

Mountains to Plains Energy by Design Report to the Colorado State Land Board

January 10, 2013



Prepared by:

Megan Kram, Energy Projects Director/Natural Resources Planner
Jamie Robertson, GIS Manager
The Nature Conservancy in Colorado (Boulder, Colorado)

Core Team (in alphabetical order by organization and individual):

- City of Fort Collins: Daylan Figgs, Natural Areas Senior Environmental Planner; and Justin Scharton, Environmental Planner.
- Colorado Natural Heritage Program: Renee Rondeau, Conservation Planning Team Leader/Ecologist.
- Colorado State Land Board: Bill Gaertner, Inventory Manager/GIS; Mindy Gottsegen, Conservation Services Manager; Pete Milonas, Minerals Director; and Melissa Yoder, External Affairs Officer.
- Larimer County: Jeffrey Boring, Resource Specialist; and Meegan Flenniken, Resource Program Manager.
- The Nature Conservancy: William Burnidge, Grasslands Program Director; Megan Kram, Project Manager; Chris Pague, Senior Scientist; and Jamie Robertson, GIS Manager.

The Nature Conservancy completed this project with and for the Colorado State Land Board, pursuant to Contract #38818 / PO PCA C152179, and in close cooperation with Larimer County and the City of Fort Collins.



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ACKNOWLEDGEMENTS

It is with deep appreciation that The Nature Conservancy wishes to recognize the contributions made to the Mountains to Plains Energy by Design project by the members of the Core and Technical Teams. First and foremost, Pete Milonas, Melissa Yoder, Mindy Gottsegen, and Bill Gaertner of the Colorado State Land Board (SLB) all shaped the vision for the project, provided key technical input, and helped guide the management of the project to ensure its success as members of the Core Team. They demonstrated a commitment to the goals and responsibilities of the SLB, as well as an understanding of and sensitivity to the issues faced by the City of Fort Collins and Larimer County as they represented their constituents and the unique open space investments previously made in the area.

Daylan Figgs and Justin Scharton at the City of Fort Collins (the City), and Meegan Flenniken and Jeffrey Boring at Larimer County (the County), also stepped up for their respective units of local government to pursue a collaborative approach to honoring the mandate and property of the SLB by taking the best account possible of City and County interests. Under their leadership, the City and County also provided a tremendous amount of technical information about their properties. Their knowledge of their lands, awareness of their constituents' concerns, and long-term stewardship approach added immense value to the project.

Renee Rondeau with the Colorado Natural Heritage Program also contributed invaluable scientific expertise and data, helping to ensure that the recommendations were grounded in science.

In addition to these Core Team members, the organizations and individuals that comprised the Technical Team also deserve great credit for all of the data that they brought to the table, as well as interpretation of that data, relative to the oil and gas development activities under consideration. The members of the Technical Team participated on behalf of the City of Fort Collins, Colorado Parks & Wildlife, Colorado Natural Heritage Program, Colorado State University, Larimer County, Legacy Land Trust, Marathon Oil, Natural Resources Conservation Service, Platte River Power Authority, Rocky Mountain Bird Observatory, and the US Fish and Wildlife Service. The ideas they shared greatly strengthened the products herein.

Finally, we wish to thank the members of the Colorado Board of Land Commissioners and the senior staff at the SLB for their leadership in working with local units of government and for their initiative in exploring tools like Energy by Design in order to enable all parties to better serve the collective constituent interests. We recognize that Energy by Design projects may require more up-front time and resources than organizations typically put into energy development projects, but our hope is that the SLB will benefit from the reduction in risks to successful mineral development and to nature. We therefore very much appreciate the commitment of the SLB to this effort and its proactive initiative to set the stage for success as development moves forward.

ABSTRACT

Based on The Nature Conservancy's Energy by Design methodology, this report identifies priority biological, cultural, scenic, and recreational resource values within 60,000 acres in northeastern Colorado and recommends strategies to avoid, minimize, and offset the potential impacts of oil and gas development to these values. It provides an example of collaborative energy planning between federal, state, and local governments, a mineral owner (Colorado State Land Board), and nonprofit organizations. The Colorado State Land Board (SLB) established this project as a strategy to lease and develop its oil and gas holdings underlying three large, publicly-owned properties in northern Larimer County: Red Mountain Open Space (owned by Larimer County), and Soapstone Prairie Natural Area and Meadow Springs Ranch (owned by the City of Fort Collins). The SLB sought a process to design an oil and gas leasing plan that would consider energy development with the conservation goals of local governments. Under contract with the SLB, The Nature Conservancy led this project working closely with the SLB, the City of Fort Collins (the City), Larimer County (the County), and with input from a Technical Team. This report identifies recommendations to the SLB for surface restrictions across the Project Area (for lands including but not limited to those where the SLB owns minerals), including areas for avoidance, minimization of impacts, and preferred areas for oil and gas development. It also provides guidance for timing limitations for biological resources, restoration standards, and possible compensatory mitigation to aid the SLB in its creation of an Oil and Gas Leasing Plan. It may also be used by operators and the City and County to identify provisions of Surface Use Agreements for oil and gas development.

EXECUTIVE SUMMARY

MOUNTAINS TO PLAINS ENERGY BY DESIGN (JANUARY 10, 2013)

INTRODUCTION

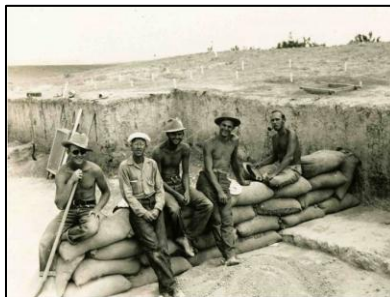
In 2011, the State Land Board (SLB) began seeking a strategy to lease and develop its oil and gas holdings underlying three large, publicly-owned properties in northern Larimer County: Red Mountain Open Space (owned by Larimer County) and Soapstone Prairie Natural Area and Meadow Springs Ranch (owned by the City of Fort Collins). These properties are highly valued by the public for their vast open space and many sensitive resources and unique values, from rare species to ancient cultural artifacts. The City and County properties are considered “split estate” in that the surface is owned by the City and County, while the underlying mineral estate is owned by separate entities including, but not limited to, the SLB. Not only do the SLB and other mineral owners have the right to develop their mineral estate, but the SLB also is charged with generating revenue from its minerals throughout Colorado, primarily to help fund K-12 education.

In keeping with its responsibilities to the citizens of Colorado, yet acknowledging the sensitivities of the Project Area, the SLB sought a process to design an oil and gas leasing plan that would **allow for reasonable energy development while achieving the biological, cultural, scenic and recreational resource conservation goals** of local governments. The SLB contracted with The Nature Conservancy (TNC) to employ its “Energy by Design” (EBD) process (also known as Development by Design) to develop a science-based plan that would identify strategies to avoid, minimize, and mitigate the potential impacts of oil and gas development to biological, cultural, and scenic values. The SLB intends to use this information to create an Oil and Gas Leasing Plan. This project is also a pilot effort for the SLB to explore possible application of the EBD or a similar process to its other holdings in the state.

The SLB, TNC, the City, and the County comprised the “Core Team” that completed the majority of the work on this project. They also solicited input from a “Technical Team” of experts from federal, state, and local government agencies and natural resource management science-based conservation organizations including: Colorado Parks & Wildlife (CPW), Colorado Natural Heritage Program, Colorado State University (CSU), Legacy Land Trust, Natural Resources Conservation Service, Platte River Power Authority, Rocky Mountain Bird Observatory, and the US Fish and Wildlife Service. By involving the surface owners, regulatory authorities, and other stakeholders in this surface use planning process prior to leasing, SLB staff believes this project will streamline leasing and generate revenue from the mineral estate underlying a highly visible asset. The SLB also is supportive of responsible development and stewardship of surface natural values when developing its mineral estate.



Soapstone Prairie Natural Area
© Charlie Johnson



Archaeological dig at the Lindenmeier site
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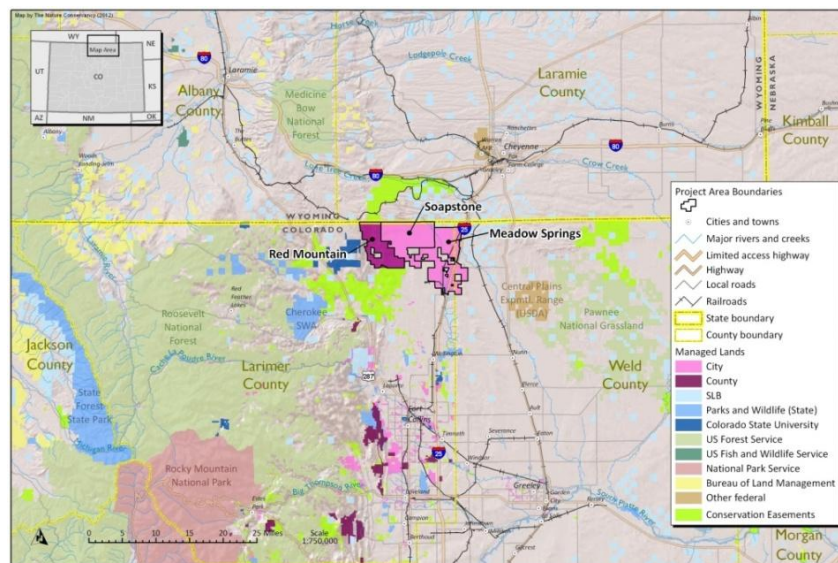
Pronghorn antelope on Soapstone Prairie
© Meegan Flenniken

SITE OVERVIEW

The three properties in the Project Area are contiguous and cover over 60,000 acres north of Fort Collins, along the Wyoming border (Map 1). The City and County, together with Great Outdoors Colorado (GOCO; the state lottery-funded open space program), spent several million dollars to acquire the properties as part of a regional conservation effort called the Laramie Foothills Mountains to Plains Project, through which partners are creating a corridor of protected lands to link the Rocky Mountains with the Great Plains. The properties are well-known amongst residents of the City and County and contain many important values:

- **Biological values:** From west to east, elevation decreases and vegetation shifts from woodlands up high to grasslands down low. Creeks and streams traverse the area and host a rare fish, the Iowa darter, while wetlands provide habitat for waterfowl and many rare species, including the federally-threatened Colorado butterfly plant. Golden eagles, swift fox, pronghorn, and many other sensitive species inhabit the area too. Meadow Springs surrounds the National Black-footed Ferret Conservation Center owned and managed by the U.S. Fish & Wildlife Service. Although a variety of existing roads (mostly unimproved natural surface roads) cross the landscape and buildings, corrals, and other infrastructure dot it, the biological values throughout the Project Area remain relatively intact and high quality.
- **Cultural values:** Soapstone Prairie boasts a National Historic Landmark - the Lindenmeier Archaeological Site - which is more than 12,000 years old and is the most extensive Folsom culture campsite known on the planet. In addition, stone tools, cooking hearths, and other cultural artifacts can be found throughout the Project Area.
- **Scenic and recreational values:** In keeping with the objectives of GOCO, Red Mountain and Soapstone Prairie are open to public use and are popular destinations for hiking, biking, horseback riding, and other recreation activities. Visitors to the Project Area enjoy extraordinary views of rolling grasslands, textured shrublands, and the “Big Hole,” a broad sandy wash surrounded by multicolored cliff bands.
- **Other values:** Meadow Springs is not open to public use and while protecting important biological and cultural attributes, also serves as the City’s bio-solid application facility, which is a critical component in the City’s wastewater program. All three properties are also managed as working cattle ranches.

Map 1. Location of the Project Area



OIL AND GAS DEVELOPMENT POSSIBILITIES

Energy development is booming in eastern Colorado. Although the plains have been the target of oil and gas development activities for decades, the 2009 discovery of the Jake Well near the Wyoming border (due east of the Project Area by approximately 30 miles) prompted a new explosion of oil leasing and exploration throughout the eastern half of Colorado in a geological layer called the Niobrara Formation. Technological advances in the capture of oil and gas in the Niobrara and other shale formations have further catalyzed leasing and development.

The eastern part of the Project Area lies within the Niobrara Formation. The oil and gas development potential of the Project Area is unproven, but is predicted to increase from west to east, with Meadow Springs having the highest potential based on at least one analysis. According to the Colorado Geological Survey, there may only be one place in the Soapstone Prairie – southeast of Round Butte – where energy companies could successfully explore for oil. Also, oil and gas exploration is not new to this landscape. Over the last 60 years, a number of wells in the area have been drilled (and subsequently plugged and abandoned) according to the Colorado Oil and Gas Conservation Commission (COGCC).

Activity is ramping up once again, as evidenced by oil and gas companies contacting the City with an interest in exploring and developing the area. For example, in March 2012, a seismic company approached the City to study 20,000 acres covering much of Meadow Springs and part of Soapstone Prairie. In May 2012 and pursuant to previous leasing activity, Marathon Oil received approval from the COGCC to expand and establish new drilling and spacing units for 32 wells within and near the Project Area, several of which lie within Soapstone Prairie and Meadow Springs. Marathon also has successfully completed a producing well just a few miles south of the Project Area. In addition, the SLB has received numerous requests to lease its minerals underlying the Project Area, but has refrained from auctioning these tracts to develop a more comprehensive leasing and development strategy.

As stated above, the City and County do not appear to own any of the mineral estate underlying the Project Area. Major mineral owners include the SLB and Anadarko, with the SLB holding approximately 15,000 acres in trust, primarily in the eastern half of the Project Area. Several additional owners/lessees have less substantial mineral holdings throughout the parcels, with Marathon Oil being the major leaseholder at present. The Core Team solicited participation from several operators throughout the project. Marathon participated in one of the Technical Team workshops and hosted a well site visit mid-project. The SLB also has conducted outreach to the Colorado Oil and Gas Association. The Core Team may continue to solicit input and participation from oil and gas companies in subsequent phases of the project (see Implementation of Results).



Well site © Gary Buffington

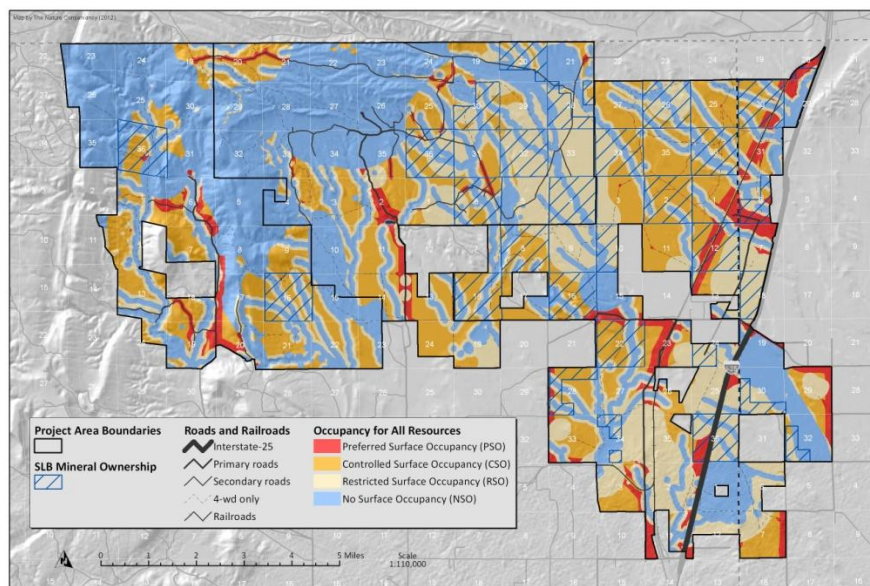
PLAN RESULTS: SURFACE OCCUPANCY AREAS

The goal of the project is to create a comprehensive plan for oil and gas development in the near term while maintaining important biological, cultural, scenic, and recreational values. To this end, the Core Team (with input from the Technical Team) created a series of recommendations designed to avoid, minimize, and mitigate impacts, with a goal of achieving “no net loss” or “net zero impact” to the conservation values of the project area.

Surface Occupancy Areas for biological and cultural values – Based on known locations of biological and cultural values, the Technical Team defined and mapped four types of “surface occupancy areas:” No Surface Occupancy (NSO), Limited Surface Occupancy (LSO), Controlled Surface Occupancy (CSO), and Preferred Surface Occupancy (PSO)(Map 2). The main differences between the areas are (1) the sensitivity of the biological and cultural values for which they were created and (2) compensatory mitigation provisions for biological values. The goal of these tiered areas is to protect key biological and cultural values by providing incentives to operators to develop in the areas where development has the least impact. Examples of NSO areas include wetlands plus a 300’ buffer, golden eagle nests plus a ¼ mile buffer, and the Lindenmeier Archaeological Site plus a one-mile buffer. PSO areas, at the other end of the spectrum, are preferred for development from a biological perspective due to previous and existing disturbances such as roads and utility lines. The precise designation of the surface occupancy areas will be based on site-specific, on-the-ground surveys conducted by the operator prior to development.

Map 2, Surface Occupancy Areas, is a result of an intensive process of identifying and prioritizing key biological and cultural areas for short and long-term protection. This map is intended to guide both surface and mineral owners in the leasing and development of their mineral estate. For the Project Area as a whole, new surface disturbance is prohibited for 44% (NSO) of the land while the remaining 56% falls within the other three categories (LSO, CSO, and PSO). For the SLB mineral ownership, new surface disturbance is prohibited for 27% (NSO), while the remaining 73% falls within the other three categories. Three sections in the northern portion of Soapstone Prairie are designated entirely as NSO due to the Lindenmeier site. Several other sections in the western and northwestern parts of the Project Area fall entirely into NSO designations for biological reasons. All other sections provide access to minerals.

