Vent analysis weight fractions

Copyright 2013 Kleinfelder

21. Operations Pneumatic Emissions

Pneumatic Device Emissions 33.360 scf/day or less = low bleed device [a]

Gas Component	Molecular Weight (lb/lb-mole)	Mole Percent	Relative Mole Weight (lb/lb-mole)	Weight Percent	Volume Flow Rate (scf/day)	Mass Flow Rate (lb/hr)	Mass Flow Rate (tons/yr)
Methane	16.043	89.759	14.400	78.092	29.944	0.05274	0.23
Ethane	30.07	5.702	1.715	9.299	1.902	0.00628	0.028
Propane	44.097	2.171	0.957	5.191	0.724	0.00351	0.0154
i-Butane	58.123	0.403	0.234	1.270	0.134	0.00086	0.0038
n-Butane	58.123	0.529	0.307	1.666	0.176	0.00113	0.0049
i-Pentane	72.15	0.197	0.142	0.769	0.066	0.00052	0.0023
n-Pentane	72.15	0.157	0.113	0.615	0.052	0.00042	0.0018
Hexanes	86.177	0.121	0.104	0.565	0.040	0.00038	0.0017
Heptanes	100.204	0.099	0.099	0.539	0.033	0.00036	0.0016
Octanes +	114.231	0.027	0.031	0.167	0.009	0.00011	0.00049
Benzene	78.12	0.013	0.010	0.054	0.004	0.00004	0.000160
Toluene	92.13	0.011	0.010	0.055	0.004	0.00004	0.000163
Ethylbenzene	106.16	0.0003	0.0003	0.002	0.0001	0.000001	0.000005
Xylenes	106.16	0.003	0.003	0.016	0.001	0.00001	0.000047
n-Hexane	86.177	0.059	0.051	0.275	0.020	0.00019	0.000814
Nitrogen	28.013	0.419	0.117	0.636	0.140	0.00043	0.0019
Carbon Dioxide	44.01	0.331	0.146	0.790	0.110	0.00053	0.0023
	VOC Subtotal	3.79	2.06	11.18	1.26	0.0076	0.033
	HAP Subtotal	0.086	0.074	0.40	0.029	0.00027	0.0012
	Total	100.00	18.44	100.00	33.36	0.068	0.30

	Number of Wells	VOC emissions (tons/year)	Methane Emissions (tons/yr)	CO_2 Emissions (tons/yr)
Proposed Action	2	0.13	0.92	0.0093

Pneumatic sources / well		VOC lb/hr	VOC ton/yr
2	Liquid level controllers	0.015	0.066
	Totals (per well) =	0.015	0.066

Pneumatic sources / well		Emission Factor scf/hr/component	Methane lb/hr	Methane ton/yr	Carbon Dioxide lb/hr	Carbon Dioxide ton/yr
2	Liquid level controllers	1.39	0.11	0.46	0.0011	0.0047
	Totals (per well) =		0.11	0.46	0.0011	0.0047

a Emission factor for liquid level controllers is based on Table A-1A of Subpart W - EF for Western U.S. Low Continuous Bleed Pneumatic Device Vents.

Copyright 2013 Kleinfelder

22. Well Development Venting

Following completion, wells are vented prior to connnection to the gathering pipeline

Amount of Vented Gas: 5.0 Mscf (Average volume estimated)

Development Rate: 2 Wells per year

Control Rate 0 Percent from flaring

Component	Molecular Weight (lb/lb-mole)	Mole Percent	Relative Mole Weight (lb/lb-mole)	Weight Fraction	Component Flow Rate (Mscf)	Component Emission Rate (tons/well)	Total Emission Rate (tons)
Methane	16.043	89.759	14.400	0.781	4.488	0.095	0.19
Ethane	30.070	5.702	1.715	0.093	0.285	0.011	0.023
Propane	44.097	2.171	0.957	0.052	0.109	0.0063	0.013
i-Butane	58.123	0.403	0.234	0.013	0.020	0.0015	0.0031
n-Butane	58.123	0.529	0.307	0.017	0.026	0.0020	0.0040
i-Pentane	72.150	0.197	0.142	0.008	0.010	0.00093	0.0019
n-Pentane	72.150	0.157	0.113	0.006	0.008	0.00075	0.0015
Hexanes	86.177	0.121	0.104	0.006	0.006	0.00069	0.0014
Heptanes	100.204	0.099	0.099	0.005	0.005	0.00066	0.0013
Octanes +	114.231	0.027	0.031	0.002	0.001	0.00020	0.00041
Benzene	78.120	0.013	0.010	0.001	0.001	0.000066	0.00013
Toluene	92.130	0.011	0.010	0.001	0.001	0.000067	0.00013
Ethylbenzene	106.160	0.0003	0.0003	0.00002	0.00002	0.000002	0.000004
Xylenes	106.160	0.003	0.003	0.000	0.000	0.000019	0.000039
n-Hexane	86.177	0.059	0.051	0.003	0.003	0.00033	0.00067
Nitrogen	28.013	0.419	0.117	0.006	0.021	0.00077	0.0015
Carbon Dioxide	44.010	0.331	0.146	0.008	0.017	0.0010	0.0019
VOC Subtotal		**3.79**	**2.06**	**0.11**	**0.19**	**0.014**	**0.027**
HAP Subtotal		**0.086**	**0.074**	**0.0040**	**0.0043**	**0.0005**	**0.0010**
Total		**100**	**18.44**	**1.00**	**5.00**	**0.12**	**0.24**

Copyright 2013 Kleinfelder

23. TEG Dehydrator Emissions

Assumptions

Production Rate: 5.0 MMscf/day
2 Total Number of Dehys

Inlet Gas Conditions: Inlet gas saturated at 250 psig and 77 F
Pump: gas injection

Glycol Recirculation Rate: 3 lb/gal H2O

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Controls

95% Control Efficiency

Dehy Unit Emissions

Species	Uncontrolled Dehydrator Emissions (lb/hr/dehy)	Uncontrolled Dehydrator Emissions (tons/year/dehy)	Controlled Dehydrator Emissions (lb/hr/dehy)	Controlled Dehydrator Emissions (tons/year/dehy)	Controlled Total Emissions (tons/year)
VOC	5.66	24.78	0.28	1.24	2.48
Benzene	0.73	3.20	0.04	0.16	0.32
Toluene	1.21	5.29	0.06	0.26	0.53
Ethylbenzene	0.06	0.27	0.00	0.01	0.03
Xylenes	0.753	3.30	0.04	0.16	0.33
n-Hexane	0.11	0.47	0.01	0.02	0.05
Total HAPs	2.86	12.53	0.14	0.63	1.25
Greenhouse Gases					
CH_4	3.34	14.62	0.17	0.73	1.46

Copyright 2013 Kleinfelder

24. Development Emissions Sumary

Pollutant	Development Emissions (tons/year) [a]					Total
	Construction	Drilling[b]	Completion	Interim Reclamation	Wind Erosion	(tons/yr)
Criteria Pollutants & VOC						
NO_X	0.49	1.70	0.79	0.0026	---	2.99
CO	0.16	0.94	0.32	0.0029	---	1.42
VOC	0.041	0.35	0.12	0.00021	---	0.51
SO_2	0.0000024	0.033	0.025	0.0000024	---	0.058
PM_{10}	0.17	0.43	0.16	0.11	0.027	0.90
$PM_{2.5}$	0.052	0.09	0.062	0.011	0.0041	0.22
Hazardous Air Pollutants						
Benzene	---	0.0010	0.00026	---	---	0.0012
Toluene	---	0.00035	0.00014	---	---	0.00049
Ethylbenzene	---	---	0.00067	---	---	0.00067
Xylene	---	0.00024	0.0016	---	---	0.0019
n-Hexane	---	---	0.0019	---	---	0.0019
Formaldehyde	---	0.00022	0.00012	---	---	0.00034
Total HAPs	---	0.0018	0.0047	---	---	0.0065
Greenhouses Gases						
CO_2	11.35	196.78	52.04	0.27	---	260.44
CH_4	0.0000087	0.008	0.19	0.0000087	---	0.20
N_2O	0.0000029	0.0016	0.00042	0.0000029	---	0.0020

a Assumes maximum development scenario of 2 wells in one year.
b Total drilling emissions includes Tier 2 drill rig engines.

Copyright 2013 Kleinfelder

25. Well Production Summary

Species	Stock Tanks (tons/yr)	Truck Loading (tons/yr)	Dehy Unit (tons/yr)	Operations Vehicle (tons/yr)	Pneumatics (tons/yr)	Total Well Production [a] (tons/yr)
Criteria Pollutants & VOC						
NO_x	---	---	---	0.32	---	0.32
CO	---	---	---	0.32	---	0.32
VOC	8.49	0.37	2.48	0.018	0.13	11.48
SO_2	---	---	---	0.00027	---	0.00027
PM_{10}	---	---	---	19.03	---	19.03
$PM_{2.5}$	---	---	---	1.93	---	1.93
Hazardous Air Pollutants						
Benzene	0.068	0.0029	0.32	---	0.00064	0.39
Toluene	0.15	0.0063	0.53	---	0.00065	0.68
Ethylbenzene	---	---	0.027	---	0.000020	0.027
Xylene	0.058	0.0025	0.33	---	0.00019	0.39
n-Hexane	0.25	0.011	0.047	---	0.0033	0.31
Formaldehyde	---	---	---	---	---	---
Total HAPs	0.52	0.022	1.25	---	0.0048	1.80
Greenhouse Gases						
CO_2	1.23	0.053	---	30.35	0.01	31.63
CH_4	4.03	0.17	1.46	0.00068	0.92	6.60
N_2O	---	---	---	0.00018	---	0.00018

a Emissions for Peak Field Development

Copyright 2013 Kleinfelder

26. Total Project Emissions Summary

Pollutant	Project Emissions (tons/year)		Total Emissions [i] (tons/year)
	Well Development	Well Production	
Criteria Pollutants & VOC			
NO_X	2.99	0.32	3.31
CO	1.42	0.32	1.73
VOC	0.51	11.48	12.00
SO_2	0.058	0.00027	0.058
PM_{10}	0.90	19.03	19.93
$PM_{2.5}$	0.22	1.93	2.15
Hazardous Air Pollutants			
Benzene	0.0012	0.39	0.39
Toluene	0.00049	0.68	0.68
Ethylbenzene	0.00067	0.027	0.027
Xylene	0.0019	0.39	0.39
n-Hexane	0.0019	0.31	0.31
Formaldehyde	0.00034	---	0.00034
Total HAPs	0.0065	1.80	1.81
Greenhouse Gases			
CO_2	260.4	31.63	292.1
CH_4	0.20	6.60	6.80
N_2O	0.0020	0.00018	0.0022

Copyright 2013 Kleinfelder

VISCREEN VISUAL IMPACT ANALYSIS RESULTS Date: 20-Dec-13 12:20:16 PM

SOURCE: Drill Rig

RECEPTOR: Ouray NWR

Filename: C:\VISCREEN\Viscreen\Thurston_2well_5km.out

File Created: 20-Dec-13 12:17:47 PM

INPUT EMISSION RATES FOR:

	VALUE	UNIT Keys
PARTICULATES	0.05	MASS Key:
NOX (AS NO2)	1.62	1
PRIMARY NO2	0	TIME Key:
SOOT	0	1
PRIMARY SO4	0	

MASS	UNIT	TIME	UNIT
1	= GM	1	= SEC
2	= KG	2	= MIN
3	= MT	3	= HR
4	= LB	4	= DAY
5	= Ton	5	= YR

SOURCE OBSERVER DISTANCE (KM):	5
MIN. SOURCE-CLASS I DISTANCE (KM):	5
MAX. SOURCE-CLASS I DISTANCE (KM):	200
BACKGROUND VISUAL RANGE (KM):	170

PARTICLE CHARACTERISTICS:

	DENSITY (GM/CM3)	SIZE CLASS
BACKGR'D FINE	1.5	3
BACKGR'D COARSE	2.5	8
PLUME PARTICLES	2.5	6
SOOT	2	1
PRIMARY SO4	1.5	4

CLASS	SIZE
1	= 0.1 um
2	= 0.2 um
3	= 0.3 um
4	= 0.5 um
5	= 1.0 um
6	= 2.0 um
7	= 5.0 um
8	= 6.0 um
9	= 10.0 um

ADDITONAL DATA:

OZONE CONC. (PPM):	0.04	
WIND SPEED (M/S):	1	Stability Classes:
STABILITY CLASS:	6	1=A,2=B,3=C,4=D,5=E,6=F
PLUME OFFSET ANGLE:	11.25	

Total number Lines of Sight:	34	for Delta E Results
Total number Lines of Sight:	34	for Contrast Results

VISCREEN VISUAL IMPACT ANALYSIS RESULTS Date: 20-Dec-13 12:20:16 PM

SOURCE: Drill Rig

RECEPTOR: Ouray NWR

Filename: C:\VISCREEN\Viscreen\Thurston_2well_5km.out

VISCREEN VISUAL IMPACT ANALYSIS RESULTS Date: 20-Dec-13 12:20:16 PM

SOURCE: Drill Rig

RECEPTOR: Ouray NWR

Filename: C:\VISCREEN\Viscreen\Thurston_2well_5km.out

D E L T A E R E S U L T S

D E L T A E R E S U L T S

LINE OF SIGHT	OUT/ IN	PHI	ALPHA	X	RP	RO	PSI	CONTRAST THRESHLD	DELTA E THRESHLD	DELTA E PL/SKY FORW'D	DELTA E THRESHLD	DELTA E PL/SKY BACK	DELTA E THRESHLD	DELTA E PL/TER FORW'D	DELTA E THRESHLD	DELTA E PL/TER BACK
32	0	2.8	166	1	4	4.5	0.84	0.05	2	4.65	2	2.96	2	4.31	2	1.46
1	0	5	163.7	1.6	3.5	4.1	1.29	0.05	2	4.31	2	2.69	2	3.21	2	1.21
2	0	10	158.7	2.4	2.7	3.6	2.14	0.05	2	2.71	2	1.69	2	2.08	2	0.64
3	0	15	153.8	2.9	2.2	3.1	2.92	0.05	2	2.04	2	1.27	2	1.64	2	0.42
4	0	20	148.8	3.3	1.9	2.8	3.64	0.05	2	1.66	2	1.03	2	1.4	2	0.31
5	0	25	143.8	3.6	1.6	2.6	4.33	0.05	2	1.41	2	0.88	2	1.25	2	0.25
6	0	30	138.7	3.8	1.5	2.4	4.97	0.05	2	1.24	2	0.77	2	1.14	2	0.2
7	0	35	133.7	4	1.4	2.3	5.58	0.05	2	1.11	2	0.69	2	1.06	2	0.17
8	0	40	128.8	4.1	1.3	2.2	6.13	0.05	2.04	1.01	2	0.63	2	1	2	0.15
9	0	45	123.8	4.3	1.2	2.1	6.63	0.05	2.19	0.94	2	0.59	2	0.95	2	0.13
10	0	50	118.8	4.4	1.1	2	7.09	0.05	2.32	0.88	2	0.55	2	0.91	2	0.12
11	0	55	113.7	4.5	1.1	2	7.48	0.05	2.43	0.84	2	0.52	2	0.87	2	0.11
12	0	60	108.7	4.6	1	1.9	7.82	0.05	2.53	0.8	2	0.5	2	0.84	2	0.1
13	0	65	103.8	4.7	1	1.9	8.09	0.05	2.61	0.77	2	0.48	2	0.82	2	0.1
14	0	70	98.8	4.8	1	1.9	8.31	0.051	2.68	0.75	2	0.47	2	0.8	2	0.1
15	0	75	93.8	4.8	1	1.9	8.46	0.051	2.72	0.74	2	0.46	2	0.78	2	0.09
16	0	80	88.8	4.9	1	2	8.55	0.052	2.75	0.73	2	0.46	2	0.76	2	0.09
33	1	84.4	84.4	5	1	2	8.57	0.052	2.75	0.73	2	0.46	2	0.75	2	0.09
17	1	85	83.8	5	1	2	8.57	0.052	2.75	0.73	2	0.46	2	0.75	2	0.09
18	1	90	78.8	5.1	1	2.1	8.53	0.052	2.74	0.74	2	0.46	2	0.74	2	0.09
19	1	95	73.8	5.2	1	2.2	8.42	0.051	2.71	0.74	2	0.46	2	0.73	2	0.09
20	1	100	68.8	5.3	1	2.3	8.25	0.05	2.66	0.76	2	0.47	2	0.72	2	0.09
21	1	105	63.8	5.4	1.1	2.4	8.01	0.05	2.59	0.78	2	0.49	2	0.71	2	0.09
22	1	110	58.8	5.5	1.1	2.6	7.71	0.05	2.5	0.81	2	0.5	2	0.7	2	0.09
23	1	115	53.8	5.6	1.2	2.8	7.36	0.05	2.4	0.85	2	0.53	2	0.69	2	0.1
24	1	120	48.8	5.8	1.3	3.1	6.94	0.05	2.28	0.89	2	0.56	2	0.68	2	0.1
25	1	125	43.8	5.9	1.4	3.6	6.47	0.05	2.14	0.95	2	0.6	2	0.67	2	0.11
26	1	130	38.8	6.1	1.6	4.1	5.95	0.05	2	1.03	2	0.64	2	0.65	2	0.12
27	1	135	33.8	6.4	1.8	5	5.38	0.05	2	1.13	2	0.71	2	0.63	2	0.13
28	1	140	28.8	6.7	2	6.4	4.77	0.05	2	1.26	2	0.79	2	0.6	2	0.13
29	1	145	23.8	7.1	2.4	8.8	4.11	0.05	2	1.44	2	0.9	2	0.54	2	0.14
30	1	150	18.8	7.8	3	14.7	3.41	0.05	2	1.68	2	1.05	2	0.43	2	0.12
31	1	155	13.8	8.9	4.1	43.9	2.67	0.05	2	2.05	2	1.27	2	0.18	2	0.04
34	1	168.5	0.3	200	195.1	195.1	0.13	0.05	2	0	2	0	2	0	2	0

APPENDIX F

Thurston Energy LLC's Draft Reclamation Plan

Thurston Energy, LLC's:
Ouray National Wildlife Refuge
2-Well Development Program

Reclamation & Monitoring Plan

Prepared for:

Thurston Energy, LLC
4925 Greenville Ave. Suite 840
Dallas, TX 75206

And

United States Fish and Wildlife Service
Ouray National Wildlife Refuge
HC 69 Box 232
Randlett, Utah 84063

Prepared by:

KLEINFELDER
Bright People. Right Solutions.

Report Date: November 2013
Report Number: KLF-xx-xxx
Internal Number: LITxxxxxx

1.0 INTRODUCTION

This reclamation plan is designed to outline interim and final reclamation procedures to be implemented for the Thurston Energy, LLC (Thurston) Ouray National Wildlife Refuge 2-Well Development Program to achieve agency reclamation standards and visual resource management objectives.

Reclamation activities would consist of two stages, interim and final reclamation, which are defined as:

- The interim, short-term goal is to immediately stabilize disturbed areas, minimize soil erosion and sedimentation and to provide the necessary conditions to achieve the long-term goal.
- The final, long-term goal is to facilitate eventual ecosystem reconstruction by returning the land to a safe, stable and properly functioning condition.

HOW TO USE THIS PLAN

This plan incorporates reclamation into project planning, site development, operations and final abandonment actions. The guidance and action steps outlined here will result in successful reclamation and revegetation, save the company time and money in both the short- and long-term, and provide for future productive uses of the land.

Thurston is responsible for certain aspects of vegetation management within their lease holdings, including noxious and invasive weed control and reclamation and revegetation. While this plan focuses on reclamation and revegetation, it is understood that Thurston will control noxious and invasive weed species on the lease holdings from project initiation through final abandonment of the leased area. The proposed Noxious Weed Management Plan can be found attached as **Appendix A**.

DRAFT

1.1 Goals and Objectives

The overall goals of reclamation are achieved in two steps:

- **Interim Reclamation:** Consists of minimizing the footprint of disturbances by reclaiming all portions of the well site not needed for production operations. It is understood that interim reclamation may need to be repeated several times on the same area prior to final reclamation. The need for interim reclamation may be due to actions which result in disturbance to the reclaimed surface (i.e., ongoing maintenance and operation activities), or should interim reclamation not prove successful or create the desired results.

- **Final Reclamation:** Sets "…the course for eventual ecosystem restoration….", which means returning the land to a condition approximating or equal to that which existed prior to the disturbance. Final reclamation would be completed following final plugging and abandonment actions of the final well location on the well pad site. Final reclamation actions will be completed on the entire well pad, access route (unless directed by land owner or surface managing agency to leave access road in place) and pipeline corridor areas.

The objectives of this reclamation plan are:

- Establish a desired self-perpetuating diverse vegetative cover that will provide wildlife habitat, livestock grazing and/or other land uses comparable to those available prior to disturbance.
- Establish slope stability and desired topographic diversity.
- Reconstruct and stabilize altered water courses and drainage features.
- Ensure the biological, chemical and physical integrity of the topsoil resource during all phases of construction, operation and reclamation.
- Re-establish the visual composition and characteristics to blend with the natural surroundings.
- Control the occurrence of noxious weeds and undesirable invasive species by utilizing principles of integrated weed management including prevention, mechanical, chemical and biological control methods.
- Minimize the surface impacts to other resources and authorized uses in the vicinity of surface disturbing activities.
- Restore the landform and natural processes to re-establish and sustain a pre-disturbance productivity of the site.
- Be adaptive to changing environmental conditions. Consider applicable agency Conditions of Approval as a baseline to minimize surface impacts and enhance subsequent reclamation actions.
- Conduct monitoring that enables the proper assessment of the reclamation actions and can quickly and effectively identify an unwanted deviation from successful trends in reclamation.

2.0 RECLAMATION PLAN

2.1 Topsoil Management

Proper management of on-site topsoil, from the time it is initially removed until final reclamation is completed, is paramount to facilitate successful recovery of the disturbed sites within the project area.

2.1.1 Initial New Disturbance

Topsoil is defined as the uppermost layer of soil distinguishable by color, texture or type, or that contains 80 percent of the vegetative covers root system and organic matter. The dirt contractor will be instructed to carefully remove the topsoil to the appropriate depth(s). Topsoil will be stored in windrows along the non-construction side of the project area, on level terrain, or in areas where surface drainage patterns would not result in loss of topsoil. The dirt contractor will be careful to ensure no subsoil materials are placed with or mixed in with the topsoil.

2.1.2 Proper Storage of Topsoil

Essential organic material and microbes are found in the topsoil. The elements are essential to retain soil moisture, enhance seed germination, and sustain plant growth and development over the short- and long-term. Loss of organic material or microbial death can directly limit the success of implemented reseeding actions. The following actions will be taken to ensure the short- and long-term protection and continued viability of the topsoil.

DRAFT

- Topsoil will be kept free of noxious and invasive weed species and seeds. Thurston will regularly inspect stored topsoil and treat it as needed to control noxious and invasive weed species and kill weeds that may be present.
- Stores topsoil will not be compacted.
- Additional erosion prevention practices will be implemented if necessary.

2.2 General Practices

The following practices will be completed prior to the initiation of any specific reclamation action:

- Thurston will take photos of the area to be disturbed. These photos can aid in reestablishing contours, drainage patterns, etc., during reclamation and can serve as a baseline of existing vegetation for monitoring purposes.
- Thurston will ensure a company employee or representative is on site during all reclamation actions. Should a question arise as to the specific actions/processes to be undertaken, surface-disturbing actions will cease and the surface-managing agency or the private landowner will be consulted. Surface-disturbing actions will resume only after clarification and/or adjustments to the specific actions are agreed to by all involved parties.
- The surface-managing agency and any private landowner will be notified at least 24-hours prior to initiation of any reclamation action.
- Drill pit and reserve pits will be reclaimed in strict adherence to requirements established in *Onshore Order #7*. These requirements include having pits be free of oil and other liquid prior to filling; making sure pit liners are removed to the solids level or treated to prevent re-emergence to the surface; and having the pit area filled in and mounded slightly to allow for settling and positive drainage. Such actions would be completed within 90 days of completion of drilling activities for each well or at the direction of the surface managing agency.

DRAFT

2.3 Site Preparation

These actions will apply to both interim and final reclamation, as appropriate, and may be repeated as often as needed to prepare a suitable site for reclamation and revegetation.

Action Steps	Interim	Final
After well completion, areas not necessary for well production will be reclaimed.	X	
Re-strip all topsoil and vegetation from all portions of the pad site not previously reshaped to blend with the surrounding contours.		X
Ensure that the site to be reclaimed is free of noxious and invasive weed plants prior to completing any reclamation actions. Pre-treat the site as appropriate to control existing noxious and invasive weed plant and to kill any seeds. Follow directions provided on weed control agent containers regarding the length of time needed following chemical treatment to plant or reseed the site.	X	X

Action Steps	Interim	Final
Re-contour areas to be reclaimed to create topography similar to that occurring prior to disturbance. Natural channels will be reconstructed and riprap will be used as appropriate to minimize the potential for water and soil erosion.	X	X
Backfill any remaining excavations and/or pits when they are dry and free of waste and grade to conform to the surrounding terrain.		X
Spread stored topsoil to a uniform depth over the entire disturbed area.		X
Leave the reclaimed surface rough, uneven, and pock-marked to create an uneven surface. This condition will increase the capture surface water or snowmelt, diminish the formation of erosive gullies or rills, and enhance vegetation growth and development.	X	X
Install water control structures to prevent erosion until the site is successfully stabilized. Water control structures would be specifically designed per the APD or other authorization.	X	X

2.4 Revegetation

Following surface preparation, the site will be reseeded as outlined below.

Action Steps	Interim	Final
Apply seed during periods when maximum soil moisture exists or is anticipated, i.e., preferably in the late fall or early winter.	X	X
Following seeding Thurston would apply lightly spread straw or branches over the entire seeded area to reduce wind and water erosion, and to add to the organic material and help maintain soil moisture.	X	X

DRAFT

Seed may be applied using one or a combination of methods and equipment. Criteria for determining which method(s) to use include:

- Drill seeder: in relatively flat areas (less than 30 percent slopes) and free of boulders.
- Hydro seeder: in areas having slopes exceeding 30 percent, or containing boulders, or to minimize damage to the prepared seedbed.
- Broadcast seeding: used in limited situations where the area to be reseeded is too small to effectively use a drill seeder or hydro-seeder. If broadcast seeding is appropriate, seed may be applied by pedestrian methods (with a back-mounted seed bag) or a small ATV-mounted seeder. For broadcast seeding, double the amount of required seed.

The reclaimed area would be reseeded using the USFWS recommended plant species listed in the table below. Other plant may be selected for reseeding on a site specific basis during the well permitting process. All seed application would be administered using the recommended pound per acre value recommended by the USFWS.

Recommended Plant Species	Scientific Name	Recommended Quantity (pounds/acre)
Western Wheatgrass	*Pascopyrum smithii*	-
Inland Saltgrass	*Distichlis spicata*	-
Slender Wheatgrass	*Elymus trachycaulus*	-
Alkali Sacaton	*Sporobolus airoides*	-

2.4.1 Drill Seeding

Drill seeding will be implemented whenever possible as the desirable seeding method. An appropriate drill seeder and operator care will be utilized to insure that the segregation of seed or the plugging of seed tubes does not occur during the seeding process.

Action Steps	Interim	Final
In areas where the goal is to simulate a natural appearance, the site will be drilled in multiple, cross, or overlapping patterns. This action will eliminate the "row crop" appearance of the site.	X	X
Thurston will use a drill seeder that is of a size and properly equipped to complete the reseeding action. The drill seeds will be equipped with the following: a) light-weight chains attached to the drill tubs to lightly cover the seed after deposition; and b) packer wheels to compact the seeded furrow and lessen the depth of soil overlying the planted seed.	X	X

2.4.2 Hydro-seeding and Hydro-mulching

The hydro-seeder will be used from the adjacent road or right-of-way. In areas too distant to effectively spray from the road/right-of-way, a hose line may be required. *Only as a last resort* will the hydro-seeder drive over a scarified site. Hydro-seeding and/or hydro-mulching is generally applied in layers.

Action Steps	Interim	Final
First Layer: Overspray the disturbed site with the recommended seed mix in combination with organic tackifier water. This action allows the seed to have direct contact with the soil.	**X**	**X**
Second Layer: Overspray the first layer with wood fiber mulch and water. On slopes greater than 50 percent, an additional organic tackifier will be added.	**X**	**X**
Third Layer: Within 24 hours of applying the seed, the area will be over sprayed with additional wood fiber mulch in combination with fertilizer, if appropriate. This layer will minimize depredation of seeds by birds and rodents.	**X**	**X**
Thurston would not allow disturbance to occur following hydro-seeding or hydro-mulching. If hydromulch is penetrated (by humans, vehicles, livestock, etc.) erosion can quickly start directly reducing the success of this method. (refer to **Section 3.3.5**)	**X**	**X**

2.4.3 Seed Mix

All seed will be acquired from a reputable and knowledgeable source. All acquired seed will be certified weed-free. All seed poundage will be pure-live seed. All seed bag tags will be kept as part of the reclamation record as these tags have important information.

Annual planning or reseeding and reclamation actions would be conducted when feasible. The Service recommended plant species utilized for reclamation activities associated with this project can be found in **Section 2.4**. This seed mix will create a diverse vegetative cover, maximize the benefits to both wildlife and domestic livestock, and ensure compatibility with the surrounding

DRAFT

landscape. They typically include species that provide quick soil stabilization and quick vegetative cover. Final reclamation would be initiated following the decommissioning of the proposed wells. Given that the life of the project (LOP) could be as long as 30 years, advantageous and more efficient methods of reclamation could become common practice. Should this be the case, Thurston would consider utilizing reclamation methods that are currently considered "best practice" in coordination with the Service.

It must be noted that individual surface use agreements negotiated with individual private landowners may replace these seed mixes with crop seed, such as alfalfa, corn, wheat or sorghum.

2.4.4 Protection of Reseeded Areas

Animals, including birds, rodents, big game and livestock, are drawn to reseeded areas when the site is seeded and following germination. Seeds provide protein, carbohydrates and sugars; and new vegetation provides substantial nutrition and fiber, as well as moisture to foraging animals.

The following actions are proposed to ensure protection of seeded/reseeded areas from animal predation.

Action Steps	Interim	Final
Thurston would follow directions outlined above to minimize predation of seeded areas by foraging birds and rodents (see **Sections 2.4.1** and **2.4.2**).	X	X
It may be appropriate to install a temporary protective fence around reseeded areas to reduce the possibility of foraging by wildlife and/or livestock. If range-standard livestock fences are deemed appropriate, such fences would be built to current BLM fence standards deemed appropriate for specific wildlife and livestock species, or as directed by the surface managing agencies or private landowner. Thurston would coordinate with the Service to determine whether fencing would be necessary during reclamation.	X	X
If the established reclamation objectives are not being met, the protective fence would remain and be regularly maintained, until the reseeded areas achieve the desired density and are mature enough to withstand foraging pressures.	X	X
Thurston would install barricades and signs, as needed, to prevent unwanted vehicle traffic while access routes, ROW corridors and well pads are being revegetated.	X	X

DRAFT

2.4.5 Monitoring

The following monitoring strategy will be undertaken to provide quantifiable data needed to assess the success of this plan to quickly identify changes in trends/progress towards realizing the overall objectives of this plan. Monitoring would be initiated following the second growing season of interim and final reclamation and would be considered complete once 75 percent relative cover is achieved or prior to that mark should the Service deem otherwise.

Action Steps	Interim	Final
Thurston would use the pre-disturbance photos to help reclaim the site, restore drainage patterns, provide a qualitative record of pre-disturbance vegetation composition and production (refer to **Section 2.2**).	X	X
Established photo point(s) at permanent/long-term reference locations would be used to provide a general view of the reclaimed areas associated with the well pads and along the access route and pipeline corridors.	X	X
If after two years interim reclamation actions are successful, i.e., meeting the objectives or making substantial progress towards meeting the objectives outlined in this plan, Thurston would reduce monitoring to every other year until final reclamation is completed and also determined successful.	X	X

Criteria to Determine Success

On Federal, State or Tribal lands, the reclamation objective would be a vegetation community that within two years is comprised of desired and/or seeded species, and where the basal vegetative cover is 75 percent of a similar undisturbed adjacent native vegetation community. If after 3 years, basal cover is less than 30 percent, then additional seeding and reclamation efforts may be required. On private surface land, the criteria for determining success would be as set out above or as specified in the individuals SUA.

3.0 CONCLUSIONS

Successful implementation of this reclamation plan will achieve both short- and long-term goals set out above, and re-establish desirable and diverse vegetative cover for wildlife habitat, livestock grazing and other land uses comparable to those available prior to disturbance. Close coordination between agency representatives and company personnel will encourage successful reclamation and minimize expensive duplicate efforts to insure success.

DRAFT

REFERENCES:

Monsen, Stephen B., Richard Stevens, Nancy L. Shaw., comps. 2004. *Restoring western ranges and wildlands* (Gen. Tech. Rep. RMRS-GTR-136, vols. 1 and 2.) Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 698 pp, plus indices.

United States Department of the Interior and Department of Agriculture (BLM-USFS). 2007. *Surface operating standards and guidelines for oil and gas exploration and development*. BLM/WO/ST-06/021+3071/REV 07. Bureau of Land Management. Denver, CO. 84 pp.

DRAFT

Appendix A – Noxious Weed Management Plan

Noxious Weed Management Plan

Thurston Energy, LLC

Ouray National Wildlife Refuge 2-Well Development Program

Prepared for:

Thurston Energy, LLC
4925 Greenville Ave. Suite 840
Dallas, TX 75206

And

United States Fish and Wildlife Service
Ouray National Wildlife Refuge
HC 69 Box 232
Randlett, Utah 84063

Prepared by:

KLEINFELDER
Bright People. Right Solutions.

Table of Contents

1.0 Introduction
- 1.1 Plan Purpose
- 1.2 Goal and Objectives

2.0 Noxious Weed Inventory

3.0 Noxious Weed Management
- 3.1 Preventative Measures
- 3.2 Treatment Methods
- 3.3 Education

4.0 Monitoring

5.0 Herbicide Application, Handling, Spills and Cleanup
- 5.1 Herbicide Application and Handling
- 5.2 Herbicide Spills and Cleanup
- 5.3 Worker Safety and Spill Reporting

1.0 Introduction

This plan was developed to identify post-construction and post-reclamation noxious weed control practices that would be implemented for the Thurston Energy, LLC (Thurston) Ouray National Wildlife Refuge 2-Well Development Program. Noxious weeds have the potential to invade areas disturbed by construction and may spread along the reclaimed areas of the development. Soil disturbance may also allow weed seed already present to germinate and grow. Several laws, regulations, and policies govern the management of noxious weeds on public, state and private lands. Under the Noxious Weed Act, county, state, and federal agencies are charged with the responsibility to identify and control invasive plant species that are harmful to public health, crops, livestock, land, or other property. Utah specifies that each property owner has the responsibility to control noxious weeds on lands in their possession or under their control. County weed boards may issue individual notices requiring control of noxious weeds on a particular property, and can cause weeds to be controlled with all expenses to be paid by the person in possession of the property.

1.1 Plan Purpose

The purpose of this plan is to prescribe methods to prevent and control the spread of noxious weeds during post-construction and post-reclamation within the project area. Thurston and their contractors would be responsible for carrying out the methods described in this plan.

This plan is applicable to the well location, reclaimed well location, access road corridor, pipeline corridor and, extra workspaces previously disturbed for the construction and drilling of the project.

1.2 Goal and Objectives

The goals of weed control are to implement measures to prevent the spread of noxious weeds during construction, production and reclamation operations and to implement prescribed treatments to eliminate, to the extent possible, the invasion of noxious weeds from surrounding lands. Monitoring during the construction, production, and reclamation phases will ensure that the weed management goals are achieved.

2.0 Noxious Weed Inventory

Prior to construction commencement, BLM and company personnel would identify known existing noxious weed infestations in the immediate area of construction. The results of this identification would trigger post-construction, and post-reclamation noxious weed monitoring and determine that control is required for the immediate area. Early identification of existing infestations has helped to minimize the spread of noxious weeds during construction and drilling operations in the past. Information available through the County will include species identified within or adjacent to the project area, locations of infestations, and extent of infestations. Noxious and invasive weeds known to occur within the Ouray National Wildlife Refuge are listed below in **Table 2-1** below.

Table 2-1. Noxious Weeds Known to Occur on the Ouray National Wildlife Refuge

Common Name	Scientific Name	State or County Noxious Weed List
Musk Thistle	*Cardus Nutans*	State List Class B
Broad-leaved Peppergrass*	*Lepidium latifolium*	State List Class B
Russian Knapweed	*Centaurea repens*	State List Class B
Scotch Thistle	*Onopordum acanthium*	State List Class B
Canada Thistle	*Cirsium arvense*	State List Class C
Field Bindweed	*Convolvulus arvensis*	State List Class C
Saltcedar*	*Tamarix ramosissima*	State List Class C
Russian Olive	*Elaeagnus angustifolia*	Uintah County List C
Russian Thistle	*Salsola tragus*	N/A
Bull Thistle	*Cirsium vulgare*	N/A
Siberian Elm	*Ulmus pumila*	N/A
Kochia	*Kochia scoparia*	N/A
Cheatgrass	*Bromus tectorum*	N/A

Source: USFWS 2013

* Known to occur within the Project Area

3.0 Noxious Weed Management

Weeds are spread by a variety of means including vehicles, construction equipment, construction and reclamation materials, livestock, wildlife and recreational activities. Implementation of preventative measures to control and spread of noxious weeds is the most cost-effective management approach.

3.1 Preventative Measures

Noxious weed free certification will be required for all straw bales, mulches or additional seed used in the reclaimed project. Certification must be valid for the state in which it will be used.

Any noxious weed program conducted within the project area will be conducted in cooperation with neighboring landowners. On non-federal lands, Thurston may be responsible for control of new weed invasions on areas cleared in association with the project, depending on agreements made among private landowners, weed control districts, and other entities. On federal lands, Thurston is responsible for all noxious weed control associated with the project.

3.2 Treatment Methods

Thurston will implement noxious weed control measures as determined in consultation with the affected agencies. The appropriate duration of control measures carried out by Thurston and how those measures will be coordinated with adjacent landowners and the weed control districts will be provided by the regulatory agencies. The noxious weed controls will be in accordance with existing regulations and jurisdictional land management agency or landowner agreements. When identified weed

populations are in their appropriate growth stage for effective herbicide control, appropriate herbicides will be applied to the identified weed infestations to reduce the spread or proliferation of weeds.

Herbicide application can be an effective means of reducing the size of or eradicating noxious weed populations. Applications will follow a strict adherence to label specifications and will be controlled, as described in **Section 5.1**, to minimize the impacts on the surrounding, desired vegetation. In areas of dense weed infestation, a broad application may be appropriate, followed by a seeding program. Supplemental seeding will be based on the criteria of the federal permit. The timing of subsequent revegetation efforts will be based on the persistence of the selected herbicide.

Herbicide treatment is designed to kill or weaken weeds, and prevent seed formation if site conditions are acceptable. All herbicide application will be completed by a state-approved and licensed applicator. Proposed weed control programs on private lands will be reviewed and approved by the landowner and local weed control districts.

Post-construction and post-reclamation treatment methods for areas with continuing weed infestations will be based on species-specific conditions (e.g., slope, time of year) and will be coordinated with the local regulatory offices.

The importance of timing of control methods for each species should be emphasized. When methods are implemented at the wrong time, they may be ineffective or stimulate additional growth or seed production by the noxious weed. Also note that some species are so persistent that a combination of methods potentially in multiple years may be necessary for successful control. A one-time application of a control method is rarely sufficient to control a noxious weed population. Follow-up applications, combined with sustained monitoring, are necessary to control, contain, and in some cases, eradicate populations of noxious weeds. The duration and long-term responsibility of monitoring and noxious weed management by Thurston will be determined by the regulatory agency.

3.3 Education

Thurston will provide information to their employees regarding noxious weed identification, management, and impacts on agriculture, livestock and wildlife. The critical importance of preventing the spread of noxious weeds in areas not infested, and controlling the proliferation of weeds already present will be explained. The importance of adhering to measures to prevent the spread of noxious weeds will be stressed (e.g., utilizing weed free straw bales and quickly identifying new infestations of noxious weeds).

4.0 Monitoring

Thurston will monitor for noxious weeds after completion of reclamation for a period specified by the BLM. Surveys will be conducted as early in the year as feasible to identify and treat noxious weeds before they produce seed. Areas where field surveys will be conducted every year include: 1) invasion or infestation sites on reclaimed land identified during post-project monitoring surveys, by local agencies, or by Thurston; 2) sites adjacent to existing noxious weed infestations; and 3) areas previously treated for noxious weeds. Field survey information, including species identified, locations of infestations, and extent of infestations, will be submitted to the local regulatory office involved (e.g. BLM or Weed Control District).

5.0 Herbicide Application, Handling, Spills and Cleanup

5.1 Herbicide Application and Handling

Herbicide selection will be based on information gathered from the Weed Control Districts and land management agency. Prior to herbicide application, Thurston or the Contractor will obtain any required permits from the local authorities. The herbicide application will be performed by a licensed contractor in accordance with all applicable laws and regulations.

Herbicide EPS label instructions will be strictly adhered to. Application of herbicides will be suspended when any of the following conditions exists:

- Wind velocity exceeds 6 miles per hour for application of liquids or 15 miles per hour for application of granular herbicides;
- Snow or ice covers the foliage of noxious weeds;
- Precipitation is occurring or is imminent.

Vehicle-mounted sprayers (e.g., handgun, boom, and injector) will be used primarily in open areas that are readily accessible by vehicles. Hand application methods (e.g., backpack spraying) that target individual plants will be used to treat small, scattered weed populations in rough terrain or along the road corridor. Calibration checks of equipment will be conducted at the beginning of spraying and periodically to ensure that proper application rates are being achieved.

Herbicides will be transported daily to the project site with the following provisions:

- Only the quantity needed for that day's work will be transported;
- Concentrate will be transported only in containers and in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing and safety equipment; and
- Mixing will only be conducted on-site and only at a distance greater than 200 feet from open or flowing water, wetlands, or other sensitive resources.

All herbicide equipment and containers will be inspected daily for leaks.

5.2 Herbicide Spills and Cleanup

All reasonable precautions will be taken to avoid spilling herbicides. In the event of an herbicide spill, cleanup required immediate action that is based on adequate preparation. A spill kit carried on contractor vehicles and kept in herbicide storage areas will allow quick and effective response to spills. Items to be included in a spill kit are:

- Protective clothing and gloves
- Absorptive clay, "kitty litter" or other commercial absorbent
- Plastic bags and bucket
- Shovel
- Fiber brush and screw-in handle
- Dust pan
- Caution tape
- Detergent

Response to an herbicide spill will vary with the size and location of the spill, but general procedures include:

- Utilizing protective clothing
- Stopping the leaks
- Containing the spilled material
- Cleaning up and removing the spilled herbicide and contaminated absorptive material and soil, and
- Transporting the spilled pesticide and contaminated material to an authorized disposal site.

5.3 Worker Safety and Spill Reporting

All herbicide contractors will obtain and have readily available copies of the appropriate EPA Material Safety Data Sheets (MSDS) for the herbicides being used. Herbicide spills will be reported in accordance with all applicable laws and requirements.

APPENDIX G

Thurston Energy LLC's Draft Spill Prevention, Control and Countermeasure (SPCC) Plan
and
Thurston Spill Response Plan Supplement

SPILL PREVENTION, CONTROL AND COUNTERMEASURE PLAN

Thurston Energy Ouray National Wildlife Refuge 2-Well Development Program

November 2013

Prepared for:

Thurston Energy LLC

Prepared by:

300 E. Mineral Ave., Suite 7
Littleton, Colorado 80122
(303) 781-8211
www.kleinfelder.com

This Page Intentionally Blank.

TABLE OF CONTENTS

TABLE OF CONTENTS ..... **I**

LIST OF APPENDICES ..... **I**

REGULATORY CROSS-REFERENCE (40 CFR 112.7) ..... **III**

1.0 GENERAL INFORMATION **1**

1.1 Facility and Operator General Information 1
1.2 Designated Person Accountable for Oil Spill Prevention (40 CFR 112.7 (f) (2)) 1
1.3 Management Approval (40 CFR 112.7) 1
1.4 Plan Implementation (40 CFR 112.7) 3
1.5 Professional Engineer Certification (40 CFR 112.3 (d)) 3
1.6 Plan History 5
1.7 Plan Review and Amendments (40 CFR 112.5) 5
1.7.1 Review Summary *5*
1.7.2 SPCC Plan Amendments (40 CFR 112.5 (a) and (c)) *7*

2.0 SPILL PREVENTION AND CONTROL **1**

2.1 Facility Conformance (40 CFR 112.7(a)(1) and (2)) 1
2.2 Facility Physical Layout (40 CFR 112.7 (a)(3)) 2
2.3 Drainage Pathways and Distances to Navigable Waters 2
2.4 Applicable Industry Standards (40 CFR 112.3) 3
2.5 Spill Discovery and Response Procedures (112.7 (a)(3)(iv), (a)(4) and (5)) 6
2.6 Spill Prediction and Control (40 CFR 112.7 (a)(3), (b), (c) and (d)) 7
2.7 Impracticability of Containment or Diversion Measures (40 CFR 112.7 (d)) 9
2.8 Oil Spill Contingency Plan and Commitment of Manpower (40 CFR 112.7 (d)(1) and (2)) 10
2.9 Discharge Countermeasures and Methods of Disposal (40 CFR 112.7 (a)(3)(iv), (v) and (a)(4)) 10
2.10 Regulatory Conformance (40 CFR 112.7 (j)) 11
2.11 Regulatory Exclusions 12

3.0 INSPECTIONS, TESTING AND TRAINING **1**

3.1 Inspections and Testing (40 CFR 112.7 (e) and 112.9(c)(3)) 1
3.1.1 Scheduled Examinations *1*
3.1.2 Inspections *5*
3.1.3 Integrity Testing Procedures (40 CFR 112.7 (e)) *5*
3.1.4 Brittle Fracture Evaluation (40 CFR 112.7(i)) *6*
3.2 Personnel Training and Discharge Prevention Procedures (40 CFR 112.7 (f)(1), (2) and (3)) 6

LIST OF APPENDICES

Appendix A Contact List and Phone Numbers; Federal, State and Local Agency Call List; Utah Spill Reporting Requirements; Utah Department of Oil, Gas and Mining General Rules and Incident Report Form; Qualified Discharge Report Form; and Spill Report Form
Appendix B Annual SPCC Inspection Summary, Annual Production Facility Examination SPCC Form and Inspection Forms
Appendix C Stormwater Inspection Procedure and Drainage Record and Flowline Maintenance Program
Appendix D Training Record Form
Appendix E SPCC Plan Technical Amendment Summary and Certifications
Appendix F Facility List and Site Specific Information

This Page Intentionally Blank.

REGULATORY CROSS-REFERENCE (40 CFR 112.7)

Regulatory Citation	Description of Regulatory Requirement	*Section Number*
§112.3 (d)	Professional Engineer Certification	1.5, Appendix F
§112.3	Applicable Industry Standards	2.3
§112.5 (a),(c)	Plan Amendments and Certification	1.7.1, 1.7.2 Appendix E
§112.5(b)	Plan Review	1.7.1
§112.7	General Requirements - Management Approval	1.3
§112.7	General Requirements - Sequence or Cross-Reference	Cross-Reference
§112.7	General Requirements - Discussion of Facilities Not Yet Fully Operational	1.4
§112.7(a)(1) – (2)	Deviation from Requirements: Reasons, Methods, and Equivalent Protection	2.1, Appendix F
§112.7(a)(3)	Physical Layout and Facility Diagram	2.2, Appendix F
§112.7(a)(3)(i)	Container Capacity and Type of Oil	2.6, Appendix F
§112.7(a)(3)(ii)	Discharge Prevention Measures	2.6
§112.7(a)(3)(iii)	Discharge or Drainage Controls	2.6
§112.7(a)(3)(iv)	Countermeasures: Discovery, Response, and Cleanup	2.5, 2.9
§112.7(a)(3)(v)	Disposal: Legal Requirements	2.9
§112.7(a)(3)(vi)	Notification Phone Lists	2.2, Appendix A
§112.7(a)(4)	Discharge Notification Form	2.5, 2.9 Appendix A
§112.7(a)(5)	Discharge Procedures Organized	2.5, Appendix A
§112.7(b)	Fault Analysis	2.6
§112.7(c)	Adequate Secondary Containment	2.6, Appendix F
§112.7(d)(1)	Contingency Planning	2.8
§112.7(d)(2)	Commitment of Resources	2.8
§112.7(e)	Inspections, Tests, and Records - Written Procedures	3.1
§112.7(e)	Inspections, Tests, and Records - Records of Inspections & Tests; Signatures	Appendix B
§112.7(e)	Inspections, Tests, and Records - Records Maintenance	Appendix B
§112.7(f)(1)	Personnel Training	3.2
§112.7(f)(2)	Designated Person Accountable for Spill Prevention	1.2, 3.2
§112.7(f)(3)	Spill Prevention Briefings	3.2
§112.7(g)	Security	2.11
§112.7(h)	Tank Truck Loading/Unloading Area	2.6
§112.7(i)	Brittle Fracture Evaluation	3.1.4
§112.7(j)	Conformance with State Requirements	2.10, Appendix A
§112.8	SPCC Plan Requirements: Onshore Facilities Excluding Production Facilities	2.11
§112.9(b)	Oil production facility drainage	Appendix C
§112.9(c)	Oil production facility bulk storage containers	2.6, 3.1, Appendix F
§112.9(d)	Facility transfer operations, oil production facility	Appendix C
§112.10	Drilling and Workover Facilities	2.11
§112.11	Plan Requirements for offshore oil drilling, production, or workover Facilities	2.1
§112.12	SPCC plan requirements	2.1
§112.20	Facility Response Plans / Certification of Applicability of Substantial Harm Criteria	2.1, Appendix F

This Page Intentionally Blank.