Map 2. Surface occupancy areas for biological and cultural values



PLAN RESULTS: SUPPLEMENTARY RECOMMENDATIONS

Timing limitations for biological values – Some species need seasonal restrictions from construction or general human disturbance to support their life cycles. For example, Colorado Parks & Wildlife (CPW) recommends timing limitations of no human encroachment within ½ mile radius of golden eagle nests from December 15-July 15 to prevent nest abandonment, and no post-development well-site visits within critical winter range for mule deer from December 1-April 15 (from 3 p.m.-10 a.m.). The Technical Team incorporated all timing limitations from the COGCC Rules, CPW’s best practices and other sources to identify both legal requirements for timing limitations and additional recommendations as appropriate. As with surface occupancy areas, pre-development surveys must be completed to determine whether timing limitations will apply.

Surface development standards and mitigation – The combination of surface occupancy areas and timing limitations identify sensitive natural values, with the ultimate goal of guiding surface development away from these areas. But the mere identification of these areas is not likely to achieve complete avoidance of impacts to the biological and cultural values in the project area. The Core Team created a suite of complementary recommendations for incorporation into the SLB leasing package and the City and County’s Surface Use Agreements. These tools work together like a three-legged stool to support the surface occupancy areas by creating incentives to achieve the plan’s overarching goal: To avoid, minimize, and mitigate the short- and long-term impacts of new disturbance in the Project Area.

- **Disturbance caps** – The Core Team identified two disturbance caps: A long-term disturbance cap of 3% per section (or lease holding) to allow for production on up to four well pads per section, and a temporary disturbance cap of an additional 1.25% per section to allow for the development of one well pad per section before reclamation success is achieved and development of a subsequent well pad can begin.
- **Compensatory mitigation fees** – An operator must participate in a compensatory mitigation program with the Surface Owners by contributing to a mitigation fund. Fees apply to long-term impacts only (not to temporary impacts), and vary based on the number of well pads and surface occupancy areas, ranging from \$2,200/acre in Preferred Surface Occupancy up to \$13,200/acre for a fourth well pad in a section and in a Limited Surface Occupancy area. Mitigation projects will ensure “ecological equivalency” by completing projects that benefit the same conservation values that are impacted. Potential projects include land protection, habitat improvement, or mineral/water rights acquisitions.
- **Reclamation provisions** – Prior to development, an operator must create a reclamation plan and provide a bond of \$10,000 per acre of surface disturbance. Operators must reclaim both temporary and long term impacts over time, according to specified standards. The City and County will return the bond, or applicable portions thereof, to the operator upon successful reclamation of impacts.

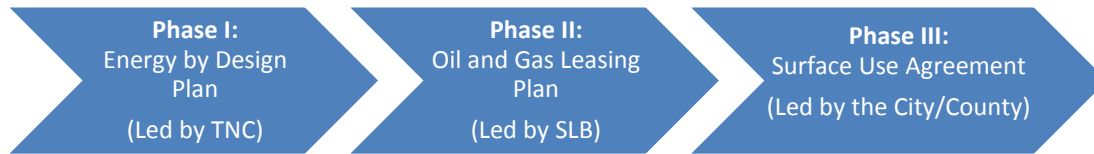
To complement these tools, the City and County are also developing a series of Best Management Practices to address the resources on the property and their importance, by expanding on the COGCC Rules as a basis.

Scenic and recreational values and cultural resource potential – To guide energy companies in the placement of well pads and other infrastructure in locations that would have the least visual impact possible, the Technical Team prioritized scenic values from important viewpoints and trails, and CSU developed a predictive model and map showing potential sites for cultural resources such as tools and cooking hearths. These maps can be used in combination with the biological and (existing) cultural resource maps to help select alternative locations for development. However, they do not replace on-the-ground surveys for the final selection of sites.

IMPLEMENTATION OF RESULTS

This report and its recommendations constitute the first of three phases toward the potential development of oil and gas in the Project Area (Figure 1).

Figure 1. Project phases. This report addresses Phase I only.



In Phase II, the SLB will use the Phase I recommendations to create an Oil and Gas Leasing Plan for the SLB minerals in the Project Area. In Phase III, the City and County will create a Surface Use Agreement, which will build on Phases I and II and will be used with all potential operators in the Project Area, including but not limited to those associated with the SLB minerals. Operators can use all of this information in their planning for oil and gas development.

The SLB, City, County, and TNC envision continuing to work together on Phases II and III, and may solicit additional input from the Technical Team as needed. As was the case with Phase I, representatives from the oil and gas industry are welcome and encouraged to participate in the remaining phases of the project. Given the checkerboard subsurface ownership, the plan will only be as effective as the implementation of its recommendations. This plan provides reasonable access to minerals while protecting biological and cultural resources. The implementation of this plan will provide reasonable assurance that if mineral development occurs at Red Mountain Open Space, Soapstone Prairie Natural Area, or Meadow Springs Ranch, critical cultural and biological resources and extraordinary scenic and recreational values will be protected.

FOR MORE INFORMATION

- City of Fort Collins: Daylan Figgs, Natural Areas Senior Environmental Planner, 970-416-2814, dfiggs@fcgov.com.
- Larimer County: Meegan Flenniken, Resource Program Manager, 970-679-4562, mflenniken@larimer.org.
- State Land Board: Pete Milonas, Minerals Director, 303-866-3454 x3324, pete.milonas@state.co.us, and Melissa Yoder, External Affairs Officer, 303-866-3454 x3330, melissa.yoder@state.co.us.
- The Nature Conservancy: Megan Kram, Project Manager, 303-257-0430, mkram@tnc.org.



Soapstone Prairie Natural Area © Meegan Flenniken

PART I. INTRODUCTION AND OVERVIEW

A. PURPOSE AND HISTORY

In 2011, the State Land Board (SLB) began seeking a strategy to lease and develop its oil and gas holdings on state trust lands underlying three large, publicly-owned properties in northern Larimer County: Red Mountain Open Space (owned by Larimer County Open Lands), Soapstone Prairie Natural Area (owned by the City of Fort Collins Natural Areas Department) and Meadow Springs Ranch (owned by the City of Fort Collins Utility). These properties are valued by the public and contain many sensitive and unique values, from rare species to ancient cultural artifacts to vast views. At the same time, the SLB has a constitutional mandate to generate revenue from its mineral estate which primarily helps fund K-12 education in Colorado. In recognition of the potentially conflicting uses of the property, the SLB sought a thorough, transparent, and science-based process to design an oil and gas leasing plan that would take into consideration biological, cultural, scenic, and recreational resource conservation.

The SLB contracted with The Nature Conservancy (TNC) to employ its “Energy by Design” (EBD) tool¹ to identify strategies to avoid, minimize, and mitigate the potential impacts of oil and gas development to biological, cultural, scenic, and recreational values. To date, TNC has applied EBD to approximately 20 projects in the U.S. and around the world, with the first being the Jonah Project in Wyoming in 2006. The Mountains to Plains EBD project differs from other EBD projects in several ways:

- It addresses biological, cultural, scenic and recreational values. Other EBD projects have addressed biological values only;
- It includes more detailed recommendations about how to avoid and minimize oil and gas-related impacts than have other EBD projects; and
- It provides guidance for compensatory mitigation, but does not provide maps of preferred locations for mitigation projects. Other EBD projects have done the opposite.

The SLB, TNC, the City of Fort Collins, and Larimer County comprised the “Core Team” that completed the bulk of the work on this project. They defined the project scope in terms of potential impacts stemming from surface disturbances and the construction and operation of surficial oil and gas infrastructure. The scope did not directly analyze or otherwise consider potential risks posed by the subsurface oil and gas development or extraction activities or infrastructure, including hydraulic fracturing (aka, “hydro-fracking” or “fracking”).

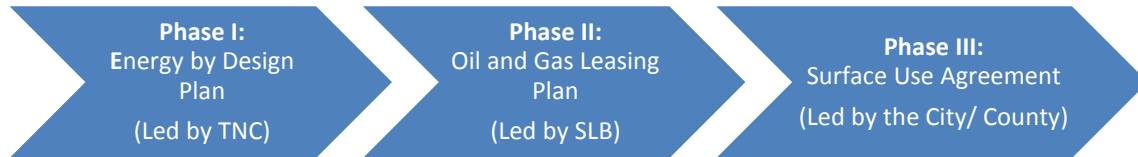
The Core Team also solicited input from a “Technical Team” of experts from federal, state, and local government agencies and science-based conservation organizations (see Part I-F, Participants). By involving the surface owners and the regulatory authorities in this surface use planning process prior to leasing, the SLB believes this project will lower the risk for oil and gas companies, proactively address the concerns of the local jurisdictions, and increase the likelihood of oil and gas development for the state’s mineral holdings.

¹ TNC’s official and more commonly used term for this methodology is Development by Design. However, because those involved with this project, including the media, have called this project Energy by Design from its outset, this project will continue to use the EBD term.

B. PROCESS OVERVIEW AND TIMELINE

This report describes the methods and results for the Energy by Design Plan, which is the first of three phases of this project (Figure 1).

Figure 1. Project phases. This report addresses Phase I only.



Phase I (Energy by Design Plan) – Identify priority areas and strategies to avoid, minimize, and mitigate impacts: This phase began in November 2011 with the execution of a contract between the SLB and TNC and ended in January 2013 with the completion of this report (Table 1). TNC led this phase, working closely with the SLB, the City, and the County and with input from the Technical Team (see Part I-F, Participants). This phase provided an “onsite analysis” of priority biological, cultural, scenic and recreational resource values prior to the SLB’s lease sale. It identified recommendations to the SLB for surface restrictions across the Project Area (for lands including but not limited to those where the SLB owns minerals), including areas for avoidance, minimization of impacts, and preferred areas for oil and gas development. It also provided disturbance caps, reclamation standards, and guidance for possible compensatory mitigation to aid the SLB in its future creation of an Oil and Gas Leasing Plan (Phase II) and the City and County in their creation of a Surface Use Agreement (Phase III). The results are based partially on the concepts in the documents associated with oil and gas development on the Lowry Range Oil and Gas Lease, which the SLB completed in April 2012 (Colorado State Land Board, 2012).²

TNC built the work for Phase I around three workshops with the Technical Team (see Part I-F, Participants). Prior to each Technical Team workshop, TNC first drafted materials with input from the TNC Science Team, and then met with the Core Team to review the draft materials and workshop agendas.

Table 1. Phase I milestones and dates

Phase I Milestones	Dates
Contract signed between the SLB and TNC	November 23, 2011
Technical Team workshop #1	January 23, 2012
MOU signed between the SLB, the City, and the County	January 24, 2012
Technical Team workshop #2	March 29, 2012

² This lease consists of a series of documents: (1) A general Lease Agreement, (2) Exhibit A - Premises description, (3) Exhibit B – Lease Stipulations, (4) Maps, and (5) a Surface Use, ROW and Damages Agreement. Prior to the approval of these documents, the Lowry Range Integrated Management Plan was developed and adopted. To complement these materials, ConocoPhillips is developing an oil and gas development plan and a map of an “Oil and Gas Operations Area” that will eventually define where and when the infrastructure will be constructed.

Phase I Milestones	Dates
Technical Team workshop #3	May 23, 2012
Draft report to Core Team (SLB, City, County)	June 30, 2012
Draft report to Technical Team	August 10, 2012*
Final deliverables to the SLB	January 9, 2013

* Between August 10 and January 9, the Core Team primarily worked on creating the supplementary recommendations for surface disturbance and mitigation.

Phase II (Oil and Gas Leasing Plan) – Identify a leasing plan for the SLB mineral ownership area: The SLB will lead this phase in consideration of the Phase I recommendations and with input from the City of Fort Collins, Larimer County, TNC, and ideally other mineral owners and potential lessees.

Phase III (Surface Use Agreement; SUA) – Create a draft agreement between the City, the County, and future operators: The City and County will lead this phase with input from the SLB and TNC. This document will be developed in consideration of the results from Phases I and II. It will identify provisions to avoid, minimize, and mitigate the impacts of oil and gas development to surface features. The City and County will use this SUA as the basis for negotiations with future operators within the Project Area, including but not limited to those associated with the SLB mineral estate.

C. BENEFITS TO PARTIES

i. Surface owners (City of Fort Collins and Larimer County)

- Gives the City and County an opportunity to participate in mineral development planning;
- Helps protect the important biological, cultural, scenic, and recreational values of the site to the extent possible;
- Allows the City and County to forge relationships with the SLB and oil and gas companies, explain the purpose for acquiring these lands, and provide reasonable access to privately held minerals in an environmentally, culturally, visually, and recreationally sensitive manner;
- Provides the City and County the opportunity to share with the public the reality of their surface ownership and severed minerals interests and build public support for in the use of the “mitigation hierarchy” (i.e., first avoid, then minimize, then reclaim/restore, and lastly mitigate for unavoidable impacts);
- Allows the City and County adequate time to compile available data and consult with experts to develop conservation strategies such as science-based buffer widths, timing requirements for specific species, etc.

ii. State Land Board

- Reduces uncertainty for the SLB oil and gas lessees and other owners and operators in the Project Area by identifying critical natural value concerns prior to leasing;
- Provides and potentially expands the surface access for reasonable development of the SLB mineral estate;
- Reduces potential regulatory and planning conflicts with the jurisdictional entities through developing collaborative relationships and cooperative agreements;

- Provides coordination for an impressive panel of local and regional subject matter experts, supporting a science-based methodology with considerable stakeholder input;
- Streamlines development of the oil and gas resource by providing comprehensive biological, cultural, scenic, and recreational assessments prior to leasing;
- Demonstrates to the public a thoughtful, cooperative approach to developing severed state-owned minerals;
- Establishes a solid rapport and relationship with the City and County for long-term project management;
- Provides strategies to reduce surface impacts of oil and gas development and considers objectives for other state and federal agencies; and
- Provides model approach to the creation of minerals development plans for large trust assets as outlined in current strategic plan.

D. PRINCIPLES

- This report provides recommendations only to the State Land Board (SLB), the City of Fort Collins (the City), and Larimer County (the County):
 - The SLB, the City, and the County are the ultimate decision-makers and will decide how to use the information in this report.
 - The SLB, the City, and the County will use common sense and flexibility to address unforeseen circumstances when making decisions on the ground and may need to deviate from the recommendations herein to do so.
- Be consistent with the SLB's constitutional mandate to provide "reasonable and consistent income" from mineral extraction while "protecting and enhancing the natural values." The project will consider the impacts of natural resource extraction on biological, cultural, scenic, and recreational values:
 - Provide legally-required and reasonable access for resource extraction.
 - Avoid or minimize surface impacts (especially roads and other new impacts) in the places that are most important to biological, cultural, scenic, and recreational values while directing surface impacts to the areas that are less important or not important to these values.
 - Propose restrictions to surface impacts only where they are absolutely needed to protect biological and cultural values and that are proportional to the anticipated impact and to the ability to reverse it.
- Provide transparent and science-based recommendations with documentation of rationale.
 - Provide oil and gas surface occupancy recommendations along a continuum from "no surface occupancy" to "preferred surface occupancy," with the intent to protect biological and cultural resources
 - Prioritize scenic values and predict locations of cultural resources to inform and influence the final siting of individual wells and infrastructure.
- Avoid, minimize, and mitigate impacts to biological, cultural, scenic, and recreational values, striving to achieve "no net loss" or "net zero impact" to these values,³ through the period of minerals extraction and

³ It may not be possible to achieve no net loss for all cultural values because they are irreplaceable. In some cases, losses may be unavoidable and compensatory mitigation impossible. Unlike the majority of biological values which can be reclaimed or restored, cultural values occur only in the places they are found. Damage or destruction to cultural resources is permanent.

subsequent restoration of the site (i.e., in 30-50 years) by applying the mitigation hierarchy to surface impacts:

- Avoid irreplaceable biological and cultural values;
 - Minimize fragmentation and disturbance of biological and cultural values through direct and indirect impacts. Minimize the impact to scenic and recreational resources by siting well pads and infrastructure in the least visible locations possible while protecting biological and cultural resources; and
 - Mitigate biological values within biologically meaningful timeframes through reclamation and compensatory mitigation. Where possible, improve the site functionally from biological, cultural, scenic and recreational perspectives.
- Respect related government entities and investments of significant public resources in the conservation of important natural, cultural, scenic, and recreational values.

E. PROJECT AREA

i. Surface ownership and values

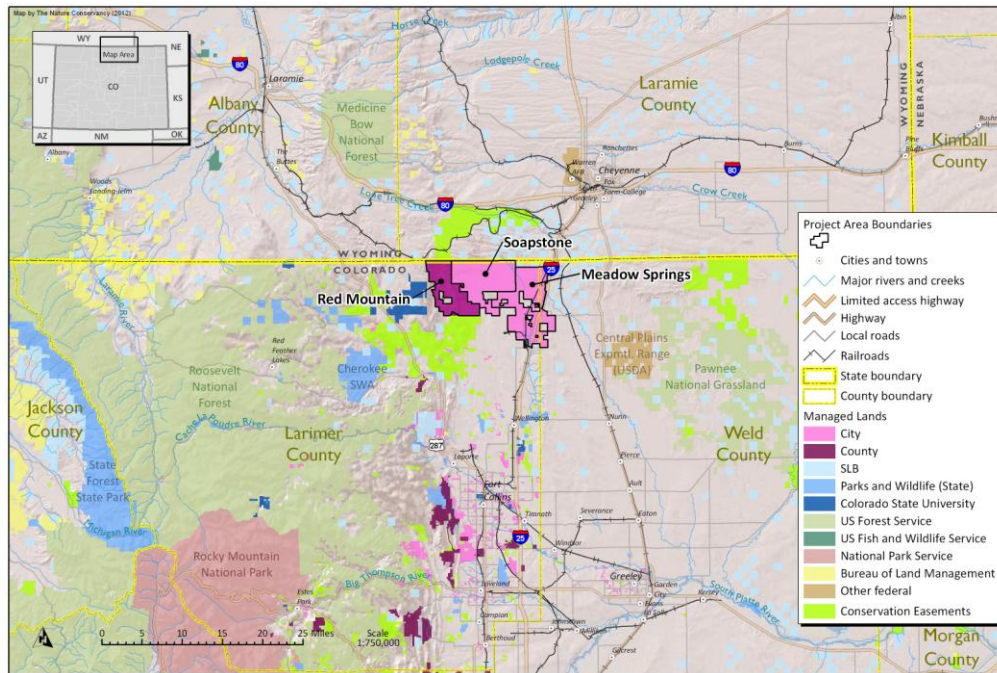
The Project Area includes three publically-owned properties with severed mineral estate. The properties are contiguous and cover over 60,000 acres north of Fort Collins, along the Wyoming border (Map 1, Table 2). The Project Area excludes several large inholdings within the broader boundary.