1.0 GENERAL INFORMATION

1.1 Facility and Operator General Information

1. Name of Facility: **Thurston Energy Ouray National Wildlife Refuge 2-Well Development Program**

2. Type of Facility: **Onshore Production Facilities**

3. Facility Location: **A list of the individual facilities subject to this plan is located in Appendix F.**

4. Name and Address of Owner or Operator

   Name: Thurston Energy LLC

   Address: P. O. Box 749
   Vernal, Utah 84078

1.2 Designated Person Accountable for Oil Spill Prevention (40 CFR 112.7 (f) (2))

The following person reports to management and is accountable for discharge prevention at the subject facility:

Name: Dave Allin
Title: Thurston Representative

1.3 Management Approval (40 CFR 112.7)

Thurston Energy LLC is committed to the prevention of discharges of oil to the environment, including navigable waters, and maintains the highest standards for spill prevention control through regular review, updating and implementation of this SPCC plan. With the signature below, I certify that this Spill Prevention, Control and Countermeasure Plan will be implemented as herein described.

Signature _____ Date _____

Name: Dave Allin
Title: Thurston Representative

This Page Intentionally Blank.

1.4 Plan Implementation (40 CFR 112.7)

The facility, procedures, methods, or equipment are fully operational as of the date of this plan.

1.5 Professional Engineer Certification (40 CFR 112.3 (d))

By means of this Professional Engineer Certification, I hereby attest that:

1) I am familiar with the provisions of 40 CFR Part 112;
2) I, or my agent, have visited and examined the facilities (facility specific certification is included in Appendix F);
3) This SPCC Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards, and with the requirements of 40 CFR 112;
4) Procedures for required inspections and testing have been established, and
5) This plan is adequate for the subject facilities (facility specific certification is included in Appendix F).

_____
Printed Name of Registered Professional Engineer

Registration No.:_____ State: CO_____ _____
Signature of Registered Professional Engineer
Date:_____

This Page Intentionally Blank.

1.6 Plan History

This plan supersedes all plans listed in the following table**:**

Plan Name	Date Created
1. None	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

1.7 Plan Review and Amendments (40 CFR 112.5)

1.7.1 Review Summary

In accordance with 40 CFR 112.5(b), a review and evaluation of this SPCC plan is conducted at least once every five years. As a result of this review and evaluation, Thurston Energy LLC will amend the plan to include more effective spill prevention and control technology if:

1) Such technology will significantly reduce the likelihood of a spill event from the facilities, and
2) If such technology has been field-proven at the time of the review.

Original Date of Plan: **November 20, 2013**

By my signature below, I attest that I have completed a review and evaluation of this SPCC plan for the Thurston Energy Ouray National Wildlife Refuge 2-Well Development Program.

Review Date	Signature	Printed Name	Title	Plan Amended (Yes/No)

This Page Intentionally Blank.

1.7.2 SPCC Plan Amendments (40 CFR 112.5 (a) and (c))

In accordance with 40 CFR 112.5(a) and (c), this SPCC plan will be amended within six months if modifications to the facility materially affect the potential for discharges of oil into or upon navigable waters. Technical amendments to this SPCC plan shall be certified by a Registered Professional Engineer. Modifications which may require plan amendments and certification include, but are not limited to:

1) Commissioning or decommissioning of containers;
2) Replacement, reconstruction, or movement of containers;
3) Reconstruction, replacement or installation of piping systems;
4) Construction or demolition actions that may alter secondary containment structures;
5) Changes in products or type of equipment service; or
6) Changes in operating and maintenance procedures.

Such amendments shall be implemented as soon as possible, but no later than six months after such changes occur.

Administrative or non-technical amendments do not require the certification of a Registered Professional Engineer. Examples of administrative changes include, but are not limited to, phone number changes, contact name changes, facility name changes or any non-technical text revisions.

Technical and administrative amendments to this plan are tracked on the Amendment Summary in Appendix E. Detailed descriptions and certification pages, if necessary, for each amendment follow the Amendment Summary in Appendix E.

This Page Intentionally Blank.

2.0 SPILL PREVENTION AND CONTROL

2.1 Facility Conformance (40 CFR 112.7(a)(1) and (2))

The subject facility is in conformance with 40 CFR 112 with the following exceptions noted below. The reason for any nonconformance and the provided equivalent environmental protection measures are also noted.

Conformance Deviation	Reason for Nonconformance	Equivalent Environmental Protection Measures
Piping is not provided with a means of secondary containment as specified by 112.9(d)(3).	Construction techniques utilized for these facilities make secondary containment for piping impracticable.	The operator has implemented an oil spill contingency plan and a written commitment of manpower. The facility is visited on a frequent basis and any spills or accidental releases of oil are promptly cleaned up by the operator.
Separation equipment are not provided with a means of secondary containment as specified by 112.7(k).	Secondary containment for separation equipment is not practicable as dikes or trenches can trap explosive and toxic gases creating a safety hazard and would also interfere with access required for normal operations.	The operator has implemented an oil spill contingency plan and a written commitment of manpower. The facility is visited on a frequent basis and any spills or accidental releases of oil are promptly cleaned up by the operator.

2.2 Facility Physical Layout (40 CFR 112.7 (a)(3))

The subject facility is a typical onshore crude oil and/or natural gas production facility and saltwater disposal facility consisting of wellheads, separation equipment and bulk storage containers.

A diagram of the subject facility is located in Appendix F. The following details and location information, as applicable, is included on the diagram:

1) Containers and their contents;
2) Completely buried and/or bunkered tanks including underground storage tanks subject to 40 CFR Part 280 or 281;
3) Drum and portable container storage areas;
4) Secondary containment measures and type; and
5) Transfer operation points.

Emergency contact numbers are located in Appendix A. These contacts include the National Response Center, Federal and State agencies. Also included is the operator's internal contacts and a list of cleanup contractors in case of a spill.

2.3 Drainage Pathways and Distances to Navigable Waters

Drainage pathways proximate to the subject facility is depicted on scaled USGS topographic maps for the area are contained in Appendix F.

2.4 Applicable Industry Standards (40 CFR 112.3)

The design, construction, operation and maintenance of the subject facility is to be conducted in conformance with the following industrial standards as applicable.

Facility Component	Applicable Industry Standards
Secondary Containment	**API Standard 2610** - Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities. **API Recommended Practice 51** - Onshore Oil and Gas Production Practices for Protection of the Environment. **NFPA 30** - Flammable and Combustible Liquids Code **BOCA** - National Fire Prevention Code
Loading and Unloading Areas	**API Standard 2610** - Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities. **NFPA 30** - Flammable and Combustible Liquids Code
Diked Area Drainage	**API Standard 2610** - Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities. **API Recommended Practice 51** - Onshore Oil and Gas Production Practices for Protection of the Environment. **NFPA 30** - Flammable and Combustible Liquids Code
Storage Tank Construction and Materials	**API Standard 620** - Design and Construction of Large Welded Low Pressure Storage Tanks. **API Standard 650** - Welded Steel Tanks for Oil Storage. **STI F911** - Standard for Diked Aboveground Steel Tanks **STI Publication R931** - Double Wall Aboveground Storage Tank Installation and Testing Instructions. **UL Standard 142** - Steel Aboveground Tanks for Flammable and Combustible Liquids. **UL Standard 1316** - Standard for Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products. **PEI Recommended Practice 200** - Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling
Facility Equipment	**API Specification 12 B** - Bolted Tanks for Storage of Production Liquids **API Specification 12 D** - Field Welded Tanks for Storage of Production Liquids **API Specification 12 F** - Shop Welded Tanks for Storage of Production Liquids **API Specification 12 J** - Oil Gas Separators **API Specification 12 K** - Indirect-Type Oil Field Heaters **API Specification 12 L** - Vertical and Horizontal Emulsion

Facility Component	Applicable Industry Standards
	Treaters
Corrosion Protection for Buried Piping	**NACE Recommended Practice 0169** - Control of External Corrosion on Underground or Submerged Metallic Piping Systems. **STI Recommended Practice 892** - Recommended Practice for Corrosion Protection of Underground Piping Networks Associated with Liquid Storage and Dispensing Systems.
Inspection Procedures	**API Recommended Practice 12R1** - Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Productions Service. **API Recommended Practice 510** - Alternative Rules for Exploration and Production Pressure Vessels. **API Standard 574** - Inspection Practices for Piping Systems. **API Standard 653** - Tank Inspection, Repair, Alteration, and Reconstruction.
Inspection and Testing of Piping and Valves	**API Standard 570** - Piping Inspection Code. **API Recommended Practice 574** - Inspection Practices for Piping System Components. **ASME B31.3** - Process Piping **ASME 31.4** - Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols.
Secondary Containment for Drilling and Workover Operations	**API Recommended Practice 52** - Land Drilling Practices for Protection of the Environment. **NFPA 30** - Flammable and Combustible Liquids Code **BOCA** - National Fire Prevention Code
Integrity Testing	**API Standard 653** - Tank Inspection, Repair, Alteration, and Reconstruction. **API Recommended Practice 575** - Inspection of Atmospheric and Low-Pressure Tanks. **API Standard 570** - Piping Inspection Code **ASME B31.3** - Process Piping **ASME 31.4** - Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols. **STI Standard SP001-00** - Standard for Inspection of In-Service Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids **UL Standard 142** - Steel Aboveground Tanks for Flammable and Combustible Liquids.
Brittle Fracture Evaluation	**API Standard 653** - Tank Inspection, Repair, Alteration, and Reconstruction. **API Recommended Practice 920** - Prevention of Brittle Fracture of Pressure Vessels.

Note: API - American Petroleum Institute
ASME - American Society of Mechanical Engineers
BOCA - Building Officials and Code Administrators International
NACE - National Association of Corrosion Engineers
NFPA - National Fire Protection Association
PEI - Petroleum Equipment Institute
STI - Steel Tank Institute
UL - Underwriters Laboratories

2.5 Spill Discovery and Response Procedures (112.7 (a)(3)(iv), (a)(4) and (5))

The facility in this SPCC Plan is visually inspected on each visit by the lease operator. These visual inspections are made to insure that the facility is operating properly and to verify that there are no signs of spills, releases, or potential for spills. Production records are available for review to indicate anomalies in flow which may be an indicator of a spill or release.

If a spill or release is discovered using the above methods, then the following steps could be taken to reduce the magnitude of the spill and initiate containment and cleanup:

1. Account for personnel and assure the safety of personnel. In the case of fire, explosion, or exposure hazards, evacuate all personnel.
2. Stop the release at the source, if such action can be performed without risk of injury, and remove all sources of ignition.
3. Position fire suppression equipment, if necessary.
4. Alert the local fire department, if necessary.
5. Shut of pumps and close valves that allow oil to flow to the segment of the system from where the spill is occurring.
6. Alert adjacent property owners/operators, as necessary.
7. If conditions have been deemed safe, qualified personnel are to attempt to contain the spill. Prevent or divert spilled oil from approaching structures, in particular, water or storm drains. Sorbent material, spark-proof shovels, brooms, neoprene gloves, and other spill response materials may be obtained and utilized as necessary.
8. Repair, plug, or patch the leaking equipment if practical and can be done without injury.
9. Contact Thurston Energy operation personnel (Appendix A) to provide details of the situation and to receive further instruction regarding additional and cleanup actions, as needed.

Lists of contact names and phone numbers for Thurston Energy personnel, company approved cleanup contractors, and federal and state agencies are contained in Appendix A. Also included in Appendix A are forms to be used for organizing release notification information and the submission of required information to the EPA Regional Administrator for qualified discharges.

A qualified discharge is any oil spill that contacts surface water, whether flowing or not, or an intermittent drainage and results in a “visible sheen” on the water.

2.6 Spill Prediction and Control (40 CFR 112.7 (a)(3), (b), (c) and (d))

Listed below is a general list of equipment that may be present at the facility. Specific equipment located at the subject facility with the potential to accidentally release oil are specifically addressed by location in Appendix F, which describes the prediction of the direction rate of flow, and total quantity of oil that could be discharged.

The reasonably expected modes of major failure or accident for which oil could be released from the facility is as follows:

A. Bulk Storage Tank Leak or Failure

I. Failure Modes: Corrosion, vandalism, lightning strikes, valve or piping failure, overfilling.

II. Rate of Flow: Variable, depending upon the type, size and location of the tank failure. The ambient temperature at the time of the release may affect the viscosity of the oil and thereby impact the rate of flow. Flow rates for corrosion failure are typically low, ranging from less than a gallon per day to a gallon per hour. Flows resulting from valve and piping failures or vandalism typically range from a gallon per hour to 400 bbls per hour. Lightning strikes may result in a release that is essentially instantaneous.

III. Discharge Quantity: Variable depending upon the type and location of the failure. The total quantity discharged would not exceed the working capacity of the largest tank.

IV. Preventative Measures: Personnel routinely perform visual inspections of storage tanks. Storage tanks are constructed in accordance with API industry standards. Materials used in constructing the tanks are compatible with the substances stored. Earthen berms or other diversionary structures are utilized to control any released fluids. Tanks are appropriately sized to minimize the risk of overfilling.

B. Tanker Truck Loading, Unloading and Salt Water Disposal Operations

I. Failure Modes: Piping or valve failure, tank failure, overflow, and human error.

II. Rate of Flow: Variable depending upon the type, size and exact location of the failure, and the amount of oil in the tanker truck and storage tank. The ambient temperature at the time of the release may affect the viscosity of the oil and thereby impact the rate of flow. Flow rates resulting from piping and valve failures can range from 1 gallon per hour up to 400 bbls per hour. The flow rate for tank truck overflows typically will not exceed 5 to 10 bbls per

minute. Tank failures may result in releases that are essentially instantaneous.

III. Discharge Quantity: Variable depending upon the type and location of the failure. The total quantity discharged would not exceed the working capacity of the largest tank.

IV. Preventative Measures: Tanker truck loading and unloading operations are conducted in accordance with United States Department of Transportation regulations (49 CFR 177). All loading operations are attended by the truck driver. No smoking or open flames are allowed in the vicinity of the storage tanks and loading area. Wheel chocks are placed at the wheel nearest the truck loading connection to reduce the risk of the truck movement during loading operations. Following the completion of loading operations, the transfer line is disconnected and all valves and outlets on the tanker truck and the storage tank are visually inspected for leakage prior to vehicle departure.

In addition, for truck loading where the loading occurs outside of containment, absorbents are readily available for use in the case of a release.

C. Process Unit Failure (Separator/Heater Treater/Gun Barrel)

I. Failure Modes: Process vessels may potentially rupture, or associated lines, valves and gauges may fail or leak.

II. Rate of Flow: Variable, depending upon the mode and extent of the failure. The maximum expected rate of flow from a process unit failure is the oil process rate of the equipment plus any additional fluid volume contained in the vessel above the elevation of the rupture. The oil process rates for the subject equipment are contained in Appendix F.

III. Discharge Quantity: Variable, depending on the type of failure and the length of time that the failure went undetected.

IV. Preventative Measures: Personnel routinely perform visual inspections of process units. Process units are constructed in accordance with API and ASME industry standards. Earthen berms or other diversionary structures are utilized to control any released fluids.

D. Piping Failure

I. Failure Modes: Both aboveground and buried pipelines may rupture or corrode and leak. Associated flanges, screwed connections, valves and gauges are also subject to corrosion and may fail or leak.

II. Rate of Flow: Variable, depending on the size and location of the piping related failure. The maximum potential rate of flow is not expected to exceed the oil process rates as listed in Appendix F.

III. Discharge Quantity: Variable depending upon the type and extent of the failure and the length of time that the failure went undetected.

IV. Prevention Measures: Personnel routinely perform visual inspections of aboveground piping and buried flowline right-of-ways to detect failures. As warranted by soil conditions, corrosion protection is provided for buried pipelines. Earthen berms or other diversionary structures are utilized to control any released fluids. Operator has also implemented a flowline maintenance program, located in Appendix C.

E. Compressor Engine Oil Sump Failure

I. Failure Modes: Corrosion, vandalism, valve or piping failure, overfilling, mechanical damage to sump.

II. Rate of Flow: Variable, depending upon the type, size and location of the failure. Flow rates for corrosion failure are typically low, ranging from less than a gallon per day to a gallon per hour. Flows resulting from valve and piping failures or vandalism typically range from a gallon per hour to instantaneous. Mechanical damage to the engine sump may result in a release that is essentially instantaneous.

III. Discharge Quantity: Variable depending upon the type and location of the failure. The total quantity discharged would not exceed the working capacity of the oil sump.

IV. Where practicable, floor drains, containment structures or sorbent materials are utilized to control releases of lubricating oil. Oil changes are attended to prevent accidental spills of used and unused oils.

2.7 Impracticability of Containment or Diversion Measures (40 CFR 112.7 (d))

Containment at the facility subject to this Plan is adequate and therefore is not required to prepare an Oil Spill Contingency Plan.

2.8 Oil Spill Contingency Plan and Commitment of Manpower (40 CFR 112.7 (d)(1) and (2))

Thurston Energy, LLC maintains a contingency plan for oil spills and a written commitment of manpower follows.

Thurston Energy, LLC is committed to a strong antipollution and spill prevention program. Thurston Energy, LLC is committed to designing and operating their facilities in a manner that will minimize the size and occurrence of spills. They are committed to a pro-active training and inspection program that will insure that their facilities are operated and maintained in a manner that will prevent or minimize the occurrence of spills.

In the event of a spill, Thurston Energy, LLC will commit the manpower, equipment and materials necessary to ensure that the cleanup occurs in the shortest practical time while minimizing environmental damage and maximizing product recovery.

2.9 Discharge Countermeasures and Methods of Disposal (40 CFR 112.7 (a)(3)(iv), (v) and (a)(4))

In the event of an accidental release, Thurston Energy personnel will promptly initiate recovery actions as appropriate.

Levels of Response

Major Releases: Major releases are defined as:

1) Spills of crude oil, condensate, or saltwater greater than 10 bbls, or 2) Spills of refined crude oil products, including but not limited to, gasoline, diesel fuel, aviation fuel, asphalt, road oil, kerosene, fuel oil, and derivative of mineral, animal or vegetable oils, or 3) Any volume of oil which results in a fire, will reach a water course, or may with reasonable probability endanger public health or result in substantial damage to property or the environment.

Major releases will be handled under the direction of Thurston Energy personnel. Response contractors listed in Appendix A will be utilized as necessary to complete the clean-up. If oil should threaten surface waters, the company contingency plan will be implemented. Containment structures would be constructed and booms would be deployed as needed to protect waterways.

Minor Releases: Releases not classified as major shall be reported internally to the appropriate supervisor on an incident report.

Product Recovery, Handling and Cleanup

Spills onto Soil

Mobile oil spills should be contained as soon as possible by the construction of earthen dams or by the placement of mechanical barriers. Free oil may be removed from the ground by the use of a vacuum truck. Sumps or trenches may be dug to intercept or drain free oil. Remaining free oil may be removed from the ground by the use of oil-absorbent materials.

When all free oil has been removed, the affected soil should be delineated, both vertically and horizontally. All impacted soil should then be excavated by backhoe or similar appropriate equipment for remediation or disposal.

To prevent stormwater contamination, all impacted soils are to be placed in an approved disposal site or in a secure interim storage location for future remediation or disposal, unless more immediate on-site techniques and be implemented. Placing the impacted soil on a sheet of visquene and providing appropriate cover, diking, or stormwater diversions, is acceptable.

A final cleanup should be achieved as soon as practicable. Several methods are acceptable for the cleanup of oil contaminated soil; regulatory agencies may specify which methods are appropriate.

Spills onto Water

Oil spills onto surface waters must be cleanse up to the satisfaction of the regulatory agencies. The spill should be contained as soon as possible by the use of floating booms or other mechanical barriers. Free oil may be removed from the water by the use of a vacuum truck or by oil-skimming equipment. Remaining free oil may be removed from the water by the use of oil-absorbent materials such as spray-sorb. Oil-absorbent materials may also be used to remove oil that has accumulated on shoreline soils, rocks and vegetation. Oil contaminated shoreline materials may require removal to a suitable treatment site for cleanup as described above.

2.10 Regulatory Conformance (40 CFR 112.7 (j))

The facility in this plan is subject to state regulated discharge prevention and notification requirements beyond those specified by federal regulation. These state regulations are addressed in Appendix A.

2.11 Regulatory Exclusions

The subject facility is classified as onshore production facility which store only petroleum based oils. Furthermore, the facility is not expected to cause substantial harm to the environment as demonstrated by the completed Certification of Substantial Harm Determination form contained with facility site specific information in Appendix F. As such, the subject facility is excluded from the following regulations:

Subpart A – General Requirements

40 CFR 112.7(g)	Security

Subpart B - Requirements for Petroleum Oils and Non-Petroleum Oils except Animal Fats

40 CFR 112.8	SPCC plan requirements for onshore facilities (excluding production)
40 CFR 112.10	SPCC requirements for onshore oil drilling and workover facilities
40 CFR 112.11	SPCC plan requirements for offshore oil facilities

Subpart C - Requirements for Animal Fats and Oils, Greases, Fish and Marine Oils

40 CFR 112.12	SPCC plan requirements

Subpart D - Response Requirements

40 CFR 112.20	Facility response plans
40 CFR 112.21	Facility response training and drills/exercises

This Page Intentionally Blank.

3.0 INSPECTIONS, TESTING AND TRAINING

3.1 Inspections and Testing (40 CFR 112.7 (e) and 112.9(c)(3))

Written procedures are outlined in Section 3.1.1 and utilized when performing prescribed inspection and testing of equipment. Records of inspections and tests are to be signed by the appropriate supervisor/inspector and maintained at the local office.

The following items are inspected to minimize oil discharges from occurring; tanks for leaks and corrosion, process units for leaks and corrosion, sight glasses for leaks, pumps for leakage around packing glands, lines for leaks around fittings, flowlines for leaks, wellheads and metering stations for leakage. If problems are identified, prompt action is taken for repairs. A record of annual inspection is to be kept with the SPCC Plan for at least 3 years. A copy of the annual inspection form is included in Appendix B.

3.1.1 Scheduled Examinations

The lease operator, in the course of their normal routine, is responsible for examining the facility covered by this SPCC Plan. In addition to routine observations made by lease personnel in the course of their routine activities, an annual inspection will be documented to insure that the facilities are in compliance with the SPCC Plan and SPCC regulations. Following are general procedures for conducting the annual inspection. There may be specific items covered in the SPCC Plan that are specific to the facility and may not be covered by these general guidelines. Conversely, certain items covered by these procedures may not apply to every facility.

THE FOLLOWING ITEMS (if present) MUST BE INSPECTED:

Entrance to Facility

Well/Tank Battery signs must be present and legible, proper warning signs should be present at entrance, verify that housekeeping is adequate, cattle guard & access road are in good shape, inspect off location and lease road for any erosion or discharge issues.

Wellsite & Tank Battery

Verify all applicable safety signs and windsocks are visible and functional, weeds and vegetation is under control, well head and associated equipment is free of extraneous oil.

If present, earthen berms will be inspected for adequate capacity, erosion and leaks. If present, steel berms will be inspected for damage and leaks. If present, liners will be inspected for damage and leaks. All recorded damage will be repaired.

All berms or firewalls will be inspected for accumulations of liquid. Accumulations of liquid will be removed. If the liquid is from one of the tanks, the source will be found and repaired. Rainwater will be removed as soon as feasible after rain.

If a firewall or berm is equipped with a drain, the drain MUST be closed, sealed and locked when not in use. The drain must be manned whenever it is in use. Each drainage event must be recorded. The Drainage Log contained in Appendix C will be used for this record.

Any liquid handling system associated with a flare system, liquid knock-outs, etc., should be inspected.

If present, the flare ignition system should be checked periodically. Any evidence of liquid carryover should be reported and corrective action to prevent reoccurrence implemented. If liquid carryovers are frequent, containment should be constructed to contain the carryover.

Circulation Pump(s), Transfer Pump(s), LACT Unit, Pumping Unit

These pieces of equipment should be visually inspected for leaks, especially around valves, fittings, inspection plates, drip pans, pipe supports, pumping well polish rod stuffing boxes, bleeder & gauge valves, and sight glasses.

Verify that auto kill switches are functioning properly, appropriate safety signs are posted, and planned maintenance of equipment has been accomplished.

Separator(s), Free Water Knockout(s), Heater Treater(s)

These pieces of equipment should be visually inspected for leaks, especially around valves, fittings, flange joints, valve glands & bodies, drip pans, pipe supports, bleeder & gauge valves, inspection plates and sight glasses. Vents on glycol units should be inspected for excessive liquid carryover. Glycol still vents must discharge into an appropriate container if liquids are generated.

Pressure relief valves should be checked for leaks, evidence of leaks and signs of failure.

Inspect safety equipment, such as fixed ladders and platforms, to ensure they are in proper using condition.

Fired equipment is equipped with flame arrestor(s), and the flame arrestor(s) should be clean and in good condition.

Valves for treater dumps and back pressure should be working properly and free of leaks.

Ensure that cathodic protection readings are within proper ranges.

Production Tanks

Ensure that proper identification numbers, signs and hazard warning are posted.

Inspect stairways, walkways, handrails, landings, toe boards and man ways are in proper working condition and free of obstructions.

All liquid storage tanks, except fresh water tanks, (including crude oil, saltwater, fuel, treatment chemicals containing oils, lube oil, etc.) and associated piping will be visually inspected for leaks, overflows, and signs of potential problems. Special emphasis will be placed on the inspection of foundations, bottom seams, patches, flanges, piping connections, sight-glasses, and other openings. Valves should be in their proper position and locked or sealed, if required.

Earthen berms will be inspected for adequate capacity, erosion and leaks. Steel berms will be inspected for damage and leaks. Cement firewalls will be inspected for leaks, cracks, or other signs of failure. If present, liners will be inspected for damage and leaks. All recorded damage will be repaired.

All berms or firewalls will be inspected for accumulations of liquid. Accumulations of liquid will be removed. If the liquid is from one of the tanks, the source will be found and repaired. Rainwater will be removed as soon as feasible after rain.

If a firewall or berm is equipped with a drain, the drain MUST be closed, sealed and locked when not in use. The drain must be manned whenever it is in use. Each drainage event must be recorded. The Drainage Log contained in Appendix C will be used for this record.

Flowlines and other piping in and around batteries will be inspected for leaks, evidence of leaks, and evidence of potential leaks.

All discharges of rainwater from berms to drainage MUST BE RECORDED. The date of discharge must be noted on the Drainage Log contained in Appendix C. Prior to discharge, the water must be visually inspected for the presence of oil and tested for the presence of saltwater. If either is present, the water cannot be discharged and must be disposed of in a permitted disposal system or other acceptable manner.

Saltwater Disposal Wells

Verify all applicable safety signs and windsocks are visible and functional, weeds and vegetation is under control, well head and associated equipment is free of extraneous oil.

If present, earthen berms will be inspected for adequate capacity, erosion and leaks. If present, steel berms will be inspected for damage and leaks. . If present, liners will be inspected for damage and leaks. All recorded damage will be repaired.

All berms or firewalls will be inspected for accumulations of liquid. Accumulations of liquid will be removed. If the liquid is from one of the tanks, the source will be found and repaired. Rainwater will be removed as soon as feasible after rain.

If a firewall or berm is equipped with a drain, the drain MUST be closed, sealed and locked when not in use. The drain must be manned whenever it is in use. Each drainage event must be recorded. The Drainage Log contained in Appendix C will be used for this record.

Inspect facility following a sudden change in atmospheric temperature, to detect possible system upsets capable of causing a discharge.

Mechanical integrity of the disposal well must be established by the owner or operator no less than once every five (5) years in accordance with Chapter 4, Section 5 of the Wyoming Oil and Gas Conservation Commission.

Chemical Storage Tanks, Pumps and Piping

Chemical injection systems should be inspected for leaks, especially around storage tanks, pumps and fittings on tubing or piping.

Lube Oil Systems

Lube oil storage tanks and the piping systems should be inspected, especially around tanks, pumps and fittings on the piping or tubing.

Drain Pans or Drip Pans

The liquid level in drip or drain pans should be checked and emptied as necessary.

Ditches and Waterways

Drainage ditches in and around the facility and within the field, roadside ditches, water courses, ponds, etc. will be inspected for oil accumulations and/or evidence of saltwater spills.

Above Ground Piping

Flowlines, injection lines, gathering lines, gas lift lines, and other piping in and around batteries, separation facilities, saltwater handling facilities, etc. will be inspected for leaks, evidence of leaks, and evidence of potential leaks. Lines along roads will be inspected while driving through the field. Other above ground lines will be walked periodically.

Plant Process Heaters

Plant process heaters should be checked for leaks, evidence of leaks and signs of failure. The stack should be checked for visible smoke emissions.

Rainwater Removed from Berms

All discharges of rainwater from berms to drainage **MUST BE RECORDED**. The date of discharge must be noted on the Drainage Log contained in Appendix C.

Prior to discharge, the water must be visually inspected for the presence of oil and tested for the presence of saltwater. If either is present, the water cannot be discharged and must be disposed of in a permitted disposal system or other acceptable manner.

3.1.2 Inspections

Comprehensive inspections of oil containing equipment may be performed on an annual basis or when indicated during the completion of a scheduled examination. These inspections should be conducted by a competent person or a qualified inspector in accordance with the standards and scheduled frequency listed below. The inspections are to be documented using the checklists contained in Appendix B and the records maintained at the appropriate field office. If problems are identified, appropriate corrective actions are to be implemented and noted on the inspection form.

Equipment	Inspection Standard
Bulk Storage Tanks	**API RP 12R1** - Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks In Production Service
Pressure/Process Vessels	**API RP 510** - Alternative Rules for Exploration and Production Pressure Vessels
Piping	**API 574** - Inspection Practices for Piping System Components

3.1.3 Integrity Testing Procedures (40 CFR 112.7 (e))

Integrity testing records should be kept for the life of the affected storage containers and separation equipment. The following industrial standards for conducting integrity tests will be utilized as appropriate. Integrity testing will occur at the time of installation, modification, construction, relocation, or replacement of applicable equipment.

Industrial Testing Standard	Title
API Standard 653	Tank Inspection, Repair, Alteration, and Reconstruction
API Recommended Practice 575	Inspection of Atmospheric and Low-Pressure Tanks
API RP 510	Production Pressure Vessels
ASME 31.4	Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols
Steel Tank Institute Standard SP001-00	Standard for Inspection of In-Service Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids
UL Standard 142	Steel Aboveground Tanks for Flammable and Combustible Liquids

3.1.4 Brittle Fracture Evaluation (40 CFR 112.7(i))

If present, all field constructed aboveground tanks and process equipment are to be evaluated for the risk of failure due to brittle fracture whenever:

1) The equipment undergoes repair, alteration, reconstruction, or a change in service that may affect the risk of a discharge or failure due to brittle fracture, or

2) The equipment has discharged oil or failed due to brittle fracture failure or other catastrophe.

The brittle fracture risk evaluation is to be conducted in accordance with the following industrial standards as appropriate.

1) **API Standard 653** - Tank Inspection, Repair, Alteration, and Reconstruction.

2) **API Recommended Practice 920** - Prevention of Brittle Fracture of Pressure Vessels.

3.2 Personnel Training and Discharge Prevention Procedures (40 CFR 112.7 (f)(1), (2) and (3))

1) Personnel are properly instructed in the following:

    a. Proper operation and maintenance of equipment to prevent oil discharges,
    b. Discharge procedure protocols,
    c. Applicable oil spill prevention laws, rules and regulations,
    d. General facility operations, and

e. The contents of facility SPCC plans and applicable pollution control laws, rules, and regulations.

Appropriate oil-handling personnel will be trained in discharge prevention procedures prior to the assignment of job responsibilities. Company and contract personnel attend in-house compliance awareness programs prior to the assignment of job responsibilities. Compliance awareness briefings are conducted at least annually to assure continued understanding of the applicable SPCC plans. In addition, spill related topics are discussed at safety meetings. Safety meeting topics include: spill control equipment; equipment operation and maintenance; inspection of containment structures, vessels, tanks and piping; spill response, containment and clean up; company policies on reporting and responding to spills; and specific SPCC Plans.

2) For the subject facility, the designated person accountable for oil discharge prevention is:

   Name: Dave Allin
   Title: Thurston Representative

3) Scheduled prevention briefings for the operating personnel are conducted on a annual basis to assure adequate understanding of the SPCC Plan. The briefing program is as follows:

   A SPCC compliance awareness program is presented on an annual basis. The program includes a review of specific SPCC Plans, updates on state and federal regulations, company policy and procedures, and spill reporting.

   Additional short briefing sessions are held as needed before and during certain jobs to review spill potential, necessary precautions and appropriate responses. Also, included in the briefing is a review of known spill events or failures, malfunctioning components and recently developed precautionary measures. A copy of the Training Record Form is attached in Appendix D.

4) Contractors working at the facility are instructed as follows:

   1) Pollution control will be maintained at all times in connection with all operations by the contractor. Thurston Energy personnel will be notified immediately of any emitting, spilling, venting, discharging, disposal or loss of any hazardous or harmful substances, air contaminants and/or pollutants of any nature (referred to as discharges).

   2) If any discharges occur as a result of the performance of work by the contractor, its agents, employees and subcontractors, or other persons for

whom the contractor is responsible, the contractor will immediately proceed to stop or abate such discharges.

3) The contractor will comply with any and all local, state and federal laws, regulations, standards and orders applicable to the controlling and prevention of discharges.

4) Contractors will install and maintain adequate discharge control equipment on or about their plant, rig or other equipment to prevent discharges, in violation of any local, state and federal laws, regulations, standards and orders.

APPENDIX A

CONTACT LIST AND PHONE NUMBERS

FEDERAL, STATE AND LOCAL AGENCY CALL LIST

UTAH SPILL REPORTING REQUIREMENTS

UTAH DEPARTMENT OF OIL, GAS, AND MINING GENERAL RULES AND INCIDENT REPORT FORM

QUALIFIED DISCHARGE REPORT FORM

SPILL REPORT FORM

SPCC NOTIFICATION LIST

Thurston Energy Call List

Dave Allin / Thurston Representative
Office: 469-726-2222

Ralph Curton / Chief Executive Officer
Office: 469-726-2222

Chris Curton / Chief Operating Officer
Cell: 469-726-2222

Emergency Response Contractors

Uintah City Emergency Manager / 435-828-5008
Emergency Response

SPCC NOTIFICATION LIST
FEDERAL, STATE AND LOCAL AGENCY CALL LIST

If any oil contacts surface water, whether flowing or not, or an intermittent drainage, and results in a "visible sheen" on the water, the following phone contacts must be made as soon as possible following the discovery of the spill. The contacts must be made regardless of the quantity discharged.

1) National Response Center (The NRC should automatically contact the EPA)
2) The Regional office of the EPA
3) State Water Quality Control Division
4) State Oil and Gas Regulatory Agency
5) Any other state agencies with responsibility for oil pollution control
6) Affected land owners

FOLLOW COMPANY REPORTING PROCEDURES SHOULD IT BECOME NECESSARY TO CONTACT ANY OF THE ABOVE AGENCIES. USE THE RELEASE NOTIFICATION FORM ON THE FOLLOWING PAGE TO ORGANIZE AND COMMUNICATE INFORMATION CONCERNING THE SPILL.

FEDERAL AGENCIES

National Response Center: (800) 424-8802
EPA Region VIII Spill Line: (303) 293-1788
EPA Region VIII: (303) 312-6312 (Working Hours) 1-800-227-8914 (24-Hour)
BLM Vernal Field Office (Vernal , UT): (435) 781-4400
USFS Office: Ouray National Wildlife Manager- Dan Schaad (435) 545-2522 x 13

STATE AGENCIES

Utah Division of Oil, Gas and Mining: (801) 243-9466
Utah Department of Environmental Quality: (801) 536-4123

LOCAL EMERGENCY RESPONSE AGENCIES

Emergency Central Dispatch (Where Available - Local Calls Only) : 911
Sheriff: 911 or (435) 789-4222
Vernal Police: 911 or (435) 781-7121
Ambulance: 911

RELEASE NOTIFICATION FORM

Should it become necessary to inform any federal or state agency concerning an accidental release, be prepared to provide the following information.

Reporter's Full Name:_____ Title:_____
Primary Phone Number: _____ Secondary Phone Number:_____
Company:_____ Office Address:_____
_____

Spill Location:_____ Sec._____ Twp._____ Rge._____
Nearest City:_____ County:_____ State:_____
Directions From Nearest City to Spill Location:_____
_____

Date and Time of Release:_____ Type of Material Released:_____
Source of the Material Release:_____
Total Quantity Released:_____ Quantity Released Into Water:_____
Container Type:_____ Container Material:_____
Container Storage Capacity:_____ Facility Storage Capacity:_____
Cause of Release: _____
Actions Undertaken to Correct, Control and Mitigate the Incident:_____
_____

Description of Damages:_____
_____

Number of Injuries:_____ Number of Deaths:_____
Evacuation(s) Conducted:_____ Number Evacuated:_____

NOTIFICATION LOG

Agency Contacted	Contact Person	Date and Time of Contact
National Response Center (NRC)		
EPA Regional Office		
State Water Quality Division		
State Oil & Gas Commission		
BLM Field Office		
Forest Service		
Other:_____		
Other:_____		

Information Submittal to EPA Regional Administrator for Qualified Discharge(s)

In the event of a qualified discharge or discharges, this form can be utilized to provide official notification to the EPA Regional Administrator. If a facility has experienced a discharge or discharges that meet one of the following two criteria, then this report must be submitted to the Regional Administrator within 60 days.

(Check as appropriate)

☐ This Facility has experienced a reportable spill as referenced in 40 CFR Part 112.1(b) of 1,000 gallons or more.

☐ This Facility has experienced two (2) reportable spills (as referenced in 40 CFR Part 112.1(b) of greater than 42 gallons each within a 12-month period.

Facility Name and Location:_____

Facility Contact Person (Name, address/phone number):_____

Facility Maximum Storage or Handling Capacity:_____

Facility Normal Daily Throughput:_____

Describe the Corrective Actions and Countermeasures Taken (include description of equipment repairs and replacements):_____

Describe the Facility (Attach maps, flow diagrams and topographical maps as necessary):_____

Describe the Cause of the Discharge (as referenced in 40 CFR Part 112.1(b)) Including Failure Analysis of the System:_____

Describe the Preventative Measures Taken or Contemplated to Minimize the Possibility of Recurrence:_____

Other pertinent information:_____

NOTE: A copy of this report must also be sent to the appropriate state agency in charge of oil pollution control activities.

APPENDIX B

ANNUAL SPCC INSPECTION SUMMARY

ANNUAL PRODUCTION FACILITY SPCC EXAMINATION FORM

INSPECTION FORMS

SPCC INSPECTION SUMMARY

SPCC Inspection Summary

Facility: _____

Stock tank and Pressure Vessel Summary

Stock Tank Description / Designation	Year of Construction	Pressure Vessel Description / Designation	Year of Construction	Risk Designation (High or Low) (1)

Inspection History

Facility Examination (Annually)	Piping External Examination (Annually)	Piping Internal Inspections (2)	Tank External Examination (Annually)	Tank External Inspection (Within 15 years after construction)	Tank Internal Inspection/ Examination (3)	Pressure Vessel External Inspections (4)	Pressure Vessel Internal/ On-Stream Inspections (5)

Notes: 1 - Pressure vessel risk is categorized as high or low based upon three criteria:
1) potential for failure,
2) vessel history including operating conditions, age and remaining corrosion allowance, and
3) consequences of failure including location relative to employees, the public, and environmental receptors.

2 - Piping internal examinations may be conducted when equipment is shut-down for maintenance or repairs.

3 - Tank internal examinations are to be conducted when a tank is:
a) cleaned, b) transferred to a new location, c) service is changed more than 5 years following an inspection, or d) entered for any type of maintenance or repair.

Internal tank inspections are to be conducted at 3/4 of the corrosive rate life as determined by external inspections.

4 -External inspections for pressure vessels categorized as low or high risk shall be performed:
when on-stream or internal inspections are performed or at shorter intervals at the owners option.

5 - On-stream or internal pressure vessel inspections shall be performed:
at least every 15 years or 3/4-remaining corrosion life, whichever is less for low risk vessels, or
at least every 10 years or ½-remaining corrosion life, whichever is less for high risk vessels.

ANNUAL PRODUCTION FACILITY SPCC EXAMINATION FORM

ANNUAL PRODUCTION FACILITY SPCC EXAMINATION FORM

Facility:_____ Date:_____

Circle the appropriate response. Note that any "No" response requires corrective actions.

I. Wellheads / Salt Water Disposal Wellheads

A. All wellhead and tree connections should be leak free: Yes / No / NA

B. All active wells should have their master valves operating and serviced to assure they function: Yes / No / NA

II. Flowlines

A. All active flowlines are leak free: Yes / No / NA

B. All visible flowlines are free from serious corrosion: Yes / No / NA

C. All active flowlines have a gauge installed to monitor pressure: Yes / No / NA

D. Any clamp-type repairs on active flowlines are free from leaks: Yes / No / NA

III. Process Equipment

A. All incoming flowlines (active and inactive) should be identified: Yes / No / NA

B. Shut down valves are checked for fail-safe closure: Yes / No / NA

C. Header/manifold systems, process vessels and their interconnecting piping should be leak-free: Yes / No / NA

D. All automatic dump valves should be checked for fail-safe closure:Yes / No / NA

E. Operating pressures on process vessels should be at or below the vessel's rated working pressure: Yes / No / NA

F. Secondary containment system is intact and competent: Yes / No / NA

IV. Tanks

A. All bulk storage tanks and their related piping are leak-free: Yes / No / NA

B. Secondary containment system is intact and competent: Yes / No / NA

C. All pressure/vacuum reliefs and atmospheric tank vents are operational: Yes / No / NA

D. Rainwater drain valve is kept in the closed position: Yes / No / NA

E. Foundations and supports are stable and sufficient: Yes / No / NA

F. Storage container are free of serious corrosion: Yes / No / NA

G. Tanks have not experienced overflows: Yes / No / NA

V. General

A. Drainage ditches proximate to the site are free from oil: Yes / No / NA

B. Chemical injection systems are free from leaks: Yes / No / NA

C. Lube oil systems are free from leaks: Yes / No / NA

D. Facility is graded to drain stormwater away from natural watercourses: Yes / No / NA

E. Pits are free from oil: Yes / No / NA

F. Pits have at least 1 foot of freeboard: Yes / No / NA

G. Liquid level in sumps is adequate to prevent overflow: Yes / No / NA

H. Alarm systems operate properly: Yes / No / NA

I. Drip and drain pans are emptied as needed to prevent overflows: Yes / No / NA

J. Secondary containment for portable oil containers is adequate: Yes / No / NA

K. Stormwater siphons are free from debris and blockage: Yes / No / NA

L. Pump seals and related piping are free from leaks: Yes / No / NA

VI. Corrective Actions

_____

_____

_____

_____

_____

_____

VII. Certification

A. Original Inspection By:_____

Title:_____

Date:_____

B. Corrective Actions By:_____

Title:_____

Date:_____

INSPECTION FORMS:

PROCESS PIPING INSPECTION FORM

PRESSURE VESSEL INSPECTION FORM

STORAGE TANK INSPECTION FORMS

EXTERNAL INSPECTION CHECKLIST FOR PROCESS PIPING

API 574 - Inspection Practices for Piping System Components

Facility:_____ Date:_____

Authorized Inspector:_____

A. 1 Leaks

a. Process.	Adequate/Corrective Action Required
b. Stream tracing.	Adequate/Corrective Action Required
c. Existing clamps.	Adequate/Corrective Action Required

A. 2 Misalignment

a. Piping misalignment/restricted movement.	Adequate/Corrective Action Required
b. Expansion joint misalignment.	Adequate/Corrective Action Required

A. 3 Vibration

a. Excessive overhung weight.	Adequate/Corrective Action Required
b. Inadequate support.	Adequate/Corrective Action Required
c. Thin, small bore, or alloy piping.	Adequate/Corrective Action Required
d. Threaded connections.	Adequate/Corrective Action Required
e. Loose supports causing metal wear.	Adequate/Corrective Action Required

A. 4 Supports

a. Shoes-off support.	Adequate/Corrective Action Required
b. Hanger distortion of breakage.	Adequate/Corrective Action Required
c. Bottomed-out springs.	Adequate/Corrective Action Required
d. Brace distortion/breakage.	Adequate/Corrective Action Required
e. Loose brackets.	Adequate/Corrective Action Required
f. Slide plates/rollers.	Adequate/Corrective Action Required
g. Counterbalance condition.	Adequate/Corrective Action Required
h. Support corrosion.	Adequate/Corrective Action Required

A. 5 Corrosion

a. Bolting support points under clamps.	Adequate/Corrective Action Required
b. Coating/painting deterioration.	Adequate/Corrective Action Required
c. Soil-to-air interface.	Adequate/Corrective Action Required
d. Insulation interfaces.	Adequate/Corrective Action Required
e. Biological growth.	Adequate/Corrective Action Required

A. 6 Insulation

a. Damage/penetrations.	Adequate/Corrective Action Required
b. Missing jacketing/insulation.	Adequate/Corrective Action Required
c. Sealing deterioration.	Adequate/Corrective Action Required
d. Bulging.	Adequate/Corrective Action Required
e. Banding (broken/missing).	Adequate/Corrective Action Required

API RP 510 - Alternative Rules for Exploration and Production Pressure Vessels

PRESSURE VESSEL INSPECTION RECORD

Form Date_____
Form No._____
Owner or User_____
Vessel Name_____

Name of Process_____
Location_____
Internal Diameter_____
Tangent Length/Height_____
Shell Material Specification_____
Head Material Specification_____
Internal Materials_____
Nominal Shell Thickness_____
Nominal Head Thickness_____
Design Temperature_____
Maximum Allowable Working Pressure_____
Maximum Tested Pressure_____
Design Pressure_____
Relief Valve Set Pressure_____
Contents_____

Owner or User Number_____
Jurisdiction/National Board Number_____
Manufacturer_____
Manufacturer's Serial No._____
Date of Manufacture _____
Contractor _____
Drawing Numbers_____

Construction Code _____
Joint Efficiency _____
Type Heads _____
Type Joint _____
Flange Class _____
Coupling Class _____
Number of Manways _____
Weight _____

Special Conditions_____

Thickness Measurements

Sketch or Location	Location Number	Original Thickness	Required Minimum Thickness	Date

Comments (See Note 2)_____

Method_____

Authorized Inspector_____

Notes:
1. Use additional sheets, as necessary.
2. The location that each comment relates to must be described.

Checklist for External Inspection

Identification

Tank Designation: _____

Size: _____

Date of Inspection: _____

Measured or Estimated Liquid Level: _____

Contents: _____

Foundation

Tank Shell Adequately Supported	Yes / No
Tank Floor Level (No Differential Settlement)	Yes / No
Signs of Soil or Foundation Failure (Major Tank Settlement)	Yes / No
Grade Ring/Foundation Structurally Sound	Yes / No
Adequate Drainage Away from Tank	Yes / No

Tank Bottom

Visible Signs of Leakage Around Tank Bottom	Yes / No
Bottom/Shell Connection Free of Cracks & Leaks	Yes / No

Tank Shell

Tank Shell Patches — Yes / No
If Yes, Number & Location

_____

_____

Tank Shell Abnormalities/Distortions — Yes / No
If Yes, Number & Location

_____

_____

Visible Signs of Holes/Leaks — Yes / No
If Yes, Number & Location

_____

_____

Cracks or Seepage in Seam — Yes / No
If Yes, Number & Location

_____

_____

Cracks in Shell/Roof Seam Yes / No
If Yes, Number & Location

_____

_____

Condition of Eternal Coating of Uninsulated Tanks, Holes, Disbonding, Deterioration, Discoloration
Number & Location

_____

_____

Checklist for External Inspection (Continued)

Condition of Insulation Protection of Insulated Tanks, Shell Material (Holes/Tears).
Number & Location

_____

_____

Seal Around Roof/Shell Joint (Separations). Number & Location

_____

_____

Seal Around Appurtenances (Separations). Number & Location

_____

_____

External Corrosion Yes / No

Tank Bolt/Rivets Corrosion Yes / No / NA
If Yes, Number & Location

_____

_____

Tank Fiberglass Delaminated Yes / No / NA
If Yes, Number & Location

_____

_____

Results of Ultrasonic Measurements

In Vapor Zone

_____

_____

In Liquid Zone

_____

_____

Tank Roof Deck

Hatches Securely Closed Yes / No / NA

Roof Patches Yes / No
If Yes, Number & Location

_____

_____

Roof Deck Abnormalities/Distortions Yes / No
If Yes, Number & Location

_____

_____

Visible Signs of Holes/Leaks Yes / No
If Yes, Number & Location

_____

_____

Checklist for External Inspection (Continued)

Deck External Corrosion
None, Minimal, Moderate, Severe

_____

Adequate Drainage Off of Deck Yes / No

Condition of External Coating of Uninsulated Deck, Disbonding, Deterioration, Discoloration
Number & Location

_____

_____

Condition of Insulation Protection of Insulated Deck
Roof Material (Holes/Tears). Number & Location

_____

_____

Seal Around Appurtenances (Separations). Number & Location

_____

_____

Results of Ultrasonic Thickness Measurements. (Compare to Original Values)

_____

_____

_____

Results of Hammer Tests

_____

_____

_____

Appurtenances

Thief Hatch & Vent Valves Seal Properly	Yes / No
Thief Hatch Opens Freely W/O Plugging	Yes / No
Vent Valve Operational	Yes / No
Sample & Drain Valves Leak	Yes / No
Inspect Nozzle Seams for Cracks	Yes / No
Piping, and the like, Properly Supported Off of Tank	Yes / No
Tank Shell Dimpling at Connections	Yes / No
Metal Appurtenance Bonded OR Gas Blanket	Yes / No
Operational on Fiberglass Tank	Yes / No / NA
Stairways & Walkways Structurally Sound	Yes / No

Checklist for External Inspection (Continued)

Miscellaneous

Cathodic Protection Operational/Potential Adequate	Yes / No / NA
Vapor Recovery System Operational	Yes / No / NA
Gas Blanket System Operational	Yes / No / NA
Containment Dikes and/or Liner Maintained & Adequate Size	Yes / No / NA
Proper Warning Signs in Place	Yes / No
Automatic Level Indicator Operational & Accurate	Yes / No
(Compare to Hand Gauge Level)	Yes / No / NA
Tank Area Clean of Trash & Vegetation	Yes / No

Recommended Future Action

_____

_____

_____

_____

Checklist for Internal Inspection

Identification

Tank Designation: _____

Size: _____

Date of Inspection: _____

Measured or Estimated Liquid Level: _____

Contents: _____

Pre-Inspection

Tank Properly Cleaned Yes / No

Tank Atmosphere Properly Tested Yes / No

Tank Properly Isolated Yes / No

Tank Structurally Sound Yes / No

Confined Space Entry Procedure Implemented Yes / No

Tank Bottom

Floor Adequately Supported (Limited Voids Under Floor Plate) Yes / No

Floor Sloped for Adequate Drainage. If Low Spots Exist, Number & Location Yes / No

_____

_____

_____

Plate Buckling/Deflection Acceptable Yes / No

Visually Inspect & Record Plate & Weld Condition

_____

_____

_____

Inspect Shell/Bottom Seam

_____

_____

_____

Condition of Internal Coating (Holes, Disbonding, Deterioration). Number & Location

_____

_____

_____

Inspect & Describe Pitting Appearance (Depth, Sharp Edged, Lake Type, Dense, Scattered)

Results of Ultrasonic Thickness Measurement

Checklist for Internal Inspection (Continued)

Results of Vacuum Tests

_____

_____

_____

Results of Penetrant Dye Tests

_____

_____

_____

Results of Hammer Tests

_____

_____

_____

Results of Other Testing (Magnetic Flux Leakage, Acoustical Emission and so forth)

_____

_____

_____

In Earthquake Zones 3 & 4, Roof Supports Restrained From Horizontal Movement Only (Not Welded to Floor) Yes / No

Identify Areas to Be Repaired. Number & Location

_____

_____

Tank Shell

Visually inspect & Record Plate & Weld Conditions. Number & Location

_____

_____

Inspect & Describe Pitting Appearance. (Depth, Sharp Edged, Lake Type, Dense, Scattered, and so on)

_____

_____

Condition of Internal Coating (Holes, Disbonding, Deterioration). Number & Location

_____

_____

Survey Shell to Check Plumb & Roundness

_____

_____

Results of Ultrasonic Thickness Measurements in Vapor Zone

Checklist for Internal Inspection (Continued)

In Liquid Zone

_____

_____

_____

Identify Areas to Be Repaired. Number & Location

_____

_____

_____

Tank Roof

Inspect & Describe Pitting Appearance (Depth, Sharp Edge, Lake Type, Dense, Scattered)

_____

_____

_____

Conditions of Internal Coating. (Holes, Disbonding, Deterioration) Number & Location

_____

_____

_____

Visually Inspect & Record Plate & Weld Conditions. Number & Location

_____

_____

_____

Results of Ultrasonic Thickness Measurements

_____

_____

_____

Check Roof Support Columns for:

- Thinning in Vapor Zone
- Thinning in Liquid Zone
- Drain Opening in Bottom of Pipe or Concrete Filled
- Proper Attachment to Roof & Bottom
- Inspect Girders & Rafters for Thinning

Girders & Rafters Properly Secured Yes / No

Identify Areas to Be Repaired. Number & Location

_____

_____

_____

_____

Checklist for Internal Inspection (Continued)

Appurtenances

Visually Inspect All Seals & Gaskets

Inspect & Service Pressure/Vacuum Hatches/Valves

Inspect Gauge Well (If Existing)

Inspect Internal Reinforcing Pads (If Existing) for Cracks

Inspect Internal Nozzle Seams for Cracks, Corrosion, and the like

Inspect Diffusers & Rolling Systems

Inspect Swing Lines

Inspect Wear Plates

Recommended Future Action

_____

_____

_____

APPENDIX C

STORMWATER INSPECTION PROCEDURE AND DRAINAGE RECORD

FLOWLINE MAINTENANCE PROGRAM

STORMWATER INSPECTION PROCEDURE AND DRAINAGE RECORD

Earthen berms, containment rings, and other containment structures are inspected on a regular basis for accumulations of oil and precipitation. These inspections are not typically documented. Generally, drainage from containment structures is not conducted. Minor accumulations of precipitation are allowed to evaporate. Large accumulations of fluids may be removed by vacuum truck and either returned to a separation vessel for processing or transported to a permitted recovery/disposal facility.

In the unlikely event that drainage events are conducted, the accumulated stormwater is visually inspected for contamination from oil. **NO** oil is released from or pumped from within the berm onto the ground or into a water course. Drainage or pumping does not occur until the fluids have been inspected for oil. Draining only occurs with constant visual supervision of the drain outlet, and only after determining that the water is indeed fresh. Draining ceases at the first sign of an oil sheen and the remaining fluid is removed and properly treated or disposed. The foreman in charge of the facility operations is consulted before any berm is drained or purged.

As required by law, any time that stormwater is discharged from the dike, a record of the inspection, discharge and oil removal is to be maintained. The following is the discharge record:

Date of Discharge	Oil Sheen Present	Inspector's Signature	Comments

APPENDIX D

TRAINING RECORD FORM

TRAINING RECORD FORM

DATE: _____ TRAINER:_____

SUBJECT:_____

_____

_____

ATTACH COPIES OF ALL HANDOUTS ETC.

NAME	SIGNATURE	COMPANY	JOB TITLE

APPENDIX E

SPCC PLAN TECHNICAL AMENDMENT SUMMARY AND CERTIFICATIONS

AMENDMENT SUMMARY

The November 20, 2013 SPCC plan for the Thurston Energy Ouray National Wildlife Refuge 2-Well Development Program has been amended as shown in the summary table, below. All amendments to the SPCC plan are further detailed in the following pages. Technical amendments include Professional Engineer Certifications in accordance with 40 CFR 112.5 (c).

Amendment Date	Purpose and Description of Amendment	Amendment Type (Administrative or Technical)	Amendment Certified by P.E. (Yes/No)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Note: P. E. certification is not required for administrative amendments.

FIRST TECHNICAL AMENDMENT

Amendment Date	Purpose and Description of Amendment	Amendment Type (Administrative or Technical)	Amendment Certified by P.E. (Yes/No)
1.			

New Facilities **Modified Facilities**

Amendment Certification (40 CFR 112.5 (c))

First Technical Amendment

I hereby attest that:

1) I am familiar with the provisions of 40 CFR Part 112;
2) I, or my agent, have visited and examined the facilities (facility specific certifications are provided in Appendix F);
3) This SPCC Plan has been prepared and amended in accordance with good engineering practice, including consideration of applicable industry standards, and with the requirements of 40 CFR 112;
4) Procedures for required inspections and testing have been established, and
5) This plan is adequate for the subject facilities (facility specific certifications are provided in Appendix F).

_____
Printed Name of Registered Professional Engineer

Registration No.:_____ State: CO_____ _____
Signature of Registered Professional Engineer
Date:_____

APPENDIX F

FACILITY LIST AND SITE SPECIFIC INFORMATION

FACILITY LIST

The following facilities are included in this SPCC Plan.

FACILITY NAME	CO-LOCATED SITE(S)		DATE OF LAST UPDATE
Thurston 11-31-7-21			11/20/2013
Thurston 12-31-7-21			11/20/2013

Spill Avoidance, Monitoring, Management and Remediation Plan Supplemental Memorandum

Proposed Ouray National Wildlife Refuge 2-Well Development Program in Uintah County, Utah
Thurston Energy Operating Company, LLC and Thurston Energy, LLC

January 15, 2014

Overview

Best practices in oil and gas well construction and production life management by Thurston Energy Operating Company and Thurston Energy, LLC (Thurston) on the Ouray National Wildlife Refuge (Ouray NWR) will result from a combination of compliance with an extensive, multi-agency regulatory environment and Applicant Committed Environmental Protection Measures (ACEPM). The Utah Division of Oil, Gas & Mining (UDOGM) regulations govern all oil and gas extractive operations on minerals owned by the State of Utah as managed by the Utah State and Institutional Trust Lands Administration (SITLA), and in the case at hand, under Oil and Gas Lease ML- 52016 issued to Thurston Energy, LLC effective September 1, 2011. The UDOGM and SITLA rules governing each application for a permit to drill (APD) are equivalent to or in some instances more stringent than rules that govern oil and gas operations on United States minerals and surface managed by the Department of Interior Bureau of Land Management (BLM). Refer to **Appendix 1** for an example of the site engineering submittal required for a UDOGM APD for one of the wells (Thurston 11-31-7-21).

In addition to compliance with the UDOGM and SITLA regulations, Thurston will conduct its proposed operations on the Ouray NWR in compliance with a surface use agreement anticipated to be issued between it and the United States Fish and Wildlife Service (USFWS). Furthermore, Thurston must comply with the United States Environmental Protection Agency (USEPA) regulations which include but are not limited to the requirement to formulate, implement, and adhere to a Spill Prevention, Control and Countermeasure (SPCC) Plan based upon the unique and final configuration of each oil and gas well pumping, treatment, and on-site storage installation.

The unique properties of the crude oil (known as Utah Black Wax) that is likely to be produced from wells sited on the Ouray NWR by Thurston, and other operators for that matter, limit the possible extent of contamination from spills. The crude oil produced from the upper Wasatch Formation in the Brennan Bottom field adjacent to and within the northern area of the Ouray NWR has an API gravity of about 40° (a measurement of oil density relative to water) and a pour point range of 90 to 100° F (the highest temperature at which the oil remains semi-solid). The API gravity of the crude oil produced from the lower Green River Formation in the same field ranges from 20 to 24° and the pour point is about 70° F. Both formations yield crude oil that is paraffin-based although the Green River formation also contains some asphalt-based crude oil. A mix of crude oil from both formations will be included in a typical "commingled" completion of oil wells on the Ouray NWR and the mixture will have a pour point of about 90° F.

The temperature of the oil reservoirs between 5,000' and 7,500' beneath the surface of the Ouray NWR ranges from 120 to 150° F where the crude oil remains in a liquid form. However, as the crude oil is pumped to the surface up the production tubing set inside the long string casing (see **Appendix 2**), the crude oil is cooled as its nears the ambient temperature conditions at the surface. The wellhead, three-phase separator, produced oil storage tank battery, and related plumbing is insulated and heat-traced (steam or electrical) to insure that the temperature of the crude oil moving through the system remains in liquid form. Prior to shipment in insulated tank trucks, the crude oil is heated by natural gas-fired

furnaces installed in the storage tanks to 180° F to insure that it will still be in a liquid state upon arrival at the refinery. All of this heating effort is required because of the high pour point of the crude oil.

The high pour point of the produced crude oil in combination with the normal to subnormal reservoir pressure known to exist in the subsurface make spill management a straightforward process. After the depletion of the initial pressure induced by hydraulic frac stimulation of the reservoir rock by flowback within a few days of the initial well completion, subsurface fluid including crude oil and brine water will not flow to the surface and must be moved by artificial lift (pump). The pumping equipment proposed by Thurston will be powered by an electric motor which is controlled by automated limit switches and a time clock. More detail on the advantages provided by the control equipment appears in a later section below. The pumping rate is relatively slow which means that leaks can be detected before substantial amounts of fluid are spilled and the spilled oil solidifies at average ambient surface temperatures. The crude oil sets up like candle wax because of its high paraffin content, unless the surface temperatures are above 90° F, which occur only during summer afternoons in the Uinta Basin setting of the Ouray NWR. Like most crude oil, the Utah Black Wax is immiscible in water and lighter than water, but in solid form has minimal fugitive characteristics to cause pollution.

Well Construction Phase

Spill management begins with site configuration. The engineering of the well sites proposed by Thurston on the Ouray NWR will control and divert run-on of water from precipitation from areas uphill from the site and will impound all precipitation along with any spilled substances on the well pad. The site engineering package required by UDOGM for the APD for one of the proposed wells (Thurston 11-31-7-21) is attached hereto as **Appendix 1** to illustrate how run-on and run-off are controlled on and around the well pad. Specifically, Sheet 3 in **Appendix 1** illustrates the proposed cut and fill dirt work to create a level work area and cut soil substrate under the rig for a solid foundation. Berms composed of topsoil stored for future reclamation and excess native material removed from the cut form barriers to run-on from the surrounding land. Standard practice is to insure that the berms connect to form a continuous barrier upslope and a small downslope berm composed of impermeable topsoil and excess material is created at the toe of fill slope just above and adjacent to the 4,667’ elevation contour (in the case of the Thurston 11-31-7-21 well pad plan) to insure well pad run-off impoundment.

The Ouray National Fish Hatchery access road and an abandoned irrigation ditch will provide an area-wide secondary containment structure which isolates the surface of the entirety of the proposed development work area from the Green River floodplain. Sheet 10 in **Appendix 1** indicates the location of both proposed wells sites and their position upslope from the access road and the abandoned irrigation ditch which parallels the road on its upslope (northwest) side. To minimize spill threats from soil percolation during the well drilling operations, Thurston has agreed to an ACPEM to circulate all drilling fluids in surface tanks and forgo the use of a standard reserve pit installed on the well pad. All drill cuttings will be impounded in tanks and exported from the site to an appropriately permitted commercial Class II oil field waste disposal facility such as Ace Disposal in the nearby East Gusher Field area of Uintah County, Utah.

The drill rig and its support equipment will be arranged on the well pad on a solid cut surface as illustrated by Sheet 5 in **Appendix 1**. Note that no reserve pit is present in this drawing as mentioned in the preceding paragraph. Mud tanks will be used to isolate cuttings from the drilling mud circulation system. Standard practice during drilling operations, which are prosecuted on a 24-7 basis, is to police the area at the beginning of each 12-hour shift (drilling tour or tower) in search of leaks and spills from the mud system or motorized equipment. Drippings from motorized equipment are shoveled up and placed in containers for shipment to the Uintah County Class II landfill in the on-site trash cage. Spills of

motor oil, crude oil, and contaminated soil are shoveled up and placed in drums for disposal at a commercial Class I landfill, such as those in Salt Lake County, Utah, the Clean Harbors Grass Mountain or Energy Solutions, LLC landfills near Clive, Utah, or ECDC Environmental LC landfill at East Carbon, Utah. The wellhead beneath the drill rig derrick is contained entirely within a metal cellar created by a vertically embedded segment of 6' diameter corrugated steel culvert. The wellhead itself is mounted on the surface casing (pipe) string which is entirely cemented in place from the shoe (bottom at a depth of 900') to the surface (See **Appendix 2**) to protect freshwater aquifers. Following standard practice, the fluid level in the cellar is monitored during drilling and completion operations and pumped out into the mud tanks as needed to insure that no fluid overflows onto the well pad.

Blow-out prevention equipment (BOPE) is required by UDOGM to be installed on the surface casing wellhead. Prior to beginning to drill the long string hole through the surface casing shoe, the BOPE and surface casing must pass a pressure test conducted in the presence of a UDOGM Petroleum Specialist (field operations inspector). When drilling operations resume, any flow events from the well can be controlled and/or diverted to the mud tanks using the BOPE to eliminate spills. The long string (production) casing must also pass a pressure test prior to well completion operations similar to the surface casing testing procedure that must be witnessed under UDOGM rules. Refer to **Appendix 3** for more information on UDOGM testing and reporting requirements related to well components. Extensive evidence from previous drilling operations conducted in the vicinity indicates that the casing plan and casing cementing program in combination with the BOPE will be sufficient to eliminate the threat of uncontrolled fluid flow from the well. No poisonous gas (hydrogen sulfide) is known to exist in the subsurface in the vicinity from previous work.

Well Production Phase

The plan of the surface equipment is depicted by Sheet 6 and Sheet 7 in **Appendix 1**. Produced liquid hydrocarbons would be stored in tanks surrounded by a secondary containment berm or other impermeable enclosure of sufficient capacity to contain 110 percent of the total capacity of the largest tank within the tank battery and sufficient freeboard to contain precipitation. The number of tanks involved might be up to four depending upon the tested capacity of the well to yield oil and brine water. Following a short period of a few hours to a few days of flowback after frac stimulation, the well will require a pumping unit to lift oil, gas, and associated brine water to the surface. The pumping unit will be a beam type positioned at the wellhead (not shown in the appended figures). This unit will be driven by an electric motor rather than a natural gas engine to minimize additions to the ambient noise level as an ACEPM for Thurston's oil and gas producing operations on the Ouray NWR. The fluid lifted from the well will be separated into streams of oil, water, and gas in a three-phase separator that is heated with a natural gas burner. The oil and water are stored in the tanks isolated with a berm or wall on the well pad as previously mentioned and will be equipped with tank level measuring devices that will automatically shut off the pumping unit when the tanks are filled to eliminate the threat of pumping spills. Similarly, the three-phase separator and the gas export pipeline will be equipped with pressure sensors that will stop the pumping unit and shut in the well should a pressure drop indicative of a gas leak be detected.

According to best management practices in modern oilfield operations, the vital signs of the well and associated equipment on the well pad are monitored electronically on a 24/7 basis and that data is transmitted to an internet-based system available to authorized users. Alarms for upset conditions or automatic shut-off are transmitted via telephone to appropriate personnel to instigate immediate response. A visual inspection of all of the production equipment and connected plumbing will be made weekly at a minimum, and more likely upon every visit from a pumper, which might be daily. The above schedule of inspection and the responses committed by Thurston will be partly duplicated in the SPCC Plan. The SPCC plan is required to be written under USEPA regulations once all of the final production plumbing is

in place on the well pad and mapped by a licensed petroleum engineer. The existence of a SPCC Plan does not change the commitment to spill prevention and management to be practiced by Thurston as described by this supplement to the EA document.

Leaks will be repaired and drips or spills will be dealt with according to the volume involved as noted previously in the section on the drilling phase. Drippings absorbed with rags or spill blankets can be disposed of in Class II municipal landfills such as the Uintah County Landfill. Significant spills of crude oil will be shoveled up (since it will be in solid form due to the high wax content) and delivered to a recycling (centrifuge cleaning) facility such as LaPoint Recycle & Storage near LaPoint, Utah for recovery and sale. Pumping operations will be suspended upon recognition of any leakage from the wellhead, the leak will be repaired and any fluid accumulation in the wellhead cellar will be pumped out and disposed of with the produced brine water (unless the leakage was primarily oil) at a Class II produced water disposal facility such as DNL East Gusher Disposal nearby at East Gusher, Utah.

The natural gas export pipeline will be inspected for leaks at least once per year and after any wildfire or vehicular encroachment events that might have impacted the right-of-way. The pipeline will be depressurized immediately upon recognition of a leak and damage will be repaired as soon as possible.

Within a few years after initial completion of each well, and if the management of the Ouray NWR deems it desirable, an interim reclamation plan can be implemented to reduce the footprint of the well pads. A design of such a plan for the Thurston 11-31-7-21 is presented by Sheet 7 in **Appendix 1**. The goal is to reduce the footprint and reclaim unused parts of the well pad, yet retain berms to control run-on and run-off. Any accumulations of fluid that are not precipitation can be recovered by vacuum truck or shoveling and disposed of at an appropriately permitted disposal facility depending upon the composition of the fluid. Precipitation run-on or flooding of the proposed well pads is a limited threat due to the known desert environment conditions of the Ouray NWR but must be considered at all times that the installations exist. The abandoned irrigation ditch and hatchery access road will continue to provide broad area secondary containment of any spill or flooding event.

Submitted by David L. Allin
Allin Proprietary/Petroleum Consulting
AAPG Certified Petroleum Geologist 2934
Utah Professional Geologist DOPL 5526699
allinpro@bresnan.net

Attachments: Appendix 1; Appendix 2; Appendix 3

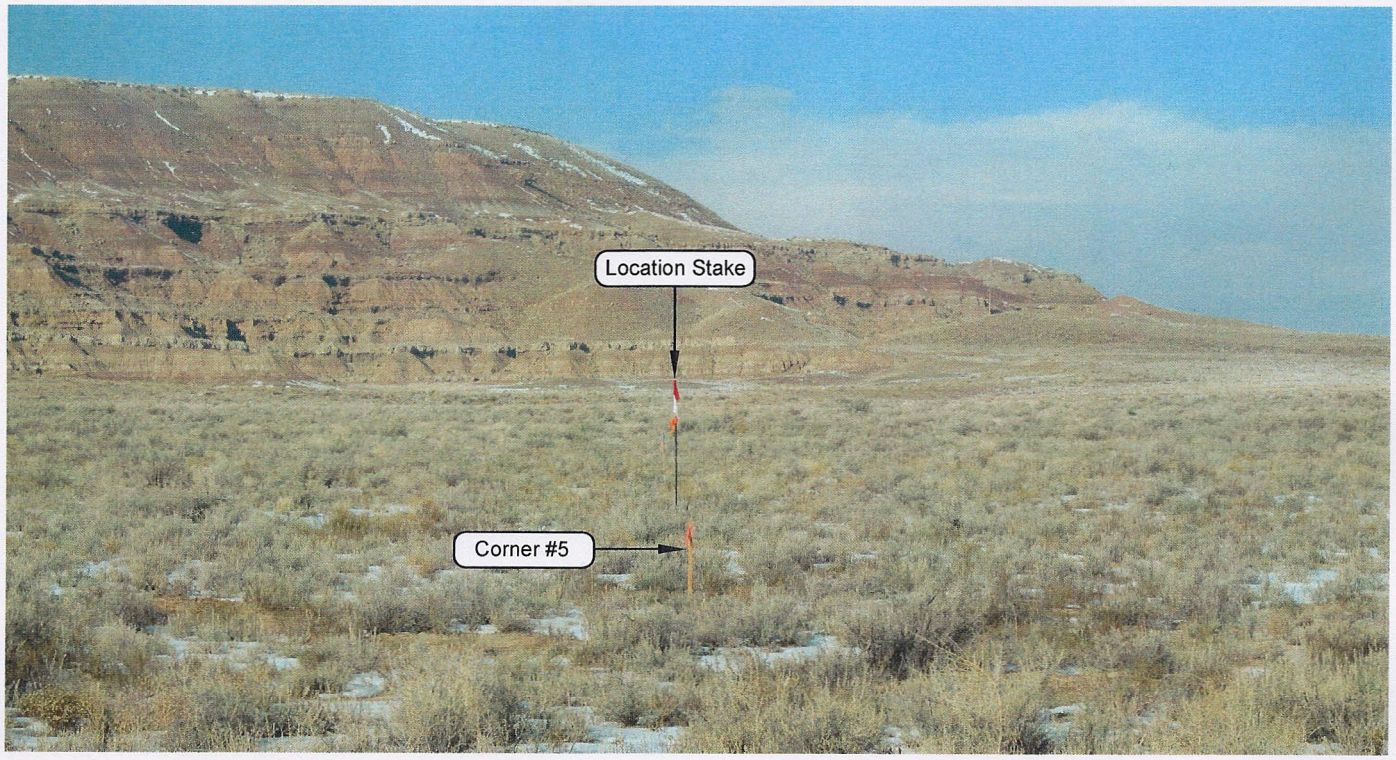


PHOTO VIEW: FROM CORNER #5 TO LOCATION STAKE **CAMERA ANGLE: NORTHERLY**

PHOTO VIEW: FROM BEGINNING OF PROPOSED ROAD **CAMERA ANGLE: NORTH WESTERLY**

THURSTON ENERGY OPERATING COMPANY

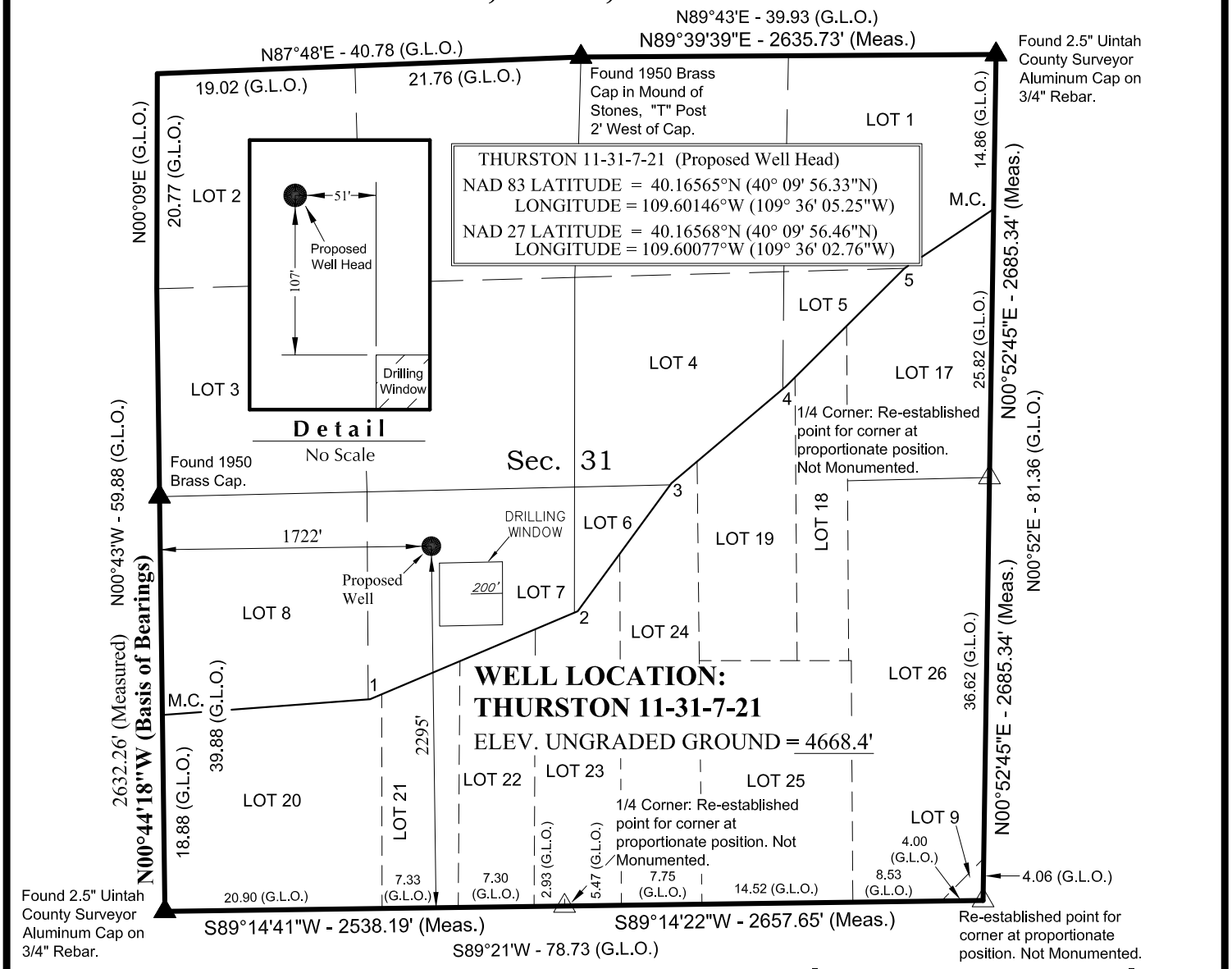
LOCATION PHOTOS

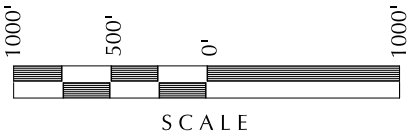
THURSTON 11-31-7-21
2295' FSL, 1722' FWL
LOT 7 OF SECTION 31, T7S, R21E,
S.L.B.&M., UINTAH COUNTY, UTAH.

TIMBERLINE (435) 789-1365
ENGINEERING & LAND SURVEYING, INC.
209 NORTH 300 WEST - VERNAL, UTAH 84078

DATE PHOTOS TAKEN: 12-22-11	PHOTOS TAKEN BY: D.J.S.	SHEET
DATE DRAWN: 01-11-12	DRAWN BY: M.W.W.	1
Date Last Revised:		OF 10

T7S, R21E, S.L.B.&M.





NOTES:

▲ = Section Corners Located

1. Well footages are measured at right angles to the Section Lines.
2. Government Land Office (G.L.O.) distances are shown in feet or chains. 1 chain = 66 feet.
3. Bearings are based on Global Positioning Satellite observations.
4. BASIS OF ELEVATION: NAVD 88 DATUM USING THE UTAH REFERENCE NETWORK CONTROL SYSTEM

N

THURSTON ENERGY OPERATING COMPANY

*Distances measured perpendicular to the Lease Line

SURVEYOR'S CERTIFICATE

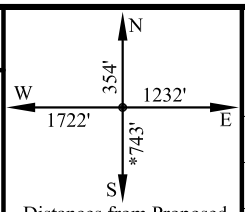
THIS IS TO CERTIFY THAT THE ABOVE PLAT WAS PREPARED FROM FIELD NOTES OF ACTUAL SURVEYS MADE BY ME OR UNDER MY SUPERVISION AND THAT THE SAME ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. 1-16-12

PROFESSIONAL LAND SURVEYOR
REGISTRATION NO. 6028691
STATE OF UTAH

PROFESSIONAL LAND SURVEYOR
6028691
JOHN R SLAUGH
STATE OF UTAH

LEGAL PLAT

THURSTON 11-31-7-21
2295' FSL, 1722' FWL
LOT 7 OF SECTION 31, T7S, R21E, S.L.B.&M., UINTAH COUNTY, UTAH.



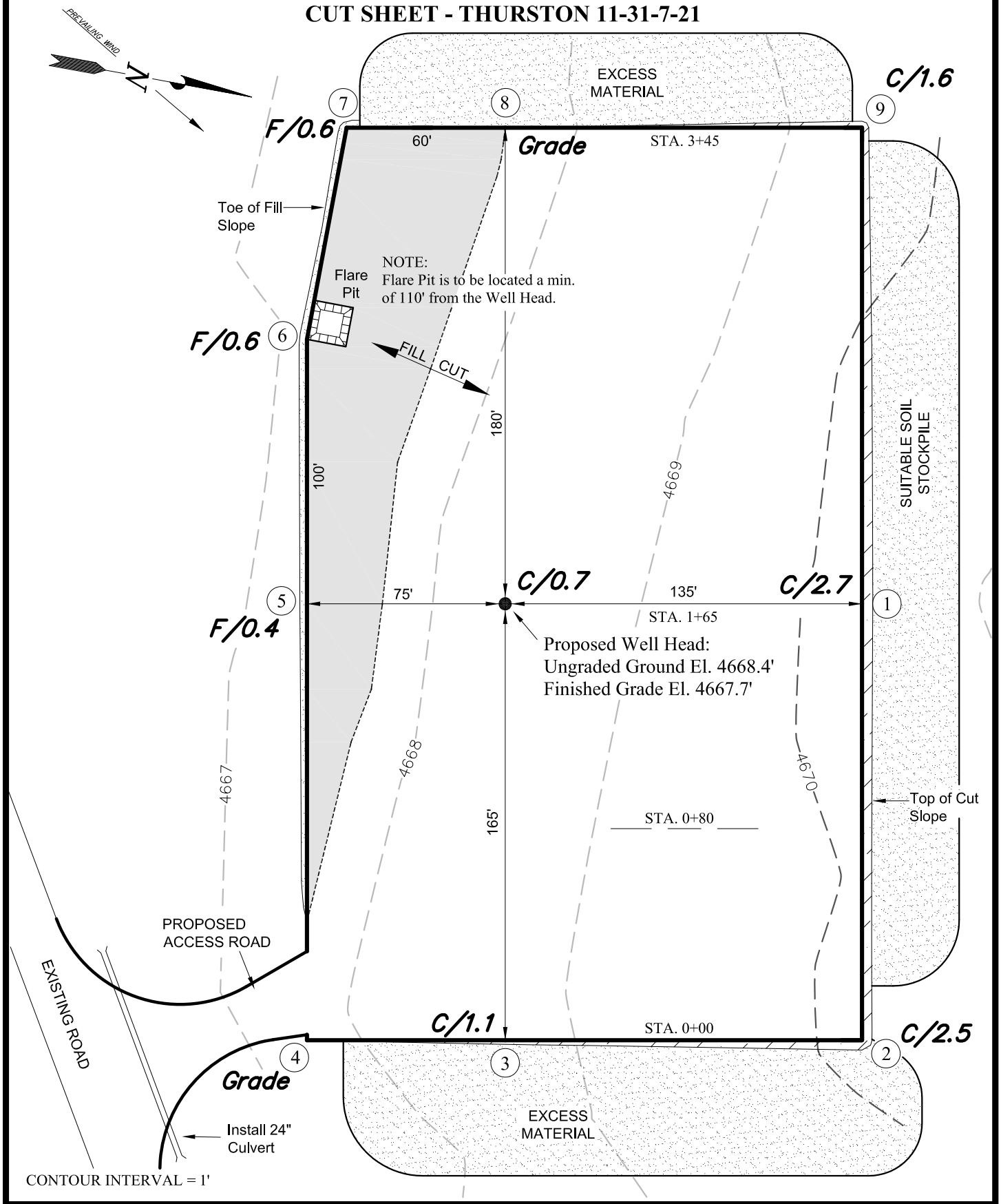
Distances from Proposed Well to Lease Lines

TIMBERLINE (435) 789-1365
ENGINEERING & LAND SURVEYING, INC.
209 NORTH 300 WEST - VERNAL, UTAH 84078

DATE SURVEYED: 12-22-11	SURVEYED BY: D.J.S.	SHEET 2 OF 10
DATE DRAWN: 01-10-12	DRAWN BY: M.W.W.	
SCALE: 1" = 1000'	Date Last Revised:	

THURSTON ENERGY OPERATING COMPANY

CUT SHEET - THURSTON 11-31-7-21

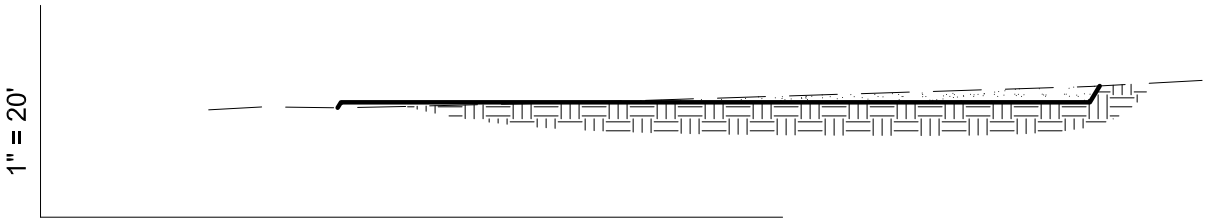


Section 31, T7S, R21E, S.L.B.&M.	Qtr/Qtr Location: LOT 7	Footage Location: 2295' FSL & 1722' FWL

Date Surveyed: 12-22-11	Date Drawn: 01-09-12	Date Last Revision:	**TIMBERLINE** (435) 789-1365 **ENGINEERING & LAND SURVEYING, INC.** 209 NORTH 300 WEST - VERNAL, UTAH 84078	SHEET 3 OF 10
Surveyed By: D.J.S.	Drawn By: M.W.W.	Scale: 1" = 50'		

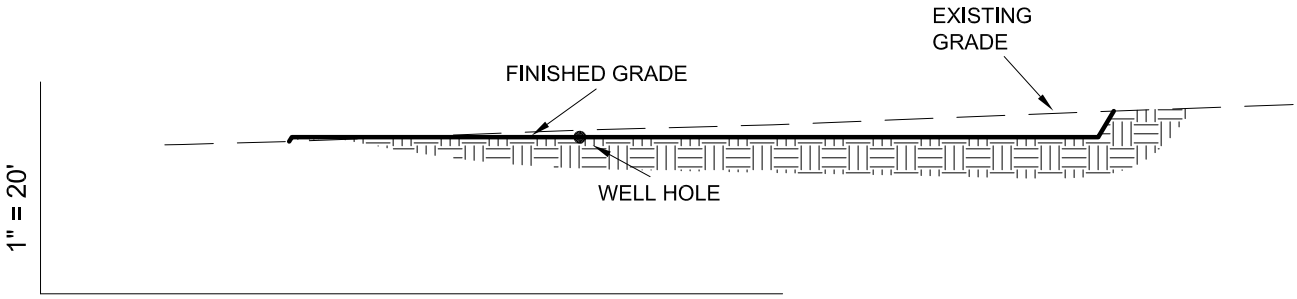
THURSTON ENERGY OPERATING COMPANY

CROSS SECTION - THURSTON 11-31-7-21



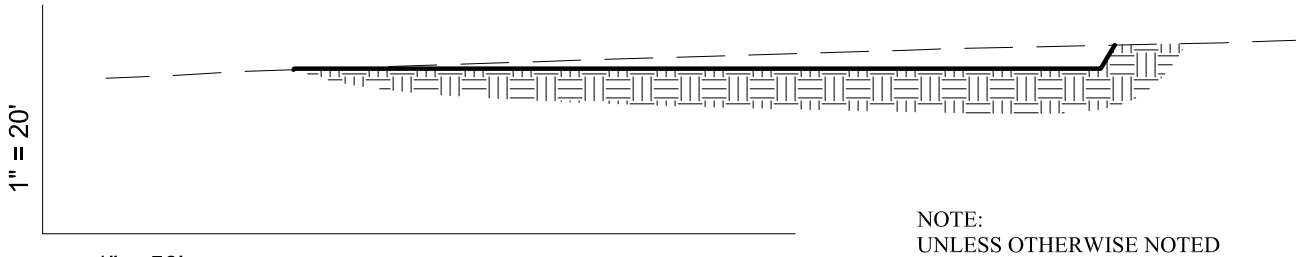
1" = 50'

STA. 3+45



1" = 50'

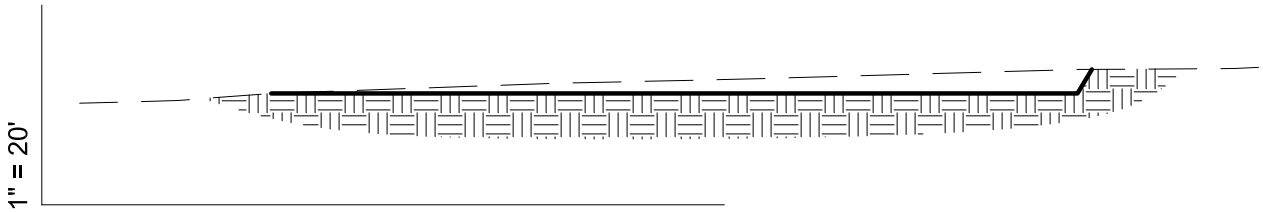
STA. 1+65



1" = 50'

STA. 0+80

NOTE:
UNLESS OTHERWISE NOTED
ALL CUT/FILL SLOPES ARE AT
1.5:1



1" = 50'

STA. 0+00

REFERENCE POINTS

215' SOUTHEASTERLY = 4668.2'
265' SOUTHEASTERLY = 4668.3'
185' NORTHEASTERLY = 4671.1'
235' NORTHEASTERLY = 4671.7'

ESTIMATED EARTHWORK QUANTITIES
(No shrink or swell adjustments have been used)
(Expressed in Cubic Yards)

CUT	Excess Material = 4,050
6" Topsoil Stripping = 1,330	Topsoil = 1,330
Remaining Location = 2,810	
TOTAL CUT = 4,140	
FILL = 90	Excess Unbalance = 2,720 (After Rehabilitation)

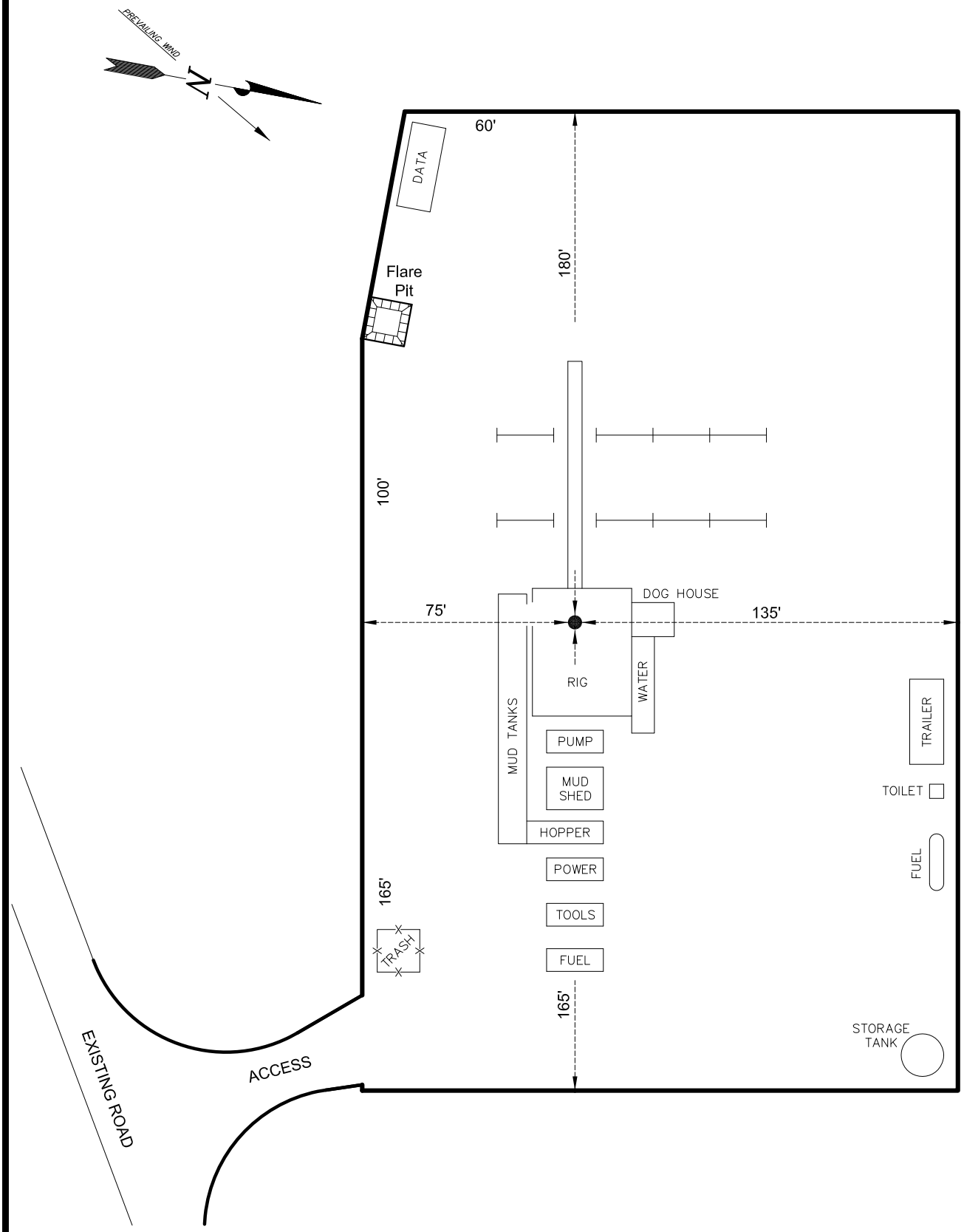
Section 31, T7S, R21E, S.L.B.&M.	Qtr/Qtr Location: LOT 7	Footage Location: 2295' FSL & 1722' FWL

Date Surveyed: 12-22-11	Date Drawn: 01-09-12	Date Last Revision:	**TIMBERLINE** (435) 789-1365 **ENGINEERING & LAND SURVEYING, INC.** 209 NORTH 300 WEST - VERNAL, UTAH 84078
Surveyed By: D.J.S.	Drawn By: M.W.W.	Scale: 1" = 50'	

SHEET 4 OF 10

THURSTON ENERGY OPERATING COMPANY

RIG LAYOUT - THURSTON 11-31-7-21

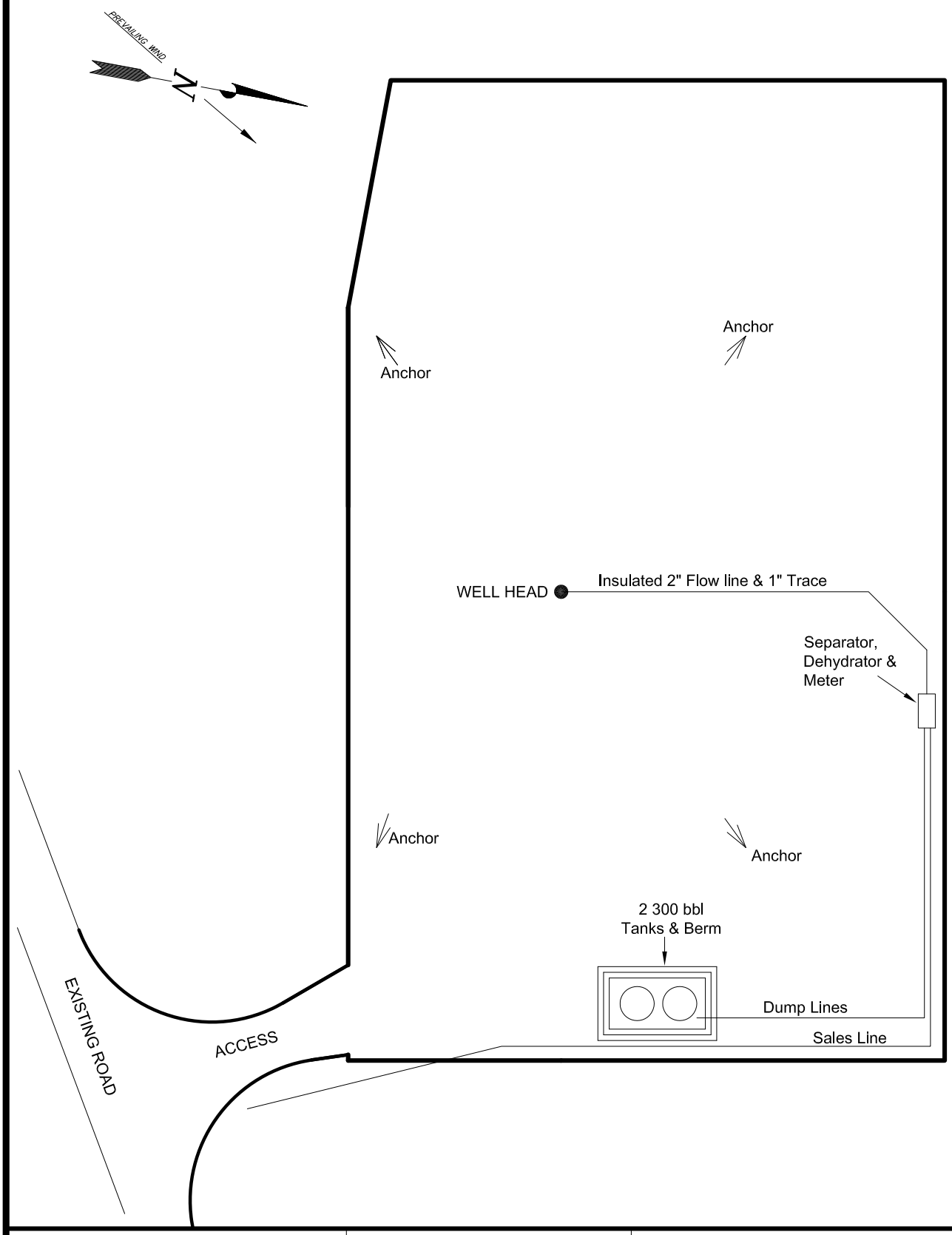


Section 31, T7S, R21E, S.L.B.&M.	Qtr/Qtr Location: LOT 7	Footage Location: 2295' FSL & 1722' FWL