These properties are well-known amongst residents of Larimer County and the City of Fort Collins. Red Mountain and Soapstone are open space properties that are open to public use and are popular destinations for hiking, biking, horseback riding, and other recreation activities. Meadow Springs is not open to public use and serves as a bio-solid application facility, which is a critical component in the City's wastewater program. All three properties are also managed as working cattle ranches. Meadow Springs surrounds a 40-acre black-footed ferret recovery center owned and managed by the U.S. Fish & Wildlife Service.

The properties are part of a regional conservation effort called the Laramie Foothills Mountains to Plains Project, through which partners are creating a corridor of protected lands to link the Rocky Mountains with the Great Plains.⁴ The City and County, together with Great Outdoors Colorado (GOCO; the state lottery-funded open space program), invested several million dollars to purchase the properties in the Project Area as part of the Laramie Foothills project. The EBD project compliments the efforts of the broader Laramie Foothills Mountains to Plains Project by ensuring that the conserved properties retain their key values, even if energy development proceeds.

⁴ The Laramie Foothills Mountains to Plains Project should not be confused with the Mountains to Plains *EBD* Project, which this report describes.

Map 1. Location of the Project Area within the broader Mountains to Plains region



Sources: Land ownership/management (Lavender, Fink, Linn, & Theobald, 2011)

Table 2. Parcels in the Project Area

Parcel	Ownership	Acres*	% of Project Area	Open to public
Red Mountain Open Space	County	15,000	24%	Yes
Soapstone Prairie Natural Area	City	22,000	35%	Yes
Meadow Springs Ranch	City	26,000	41%	No
Total		63,000	100%	

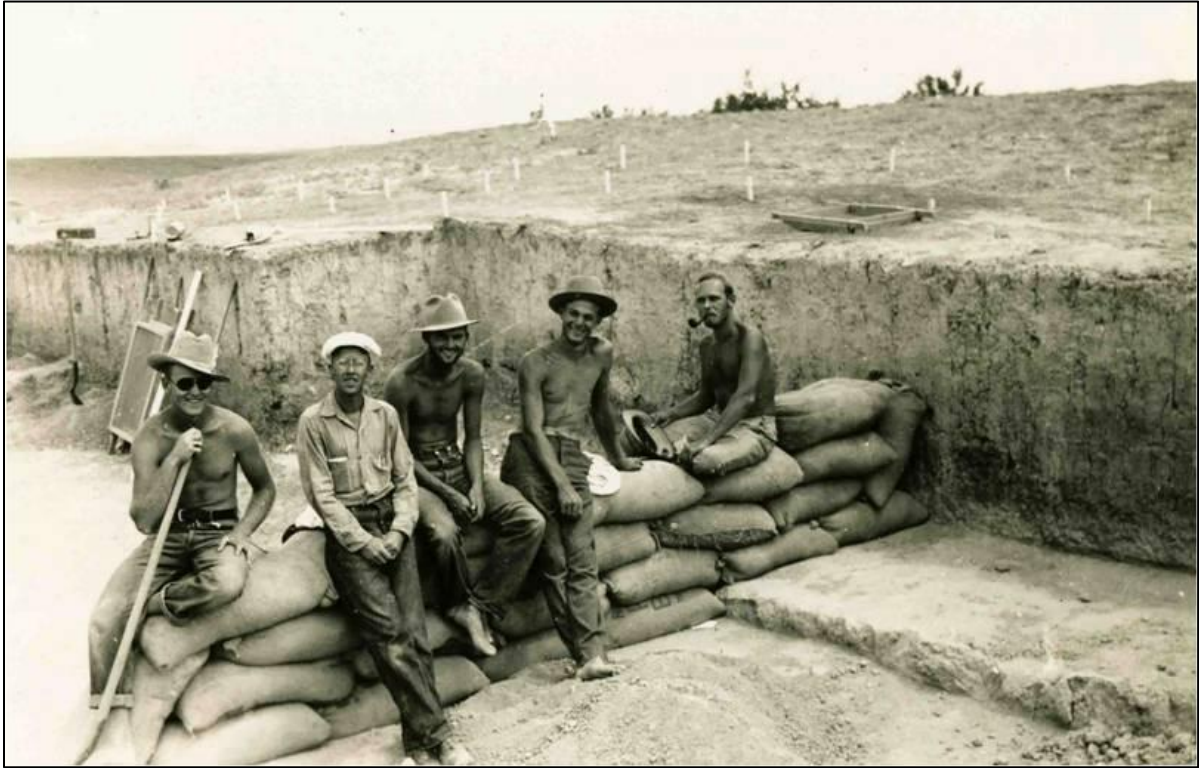
* Rounded to the nearest 1,000; acres calculated in GIS (i.e., not based on surveys).

The properties have significant biological, cultural, scenic, and recreational values identified through years of surveys. Examples include:

- One known federally-threatened species, the Colorado butterfly plant, is present on Soapstone and Meadow Springs (U.S. Fish & Wildlife Service, 2011);
- “Restricted Surface Occupancy Areas” and “Sensitive Wildlife Areas” as defined by the Colorado Oil and Gas Conservation Commission Rules, including mule deer critical winter range, elk production areas, and pronghorn winter concentration areas (Colorado Oil and Gas Conservation Commission, 2008);
- The properties are located entirely within TNC’s “Mountains to Plains” site as identified in the Central Shortgrass Prairie Ecoregional Plan (Neely, et al., 2006); and
- They lie within Colorado Natural Heritage Program “Potential Conservation Areas” that have been ranked as having “very high” and “high” biodiversity significance (Colorado Natural Heritage Program, 2011).

Furthermore, the City of Fort Collins and Larimer County have developed recreational infrastructure such as a trail network, public access, restrooms, parking lots, an entrance station, and picnic areas on two of the parcels. Most famously, Soapstone Prairie boasts a National Historic Landmark, the Lindenmeier Archaeological Site, which is

more than 12,000 years old and is the most extensive Folsom culture campsite known. Visitors to the Project Area enjoy vast vistas, in many places limited only by how far the eye can see.



Lindenmeier Archaeological Site © Unknown

ii. Subsurface ownership and values

The City and County do not appear to own any of the subsurface rights beneath the project site. Major mineral owners include the SLB and Anadarko. Several additional owners/lessees have less substantial mineral holdings throughout the parcels, with Marathon Oil being the major leaseholder at present (Table 3). The SLB holds approximately 15,000 acres in trust, primarily in the eastern half of the Project Area.

The SLB's mineral ownership lies in a checkerboard pattern, with other ownerships interspersed amongst the SLB's parcels. This non-contiguous ownership pattern prompted the SLB to support a comprehensive analysis of the entire planning area, as it would be difficult to make recommendations for the SLB parcels without considering other mineral ownership. The SLB also wanted to foster potential collaboration with other mineral owners and operators regarding future minerals development.

Table 3. Mineral ownership and leases in the Project Area (in acres, rounded to the nearest 1,000)

Subsurface minerals ownership and leases are combined from (Colorado State Land Board, 2012) and (City of Fort Collins, 2012).

Mineral Owner or Lessee	Ownership	Acres of minerals leased	Comments
SLB	15,000	0	
Federal	2,000	0	
Spencer Winn Trust	6,000	0	
Anadarko	12,000	7,000	According to the data used in this analysis, some of Anadarko leases overlap its mineral ownership. This appears to be an error in the data.
Chesapeake	0	12,000	
Marathon	0	9,000	
Cirque Res Noble	0	3,000	
DJ Resources	0	2,000	
Slawson Exploration	0	2,000	
Ichor St. Croix	0	<1000	
Rubicon	0	<1000	
Thru Line	0	<1000	
Other interests	16,000	0	
Unknown	12,000	n/a	
Total	62,000	n/a**	

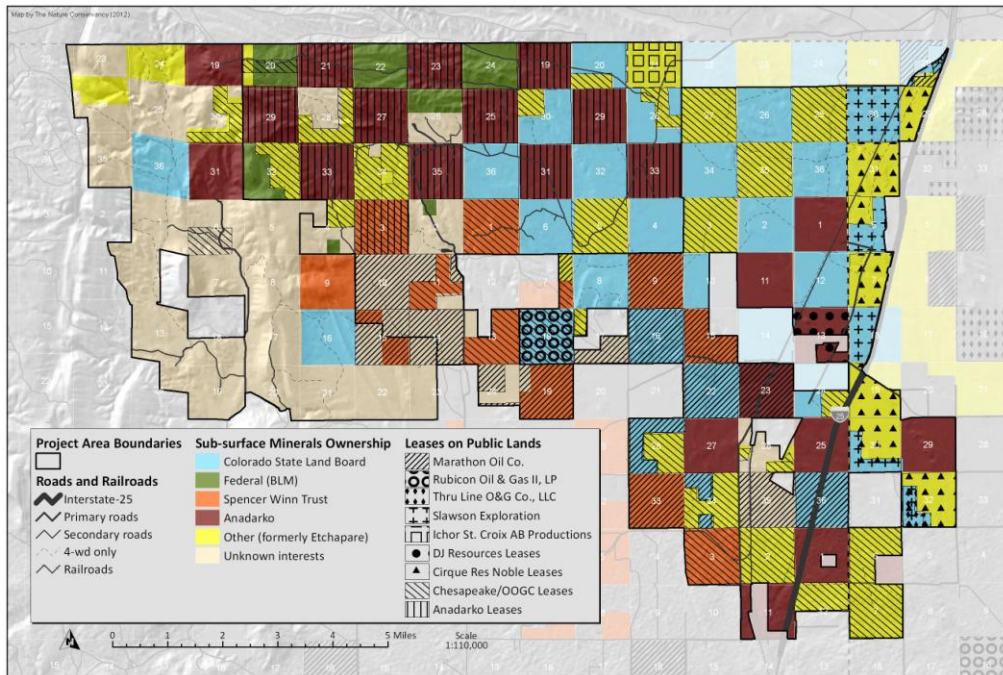
** Mineral leasing overlaps on some sections because more than one company can hold a lease on the same section. Therefore, the acres of minerals leased would not necessarily total 63,000 acres.

The oil and gas development potential of the Project Area is unproven. The development potential of the Project Area is believed to increase from west to east, with Meadow Springs having the highest potential based on at least one analysis (Map 3) (Copeland, Dougherty, Naugle, Pocerwicz, & Kiesecker, 2009). This is not surprising given that the eastern portion of the project may lie within the Niobrara Formation,⁵ which has received significant attention from oil and gas companies in the last few years due to technological advances in the capture of oil and gas in shale formations. According to the Colorado Geological Survey, there may only be one place in the Soapstone Prairie area – southeast of Round Butte - where energy companies could successfully explore for oil (Magill, 2012). That being said, oil and gas companies have recently demonstrated interest in developing the area. For example, in March 2012, a seismic company approached the City to study 20,000 acres covering much of Meadow Springs and part of Soapstone. Two months later and pursuant to previous leasing activity, Marathon Oil received approval from the Colorado Oil and Gas Conservation Commission to expand and establish new drilling and spacing units for 32 wells in the vicinity of the Project Area, several of which lie within Soapstone Prairie and Meadow Springs (Magill, 2012). In the future, technological advances and shifting global economics may allow resource capture in locales where it is currently uneconomic (Staub, 2012) (Haggerty, 2012).

⁵ The boundary of the Niobrara Formation varies depending on the source and map consulted.

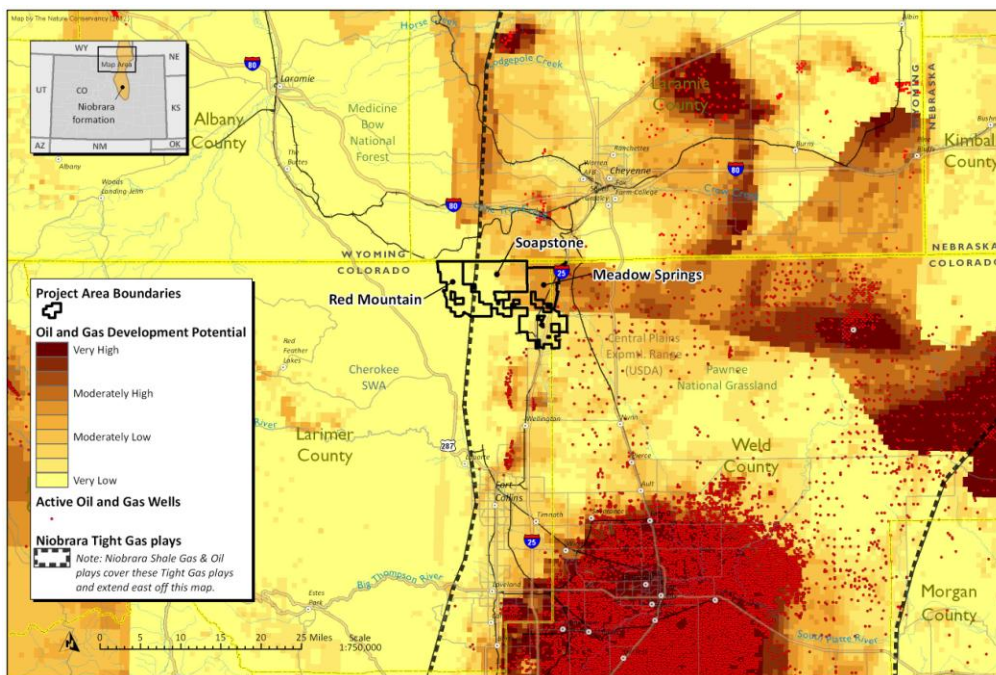
Map 2. Subsurface ownership and mineral leases

This map includes known mineral owners and lessees. Accuracy may vary; it is unclear why some parcels both show ownership and leasing by Anadarko. If parcels are blank, mineral ownership and leases are unknown.



Sources: Subsurface minerals ownership and leases combined from (Colorado State Land Board, 2012) and (City of Fort Collins, 2012).

Map 3. Oil and gas development potential in the Project Area and the surrounding vicinity



Sources: Oil and gas development potential: (Copeland, Dougherty, Naugle, Pocerwicz , & Kiesecker, 2009). Oil and Gas Wells in Colorado: (Colorado Oil and Gas Conservation Commission, 2012). Oil and gas wells in Wyoming: (Wyoming Oil and Gas Conservation Commission, 2012). Niobrara formation boundary: (Energy Information Administration, 2010).

F. PARTICIPANTS

TNC worked collaboratively with the SLB as its client, project partners including the City and County, and a technical team comprised of experts from government agencies (federal, state, and local) and conservation organizations (Table 4). The SLB formalized its relationship with TNC through a contract and with the City and County with a Memorandum of Understanding. To complete the work of the project, TNC formed several teams:

- **TNC Project Management & Science Team** – Megan Kram (Project Manager) and Jamie Robertson (GIS Manager) led the work for this project. Chris Pague (TNC Colorado Lead Scientist) and Renee Rondeau (Ecologist with the Colorado Natural Heritage Program and under contract to TNC) provided the vast majority of initial science input to the project. William Burnidge (Grasslands Program Director) provided significant input throughout. TNC's Development by Design lead, Joe Kiesecker, provided oversight. Other TNC employees stayed abreast of the project and contributed science input as well.
- **Core Team** – Thirteen representatives from the City, the County, the SLB, and TNC formed the Core Team, which provided ongoing guidance and decision-making and reviewed draft materials prior to each workshop (Table 4).
- **Technical Team** – This group of science and management experts included 41 representatives from 13 organizations (Table 4). These individuals received all Technical Team communications, volunteered their time at one or more of the Technical Team workshops, and provided input into draft methods and results for the surface occupancy areas and timing limitations. There were a total of 80 participants in three Technical Team workshops (Table 5).

The Core Team obtained **industry review** from a company with no vested interest in the Project Area. The review focused on the plan's implications to the SLB's ability to lease its holdings. The Core Team modified certain elements of the plan in consideration of this review, primarily the sections on compensatory mitigation and the disturbance cap.

The Core Team also shared information with and solicited input from the following entities:

- **SLB Commissioners and staff**
- **Elected officials and citizen boards for the City of Fort Collins and Larimer County** – The City and the County held meetings with their respective councils and commissioners to update them on the planning effort and provide opportunity for feedback.
- **General public in Larimer County and the City of Fort Collins** – The City of Fort Collins and Larimer County held a public open house on 9/10/2012 to share information about the planning effort with interested parties and to solicit their input. Participants were asked specifically about their preferences between locating wells out of sight of recreational amenities (trails, trailheads, etc.) or locating wells to best protect biological and natural resources. Given the choice, they unanimously supported the conservation of biological values as the top priority, followed by cultural and then recreational/scenic values, in that order.

Table 4. Core Team and Technical Team Members

This table includes all members of the Technical Team, which includes all individuals who participated in at least one Technical Team workshop unless otherwise noted and received all communications to the Technical Team.

Core Team members are in bold.