Date Surveyed: 12-22-11	Date Drawn: 01-09-12	Date Last Revision:	**TIMBERLINE** (435) 789-1365 **ENGINEERING & LAND SURVEYING, INC.** 209 NORTH 300 WEST - VERNAL, UTAH 84078	SHEET 5 OF 10
Surveyed By: D.J.S.	Drawn By: M.W.W.	Scale: 1" = 50'		

THURSTON ENERGY OPERATING COMPANY

PRODUCTION LAYOUT - THURSTON 11-31-7-21

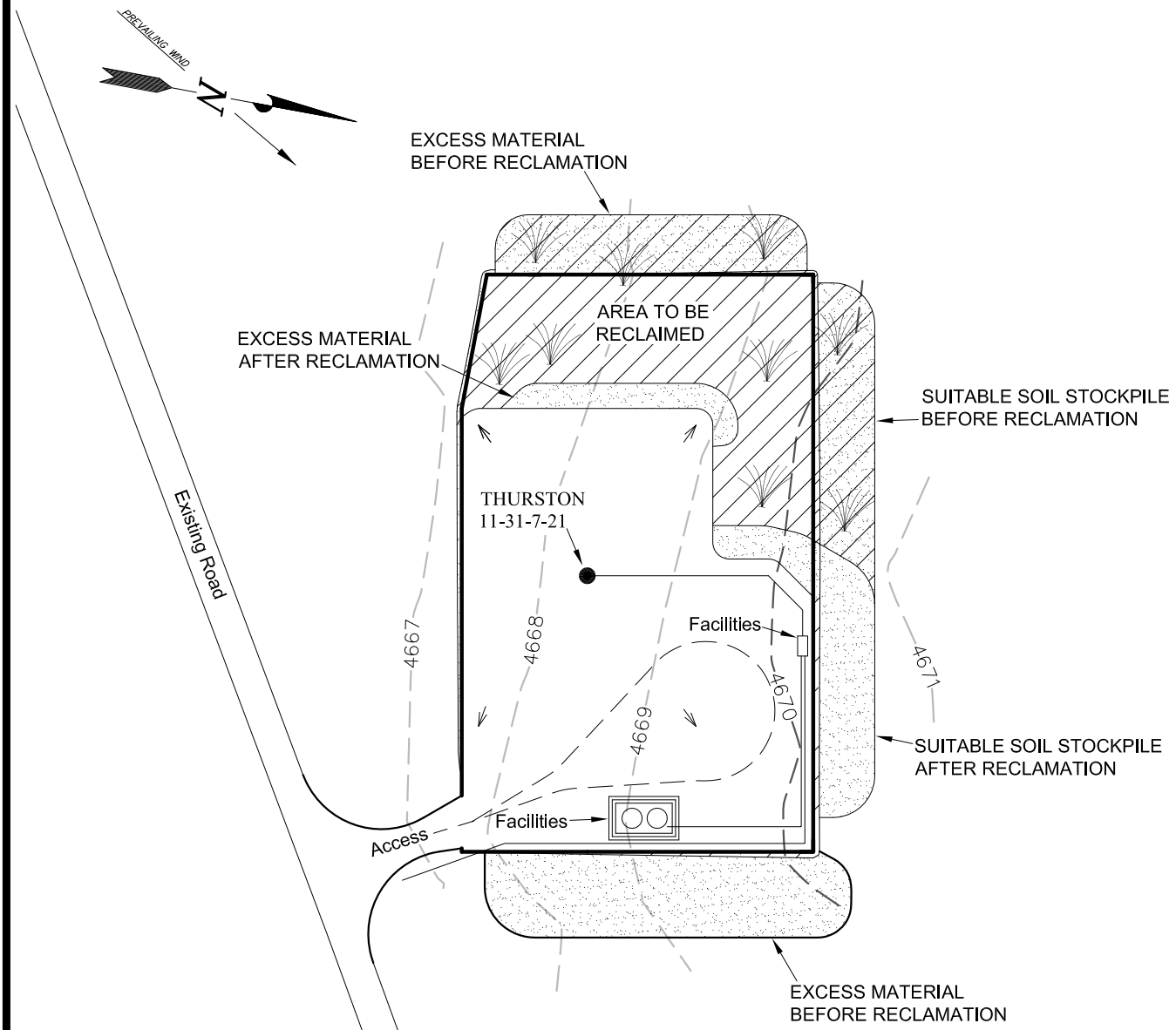


Section 31, T7S, R21E, S.L.B.&M.	Qtr/Qtr Location: LOT 7	Footage Location: 2295' FSL & 1722' FWL

Date Surveyed: 12-22-11	Date Drawn: 01-09-12	Date Last Revision:	**TIMBERLINE** (435) 789-1365 **ENGINEERING & LAND SURVEYING, INC.** 209 NORTH 300 WEST - VERNAL, UTAH 84078	SHEET 6 OF 10
Surveyed By: D.J.S.	Drawn By: M.W.W.	Scale: 1" = 50'		

THURSTON ENERGY OPERATING COMPANY

INTERIM RECLAMATION DIAGRAM - THURSTON 11-31-7-21



= Anchor

= Area to be Reclaimed and Vegetated

100' 50' 0' 100'

SCALE

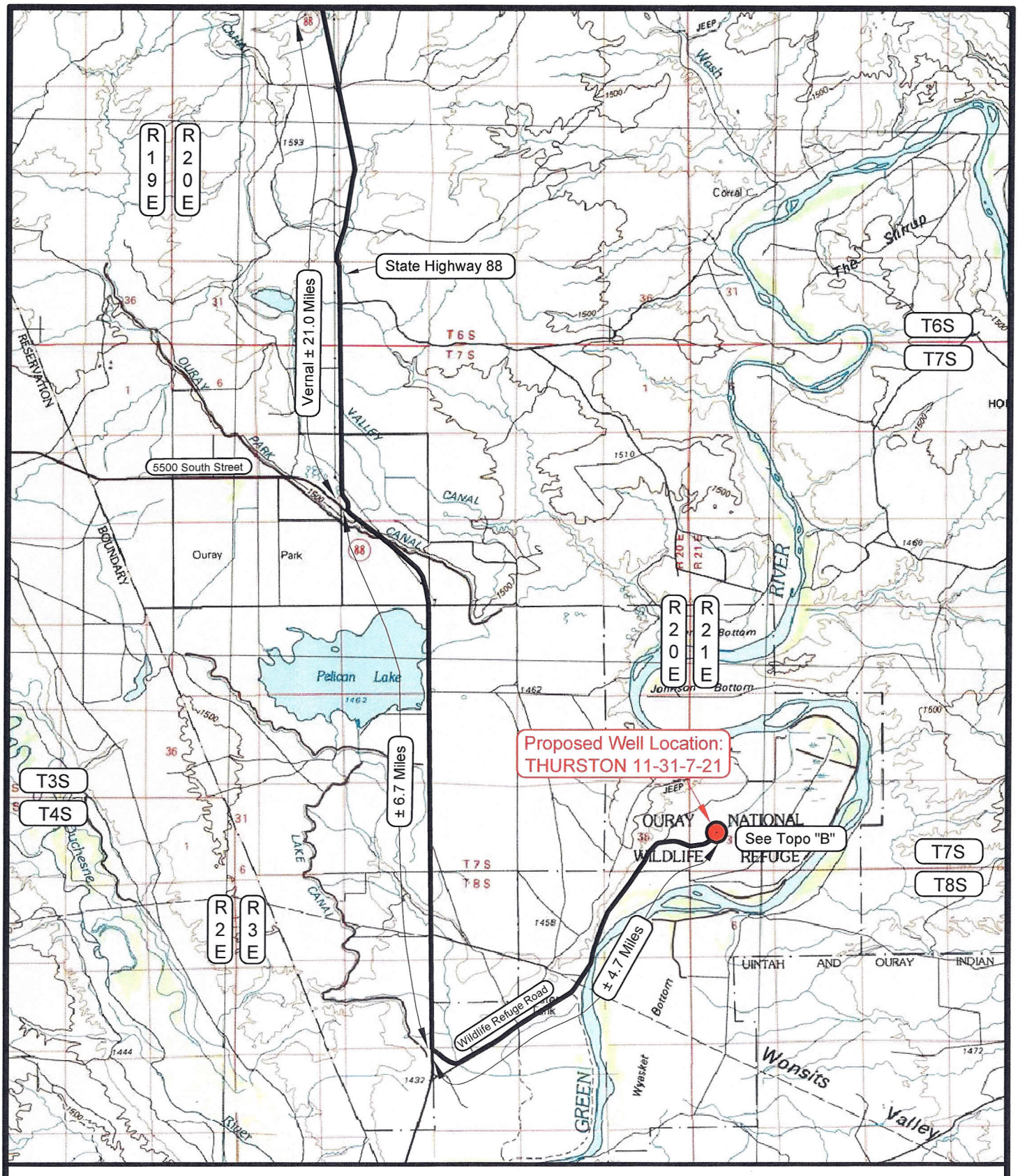
NOTE:

1. PRODUCTION EQUIPMENT LOCATION COULD VARY DUE TO SITE AND OPERATION EFFECTIVENESS.

2. TOTAL DISTURBED AREA: ±2.32 ACRES
   RECLAIMED AREA: ±0.71 ACRES
   UN-RECLAIMED AREA: ±1.61 ACRES

CONTOUR INTERVAL = 1'

Section 31, T7S, R21E, S.L.B.&M.	Qtr/Qtr Location: LOT 7		Footage Location: 2295' FSL & 1722' FWL	
Date Surveyed: 12-22-11	Date Drawn: 01-09-12	Date Last Revision:	**TIMBERLINE** (435) 789-1365 **ENGINEERING & LAND SURVEYING, INC.** 209 NORTH 300 WEST - VERNAL, UTAH 84078	SHEET 7 OF 10
Surveyed By: D.J.S.	Drawn By: M.W.W.	Scale: 1" = 100'		



LEGEND

PROPOSED ACCESS ROAD
= SUBJECT WELL
= OTHER WELLS
= EXISTING ROAD
= EXISTING ROAD (TO BE IMPROVED)

B-5460 = COUNTY ROAD CLASS & NUMBER

N

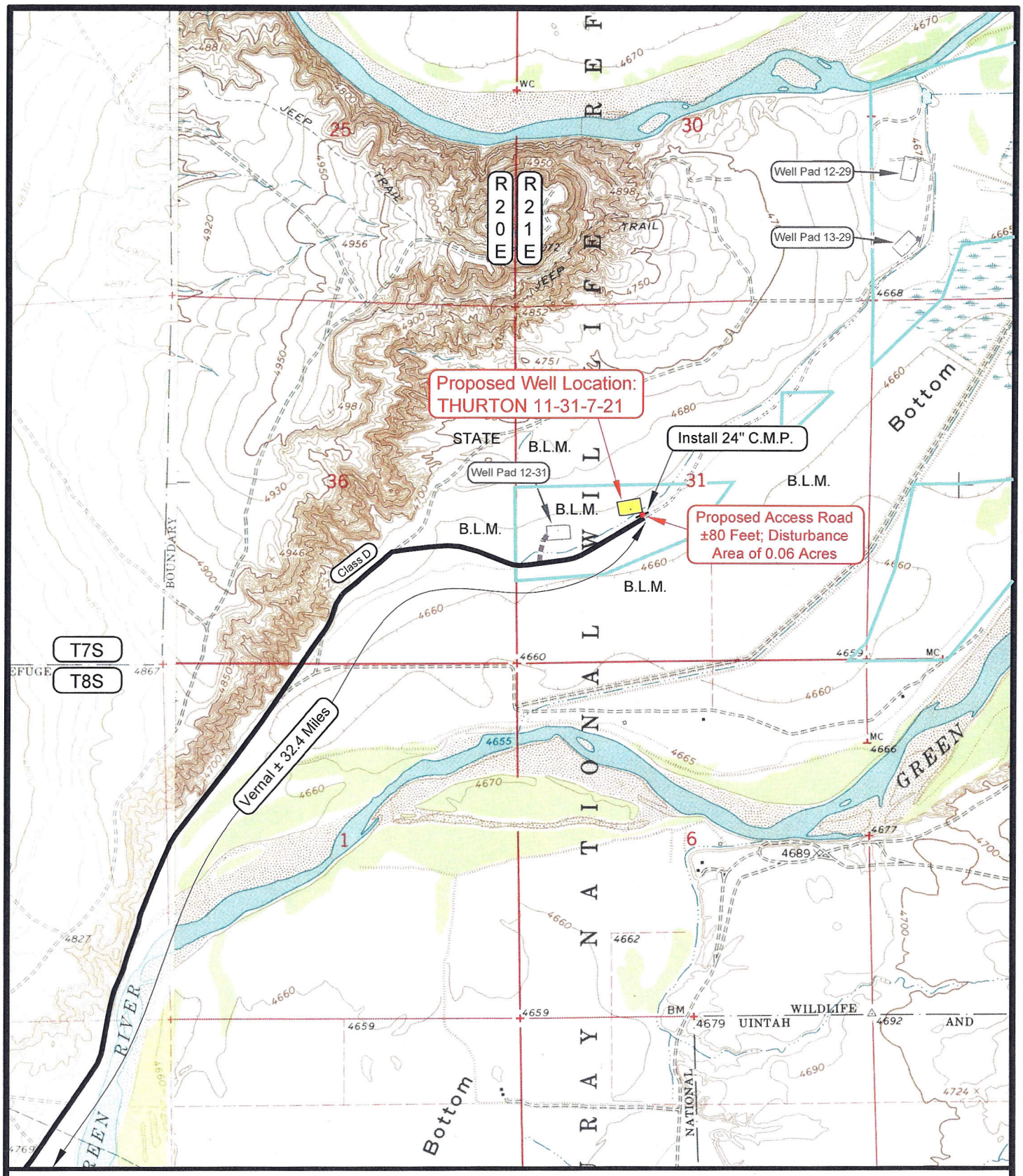
THURSTON ENERGY OPERATING COMPANY

THURSTON 11-31-7-21
SECTION 31, T7S, R21E, S.L.B.&M.
2295' FSL & 1722' FWL

TOPOGRAPHIC MAP "A"		DATE SURVEYED: 12-22-11
		DATE DRAWN: 01-10-12
SCALE: 1:100,000	DRAWN BY: M.W.W.	REVISED:

TIMBERLINE (435) 789-1365
ENGINEERING & LAND SURVEYING, INC.
209 NORTH 300 WEST - VERNAL, UTAH 84078

SHEET 8 OF 10



LEGEND

PROPOSED ACCESS ROAD
= SUBJECT WELL
= OTHER WELLS
= EXISTING ROAD
= EXISTING ROAD (TO BE IMPROVED)

B-5460 = COUNTY ROAD CLASS & NUMBER
= LEASE LINE

N

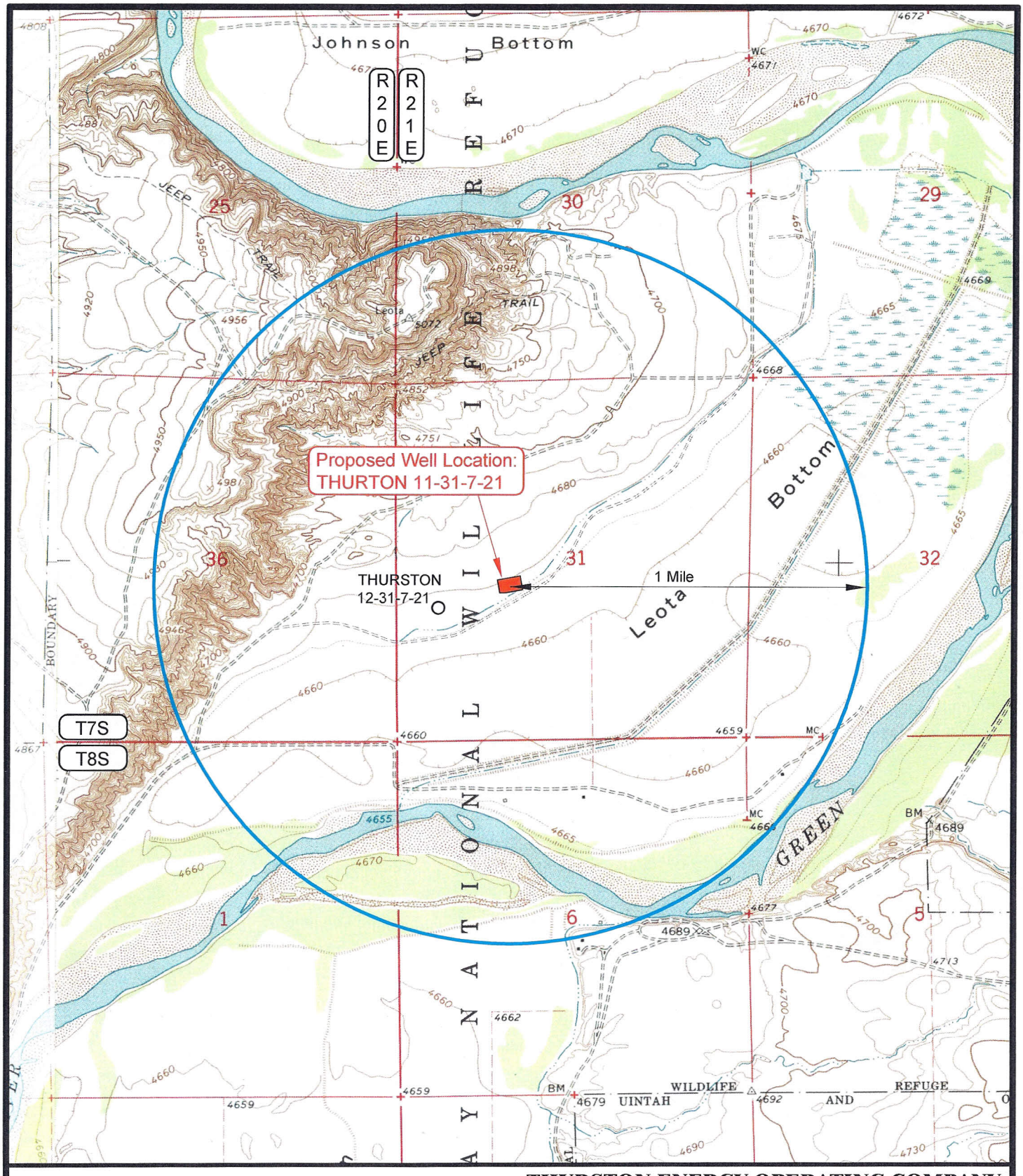
THURSTON ENERGY OPERATING COMPANY

THURSTON 11-31-7-21
SECTION 31, T7S, R21E, S.L.B.&M.
2295' FSL & 1722' FWL

TOPOGRAPHIC MAP "B"	DATE SURVEYED: 12-22-11	
	DATE DRAWN: 01-10-12	
SCALE: 1" = 2000'	DRAWN BY: M.W.W.	REVISED:

TIMBERLINE (435) 789-1365
ENGINEERING & LAND SURVEYING, INC.
209 NORTH 300 WEST - VERNAL, UTAH 84078

SHEET 9 OF 10



LEGEND

- ∅ = DISPOSAL WELL
- ● = PRODUCING WELL
- ● = SHUT IN WELL
- ○ = PROPOSED WELL
- ∅ = WATER WELL
- ● = ABANDONED WELL
- ● = TEMPORARILY ABANDONED WELL
- ⊕ = ABANDONED LOCATION

N

THURSTON ENERGY OPERATING COMPANY

THURSTON 11-31-7-21
SECTION 31, T7S, R21E, S.L.B.&M.
2295' FSL & 1722' FWL

TOPOGRAPHIC MAP "C"		DATE SURVEYED: 12-22-11
		DATE DRAWN: 01-10-12
SCALE: 1" = 2000'	DRAWN BY: M.W.W.	REVISED:

TIMBERLINE (435) 789-1365
ENGINEERING & LAND SURVEYING, INC.
209 NORTH 300 WEST - VERNAL, UTAH 84078

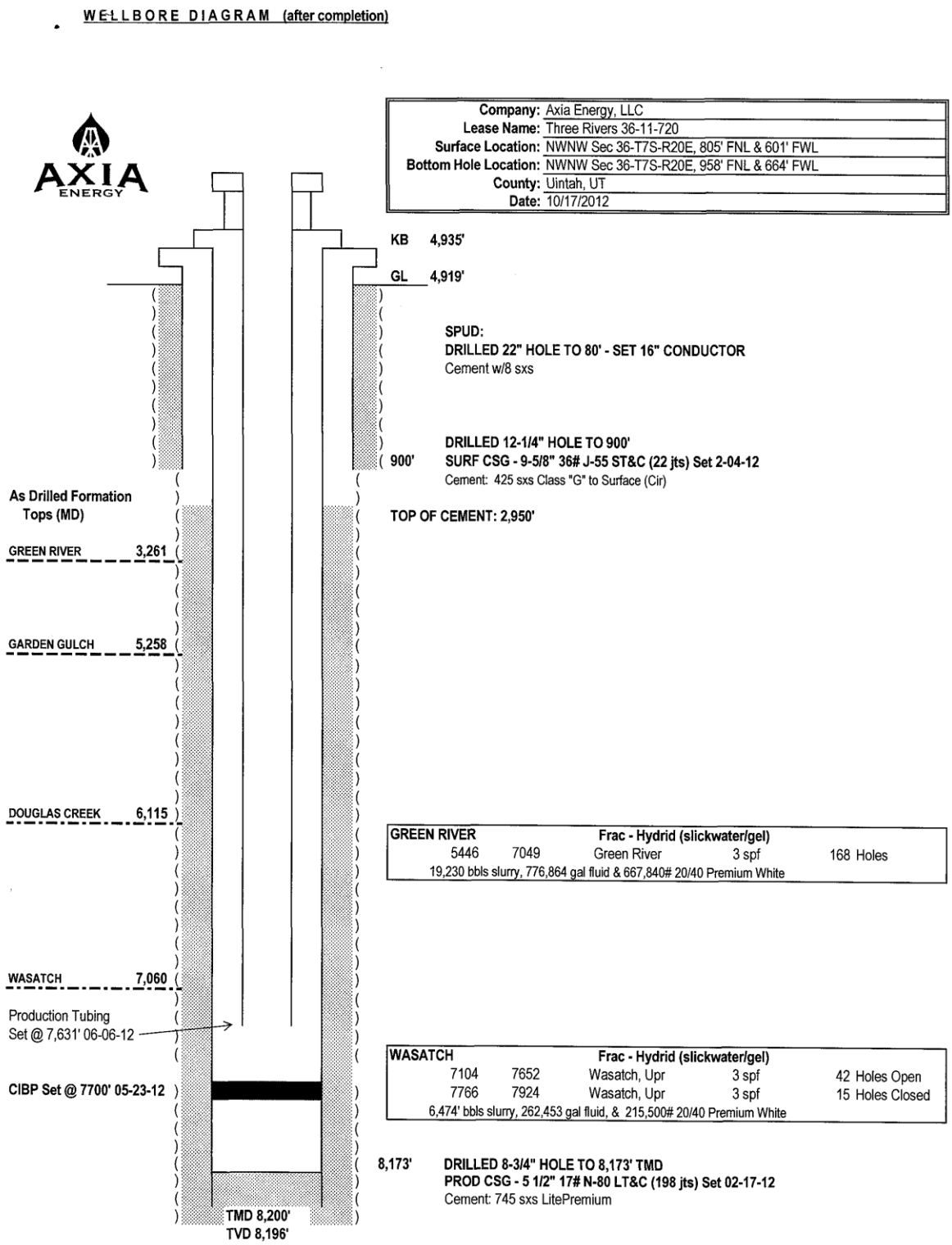
SHEET 10 OF 10

THURSTON ENERGY OPERATING COMPANY
THURSTON 11-31-7-21
Section 31, T7S, R21E, S.L.B.&M.

Proceed in a westerly direction from Vernal, Utah along U.S. Highway 40 approximately 13.9 miles to the junction of State Highway 88. Exit left and proceed in a southerly direction along State Highway 88 approximately 7.1 miles to the intersection of 5500 South Street. Continue along State Highway 88 approximately 6.7 miles to the Wildlife Refuge Road (County D Road). Exit left and proceed in a southeasterly then northeasterly direction along the Wildlife Refuge Road (County D Road) approximately 4.7 miles to the proposed access road. Follow road flags in a northwesterly direction approximately 80 feet to the proposed well location.

Total distance from Vernal, Utah to the proposed well location is approximately 32.4 miles in a southerly direction.

Appendix 2: Example of typical well construction configuration to protect subsurface water resources and eliminate interformational fluid transfer.



Appendix 3: DOGM requirements for spill prevention and well pad housekeeping recited in a typical APD.

R649-3-6.2 *Reporting Requirements.* Written notices and filing of forms with DOGM other than those that can be filed on-line will be directed to:

Utah Division of Oil, Gas and Mining
P.O. Box 145801
Salt Lake City, UT 84114-5801

The telephone number of the DOGM receptionist during business hours and number to be used for leaving routine messages after business hours:

Utah DOGM: (801) 538-5340

MAJOR UNDESIRABLE EVENTS must be reported by telephone immediately after calling for emergency services if needed. In the case of a major undesirable event ONLY, a notification to DOGM can be made after business hours by calling (801) 243-9466.

The Applicant as operator will comply with the following routine reporting requirements to DOGM:

1. The spudding of this well will be reported within 24 hours. This report will include the well name, drilling contractor, rig number and type, spud date and time, the date that continuous drilling will be commenced, the name of the reporter and the reporter's contact number. The spud report can be directed to Oil and Gas Well Information Specialist, Carol Daniels, verbally by calling (801) 538-5284 or transmitting the report via e-mail to Ms. Daniels at caroldaniels@utah.gov.
2. Within five working days of spudding the well, the operator will fill out and file Form 6, Entity Action Form, to receive the well's entity number for future operational reporting requirements.
3. Twenty-four hours advance notice of testing blow-out preventer equipment.
4. A monthly status report on the well will be filed until such time as the well is completed and the well completion report ("WCR") is filed. The monthly reports will be filed on Form 9 and include the well depth and a description of the operations conducted on the well during the month. The reports are due no later than the fifth day of the following calendar month.
5. Twenty-four hours advance notice of casing tests required prior to drilling through the casing shoe or continuing with completion operations.
6. Fresh water aquifer layers encountered during drilling will be reported on Form 7, Report of Water Encountered during Drilling. This report will be filed with Form 8, Well Completion Report or Recompletion Report and Log.

R649-3-14. Fire Hazards on the Surface. All rubbish or debris that might constitute a fire hazard shall be removed to a distance of at least 100' from the well location, tanks, separator, or any structure. All waste oil or gas shall be burned or disposed of in a manner to avert creation of a fire hazard.

Any gas other than poisonous gas escaping from the well during drilling operations will be conducted to the blooie pit by the blooie line or gas buster line where a continuous igniter will insure that the gas is burned. The end of the blooie line will be a least 100' from the well.

R649-3-15. Pollution and Surface Damage Control. The Applicant will take all reasonable precautions to avoid polluting lands, streams, reservoirs, natural drainage ways, and underground water.

The Applicant will carry on all operations and maintain the property at all times in a safe and workmanlike manner having due regard for the preservation and conservation of the property and for the health and safety of employees and people residing in close proximity to those operations.

At minimum, the Applicant will:

1. Take reasonable steps to prevent and will remove accumulations of oil or other materials deemed to be fire hazards from the vicinity of the well locations, lease tanks and pits;
2. Remove from the property or store in an orderly manner, all scrap or other materials not in use;
3. Provide secure, workmanlike storage for chemical containers, barrels, solvents, hydraulic fluid and other non-exempt materials;
4. Maintain tanks in a workmanlike manner that will preclude leakage and provide for all applicable safety measures and construct berms of sufficient height and width to contain the quantity of the largest tank at the storage facility;
5. Insure that the use of storage tanks for crude oil or water without tops is limited to well testing operations;
6. Catch leaks and drips, contain spills and clean up promptly;
7. Practice waste reduction and recycling in order to help reduce disposal volumes;
8. Dispose of produced water, tank bottoms and other miscellaneous waste in a manner that is in compliance with DOGM Rules and other Utah State, Federal and county regulations or ordinances; and
9. Use good housekeeping practices in general.

APPENDIX H

Biological Assessment Memorandum for Thurston Energy's Proposed Ouray National Wildlife Refuge 2-Well Development Program in Uintah County, Utah

MEMORANDUM

TO:	Bekee Hotze, *Branch Chief*, U.S. Fish & Wildlife Service, Terrestrial Endangered Species Branch, Utah Field Office
CC:	Sonja Jahrsdoerfer, *Project Leader*, U.S. Fish & Wildlife Service, Lower Green River National Wildlife Refuge Complex
FROM :	Louis Bridges, *Project Manager*, Kleinfelder
DATE :	Monday, February 3, 2014
SUBJECT:	Draft Biological Assessment (BA) for Thurston Energy, LLC's Proposed Ouray National Wildlife Refuge 2-Well Development Program in Uintah County, Utah

---

The U.S. Fish and Wildlife Service (USFWS) Refuge Planning Division (Service) has prepared an Environmental Assessment (EA) and Biological Assessment (BA), incorporated by reference into the EA in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and state laws and regulations, to analyze Thurston Energy, LLC's (Thurston[s]) proposed oil and natural gas development within the Ouray National Wildlife Refuge (NWR) boundary. The EA and incorporated BA disclose the potential environmental consequences associated with Thurston's proposal to drill and operate up to two exploratory oil and natural gas wells from two proposed well pads and construct associated infrastructure on federal surface and state mineral leases in the Ouray NWR.

The Draft EA/BA was submitted to the USFWS for internal review on Friday, November 22, 2013. The Draft EA was updated based on comments received from the Service in December 2013 and January 2014. Responses to comments were incorporated into the EA and completed on February 12, 2014. The Draft BA Memo was updated on February 3, 2014, based on changes that were made to the EA.

1.0 INTRODUCTION

1.1 REGULATORY BACKGROUND

The incorporated BA was prepared pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (Title 16, United States Code, Section 1531 et seq. [16 U.S.C. § 1521 et seq.]), to address potential effects of the proposed oil and gas development on federally listed threatened and endangered species, species proposed for listing, candidate species and, where applicable, their designated critical habitat.

The development of the BA is intended to fulfill the compliance requirements of pertinent environmental laws, regulations, and policies in accordance with the requirements of Section 7(b) of the ESA of 1973, as amended, and implementing regulations [16 U.S.C. 1536 (c), 50 Code of Federal Regulations (CFR) 402.12 (f) and 402.14 (c)], and EDA guidance contained in the Endangered Species Consultation Handbook (USFWS and National Marine Fisheries Service 1998).

Federal agencies, in consultation with the U.S. Fish and Wildlife Service, Ecological Services Office (USFWS-ESO), are required to ensure that any action they authorize, fund, or carry out will not jeopardize the continued existence of a federally listed or proposed threatened or endangered species. As the Federal lead agency for the EA, the Service is responsible for Intra-Service Section 7 consultation with the USFWS-ESO. It is Service policy to consider candidate species when making natural resource decisions and thus, candidate species will be included for consideration in this BA.

1.2 PROPOSED CONSERVATION MEASURES BY SPECIES

This section provides a general list of conservation measures Thurston will incorporate into the Proposed Ouray National Wildlife Refuge 2-Well Development Program. For a complete list of ACEPMs and Service-specified environmental terms and conditions, refer to **Chapter 2.0** of the BA Memo. Additional, resource specific mitigation measures can be found in **Chapter 4.0** of the EA/BA.

1.2.1 Yellow-Billed Cuckoo

Thurston would incorporate the following conservation measures to minimize potential impacts to the yellow-billed cuckoo:

- Thurston would not conduct construction, drilling, and completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st);
- Thurston would utilize electrified pump-jacks during the production phase to reduce ambient noise within the Project Area;
- Wetland and riparian habitats would be avoided to the extent possible;
- All open-top oil, condensate, or produced water tanks, dehydration unit tubs, secondary containment tubs, and any other open tub, tank, pan, or similar item will be netted or screened;
- Potential increased risk of electrocution would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Power Lines: the State of the Art in 2006* (APLIC 2006);

- In addition, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Power Lines: the State of the Art in 2012* (APLIC 2012);
- A closed-loop drilling system would be utilized to minimize environmental exposure to drilling waste.
- Operational lighting would be kept to a minimum.
- Drilling and operational noise would be abated as appropriate based on activity.

1.2.2 Colorado River Endangered Fish Species

Thurston would incorporate the following conservation measures to minimize potential impacts to the Colorado River endangered fish species:

- Thurston would sample existing water wells within a 0.25 mile radius up- and down-gradient from the proposed well sites;
- Site specific Spill Prevention, Control, and Countermeasure (SPCC) plans would be developed for each well pad and would be kept on site to reduce the risk of hazardous materials being introduced into the Green River;
- Site specific Storm Water Pollution Prevention Plans (SWPPP) would be developed for project facilities to reduce the level of sedimentation into the Colorado River watershed; and
- A closed-loop drilling system would be utilized to minimize environmental exposure to drilling waste.

1.2.3 Uinta Basin Hookless Cactus

Thurston would incorporate the following conservation measures to minimize potential impacts to the Uinta Basin hookless cactus:

- Thurston has conducted 300 foot (or at distances otherwise specified for certain facilities in **Section 2.1.11** of the EA/BA) clearance surveys for the proposed two well development;
- A biological monitor would be present prior to construction activity;
- Dust suppression activities would be conducted during construction, drilling, and completion activities; and
- Areas of avoidance would be flagged prior to construction, well drilling, and completion activity.

1.2.4 Ute Ladies'-tresses

Thurston would incorporate the following conservation measures to minimize potential impacts to the Ute ladies'-tresses:

- Wetland and riparian habitats would be avoided to the extent possible;
- Site specific SPCC plans would be developed for each well pad and would be kept on site to reduce the risk of hazardous materials being introduced into wetland and riparian habitats;
- Site specific SWPPPs would be developed for project facilities to reduce the level of sedimentation into wetland and riparian habitats.

2.0 CONSERVATION AND MITIGATION MEASURES

2.1 APPLICANT-COMMITTED ENVIRONMENTAL PROTECTION MEASURES

Section 2.1.10 of the EA/BA includes a number of Applicant-Committed Environmental Protection Measures that would directly or indirectly reduce potential impacts to special status species and their habitats. The ACEPMs listed below:

2.1.1 General

- Thurston will annually monitor its facilities to ensure that normal operations will be in compliance with the Federal Onshore Oil and Gas Orders; its SUPO (as contained in each APD); other rules and regulations that apply to the Proposed Action; the Thurston Reclamation and Weed Plan; commitments proposed by Thurston (as contained in this EA); and any conditions that may result from approval of the Proposed Action. Thurston will provide an annual report to the Service describing the progress of its reclamation operations until the Service agrees that reclamation has been successful.
- Thurston will secure all required permits and approvals from the Service, State of Utah, and Uintah County prior to construction. Thurston will adhere to all applicable federal, state, county, regulations while performing all operations associated with the Proposed Action.
- Thurston will instruct its employees and contractors not to exceed 20 miles per hour on any well access road during construction, drilling/completion, or normal daily activities to discourage the generation of fugitive dust.
- Thurston will use BMPs for control of nonpoint sources of water pollution to prevent erosion, allow year-round traffic, and ensure safe conditions in its general operating procedures.
- Thurston will implement hiring policies that would encourage the employment of area residents and will purchase equipment and materials from local area merchants to the extent feasible.
- Thurston's drug and alcohol policies will be rigorously enforced.

2.1.2 Construction and Drilling

- Construction operations would be conducted in consideration of the *Surface Operating Standards for Oil and Gas Exploration and Development, 4th Edition* (Gold Book) (USDI-USDA 2007 as revised).
- During drilling and completion operations, Thurston will perform dust abatement measures on proposed access roads and/or well pads as necessary. Dust control measures will be performed on access roads as needed during normal daily operations.
- Thurston has conducted a Class III cultural resource survey on lands that would be affected by surface-disturbing activities and will avoid all sites determined to be eligible to the NRHP or will perform mitigation as recommended by the cultural resource consultant and directed by the AO. The results of the survey were submitted to the Service.
- If the proposed surface disturbance will affect an NRHP-eligible site, data recovery will be performed. Data recovery will include detailed recordation and archival research. The gathered information will be analyzed and described in a report that details the results of the investigation. The report will be submitted to the Service and the State Historic Preservation Office (SHPO) in Salt Lake City.

- Thurston will educate its contractors and employees about the relevant federal regulations intended to protect cultural resources. All vehicular traffic, personnel movement, construction and restoration activities will be confined to existing roads and to areas cleared by the site inventory unless mitigation measure are undertaken. In the event historic or archeological resources are uncovered during construction, work will stop immediately and the Service AO will be notified.
- Thurston will conduct preconstruction surveys, as needed.
- Thurston has conducted paleontological surveys on lands that would be affected by surface-disturbing activities. The results of the survey were submitted to the Service with the APD for each well.
- Thurston will educate its contractors and employees about the relevant federal regulations intended to protect paleontological resources. All vehicular traffic, personnel movement, construction, and restoration activities will be confined to existing roads and to areas cleared by the site inventory unless mitigation measure are undertaken. If any potential paleontological resources are uncovered during construction, work will stop immediately in the area and the AO will be notified.
- Thurston will educate staff and contractors regarding illegal collection or destruction of cultural resources.

2.1.3 Production and Maintenance Operations

- Thurston will maintain existing and new roads and well pads in consideration of Gold Book standards.
- Thurston will monitor the growth of noxious and invasive species resulting from surface disturbance caused by project activities and will control weeds according to procedures contained in the Reclamation Plan (included as **Appendix F** of the EA/BA).
- Thurston will paint all permanent (onsite 6 months or longer) structures either constructed or installed a flat, non-reflective, earth-tone color (Covert Green), as determined by the Service AO.
- Thurston will develop and implement SPCC plans for the wells (see Draft SPCC Plan in **Appendix G** of the EA). In addition, Thurston has provided a spill response plan as a supplement in **Appendix G** of the EA/BA that includes information about spill avoidance and management.
- Thurston will construct a secondary containment berm of sufficient capacity to contain 110 percent storage capacity of the largest tank in the tank battery and sufficient freeboard to contain precipitation. Thurston will install containment for the chemical injection tanks.
- Thurston would sample any known water wells located within a 0.25 mile radius up-gradient or immediately down-gradient of the oil extraction wells.

2.1.4 Reclamation

- Thurston has developed a Reclamation Plan that will be used to direct reclamation and monitoring operations and to ensure that the results meet acceptable standards (included as **Appendix F** of the EA/BA).
- Thurston will develop vegetation baselines for the proposed well sites or will implement other methods to determine reclamation success, in cooperation with the Service AO.
- Thurston will provide the Service with an annual report detailing reclamation status.
- Thurston will reclaim as much of a well pad as possible after the well is drilled and completed.

2.2 ADDITIONAL SERVICE-SPECIFIED ENVIRONMENTAL TERMS AND CONDITIONS

The Service has identified the following additional environmental stipulations that would be imposed under the Proposed Action to further protect or minimize impacts to the surface estate of the Refuge and associated resources. These measures would represent the Service's specific terms and conditions for the issuance of the SUP.

2.2.1 General Mitigation and Conservation

- Existing high resolution aerial imagery of the Project Area will be provided pre- and post-construction. Aerial photography must be in color and procured from a reputable source (e.g., ESRI, National Aerial Photography Program [NAPP], National Agricultural Imagery Program [NAIP], etc.). Preconstruction imagery shall be submitted within 10 days of initiation of drilling; post-survey imagery shall be provided as soon as updated imagery becomes available. All imagery will become the property of the Refuge.
- Thurston will provide a detailed description of all BMPs that will be used during any aspect of the proposed exploration project.
- A lockbox or similar security system will be provided to Thurston for after-hours access to the project site during drilling and completion operations. No unauthorized entry of non-project related personnel will be permitted on the Refuge after normal operating hours.
- The Operator must provide detailed maps or plats of the proposed project layout (as required by the Refuge Manager or the Service AO) that shows routes, staging areas, construction areas, and work locations. The map should include the following minimum information:

    a) Dimensions on adjacent exterior section lines sufficient to completely describe the quarter section that contains the proposed well shall be indicated. If dimensions are not field measured, state how the dimensions were determined.

    b) The latitude and longitude of the proposed well location shall be provided on the drawing with a minimum of five (5) decimal places of accuracy and precision using the North American Datum (NAD) of 1983 (e.g.; latitude 37.12345 N, longitude 104.45632 W).

    c) For irregular, partial or truncated sections, dimensions will be furnished to completely describe the entire section containing the proposed well.

    d) The field-measured distances from the nearer north/south and nearer east/west section lines shall be measured at ninety (90) degrees from said section lines to the well location and referenced on the plat.

    e) A map legend.

    f) A north arrow.

    g) A scale expressed as an equivalent (e.g. - 1" = 1000').

    h) A bar scale.

    i) The ground elevation.

    j) The basis of the elevation (how it was calculated or its source).

    k) The basis of bearing or interior angles used.

l) Complete description of monuments and/or collateral evidence found; all aliquot corners used shall be described.

m) The legal land description by section, township, range, principal meridian, baseline and county.

n) Operator name.

o) Well name and well number.

p) Date of completion of scaled drawing.

q) A line designating the 100-year floodplain for the Green River relative to pad and well placement.

- Refuge officials will conduct an onsite meeting before rig-up with representatives of Thurston. The purpose of the meeting is to review and reiterate regulations and conditions that apply to work crew conduct on the Refuge. Thurston will be responsible for ensuring that employees, representatives, consultants, contractors, and subconsultants adhere to the COAs and BMPs identified in the SUP and DR for this EA.
- Prior to rig-up, Thurston must provide operational contacts to the Refuge Manager in the form of a telephone list that names key contacts for emergency operations and activation.
- The Operator must upgrade and maintain all access routes, roads, and bridges designated for its use across the Refuge in accordance with acceptable specifications and standards. The Operator must have road maintenance equipment and operator(s) readily available to perform road repairs and maintenance as needed, or as directed by the Refuge Manager or the Service AO.
- General Refuge access conditions:

a) Thurston and/or its contractors shall be allowed access to portions of the Refuge for the purpose of carrying out drilling of oil and gas exploration wells previously identified (50 CFR 26.22).

b) The Refuge Manager is the coordinating official having immediate jurisdiction and administrative responsibility for oil and gas operations on Refuge lands and property; all entry upon the Refuge must be coordinated with the Refuge Manager or the Service AO. The Refuge Manager must be advised at least 48 hours prior to initiation of construction (50 CFR 26.22).

c) The failure of the United States to require strict performance of the terms, conditions, covenants, agreements, or stipulations of this permit for access to conduct exploration activities on NWR lands shall not constitute a waiver or relinquishment of the right of the United States to strictly enforce thereafter such terms, conditions, covenants, agreements, or stipulations, which shall, at all times, continue in full force and effect.

d) Thurston and/or its contractors shall save, hold harmless, defend, and indemnify the United States, its agents and employees for loss, damages, or judgments and expenses on account of bodily injury, death, or property damage, or claims for bodily injury, death or property damage of any nature whatsoever, and by whomever made, arising out of the Operator, their employees, subcontractors, or agents with respect to the exploration of any and all mineral rights within the lands administered by the Refuge.

e) All applicable federal and state regulations apply and will be in force. Operator shall be responsible for the actions of all exploration and support personnel. Violations of applicable laws or regulations will subject the Operator and/or their employees to prosecution under state and/or federal laws. Individuals using the Refuge under the Operator's authorization are subject to inspections of vehicles and their contents by federal and state law enforcement officers.

f) Proof of general liability insurance as required by State law must be furnished to repair/mitigate any damages. This does not limit the liability for damages to this amount.

g) Operators will act in a manner that is respectful of Refuge habitats, wildlife, and property. Gates are to be locked or unlocked as they are found (50 CFR 27.21; 50 CFR 27.51).

h) All vehicle access will be restricted to developed roads and two-tracks. All-terrain vehicle (ATV) use and deviations to vehicle use must be pre-approved by the Refuge Manager in writing prior to any action taken (50 CFR 27.31).

i) To reduce potential impacts to air quality, all equipment associated with drilling and completion activities, as well as, service equipment used for fracing and cementing, would be with Tier-1 grade engines and emissions at a minimum.

j) Vehicle speed limits will be set at the discretion of Refuge Manager and limits will be strictly adhered to (50 CFR 27.31).

k) No pets will be allowed on the Refuge.

l) Person(s) entering or remaining on the Refuge when under the influence of alcohol is prohibited (50 CFR 27.81).

m) Possession of drugs or controlled substances is strictly prohibited on the Refuge (50 CFR 27.82.

n) Possession, transportation, or discharge of firearms, fireworks, or explosives on the Refuge is prohibited unless specifically authorized (50 CFR 27.41; 50 CFR 27.42).

o) Open fires are strictly prohibited in any areas of the Refuge (50 CFR 27.95).

p) Operators will not be considered agents of the Service and will not represent the Service in any matters (50 CFR 27.84).

q) Operators will perform all work in accordance with the highest standards of the industry and to the satisfaction of the Service.

r) Operators will perform all work in accordance with all applicable laws and regulations and will obtain all necessary permits or licenses when required to do so (50 CFR 25.13; 50 CFR 29.32).

s) All personnel and activities shall be restricted to the immediate drilling area and the direct access road to the drill site (50 CFR 26.22).

t) Feeding wildlife species is prohibited. Molesting or destroying the home or dens of wildlife is prohibited. If dens are found during the normal course of operations, distinctive flagging will be used to alert all personnel of the den location. Adverse impacts on fish, wildlife, and the environment shall be kept to an absolute

minimum. All road kills will be reported to the Refuge Manager or the Service AO (50 CFR 27.51).

u) Littering is prohibited. All cans, bottles, lunch papers, and operations trash must be removed. Cigarette butts are considered litter. All vehicles must be equipped with a container to carry out trash (50 CFR 27.94).

v) Thurston must complete or obtain all necessary permits, contacts and clearances prior to the start of the activity (50 CFR 25.13).

w) No overnight quarters will be permitted on the Refuge unless authorized by the Refuge Manager (50CFR 27.92).

- A brief Worker Environmental Awareness Program (WEAP) will be implemented for construction and drilling crews prior to the commencement of the project activities. Training materials and briefings will include, but are not be limited to, discussion of the federal and state ESAs, the consequences of noncompliance with these acts, identification and values of wildlife and natural plant communities, threatened and endangered species within the Project Area, hazardous substance spill prevention and containment measures, and review of all required and recommended mitigation measures.

2.2.2 Erosion and Sedimentation

- The drill site and immediate access roads must be constructed of Refuge-approved material for all drilling locations. All existing drainage patterns within roads to be constructed must be maintained uninterrupted by the use of culverts, bridges, or other applicable techniques as specified and authorized by the Refuge Manager or the Service AO.

- Thurston shall implement and maintain BMPs at all oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation. BMPs shall be maintained until the facility is abandoned and final reclamation is achieved. Operators shall employ BMPs, as necessary, to comply with this rule, at all oil and gas locations, including, but not limited to, well pads, soil stock piles, access roads, tank batteries, and pipeline ROWs. BMPs shall be selected based on site-specific conditions, such as slope, vegetation cover, and proximity to water bodies, and may include maintaining in-place some or all of the BMPs installed during the construction phase of the facility. Where applicable, based on site-specific conditions, operators shall implement BMPs in accordance with good engineering practices.

2.2.3 Spill Procedures

- In accordance with EPA regulations (40 CFR Part 112), Thurston must prepare and implement a SPCC plan within six months of beginning operations. Copies of the SPCC plans shall be provided to the Refuge Manager within six months of commencing production operations. A Draft SPCC Plan, which illustrates the types of spill prevention measures that will be installed, is included in **Appendix G** of the EA/BA. This plan will be reviewed by the Service and should include a listing of secondary containment and/or diversionary structures or equipment for all oil handling containers, equipment, and transfer areas. It should also include a table identifying tanks and containers at the facility with the potential for an oil discharge, the mode of potential failure, and the likely flow direction and potential quantity of the discharge, as well as provide the secondary containment method and containment capacity. In addition, the SPCC Plan should include the physical layout of the facility and a facility diagram, which must mark the location and contents of each container. The facility diagram must also include all transfer stations and connecting pipes.

- All open-top oil, condensate, or produced water tanks, dehydration unit tubs, secondary containment tubs, and any other open tub, tank, pan, or similar item will be netted or screened to prevent entrapment and mortality of migratory birds. Where there are open-top tanks which do not contain harmful substance, such as, stock water tire tanks, we recommend the use of escape ramps in these tanks to minimize the potential drowning of migratory birds and possible violations of MBTA.
- Secondary containment (i.e., catch pans or other liner systems consistent with industry standards) are required for equipment and locations such as mud pumps, bulk mud additive tanks, fuel tanks, mixing sheds, generators, accumulator and lines, and under the entire rig floor. The catch pans must cover the entire surface area under the equipment. The rig floor catch pan (collector) must be properly secured to allow for wash down and mud drainage from the drill pipe. The catch pans must be kept free of accumulated debris and spill materials must be emptied on a regular basis.
- Earthen berms and storage tank containment areas would be lined with a non-permeable liner in order to reduce the risk of groundwater and soil contamination. These liners will be maintained and replaced per manufacturer guidelines.

2.2.4 Noxious and Invasive Weeds

- All vehicles and equipment used in construction must be decontaminated prior to arriving at the Refuge per Service procedures to prevent the introduction of noxious weeds to the Refuge. It is recommended that the operator consult with the local weed control agency or other weed control authority if weed infestation occurs. It is the responsibility of the operator to monitor affected and reclaimed lands for noxious weed infestations. The Refuge will require a weed control plan.
- Impacts on sensitive habitat (e.g., wetlands, riparian areas), wildlife, plants, and other natural or historical resources must be avoided to the extent possible while constructing the access road and well pads. Existing roads shall be used to the greatest extent practicable to avoid erosion and minimize the footprint devoted to oil and gas operations. Roadbeds shall be engineered to avoid or minimize impacts to riparian areas or wetlands to the extent practicable. Unavoidable impacts shall be mitigated.
- Any materials brought into the Refuge as fill material for construction must be authorized by the Refuge Manager or the Service AO. To minimize the spread of invasive species, no top soils will be brought in from outside the Refuge.

2.2.5 Wildlife

- Thurston will install electricity to provide power for separators and pump jacks on the two proposed well pads to reduce the level of noise for both wildlife and visitors. An aboveground distribution line would be built on single wood utility poles located within the proposed road ROW. The proposed distribution line would tie into an existing power source at the Ouray NFH.
- Construction and drilling operations conducting during the Refuge's seasonal closure period must be coordinated and authorized with the Refuge Manager or the Service AO to avoid conflicts with wildlife. At the discretion of the Refuge Manager or the Service AO, additional wildlife monitoring or mitigation may be required during this closure period based on site-specific conditions.

- Should the project schedule construction activities between March 1st and August 31st, all areas within 0.5 miles of the proposed project would be surveyed for the presence of raptor nests by a Service-approved biologist. If occupied raptor nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- Burrowing owl surveys would be conducted concurrently with the raptor surveys within 0.25 miles of the proposed project if the project schedule occurs between March 1st and August 31st. If occupied burrowing owl nests are found within the recommended spatial buffers, the Utah ESO would be consulted to determine if the recommended spatial buffers can be modified on a nest-by-nest basis by considering the species, timing, nest status, disturbance type and duration, vegetation, and topography.
- To avoid and minimize impacts to birds during construction and operations and to ensure ground-disturbing activities do not result in the "take" of an active nest or migratory bird protected under the MBTA, the Service requires the following of Thurston:
    a) Any groundbreaking activities or vegetation treatments should be performed before migratory birds begin nesting or after all young have fledged to avoid take;
    b) Time tree and shrub removal and ground disturbing activities should occur during the non-nesting season (approximately September 1st to February 28th). If this is not possible, surveys should be conducted prior to disturbance to determine whether active nests are present; active nests found in the area should be left untouched until the young have fledged;
    c) If activities must be scheduled to start during the migratory bird breeding season, appropriate steps to prevent migratory birds from establishing nests in the potential impact area should be taken. These steps could include covering equipment and structures and use of various excluders (e.g., noise). Birds can be harassed to prevent them from nesting on the site;
    d) If activities must be scheduled during the migratory bird breeding season, a site-specific survey for nesting birds should be performed starting at least two weeks prior to vegetation treatments. Established nests with eggs or young cannot be moved, and the birds cannot be harassed (see item b above), until all young have fledged and are capable of leaving the nest site; and
    e) If nesting birds are found during the survey, appropriate spatial buffers should be established around nests. Vegetation treatments within the buffer areas should be postponed until the birds have left the nest. Confirmation that all young have fledged should be made by a qualified biologist.
- The Refuge Manager or the Service AO may require drill pads to be fenced and signed if problems arise as a result of refuge visitors and wildlife at these sites.
- To protect special status species such as, but not limited to, the Uinta Basin hookless cactus (*Sclerocactus wetlandicus*), the Service requires the following of Thurston. In order to minimize effects to the federally threatened Uinta Basin hookless cactus, the BLM in coordination with the Service, developed the following avoidance and minimization measures. Integration of and adherence to these measures will help ensure the activities carried out during oil and gas development (including, but not limited to, drilling, production, and maintenance)

are in compliance with the ESA. The following avoidance and minimization measures should be included in the POD:

a) Pre-project habitat assessments will be completed across 100% of the project disturbance area within potential habitat[1] prior to any ground disturbing activities to determine if suitable Uinta Basin hookless cactus habitat is present.

b) Within suitable habitat[2], site inventories will be conducted to determine occupancy. Inventories:

1. Must be conducted by qualified individual(s) and according to the USFWS and Service-accepted survey protocols;

2. Will be conducted in suitable and occupied habitat[3] for all areas proposed for surface disturbance prior to initiation of project activities and within the same growing season, at a time when the plant can be detected, and during appropriate flowering periods:

   a. *Sclerocactus brevispinus* surveys should be conducted March 15th to June 30th, unless extended by the USFWS.

   b. *Sclerocactus wetlandicus* surveys can be done any time of the year, provided there is no snow cover;

3. Will occur within the ROW and 50 feet from the outside edge of the ROW on one side of the road only (the side on which the pipeline will be laid); applies to buffers for roadside surface pipelines;

   Will occur within the ROW and 50 feet from both sides of the ROW edge; applies to buffers for hand laid cross-country surface pipelines;

   Will occur within the ROW and 300 feet from both sides of the ROW edge; applies to buffers for access roads; and

   Will occur out to a distance of 300 feet from the edge of disturbance for the proposed well pads; applies to buffer distances (avoidance).

4. Will include, but is not be limited to, plant species lists and habitat characteristics; and

5. Will be valid until March 15th the following year for *Sclerocactus brevispinus* and one year from the survey date for *Sclerocactus wetlandicus*.

---

[1] *Potential habitat is defined as areas which satisfy the broad criteria of the species habitat description; usually determined by preliminary, in-house assessment.*

[2] *Suitable habitat is defined as areas which contain or exhibit the specific components or constituents necessary for plant persistence; determined by field inspection and/or surveys; may or may not contain Uinta Basin hookless cactus. Habitat descriptions can be found in the U.S. Fish and Wildlife Service's 1990 Recovery Plan and Federal Register Notices for the Uinta Basin hookless cactus (http://www.fws.gov/endangered/wildlife.html).*

[3] *Occupied habitat is defined as areas currently or historically known to support Uinta Basin hookless cactus; synonymous with "known habitat."*

c) Design project infrastructure to minimize impacts within suitable habitat:

1. Reduce well pad size to the minimum needed, without compromising safety;
2. Limit new access routes created by the project;
3. Roads and utilities should share common ROWs where possible;
4. Reduce width of ROWs and minimize the depth of excavation needed for the road bed and where feasible, use the natural ground surface for the road within habitat;
5. Place signing to limit off-road travel in sensitive areas;
6. Stay on designated routes and other cleared/approved areas;
7. All disturbed areas will be re-vegetated with native species comprised of species indigenous to the area and non-native species that are not likely to invade other areas; and
8. A biological monitor will be onsite during facility installation.

d) Within occupied habitat, project infrastructure will be designed to avoid direct disturbance and minimize indirect impacts to populations and to individual plants:

1. Follow the above (#c) recommendations for project design within suitable habitats;
2. Buffers of 300 feet minimum between the edge of the ROW (roads and surface pipelines) or surface disturbance (well pads) and plants and populations will be incorporated;
3. Surface pipelines will be laid such that a 300-foot buffer exists between the edge of the ROW and the plants and use stabilizing and anchoring techniques when the pipeline crosses the habitat to ensure the pipelines do not move towards the population;
4. Before and during construction, areas for avoidance should be visually identifiable in the field, e.g., flagging, temporary fencing, rebar, etc.;
5. Where technically and economically feasible, use directional drilling or multiple wells from the same pad;
6. Designs will avoid concentrating water flows or sediments into occupied habitat;
7. Place produced oil, water, or condensate tanks in centralized locations, away from occupied habitat; and
8. Minimize the disturbed area of producing well locations through interim and final reclamation. Reclaim well pads following drilling to the smallest area possible.
9. Occupied Uinta Basin hookless cactus habitats within 300 feet of the edge of the surface pipelines' ROWs, 300 feet from the edge of the roads' ROWs, and 300 feet from the edge of the well pad shall be monitored for a period of three years after ground disturbing activities. Monitoring will include annual plant surveys to determine plant and habitat impacts relative to project

facilities. Annual reports shall be provided to the BLM and the Service. To ensure desired results are being achieved, minimization measures will be evaluated and may be changed after a thorough review of the monitoring results and annual reports during annual meetings between the BLM and the Service.

10. Re-initiation of Section 7 consultation with the Service will be sought immediately if any loss of plants or occupied habitat for the Uinta Basin hookless cactus is anticipated as a result of project activities.

e) Additional site-specific measures may also be employed to avoid or minimize effects to the species. These additional measures will be developed and implemented in consultation with the Service to ensure continued compliance with the ESA.

- As necessary, Thurston will notify the appropriate authorities (UDOT on highways and UDWR or USFWS on county and Refuge roads) of the presence of roadside carrion and ask that they remove the carrion as soon as possible. Carcasses may be covered in the interim to discourage scavenging by bald eagles and other raptors. However, only authorized personnel may touch or remove the carcasses.
- Thurston would not commence construction, drilling, or completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st).
- To avoid the potential for mortality and harassment of wildlife, all firearms and dogs will be prohibited from the project site, and all workers will be required to check under their vehicles prior to departing the project site.
- Trash and food items will be disposed of promptly in containers with resealable lids. Trash containers will be removed regulatory (at least once per week). This effort will reduce the attractiveness of the area to opportunistic wildlife.
- Project activities would comply with applicable requirements of the MBTA, BGEPA, and ESA, as amended.
- The following measures would be implemented for new power lines:
    - Potential impacts to raptors would be mitigated by designing poles according to criteria presented in *Suggested Practices for Raptor Protection on Powerlines: the State of the Art in 2006* (APLIC 2006). In addition, strategies for minimizing collision risk with power lines would follow criteria presented in *Reducing Avian Collisions with Powerlines: the State of the Art in 2012* (APLIC 2012). Depending on the alternative selected, specific standards to be followed will be identified in the Decision Record for the EA.

2.2.6 Aesthetics

- During all phases of this project, noise levels must be kept to a minimum and should not exceed the established industry standard above ambient day and nighttime noise levels. Thurston should make every effort to use electric pumping equipment (most quiet) during the production phase of this operation.
- Thurston must implement the following conditions to reduce the impacts on daytime and nighttime visual resources:

    a) The production equipment and associated infrastructure must be painted a flat, non-reflective, earth-tone color to blend with the natural landscape background.

b) During pad construction and when erecting or disassembling the drilling rig, outdoor lighting should be kept to a minimum and turned off when not needed.

c) Whenever possible, each series of lights must be either on a separate switch, timer, or motion sensor to allow the operator to tailor their use to activity in a specific area of the drill pad.

d) All area lights must be downward pointing and fully shielded. All lighting focused on a particular apparatus must be laterally shielded so that all light falls upon the intended work area and a minimum amount of light is emitted sideways or upward.

e) Lights that are required by OSHA for emergencies must be linked to alarms so that they are only operational when an emergency situation arises.

f) No light shall exceed 400 watts.

g) All lamps must be ≤ 3500 ° Kelvin color temperature to reduce blue-rich light, which causes greater sky glow and is typically more attractive to wildlife.

h) A Service designee will observe the facility from critical angles and distances. Excessively glaring lights must be shielded, re-aimed, or otherwise mitigated with an adaptive approach without compromising worker safety requirements.

i) Lighting will be minimized where applicable unless safety is an issue.

2.2.7 Water Resources, Including Wetlands and Floodplains

- Thurston must provide the Refuge Manager or the Service AO a copy of the wetland determination/delineation that was issued by the U.S. Army Corps of Engineers (USACE) for the Project Area showing that none of the well pad locations or roads will impact wetland areas.
- Summaries of all the results generated from existing water quality data, cultural resource surveys, biological resource surveys, and any other sampling or monitoring must be provided to the Refuge Manager or the Service AO prior to the onset of construction.
- The Operator will be responsible for providing all water needed for drilling operations. No wastewater will be discharged onto Refuge lands, ditches, or water bodies. The Operator will provide a containerized or temporary septic system for domestic sewage disposal during drilling operations, which must be removed upon completion of drilling. Use of portable toilets at the drill site or the installation of a temporary septic system, or similar treatment system or tanks, will be required for any trailer or quarters onsite. No surface discharge of septic system or portable toilet water is permitted. Septic tanks must be inspected weekly during operations and pumped as necessary. Upon completion of operations, the septic tanks must be pumped out, removed, and all material hauled away.
- Thurston shall provide a detailed topographic map, using established map making practices, showing the location of the 100-year floodplain along the Green River inside the Ouray NWR boundary.

2.2.8 Reclamation

- All construction of roads and pads will occur in a manner that best facilitates their subsequent complete removal and reclamation once Thurston activities have ceased at these sites. This includes separating, stockpiling, and covering topsoil layers onsite to be replaced during reclamation. All disturbed areas must be reclaimed with Service input at the time reclamation occurs. Only endemic plants and seed mixtures are to be used in reclamation. Thurston shall separate and store the topsoil horizon or the top six-inches, whichever is deeper, and mark or document stockpile locations to facilitate subsequent reclamation. When separating the topsoil layers, the operator shall segregate the horizon based upon noted changes in physical properties such as organic content, color, texture, density, or consistency. All stockpiled soils shall be protected from degradation due to contamination, compaction and, to the extent practicable, from wind and water erosion during drilling and production operations. BMPs to prevent weed establishment and to maintain soil microbial activity shall be implemented. Final reclamation of all disturbed areas shall be considered complete as follows:

    a) When all activities disturbing the ground have been completed and;

    b) When all disturbed areas have been either built upon, compacted, covered, paved, or otherwise stabilized in such a way as to minimize erosion, or;

    c) When a uniform vegetative cover has been established that reflects pre-disturbance or;

    d) When reference area forbs, shrubs, and grasses with total percent plant cover of at least 80 percent of pre-disturbance or reference area levels (excluding noxious weeds) or equivalent permanent, physical erosion reduction methods have been employed. Re-seeding alone is not sufficient.

- Upon completion of drilling operations, the Refuge Manager or the Service AO must be advised within 120 days whether the well is to be retained or plugged. If the well site is to be abandoned, the well is to be plugged to meet the standards of both state requirements and Federal *Oil and Gas Onshore Order No. 2*, all above-ground structures removed, and the site and road restored as directed by the Refuge Manager or the Service AO. Any damage to existing surface vegetation, water channels, or other physical features must be restored to near original site conditions. All costs shall be borne by the Operator.

2.2.9 Dust Abatement

- Dust levels on regularly traveled access routes must be kept to a minimum. The Operator must have a water truck and operator(s) readily available to perform dust abatement as needed, or as directed by the Refuge Manager or the Service AO. Magnesium water or an approved equivalent may be used as needed with prior approval from the Refuge Manager or the Service AO. Dust control measures must be implemented throughout the traveled areas of the Project Area.

2.2.10 Hazardous Materials and Solid Waste

- All cuttings and drilling fluids will be removed from the Refuge and disposed of off-site in an approved disposal facility.
- Onsite disposal of produced water is prohibited. Produced water may only be disposed of at an offsite State-approved facility.
- All toxic construction and equipment supplies and refuse (oil, grease, gasoline, diesel, paint, and other petrochemical derivatives) must be centrally stored. Wastes must be removed from the Refuge immediately following completion of drilling operations and disposed of properly. In the event of an accidental spill or discharge of oil, brine, or any other petrochemical substance, the Operator must immediately notify the Refuge Manager or authorized representative. The Operator must remove contaminated soils for proper disposal off Refuge and replace them with the same type soils or one specified and approved by the Refuge Manager or the Service AO. A site reclamation plan may be required by the Refuge Manager or the Service AO.
- All disposable type materials and trash brought onto the Refuge or generated at the drill site must be removed from the Refuge on a biweekly basis and upon completion of the drilling activities. The drill site and operational area must be kept free of debris and trash at all times. Trash must be contained securely at the drill site in such a manner (fully enclosed trash cages) as to prevent trash from being spread by wind or wildlife. No trash may be disposed of or buried on the Refuge.

2.2.11 Cultural Resources and Native American Concerns

- In the event that unanticipated cultural resources are uncovered during surface-disturbing activities, procedures outlined in the Service's 614 FW 2, Survey and Identification Manual (USFWS 1992c) and other applicable regulations would be followed. Thurston would suspend operations at the site and immediately contact the Service, who will arrange for a determination of eligibility in consultation with the State Historic Preservation Office (SHPO) and if necessary, will recommend a recovery or avoidance plan.
- Thurston is responsible for informing all persons in the area who are associated with this project that they may be subject to prosecution for knowingly disturbing historic or archaeological sites or for collecting artifacts. All vehicular traffic, personnel movement, and construction and restoration activities would be confined to the areas evaluated in the pre-disturbance survey.
- Per consultation with the Utah SHPO, a contracted paleontologist will be onsite when construction occurs.

3.0 AFFECTED ENVIRONMENT

A description of the existing human environment including biological, physical, and social resources that may be affected by the Proposed Action or the No Action Alternative, as described in **Chapter 2.0** of the EA, is provided under **Chapter 3.0** of the referenced EA/BA.

Section 3.4.4 - Special Status Plant and Animal Species of the EA/BA addresses special status plant and animal species including those listed as threatened or endangered under the ESA of 1973, as amended, species proposed for listing, species of special concern and other species identified either by the USFWS-ESO, Utah Division of Wildlife Resources (UDWR), or Utah Natural Heritage Program (UNHP) as unique or rare, and which have the potential to occur within the Project Area and surrounding region.

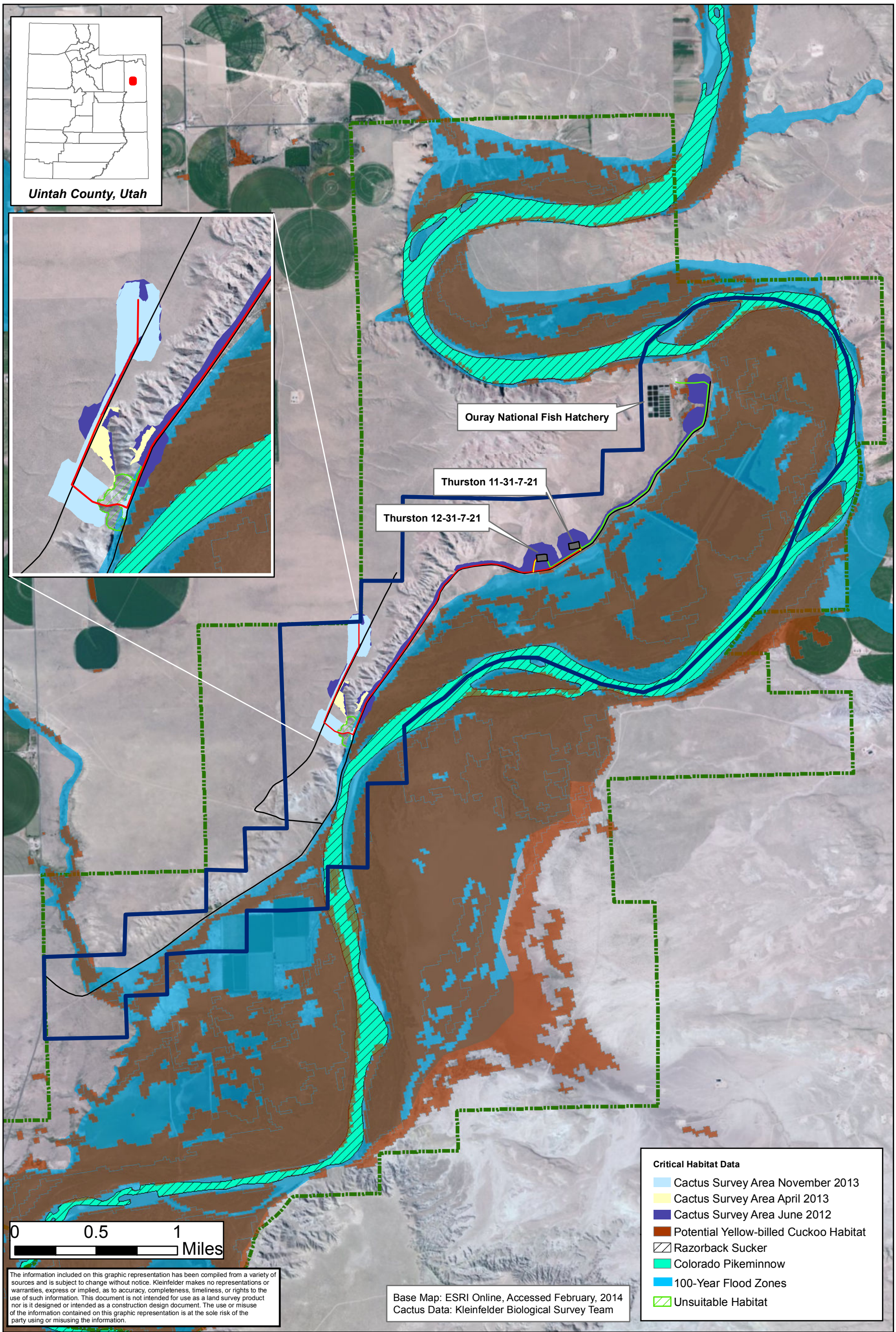
Section 3.4.4.1 - Federally Threatened, Endangered, or Proposed Species of the EA/BA discusses those threatened, endangered, or proposed species identified as potentially occurring within the Project Area (see **Table 3-10** in the EA/BA or **Table 3-1** provided below). A total of seven species or subspecies of plants and animals are addressed in this EA/BA, four of which are listed as endangered, two of which are federally listed as threatened, and one proposed threatened species. Critical habitat has been designated for four of the seven species (all fish), as indicated in **Table 3-1.**

Figure 1 identifies project activities, components of the Proposed Action including well pads, access roads, surface pipeline routes, power lines, the completed cactus surveys delineated and identified by date, and habitat locations for cacti, Yellow-billed cuckoo, and two of the Colorado River Fish species.

Table 3-1. Federally Listed Species Considered for Evaluation in the EA (Modified to Include Determination Made for Each Species and Designated Critical Habitat)

Species	Status	Species Listing		Critical Habitat		Abundance	Primary Refuge Habitat Use	Determination Made for Each Species	Designated Critical Habitat
		Date Listed	Federal Register No.	Date Designated	Federal Register No.				
Birds									
Yellow-billed cuckoo (*Coccyzus americanus*)	PT	December 26, 2013	78 FR 78321	N/A	N/A	Uncommon Summer	Riparian Habitats	***may affect yellow-billed cuckoo potential habitat, but would not likely result in a trend towards federal listing of this species***	No
Fish									
Colorado pikeminnow (*Ptychocheilus lucius*)	E	March 11, 1967	32 FR 4001	March 21, 1994	59 FR 13374	Rare; Ouray reach is occupied habitat, an annual migratory corridor, and important nursery area for young-of-year fish.	Riverine & Wetlands/ Bottomlands	***may affect, likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River. This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin.	Some 726 total miles of river and its associated 100-year floodplain in Utah have been designated as critical habitat for the Colorado pikeminnow by the USFWS. The Project Area contains approximately 266 acres of critical habitat along the Green River, not inclusive of associated floodplains (USFWS 2007).
Bonytail chub (*Gila elegans*)	E	April 23, 1980	45 FR 27713	March 21, 1994	59 FR 13374	Rare; No wild caught in several years; stocking of hatchery-raised individuals of this species occurs in the Ouray reach.	Riverine	***may affect, likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River. This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin.	In Utah, a total of 139 river miles and their associated 100-year floodplains have been designated by the USFWS as critical habitat for the bonytail chub in portions of the Green River and Colorado River.
Razorback sucker (*Xyrauchen texanus*)	E	October 23, 1991	56 FR 54957	March 21, 1994	59 FR 13374	Rare; Ouray reach is occupied habitat and an annual migratory corridor; associated floodplains of Ouray reach are an important nursery area for young-of-year fish; stocking of hatchery-raised individuals of this species occurs in the Ouray reach.	Riverine & Wetlands/ Bottomlands	***may affect, likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River. This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin.	A total of 688 river miles and their associated 100-year floodplains have been designated as critical habitat for the razorback sucker. The entire length of the Green River within the Project Area is designated as critical razorback habitat. This accounts for approximately 266 acres of habitat within the Project Area, not inclusive of 100-year floodplains (USFWS 2007).
Humpback chub (*Gila cypha*)	E	March 11, 1967	32 FR 4001	March 21, 1994	59 FR 13374	Rare; Severely reduced in numbers; occupied habitat is downstream of Ouray reach.	Riverine	***may affect, likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River. This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin.	Some 139 river miles and their associated 100-year floodplains have been designated as critical habitat for the humpback chub by the USFWS in portions of the Colorado and Green Rivers. There is no critical humpback chub habitat within the Project Area.
Plants									
Uinta Basin hookless cactus (*Sclerocactus wetlandicus*)	T	October 11, 1979	44 FR 58869	N/A	N/A	Uncommon	Dry Gravel Terraces	***may affect, but is not likely to adversely affect***	No
Ute ladies'-tresses (*Spiranthes diluvialis*)	T	January 17, 1992	57 FR 2048	N/A	N/A	Uncommon	Stream Terraces, Wetlands, & Floodplains	***may affect, but is not likely to adversely affect***	No

E = Endangered, T = Threatened, PT=Proposed Threatened



The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

Legend

- Project Area Boundary
- Proposed Well Pad
- Proposed Access Road
- Proposed Surface 3" HDPE Gas Line
- Proposed Power Line
- Existing Roads
- Ouray National Wildlife Refuge Boundary

N

PROJECT NO.	126694
DRAWN:	2/10/2014
DRAWN BY:	B. McDavid
CHECKED BY:	C. Wharry
FILE NAME:	BA_Fig1_CriticalHabitat.mxd

Thurston Energy

Ouray NWR 2-Well Development Program

Critical Habitat Map
Uintah County, Utah

FIGURE
1

4.0 ENVIRONMENTAL CONSEQUENCES

Chapter 4.0 of the referenced EA/BA summarizes and analyzes the potential impacts or environmental consequences that would result from implementation of the Proposed Action or the No Action Alternative, as described in **Chapter 2.0** of the EA/BA. The resource-specific effects of the alternatives are evaluated both quantitatively and qualitatively, depending on available data and the nature of the resources analyzed. Mitigation measures and residual impacts are discussed, where appropriate, to further minimize impacts.

An environmental consequence or impact is defined as a modification in the existing environment resulting from the Proposed Action or an Alternative. Impacts can be a primary result of the action (direct) or a secondary result (indirect), and can be permanent or long-lasting (long-term) or temporary and of short duration (short-term). Impacts can vary in degree from only a slightly discernible change to a total change in the environment. In addition, cumulative impact analysis is presented for each resource following the direct and indirect effects discussion and provides a framework for forecasting and evaluating future environmental changes that may affect the quality and extent of the natural and human environment.

For the purposes of the environmental consequences analysis of the EA, the term "Proposed Action" is used to represent the construction footprint (area of disturbance). The term "Project Area" encompasses approximately 3,684 acres of land including the Proposed Action and surrounding adjacent lands that may be directly impacted by components of the proposed project. The term "surrounding region" included surrounding lands (outside but adjacent to the Project Area) and is used to denote a more expansive landscape context.

Section 4.4.4 - Special Status Plant and Animal Species of the EA/BA discusses construction and operational impacts on special status plant and animal species and their habitats. These impacts can be more severe for special status plant, fish, and wildlife species, if present, because the distribution and abundance of many of these species is limited within the Project Area and surrounding region. An adverse impact to special status species will have occurred if construction and/or operation of any component of the proposed project results in a substantial change to the existing abundance, distribution, or habitat value for a special status fish and wildlife species. The magnitude and nature of effects resulting from implementation of the Proposed Action is assessed for the species relative to existing conditions as to whether these effects are expected to appreciably reduce likelihood of species survival and recovery. Conclusions regarding the effects of the Proposed Action on the species, as well as a determination of effect (no effect; may affect, not likely to adversely affect; may affect, likely to adversely affect; and likely to jeopardize the species or adversely modify critical habitat) is presented in the conclusions and determination section at the end of the analysis for each species. Cumulative impacts and proposed mitigation for special status plant and animal species are discussed in **Section 4.4.4.3** and **Section 4.4.4.4** of the EA/BA, respectively.

4.1 YELLOW-BILLED CUCKOO

The yellow-billed cuckoo is known to use riparian habitat that occurs north and east, but outside, of the disturbance footprint for the Project along the Green River. Therefore, the Proposed Action would not have direct impacts to this habitat. Potential effects of the Proposed Action on the western yellow-billed cuckoo would likely be in the form of direct noise disturbance or lighting. Noise and/or lighting may arise from construction, drilling, and production activities associated with the proposed project, which could affect cuckoos, if present in the immediate vicinity of these activities. This could lead to avoidance

of affected areas (Goodwin and Shriver 2010). Displacement could also lead to increased use of adjacent habitats, which could lead to increased inter- and intra-specific competition for resources.

Existing studies on noise indicate that the response of wildlife to noise disturbance is complex; that is, it is neither uniform nor consistent. Delaney et al. (1997) reviewed literature on the response of raptors and other birds to noise and concluded the following: (1) birds are more susceptible to disturbance-caused nest abandonment early in the nesting season, (2) birds generally flush in response to disturbance when distances to the source are less than approximately 200 feet and when sound levels are in excess of 95 dB(A), and (3) the tendency to flush from a nest declines with experience or habituation to the noise, although the alert response (i.e., head movements or agitated behavior) cannot be completely eliminated by habituation.

Elevated ambient daytime noise from the proposed project during the western yellow-billed cuckoo breeding season could result in decreased utilization within an indeterminate number of acres north and east of the current Wildlife Refuge Road along the floodplain. The magnitude of impacts would depend on the specific type of activity, the noise level generated by various types of equipment, the distance between the activity and individual cuckoos, and whether local barriers and topography provide shielding effects. Noise analysis completed for the Montebello Hills Specific Plan Environmental Impact Report revealed that use of electric pumpjack equipment and transformers similar in size to what would be installed on the Refuge would generate noise levels at distances greater than 150 feet that are considered ambient conditions in a rural residential area (i.e., noise levels near or below 40 dB[A]) (BridgeNet International 2009). Topographic screening between the area of disturbance and the birds' location creates a noise buffer and could assist in the reduction of noise disturbance (Knight and Cole 1995).

Table 4-1 lists noise levels associated with common activities and events.

Table 4-1. Common Noise Levels Associated with Activities and Natural Events

Source	Sound Level
Threshold of Hearing	0 dB(A)
Wind in Deciduous Trees (2-14 mph)	36-61 dB(A)
Falling Rain (Variable Rainfall Rates)	41-63 dB(A)
Light Traffic (at 100 feet)	50 dB(A)
Average Residence	50 dB(A)
Loud Automobile Horn (at 1 meter)	115 dB(A)
Oil Drilling Rig (at 50 feet)	90-115 dB(A)

Source: EPA 1974

Table 4-2 shows the attenuation of noise levels in association with distance from the receptor. .

The influences of vegetation, topography, and atmospheric conditions on noise reduction factors can vary greatly and are often impossible to quantify. Therefore, these factors are generally not taken into account in environmental noise analysis, which generally results in predicted noise levels that are higher than actual noise levels. For example, a break in the line of sight between a noise source and receptor can result in a 5 dB(A) reduction. Dense vegetation can reduce noise levels by 5 dB(A) for every 100 feet of vegetation, up to a maximum reduction of 10 dB(A) (USDOT 1995). Wind can reduce noise levels by as much as 20 dB(A) to 30 dB(A) at long distances (USDOT 1995).

Table 4-2. Estimated Noise Attenuation Associated with an Increase in Distance

Distance to Receptor (Feet)	Sound Level at Receptor (Decibels)
50	92
100	86
200	80
400	73
600	69
800	67
1,000	64
1,500	60
2,000	57
2,500	54
3,000	51
4,000	47

Source: California State Water Resources Control Board (2002).

Thurston would not conduct construction, drilling, and completion activities during the yellow-billed cuckoo nesting season (June 15th to August 31st); therefore, intensive noise, light, and human related impacts to nesting cuckoos during these project phases are not anticipated. Due to the distance the proposed well pads would be from the nearest area that contains riparian vegetation, the use of electrified pump-jacks, and the buffering effects of vegetation, topography, and atmospheric conditions, the magnitude of project-related noise impacts on the yellow-billed cuckoo are not expected to reach adverse levels.

Potential indirect impacts to potential yellow-billed cuckoo habitat could result under the Proposed Action from increased soil erosion and potential for spills and leaks. These impacts would be reduced with interim reclamation, recommended mitigation measures for erosion control to avoid or minimize soil erosion and off-site deposition, and spill containment measures. Further, while the yellow-billed cuckoo is known to occur and nest within the Ouray NWR, they are considered as uncommon to rare summer residents within the Refuge. Based on this information, the Proposed Action ***may affect, is not likely to adversely affect*** the yellow-billed cuckoo within the Project Area.

4.2 COLORADO RIVER ENDANGERED FISH SPECIES

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

Total water needed for the proposed project would be approximately 5.7 acre-feet (see **Section 2.1.7** of the EA/BA). The estimated total freshwater needed for the proposed project (5.7 acre-feet) could result in depletion to the Green River, thus directly affecting the Colorado River fish and their habitat. Water depletions can reduce the ability of the Green River and its tributaries to create and maintain the physical habitat required by these fish and the supporting biological environment. Water depletions can also contribute to alterations in flow regimes that favor increased forage and habitat competition for, and predation on, the Colorado River fish from non-native fish species.

In order to address depletion and other direct and indirect impacts on the Colorado River fish, a Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery

Program) was initiated in January 22, 1988. Under the Recovery Program, any water depletions from tributary waters within the Colorado River drainage are considered to "jeopardize the continued existence" of these fish. To further define and clarify the recovery processes in the Recovery Program, a Section 7 agreement was implemented on October 15, 1993, by the recovery program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP). The RIPRAP identifies actions currently required to recover the endangered fish species in the most expeditious manner. Included in the RIPRAP was the requirement that a one-time depletion fee would be paid to help support the recovery program for all non-historic water depletions (i.e., occurring after January 1988) from the Upper Colorado River Basin. The depletion fee ($19.82 per acre-foot as of October 1, 2012, and updated annually) was intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions to the Upper Colorado River Basin (USFWS 2013a). In 1995, the USFWS eliminated these fees for non-historical water depletions (permitted after January 1988) from the Upper Colorado River Basin of 100 acre-feet or less (USFWS 1994). For this EA, it is assumed that all water depletions from fresh water sources would be considered non-historical.

Local floodplain areas to the project (i.e., Leota Bottom) are important nursery habitats for razorback sucker. As part of the newly implemented *Study Plan to Examine the Effects of Using Larval Razorback Sucker Occurrence in the Green River as a Trigger for Flaming Gorge Dam Peak Releases* (LTSP) (Larval Trigger Study Plan ad hoc committee 2012), the Upper Colorado River Endangered Fish Recovery Program plans to use floodplains in the Leota Bottom area as nursery habitat under various hydrologic conditions. Specifically, Leota 7 would be targeted for larval razorback in all average and wetter years, and Leota 7a and 4 would be targeted in moderately wet and wet years. These floodplain units located within the Project Area lie directly east of Wildlife Refuge Road and the proposed disturbance. More specifically, units 4, 7 and 9 are those most likely to suffer from indirect impacts associated with project activities. Potential indirect effects to the floodplains in the Leota Bottom and their associated fish habitat are described below.

Implementation of the Proposed Action could also degrade USFWS-designated critical habitat for the Colorado River fish species in major tributaries and floodplains of Green River by increasing erosion, sediment yield, and the potential for exposure to hazardous substances in the case of an accidental spill that would result in condensate and hydrocarbon material to enter the Green River. However, degradation of habitat related to increased erosion and sedimentation would be minimized by actions set out in the Proposed Action, including ACEPMs (**Section 2.1**) and Service prescribed environmental protection measures (**Section 2.2**), which include provisions to implement reclamation, implement and adhere to a stormwater management plan (SWMP), and use BMPs to reduce or minimize erosion from the Project Area. In addition, impacts related to the increased potential for exposure to hazardous substances would be minimized by implementation of and adherence to the specific action items of a SPCC plan that would contain and/or control contaminated water.

The Proposed Action would not result in any direct impacts to the Ouray NFH. The proposed well pads, access road, and pipeline corridor would occur approximately 7,571.5 feet southeast of the hatchery. The hatchery could be indirectly impacted by the construction of the proposed above ground power line running from the hatchery to the proposed well sites. These impacts could include increased noise and human presence within the vicinity of the facility. However, these impacts are considered negligible as they would be short in duration and minor in scope.

As discussed in **Section 4.3.1.1** of the EA/BA, the use of water for drilling under the Proposed Action will result in a small depletion to the Green River, 0.0001 percent. While this amount may be minor to the flow of the Green River, any loss of water from the Upper Colorado River Basin represents a

measurable loss of habitat for fish species; therefore, implementation of the Proposed Action ***may affect, is likely to adversely affect*** the Colorado River fish and their USFWS-designated critical habitats in the Green River.

This determination can be attributed to the anticipated 5.7 acre-feet depletion of water from the Green River Basin and the potential for the Colorado River fish and their designated critical habitat to be exposed to hazardous substances originating from an accidental spill (which could result in the release or discharge of condensate or hydrocarbon materials into the Green River and its associated 100-year floodplain).

4.3 UINTA BASIN HOOKLESS CACTUS

Implementation of the Proposed Action would directly result in the disturbance of approximately 14.4 acres of potential habitat for Uinta Basin hookless cactus within the Project Area, which represents approximately 0.003 percent of the total potential habitat for Uinta Basin hookless cactus across their entire range. Following construction, approximately 4.4 acres (31 percent) of land associated with the construction of the well pads, access roads, and pipeline ROWs not needed for operation purposes would be reclaimed. This would reduce the long-term disturbance to Uinta Basin hookless cactus habitat associated with the Proposed Action to approximately 10 acres. Neither of the proposed well pads or their associated project infrastructure would be constructed within Level 1 and 2 Core Conservation Areas for the Uinta Basin hookless cactus.

Figure 1 shows the results of cactus areas surveyed in June 2012, April 2003, and November 2013. As identified in **Appendix D** of the EA/BA, the proposed cross-country 3-inch surface HDPE gas pipeline would be located approximately 87 feet from the nearest identified *Sclerocactus* individual. However, this route would be subgrade to the identified cactus populations and would have minimal indirect impacts. No appreciable surface disturbance associated with installation of this surface pipeline would be expected.

Implementation of the Proposed Action would increase the potential for occurrence of indirect and dispersed direct effects to the Uinta Basin hookless cactus, if present. Disturbances from construction could increase the potential for the invasion and establishment of noxious weed species. Invasion by non-native species is particularly problematic because they are capable of effective competition with native species for space, water, light, nutrients, and subsequent survival. Over time, the successful establishment of non-native species can out-compete native vegetation and eventually dominate large areas. An increase in weedy annual grasses also increases the potential for fire by increasing the density and flammability of available fuels. Grasses are more flammable and establish in denser populations than woody and non-woody native vegetation.

Additional indirect construction-related impacts could include an increased potential for wind erosion of disturbed areas creating airborne dust that could be transported into suitable habitat for these species. Airborne dust generated by vehicles could inhibit photosynthesis and transpiration in the Uinta Basin hookless cactus. Inhibited and reduced rates of photosynthesis could affect the rate of growth, the reproductive capacity of individual plants, and ultimately the ability of these individuals to persist in adjacent areas. Thompson et al. (1984) and Farmer (1993) have indicated that varying amounts of dust settling on vegetation can block stomata, increase leaf temperature, and reduce photosynthesis.

Other indirect impacts to Uinta Basin hookless cactus in the Project Area would include an increased risk of crushing by off-road vehicles due to an expanded road network, impacts from herbicides used to control invasive plants, and possible reductions in pollination or seed dispersal due to a larger road

network and resulting habitat fragmentation and dust. Because the Uinta Basin hookless cactus requires insect pollinators for successful reproduction (Tepedino et al. 2010), impacts to pollinator nesting and foraging habitats can negatively affect the cactus by reducing the diversity and abundance of pollinators and, thereby, the plant's ability to successfully reproduce. The expanded road network also will increase the risk of illegal collection of cacti.

Design features outlined under the Proposed Action would reduce the impacts to *Sclerocactus spp.* Actions outlined include: noxious weed and invasive species monitoring, use of existing roads where possible, minimizing new surface disturbance, dust abatement techniques, preconstruction surveys in potential habitat, and adherence to species-specific conservation measures. The species-specific conservation measures for the Uinta Basin hookless cactus include provisions to avoid occupied habitat, employ the use of spatial buffers between surface activities and known populations of plants, limit off-road travel, and monitor the effectiveness of these measures.

Although these measures will minimize the impacts of the action to *Sclerocactus spp.*, larger landscape-level changes such as increased habitat fragmentation and habitat loss, pollinator disturbance, changes in erosion and water runoff, and increased weed invasion cannot be entirely negated. These disturbances will continue to negatively impact the Uinta Basin hookless cactus throughout the Project Area. Therefore, the Proposed Action ***may affect, is likely to adversely affect*** the Uinta Basin hookless cactus.

4.4 UTE LADIES'-TRESSES

No disturbance to wetlands, riparian areas, or floodplains would likely occur under implementation of the Proposed Action. Therefore, no loss of Ute ladies'-tresses is anticipated as a result of the proposed project. Additionally, no Ute ladies'-tresses have been observed south of Highway 40 (Fertig et al. 2005). For the same reasons, the potential for occurrence of indirect and dispersed direct effects to this species from the Proposed Action would be unlikely to occur. Therefore, the Proposed Action ***may affect, is not likely to adversely affect*** the Ute ladies'-tresses.

Section 4.4.3.4. Special Status Plant and Animal Species describes the cumulative impacts on special status plant and animal species and their habitats, including the Yellow-Billed Cuckoo, Colorado River Endangered Fish Species, and the Uinta Basin Hookless Cactus. These impacts were analyzed using cumulative impact assessment areas (CIAAs) with spatial boundaries that vary by resource. The CIAA for special status plant and animal species and their associated habitat is defined as the Ouray NWR boundary. Given ongoing habitat losses, sensitivity to disturbance, and declining overall population numbers, special status plant and wildlife species would likely be more sensitive to impacts related to development within the Refuge than other species that are more common. Based on these sensitivities, existing and reasonably foreseeable development land uses have reduced and would likely continue to reduce the quality and quantity of habitats within the Ouray NWR and surrounding region for special status species.

On Federally administered lands, surveys are required in potential or known habitats of threatened, endangered or otherwise special status species prior to project implementation. These surveys help determine the presence of any special status plant and wildlife species or the extent of their habitat. Protective measures, including seasonal and/or spatial and temporal buffers, would generally be implemented to avoid or minimize direct disturbance or impacts. As such, the additive impacts of the Proposed Action to past, present, and reasonably foreseeable actions could affect but would not likely adversely affect special status species populations within the Refuge. Given the status of the Uinta Basin hookless cactus and the Colorado River endangered fish, cumulative impacts may be more pronounced than those for other special status species and they are discussed in more detail below.

5.1 YELLOW-BILLED CUCKOO

As the Proposed Action does not result in the loss of any riparian woodlands or other vegetation communities that may provide habitat for the yellow-billed cuckoo, the proposed project would not provide an incremental contribution to the loss of nesting habitat within the CIAA. Implementation of the Proposed Action along with past, present, reasonably foreseeable development within the CIAA could degrade available riparian woodland habitat through indirect impacts such increased erosion and ambient noise levels. Adherence to project design features, ACEPMs in **Section 2.1.10**, and Service-specified environmental terms and conditions in **Section 2.1.11** would further reduce the impacts of the proposed project on yellow-billed cuckoo within the CIAA.

5.2 COLORADO RIVER ENDANGERED FISH

Water depletions associated with the Proposed Action in combination with depletions from other activities in the CIAA would result in small but incremental impacts to the Upper Colorado River Basin and the biological environment for the Colorado River Endangered Fish species. Implementation of the Proposed Action in combination with other activities in the CIAA could degrade USFWS-designated critical habitat for the Colorado River Endangered Fish Species using the Green River by increasing erosion, sediment yield, and the potential for leaks or spills. Implementation of certain design features (see **Section 2.1** of the EA/BA), ACEPMs (see **Section 2.1**), and additional Service-prescribed environmental terms and conditions (see **Section 2.2**), including appropriate erosion control measures and use of closed-loop drilling techniques, would reduce impacts to the Colorado River Endangered Fish species. Many of the aforementioned impacts would be minimized and/or monitored.

5.3 UINTA BASIN HOOKLESS CACTUS

Cumulative effects to the Uinta Basin hookless cactus would be similar to those discussed for general vegetation within the Ouray NWR boundary. Direct cumulative impacts would result from potential crushing of individual cacti, the temporary or permanent loss of suitable habitat, soil compaction (as the result of construction), Refuge management activities, and recreational use. Indirect cumulative impacts include habitat fragmentation; increased dust effects; introduction and spread of invasive species; temporary or permanent loss of suitable habitat; and changes to the composition of the native vegetative community from surface disturbance activities such as oil and gas development, road construction, and other human activities. Changes in land use patterns or increased human encroachment also would adversely impact occupied and suitable habitats. Recovery and reclamation of suitable habitats could be compounded by limiting reclamation conditions (e.g., drought).

Cumulative impacts to the Uinta Basin hookless cactus resulting from the Proposed Action would be minimized through implementation of ACEPMs (see **Section 2.1**) and additional Service-prescribed environmental terms and conditions (see **Section 2.2**). In addition, implementation of recommended mitigation measures would further reduce impacts related to the loss of potential habitat and accidental loss of individual species resulting from construction and/or operation activities.

5.4 UTE LADIES'-TRESSES

As no habitat for the Ute ladies'-tresses would be disturbed by the proposed project, no incremental increase in direct cumulative impacts to the CIAA resulting from the Proposed Action are anticipated. Indirect cumulative impacts such as increased erosion and subsequent sedimentation into wetland, floodplain, river terrace, and shoreline habitats, along with the increased potential for the introduction of hazardous substances through accidental release. These impacts could further reduce the quality and overall available habitat for Ute ladies'-tresses within the CIAA. Cumulative impacts to Ute ladies'-tresses resulting from the Proposed Action would be minimized through implementation of ACEPMs described in **Section 2.1** and the additional Service-prescribed environmental terms and conditions detailed in **Section 2.2**.