Organization	Name	Title or Role
City of Fort Collins	Chris Metz	Land Management Tech
	Courtney Bennett	Land Management Program Assistant
	Crystal Strouse	Natural Areas Botanist
	Daylan Figgs	Natural Areas Senior Environmental Planner
	Jennifer Ward	GIS Mapping Specialist
	Justin Scharton	Environmental Planner
Colorado Parks & Wildlife	Ron Russell	Technical Services Supervisor, Water Reclamation
	Celia Greenman	NE Region Energy Coordinator
	Mark Leslie*	Area Wildlife Manager
Colorado Natural Heritage Program	Nancy Howard	District Manager
	Pam Smith	Field Botanist/Ecologist
Colorado State University	Renee Rondeau	Team Leader and Ecologist
	Jason LaBelle	Director, Center for Mountain and Plains Archaeology. Provided the cultural data for the EBD project.
Larimer County	Jeffrey Boring	Resource Specialist
	Gary Buffington	Natural Resources Director
	Charlie Johnson	Land Agent
	Meegan Flenniken	Resource Program Manager
Legacy Land Trust	Hanna Wilbur	Intern
	K-Lynn Cameron	Director of Conservation
Marathon Oil**	Scott Park	HES Professional
	Greg Ralston	Land Professional
	Melissa Reeves	HES Supervisor
Natural Resources Conservation Service	John Fusaro	Rangeland Management Specialist
Platte River Power Authority	David Ussery	Environmental Services Manager
Rocky Mountain Bird Observatory	Arvind Panjabi*	International Program Director
	David Hanni*	Science Division Director
	Erin Youngberg	Wildlife Biologist
State Land Board	Bill Gaertner	Inventory Manager/GIS. Completed the scenic values analysis for the EBD project.
	Melissa Yoder	External Affairs Officer
	Mindy Gottsegen	Conservation Services Manager
	Pete Milonas	Minerals Director
The Nature Conservancy (global organization)	Joe Kiesecker	Global lead for Development by Design. Provided oversight for this project
	Kei Sochi	Spatial Ecologist, Development by Design Team.
The Nature Conservancy in CO	Chris Pague	Senior Scientist
	Heather Knight	Laramie Foothills Project Director
	Jamie Robertson	GIS Manager
	Megan Kram	Project Manager for this EBD project
	William Burnidge	Grasslands Project Director and project oversight
U.S. Fish & Wildlife	Paul Marinari	Fish and Wildlife Biologist

Organization	Name	Title or Role
Service	Sandy Vana-Miller	Wildlife Biologist/Platte River Specialist
	Tyler Abbott*	Deputy Field Supervisor

*Did not participate in any of the Technical Team workshops, but received all Technical Team communications.

** Marathon Oil contributed background information, including a field tour, to provide input to the Technical Team.

Table 5. Technical Team organizations and numbers of participants for each workshop

Organization	Workshop #1 (January 11)	Workshop #2 (March 29)	Workshop #3 (May 23)	Total attendees all workshops
City of Fort Collins	6	7	7	20
Colorado Parks & Wildlife	2	2	2	6
Colorado Natural Heritage Program	2	2	1	5
Colorado State University	1	1	1	3
Larimer County	2	4	2	8
Legacy Land Trust	2	0	0	2
Marathon Oil	0	3	0	3
Natural Resources Conservation Service	1	0	1	2
Platte River Power Authority	1	0	0	1
Rocky Mountain Bird Observatory	1	1	1	3
State Land Board	4	3	4	11
The Nature Conservancy	4	5	4	13
U.S. Fish & Wildlife Service	1	2	0	3
Total	27	30	23	80

PART II. RESULTS: SURFACE OCCUPANCY AREAS

The Technical Team defined and mapped four categories of “surface occupancy areas” for oil and gas development on a spectrum from No Surface Occupancy to Preferred Surface Occupancy, based on known locations of biological and cultural values. The main differences between the occupancy categories are the sensitivity and needs of the biological and cultural values and the amount and type compensatory mitigation necessary to achieve “no net loss” of biological values. The lowest sensitivity and standards are for Preferred Surface Occupancy and the highest sensitivity and standards are for No Surface Occupancy. This approach will incentivize operators to develop within occupancy categories that are least impactful to biological and cultural resources.

To create these areas, the Technical Team identified and identified and mapped cultural values and biological values, and mapped surface occupancy areas for each. The biological and cultural maps were then combined to produce the final map of surface occupancy recommendations. Definitions and standards were developed for this combined map.

A. CULTURAL VALUES AND SURFACE OCCUPANCY AREAS

Creating the surface occupancy recommendations for cultural values was much easier than doing so for biological values. Thus, this report describes the cultural values first, in order to orient the reader to the methods with a simpler example. **The cultural maps are provided separately to the SLB due to the sensitivity of the information.**

i. Targets

Colorado State University (CSU) provided all maps of cultural resources based on archaeological surveys by CSU and other researchers. To date, CSU has surveyed approximately 25% of the Project Area. These surveys were conducted in an intensive manner, with archaeologists walking the ground 30 meters (~90 feet) apart from each other. Surveys have unearthed an abundance of cultural resources including but not limited to arrowheads and other tools, cooking hearths and other heat-related features, and stone circles (tipi rings).

Given the number of cultural sites discovered, CSU identified each cultural site as very high, high, medium, or low priority based on the type, condition, sensitivity, and rarity of the resources found there. Examples of very high priority cultural resources include the Lindenmeier site and those sites containing fire pits and other features that could be used to date the site as well as provide solid evidence of past ways of life. Examples of low priority cultural resources include “lithic scatters,” which represent simple stone tool manufacturing locales, revealing little more about the ancient past. Under the advice of CSU, the Technical Team included all very high and high ranked cultural sites as NSO targets. Of the 518 mapped cultural sites in the Project Area, CSU ranked 158 as very high priority, 23 as high priority, 134 as medium priority, and 203 as low priority. Most of the high-ranked sites include stone circles, hearths or fire pits, or other types of artifacts that would likely yield significant information for detailing the ancient “prehistoric” Native American record of the region.

ii. Surface occupancy areas

The Technical Team identified four categories of surface use for cultural values:

- No Surface Occupancy: The Lindenmeier site plus a one-mile buffer around it, and all surveyed, very high and high priority sites plus a 50 meter buffer around each. The Technical Team included the one-mile buffer around Lindenmeier because only a small part of the area has been surveyed. The full extent of the resources in this area is unknown.
- Limited Surface Occupancy: Areas not surveyed but that contain known sites with undetermined importance.
- Controlled Surface Occupancy: Areas not surveyed or surveyed areas/sites with lower importance (i.e., all areas not otherwise designated as NSO, LSO, or PSO)
- Preferred Surface Occupancy: None (determined by disturbance only)

No Surface Occupancy determined by cultural values comprises 7.5% of the Project Area, with the Lindenmeier site plus its one-mile buffer accounting for 3,675 acres (77%) of the NSO. Limited Surface Occupancy comprises less than 2%. Controlled Surface Occupancy covers all the remaining land within the Project Area. No portion of the Project Area was identified as Preferred Surface Occupancy because cultural resources are unknown in most locales (Table 6).

Table 6. Surface occupancy map for cultural priorities ONLY: Acres and % Project Area by occupancy type

Surface Occupancy Type	Acres	% Project Area
PSO	0	0
CSO	57,924	90.7
LSO	1,153	1.8
NSO	4,765	7.5
TOTAL	63,842	100.0

B. BIOLOGICAL VALUES AND SURFACE OCCUPANCY AREAS

Creating the surface occupancy recommendations for biological values was much more complicated than doing so for the cultural values. The Project Area has been well-surveyed for biological values. The wealth of available biological data came from many sources and differences between data sources needed to be resolved. Furthermore, different species, plant communities, and ecological systems respond differently to oil and gas development and therefore have different needs for avoidance and minimization. All of this information was considered to form this science-based plan.

i. Targets

The TNC Project Management & Science Team drafted an initial set of biological values based on available GIS data layers from sources including: City of Fort Collins, Colorado Natural Heritage Program, Colorado Parks & Wildlife (formerly Colorado Division of Wildlife), Larimer County, Rocky Mountain Bird Observatory, Southwest ReGAP, and U.S. Fish & Wildlife Service. From these sources, there were 126 unique data layers that could be used

to develop targets for protection. The Technical Team narrowed this list to 45 targets including 10 ecological systems, 2 plant communities, and 33 species (Figures 2 and 3, Maps 4 and 5) using the following methods:

- Ecological systems – Created a simple and manageable set of 10 ecological systems, including three aquatic systems and seven terrestrial systems, by reclassifying or combining 21 unique ecological systems from the Southwest Regional Gap Analysis Project (Southwest ReGAP) landcover dataset (U.S. Geological Survey, 2004); ponderosa pine systems data from the City and County; and aquatic systems from the City, County, and National Hydrological Dataset Plus (U.S. Environmental Protection Agency, 2006). For example, Inter Mountain Basins Mixed Salt Desert Scrub and Inter Mountain Basins Semi-Desert Shrub Steppe were each reclassified as Salt Desert Scrub.
- Plant communities – Plant communities tracked by CNHP were considered as potential targets. Tracked plant communities generally occupy less than 1,000 acres, represent a relatively unique combination of plant species, and often include high-quality occurrences within a common system. Of the 16 tracked plant communities in the Project Area, plus two that CNHP does not track (a pinyon pine site and choke cherry/plum thickets) the list was narrowed to two targets (Rondeau, 2012).
- Species – All species represented by a spatial data layer were considered as possible targets, from common species and habitats such as geese winter range, to rare species and habitats such as the Colorado butterfly plant. The list was reduced from 87 potential targets to 33 chosen targets. In general, the Technical Team selected species as targets if they met at least one of the criteria below:
 - Included in the Colorado Oil & Gas Rules (Colorado Oil and Gas Conservation Commission) (Colorado Oil and Gas Conservation Commission, 2008);
 - Included in the State Wildlife Action Plan as Tier 1 or Tier 2 species (Colorado Division of Wildlife, 2006);
 - City/County priority or conservation target in applicable management plans (City of Fort Collins, 2007) (Larimer County, 2007);
 - Rare as ranked by NatureServe (NatureServe); and/or
 - Included as a target in The Nature Conservancy’s Central Shortgrass Prairie Ecoregional Plan (Neely, et al., 2006).

In some cases, the Technical Team deviated from these criteria, either by including species that did not meet the above criteria or vice-versa. For example, Red Mountain Open Space has a small population of extremely rare canyon ferns that were added as a target, even though they did not meet the criteria. Similarly, the Technical Team excluded the roosting habitat for the fringed myotis (a bat species) because none have been found in the Project Area through mist-netting surveys, although the Project Area lies within the bat’s habitat range.

See Appendix 1 for more information about each of these targets, including justification for their selection.

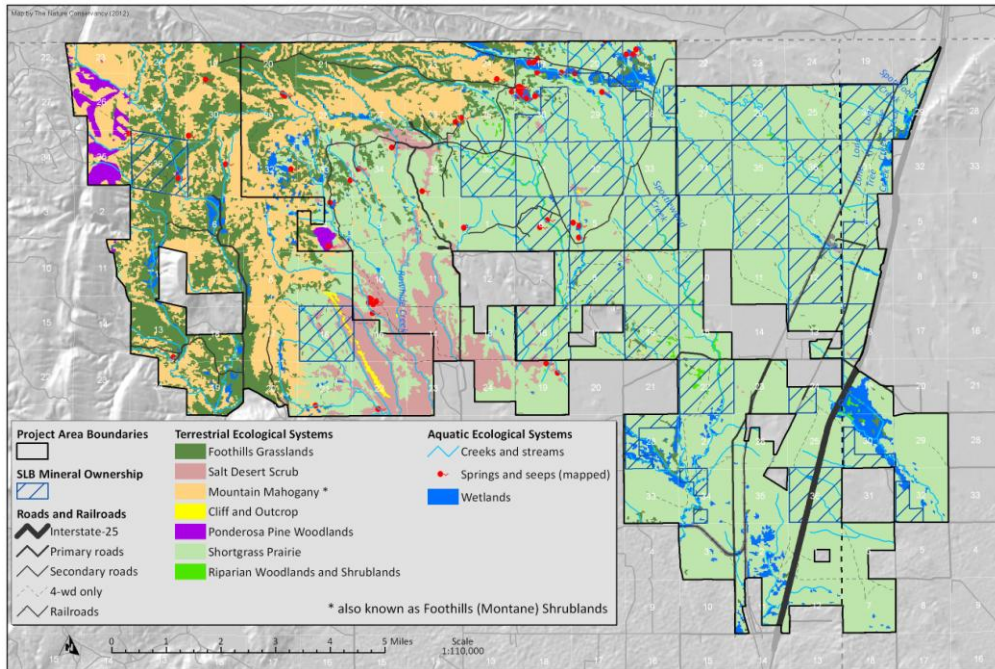
A map was created to spatially represent each target based on the best available data (Maps 4 and 5). Map data sets were combined or modified to make each target map as complete as possible, and/or to narrow the habitat extent to the most important places. For example, ponderosa pine data sets from Southwest ReGAP and the County were combined; seeps and springs were added to the Southwest ReGAP layer based on historic topographic maps; and the chestnut collared longspur habitat layer from Rocky Mountain Bird Observatory was narrowed to include only the breeding areas. The only data layers that were modeled were for the McCown’s longspur and lark bunting core areas, which Rocky Mountain Bird Observatory created based on survey observations.

Figure 2. Biological targets

The Technical Team identified 45 targets including 10 ecological systems, 2 plant communities, and 33 species.

<u>ECOLOGICAL SYSTEMS</u>	<u>SPECIES, CONTINUED</u>
<p>Aquatic</p> <ul style="list-style-type: none"> Creeks and streams Seeps and springs Wetlands <p>Terrestrial</p> <ul style="list-style-type: none"> Cliffs and outcrops Foothills grasslands Mountain mahogany [aka Foothills (Montane) Shrublands] Ponderosa pine woodlands Riparian woodlands and shrublands Salt desert scrub Shortgrass prairie <p><u>PLANT COMMUNITIES</u></p> <ul style="list-style-type: none"> Foothills ponderosa pine savannas (<i>Pinus ponderosa</i> / <i>Leucopoa kingii</i> Woodland) Western slope grasslands (<i>Krascheninnikovia lanata</i> / <i>Pascopyrum smithii</i> - <i>Bouteloua gracilis</i> Dwarf-shrub Herbaceous Vegetation) <p><u>SPECIES</u></p> <p>Amphibians</p> <ul style="list-style-type: none"> Northern leopard frog <p>Birds – Raptors</p> <ul style="list-style-type: none"> Bald eagle nests and winter roosts Ferruginous hawk nests Golden eagle nests Prairie falcon nests Swainson's hawk nests Owls and other raptor nests Western burrowing owl nests 	<p>Birds - Other</p> <ul style="list-style-type: none"> Chestnut-collared longspur breeding areas Lark bunting core areas McCown's longspur core areas Mountain plover staging areas and nests <p>Fish</p> <ul style="list-style-type: none"> Iowa darter <p>Fungus</p> <ul style="list-style-type: none"> <i>Smithiomyces crocodilinus</i> <p>Insects</p> <ul style="list-style-type: none"> Aquatic insects Colorado blue (butterfly) <p>Mammals</p> <ul style="list-style-type: none"> Black-footed ferret (captive population) Black-tailed prairie dog Swift fox dens Elk production areas Elk winter concentration areas Mule deer critical winter range Mule deer severe winter range Pronghorn winter concentration area <p>Rare Plants</p> <ul style="list-style-type: none"> <i>Agrimonia striata</i> Colorado butterfly plant (<i>Oenothera coloradensis</i> ssp. <i>Coloradensis</i>) Hops (<i>Humulus lupulus</i> subsp. <i>neomexicanus</i>) Large Indian breadroot (<i>Pediomelum esculentum</i>) Pale blue-eyed grass (<i>Sisyrinchium pallidum</i>) Prairie goldenrod (<i>Oligoneuron album</i>) Purple spikerush (<i>Eleocharis atropurpurea</i>) Rare canyon ferns Slender wildparsley (<i>Musineon tenuifolium</i>)

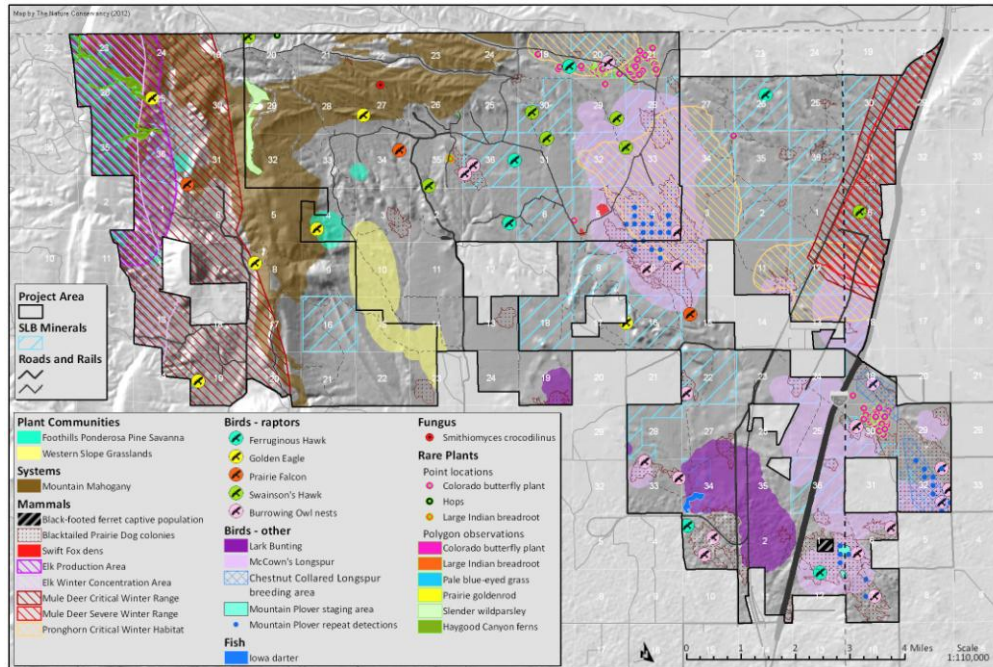
Map 4. Biological values - Ecological system targets



Sources: Aquatic ecological systems: Creeks and streams (U.S. Environmental Protection Agency, 2006); seeps and springs (Larimer County Natural Resources Department, 2011) and (City of Fort Collins Natural Areas Department, 2011) – based on ground-truthed observations from topographic maps; wetlands (U.S. Environmental Protection Agency, 2006) as modified by the City and County. Terrestrial ecological systems: All from (U.S. Geological Survey, 2004) except ponderosa pine, which was from (Larimer County Natural Resources Department, 2007) and (City of Fort Collins Natural Areas Department, 2007).

Map 5. Biological values – Species and plant community targets

This map shows all species and plant communities for which mapped data was available. No maps were available for the following targets: aquatic insects, northern leopard frog, bald eagle nests and winter roosts, owls and other nesting raptor nests, and plants including *Agrimonia striata* and purple spikerush. Mountain plover nests are represented as repeat detection areas, within which the nests themselves are found.



Sources: Plant communities: (Colorado Natural Heritage Program, 2012). Mammals: Black footed ferret captive population (The Nature Conservancy, 2012); black-tailed prairie dogs (City of Fort Collins Natural Areas Department, 2007) and (Larimer County Natural Resources Department, 2007) - the City used its 2007 maximum extent layer before plague reduced acreage, the City has data through 2012 and the colonies are nearly back to the 2007 acreage; swift fox dens (City of Fort Collins Natural Areas Department, 2007-2012) (Colorado Natural Heritage Program, 2012); elk production area and elk winter concentration area (Colorado Parks & Wildlife , 2011); mule deer critical winter range and mule deer severe winter range (Colorado Parks & Wildlife , 2011); pronghorn critical winter range - updated by the City from (Colorado Parks & Wildlife , 2011); birds-raptors – combined data from (City of Fort Collins Natural Areas Department, 2007-2012) (Larimer County Natural Resources Department, 2011) (Colorado Natural Heritage Program, 2012) (Rocky Mountain Bird Observatory, 2012); birds-other - (Rocky Mountain Bird Observatory, 2012); fish - Iowa darter (City of Fort Collins Natural Areas Department, 2008, 2010); rare plants – all combined from (City of Fort Collins Natural Areas Department, 2007-2011) and (Colorado Natural Heritage Program, 2012); Fungus (Colorado Natural Heritage Program, 2012); Colorado blue butterfly (City of Fort Collins Natural Areas Department, 2007) – City conducted surveys in 2004 and 2007, but the Colorado blue were found only in 2007.

Figure 3. Photos of Select Biological Targets

Photos were taken from within the Project Area where noted.

Ecological systems



Shortgrass prairie in Project Area ©Meegan Flenniken



Salt desert scrub ©CNHP



Foothills grasslands ©CNHP



Wetland in Project Area © Crystal Strouse

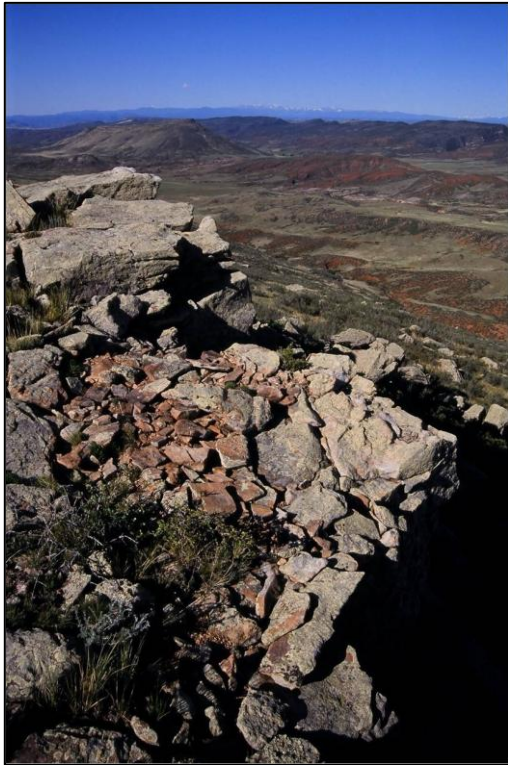


Mountain mahogany ©CNHP



Ponderosa pine woodlands ©CNHP

Ecological systems, continued



Cliff and outcrops in Project Area ©Meegan Flenniken



Riparian woodlands and shrublands ©Joel Nystrom

Rare plant communities



Ponderosa pine savannas in Project Area © Crystal Strouse

Birds



Bald eagle © Scott Copeland



Swainson's hawk © Flickr/USFWS Mtn. Prairie



Lark bunting © Magill Weber/TNC



Burrowing owl © Paul Berquist



Ferruginous hawks © Jim Watson/
Washington Dept. of Fish and Wildlife

Mammals



Swift fox © Flickr/USFWS Mountain Prairie



Black-tailed prairie dog © Rurik List



Black-footed ferret in Project Area (captive population)
© Erik Rudolph



Pronghorn antelope in Project Area
© Meegan Flenniken



Mule deer © Scott Copeland



Elk © John Morrow II

Amphibian



Northern leopard frog

Fish



Iowa darter © Flickr/
Wisconsin Department of Natural Resources

Rare plants



Colorado butterfly plant in Project Area
© Crystal Strouse



Slender wildparsely in Project Area © Crystal Strouse

Fungus



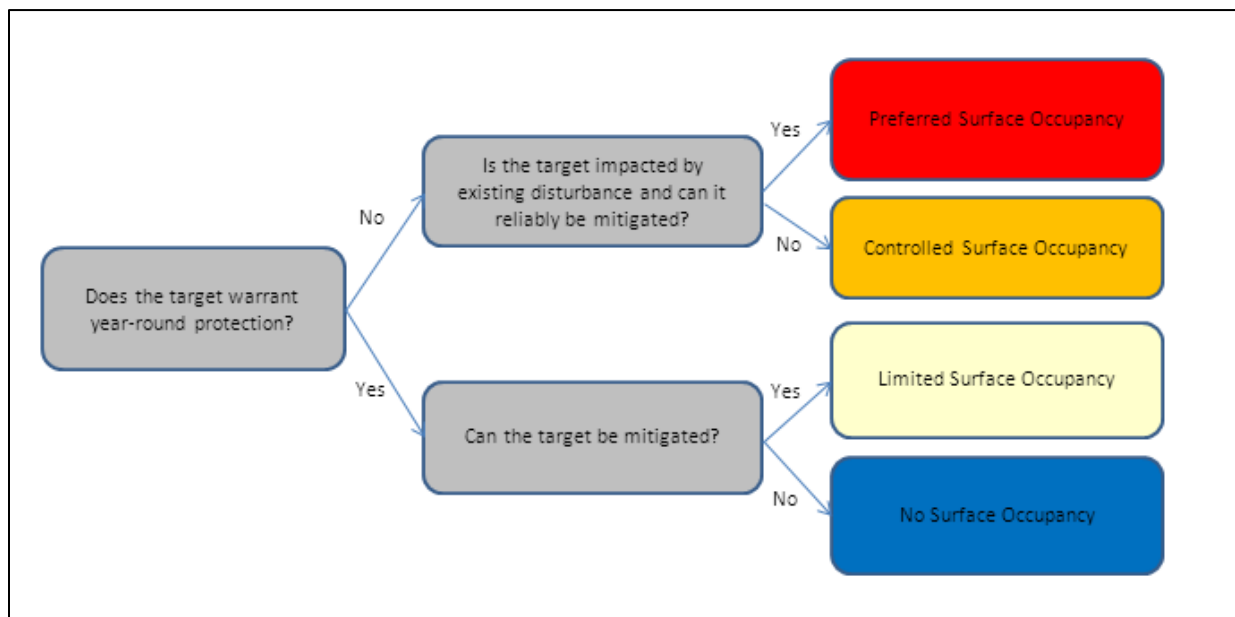
Smithiomyces crocodilinus © Rob Hallock

ii. Surface occupancy areas

The Technical Team mapped the biological values into the surface occupancy categories as described below, using the decision tree shown in Figure 4:

- **No Surface Occupancy:** Targets and surrounding buffers (as needed) that warrant *permanent, year-round protection* from new surface disturbance except for temporary low impact uses such as geophysical studies because impacts to them *cannot successfully be mitigated* through restoration or land protection. The ability to “successfully mitigate” a target is defined by its irreplaceability (whether it is possible to restore or recreate the target); financial practicality (whether it is possible to recreate, restore, or conserve the target elsewhere with reasonable funding relative to the conservation benefits); and timeframe (whether it is possible to recreate, restore, or conserve the targets elsewhere, within biologically-meaningful timeframes of 30-50 years).
- **Limited Surface Occupancy:** Targets and surrounding buffers (as needed) that warrant year-round protection, but not necessarily *permanent* protection from new surface disturbance because they can be mitigated -- they are *not* irreplaceable, mitigation *is* financially feasible, and they *can* be restored within biologically reasonable timeframes.
- **Controlled Surface Occupancy:** All areas that do not fall into one of the other categories. Biological values also exist throughout CSO areas, but they do not need year-round protection from new surface disturbance and can be mitigated.
- **Preferred Surface Occupancy:** Areas in which surface occupancy is preferred from a biological perspective due to previous and existing disturbances such as roads and transmission lines.

Figure 4. Decision tree for assigning surface occupancy to biological targets



a. *No Surface Occupancy and Limited Surface Occupancy Areas for biological values*

Mapping NSO and LSO areas for biological resources entailed two steps:

1. Identifying targets and surrounding buffers (as needed) warranting year-round avoidance of oil and gas activities;
2. For each target warranting year-round avoidance, identifying feasibility of compensatory mitigation success and categorize as NSO or LSO accordingly.

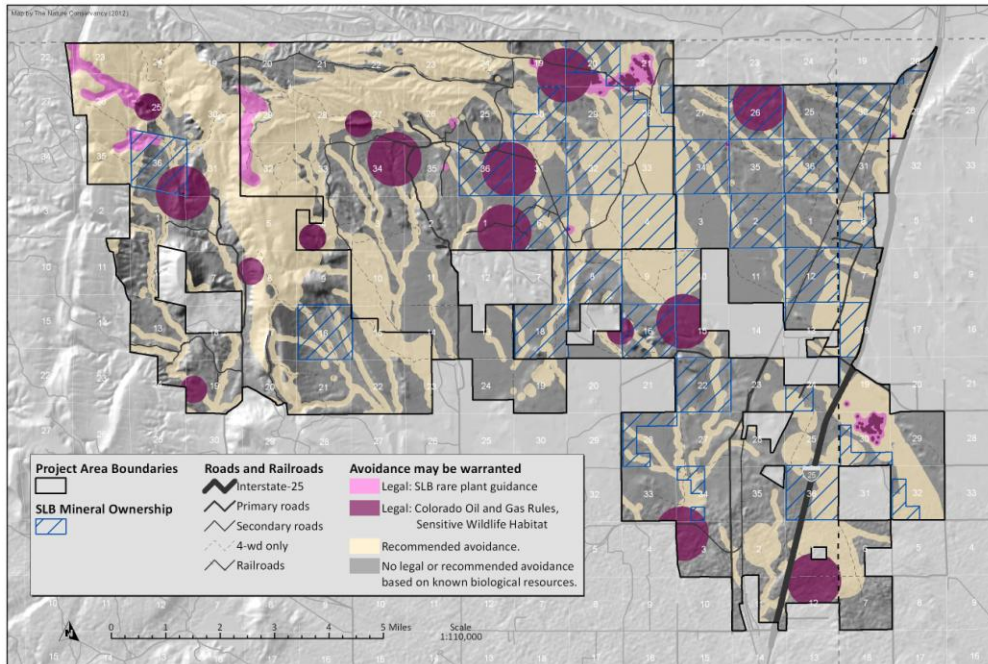
Both steps are described below. In order to explain these steps as simply as possible, this section includes results for a subset of the targets including wetlands, mountain mahogany, shortgrass prairie, ferruginous hawk nests, swift fox dens, and the Colorado butterfly plant. Appendix 3 includes results for all targets.

Step 1. Identify targets and surrounding buffers warranting year-round avoidance from oil and gas activities.

Aquatic systems, plant communities, and some of the species were buffered to capture areas warranting some degree of year-round avoidance of oil and gas activities. The TNC Project Management & Science Team first documented possible avoidance buffers and identified any inconsistencies amongst them from the Colorado Oil and Gas Conservation Commission Rules (Colorado Oil and Gas Conservation Commission, 2008), various Best Management Practices pertaining to Colorado or nearby surrounding states, and expert opinion from members of the Technical Team. The Technical Team resolved any inconsistencies and made recommendations to the SLB. In many cases, sources were consistent. For example, none of the sources consulted recommended year-round avoidance for swift fox dens. In other cases, sources consulted differed in their recommendations. For example, ferruginous hawk avoidance recommendations ranged from 1/5 mile - 1/2 mile from nests. Wetland avoidance recommendations also varied widely in terms of where to measure the buffer (i.e., from legal edge vs. ordinary high water mark) and how large the buffer should be (i.e., distances ranging from 50 ft-300 ft.).

Additionally, the Technical Team differentiated between buffers established by legal requirements and those established by technical recommendations, termed “recommended avoidance” within this document. *Legal requirements* and organizational policies included Restricted Surface Occupancy Areas from the Colorado Oil and Gas Conservation Commission Rules (Colorado Oil and Gas Conservation Commission, 2008) and SLB Procedures for Rare Plant Environmental Review for Development Projects and Land Use Changes (Colorado State Land Board, 2012). *Recommended avoidance* refers to any avoidance areas above and beyond the legal requirements that the Technical Team determined to be biologically necessary and scientifically justifiable (Map 6).

Map 6. Biological values – Legal and additional recommended areas warranting year-round avoidance (input to No Surface Occupancy and Limited Surface Occupancy maps for biological values)



Source: “Legal” areas are Restricted Surface Occupancy areas from the COGCC rules (Colorado Oil and Gas Conservation Commission, 2008). “Recommended” areas are from the Mountains to Plains Energy by Design Technical Team.

Step 2. For each target warranting year-round avoidance, identify feasibility of mitigation success

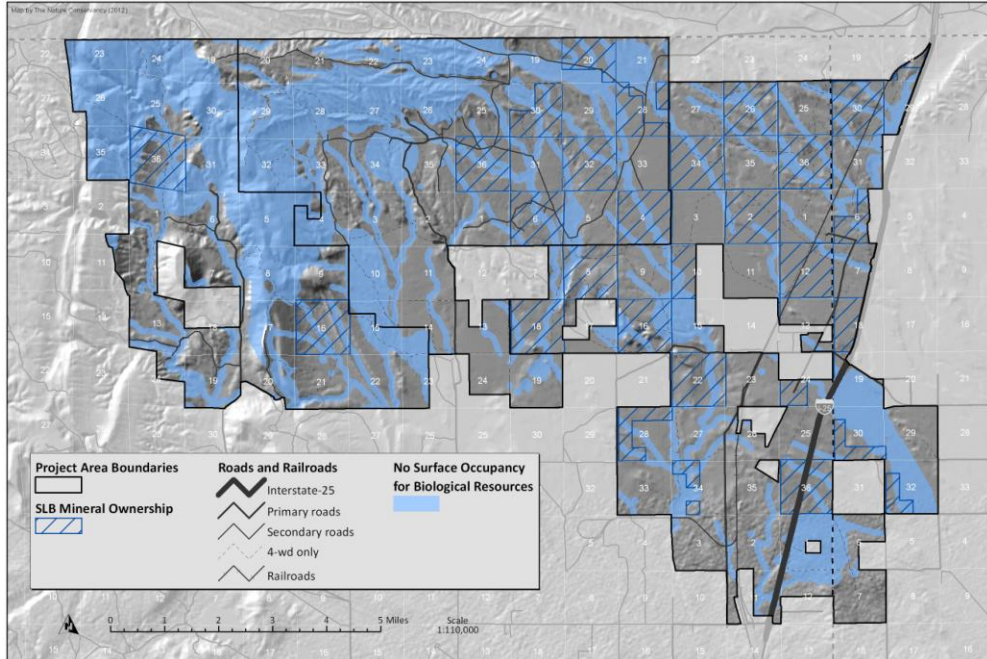
The feasibility of compensatory mitigation refers to the potential to successfully achieve no net loss of a target through re-creation, restoration, or conservation activities. Feasibility of mitigation was based on the following criteria:

- **Irreplaceability** – Due to their rarity or sensitivity, some targets cannot be restored or recreated, no matter how many resources are dedicated to the effort. Such values can be deemed “irreplaceable.” For example, golden eagle nests are irreplaceable. One could create an artificial nest for an eagle and attempt to fledge offspring in it, but the likelihood of success is extremely low and the likelihood of failure extremely high.
- **Financial practicality** – It may be possible to recreate, restore, or conserve some targets elsewhere, but only with exorbitant resources relative to the conservation gains. For example, it may not be financially practical to buy senior water rights to protect rare fish.
- **Reasonable timeframe** – It is possible to recreate, restore, or conserve elsewhere but not within a reasonable timeframe. Conservation actions must be predictably permanent within a specified timeframe. For the purpose of this analysis, we chose 5-20 years as the “reasonable timeframe.” As an example, it may take 50-100 years to restore mountain mahogany – thus, by definition, replacement of mountain mahogany cannot occur within a reasonable timeframe and therefore it cannot be mitigated (Rondeau, 2012).