APPENDIX I

State Historic Preservation Office (SHPO) Consultation

United States Department of the Interior
FISH AND WILDLIFE SERVICE

BOZEMAN FISH TECHNOLOGY CENTER
4050 BRIDGER CANYON ROAD
BOZEMAN, MONTANA 59715
(406) 994-9949/FAX (406) 586-5942

1/22/13

From: Brant Loflin, U.S. Fish and Wildlife Service Zone Archaeologist

RE: Contractor's report for well and road construction at Ouray National Wildlife Refuge, Uintah County, Utah

Wilson Martin - SHPO
Utah State Historical Society
300 Rio Grande
Salt Lake City, UT 84101

Dear Mr. Martin,

In accordance with section 106 of the *National Historic Preservation Act of 1966* (Public Law 89-6650), I have a copy of a cultural resources report and a paleontological report conducted by Sagebrush Consultants in preparation for well drilling and road construction at Ouray National Wildlife Refuge in Unita County. Approximately 178 acres were surveyed. The location can be legally described as: T7S R21E sections 29, 30, 31 and T7S R20E sec 36 and T8S R20E sections 1, 2 and 11. The survey was funded by Thurston Energy of Vernal, Utah.

During the cultural resources survey one isolate and a historic irrigation canal was identified. The canal was recorded as 42UN7913. The canal was essential in settlement of the area. 42UN7913 was determined eligible for the National Register, but the segment within the project area was modified with two later canals. The active portion of 42UN7913 retains the same place and feeling of the original canal, but is modern and; therefore, does not contribute to the qualities that make the canal eligible for the National Register. The project should have no adverse effects to properties eligible for the National Register.

During the paleontological investigation two areas were determined to be significant fossil localities (42UN4942V and 42UN4943V). In order to protect these resources, the contractor recommended a licensed paleontologist monitor the road widening at NE/NW of sec. 11 and the SE/SE of sec. 2T8S R20E if that work disturbs bedrock. Paleontological monitoring is recommended for that portion of the pipeline in SE/NE of sec 2 T8S R20E. Paleontological

monitoring is also required in sec 1 T8S R20E and sec. 36 T7S R20E during pipeline construction. The Service concurs with these mitigation measures and will work with the contractor to make sure that a licensed paleontologist is present in the specified locations and conditions.

The Service believes that the project will have no adverse effect on properties eligible for the National Register and the suggested mitigation measures will protect the paleontological resources. Pursuant to 36 CFR 800, we request your comment on the determination of effect for this project. The U.S. Fish and Wildlife Service believes this treatment of the area of potential effect adequately considers reasonable potential effects to historic properties.

If you have any questions please feel free to call me at 406-994-9949.

Sincerely,

Brant Loflin
WY, MT and UT Zone Archaeologist

State of Utah

GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of Heritage and Arts

Julie Fisher
Executive Director

State History

Wilson G. Martin
Director

January 30, 2013

Brant Loflin
WY, MT and UT Zone Archaeologist
Fish and Wildlife Service
Bozeman Fish Technology Center
4050 Bridge Canyon Road
Bozeman, Montana 59715

RE: Well and Road Construction at Ouray National Wildlife Refuge, Uintah County, Utah
U-12-SJ-0774

For future correspondence please reference Case No. 13-0125

Dear Mr. Loflin:

The Utah State Historic Preservation Office received your request for our comment on the above referenced undertaking on January 25, 2013.

We concur with your determinations of eligibility and effect for this undertaking.

This letter serves as our comment on the determinations you have made, within the consultation process specified in §36CFR800.4. If you have questions, please contact me at 801-245-7263.

Sincerely,

Chris Merritt, Ph.D.
Senior Preservation Specialist

A CLASS III CULTURAL AND PALEONTOLOGICAL RESOURCE INVENTORY FOR THURSTON ENERGY OPERATING COMPANY'S OURAY NATIONAL WILDLIFE REFUGE WELLS #12-29-7-21, #13-29-7-21, #11-31-7-21, AND #12-31-7-21, AND THEIR ASSOCIATED ACCESS ROADS AND PIEPLINES, UINTAH COUNTY, UTAH

by

Sandy Chynoweth Pagano
Archaeologist

Prepared for:

Thurston Energy
P. O. Box 749
Vernal, Utah 84078

Prepared by:

Sagebrush Consultants, L.L.C.
3670 Quincy Avenue, Suite 203
Ogden, Utah 84403

Under the Authority of:

U.S. Fish & Wildlife Special Use Permit Nos. 65570-11-06, 65570-12-0003 and 65570-12-004
Public Lands Policy Coordinating Office Permit #58
Utah State Antiquities Project No. U-12-SJ-0774sw

Cultural Resource Report No. 1933

January 2, 2013

ABSTRACT

During the cultural and paleontological resource inventories for the proposed Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, #12-31-7-21, With Associated Access Roads and Pipelines; one new cultural resource site and two paleontological localities were located. Although site 42UN7913 was recommended Eligible to the NRHP, the segments of the ditch located within the current project area are recommended **non-contributing** elements to the eligible site as a whole. Therefore, there should be **No Adverse Effects** to cultural resources from construction of this project.

The two paleontological localities were documented in the project area. Locality 42UN4942V was recommended as a Class 4a (PFYC4) and locality 42UN4943V was recommended as a Class 5a (PFYC5). Both are considered significant fossil localities. Three recommendations were made in the Recommendation of Effects section of the report to mitigate potential effects to significant paleontological resources in the project area. If these mitigation recommendations are followed during the construction phase of this project, potential effects to paleontological resources can be mitigated to **No Adverse Effect** to the resource.

This investigation was conducted with techniques that are considered adequate for evaluating cultural and paleontological resources that are available for visual inspection and could be adversely affected by the proposed project. However, should such resources be discovered during construction on the Ouray Fish and Wildlife Refuge (OFWR), a report should be made immediately to the Ouray Fish and Wildlife Refuge Manager, Randlett, Utah. If cultural resources are located on Utah School and Institutional Trust Lands Administration a report should be made to the SITLA archaeologist, in Salt Lake City, Utah. If additional vertebrate fossils are located during construction in the project area, the Utah Geological Survey should be notified and a professional paleontologist should be consulted.

TABLE OF CONTENTS

ABSTRACT ii
TABLE OF CONTENTS iii
LIST OF FIGURES iv
LIST OF TABLES iv
INTRODUCTION 1
RECORDS SEARCH 3
ENVIRONMENT 4
PREHISTORIC CULTURAL CONTEXT 4
Paleo-Indian Period: ca. 12000 B.C. to 9000 B.C. 5
Desert Archaic Period: ca. 9000 B.C. to A.D. 500 5
Bonneville Phase: ca. 9000 B.C. to 7500 B.C. 5
Wendover Phase: ca. 7500 B.C. to 4000 B.C. 6
Black Rock Phase: ca. 4000 B.C. to A.D. 500. 6
Formative Period: ca. A.D. 400 to 1300 6
Fremont Culture Phase: ca. A.D. 400 to 1300 6
Cub Creek Phase: ca. A.D. 650 to 800 7
Whiterocks Phase: ca. A.D. 800 to 950 7
Post-Formative Period: ca. A.D. 1200 to 1776 8
The Numic Expansion: ca. A.D. 1200 to 1776. 8
HISTORIC CONTEXT 8
Exploration, Trapping, and Trading (1776 to 1852) 8
Early Settlement Period (1853 to 1861) 9
Reservation Period (1862 to 1868) 10
Secondary Settlement and Early Irrigation Period (1869 to 1885) 11
Mineral Development Period (1886 to 1904) 12
Land Rush and Water Development Period (1905 to 1927) 14
Drought, Depression, and World War II (1928 to 1945) 17
Post-War Period (1946 to Present) 18
Leota Bottoms 18

CULTURAL RESOURCES METHODOLOGY 19
CULTURAL RESOURCES RESULTS 20
IF-1 20
Leota Bottom Canal System (Site 42UN7913) 20
CULTURAL RESOURCE RECOMMENDATIONS 22
Site 42UN7913 23
PALEONTOLOGICAL RESOURCES 23
PALEONTOLOGY METHODODLOGY 24
PALEONTOLOGY RESULTS 24
Locality 42UN4942V 26
Locality 42UN4943V 26
PALEONTOLOGY LOCALITY SIGNIFICANCE 26
42UN4942V and 42UN4943V 27
PALEONTOLOGY RECOMMENDATIONS 27
CULTURAL AND PALEONTOLOGICAL RECOMMENDATION OF EFFECTS 28
REFERENCES CITED 30
APPENDIX A: PALEONTOLOGICAL REPORTS A-1

LIST OF FIGURES

Figure 1. Location of the survey area for the Ouray Wildlife Refuge wells 2
Figure 2. Location of Site 42UN7913 and IF1 21
Figure 3. Paleontological Localities 42UN4942V and 42UN4943V 25

LIST OF TABLES

Table 1. Well Locations and Acreages 1
Table 2. Cultural Resource Projects Completed Within One Mile of the Project Area 3
Table 3. Sites Recorded Within One Mile of the Current Project Area 4

INTRODUCTION

In October 2011, Thurston Energy (Thurston) of Vernal, Utah, requested that Sagebrush Consultants, L.L.C. (Sagebrush) conduct a cultural and paleontological resources inventory of four proposed wells for Thurston, Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, and #12-31-7-21 in Uintah County, Utah. The project area is located in Leota Bottom, adjacent to the Green River, on the Ouray National Wildlife Refuge. Specifically, the proposed well pads are located in T. 7S., R. 21E., Secs. 29 and 31 (SLB&M) on the USGS 7.5' Quadrangles Pelican Lake, Utah (1964) and Brennan Basin, Utah (1964) (Figure 1). Locations and acreages for these wells are as follows (Table 1):

Table 1. Well Locations and Acreages

Thurston Well #	Lot / Acreage
#12-29-7-21	5650' FWL / 2050' FSL / 10.0 acres
#13-29-7-21	Lot 11 / 38.8 acres
#11-31-7-21	Lot 7 / 33.1 acres
#12-31-7-21	Lot 8 / 39.6 acres

Approximately ten months later, in August 2012, Thurston Energy requested that Sagebrush conduct an additional cultural and paleontological resources inventory of a proposed pipeline and access road widening for the previously surveyed wells. The additional project area included 3.8 miles (20,086 ft) of proposed surface pipeline (100 ft wide corridor) and 0.55 miles (2,920 ft) of access road widening (150 ft wide corridor) for a total of 56.17 acres on lands administered by the United States Department of the Interior, US Fish and Wildlife Service, Ouray National Wildlife Refuge (ORNW) and the Utah State Institutional Trust Lands Administration (SITLA) in Uintah County, Utah. The additional survey area for the proposed access road widening and pipeline are located in T. 7S., R. 21E., Secs. 29, 30, and 31; T. 7S., R. 20E., Sec. 36; T. 8S., R20E., Secs. 1, 2; and 11 on the USGS 7.5' Quadrangles Pelican Lake, Utah (1964) and Brennan Basin, Utah (1964) (Figure 1).

The proposed widening area for the access road corridor is for straightening the existing road to allow trucks greater visibility for safety. The purpose of this study is to identify, record, and evaluate cultural resources that may be found within the project area. This document represents a report on the results of the file search and intensive level cultural and paleontological resources field inventories of the project area. The purpose of this inventory was to identify cultural and paleontological resources that might be present within the proposed project area.

Sandy C. Pagano and Mark Pagano conducted the survey of the wells on November 22, 2011 Survey of the access roads and pipelines was conducted on September 20, 2012, by Sandy Pagano and Cheryl Jeppson. These surveys were conducted under the authority of U.S. Fish & Wildlife Special Use Permit Nos. 65570-11-06, 65570-12-0003, and 65570-12-0004; and Utah State Public Lands Policy Coordination Office Permit No. 58.

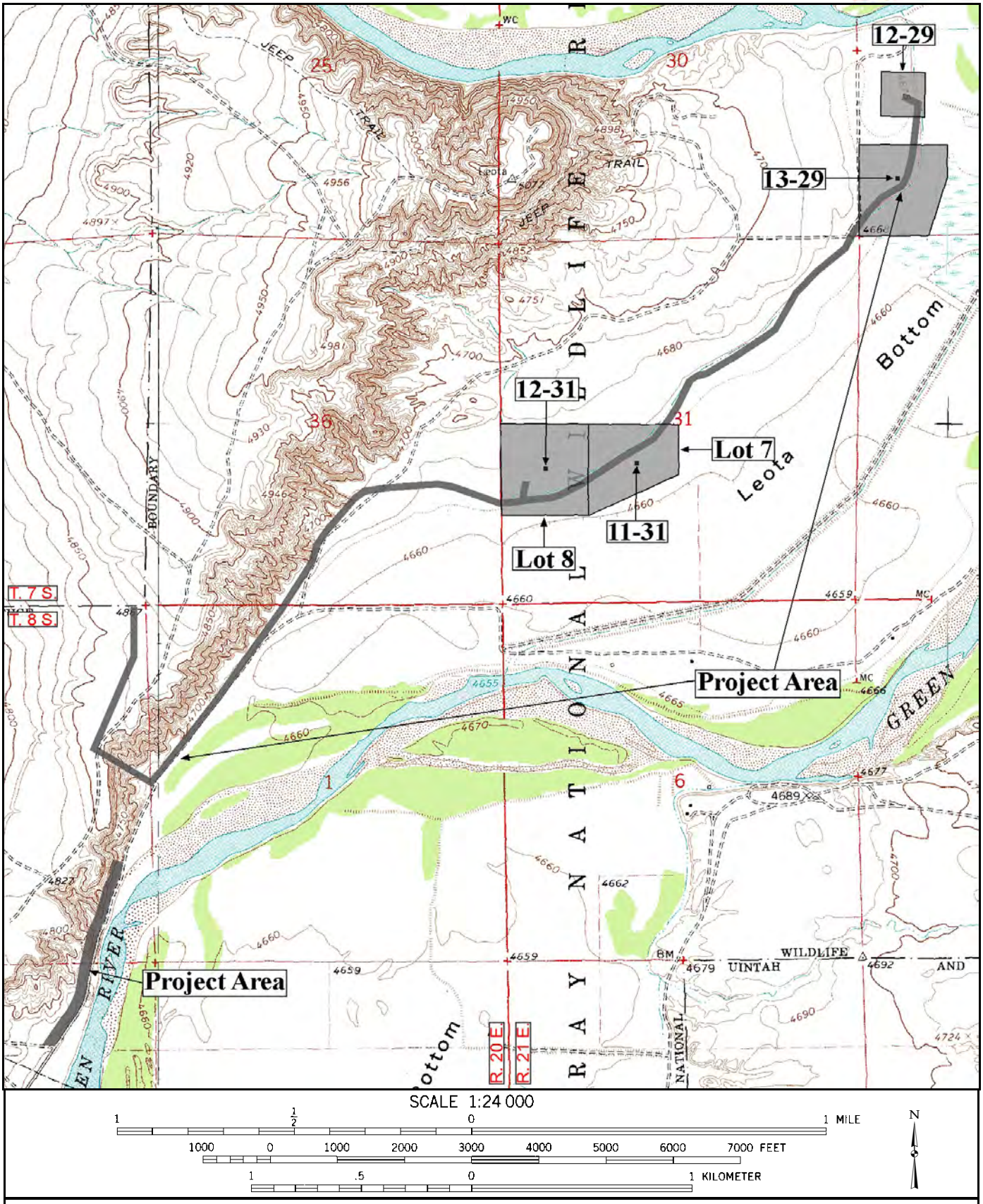


Figure 1. Location of the survey area for the Ouray Wildlife Refuge Project. Taken from USGS 7.5' Quadrangles Brennan Basin, Utah (1964) and Pelican Lake, Utah (1964).

RECORDS SEARCH

Prior to conducting fieldwork, on November 21, 2011, Arie Leeflang, Records Manager at the Utah State Historic Preservation Office (SHPO), Salt Lake City, conducted a Geographical Information Systems (GIS) file search of the project area. On November 22, 2011, Cheryl Jeppson and Maren Svare of Sagebrush conducted a records search at the SHPO, Division of State History, Antiquities Section. A second file search was conducted on September 3, 2012. The records showed that a total of 18 cultural resource projects have been conducted and three cultural resource sites have been identified within one mile of the current project area (Tables 2 and 3).

Table 2. Cultural Resource Projects Completed Within One Mile of the Project Area

Report No.	Company	Project
U94UK044w	USFW	Ouray Borrow Area.
U95BC260w	BYU	A Cultural Resource Inventory of a Proposed Powerline on the Ouray National Wildlife Refuge, Ouray, Utah.
U91UK705w	USFW	Cultural Resources Class III Report Inventory for Two Proposed projects in Leota Bottom.
U05MQ0203b	MOAC	Archaeological Survey of Questar Explorations BBW #11G-20-7-21 Access Reroute. ADDENDUM TO: Cultural Resource Inventory of Questar Explorations BBW #11G-20-7-21 Proposed Well Location in Uintah County, Utah.
U89AF708b	AERC	An Archeological Evaluation of Two Proposed Well Locations in the Johnson Bottom Locality of Uintah County, Utah.
U92BL617w	BLM	Ouray National Wildlife Refuge Powerline Inventory.
U06MQ1603bs	MOAC	Cultural Resource Inventory of Veritas Geophysical Integrity's Uintah Basin 3D Seismic Prospect Uintah County, Utah.
U08MQ1096bsp	MOAC	Cultural Resource Inventory of Questar Exploration and Production's Red Wash 3D Seismic Project Uintah County, Utah.
U94BL270b	BLM	Final Report of an Archaeological Inventory for the Diamond Mountain Resource Management Plan and the Book Cliffs Resource Management Plan Land Sale Amendment.
U07MQ1364ibsp	MOAC	Cultural Resource Inventory of Questar Exploration and Productions Wonsits 3D Seismic Project Uintah County, Utah.
U05MQ0137b	MOAC	Cultural Resource Inventory of Questar Exploration's BBW #11G-20-7-21 Proposed Well Location, Uintah County, Utah.
U06MQ1748b	MOAC	Cultural Resource Inventory of Medallion Explorations Proposed Well Location: Medallion Federal 31-35-7-20 Uintah County, Utah.
U11MQ0712bps	MOAC	Cultural Resource Inventory of Axia Energy's Proposed Three Rivers 36-11-720 and 2-11-820 Well Locations in Uintah County, Utah.
U80FS0447bw	FS	Pelican Lake Pipeline Project, Ouray National Wildlife Refuge Project
U83GC0438b	GRC	Archaeological Survey for Lomax Exploration Company's Pelican Federal 3-35, Monument Federal 3A-35 and Boundary Federal 5-21 Duchesne and Uintah Counties, Utah.
U91UK0871	USFW	Pelican Lake Pipeline.
U90BL0254w	BLM	Ouray Refuge Trailer Project.
U11SJ1052w	SB	Cultural and Paleontological Resources Inventory For Thurston Energy Ouray Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, and #12-31-7-21 in Uintah County, Utah.

KEY:
AERC – Arch. Environ. Research Corporation
BLM – Bureau of Land Management
BYU – Brigham Young University
GRC- Grand River Consultants
FS- Forest Service
MOAC – Montgomery Archaeological Consultants
SB – Sagebrush Consultants
USFW – U.S. Fish and Wildlife

Table 3. Sites Recorded Within One Mile of the Current Project Area			
Site Number	**Associated Report**	**Site Type**	***NRHP Recommendation**
42UN2049	U-92-BL-617w	Lithic Acquisition Area	Not Eligible
42UN2091	U-94-UK-0044w	Historic Dugout	Determined Not Eligible
42UN2394	U-96-MM-0624b	Historic Diversion Ditch	Not Eligible

No other cultural resource sites have been recorded in the vicinity of the current project area. The National Register of Historic Places (NRHP) and General Land Office (GLO) plat maps for the area were consulted prior to the commencement of fieldwork for the current project. One GLO plat map for the area depicts the alignment of a canal in the project area (GLO 1952).

ENVIRONMENT

Geographically the project area is located in the Uintah Basin near the convergence of the Duchesne, Green, and White Rivers, south of Halfway Hollow and east of Leland Bench. The proposed wells are located on Leota Bottom within a meander bend of the Green River, on the Ouray National Wildlife Refuge. The elevation of the area surveyed ranges between 4,660 and 4,680 feet a.s.l. Sediments consist of brown silty soils with a high clay content. Vegetation in the well locations is dominated by greasewood, rabbitbrush, and kochia. The surrounding areas include alkali tolerant plants in the flood plains such as saltbush, hopsage, and shadscale, with riparian species such as bullrush, cattails, and cottonwood and willow trees along the river and marsh areas. The nearest permanent water source is the Green River located 700 meters south of the project area; however, portions of the project area are inundated regularly due to high water in flood years and spring run-off on the Green River combined with numerous man-made ditches, dikes, and levees.

Natural disturbance in these areas consists of sheetwash and flooding erosion. Cultural disturbance includes development and the construction of roads, canals, ditches, dikes and levees, and recreational use. Numerous dikes and levees have been constructed for water control, irrigation, and waterfowl habitat.

PREHISTORIC CULTURAL CONTEXT

The prehistory of the current project area is complex and poorly understood because of the area's location near the contact zone between the Great Basin, Colorado Plateau, and Northern Plains cultures. The prehistory of the Uinta Basin is a meld of these traditions that has resulted in the identification of many enigmatic archaeological sites. Despite this mix of

archaeological traits, the authors believe that the general model of prehistory for the eastern Great Basin and northern Colorado Plateau is most prominent in the Uinta Basin. As such, that general model will be followed in this study. The cultural changes in these areas are classified into the following four general chronological periods: Paleo-Indian, Desert Archaic, Formative, and Post-Formative (Jennings 1986). Within each of these major periods are a number of separate phases that are marked by a distinct lifeway. Following is a brief description of each period (some of which may overlap in time) and their distinct phases. These descriptions note significant traits, characteristics, and artifacts associated with each period or phase.

Paleo-Indian Period: ca. 12000 B.C. to 9000 B.C.

Also known as the Clovis Period, the Paleo-Indian Period is poorly understood in the eastern Great Basin and northwestern Colorado Plateau. What little is known about this period comes from a limited number of surface sites and isolated finds of Clovis, Folsom, and Lake Mojave projectile points (Zier 1984).

Associations of large faunal remains, such as those of extinct bison, camel, mammoth, ground sloth, and other large fauna, with Paleo-Indian artifacts like those commonly found in the Great Plains are absent in the eastern Great Basin. Sites and isolates attributed to Paleo-Indian occupation of the area are typically found along the edges of extinct Pleistocene or early Holocene beaches, suggesting a possible lake edge-marsh adaptation (Madsen 1982; Heizer and Baumhoff 1970).

Desert Archaic Period: ca. 9000 B.C. to A.D. 500

This period, which is also poorly represented in the project area, is marked by broad range movement and diminishing hunting of big game by the native peoples. It also includes a time of climatic change associated with the end of the Pleistocene Epoch and with the subsequent cultural adaptations. The Desert Archaic is divided into three phases, the Bonneville Phase, the Wendover Phase, and the Black Rock Phase. Important sites associated with these periods that are located in the basin area east of Duchesne include Swelter Shelter and Thorne Cave (Jones and MacKay 1980).

Bonneville Phase: ca. 9000 B.C. to 7500 B.C.

The terminal Pleistocene, called the Bonneville Phase in the Great Basin by Aikens and Madsen (1986), represents the time of diminishing reliance on big game hunting and an increased use of a broader range of natural resources. Though evidence of this phase of human activity has been found in other parts of the western United States, its presence in Utah is largely limited to surface finds of large lanceolate-shaped projectile points along lakeshores in the western part of the state (Aikens and Madsen 1986). In north-central Utah, known evidence of this phase is limited. In addition to two fluted projectile points, one found near Duchesne in the 1950s (Schroedl 1976), and the other (a point fragment) found near Cedarview, 10 miles northwest of Roosevelt (Lindsay 1976), a small number of Plano points have been found in the

area (Loosle 1995). These Plano points suggest the influence of the Plains Cultures on the inhabitants of the general project area.

Wendover Phase: ca. 7500 B.C. to 4000 B.C.

This phase encompasses the time when Pleistocene lakes in the Great Basin greatly receded. The change in environment gave way to a more diversified hunting and gathering subsistence strategy for prehistoric inhabitants because of a wider availability of game and plant foods. Technological changes that occurred along with these environmental shifts included the appearance of an increasing number of grinding implements for wild plant processing, and of atlatls or spear-throwers. Other artifacts known from this occupation include thin slab millstones, manos, L-shaped scapula and splinter awls, antler flaking tools, basketry, and flaked stone tools (Jennings 1978).

Black Rock Phase: ca. 4000 B.C. to A.D. 500

The Black Rock Phase (Aikens and Madsen 1986) is characterized by a movement toward the occupation of sites within a broader range of ecozones and a further diversification of resource exploitation to include a large proportion of upland resources. The technology of the phase was largely similar to that of the Wendover Phase. The greatest change in technology occurred near the close of the phase when smaller projectile points were introduced, indicating a shift to the use of the bow and arrow.

Formative Period: ca. A.D. 400 to 1300

This period is characterized by a shift from a hunting and gathering lifeway to a more sedentary one based on horticulture. The growing of maize increased during this period throughout much of the Great Basin. However, it was less intensive in the Uinta Basin than in areas to the south. The native peoples associated with this period, the Fremont, were roughly contemporaneous with the Anasazi of southern Utah and the Four-Corners region. A number of important sites attributable to this period are located in the general vicinity of the project area. These sites, primarily represented by small hamlets or rancherias, include Caldwell Village, Flattop Butte, Felter Hill, the Goodrich Site, and the Gilbert Site (Marwitt 1986). The Formative Period is composed of a single phase known loosely as the Fremont Culture Phase. The broader Fremont Culture Phase in the Uinta Basin has been divided into two subphases, known as the Cub Creek Phase and the Whiterocks Phase (Marwitt 1986).

Fremont Culture Phase: ca. A.D. 400 to 1300

Near the end of the Black Rock Phase of the Desert Archaic Period, many elements of a settled horticultural lifestyle were introduced into the Archaic lifeway of Utah from the Southwest, including the manufacture of pottery and the development of horticultural practices. The Fremont Culture is a label applied to groups exhibiting this different lifestyle who occupied the Utah area from ca. A.D. 400 to 1300 (Marwitt 1986). Five geographic variants of the Fremont Culture are generally recognized today. One of them, the Uinta Basin variant, resided within the project area.

The Uinta Basin Fremont had a relatively short period of occupation compared to other Fremont variants throughout the state of Utah (Marwitt 1986). Spangler suggests a time frame of about A.D. 550 to 1300 in the Uinta Basin (Spangler 1995:591). However, a recently excavated Uinta Basin Fremont site in western Colorado yielded a date of post-A.D. 1500. This new evidence suggests that Fremont occupation of the area may have extended later than previously believed (Loosle 1995).

The occupation of the Uinta Basin Fremont is enigmatic in other ways as well. Most archaeological sites attributable to this group indicate a less intensive (population) use of the area than has been evidenced for other Fremont groups in other areas of the state. These sites often consist of only a small number of shallow, circular pit houses and no surface storage structures. Coupled with the high average elevation of the area and the short growing season, the small "village" size and lack of storage structures suggest limited use of the area by the Fremont. However, other Uinta Basin Fremont sites indicate a different scenario. Several large Fremont archaeological sites, such as those in Dry Fork Canyon and within Dinosaur National Monument, have also been documented. At least one of these sites is over 10-acres in size (Loosle 1995). Sites such as these suggest a much more intensive use of the area by the Fremont.

The material remains of the Uinta Basin Fremont are somewhat unique compared to those of other Fremont variants. For example, the "Utah type" metate, although found in the area, is far less common than in other areas of the state. In addition, it does not appear that the Uinta Basin Fremont created the clay figurines that are the hallmarks of Fremont cultures elsewhere in the region (Marwitt 1986). The Uinta Basin Fremont also restricted their use and creation of pottery to a limited stylistic assemblage dominated by undecorated, limestone, or calcite tempered grayware, known as Uinta Gray pottery. A small proportion of decorated and incised tradewares appear to have been acquired by the Uinta Basin Fremont from other Fremont and Anasazi groups (Marwitt 1986).

Cub Creek Phase: ca. A.D. 650 to 800

The Cub Creek (Sub)Phase of the Fremont Culture Period is known from sites such as Boundary Village, Goodrich, Felter Hill, and Flattop Butte. These sites are unique because they contain no surface structures. The only pottery found at Cub Creek sites thus far has been undecorated, utilitarian Uinta Grayware with a notable absence of bowl forms. No tradewares have been found at sites attributable to this subphase.

Whiterocks Phase: ca. A.D. 800 to 950

The Whiterocks (Sub)Phase was named after the archaeological site of Whiterocks Village near the project area. This phase is also known from excavations at the Caldwell Village site (Marwitt 1986). Unlike those of the Cub Creek Phase, Whiterocks Phase archaeological sites contain substantial surface structures of masonry and coursed adobe. They have also yielded surface-decorated Uinta Grayware and tradewares from other Fremont variants and from Anasazi groups (Marwitt 1986).

Post-Formative Period: ca. A.D. 1200 to 1776

The Post-Formative Period is marked by the apparent replacement of the Fremont peoples by a migratory group of Shoshonean/Numic-speaking people from the Southwest. This period also includes the arrival of the direct ancestors of modern-day Ute Indians and their use of the Uinta Basin's resources. Archaeological sites from this period are numerous, but no exceptional Post-Formative or Shoshonean sites are located near the project area.

The Numic Expansion: ca. A.D. 1200 to 1776

The final archaeologically identifiable period of occupation in the survey area is that of the Numic Expansion. This occupation apparently began as Numic/Shoshonean-speaking Indians migrated into the northern Utah area and replaced the Fremont Culture. It is not yet clear whether the Fremont abandoned the area prior to the arrival of the Shoshoneans or whether resource competition between the two groups forced the Fremont from the region (Marwitt 1986). The central Utah area was occupied by the Ute group of Numic speakers who arrived about A.D. 1200 to 1300 and continued into the historic period (Calloway et al. 1986). The western boundary of the current Uintah-Ouray (Ute) Indian Reservation, upon which many of the descendants of these Numic speakers reside, is east of the project area. Little is known about the Shoshonean groups archaeologically.

HISTORIC CONTEXT

Although the prospect of profitable fur trapping in the Uinta Basin provided the initial attraction for non-Indians, it was the presence of the Ute Tribe and the discovery and development of minerals and petroleum resources that provided the impetus for European-American activity in the area. To best understand the series of events that have occurred in the area since the arrival of European-Americans, it is helpful to view the area's history in distinct periods of time associated with significant developments. For the purpose of this brief overview, the area's history has been divided into six periods, as follows: Exploration, Trapping, and Trading (1776 to 1852); Early Settlement (1853 to 1861); Reservation Period (1862 to 1868); Secondary Settlement and Early Irrigation (1869 to 1885); Mineral Development (1886 to 1904); Land Rush and Water Development (1905 to 1927); Drought, Depression, and World War II (1928 to 1945); and Post-War (1945 to Present).

Exploration, Trapping, and Trading (1776 to 1852)

This period is marked by the initial exploration of the Uinta Basin by non-Indians. It also includes the activities of the early trappers and fur traders, their interactions with the Utes, and the establishment of trading posts throughout the area.

The first forays by Europeans and European-Americans into the Uinta Basin occurred over 200 years ago when the Spanish friars Francisco Atanasio Dominguez and Silvestre Velez

de Escalante made their way through the Uinta Basin during their search for an overland route from Sante Fe, New Mexico, to the missions of Monterey, California (Jones and MacKay 1980:66). In the ensuing years, Spanish traders followed the route of the Dominguez-Escalante expedition through the Uinta Basin, establishing a system of trade with the Ute Indians living along this corridor (Burton 1996:53-54; Morgan 1948).

The second major exploratory campaign into the Uinta Basin occurred in 1825 with the journey of General William Henry Ashley. In April of that year, Ashley followed the route of the Green River southward to Desolation Canyon, 50 miles south of the mouth of the Duchesne River. On his return trip, he retraced his route back to the Duchesne River and then followed this waterway to where he crossed the Uinta Mountains (Burton 1996:57-60; Morgan 1964:165; 167). During his explorations of the area, Ashley made copious notes of his experiences and encounters with the Ute in the Basin. It is from these journals that some of the earliest confirmed accounts of Utes living in the area are provided.

In the following years, a number of fur trappers made their way into the area. Some, such as French-Canadian trapper Baptiste Brown, set up trading posts in the Basin to trade with both the Ute Indians and the travelers along the Spanish Trail (Jones and MacKay 1980:108). In 1833, Christopher "Kit" Carson, who had been trapping in the Basin since the late 1820s, established a trading post at the confluence of the Green and White Rivers. Four years later, in 1937, Antoine Robidoux of Taos, New Mexico, erected his own trading post on the west fork of the Uinta River. This trading post, which was built from adobe, was known variously as Fort Uintah, Fort Wintey, and Fort Robidoux (Jones and MacKay 1980:66). Shortly after Robidoux established his trading post, a second trade center was set up at the future site of Fort Duchesne (Burton 1998:271; Van Cott 1990:143).

The last significant early exploration of the Uinta Basin occurred between 1844 and 1845. At that time, Lieutenant John C. Fremont of the U. S. Army's Corps of Topographical Engineers made two expeditions into the area. Guided by Kit Carson in 1844, Fremont passed through the area on his way north to Utah Valley, stopping at Robidoux's Fort Uintah along the way (Burton 1996:72). The following year, he returned to Utah from Colorado. On this journey, Fremont followed the White River to the present site of Ouray and then ascended the Duchesne River on his way westward (Morgan 1947:135-154).

Early Settlement Period (1853 to 1861)

This period is characterized by the first scattered attempts by Mormon pioneers to settle the Uinta Basin. It also includes the reaction of the resident Utes to the arrival of the settlers and the eventual establishment of the Uintah Valley Reservation.

It is not clear exactly when the first settlers made their homes in the Uinta Basin. Unlike most areas of the state at this time, the Uinta Basin was not a primary target of early settlement activities for the Mormon pioneers. While large groups of settlers were being sent by Mormon leaders to establish communities throughout the state, none were sent to the Uinta Basin. Settlement in this area occurred slowly and was widely dispersed, with individual trappers,

ranchers, and cattle rustlers constructing isolated homesteads along the river valleys. The number of settlements established in the Uinta Basin was very limited during this time. Most of those who did settle in the eastern Utah Territory built their homes in the more hospitable environments of the Ashley Valley, Bridger Basin, and northern Daggett County (Jones and MacKay 1980:109-110).

Like most areas in the State of Utah, the Mormon Church played an integral role in the development of the Uinta Basin; however, rather than encouraging settlement of this area, Mormon leaders discouraged it. In 1861, Brigham Young, president of the Mormon Church, sent an exploration party to the Uinta Basin for the purpose of evaluating the area's potential for further settlement by church members. Upon returning from the Basin, the group provided an unfavorable account of the area, stating that the land was unsuitable for further expansion by white settlers (Larsen 1965:64-65). At the same time, hostile raiding by Utes, whose traditional lands were being encroached upon by those settlers who did homestead in the harsh Basin environment, began to escalate. This, coupled with the unfavorable report of the exploration party, prompted Young to request that the federal government establish an Indian Reservation in the Uinta Basin to isolate the Utes and other Utah Indians from white settlers. In late 1861, President Abraham Lincoln issued an executive order that established the Uintah Valley Reservation for all Indians in Utah (Burton 1996:24). Congress did not confirm this order until May 1864.

Reservation Period (1862 to 1868)

This period is marked by attempts to force the Utes onto the reservation and efforts of the Utes to resist confinement. It also includes the eventual agreement of the tribe to move to reservation lands.

The desires of the white settlers to contain the Indians on the Uintah Valley Reservation were mitigated by the desires of the Utes and other tribes to remain free to pursue their semi-nomadic lifestyles. In 1865, after much negotiation and hardship, Utah Indian Superintendent Oliver Irish and Chief Tabby of the Ute Tribe signed the Treaty of Spanish Fork, under which the Utes agreed to move to the reservation. In exchange, the government agreed to establish farms on the reservation and pay the Utes annual annuities (Clemmer and Stewart 1986:526). Interestingly, Congress never ratified this treaty. Failure by the government to keep their promises to establish the farms, as well as unrest among the different bands of Utes forced to cohabitate on the reservation led to a series of uprisings in 1866 known as the Black Hawk War. Many Utes left the reservation at this time to join Chief Black Hawk in his raids on Mormon settlements in the area. The Black Hawk War continued until 1868, at which point Chief Black Hawk agreed to cease hostilities and move onto the Uintah Valley Reservation (Jones and MacKay 1980:111).

Secondary Settlement and Early Irrigation Period (1869 to 1885)

This period is characterized by renewed interest in the Uinta Basin by explorers and settlers. Several small communities were established in the area during this time, and rudimentary canal systems were set up to irrigate the farms of the new settlers.

With hostilities between the Utes and the white settlers under temporary control, settlers and explorers were once again free to travel throughout the Uinta Basin without fear of attack. This reopening of the area led to renewed efforts towards exploration. In late 1868, Pardon Dodds was appointed as the agent of the reservation. At that time, Dodds moved the headquarters of the Uintah Valley Indian Agency from Fort Duchesne to Whiterocks (Jones and MacKay 1980:111). A handful of settlers moved into the area around the Agency headquarters in the ensuing years, making Whiterocks the first official white settlement in the Uinta Basin.

With the threat of attacks by bands of Utes no longer a concern, settlers and scientists once again began to explore the largely uncharted region of the Uinta Basin for suitable homestead sites and for mapping purposes. In 1869, John Wesley Powell led a group of government scientists on an exploratory expedition down the Green River to Ouray and then over to the present site of Fort Duchesne. Later that year, Powell led a second expedition down the Green and Colorado Rivers to the Grand Canyon (Roylance 1982:89) and Clarence King, a government surveyor, supervised the survey and mapping of the Uinta Mountains. The following year, 1870, F.V. Hayden of the U.S. Department of the Interior led an exploratory party along the Green River and into the Uinta Mountains (Jones and MacKay 1980:111). This period also saw some of the first paleontological interest develop in the Uinta Basin. In 1870, O.C. Marsh led a group of students from Yale University to search for fossils in the area.

Peace between the Utes and the settlers failed to hold. A series of violent uprisings during the 1870s led to the removal of the Uncompagrhe Ute from Colorado and their relocation to the Uintah Valley Reservation. In an attempt to protect white settlers near the reservation and to ensure confinement of the Ute to their allotted lands, the federal government established a military post at the mouth of Ashley Creek Canyon (Alexander and Arrington 1964:340). The post was dubbed Fort Thornburgh in honor of Major Thomas T. Thornburgh, who was killed by the Uncompagrhe in 1879. Construction of the fort began in 1881; however, a lack of government funding and the refusal of settlers to relinquish ownership of sections of land on which the fort was to be built slowed construction considerably. By 1883, the fort remained unfinished, and funding and ownership problems continued to plague the builders. In July 1884, the military abandoned the partially completed fort and squatters took over the facility (Alexander and Arrington 1964:342-343).

Settlement was occurring at a rapid pace in the eastern half of the Uinta Basin. The Ashley Valley had become the site of the most intensive settlement as it encompassed a number of accessible water sources. Pardon Dodds, Indian Agent at Whiterocks, was the first to settle in the Ashley Valley. In 1872, after leaving his post at Whiterocks, Dodds constructed a small home in the valley. That same year, he constructed the first irrigation ditch from Ashley Creek (Jones and MacKay 1980:73). The construction of this ditch ushered in an era of sporadic,

rudimentary water development in the Uinta Basin that continued until the opening of the reservation to settlement in 1905.

By 1880, the Ashley Valley housed a number of small homesteads and settlements. These settlements supported a post office, sawmill, flour mill, and the first school for white children in the area (Strahorn 1924:911). Irrigation became all-important as farmers attempted to establish crops in the valley. By the early 1880s, several small irrigation ditches had been constructed from Ashley and Brush Creeks. The technology was simple – earthen ditches with holes cut in the sidewalls to divert water into the fields; no headgates or other diversionary structures were in use at this time (Stalheim 1983). With the rapid growth in this part of the Uinta Basin, state leaders created Uintah County, naming the community of Ashley as the county seat in 1880 (Utah State Historical Society [USHS] 1988:27). The western Uinta Basin, however, did not enjoy such rapid growth. Settlement in this area continued as isolated individual homesteads.

Water development became an increasingly important and tense issue as more and more settlers made their way into the arid Uinta Basin. During the late 1870s, residents of the Heber Valley to the west began illegally diverting water from streams in the Strawberry Valley, leaving little of the much-needed resource for settlers downstream. In 1879, the Strawberry Canal Company was organized to build a canal for illegally obtaining the water of the upper Strawberry River and conveying it to the fertile fields of the Heber Valley (Stalheim 1983). This activity incensed Uinta Basin residents and touched off a race for water rights in the area. In the Ashley Valley, the demand for improved accessibility to water and for some form of equitably allocating it led to the establishment of two canal companies in 1884, the Ashley Central Irrigation Company (ACIC) and the Ashley Upper Canal Company (AUCC) (Burton 1996:302). That same year, the ACIC constructed a 6-mile-long gravity canal off of Ashley Creek and into the valley bottom. At the same time, the AUCC built a 12-mile-long canal from the mouth of Ashley Canyon.

Mineral Development Period (1886 to 1904)

This period is marked by some of the first discoveries of mineral veins of gilsonite and copper in the Uinta Basin. It also marks the beginning of a long history of influence of the mineral industry on the area.

In 1886, a rich gilsonite vein was discovered in the Uinta Basin by Bert Seaboldt (Jones and MacKay 1980:114). Seaboldt's claim, which was located on the lands of the Uintah Valley Reservation, was the first in a series of discoveries of this ore. Additional discoveries of minable ores prompted the government to reopen sections of the reservation for leasing to white miners and homesteaders. Ute reaction to further encroachment on their allotted lands was unfavorable, and rumors of an uprising spread throughout the area. In order to quell the potential violence, President Andrew Johnson sent a military contingent of black soldiers, known as Buffalo Soldiers, to occupy Fort Duchesne. The soldiers remained at the fort for a period of 12 years (Burton 1998:271-275; Van Cott 1990:143). One year after Seaboldt's 1886 gilsonite discovery, L.D. Dyer discovered a rich vein of copper in the Little Brush Creek area to the east of modern

day Duchesne. With the discoveries of gilsonite and other ores continuing, Congress reclaimed roughly 7,000 acres of reservation lands in 1888 to further develop mining in the area. The opening of this land to whites resulted in the establishment of dozens of mines in the area over the next few years (USHS 1988:27).

Increased activity in the eastern Uinta Basin necessitated the development of a permanent, efficient road by which to transport both travelers and supplies. In the mid-1880s, a road was completed from Price through Nine Mile Canyon to the Duchesne River. The completion of the road to this point provided the opportunity for the establishment of one of the first permanent white settlements near the current project area (Daughters of Utah Pioneers 1948:263). The Duchesne River was a major obstacle for those making the journey along this route to the mines near Vernal and Ashley. In order to overcome the obstacle, settlers erected the first permanent bridge over the waterway just below the confluence of the Duchesne and Lake Fork Rivers in 1887. A trading post and small community were established near the crossing, and the town of Myton became an important rest stop for weary travelers (Van Cott 1990:268).

The exploitation of natural resources continued to develop in the Uinta Basin in the 1890s. In addition to the rich gilsonite and copper veins known to exist, the area was also suspected to contain oil. In 1891, the first major exploratory commercial oil drilling was undertaken in the Green River area by railroad magnate Simon Bamberger (Jones and MacKay 1980:79). Although these initial efforts were largely unsuccessful, they did support the contention that oil was present in the area. By 1897, large-scale drilling efforts were underway; however, profitable production from the oil wells did not come about until the 1940s.

The increasing success of the mining and petroleum industries in the area prompted financiers to explore the possibility of constructing a rail line into the Uinta Basin for transporting the abundant ore. In 1887, the Utah Midland Railroad Company was granted a right-of-way to build a line through the Uintah Valley Reservation; however, due to the loss of financial backing, the line was never built (Jones and MacKay 1980:91). Four years later, in 1891, a route was surveyed for a spur line of the Utah Central Railway. Like the Utah Midland, financial difficulties prevented the line from being built. It was not until 1903 that a rail line was finally built into the Basin. One year earlier, a major gilsonite strike at the Black Dragon Mine provided not only sufficient reason but also sufficient funds for constructing a set of tracks through the area. Under the auspices of the General Asphaltum Company, which owned the mine, the Uintah Railroad Company was incorporated in 1903 and construction began immediately (Bender n.d.:23-24). The narrow gauge line was connected to the Denver & Rio Grande Western line near Mack, Colorado.

The battle over water rights between residents of the Uinta Basin and those of the Heber Valley continued through the 1880s and into the 1890s. In 1888, Wasatch County residents helped to construct the McDonald Ditch off of Hobble Creek (Stalheim 1983). Two years later, in 1890, they oversaw the building of the Willow Creek Ditch. Both of these canals illegally diverted water from tributaries of the upper Strawberry River into Daniels Creek and on to Wasatch County. During a legislative session in 1892, a bill was introduced into Congress that would have allowed the legal diversion of water from the Uinta Basin, through the reservation,

and into Wasatch County (Jones and MacKay 1980:72). Although the bill was not passed, water continued to be bled off of Uinta Basin rivers to irrigate the crops of the Heber Valley.

Water development during the late 1880s and through the 1890s continued to occur on a relatively small scale throughout the Uinta Basin. Nearly all of the irrigation canals and holding ponds in the area had been constructed through private labor and private funding. Among such private companies was the Rock Point Canal and Irrigation Company incorporated by residents of the Ashley Valley in 1893 (Stalheim 1983). This company was to administer the Rock Point Canal, which had been in operation since late 1880. The most formidable obstacle in establishing effective irrigation systems in the area was the presence of the Uintah Indian Reservation. Although white settlers had been diverting water away from the reservation for several years, federal law prohibited them from trespassing on tribal lands to do it. In order to circumvent the law, the settlers had been diverting the water from points just outside the reservation boundaries (Fuller 1978:48). However, in 1899, the Secretary of the Interior granted rights-of-way for the construction and maintenance of "dams, ditches, and canals on or through the Uintah Indian Reservation...for the purpose of diverting and appropriating the waters of the streams...for useful purposes" (Jones and MacKay 1980:73). This act was not only the first step in creating a basin-wide irrigation system, but also a hint at the future of encroachment on Indian lands.

The discoveries of rich mineral veins continued through the turn of the century, and the push to obtain land escalated. In 1902, the Secretary of the Interior was granted the authority to allot certain portions of the Uintah Valley Reservation to Utes and to open other sections for settlement and mineral development by whites. In light of the Secretary's recent decision regarding water rights, the Utes did not look favorably upon such an arrangement and viewed it as further evidence of the government's failure to keep its promises. A number of council meetings were held between Ute tribal leaders and government officials in 1903 to secure the consent of the tribe to the opening of reservation lands to settlement. The talks failed and the Utes refused to agree to the arrangement (O'Neil 1968:317).

Land Rush and Water Development Period (1905 to 1927)

This period is marked by the opening of reservation lands to non-Indians and the subsequent rush by white settlers to homestead this land. It also includes the establishment of several new communities and the first truly intensive efforts towards water development and irrigation in the Uinta Basin.

Unwilling to accept the refusal of the Utes, the federal government continued to pursue the idea of opening the reservation to non-Indians. In 1905, a Presidential proclamation was issued, opening all un-allotted lands of the reservation to entry. This action instigated a land rush into the Uinta Basin. As hundreds of settlers and would-be miners rushed to the area, a number of towns and communities were established. The influx of settlers and establishment of small communities throughout the area brought about the need for additional roads and transportation corridors. In 1906, the General Asphaltum Company, which had overseen the construction of the Uintah Railroad, incorporated the Uintah Toll Road Company (Jones and MacKay 1980:92).

Under this newly formed company, two separate toll roads were built from Jensen to Vernal and Ouray.