Targets warranting avoidance were then classified as No Surface Occupancy or Limited Surface Occupancy depending on the likelihood of mitigation success. If a target warranted avoidance and *could not* be mitigated, it

was classified as No Surface Occupancy (Map 7). If a target warranted avoidance but *could* be mitigated, it was classified as Limited Surface Occupancy (Map 8). If a target did not warrant avoidance, it was classified either as Controlled Surface Occupancy or Preferred Surface Occupancy (see next two sections). See examples in Table 7.

Map 7. Biological values – No Surface Occupancy (input to final biological map)



Map 8. Biological values – Limited Surface Occupancy (input to final biological map)

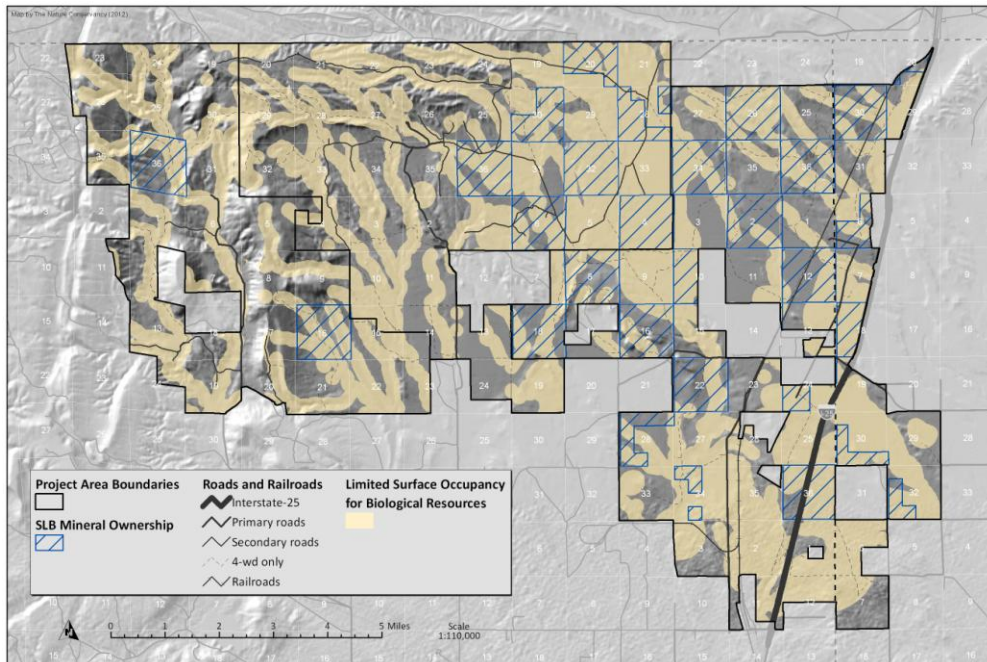


Table 7. Identification of No Surface Occupancy and Limited Surface Occupancy for sample biological targets

Target	Is year-round avoidance warranted?	Can the target be mitigated?	NSO - avoidance warranted but <i>cannot be mitigated</i>	LSO - avoidance warranted and <i>can be mitigated</i>
ECOLOGICAL SYSTEMS				
Wetlands	Legal: No Recommended: Yes - 0-300 ft. (0-100 m.) from the legal edge should be true avoidance. 300-600 ft. (100-200 m.) should generally be avoided, but negotiation may be possible.	No ⁶	0-300 ft. (0-100 m.) from the legal edge	300-600 ft. (100-200 m.) from the legal edge. Surface occupancy within this area is contingent on survey findings.
Mountain Mahogany	Legal: No Recommended: Yes – avoid large and intact patches	No	All but 300 ft. (100 m.) from existing disturbance	0-300 ft. (0-100 m.) from existing disturbance
Shortgrass Prairie	Legal: No Recommended: No	Yes	No	No
SPECIES				
Ferruginous hawk nests	Legal: 1/2 mile from active nests (Colorado Oil and Gas Conservation Commission, 2008) Recommended: Yes - 1/2 mile from alternate nests (Colorado Division of Wildlife, 2012) and other sources.	Yes – some tree nests could be “replaced” elsewhere	No	1/2 mile from active and alternate nests
Swift fox dens	Legal: No Recommended: No	Yes – could protect and manage elsewhere	No	No
Colorado butterfly plant and other rare plants	Legal: Yes - Avoid federally listed species and those that CNHP has rated as globally or critically imperiled (G1 or G2) (Colorado State Land Board, 2012) Recommended: Yes - Avoid all rare plants (incl. but not limited to those addressed by the SLB policy) by 0-300 ft. (0-100 m.) as true avoidance and by 100-200m. (300-600 ft.) as avoid, but negotiation may be possible (Elliott, et al., 2009) (Colorado State Land Board, 2012)	No – Easily avoided and the Colorado butterfly plant is a federally listed species	0-300 ft. (100 m)	300-600 ft. (100-200 m)

⁶ While it is possible to create new wetlands elsewhere, restoration to achieve no net loss including the soils, microbiota, etc. is not feasible within a reasonable timeframe (5-20 years). Also, wetlands harbor a disproportionately large portion of the fauna and flora of any area.

b. Controlled Surface Occupancy for biological values

CSO areas include all of the places that were not categorized as NSO, LSO, or PSO. These areas are still relatively intact in the Mountains to Plains Project Area, but are less sensitive than NSO and LSO areas based on known biological values.

c. Preferred Surface Occupancy for biological values

Preferred Surface Occupancy areas for biological resources are the locations where oil and gas development is preferred *from a biological perspective* due to the presence of previous and existing disturbance. The TNC Project Management & Science Team gathered available mapped layers of disturbance features such as roads, buildings, and corrals from the City and County and in consultation with the Technical Team, decided which to include in the analysis (Figure 5, Map 9). For example, existing roads were included in the analysis as they fragment ecological systems and their use for oil and gas development eliminates habitat fragmentation caused by new roads. By contrast, recreational trails were excluded from the analysis based on the Technical Team’s determination that they did not significantly impact ecological systems and were not appropriate for oil and gas development because of scenic and recreational impacts. Appendix 2 contains detailed information about data sources and rationale for including/excluding existing disturbances in the analysis.

Figure 5. Existing Infrastructure and disturbance in the Project Area and its inclusion or exclusion in the impact analysis

Included in the impact analysis	Not included in the impact analysis
Activities outside Project Area (e.g. homes, power plant) Buildings Cell or radio tower Corrals Historic buildings Irrigated areas Parking lots Quarry Roads Sheep barns Sludge headquarters facilities/building Stock water piping Stock/water tanks Trailheads Transmission lines (above ground) Transmission lines (buried)	Buried gaslines Water diversions Fencelines Gates Invasive species Pastures Reservoirs Recreational trails Stock water valves Windmills

The PSO category is based on direct and indirect impacts of existing infrastructure to biological values. In the Project Area, the direct impact (i.e., footprint) totals 1.8% of the Project Area (Table 8). The *footprint* is the

approximate spatial extent of the direct disturbance caused by infrastructure, such as the paved or cleared area for a road or the outline of a building.

Infrastructure can also cause *indirect impacts* beyond the footprint. For example, invasive species are more likely to be found along roads than in areas without roads. As another example, a natural surface road may have little vehicle traffic, but windblown dust can impact biological targets away from the actual road bed. Two ways can be used to assess indirect impacts to biological values: Assessing the impact to individual species and particular ecological systems (e.g., the impact of a road on a wetland vs. on a bald eagle nest) or adopting assumptions about impacts to species and systems as a whole. For this project, the Technical Team chose the latter option.

To quantify the indirect impacts, the following assumptions were made:

- Impacts decrease as distance from the infrastructure increases. In other words, the farther the distance is from the footprint (i.e., direct impact), the lesser the impact. For example, the impacts from Interstate-25 (I-25) will be far greater 10 feet away from the road footprint than one mile away.
- Different infrastructure impacts biological values at varying distances and to varying degrees beyond their footprint. For example, I-25 has far greater direct and indirect impacts than rarely used ranch roads.
- Where multiple infrastructure impacts overlap, the cumulative impact is the sum of those overlapping impacts.⁷

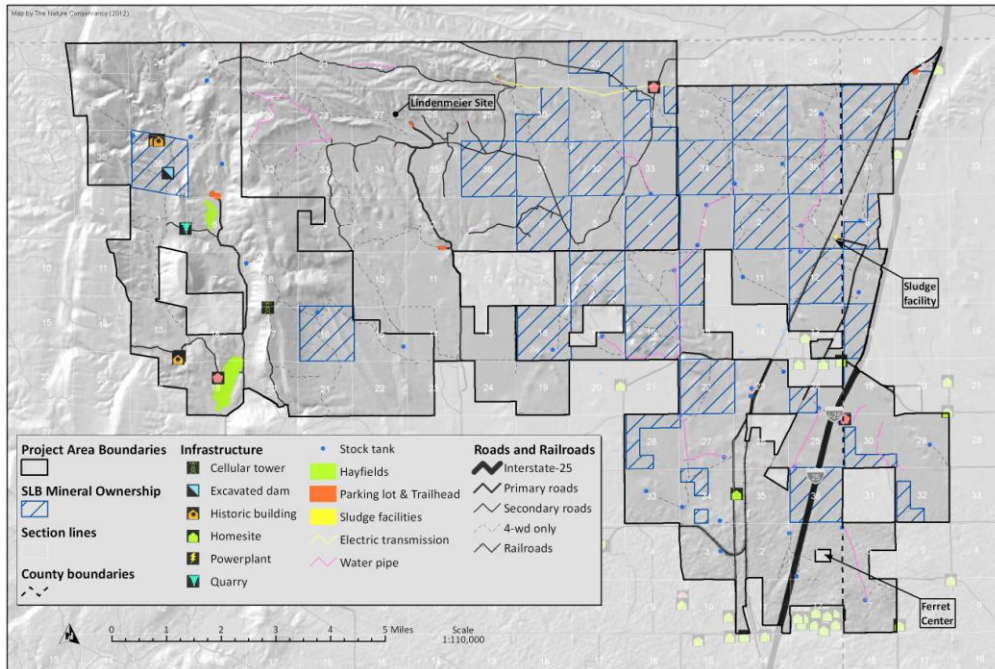
Based on these assumptions, cumulative impacts were mapped across the Project Area. Over eighty percent (80%) of the Project Area was either subject to low impacts or free from impacts to biological values. Eleven percent (11%) of the Project Area was moderately impacted, while five percent (5%) was highly impacted (Table 8, Map 10). The high and moderate impacts were used as potential Preferred Surface Occupancy areas (Map 11).

Table 8. Existing infrastructure and associated impacts

Impact Level	Acres	% Project Area	Notes
Direct impacts total (i.e., footprint)	1,151	1.8%	This is the area of the actual disturbances, not including their biological impacts beyond their direct footprint.
Indirect impacts			
High	3,164	5.0%	High and moderate impacts were designated as Preferred Surface Occupancy areas. The high indirect impacts include the direct impacts.
Moderate	7,362	11.5%	
Low	19,231	30.1%	
None or Negligible	34,086	53.4%	
Indirect impacts total	63,843	100%	

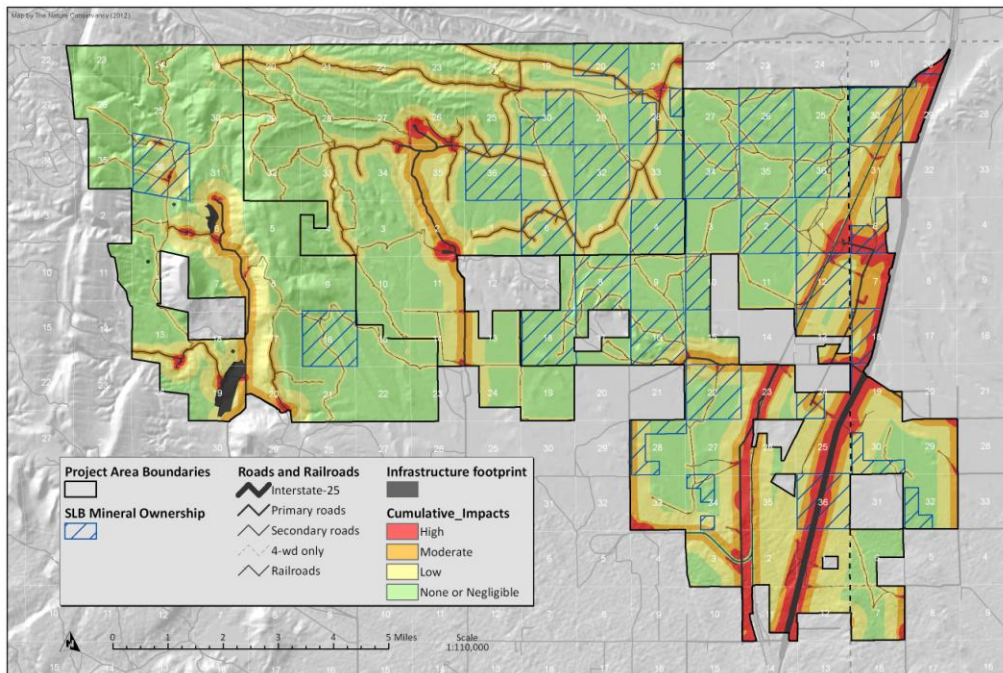
⁷ Methods developed for the Central Shortgrass Prairie Ecoregional Assessment (CSP) were used to calculate the spatial extent of indirect impacts using a distance decay function (Neely, et al., 2006). This decay function required input variables describing maximum distance of impacts, type of curve (i.e. whether impacts decrease abruptly or gradually), and a weight (i.e. maximum impact value). For each infrastructure type, results of the decay functions were represented spatially in rasterized continuous values with a 5 meter cell resolution. The rasters were then added together to create a final raster of cumulative impacts of all infrastructure. The final cumulative impact scores were categorized into four groups (None or Negligible, Low, Moderate, and High/Very High) equivalent to those in the CSP.

Map 9. Biological values – Existing infrastructure and disturbances (input to Preferred Surface Occupancy)



Sources: Roads - outside of the Project Area boundary (U.S. Census Bureau, 2006); within the Project Area boundary (U.S. Census Bureau, 2006) (City of Fort Collins Natural Areas Department, 2012) (Larimer County Natural Resources Department, 2011). Infrastructure – cellular tower, evacuated dam, historic buildings, home sites, powerplant, and quarry (The Nature Conservancy, 2012) (City of Fort Collins Natural Areas Department, 2012) (Larimer County Natural Resources Department, 2011); hayfields (Larimer County Natural Resources Department, 2007).

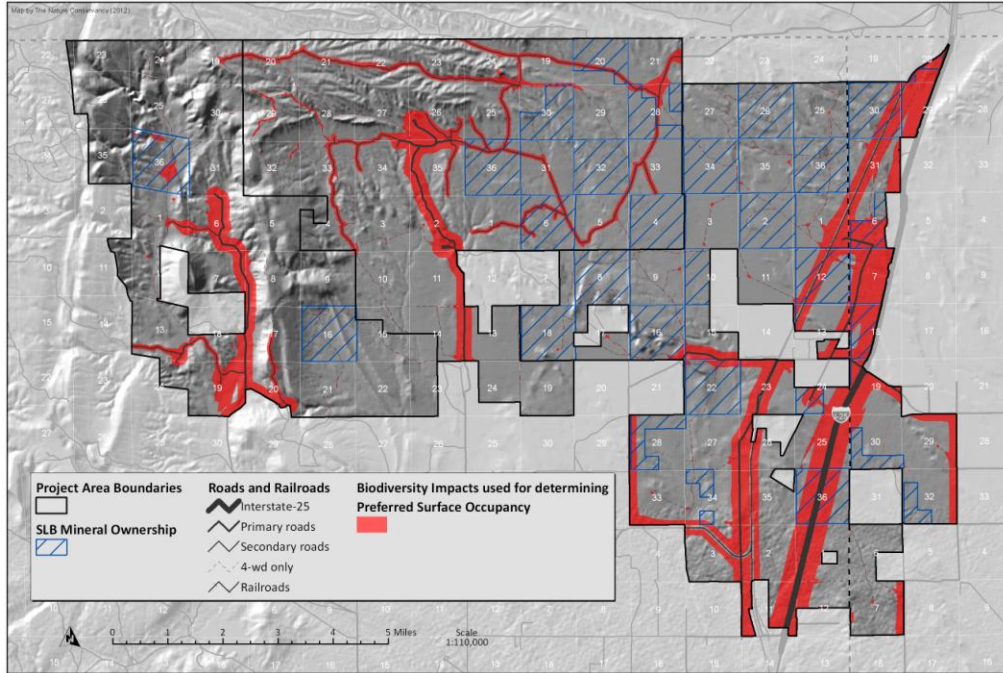
Map 10. Biological values - Cumulative impacts based on existing infrastructure and disturbances (input to Preferred Surface Occupancy)



Source: The Nature Conservancy based on methods from the Central Shortgrass Prairie Ecoregional Plan (Neely, et al., 2006).

Map 11. Biological values – Preferred Surface Occupancy (input to final biological map)

This map combined the moderate and high cumulative impacts from the previous map to create the final potential Preferred Surface Occupancy Areas. “Potential” is used because these areas could be “trumped” by No Surface Occupancy and Limited Surface Occupancy areas once combined.