The opening of reservation lands brought about a number of significant changes in the use of the Uinta Basin. Among these changes was the creation of the Ashley National Forest by Executive Order of President Theodore Roosevelt on July 1, 1908. The Ashley was developed out of a section of the larger Uintah National Forest created in 1897 (U.S. Department of Agriculture [USDA] n.d.). In 1902, Chief Grazing Officer Albert F. Potter of the U. S. Division of Forestry had recommended that lands in the area north and west of the Strawberry Valley be set aside as a forest reserve. Three years later in 1905, President Roosevelt had allotted 1,010,000 acres of land in that area as an addition to the Uintah National Forest (Jones and MacKay 1980:85). The 1908 Executive Order removed that section of land from the Uintah National Forest and designated it as the Ashley National Forest. By 1931, the area included in the Ashley National Forest had dropped to 979,435; however, various presidential administrations have added acreage to the Ashley National Forest over the ensuing years, enlarging to its current area of 1,313,000 acres (Department of Public Instruction 1933:43; USDA n.d.). Prior to its designation as a wilderness reserve, portions of the Ashley National Forest were the sites of mining and prospecting. Although less mineral-laden than many other western ranges, the Uinta Mountains contained small veins of gold and copper. Perhaps the largest of the Ashley Forest mines was the Dyer Mine operated between 1887 and 1900 (Jones and MacKay 1980:80). During that time, this copper mine yielded roughly $3 million worth of ore. Much of the forest area has remained open to date for mineral prospecting and oil and gas exploration (USDA n.d.).

As the number of settlers in the Uinta Basin increased, so did tension and dissatisfaction on the reservation. White settlers were continually diverting water away from Indian farms to supply their own crops. An attempt was made to allay the ill feelings of the Utes with the establishment of the Uintah Irrigation Project in 1906 (Jones and MacKay 1980:118). Under the auspices of the Uintah Indian Irrigation Company, this project included the construction of 22 canals to service 80,000 acres of reservation lands. The irrigation company was operated with $600,000 in funds paid to the Ute Tribe as part of their compensation for the accession of their lands for settlement (Stalheim 1983). Between 1906 and 1935, the Uintah Indian Irrigation Company was responsible for the construction of roughly 162 miles of main canals, 635 miles of laterals, and hundreds of associated structures (Stalheim 1983). These systems account for approximately one-quarter of all irrigation canals in the Uinta Basin. Unfortunately for the Utes, non-Indian farmers and ranchers bled off much of the water conveyed by these canals before it ever reached the Indian allotments. Such acts prompted Chief Red Cap and several hundred Utes to abandon the Uintah Valley Reservation and join the Sioux in South Dakota.

Canal development continued as the need for irrigation water by newly arrived settlers increased. In 1906, routes were surveyed for a number of canals in the Uinta Basin, including the Holgate or Pioneer Ditch and the Red Cap Canal (Jones and MacKay 1980:119). These canals were built and operated under the auspices of the Duchesne Irrigation Company. That same year, the Whiterocks Irrigation Company and the Dry Gulch Irrigation Company under Joseph Murdock were incorporated to supply water to the farms at Tridell, Lapoint, and other basin communities (Stalheim 1983). The latter organization, the Dry Gulch Company, soon

became the largest privately owned irrigation company in the area. During 1907, the Whiterocks and Dry Gulch Companies were responsible for the construction of several canals, including the White Rocks Canal and the U.S. Lake Fork Canal.

Even with the construction of the new canals, water remained at a premium. Intensive irrigation rapidly led to water shortages throughout the Uinta Basin. This was particularly true of the area south of the Uinta Mountains, where the Ute pastured their cattle. It was decided that the only way to provide sufficient water to sustain the new settlements was to establish a large-scale water system that would supply water to a vast area. This large-scale system took the form of the Strawberry Valley Reclamation Project. Several years earlier, on June 17, 1902, Congress had passed the Newlands Act. This act secured federal support for reclamation projects throughout the arid west (Elliott 1987:177). It was under this act that the Strawberry Valley Reclamation Project was begun. The main purpose of the project was to provide irrigation water to areas south and east of Utah Lake; however, a number of lateral canals and reservoirs were to be constructed along the way that would supply water to the Uinta Basin and other areas. Work on the project began in 1909 on 56,000 acres of reservation land appropriated by the government via the right of eminent domain (Jones and MacKay 1980:121). This project represented the first large-scale diversion of water from the Colorado River Basin to the Great Basin.

Despite the severity of the Uinta Basin environment, and with the promise of the Strawberry Valley Project, settlers and homesteaders continued to flock to the area. By 1909, dozens of small communities were scattered throughout the area. In 1910, the U.S. Indian Service instituted a fee patent policy that allowed non-Indians to purchase Ute allotments. Once again, a minor land rush was the result. Two years later in 1912, Fort Duchesne was abandoned as both a military installation and as the headquarters of the Uintah Reservation Indian Agency. The fort was later established as the tribal headquarters by the resident Ute population (Van Cott 1990:143).

In 1914, the first state road through the Uinta Basin was built via the Duchesne to accommodate the growing number of settlers. That same year, with the population reaching sufficiently high numbers, Duchesne County was created and the town of Duchesne was named the county seat (Jones and MacKay 1980:122). Efforts to provide an efficient transportation and freighting route for the Uinta Basin were renewed just prior to 1920. In 1917, the Denver & Rio Grande Western Railroad Company developed plans to construct a rail line through the area. Two years later, in 1919, Simon Bamberger planned to extend his existing line along the Wasatch Front to the communities in the Uinta Basin. However, neither of these lines was ever built (Jones and MacKay 1980:91). Attempts at developing new rail lines in the area ceased in the mid 1920s with the construction of U.S. Highway 40 over Strawberry Summit (Knowlton n.d.:254). The completion of this road in 1926 and the gains in the overland trucking industry all but eliminated efforts to construct additional rail lines into the Basin.

By the late 1910s and early 1920s, water development was in full swing in the Uinta Basin. Riding on the impetus of the Strawberry Valley Reclamation Project, a second major water project, the Moon Lake Project, was started in the Uinta Basin. This would prove to be one of the largest reservoir projects to be undertaken in the area. Through the combined efforts of the Dry Gulch Irrigation Company and John D. and LeRoy Dixon of Provo, construction of an

earthen dam for the reservoir began in 1918. Within two years the dam failed and no funding was available to repair it (Stalheim 1983). Between 1920 and the mid-1930s, the only work done on the reservoir involved minor maintenance of the facility so that the canal company could maintain their water storage rights. In 1935, President Franklin D. Roosevelt appropriated $1.5 million in funding to finish and upgrade the reservoir and to construct additional water facilities (Jones and MacKay 1980:125). Among the other facilities completed under the Moon Lake Project in the 1930s were Midview Reservoir and the Duchesne Feeder Canal, both built with Civilian Conservation Corps labor (Stalheim 1983).

Over 50 years of pioneer irrigation experience had been gained in other areas of the state and were being put to use in developing the water resources of the Uinta Basin. The presence of the towering Uinta Mountains, which held a heavy snow pack during the winter months, provided an excellent opportunity for increasing the area's water supply. Much of the mountain's water resources were lost to uncontrolled run-off. Recognizing this, developers in the basin began the construction of numerous high mountain reservoirs to trap the runoff and to hold it for future use. The Dry Gulch and Whiterocks Irrigation Companies were responsible for the construction of most of the high mountain lakes built in the 1920s, including Papoose, Wigwam, Upper Chain, Lower Chain, Fox, and Crescent Lakes (Jones and MacKay 1980:124; Stalheim 1983).

Drought, Depression, and World War II (1928 to 1945)

This period was one of hardship for Uinta Basin residents. It is marked by the dire effects of a statewide drought, a nationwide economic depression, and a worldwide military conflict.

By the late-1920s, residents in the Uinta Basin were beginning to suffer a number of difficulties that severely limited development in the area. Although obtaining water had always been a trying task, a statewide drought made conditions even more difficult. The intensive irrigation of the two previous decades had rendered a significant portion of the area's soils far too alkaline to be productive. Attempts at reclaiming the soils failed as the area was hit by a water shortage. The agriculture and livestock industries were hit hard as farmers and ranchers were unable to irrigate their crops or to provide water to their sheep and cattle. Further hardships befell Uinta Basin residents with the stock market crash of 1929. As the Great Depression swept the nation, the gilsonite industry in the Basin diminished significantly. A number of mines closed and hundreds of workers lost their jobs (Jones and MacKay 1980:92). The area remained in a state of economic difficulty throughout the 1930s and into the 1940s. It was not until the start of World War II and the accompanying demand for the mineral resources of the Uinta Basin that the economy of the area began to recover. The Basin's recovery was further accelerated by a boom in the oil industry. Many of the wells that had been drilled in the previous two decades finally began to produce significant amounts of oil. Improvements in petroleum geology and drilling technology during this time added to the success of oil companies in the area.

Post-War Period (1946 to Present)

This period is characterized by the economic prosperity enjoyed by Uinta Basin residents following World War II. It included the discovery of rich oil deposits in the area and the resulting oil boom, which brought about a significant increase in the population of the area.

The Uinta Basin has continued to grow and develop in the years following World War II, and water development has remained a pressing issue. In 1949, the Upper Colorado River Basin Compact was negotiated between the states of Colorado, New Mexico, Utah, and Wyoming to insure that water users in each state got their fair share of the precious resource (Jones and MacKay 1980:75). Further developments in this area included the construction of a dam and reservoir at Starvation between 1967 and 1970. By the time the facility was completed, the reservoir was filled to capacity (Department of Natural Resources 1993).

In addition to water development, the petroleum and mining industries have become one of the single most important factors in the success of the area. In 1970, Shell Oil Company drilled an exploratory well into the deeply buried Wasatch Formation of the Uinta Basin (Jones and MacKay 1980:79). This well continues to produce today. The discovery of such a rich oil deposit touched off an oil boom in the area, which continues to draw hundreds of workers and millions of dollars into the Basin. Between 1970 and 1980, the population of Duchesne County increased more than 70 percent. This increase, which is primarily due to the oil boom, represents the most significant population growth ever experienced in the State of Utah (Roylance 1982:572). Despite the significant amount of money produced by the oil industry in the area, the Uinta Basin remains primarily rural.

Recreational development of the Uinta Basin has also been an issue in recent decades. This has been primarily centered around the enhancement of camping and hiking opportunities in the Uinta and Ashley National Forests and on water-based recreation at the various Basin reservoirs. Increased recreational use of the Uinta Mountains led to the establishment of the High Uintas Primitive Area (Wilderness Area) by Congress on September 28, 1984. Encompassing 456,704 acres, this area is the largest protected wilderness area in Utah (USDA 1989).

One of the most significant developments in the Uinta Basin in recent years concerns the argument over legal jurisdiction of Ute tribal lands. The argument, which is being settled in a number of current court cases, debates the point of determining the exact boundaries of tribal lands, and more importantly for the Utes, who have legal jurisdiction over said lands. It is unclear as to what the outcome of these hearings will be and how that outcome will affect future development in the area.

Leota Bottoms

The first arrivals to the settlement of Leota, near modern-day Pelican Lake, arrived in 1913. The name of the settlement was taken from the Leota Ranch, which had been previously established in 1903 on the Green River bottoms (Burton 1998:318-319). When 1934 brought in

drought, several families from Leota relocated their homes from the townsite down to the river bottom near the Leota Ranch (Burton 1998:319; Cooper 1979:150-156). The small river community survived thanks to a state-funded drought relief committee that provided the people with a diesel-powered pump that drew water from the Green River and fed their irrigation canals. They lived along the shores of the shallow Lake Leota, which dried up each year after high water (Cooper 1979:154). Eventually a handful of people from all over the valley were down in the Leota Bottoms seeking refuge from the water shortage (Cooper 1979:155-156; Vernal Express 1934a:1-2). The Leota Bottom community lasted until 1947, when most the settlers were driven out by flooding, most of them moving to Ouray (Burton 1998:320). Those who remained still suffered times of flooding, and many held out until 1959, when they were forced to sell their property and move due to the creation of the Ouray National Wildlife Refuge (Vernal Express 1952:1, 1959:1).

Although talk of a hunting resort surfaced in the mid 1930s, it would be another 25 years before the U. S. Fish & Wildlife would establish the Ouray National Wildlife Refuge in 1960 (Vernal Express 1937:1, 1959:1). The refuge, purchased with funds derived from the sale of Duck Stamps, encompasses 11,987 acres, including 2,681 acres on the south end of the refuge of leased Uintah and Ouray Reservation lands (U.S. Fish & Wildlife 2011). The entire Leota Bottom area was encompassed by the refuge, and numerous canals and dikes have since been constructed and maintained (Vernal Express 1964:13).

CULTURAL RESOURCES METHODOLOGY

An intensive cultural resource inventory was carried out for the four proposed wells for Thurston, Ouray Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, and #12-31-7-21 in Uintah County, Utah. The project area consists of four lot parcels of land centered on the proposed well heads. The well pads were walked in parallel transects spaced no more than 15 m (50 ft) apart. The area surveyed during this project totaled 49.2 ha (121.5 acres), all of which lie on U.S. Fish & Wildlife managed lands.

The second survey of the access roads and pipelines was conducted on September 20, 2012 by Sandy Pagano and Cheryl Jeppson. The area was surveyed in parallel transects spaced no more than 15 m (50 ft) apart. The surface visibility of the project area was good, with more than half of the project area cleared of vegetation. The total area inventoried during the second survey was 22.73 ha (56.17acres). The acreage surveyed for both projects totaled 71.93 ha (177.67 acres).

CULTURAL RESOURCES RESULTS

An intensive cultural resource inventory was carried out for the Ouray Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, and #12-31-7-21 in Uintah County, Utah. One historic site (42UN7913) and one isolated find were located during the survey (Figure 2).

IF-1

This isolate is a small shard from a whiteware plate or bowl. The fragment has an orange, purple, and blue floral transfer print on one side, a clear glaze, and buff-colored paste. It measures 1¼" by 1½" by 1⅜" thick and bears no trademarks.

Leota Bottom Canal System (Site 42UN7913)

This site, located in the Leota Bottoms in a meander bend of the Green River, is an historic irrigation canal. The site currently consists of an earthen ditch with concrete culverts. These culverts allow for run-off into a small lake on the Ouray National Wildlife Refuge (ONWR). The canal has been largely realigned, at least three times, over the years. This is likely due to the variations in the Leota Bottom during wet and dry years, as well as possible flooding from spring run-off. The current corridor of the canal is paralleled by a modern dirt road. This road provides access through the ONWR for refuge personnel. It is also utilized by tourists and sportsmen hunting in the area. Historic maps of the project area show three different alignments of the canal in and near the current project area (see attached site sketch). The three known alignments are shown on the 1952 General Land Office plat map (GLO), the USGS 7.5' Quadrangle Brennan Basin, Utah (1964), and the current alignment. Unfortunately no map could be found of an earlier or the original alignment. Portions of the abandoned alignments are clearly visible on modern aerial photographs and satellite imagery, but difficult to see on the ground due to heavy vegetation and standing water (flooding).

The alignment on the 1964 map is generally north of the current access road and canal, but does merge with the current alignment on north end of the project (SW¼ Sec. 29). Additionally, some of the abandoned alignment shown on the 1952 GLO plat map is still visible in the current project area (E½ of the NW¼ of the SW¼ of Sec. 29), and south of the current alignment on aerial and satellite imagery. Although canal segments in the current project area have been realigned, it appears some of the original canal may still be intact.

The segment investigated during the current project measures approximately 1.94 mile (3200 m) and is primarily an earthen ditch with concrete culverts for run-off into a small lake. The currently used alignment of the canal is approximately 10-12 ft wide and 2-5 ft deep. The canal is currently maintained and utilized by the Ouray National Wildlife Refuge. There are two concrete box culverts within the investigated segment (Culvert 1 and Culvert 2). These culverts are board-formed and have slots for wood planks to divert water on the downstream line of the canal as well as laterals into a shallow lake. No specific dates for this additional construction

Figure 2. Location of Site 42UN7913 and IF1

were found in the historic record, however it appears to be within the modern period (after 1964). Although no artifacts were observed in association with this canal, the there is potential for additional features in segments not investigated.

The first settlers to the townsite of Leota, located north and west of the current project area (near modern-day Pelican Lake), arrived in 1913. The name of the settlement was taken from the Leota Ranch, which was established in 1903 on the Green River bottoms (Burton 1998:318-319). The drought of 1934 caused several Leota families to relocate their homes from the townsite, down to the river bottom near the Leota Ranch (Burton 1998:319; Cooper 1979:150-156). Eventually a handful of people from various places in the valley had moved to the Leota Bottoms, seeking refuge from the water shortage (Cooper 1979:155-156; Vernal Express 1934:1-2). The small river community survived thanks to a state-funded drought relief committee that provided the people with a diesel-powered pump that drew water from the Green River and fed their irrigation canals. They lived along the shores of the shallow Lake Leota, which dried up each year after high water (Cooper 1979:154). The Leota Bottom community lasted until 1947, when the majority of the settlers were driven out by flooding, most of them moving to Ouray (Burton 1998:320). Those who remained still suffered times of flooding. Many held out until 1959, when they either sold their property to the Federal Government for the creation of the Ouray National Wildlife Refuge, or were forced to sell under when the federal government invoked Eminent Domain (Vernal Express 1952:1, 1959:1).

Although talk of a hunting resort surfaced in the mid 1930s, it would be another 25 years before the U. S. Fish & Wildlife would establish the Ouray National Wildlife Refuge in 1960 (Vernal Express 1937:1, 1959:1). The refuge, purchased with funds derived from the sale of Duck Stamps, encompasses 11,987 acres, including 2,681 acres on the south end of the refuge of leased Uintah and Ouray Reservation lands (U.S. Fish & Wildlife 2011). The entire Leota Bottom area was encompassed by the refuge, and numerous canals and dikes have since been constructed and maintained (Vernal Express 1964:13).

CULTURAL RESOURCE RECOMMENDATIONS

An intensive cultural resource inventory was carried out for the Thurston wells #14-17-9-24, #15-17-9-24, #3-27-9-24, #10-27-9-24, #11-27-9-24, access roads, and pipelines in Uintah County, Utah. One historic site (42UN7913) and one isolated find were documented during the survey. Based on the nature of isolated finds, they are not evaluated for inclusion to the NRHP. The historic site was evaluated for significance using the following Criteria to determine the eligibility of properties as set forth in *36 CFR 60.4*:

> The quality of <u>significance</u> in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

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

(B) that are associated with the lives of persons significant in our past; or

(C) that 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

(D) that have yielded, or may be likely to yield, information important in prehistory or history.

Site 42UN7913

Site 42UN7913 represents an historic irrigation system that was fundamental to settlement and farming in the Leota Bottom region and may have association with Depression Era programs. Through the project area, the ditch has been realigned and modified so many times, that it is difficult to say where the original route of the ditch is located. However, a brief drive-by of other segments of the canal shows that the canal retains integrity in other locations. This site cannot be associated with an important person, nor does it represent a construction style or type. As such, it is recommended NOT Eligible to the NRHP under Criteria B and C. It is unlikely that the site will yield additional information important in the history of the area and is also recommended NOT Eligible under Criterion D. This site is associated with events that have made a significant contribution to the broad pattern of the history of the region, specifically irrigation, agriculture, Depression Era resettlement, and, possibly, Depression Era relief programs. This site is therefore, recommended **ELIGIBLE** to the NRHP under Criterion A. However, the segments of the canal located within the project area no longer retain integrity of location, and are therefore recommended as **non-contributing** elements to the eligible site.

PALEONTOLOGICAL RESOURCES

For the paleontological inventory of initial proposed well pads, Sagebrush contacted Martha Hayden, Utah Geological Survey, Paleontological Assistant, on November 23 to conduct a Paleontological File Search. Ms. Hayden noted that no prior paleontological localities were recorded in the project area. Additionally, it was stated that: "Quaternary and Recent alluvial deposits that are exposed here have a low potential for yielding significant fossil localities" (PFCY 1-2) (Appendix A). The attached letter report was forwarded to Margaret Van Ness, Regional Historic Preservation Officer/Archaeologist for the U.S. Fish and Wildlife Service – Region 6. A personal communication between Ms. Van Ness and Michael Polk of Sagebrush to discuss the results of paleontological file search and the recommendations made by Martha

Hayden resulted in the agreement that there would be no need for additional paleontological review for this project (personal communication).

For paleontological study of the access roads and pipelines for the wells, a second letter was sent to Martha Hayden requesting a search of existing paleontological localities. Ms. Hayden noted that one paleontological locality consisting of a significant mammal quarry was noted within the project area. She further wrote:

> Quaternary and Recent alluvial deposits that are exposed in the northeastern portion of this project right-of way have a low potential for yielding significant fossil localities (PFYC 1 – 2). However, there are also exposures of the Eocene Uinta Formation that occur at the southern and western portions of the project right-of-way (Section 36, T7S, R20E and Section 1, 2 & 11, T8S, R20E) that have the potential for yielding significant vertebrate fossil localities (PFYC 5). If these deposits will be impacted by ground disturbing activities, a permitted paleontologist should be consulted to determine and mitigate any potential impacts to paleontological resources.

Because of this, it was decided that a paleontologist should survey the access roads and pipelines for potential significant fossil localities.

PALEONTOLOGY METHODODLOGY

A reconnaissance survey was conducted for selected areas of the proposed access road widening and pipeline for this project on November 16, 2012. Selected portions of the project area were surveyed with a 200-foot corridor (100 feet either side of the stakes). An on-site observation of the proposed areas undergoing surficial disturbance is necessary because judgments made from topographic maps alone are often unreliable. Areas of low relief have potential to be erosional surfaces with the possibility of bearing fossil materials rather than surfaces covered by unconsolidated sediment or soils. When found within the proposed construction areas, outcrops and erosional surfaces were checked to determine if fossils were present and to assess needs. Careful effort was made during the survey to identify and evaluate significant fossil materials or fossil horizons when they are found. Microvertebrates, although rare, are occasionally found in anthills or upon erosional surfaces and are of particular importance.

PALEONTOLOGY RESULTS

Two paleontological localities (42UN4942V and 42UJN4943V) were recorded during the survey of the access roads and pipeline corridors for the Thurston Ouray National Wildlife Refuge wells project (Figure 3). These localities are described as follows:

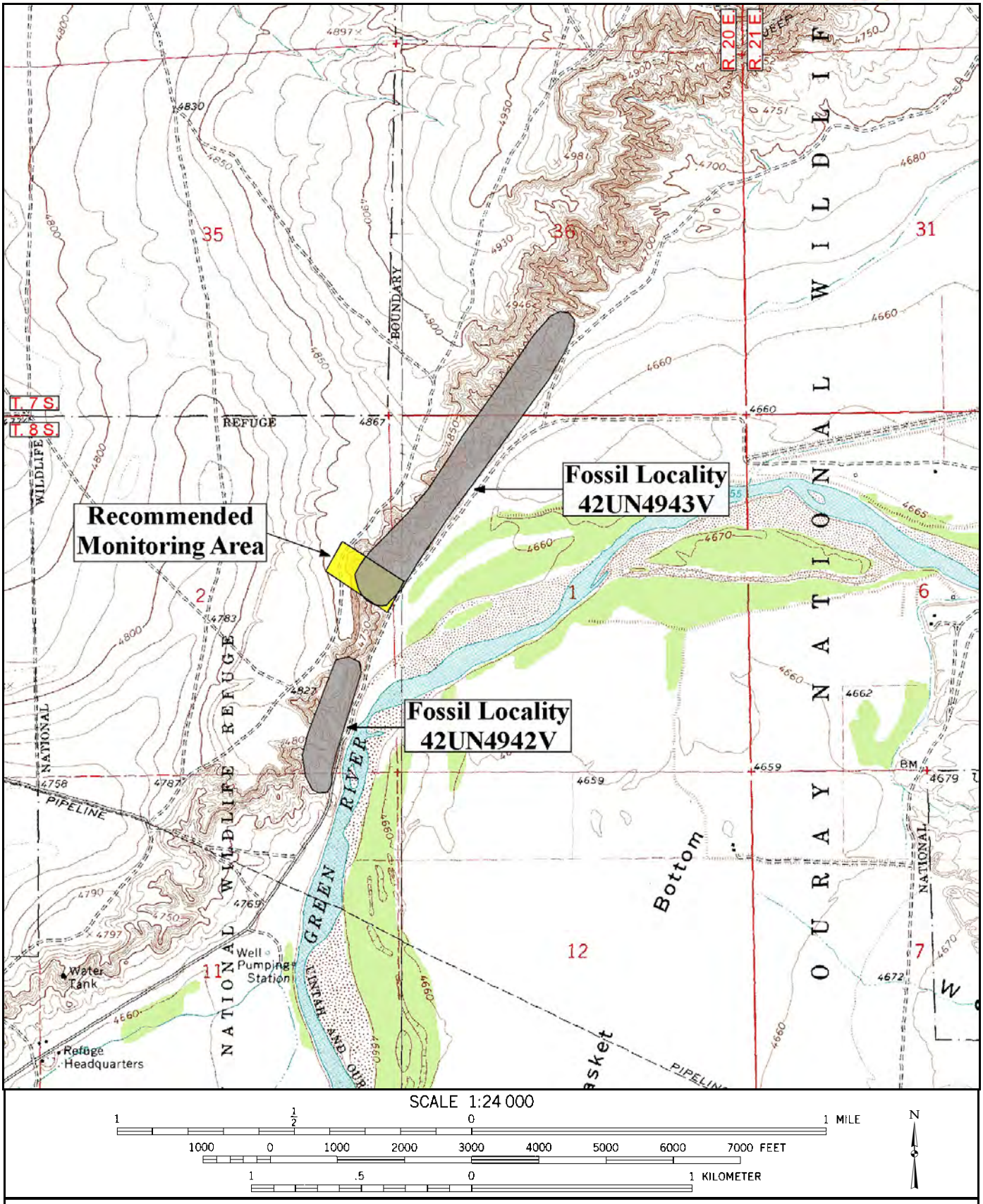


Figure 3. Map showing paleontological localities 42UN4942V and 42UN4943V. Taken from USGS 7.5' Quadrangle Brennan Basin, Utah (1964).

Locality 42UN4942V

Fossils were found in the NE/SE and SE/SE quarter-quarters of Sec. 2, T 8 S, R 20 E, on the slopes of the hills near the proposed road widening. The fossils consisted of the preserved and fragmented remains of seven turtles, namely, two *Apalone* sp., and five undifferentiated Testudinoids; and two mammals represented by limb bone fragments and one small, partial phalange.

Locality 42UN4943V

Fossil material was also found along the entire length of the proposed pipeline corridor, weathering out of the steep hillsides. The fossils consisted of: one occurrence of plant material replaced with algae (*Chlorellopsis coloniata*); a possible, poorly preserved, portion of woody plant material; twelve turtles represented by fragmented carapace and plastron elements, including one *Apalone* sp., and eleven undifferentiated Testudinoids; a crocodilian identified by the preserved skull, limb, teeth and osteoderm fragments; and three mammals represented by one medium sized, partial femur head; another individual consisting of large brontotheriid, poorly preserved teeth, along with skull and jaw fragments; and the last identified by portions of enamel from a large, perissodactyl tooth.

PALEONTOLOGY LOCALITY SIGNIFICANCE

Two paleontological localities were recorded during the current project. Paleontological resources found on public lands are recognized by the BLM as constituting a fragile and nonrenewable scientific record of the history of life on earth, and so represent an important and critical component of America's natural heritage. These resources are afforded protection under 43 CFR 3802 and 3809, and penalties possible for the collection of vertebrate fossils are under 43 CFR 8365.1-5. The two localities were evaluated for significance based on the new Potential Fossil Yield Classification (PFYC) System (BLM, 2008: BLM IM 2009-011 Assessment and Mitigation of Potential Impacts to Paleontological Resources. USDI – BLM Washington Office directive, October 29, 2008). The following section outlines. Geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher-class number indicating a higher potential.

- ***Class 1* – Very Low.** Geologic units (igneous, metamorphic, or Precambrian) not likely to contain recognizable fossil remains.
- ***Class 2* – Low.** Sedimentary geologic units not likely to contain vertebrate fossils or scientifically significant non-vertebrate fossils. (Including modern eolian, fluvial, and colluvial deposits etc.)
- ***Class 3* – Moderate or Unknown.** Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.

- ***Class 3a* – Moderate Potential.** The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.
- ***Class 3b* – Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known.

- ***Class 4* – High.** Geologic units containing a high occurrence of vertebrate fossils or scientifically significant invertebrate or plant fossils, but may vary in abundance and predictability.
  - ***Class 4a* –** Outcrop areas with high potential are extensive (greater than two acres) and paleontological resources may be susceptible to adverse impacts from surface disturbing actions.
  - ***Class 4b* –** Areas underlain by geologic units with high potential but have lowered risks of disturbance due to moderating circumstances such as a protective layer of soil or alluvial material; or outcrop areas are smaller than two contiguous acres.
- ***Class 5* – Very High.** Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils.
  - ***Class 5a* -** Outcrop areas with very high potential are extensive (greater than two acres) and paleontological resources may be susceptible to adverse impacts from surface disturbing actions.
  - ***Class 5b* -** Areas underlain by geologic units with very high potential but have lowered risks of disturbance due to moderating circumstances such as a protective layer of soil or alluvial material; or outcrop areas are smaller than two contiguous acres.

It should be noted that many fossils, though common and unimpressive in and of themselves, can be important paleo-environmental, depositional, and chronostratigraphic indicators. The two localities recorded during this project were evaluated based on the above-cited classifications.

42UN4942V and 42UN4943V

Sandau recommends that the fossils located at this site 42UN4942V be considered **Class 4a (PFYC4)**, and fossils located at this site 42UN4943V be considered **Class 5a (PFYC5**). As discussed above both of these designations are significant for fossil findings.

PALEONTOLOGY RECOMMENDATIONS

First, it is recommended that a permitted paleontologist be present to monitor the area where the road is stated to be widened in the NE/NW quarter-quarter of Sec. 11, and the SE/SE quarter-quarter of Sec. 2, T 8 S., R 20 E. if construction disturbs the bedrock composing the steep side-hills; otherwise, no paleontological monitoring is recommend for this area.

Second, a permitted paleontologist be present to monitor the construction of the pipeline in the SE/NE quarter-quarter section of Sec. 2, T 8 S., R 20 E. (Figure 3). Finally, it is recommended that no paleontological restrictions should be placed on the construction of the remainder of the pipeline that runs through Sec. 1, T 8 S., R 20 E. and in Sec. 36, T 7 S., R 20 E. However, if installation of the pipeline in this area requires any ground disturbing activities, we recommend that a permitted paleontologist be present to monitor the construction process.

Nevertheless, if any vertebrate fossil(s) are found during construction within the project area, Operator (Lease Holder) will report all occurrences of paleontological resources discovered to a site manager of the ONWR of the USFWS and the Office of the State Paleontologist. The operator is responsible for informing all persons in the areas who are associated with this project of the requirements for protecting paleontological resources.

CULTURAL AND PALEONTOLOGICAL RECOMMENDATION OF EFFECTS

During the cultural and paleontological resource inventories for the proposed Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, #12-31-7-21, With Associated Access Roads and Pipelines; one new cultural resource site and two paleontological localities were located. Although site 42UN7913 was recommended Eligible to the NRHP, the segments of the ditch located within the current project area are recommended **non-contributing** elements to the eligible site as a whole. Therefore, there should be **No Adverse Effects** to cultural resources from construction of this project.

The two paleontological localities were recommended 42UN4942V was recommended Class 4a (PFYC4), and locality 42UN4943Vwas recommended as a Class 5a (PFYC5). Both are considered significant fossil localities. Three recommendations are made as follows, to mitigate potential effects to significant paleontological resources in the project area:

1. A permitted paleontologist be present to monitor construction; if it disturbs the bedrock composing the steep side hills in the NE/NW quarter-quarter of Sec. 11, and the SE/SE quarter-quarter of Sec. 2, T 8 S., R 20 E.

2. A permitted paleontologist should be present to monitor the construction of the pipeline in the SE/NE quarter-quarter section of Sec. 2, T 8 S., R 20 E.

3. If the installation of the pipeline in Sec. 1, T 8 S., R 20 E. and in Sec. 36, T 7 S., R 20 E. requires any ground disturbing activities, it is recommended that a permitted paleontologist be present to monitor the construction process.

If these mitigation recommendations are followed during the construction phase of this project, potential effects to paleontological resources can be mitigated to **No Adverse Effect** to the resource.

This investigation was conducted with techniques that are considered adequate for evaluating cultural and paleontological resources that are available for visual inspection and could be adversely affected by the proposed project. However, should such resources be discovered during construction, a report should be made immediately to the Ouray Fish and Wildlife Refuge Manager, Randlett, Utah. If additional vertebrate fossils are located during construction in the project area, the Utah Geological Survey should be notified and a professional paleontologist should be consulted.

REFERENCES CITED

Aikens, M. C., and D. B. Madsen
1986 Prehistory of the Eastern Area. In *Great Basin, Handbook of North American Indians* 11:149-160, W. G. Sturtevant, ed. Smithsonian Institution, Washington D.C.

Alexander, Thomas, and Leonard J. Arrington.
1964 The Utah Military Frontier, 1872-1912: Forts Cameron, Thornburgh, and Duchesne. *Utah Historical Quarterly* 32(4):330-354. Utah State Historical Society, Salt Lake City.

Bender, Henry E. Jr.
n.d. *Uintah Railway: The Gilsonite Route.* Howell-North Books, Berkley, California.

Burton, Doris K.
1996 *A History of Uintah County. Scratching the Surface.* Utah Centennial County History Series, Utah State Historical Society, Salt Lake City.
1998 *Settlements of Uintah County: Digging Deeper.* Uintah County Library History Series, Uintah County Library, Vernal, Utah.

Calloway, D., J. Janetski, and O. Stewart
1986 Ute. In *Great Basin, Handbook of North American Indians* 11:336-367, W.G. Sturtevant, ed. Smithsonian Institution, Washington D.C.

Clemmer, Richard O., and Omer C. Stewart
1986 Treaties, Reservations, and Claims. In: *Great Basin*, edited by Warren L. D'Azevedo, pp. 525-557. Handbook of North American Indians, vol. 11, William G. Sturdevant, general editor. Smithsonian Institution, Washington, D.C.

Cooper, Robert P.
1979 *Leota: End of Wm. H. Smart's Stewardship.* Privately printed, Salt Lake City, Utah.

Daughters of Utah Pioneers
1948 *Early History of Duchesne County.* Art City Publishing Company, Springville, Utah.

Department of Natural Resources
1993 *Starvation State Park*. [Brochure produced by the State of Utah Natural Resources, Division of Parks and Recreation, Salt Lake City.]

Department of Public Instruction
1933 Utah - Resources and Activities. *Supplement to the Utah State Courses of Study for Elementary and Secondary Schools.* Department of Public Instruction, Salt Lake City.

Elliott, Russell
1987 *History of Nevada. Second edition*. (Originally published in 1973.) University of Nebraska Press, Lincoln.

Fuller, Craig
1978 History of the Uinta Basin. In *Survey and Evaluation of Archaeological and Historical Resources Central Utah Project*, 1977, compiled by Edward B. Sisson, pp.39-53. University of Utah Archaeological Center, Salt Lake City.

General Land Office (GLO)
1952 [Map for T. 7S., R. 21E.] Located at the Bureau of Land Management, Salt Lake District Office, Salt Lake City.

Heizer, Robert F., and Martin A. Baumhoff
1970 *Big Game Hunters in the Great Basin: A Critical Review of the Evidence.* Contributions of the University of California Archaeological Research Facility, 7, Berkeley.

Jennings, J. D.
1978 Prehistory of Utah and the Eastern Great Basin. *University of Utah Anthropological Papers* 98. University of Utah Press, Salt Lake City.
1986 Prehistory: Introduction. In *Great Basin, Handbook of North American Indians* 11:113-119, ed. W. L. d'Azevedo. Smithsonian Institution, Washington D.C.

Jones, Kevin T. and Kathryn L. McKay
1980 *Cultural Resources Existing Data Inventory: Vernal District, Utah*. Bureau of Land Management, Salt Lake City.

Knowlton, Ezra C.
n.d. History of Highway Development in Utah. Utah State Department of Highways, Salt Lake City.

Larsen, Gustive O.
1965 *Outline History of Territorial Utah.* Brigham Young University Press, Provo.

Lindsay, L.W.
1976 Unusual or Enigmatic Stone Artifacts: Post, Pipes, Points, and Pendants from Utah. *Antiquities Section Selected Papers* 2(8). Utah State Historic Preservation Office, Salt Lake City.

Loosle, Byron
1995 *Letter to Sagebrush Archaeological Consultants*. On file at Sagebrush Consultants, Ogden, Utah
.

Madsen, D. B.
1982 Get It Where the Gettin's Good: A Variable Model of Great Basin Subsistence and Settlement Based on Data from the Eastern Great Basin. In *Man and Environment in the Great Basin*, D. B. Madsen and J. F. O'Connell, eds. Society for American Archaeology Paper 2, Washington, D.C.

Marwitt, J. P.
1986 Fremont Cultures. In *Great Basin, Handbook of North American Indians* 11:161-172, W. L. d'Azevedo, ed. Smithsonian Institution, Washington D.C.

Morgan, Dale L.
1947 *The Great Salt Lake.* University of New Mexico Press, Albuquerque.
1948 *Historic Trails Map of Utah*. Utah Department of Publicity and Industrial Development, Salt Lake City.
1964 *Jedediah Smith and the Opening of the West*. (Originally published in 1953 by Dale L. Morgan.) University of Nebraska Press, Lincoln.

O'Neil, Floyd
1968 An Anguished Odyssey: The Flight of the Utes, 1906-1908. *Utah Historical Quarterly* 36(4):315-327. Utah State Historical Society, Salt Lake City.

Roylance, Ward J.
1982 *Utah: A Guide to the State.* Utah Arts Council, Salt Lake City.

Schroedl, A.
1976 *The Archaic of the Northern Colorado Plateau.* Ph.D. Dissertation, University of Utah, Salt Lake City.

Spangler, Jerry
1995 *Paradigms and Perspectives: A Class I Overview of Cultural Resources in the Uinta Basin and Tavapats Plateau, Volume III*. Bureau of Land Management publication.

Stalheim, David B.
1983 [*National Register of Historic Places Nomination Form for Irrigation Canals in the Uinta Basin, Utah*.] National Park Service, Rocky Mountain Regional Office, Denver.

Strahorn, A.T.
1924 *Soil Survey of the Ashley Valley, Utah.* U.S. Department of Agriculture, Bureau of Soils. Government Printing Office, Washington, D.C.

U. S. Department of Agriculture (USDA)
n.d. [Map. Ashley National Forest.] Forest Service, Intermountain Region, Ogden, Utah.
1989 [Map. High Uintas Wilderness.] Forest Service, Intermountain Region, Ogden, Utah.

U.S. Fish & Wildlife
2011 *Ouray National Wildlife Refuge, General Brochure.* Online document, http://www.fws.gov/ouray/brochure.html, accessed December 5, 2011.

Utah State Historical Society (USHS)
1988 Utah's Counties. *Beehive History No. 14.* Utah State Historical Society, Salt Lake City.

Van Cott, John W.
1990 *Utah Place Names*. University of Utah Press, Salt Lake City.

Vernal Express [Vernal, Utah]
1917 Leota Ranch All Under Water. *Vernal Express*, 29 June:1. Vernal, Utah.
1934a Nesting Grounds Proposed near Jensen and Leota. *Vernal Express*,1 January:1. Vernal, Utah.
1934b Leota Lakes to be Diked for Nesting. *Vernal Express*, 5 April:1. Vernal, Utah.
1934c Green River Water will be Pumped. *Vernal Express*, 28 June:1. Vernal, Utah.
1934d Green River Bottoms Have Good Crops. *Vernal Express*, 9 September:1-2. Vernal, Utah.
1937 Hunting Resort at Leota Bottoms Planned. *Vernal Express*, 7 July:1. Vernal, Utah.
1952 Green River Water to be Pumped on Farms. *Vernal Express*, 27 March:1. Vernal, Ut.
1959 County Fish, Game Developments Aired Here by Top State Officials. *Vernal Express*, 30 April:2. Vernal, Utah.
1964 Manager Rates 1964 the Big Year On Ouray U.S. Wildlife Refuge. *Vernal Express*, 17 December:13. Vernal, Utah.

Zier, Chris
1984 A *Class II Cultural Resources Inventory of the U.S. Army Dugway Proving Ground, West-Central, Utah*. Metcalf-Zier Archaeologist, Inc., Eagle, Colorado.

APPENDIX A

PALEONTOLOGICAL REPORTS

GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Utah Geological Survey

RICHARD G. ALLIS
State Geologist/Division Director

November 28, 2011

Michael R. Polk
Sagebrush Consultants
3670 Quincy Avenue, Suite 203
Ogden UT 84403

RE: Paleontological File Search and Recommendations for the Ouray Wildlife Refuge Project, Uintah County, Utah
U.C.A. 79-3-508 compliance; literature search for paleontological specimens or sites

Dear Mike:

I have conducted a paleontological file search for the Ouray Wildlife Refuge Project in response to your email of November 23, 2011.

There are no paleontological localities recorded in our files for this project area. Quaternary and Recent alluvial deposits that are exposed here have a low potential for yielding significant fossil localities (PFYC 1 – 2). Unless fossils are discovered as a result of construction activities, this project should have no impact on paleontological resources.

If you have any questions, please call me at (801) 537-3311.

Sincerely,

Martha Hayden
Paleontological Assistant

1594 West North Temple, Suite 3110, PO Box 146100, Salt Lake City, UT 84114-6100
telephone (801) 537-3300 • facsimile (801) 537-3400 • TTY (801) 538-7458 • *geology.utah.gov*

GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Utah Geological Survey
RICHARD G. ALLIS
State Geologist/Division Director

September 26, 2012

John Rasmussen
Sagebrush Consultants
3670 Quincy Avenue, Suite 203
Ogden UT 84403

RE: Updated Paleontological File Search and Recommendations for additional segments of the Ouray Wildlife Refuge Pipeline and Road Realignment Project, Uintah County, Utah U.C.A. 79-3-508 compliance; literature search for paleontological specimens or sites

Dear John:

I have conducted an updated paleontological file search for the Ouray Wildlife Refuge Pipeline and Road Realignment Project in response to your email of September 26, 2012. This project qualifies for treatment under the UDOT/UGS executed Memorandum of Understanding.

There is one paleontological locality recorded in our files for this project area, consisting of a significant mammal quarry from the Uinta Formation in the badlands northwest of the road alignment in Section 36. Quaternary and Recent alluvial deposits that are exposed in the northeastern portion of this project right-of way have a low potential for yielding significant fossil localities (PFYC 1 – 2). However, the are also exposures of the Eocene Uinta Formation that occur at the southern and western portions of the project right-of-way (Section 36, T7S, R20E and Section 1, 2 & 11, T8S, R20E) that have the potential for yielding significant vertebrate fossil localities (PFYC 5). If these deposits will be impacted by ground disturbing activities, a permitted paleontologist should be consulted to determine and mitigate any potential impacts to paleontological resources. Otherwise, unless fossils are discovered as a result of construction activities, this project should have no impact on paleontological resources.

If you have any questions, please call me at (801) 537-3311.

Sincerely,

Martha Hayden
Paleontological Assistant

1594 West North Temple, Suite 3110, PO Box 146100, Salt Lake City, UT 84114-6100
telephone (801) 537-3300 • facsimile (801) 537-3400 • TTY (801) 538-7458 • *geology.utah.gov*

INTERMOUNTAIN
PALEO-CONSULTING
Stephen D. Sandau *Paleontologist*

P. O. Box 1125
Vernal, UT. 84078
Phone & Fax (435) 789-7402
Cell: (801) 592-4328
E-mail: intermountainpaleo@yahoo.com

IPC #12-155

Paleontological Reconnaissance Survey Report

Survey of Selected Areas for the Proposed Access Road Widening and Pipeline for Thurston, Ouray National Wildlife Refuge Wells #12-31-7-21, #11-31-7-21, #13-29-7-21, & #12-29-7-21

Brennan Basin and Pelican Lake Topographic Quadrangles
Uintah County, Utah

December 14, 2012

Prepared by Stephen D. Sandau
Paleontologist for
Intermountain Paleo-Consulting
P. O. Box 1125
Vernal, Utah 84078

INTRODUCTION

At the request of Michael Polk of Sagebrush Consultants, on behalf of Thurston Energy Operating Company, and authorized by the United States Fish & Wildlife Service (USFWS), a paleontological survey of selected areas for the proposed access road widening and pipeline for Thurston's, Ouray National Wildlife Refuge (ONWR) wells #12-31-7-21, #11-31-7-21, #13-29-7-21, & #12-29-7-21 was conducted by Stephen Sandau on November 16, 2012. The survey was conducted under the USFWS Special Use Permit #6557-12-004 and the Utah Paleontological Investigations Permit #2010-386. This survey to locate, identify and evaluate paleontological resources was done to meet requirements of the National Environmental Policy Act of 1969 and other State and Federal laws and regulations that protect paleontological resources.

SUMMARY OF SURVEY RESULTS

Project, Location & Land Administration	Paleontological Findings	Recommendations
(Sec. 2 & 11, T 8 S, R 20 E) (USFWS) (SITLA)	Fossils were found in the NE/SE and SE/SE quarter-quarters of Sec. 2, T 8 S, R 20 E, on the slopes of the hills near the proposed road widening. The fossils consisted of the preserved and fragmented remains of seven turtles, namely, two *Apalone* sp., and five undifferentiated Testudinoids; and two mammals represented by limb bone fragments and one small, partial phalange. The area where the fossils were found is designated as the new vertebrate fossil locality 42Un4942V.	We recommend that no paleontological restrictions should be placed the area where the road is stated to be widened in the NE/NW quarter-quarter of Sec. 11, and the SE/SE quarter-quarter of Sec. 2, T 8 S, R 20 E. The fossils found in this area were off the road some distance and it appears that no bed rock will be disturbed. However, if the steep side-hills are disturbed, we recommend that a permitted paleontologist be present to monitor that disturbance. Class 4a
(Sec. 36, T 7 S, R 20 E) & (Sec. 1 & 2, T 8 S, R 20 E) (USFWS) (SITLA)	Fossil material was also found along the entire length of the proposed pipeline corridor, weathering out of the steep hillsides. The fossils consisted of: one occurrence of plant material replaced with algae (*Chlorellopsis coloniata*); a possible, poorly preserved, portion of woody plant material; twelve turtles represented by fragmented carapace and plastron elements, including one *Apalone* sp., and eleven undifferentiated Testudinoids; a crocodilian identified by the preserved skull, limb, teeth and osteoderm fragments; and three mammals represented by: one medium sized, partial femur head; another individual consisting of large brontotheriid, poorly preserved teeth, along with skull and jaw fragments; and the last identified by portions of enamel from a large, perissodactyl tooth. The area where the fossils were found is designated as the new vertebrate fossil locality 42Un4943V.	Furthermore, we recommend that a permitted paleontologist be present to monitor the construction of the pipeline in the SE/NE quarter-quarter section of Sec. 2, T 8 S, R 20 E (Figure 1). Class 5a Finally, we recommend that no paleontological restrictions should be placed on construction of the remainder of the pipeline which runs through Sec. 1, T 8 S, R 20 E and in Sec. 36, T 7 S, R 20 E. However, if installation of the pipeline in this area requires any ground disturbing activities, we recommend that a permitted paleontologist be present to monitor the construction process. Class 4a

FEDERAL AND STATE REQUIREMENTS

As mandated by the US Department of the Interior Bureau of Land Management, paleontologically sensitive geologic formations in BLM lands that are considered for exchange or may be impacted due to ground disturbance require paleontological evaluation. This requirement complies with:

1) The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321.et. Seq., P.L. 91-190);

2) The Federal Land Policy and Management Act (FLPMA) of 1976 (90 Stat. 2743, 43 U.S.C. § 1701-1785, et. Seq., P.L. 94-579);

BLM, 2008: BLM IM 2009-011 Assessment and Mitigation of Potential Impacts to Paleontological Resources. USDI – BLM Washington Office directive, October 29, 2008 replaces the Condition Classification System from Handbook H-8270-1. The following section outlines the new Potential Fossil Yield Classification (PFYC) System. Geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential.

- ***Class 1* – Very Low**. Geologic units (igneous, metamorphic, or Precambrian) not likely to contain recognizable fossil remains.
- ***Class 2* – Low.** Sedimentary geologic units not likely to contain vertebrate fossils or scientifically significant non-vertebrate fossils. (Including modern eolian, fluvial, and colluvial deposits etc…)
- ***Class 3* – Moderate or Unknown.** Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.
  - ***Class 3a* – Moderate Potential.** The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.
  - ***Class 3b* – Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known.
- ***Class 4* – High.** Geologic units containing a high occurrence of vertebrate fossils or scientifically significant invertebrate or plant fossils, but may vary in abundance and predictability.
  - ***Class 4a*** – Outcrop areas with high potential are extensive (greater than two acres) and paleontological resources may be susceptible to adverse impacts from surface disturbing actions.
  - ***Class 4b*** – Areas underlain by geologic units with high potential but have lowered risks of disturbance due to moderating circumstances such as a protective layer of soil or alluvial material; or outcrop areas are smaller than two contiguous acres.
- ***Class 5* – Very High.** Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils.
  - ***Class 5a*** - Outcrop areas with very high potential are extensive (greater than two acres) and paleontological resources may be susceptible to adverse impacts from surface disturbing actions.
  - ***Class 5b*** - Areas underlain by geologic units with very high potential but have lowered risks of disturbance due to moderating circumstances such as a protective layer of soil or alluvial material; or outcrop areas are smaller than two contiguous acres.

It should be noted that many fossils, though common and unimpressive in and of themselves, can be important paleo-environmental, depositional, and chronostratigraphic indicators.

LOCATION

The selected areas for the proposed access road widening and pipeline for Thurston's, ONWR wells #12-31-7-21, #11-31-7-21, #13-29-7-21, & #12-29-7-21 in Sec. 36, T 7 S, R 20 E & Sec. 1, 2 & 11, T 8 S, R 20 E is on land managed by the USFWS & SITLA in the Wyasket Bottom area of the Wonsits Valley, just west and northwest of the Green River, 3.2 miles southeast of Pelican Lake and approximately 5.7 miles northeast of Ouray, Utah. The project area can be found on the Brennan Basin and Pelican Lake 7.5 minute U. S. Geological Survey Quadrangle Maps, Uintah County, Utah.

FIELD METHODS

In order to determine if the proposed project area contained any paleontological resources, a reconnaissance survey was performed. The selected areas for the proposed access road widening and pipeline for Thurston's, ONWR wells #12-31-7-21, #11-31-7-21, #13-29-7-21, & #12-29-7-21 in Sec. 36, T 7 S, R 20 E & Sec. 1, 2 & 11, T 8 S, R 20 E were surveyed with a 200 foot corridor (100 feet either side of the stakes). An on-site observation of the proposed areas undergoing surficial disturbance is necessary because judgments made from topographic maps alone are often unreliable. Areas of low relief have potential to be erosional surfaces with the possibility of bearing fossil materials rather than surfaces covered by unconsolidated sediment or soils.

When found within the proposed construction areas, outcrops and erosional surfaces were checked to determine if fossils were present and to assess needs. Careful effort is made during surveys to identify and evaluate significant fossil materials or fossil horizons when they are found. Microvertebrates, although rare, are occasionally found in anthills or upon erosional surfaces and are of particular importance.

A brief history and description of the geological formations, together with an overview of the paleontological resources found therein, is included in Appendix A of the Intermountain Paleo-Consulting Catalog of Appendices for Selected Geographic Provinces in the Intermountain West supplement submitted annually to the offices of the Regional Paleontologists for the BLM, the offices of the State Paleontologist in the Intermountain Region, and the Ute Indian Tribe's Department of Energy and Minerals.

PROJECT AREA

The surveyed project area is situated in the Uinta C (Myton Member) of the Uinta Formation and the Brennan Basin Member of the Duchesne River Formation. The surveyed section of pipeline begins in the SW/SE quarter-quarter of Sec. 36, T 7 S, R 21 E, and travels southwest into the NW quarter of Sec. 1, for some 0.98 miles, where it then turns northwest for 0.2 miles to end in the SE/NE of Sec. 2, T 8 S, R 20 E. The surveyed section of access road travels from the NE/SE of Sec. 2, T 8 S, R 20 E, trending southwesterly and parallel to an existing road, for 0.57 miles into the NW/NE of Sec. 11, ending at an existing road.

In the NE/NW quarter-quarter of Sec. 11, and the SE/SE quarter-quarter of Sec. 2, T 8 S, R 20 E, the Green River flows along the east side of the proposed widening portion of the existing road (Figure 1). On the west side are steep hills, weathered into badland topography composed of stacked, variegated layers of maroon, gray, purple, and light-green floodplain deposits of fine-grained sandstones, siltstones and mudstones of the Uinta C (Myton Member) of the Uinta Formation, intertongued with units of off-white to yellow, coarse-grained, fluvial, sandstone beds, and yellow and brick-red overbank deposits of

siltstones and mudstones of the Brennan Basin Member of the Duchesne River Formation. The hills are draped with modern colluvial and eolian sediments derived from the deflated surfaces above and the bedrock below.

The portion of the proposed pipeline requiring a paleontological survey begins in the southern portion of Sec. 36, T 7 S, R 21 E, and travels southwest through the NW quarter of Sec. 1, T 8 S, R 20 E and into the NE quarter of Sec. 2, where it then turns sharply to the northwest and terminates at another turn to the northeast. This portion of the pipeline is staked along an existing road until it turns to the northwest and travels up a steep hill to a flat top in the NE quarter of Sec. 2. The east side of the pipeline is characterized by a modern floodplain of the Green River. The west side of the proposed pipeline corridor is lined by steep hills weathered into badland composed of the stacked, variegated layers of maroon, gray, purple and light-green floodplain deposits of fine-grained sandstones, siltstones and mudstones of the Uinta C (Myton Member) of the Uinta Formation, intertongued with units of off-white to yellow, coarse-grained, fluvial sandstone beds, and yellow and brick-red overbank deposits of siltstones and mudstones of the Brennan Basin Member of the Duchesne River Formation.

Fossils were found in the NE/SE and SE/SE quarter-quarters of Sec. 2, T 8 S, R 20 E, on the slopes of the hills near the proposed road widening. The fossils consisted of the preserved and fragmented remains of seven turtles, namely, two *Apalone* sp., and five undifferentiated Testudinoids; and two mammals represented by limb bone fragments and one small, partial phalange. The area where the fossils were found is designated as the new vertebrate fossil locality 42Un4942V.

Fossil material was also found along the entire length of the proposed pipeline corridor, weathering out of the steep hillsides. The fossils consisted of: one occurrence of plant material replaced with algae (*Chlorellopsis coloniata*); a possible, poorly preserved, portion of woody plant material; twelve turtles represented by fragmented carapace and plastron elements, including one *Apalone* sp., and eleven undifferentiated Testudinoids; a crocodilian identified by the preserved skull, limb, teeth and osteoderm fragments; and three mammals represented by one medium sized, partial femur head; another individual consisting of large brontotheriid, poorly preserved teeth, along with skull and jaw fragments; and the last identified by portions of enamel from a large, perissodactyl tooth. The area where the fossils were found is designated as the new vertebrate fossil locality 42Un4943V.

RECOMMENDATIONS

A reconnaissance survey was conducted for selected areas of the proposed access road widening and pipeline for Thurston's, ONWR wells #12-31-7-21, #11-31-7-21, #13-29-7-21, & #12-29-7-21. The access roads and pipeline covered in this report showed signs of vertebrate fossils, therefore, we advise the following recommendations.

We recommend that a permitted paleontologist be present to monitor the area where the road is stated to be widened in the NE/NW quarter-quarter of Sec. 11, and the SE/SE quarter-quarter of Sec. 2, T 8 S, R 20 E if construction disturbs the bedrock composing the steep side-hills; otherwise, no paleontological monitoring is recommend for this area.

Furthermore, we recommend that a permitted paleontologist be present to monitor the construction of the pipeline in the SE/NE quarter-quarter section of Sec. 2, T 8 S, R 20 E (Figure 1).

Finally, we recommend that no paleontological restrictions should be placed on the construction of the remainder of the pipeline which runs through Sec. 1, T 8 S, R 20 E and in Sec. 36, T 7 S, R 20 E. However, if installation of the pipeline in this area requires any ground disturbing activities, we recommend that a permitted paleontologist be present to monitor the construction process.

Nevertheless, if any vertebrate fossil(s) are found during construction within the project area, Operator (Lease Holder) will report all occurrences of paleontological resources discovered to a site manager of the ONWR of the USFWS and the Office of the State Paleontologist. The operator is responsible for informing all persons in the areas who are associated with this project of the requirements for protecting paleontological resources. Paleontological resources found on the public lands are recognized by the BLM as constituting a fragile and nonrenewable scientific record of the history of life on earth, and so represent an important and critical component of America's natural heritage. These resources are afforded protection under 43 CFR 3802 and 3809, and penalties possible for the collection of vertebrate fossils are under 43 CFR 8365.1-5.

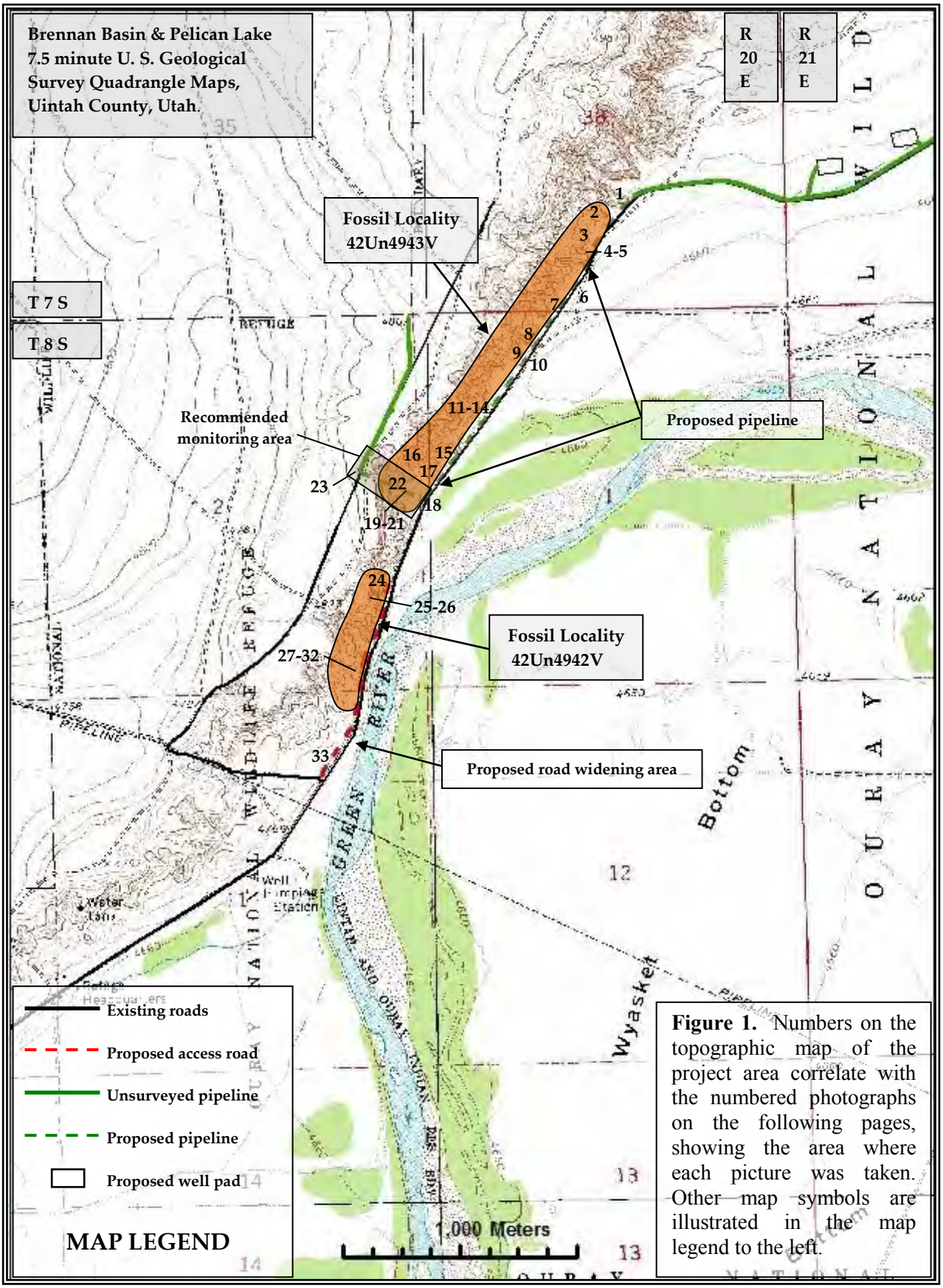


Figure 1. Numbers on the topographic map of the project area correlate with the numbered photographs on the following pages, showing the area where each picture was taken. Other map symbols are illustrated in the map legend to the left.

Figure 1. *continued*

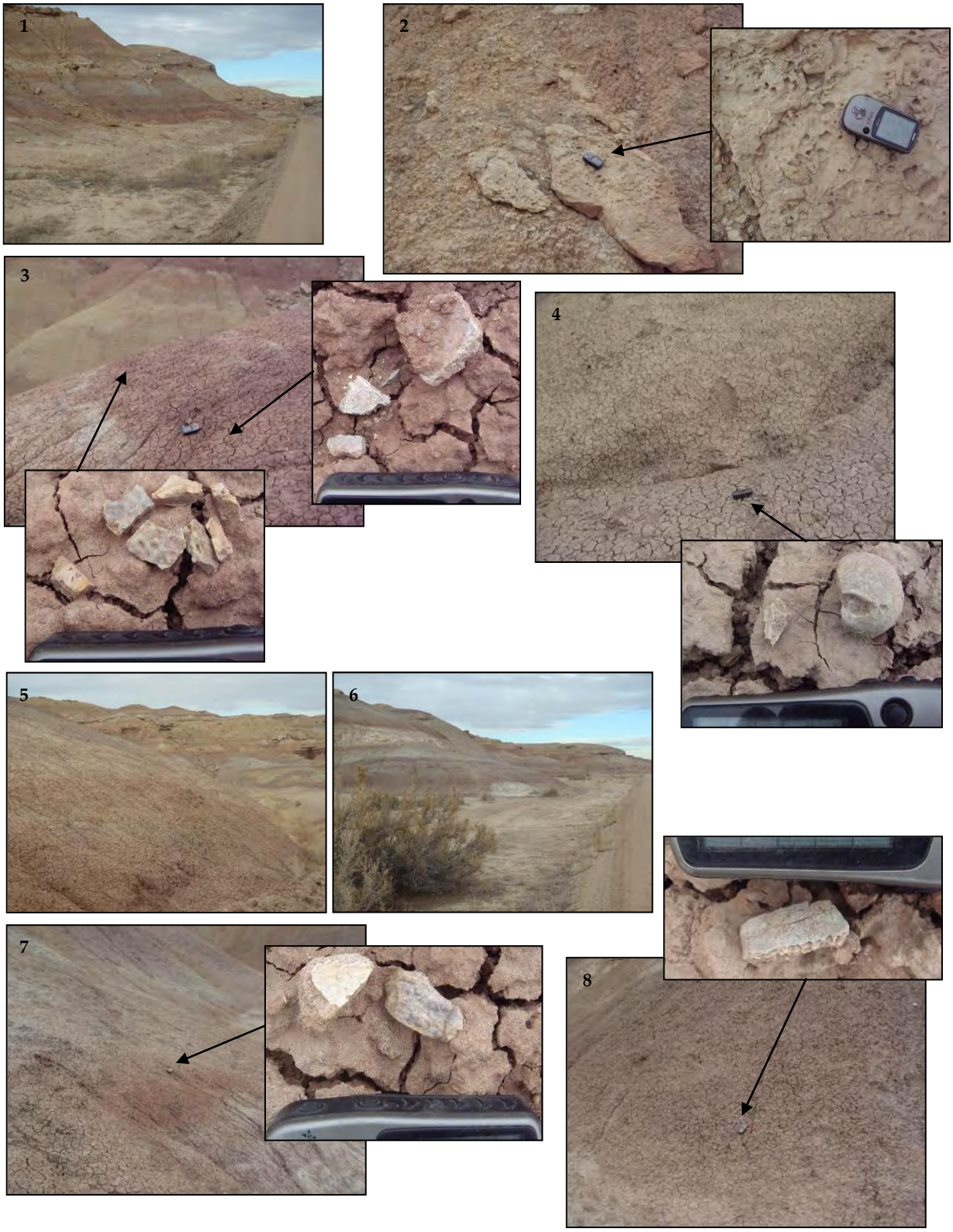


Figure 1. *continued*

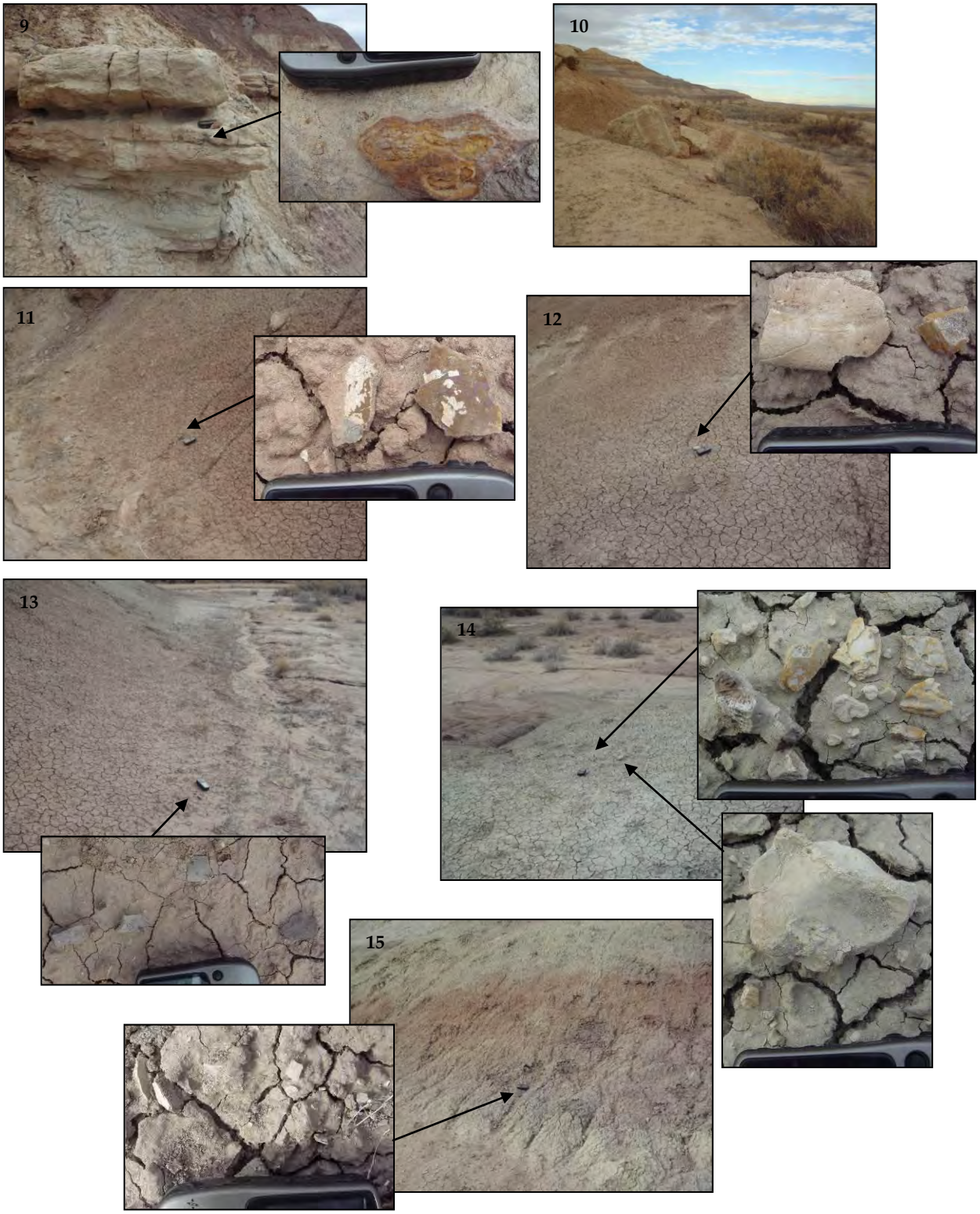


Figure 1. *continued*

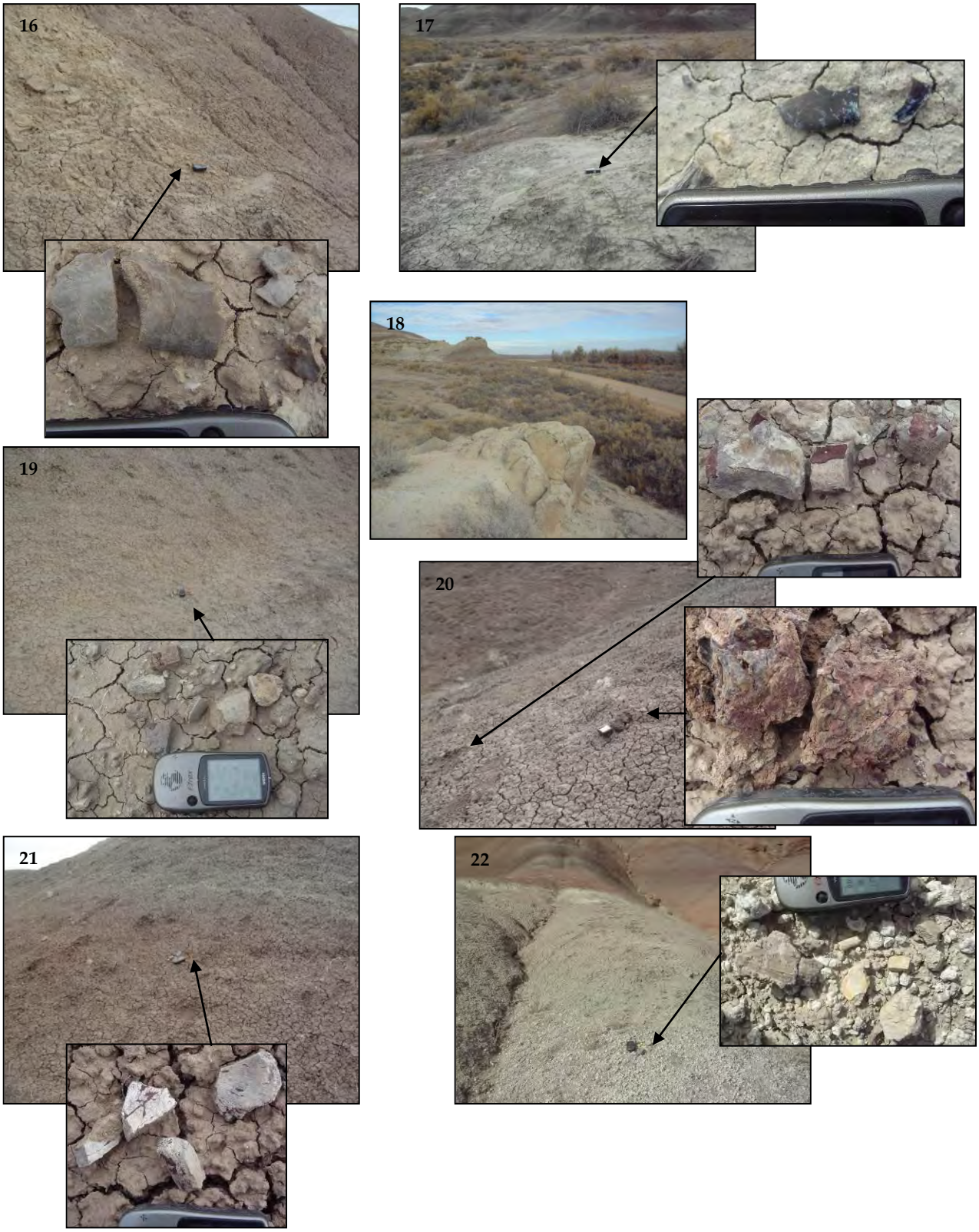
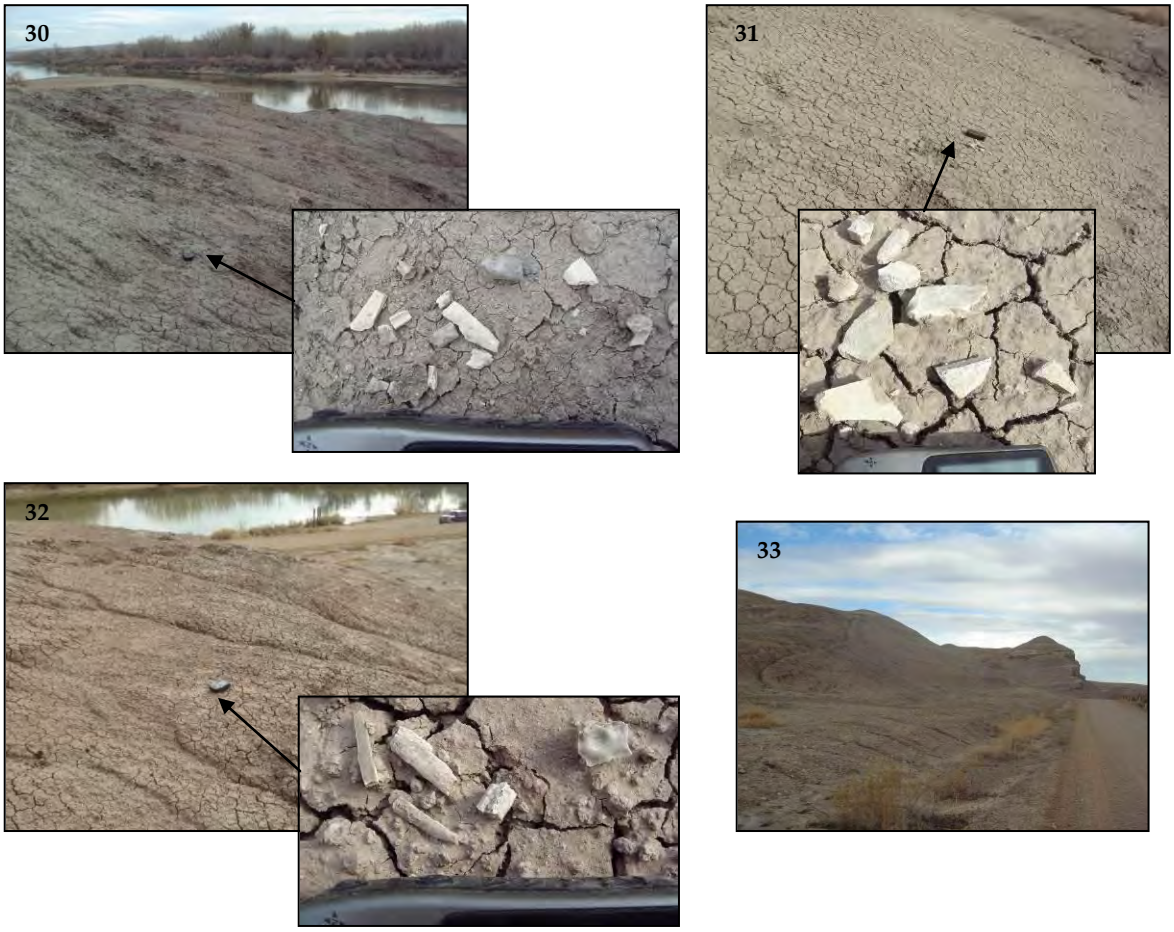


Figure 1. *continued*

Figure 1. *continued*



IMACS SITE FORM

PART A – ADMINISTRATIVE DATA

INTERMOUNTAIN ANTIQUITIES COMPUTER SYSTEM
Form approved for use by
BLM – Utah, Idaho, Wyoming, Nevada
Division of State History – Utah, Wyoming
USFS – Intermountain Region
NPS – Utah, Wyoming

***1. State No.:** 42UN7913
***2. Agency No.:**
3. Temp No.:

4. State: Utah **County:** Uintah
5. Project: A Cultural Resource Inventory for Thurston Operating Company's Ouray National Wildlife Refuge Wells #12-29-7-21, #13-29-7-21, #11-31-7-21, and #12-31-7-21, Uintah County, Utah.
***6. Report No.:** Utah State Antiquities Report No. U-11-SJ-1052w/Sagebrush Consultants Report No. 1876
7. Site Name/Property Name: Leota Bottom Canal System
8. Class [ ] Prehistoric [X] Historic [ ] Paleontologic [ ] Ethnographic
9. Site Type: Irrigation System
***10. Elevation:** 4,680 ft
11. UTM Grid: Zone 12 620350 **mE** 4449047 **mN** (North End) **NAD83**
618698 **mE** 4446813 **mN** (South End)
***12.** SE¼ **of the** SW¼ **of the** NW¼ **of Section** 29 **T.** 7S **R.** 21E
NW¼ **of the** SW¼ **of the** SW¼ **of Section** 31 **T.** 7S **R.** 21E
***13. Meridian:** Salt Lake
***14. Map Reference:** USGS 7.5' Quadrangle Brennan Basin, Utah (1964)
15. Aerial Photo: N/A
16. Location and Access: From the visitor center at the Ouray National Wildlife Refuge, continue northeast on the Wildlife Refuge Road, paralleling the Green River for 2.95 miles. The south end of the canal is located at this point, where it drains into a shallow lake in Leota Bottom.
***17. Land Owner:** U. S. Fish & Wildlife (FW)
***18. Federal Administrative Units:**
***19. Location of Curated Materials:** N/A

20. Site Description: This site, located in the Leota Bottoms in a meander bend of the Green River, is an historic irrigation canal. The site currently consists of an earthen ditch with concrete culverts. These culverts allow for run-off into a small lake on the Ouray National Wildlife Refuge (ONWR). The canal has been largely realigned, at least three times, over the years. This is likely due to the variations in the Leota Bottom during wet and dry years, as well as possible flooding from spring run-off. The current corridor of the canal is paralleled by a modern dirt road. This road provides access through the ONWR for refuge personnel. It is also utilized by tourists and sportsmen hunting in the area. Historic maps of the project area show three different alignments of the canal in and near the current project area (see attached site sketch). The three known alignments are shown on the 1952 General Land Office plat map (GLO), the USGS 7.5' Quadrangle Brennan Basin, Utah (1964), and the current alignment. Unfortunately, no map could be found of an earlier or the original alignment. Portions of the abandoned alignments are clearly visible on modern aerial photographs and satellite imagery, but difficult to see on the ground due to heavy vegetation and standing water (flooding).

The alignment on the 1964 map is generally north of the current access road and canal, but does merge with the current alignment on north end of the project (SW¼ Sec. 29). Additionally, some of the abandoned alignment shown on the 1952 GLO plat map is still visible in the current project area (E½ of the NW¼ of the SW¼ of Sec. 29), and south of the current alignment on aerial and satellite imagery. Although canal segments in the current project area have been realigned, it appears some of the original canal may still be intact.

The segment investigated during the current project measures approximately 1.94 mile (3200 m) and is primarily an earthen ditch with concrete culverts for run-off into a small lake. The currently used alignment of the canal is approximately 10-12 ft wide and 2-5 ft deep. The canal is currently maintained and utilized by the Ouray National Wildlife Refuge. There are 2 concrete box culverts within the investigated segment (Culvert 1 and Culvert 2). These culverts are board-formed and have slots for wood planks to divert water on the downstream line of the canal as well as laterals into a shallow lake. No specific dates for this additional construction were found in the historic record, however it appears to be within the modern period (after 1964). Although no artifacts were observed in association with this canal, the there is potential for additional features in segments not investigated.

The first settlers to the townsite of Leota, located north and west of the current project area (near modern-day Pelican Lake), arrived in 1913. The name of the settlement was taken from the Leota Ranch, which was established in 1903 on the Green River bottoms (Burton 1998:318-319). The drought of 1934 caused several Leota families to relocate their homes from the townsite, down to the river bottom near the Leota Ranch (Burton 1998:319; Cooper 1979:150-156). Eventually a handful of people from various places in the valley had moved to the Leota Bottoms, seeking refuge from the water shortage (Cooper 1979:155-156; Vernal Express 1934:1-2). The small river community survived thanks to a state-funded drought relief committee that provided the people with a diesel-powered pump that drew water from the Green River and fed their irrigation canals. They lived along the shores of the shallow Lake Leota,

which dried up each year after high water (Cooper 1979:154). The Leota Bottom community lasted until 1947, when the majority of the settlers were driven out by flooding, most of them moving to Ouray (Burton 1998:320). Those who remained still suffered times of flooding. Many held out until 1959, when they either sold their property to the Federal Government for the creation of the Ouray National Wildlife Refuge, or were forced to sell under when the federal government invoked Eminent Domain (Vernal Express 1952:1, 1959:1).

Although talk of a hunting resort surfaced in the mid 1930s, it would be another 25 years before the U. S. Fish & Wildlife would establish the Ouray National Wildlife Refuge in 1960 (Vernal Express 1937:1, 1959:1). The refuge, purchased with funds derived from the sale of Duck Stamps, encompasses 11,987 acres, including 2,681 acres on the south end of the refuge of leased Uintah and Ouray Reservation lands (U.S. Fish & Wildlife 2011). The entire Leota Bottom area was encompassed by the refuge, and numerous canals and dikes have since been constructed and maintained (Vernal Express 1964:13).

*21. **Site Condition:** [ ] Excellent [X] Good [ ] Fair [ ] Poor

*22. **Impact Agent(s):** This site has been impacted by flooding, development, the construction of a dirt road and continued use. Despite this continual change, portions of the site remain in good condition.

*23. **National Register Status:** [X] Significant [ ] Non-Significant [ ] Unevaluated

Justify Site 42UN7913 represents an historic irrigation system that was fundamental to settlement and farming in the Leota Bottom region and may have association with Depression Era programs. Through the project area, the ditch has been realigned and modified so many times, that it is difficult to say where the original route of the ditch is located. However, a brief drive-by of other segments of the canal shows that the canal retains integrity in other locations. This site cannot be associated with an important person, nor does it represent a construction style or type. As such, it is recommended NOT Eligible to the NRHP under Criteria B and C. It is unlikely that the site will yield additional information important in the history of the area and is also recommended NOT Eligible under Criterion D. This site is associated with events that have made a significant contribution to the broad pattern of the history of the region, specifically irrigation, agriculture, Depression Era resettlement, and, possibly, Depression Era relief programs. This site is therefore, recommended **ELIGIBLE** to the NRHP under Criterion A. However, the segments of the canal located within the project area no longer retain integrity of location, and are therefore recommended as **non-contributing** elements to the eligible site.

24. **Photos:** 1876:1-16

25. **Recorded by:** Sandy C. Pagano

*26. **Survey Organization:** Sagebrush Consultants, LLC

*28. **Survey Date:** November 22, 2011

27. **Assisting Crew Members:** Mark Pagano

List of Attachments:

[ ] Part B [X] Topo Map [X] Photos [ ] Continuation Sheets

[X] Part C [ ] Site Sketch [ ] Artifact/Feature Sketch [ ] Other:

[ ] Part E

PART A – ENVIRONMENTAL DATA

State No.: 42UN7913
Agency No.:
Temp No.:

***29. Slope:** 0-3 (Degrees) **Aspect:** Varies (Degrees)
***30. Distance to Permanent Water:** 0 x 100 Meters
Type of Water Source: [ ] Spring/Seep [X] Stream/River [ ] Lake [ ] Other
Name of Water Source: The Green River is located adjacent to the north end of this canal.

***31. Geographic Unit:** Uinta Basin (CAA)
32. Topographic Location -** ***See Guide for additional information**:**
Primary Landform: Valley (E) **Secondary Landform:** Floodplain (J)
Describe: This site is located on the Leota Bottom floodplain in a meander of the Green River.
***33. On-site Depositional Context:** Alluvial (H)
Description of Soil: Sediments at this site consist of fine-grained sandy loam with high clay content with some river cobbles.

34. Vegetation:
***a. Life Zone:** Upper Sonoran (E)
***b. Community:** [O] Primary On-Site [O] Secondary On-Site [L] Surrounding Site
Describe: Vegetation in the well locations is dominated by greasewood, rabbitbrush, and kochia. The surrounding areas include alkali tolerant plants in the flood plains such as saltbush, hopsage, and shadscale, with riparian species such as bullrush, cattails and cottonwood and willow trees along the river and marsh areas.

***35. Miscellaneous Text:**
36. Comments/Continuations:

PART C – HISTORIC SITES

State No.: 42UN7913
Agency No.:
Temp No.:

1. **Site Type:** Water Works

*2. **Historic Themes:**

3. **Culture:**

Cultural Affiliation	Dating Method	Cultural Affiliation	Dating Method
European-American	Historical Record		

Describe: This site is well documented in the historic record.

*4. **Oldest Date:** 1903 **Recent Date:** Current
How Determined? The historic record indicates water control features were constructed in the Leota Bottom by at least 1917 (Vernal Express 1917:1). Portions of the system are in use today as diversion channels for the bird habitat of the Ouray Wildlife Refuge. However, the introduction of irrigation in the Leota Bottom may have been as early as 1903 with the establishment of the Leota Ranch (Burton 1998:318-319).

5. **Site Dimensions:** 3200 **m** (Linear) ***Area** 38,400 **sq. m.**
*Site dimensions were obtained using Trimble GeoXT GPS units.

*6. **Surface Collection/Method:**
[X] None (A) [ ] Designed Sample (C)
[ ] Grab Sample (B) [ ] Complete Collection (D)

Sampling Method: N/A

*7. **Estimated Depth of Fill:**
[X] Surface (A) [ ] 20-100 cm (C) [ ] Fill noted but unknown (E)
[ ] 0-20 cm (B) [ ] 100 cm + (D) [ ] Depth Suspected, but not tested (F)

How Estimated (if tested, show location on site map)**:** This type of site includes some depth of actual excavated ditches and culverts; however, additional cultural depth is unlikely.

*8. **Excavation Status:** [ ] Excavated (A) [ ] Tested (B) [X] Unexcavated
Testing Method: N/A

*9. **Summary of Artifacts and Debris** (*Refer to Guide for additional categories*):

[ ] Glass	[ ] Bone	[ ] Leather	[ ] Ammunition	[ ] Domestic Items
[ ] Metal	[ ] Ceramics	[ ] Wire	[ ] Wood	[ ] Kitchen Utensils
[ ] Nails	[ ] Fabric	[ ] Tin Cans	[ ] Rubber	[ ] Car/Car Parts

Describe: This site currently consists of a historic irrigation and water control system. The segment investigated during the current project measures approximately 1.94 miles (3200 m) and is primarily an earthen ditch with concrete culverts for run-off into a small lake. The water control system consists of a main canal with smaller lateral ditches, utilized to irrigate crops during the drought of the 1930s.

10. **Ceramic Artifacts:**

#	Paste	Glaze/Slip	Decoration	Pattern	Vessel Form(s)

a. **Estimated Number of Ceramic Trademarks:**
Describe: N/A

11. **Glass:**

#	Manufacture	Color	Function	Trademark(s)	Decoration

Describe: N/A

12. **Maximum Density – #sq.m (glass and ceramics):**

13 **Tin Cans:**

#	Type	Opening	Size	Modified	Label/Mark	Function

Describe: N/A

*14. **Landscape and Constructed Features (locate on site map)** – (*Refer to Guide for additional categories*):

[ ] Trail/Road	[ ] Dump	[ ] Dam, Earthen	[ ] Hearth/Campfire
[ ] Tailings	[ ] Depression	[X] Ditch	[ ] Quarry
[ ] Rock Alignment	[ ] Cemetery/Burial	[ ] Inscriptions	[X] Other: Canal

Describe: The segment investigated during the current project measures approximately 1.94 mile (3200 m) and is primarily an earthen ditch with concrete culverts for run-off into a small lake. The ditch is approximately 10-12 ft wide and 2-3 ft deep. The canal is currently maintained and utilized by the Ouray National Wildlife Refuge. There are 2 concrete box culverts within the investigated segment (Culvert 1 and Culvert 2). These culverts appear to be board-

formed and have slots for wood planks to divert water on the downstream line of the canal as well as laterals into a shallow lake. No specific dates for additional construction were in the historic record. No artifacts were observed in association with this canal.

*15 **Buildings and Structures (locate on site map):**

#	Material	Type	#	Material	Type

Describe: N/A

16. Comments/Continuations – *Please make note of any Historic Record searches performed (for example – County Records, General Land Office, Historical Society, Land Management Agency Records, Oral Histories/Interview)***:**

References Cited:

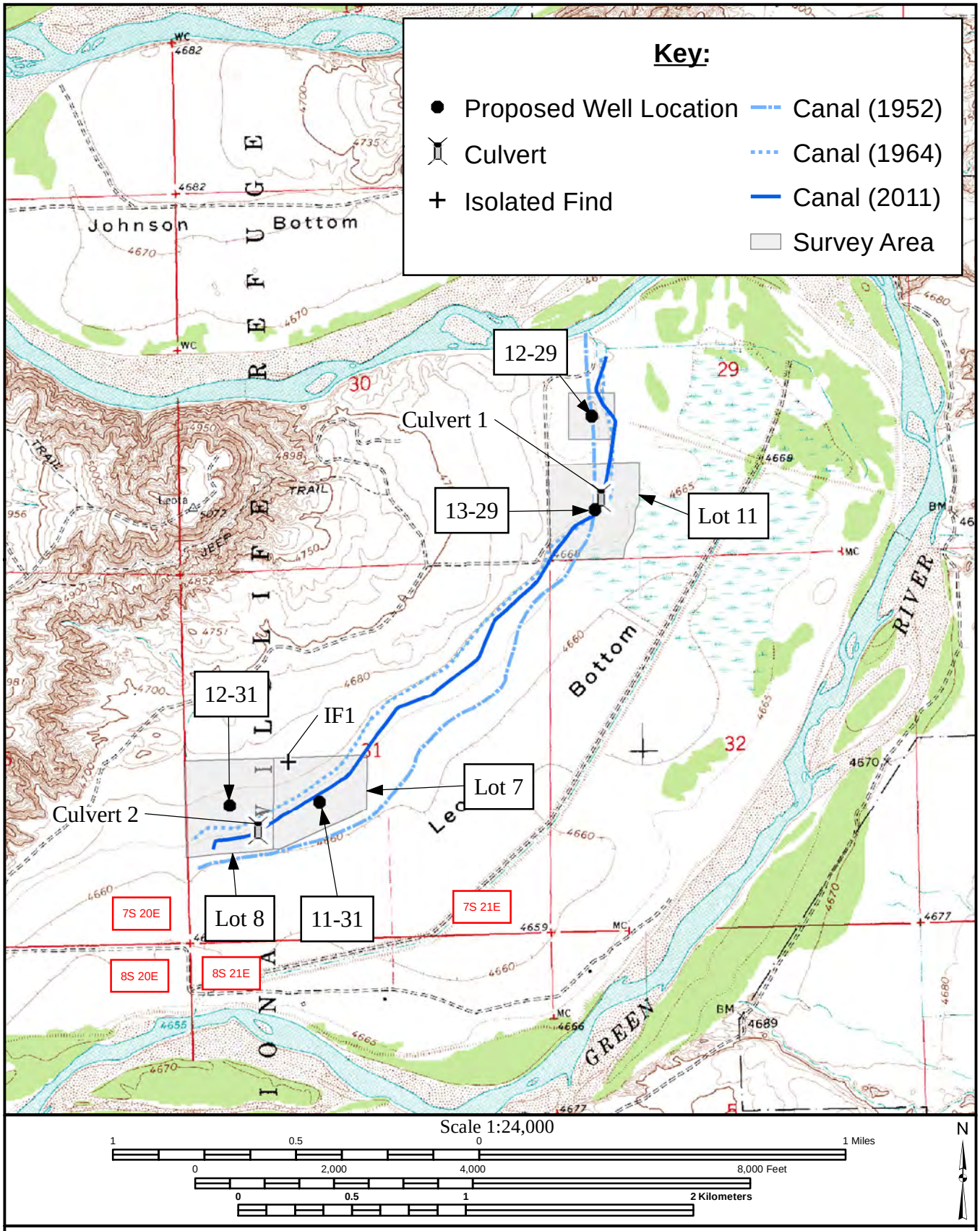
Burton, Doris K.
1996 *A History of Uintah County. Scratching the Surface.* Utah Centennial County History Series, Utah State Historical Society, Salt Lake City.
1998 *Settlements of Uintah County: Digging Deeper.* Uintah County Library History Series, Uintah County Library, Vernal, Utah.

Cooper, Robert P.
1979 *Leota: End of Wm. H. Smart's Stewardship.* Privately printed, Salt Lake City.

General Land Office (GLO)
1952 [Map for T. 7S., R. 21E.] Located at the Bureau of Land Management, Salt Lake District Office, Salt Lake City

U.S. Fish & Wildlife
2011 *Ouray National Wildlife Refuge, General Brochure.* Online document, http://www.fws.gov/ouray/brochure.html, accessed December 5, 2011.

Vernal Express
1917 Leota Ranch All Under Water. *Vernal Express*, 29 June:1. Vernal, Utah.
1934a Nesting Grounds Proposed Near Jensen and Leota. *Vernal Express*,1 January:1. Vernal, Utah.
1934b Leota Lakes to be Diked for Nesting. *Vernal Express*, 5 April:1. Vernal, Utah.
1934c Green River Water Will Be Pumped. *Vernal Express*, 28 June:1. Vernal, Utah.
1934d Green River Bottoms Have Good Crops. *Vernal Express*, 9 September:1-2. Vernal, Utah.
1937 Hunting Resort at Leota Bottoms Planned. *Vernal Express*, 7 July:1. Vernal, Utah.
1952 Green River Water to be Pumped on Farms. *Vernal Express*, 27 March:1. Vernal, Utah.
1959 County Fish, Game Developments Aired Here By Top State Officials. *Vernal Express*, 30 April:2. Vernal, Utah.
1964 Manager Rates 1964 the Big Year On Ouray U. S. Wildlife Refuge. *Vernal Express*, 17 December:13. Vernal, Utah.

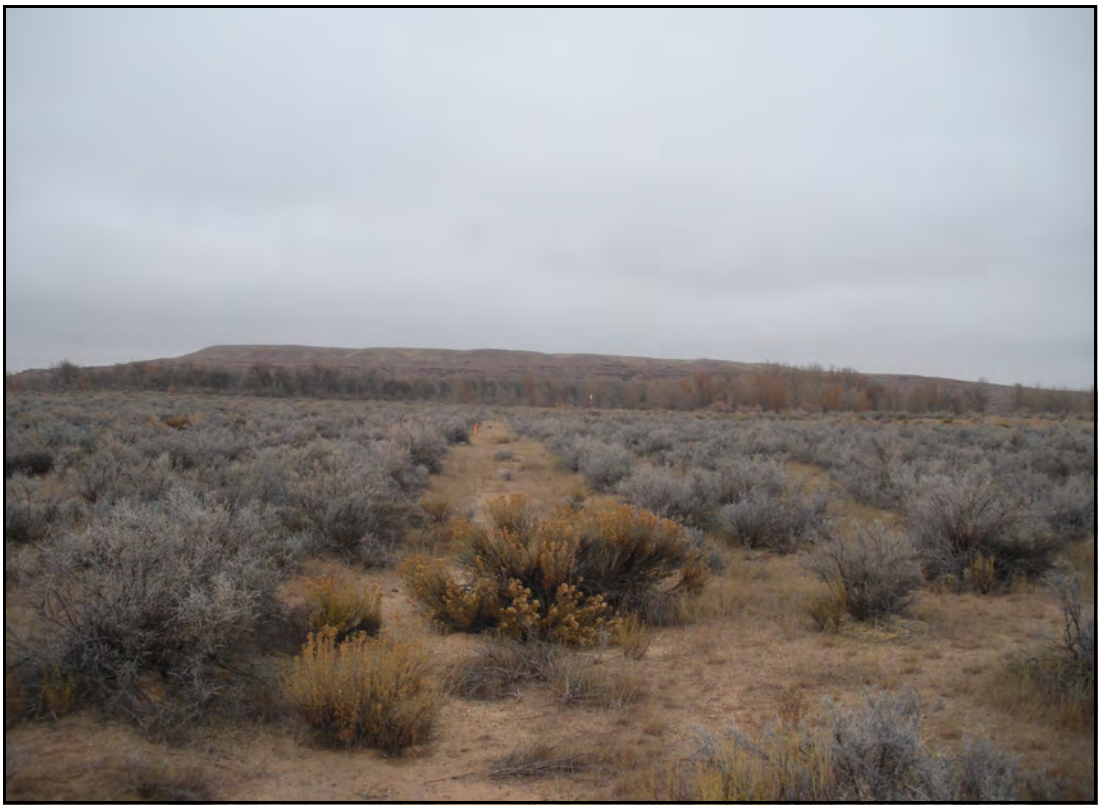


Location of Site 42UN7913, Leota Bottom Canal System. Map showing alignments on the 1952 General Land Office Plat Map, on the1964 USGS Quadrangle, and the current alignment. Map taken from USGS 7.5' Quadrangle Brennan Basin, Utah (1964).

42UN7913. Site overview showing current alignment of canal paralleling modern dirt road. View to the north.

42UN7913. Representative canal overview showing earthen embankments. View to the south.

42UN7913. Overview of abandoned canal segment showing flag for proposed 12-29 well pad to left of alignment. View to the south.



42UN7913. Overview of abandoned canal segment within the proposed 12-29 well pad. View to the north.

42UN7913. Culvert 1; overview of water control feature. View to the northeast.

42UN7913. Culvert 2; Close-up view of culvert box with wood plank gate.