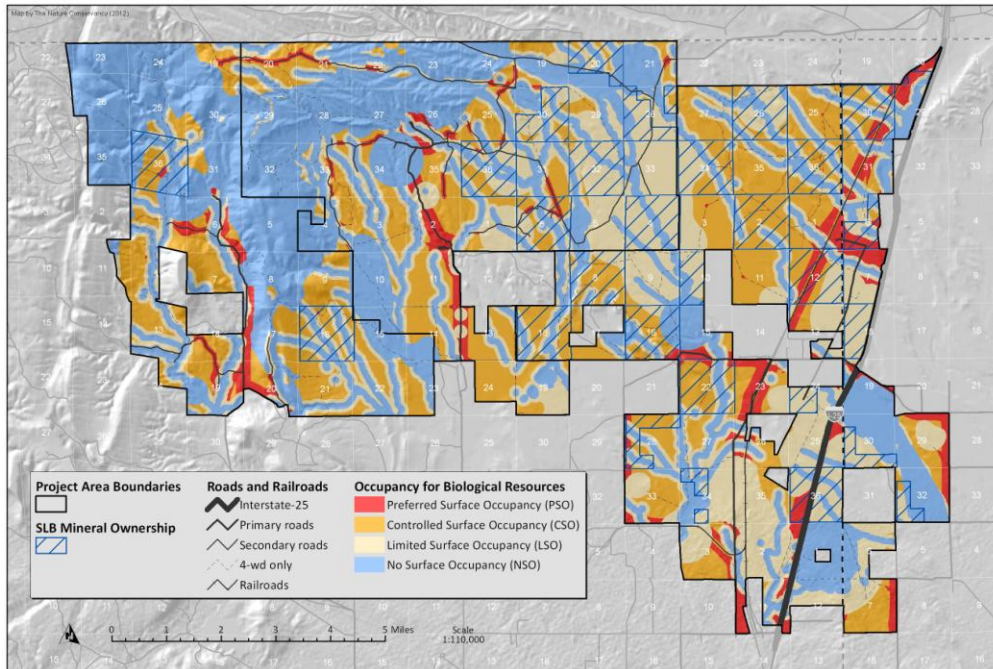
d. Combined Surface Occupancy for biological values

The resulting map of surface occupancy areas for biological priorities shows 42% as No Surface Occupancy, with the remaining 54% open to oil and gas development as Preferred Surface Occupancy (5%), Controlled Surface Occupancy (22%), and Limited Surface Occupancy (31%) (Table 9, Map 12).

Table 9. Surface occupancy map for biological priorities ONLY: Acres and% Project Area by occupancy type

Surface Occupancy Type	Acres	% Project Area
PSO	3,465	5%
CSO	13,940	22%
LSO	19,700	31%
NSO	26,737	42%
TOTAL	63,843	100%

Map 12. Biological values - combined surface occupancy recommendations for biological values ONLY



C. FINAL SURFACE OCCUPANCY AREAS, DEFINITIONS, AND STANDARDS

The TNC Project Management & Science Team created the final surface occupancy map by combining the individual maps of biological and cultural surface occupancy recommendation (Map 13). Differences in occupancy categories revealed by this effort were resolved by selecting the most restrictive category. For example, an NSO area for cultural resources overlapping a CSO area for biological resources was re-categorized as an NSO area in the combined map. For the Project Area as a whole, 56% is categorized as PSO (5%), CSO (21%) and LSO (30%). Surface disturbance is prohibited in the remaining forty-four percent (44%), classified as No Surface Occupancy. For the SLB parcels specifically, surface disturbance is prohibited on a much smaller area – NSO totals 27%, whereas the remaining 73% is comprised of 5% as PSO, 24% as CSO, and 44% as LSO (Tables 10 and 11).

Table 10. Acres in each occupancy type for combined recommendations for biological and cultural resources

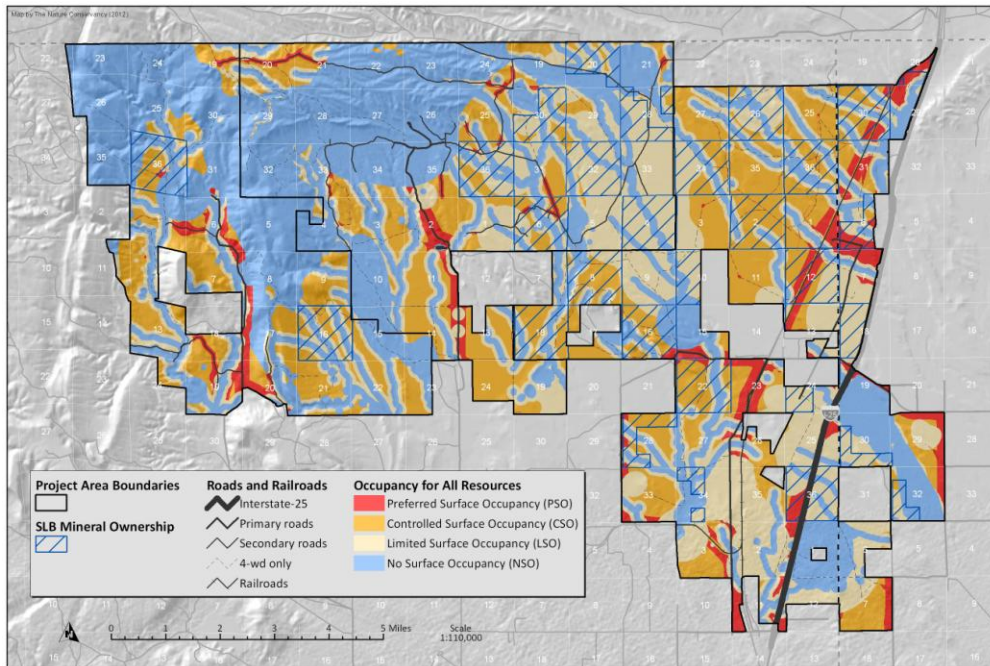
Surface Occupancy Type	SLB mineral ownership		Total for Project Area	
	Acres	% Project Area	Acres	% Project Area
PSO	654	5%	3,255	5%
CSO	3,434	24%	13,533	21%
LSO	6,184	44%	19,118	30%
NSO	3,828	27%	27,936	44%
TOTAL	14,100	100%	63,841	100%

Table 11. SLB mineral ownership - acres of each surface occupancy type

Township Range Section (Meridian 6)	NSO	LSO	CSO	PSO	Total
0110N 0670W 18	0	302	0	0	302
0110N 0670W 30	46	157	10	1	215
0110N 0670W 32	72	72	15	0	159
0110N 0670W 6	60	97	17	116	289
0110N 0680W 10	113	195	2	0	310
0110N 0680W 12	48	217	214	155	634
0110N 0680W 16	255	116	237	25	633
0110N 0680W 18	165	173	288	0	626
0110N 0680W 2	83	119	437	4	644
0110N 0680W 22	118	172	307	36	634
0110N 0680W 24	2	151	0	0	153
0110N 0680W 28	65	93	128	31	317
0110N 0680W 34	90	69	0	0	159
0110N 0680W 36	129	382	19	102	632
0110N 0680W 4	153	484	0	0	637
0110N 0680W 6	182	222	179	41	624
0110N 0680W 8	142	220	278	2	643
0110N 0690W 16	213	224	198	3	637
0120N 0670W 20	0	4	1	47	52
0120N 0670W 30	159	192	193	66	610
0120N 0680W 20	224	151	36	0	411
0120N 0680W 26	199	366	75	0	640
0120N 0680W 28	118	302	20	0	439
0120N 0680W 30	123	272	73	1	468
0120N 0680W 32	146	461	28	0	635
0120N 0680W 34	96	342	195	2	634
0120N 0680W 36	209	186	233	3	631
0120N 0690W 36	202	368	70	8	648
0120N 0700W 36	416	75	181	11	684
Total	3,827	6,184	3,434	655	14,101

Map 13. FINAL COMBINED MAP OF SURFACE OCCUPANCY RECOMMENDATIONS FOR BIOLOGICAL AND CULTURAL VALUES

The Technical Team identified and defined the four categories of surface occupancy areas: No Surface Occupancy, Limited Surface Occupancy, Controlled Surface Occupancy, and Preferred Surface Occupancy for biological and cultural values. All of these areas may be modified to accommodate existing surface uses, surveys, and compliance with the final lease, stipulations, and Surface Use Agreement (SUA).



DEFINITIONS AND STANDARDS FOR SURFACE OCCUPANCY AREAS

Requirements for all surface occupancy areas

- All surface occupancy shall be consistent with existing regulations, lease terms and stipulations (including but not limited to Best Management Practices), and surface use agreements.
- The surface occupancy area map is a starting point. On-the-ground surveys prior to oil and gas development will be used to verify or identify the presence/absence of biological and cultural targets, and associated surface occupancy requirements. The map reflects biological and cultural priorities only; it does not include scenic and recreational priorities, which may affect the design of oil and gas infrastructure.
- Based on surveys, the operator may petition the surface owner and the SLB to change the designation of any surface occupancy category at a given locale to another category. Any changes require advanced written approval of the Board, the Lessee, and the Surface Owner. For example, an NSO for a rare plant may shift to LSO, CSO or even PSO if inventories demonstrate that the plant no longer exists in that area and habitat is no longer suitable for the plant. Similarly, a CSO could shift to LSO if lark bunting habitat moves from one location to another.
- No permanent facilities.
- All lands impacted by oil and gas development will be reclaimed.
- Biological targets subject to long-term impacts from oil and gas development will require compensatory mitigation.

- Timing limitations related to construction activity and/or human disturbance may cover portions of any of these surface occupancy areas.

No Surface Occupancy (NSO)

- **Definition:** Mandated no surface occupancy except for temporary low impact uses such as geophysical studies, due to the unprecedented biological or cultural values in these areas, that are either irreplaceable or would take decades or centuries to restore. Species and ecological systems impacted here may not recover.
 - **Cultural values:** The Lindenmeier site plus a one-mile buffer around it, and all surveyed, very high and high priority sites plus a 50 meter buffer around each. The Technical Team included the one-mile buffer around Lindenmeier because only a small part of the area has been surveyed. The full extent of the resources in this area is unknown.
 - **Biological values:** Targets and surrounding buffers (as needed) that warrant *permanent, year-round protection* from new surface disturbance because impacts to them *cannot successfully be mitigated* through restoration or land protection. Examples include wetlands plus a 300 ft. buffer, golden eagle nests plus a ¼ mile buffer, and rare plants plus a 300 ft. buffer.
- **Standards:**
 - No permanent O&G operations or facilities conducted or installed.
 - Minimum intrusion may be permitted in connection with seismic exploration operations, temporary access, emergency response access and other limited purposes for effective ongoing surface owners' management of the surface resources. The surface owner, in consultation with the SLB and others entities as appropriate, may deny such access (i.e., surface owner has final decision).
 - Existing roads may provide access through NSOs depending on the amount of construction that is needed to upgrade the road, the amount of traffic, and the impact associated with viable alternatives. New roads will not be allowed, unless to avoid perverse outcomes.
 - Should accidents occur during oil and gas exploration and development that destroy or damage NSO areas, extensive and immediate reclamation will be required along with payment of the highest fees for compensatory mitigation.

Limited Surface Occupancy (LSO)

- **Definition:** Areas that are subject to stringent restrictions on surface use due to the presence and sensitivity of the biological and/or cultural values.
 - **Cultural values:** Unsurveyed areas that have known sites whose values are undetermined.
 - **Biological values:** Targets and surrounding buffers (as needed) that warrant year-round protection, but not necessarily *permanent* protection from new surface disturbance because they can be mitigated elsewhere through restoration or land protection. Examples include lark bunting core areas plus a 450 ft. buffer and mountain plover nests plus a ¼ mile buffer.
- **Standards:**
 - Limited oil and gas operations are permitted on these lands after consultation with the surface owner and the SLB, and approval of specific strategies and physical plans that will minimize (or eliminate) any permanent surface impact.
 - No new roads are allowed unless the Lessee demonstrates that there is no technologically or economically feasible alternative.

- Requires higher fees for compensatory mitigation than Controlled Surface Occupancy and Preferred Surface Occupancy as it is more difficult to restore and/or mitigate the biological values in LSO areas.

Controlled Surface Occupancy (CSO)

- **Definition:** Areas which are generally suitable for O&G development. While biological and cultural resources are present throughout the CSO areas, they are less sensitive than in Limited Surface Occupancy areas:
 - **Cultural values:** Unsurveyed areas and surveyed areas/sites identified as having lower value.
 - **Biological values:** Values that do not need year-round protection from new surface disturbance because they are less sensitive than those in LSO and NSO areas. Examples include swift fox dens and important winter habitat for elk, mule deer, and pronghorn.
- **Standards:**
 - Oil and gas operations are permitted on these lands after consultation with the surface owner and the SLB, and approval of specific strategies and physical plans that will minimize (or eliminate) any permanent surface impact.
 - Undeveloped lands may become subject to additional limitations imposed to address wildlife habitat, nesting or fawning grounds based on on-site surveys completed prior to oil and gas development.
 - Require lower fees for compensatory mitigation than Limited Surface Occupancy areas, but higher fees than Preferred Surface Occupancy.

Preferred Surface Occupancy (PSO)

- **Definition:** Areas where surface occupancy is preferred from a biological perspective due to previous and existing disturbances such as along roads, buildings, and transmission lines.
 - **Cultural values:** none – the Technical Team identified the entire project site as NSO, LSO, or CSO for cultural resources because cultural resources are unknown in most locales.
 - **Biological values:** This area includes the combined footprints and indirect impacts to biological values from existing infrastructure (e.g., roads, historic agricultural areas and transmission lines) that have a negative impact on biological values. The extent of the indirect impacts varies based on the type of infrastructure; for example, the impacts from I-25 are much greater in intensity than those of the many 4WD roads in the planning area.
- **Standards:**
 - Oil and gas operations are permitted on these lands after consultation with the surface owner and the SLB, and approval of specific strategies and physical plans that will minimize any permanent surface impact.
 - Requires lowest (i.e., baseline) fees for compensatory mitigation compared to the other surface occupancy areas and as defined by the Technical Team.

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PART III. RESULTS: SUPPLEMENTARY RECOMMENDATIONS

A. TIMING LIMITATIONS FOR BIOLOGICAL VALUES

The Technical Team identified timing limitations for each target based on the sources used for avoidance buffers. The TNC Project Management & Science Team documented possible timing limitations from a variety of sources, resolved any inconsistencies amongst them, and made recommendations to the SLB.

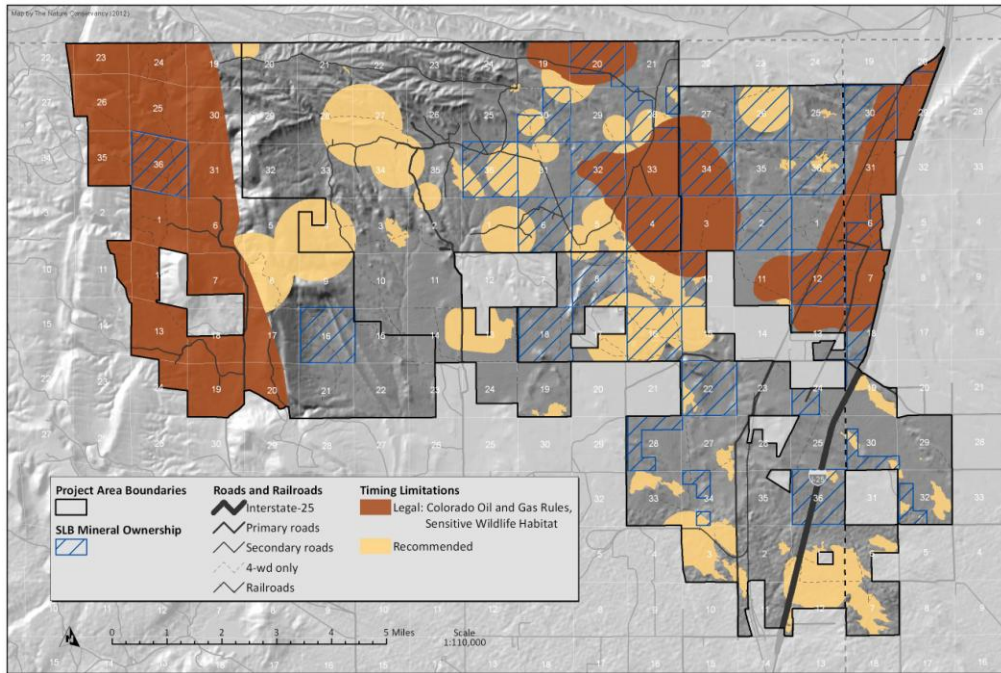
As with the surface occupancy area buffers, the Technical Team identified legal and additional recommended timing limitations. The source of “legal timing limitations” was any area identified as Sensitive Wildlife Habitat under the Colorado Oil and Gas Rules (Colorado Oil and Gas Conservation Commission, 2008). While the rules themselves do not require timing limitations for Sensitive Wildlife Habitat, they require consultation with Colorado Parks & Wildlife (CPW) in order to identify opportunities to avoid, minimize, and mitigate impacts to this habitat. CPW has created a document entitled Actions to Minimize Adverse Impacts to Wildlife Resources (Colorado Division of Wildlife, 2012), which identifies timing limitations and other activities that oil and gas operators can take to reduce impacts to select wildlife species. The TNC Project Management & Science Team thus used this document as the basis for “legal” timing limitations (Map 14).

The Technical Team identified seasonal timing limitations related to surface occupancy, human encroachment, noise, and lights and mapped those affecting surface occupancy areas (Maps 14 and 15). Examples of timing limitations include:

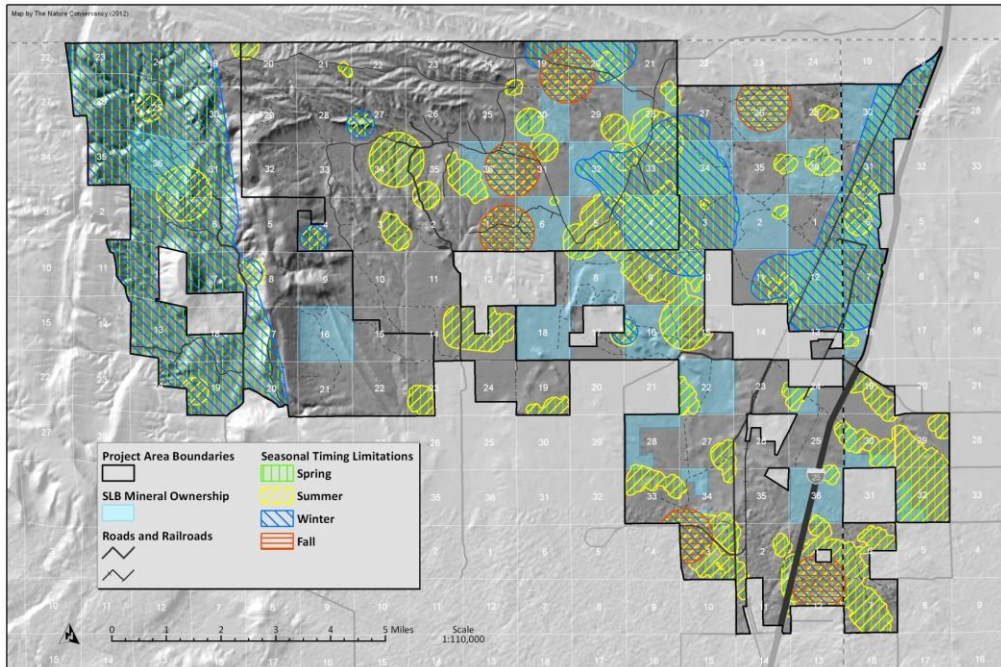
- Ferruginous hawk nests - From 2/1-7/15, no human encroachment or construction activity within 1/2 mile of active or alternate nests.
- Swift fox dens – From 3/15-6/15, avoid surface disturbance while young are den-dependent within 1/4 mile of active den sites:
- Pronghorn winter concentration area - Legal: From 1/1-3/31, avoid surface disturbance to and construction activities within winter concentration areas west of I-25

See Appendix 3a for a full list of timing limitations by target.

Map 14. Biological values – Legal and additional recommended timing limitations affecting surface occupancy



Map 15. Biological values - Seasonality of timing limitations affecting surface occupancy



B. SURFACE DEVELOPMENT STANDARDS AND MITIGATION

The Surface Occupancy areas and timing limitations identify sensitive natural values and their associated important seasons, with the ultimate goal of guiding surface development away from these areas. But the mere identification of these areas is not likely to achieve complete avoidance of impacts to the biological and cultural values in the project area. The Core Team created a suite of complementary recommendations for incorporation into the SLB leasing package and the City and County's Surface Use Agreements: Disturbance caps, compensatory mitigation fees, and reclamation standards. These tools work together like a three-legged stool to support the surface occupancy areas by incentivizing operators to achieve the plan's overarching goal: To avoid, minimize, and mitigate the short- and long-term impacts of new disturbance in the Project Area. The City and County have also produced Best Management Practices which will be used in creating the Surface Use Agreement and which are also important to achieving the plan's goal.

The City, County, and SLB may need to modify the recommendations herein based on unforeseen circumstances, opportunities to avoid "perverse outcomes," and reasonable efforts to achieve the goals of this Energy by Design plan.

i. Disturbance caps

While the surface of the Project Area is owned by just two entities – the City and the County – the mineral estate is owned by at least five entities. The development of the project area is therefore likely to involve numerous operators with different timelines and buildout footprints, and occur over an extended period of time. This reality underscores the importance of viewing the total surface impact by oil and gas development activities on a planning area scale to ensure the development by all respective operators is reasonably allowed, while minimizing the overall impact to the surface in the Project Area.

A second consideration is that little exploration has occurred within the region to date, and only a limited portion of the Project Area has been subject to a seismic survey. Due to the unproven nature of mineral resources in the Project Area, it is difficult to predict the number of wells and well pads that may be necessary to meet the goal of providing reasonable access to the mineral estate. Where minerals are determined to exist, this number has been estimated to be as few as 1 to 2 well pads per section to as high as 16 well pads per section (1 per 40 acres) or more. It is also expected that some sections will not be developed at all.

The intent of Core Team is to provide for the minimum number of well pads in order to balance reasonable access to the mineral estate while maintaining the conservation values of the site. No one well density cap will achieve this result *a priori*. As such, a maximum well density and disturbance threshold was identified to control impacts associated with the high well density potential in some parts of the Project Area. The allowance of 4 well pads per section is not expected to be the well density across the entire Project Area but rather the maximum allowed on portions of the project area where significant mineral resources are determined to be available for extraction. Ultimately, SUAs with individual developers will identify the maximum well pad density allowed within any given portion of the Project Area.

The Core Team identified two maximum disturbance caps:⁸

- Long-term impact cap (3% for up to 4 well pads) – The maximum surface area of a section that can be occupied for more than two years. For one section of 640 acres, 3% is rounded to 19 acres. This cap includes all long-term surface impacts to the site including the production well pad, new roads, and any other long-term surface impacts.
- Temporary impact cap (1.25%) – The additional surface area cap, beyond the long-term impact area cap, that can be impacted for less than two years for activities like well pad development or hydraulic fracturing of a well. For one section of 640 acres, 1.25% is 8 acres. This cap will allow development of one well pad at a time. Reclaiming temporary impacts will then enable an operator to develop any additional well pads.

The following provisions will guide implementation of the disturbance caps:

- Both temporary and long term surface impacts will count towards the operator’s allotted acres until the Surface Owner issues notice of reclamation clearance (see reclamation standards). Once reclamation of temporary or long term impacts is complete, the acreage will again be available for the operator to use for other development. In other words, once an operator reclaims any acre in its entirety, that acre goes back into their 19 (long term) plus 8 (temporary) total acreage available.
- To incentivize operators to work together on the landscape, if more than one operator cooperates in sharing infrastructure (new roads, well pads, etc.), the acres disturbed will only be counted as 50% of the acreage actually disturbed. This incentive will be applied to both temporary and long term disturbance. The Surface Use Agreement (SUA) will detail any co-locating of roads and other infrastructure by operators, and subsequent operators will be bound to continuing that colocation.

ii. Compensatory mitigation fees

An operator must participate in a compensatory mitigation program with the Surface Owners by contributing to a mitigation fund through a fee structure described below. The Surface Owners will administer the fund, holding the funds and protecting or restoring lands as opportunities arise. The intent of the mitigation program is two-fold:

- To generally encourage development in less sensitive areas over more sensitive areas; and
- To secure the necessary funds to achieve no net loss (i.e., net zero impact) of biological values for biological values that are subject to long-term impacts, where avoidance and minimization will not do so on their own.

⁸ The disturbance caps were based on the following assumptions about the development associated with one well pad: Long-term impacts - Impacts may total 4.5 acres per well pad, including an estimated 1 mile of new road per well pad at 20’ wide = approximately 2.5 acres, plus 2 acres per well pad (at 4 wellpads = 8 acres total) for production. Temporary impacts - Impacts may total an additional 8 acres per well pad (beyond the 2 long-term acres for a well pad production for drilling and hydraulic fracturing, for a total of 10 acres per pad during well development and completion).

Payment for compensatory mitigation will be based on per-acre fees for each of the surface occupancy types (Table 12). The fees are based on a combination of best available science and practical professional judgments made by the Core Team. See Appendix 4 for the methods used for calculating the mitigation fees.

Table 12. Compensatory mitigation fees per acre on any given section in the Project Area

Surface occupancy area	General per-acre rate	Surface occupancy area multiplier	Surface occupancy area base rate	1 well pad		2 well pads		3 well pads		4 well pads	
				Multiplier	Final fee	Multiplier	Final fee	Multiplier	Final fee	Multiplier	Final fee
PSO	\$2,200	1.0	\$ 2,200	1.0	\$2,200	1.0	\$2,200	1.0	\$2,200	1.0	\$2,200
CSO	\$2,200	1.5	\$ 3,300	1.0	\$3,300	1.0	\$3,300	1.5	\$4,950	2.0	\$6,600
LSO	\$2,200	3.0	\$ 6,600	1.0	\$6,600	1.0	\$6,600	1.5	\$9,900	2.0	\$13,200

IMPORTANT:

- Payment will be made in cash or an equivalent, if agreed to by the Surface Owners (e.g., mineral or water right values transferred to the Surface Owners for conservation purposes).
- Up to four well pads per section are allowed in the project area at any one time. Fully reclaimed well pads (i.e., Surface Owner has issued final reclamation clearance, see reclamation standards), including temporary and long-term impacts, will not count toward the well pad total.
- Dollar amounts are established based on recent (2006-2012) land values and other estimates of mitigation costs. Final amounts may need to be adjusted as land values or other cost factors rise in the future.
- Fees apply to long-term impacts only; operators will not be responsible for mitigating for temporary impacts.
- Operators will pay as they go. Recognizing that operators may not know their full development plans (e.g., 1 well pad or 3 well pads) at the outset, operators will pay compensatory mitigation fees by the time physical activity begins.
- Fees will be based on the number of well pads constructed over time, and will be calculated to provide the highest benefit for conservation such that a well pad in a more restrictive zone (CSO or LSO) would always incur mitigation fees as if it were the last well built. In other words, the construction of a third well pad and associated infrastructure in a section would increase the fee for a previously-constructed well pad and associated infrastructure in LSO to the 3-wellpad fee level, regardless of whether it was built first or second. For example, if Well pad #1 (year 1) is in PSO, Well pad #2 (year 5) is in LSO, and Well pad #3 (year 10) is in PSO, an operator will pay \$2,200/acre in year 1; another \$6,600/acre in year 5; and another \$2,200/acre for the PSO well + \$3300/acre. The \$3,300/acre is equivalent to the fee for a third pad in LSO (\$9,900) less the fee already paid for that LSO pad when it was the second pad for which \$6,600 was paid originally in year 5.
- For a well pad that includes two or more types of surface occupancy areas, the fee for the most restrictive are will apply to the entire acreage. For example, for a five-acre well pad including two acres of LSO and three acres of CSO, an operator would pay for five acres of LSO.

- If there is more than one operator in a section, each operator must pay fees according to the total number of well pads that have already been developed. In other words, well pad development is cumulative for the purpose of calculating compensatory mitigation fees, regardless of the number of operators. Using the example from above, if Operator A develops a well pad in PSO in year 1; Operator B develops a well pad in LSO in year 5, and Operator C develops another well pad in PSO in year 10, then Operator A will owe \$2,200/acre in year 1; Operator B will owe \$6,600/acre in year 5; and Operator C will owe \$2,200/acre for the PSO well plus an additional \$3,300/acre for the LSO well (to account for the difference in the LSO third well cost of \$9,900 minus the \$6,600 already paid) for the LSO acreage paid for in Year 5 (i.e., the LSO well would be treated as if it were the third well).
- The Surface Owner may also require operators to cover additional mitigation-related costs through the Surface Use Agreement. For example, the surface use fee does not cover Surface Owner costs of implementing the Surface Use Agreement.

Surface Owners will apply the mitigation funds within the Project Area as defined by the EBD Core Team. Mitigation projects will ensure “ecological equivalency” by completing projects that benefit the same conservation values that are impacted. Mitigation projects can include one or more of the following actions:

- Land conservation. The preferred method of compensatory mitigation will be to conserve lands with similar natural resource values (focused on “in-kind” replacement). This could include placing formal legal protections on Meadow Springs or other lands within the Laramie Foothills Mountains to Plains project area.
- Restoration projects. The second option for mitigation is to complete resource management (such as restoration of degraded lands) within the mitigation area. This is a secondary option because all three properties are in good condition and most ongoing resource management activities are already funded.
- Mineral/Water Rights acquisition. On-site mineral or water rights procurement and donation to the Surface Owners with stipulations that such mineral rights would be retired and water rights would be tied to conservation values. (Note: Although SLB is not legally able to donate its development rights to the Surface Owners, other mineral owners may be able to do so.)

It may not be possible to complete mitigation projects at the same time impacts occur. Therefore, the mitigation fund will enable the Surface Owners to identify and complete the best mitigation projects within the Project Area as close in time as possible to the impacts.

iii. Reclamation standards

This section includes the reclamation provisions identified by the Core Team. The Core Team started with the reclamation language in the Lowry Range plan (which was based on the Colorado Oil and Gas Rules) and modified it for the Mountains to Plains project. As with all the other components of this report, the City, County, and the State Land Board will build these provisions into the SLB Leasing Package and the Surface Use Agreement as they see fit. It is assumed that the operator will also comply with the Colorado Oil and Gas Rules and the Surface Owners’ Best Management Practices for reclamation.

1. **Responsibility.** In addition to any responsibilities under the Oil and Gas Rules, the operator is responsible for reclamation, monitoring, and submitting required documentation to the Surface Owner. The Surface Owner reviews and approves the final Reclamation Plan and will determine when reclamation standards have been met.

2. **Reclamation plan.** The Lessee will develop a reclamation plan for approval by the Surface Owner to fulfill the reclamation standards. This plan will detail measures to restore disturbed sites based on application of the BMPs (see above). The reclamation plan will include the following:
 - a. Identification of the reference and reclamation sites, including baseline photographs, GPS coordinates and GIS shapefiles of each.
 - b. Description of the soil conditions of the reference and reclamation sites and ensure they are consistent. See below for descriptions of reference and reclamation sites.
 - c. Documentation of the vegetation and functional group dynamics of the reference site per the monitoring methods below.
 - d. Description and map(s) of temporary and long-term impact areas to the extent practicable.
 - e. Interim and final reclamation actions, per the Colorado Oil and Gas Commission Rules and the City and County Best Management Practices.
3. **Reclamation site.** This is the area disturbed by oil and gas activities and within which reclamation is needed. The reclamation site includes both temporary and long-term impact areas.
4. **Reference site.** The Surface Owner will identify a reference site for each pad or disturbed area. The reference site will be used for restoration quality control as it will provide a baseline for the ecological conditions that the reclamation and monitoring of the reclamation site are intended to achieve. In other words, the reference site is what the reclamation site should look like post-reclamation, subject to standards (see below). This reference site will contain the same soil types, slope, and aspect as the reclamation site. In choosing the reference site, the Surface Owner will determine if the reclamation site is highly altered to begin with. If the reclamation site is not highly altered, the Surface Owner will select a reference site to generally match the pre-construction condition of the reclamation site. If the reclamation site is highly altered (e.g., dominated by cheatgrass), reclamation should seek to establish a native plant community typical of the area.
5. **Reclamation bond.** The Lessee must provide a reclamation bond to the Surface Owners for anticipated temporary and long-term impacts at a rate of \$10,000/acre, for acreage equal to the maximum amount of disturbance possible under the disturbance caps (i.e., 4.25% of the lease area). For example, for a lease of one section (640 acres), the bond amount would be $4.25\% * 640 \text{ acres} * \$10,000$, for a total of \$272,000. This amount will cover all costs of reclamation, including seed collection, seed storage, irrigation (if necessary), labor, and management and monitoring to assure success.⁹ The bond will be released upon approval of the reclaimed site by the Surface Owner (Section 9).
6. **Monitoring schedule and methods.** Monitoring will occur annually between June 15 and September 15 and include both quantitative and qualitative methods. The reference and reclamation sites will be monitored within 30 days of each other, annually, using the same methods. The point intercept method will be used along at least three permanent transects per acre. The transects must be at least 50 meters long and provide at least 100 points per transect. Photographic documentation will also be collected from each cardinal direction at a designated point at each reclamation site.

⁹ Costs are based on actual costs accrued on a 2012 project in Pueblo County (Rondeau, 2012)

7. **Annual report.** By November 1 of each year, operators must submit an annual report to the Surface Owner identifying reclamation activities and monitoring results. Any deviations from the location and extent of temporary impacts, as identified in the reclamation plan, will be delineated in the annual report and will include maps, GPS coordinates of the boundaries and GIS shapefiles of these changes.
8. **Reclamation standards.** Lands shall be considered reclaimed when the standards are met by the end of the second growing season after establishing vegetative cover (and watering, if applicable) or any subsequent set of two consecutive years within a five-year period. Standards include:
 - a. Topography and soils: Replicate the original topography of the site following the Site Preparation standards described in the Surface Owners' Best Management Practices.
 - b. Vegetative composition and cover – Achieve at least 80% vegetative cover as compared to the reference site, and reflecting the structure and vegetative composition (i.e., trees, shrubs, grasses, and forbs) of the reference site, excluding Larimer County noxious weeds. For example, plant communities dominated by certain shrub species in the reference site must be dominated by the same shrub species in the reclamation site.
 - c. Non-native plants are not considered when calculating the performance criteria.
9. **Reclamation approval.** The Surface Owner will return the bond, or applicable portions thereof, once reclamation of temporary and/or long-term impacts is complete according to the following criteria:
 - a. All reclamation standards are met by the end of the second growing season after establishing vegetative cover (including watering if applicable) or after any subsequent set of two consecutive years within a five-year period; and
 - b. Operator provides to the Surface Owner an annual report documenting that all performance criteria have been met for two consecutive years and requesting release of the bond or portions thereof, based on the acreage successfully reclaimed.

Following receipt of the annual report, the Surface Owner will complete an inspection between June 15 and September 15 to confirm report findings. If applicable, within 30 days of the site inspection and report confirmation, the Surface Owner will provide written clearance of operator responsibility, along with the bond fees for acreage successfully reclaimed. If reclamation standards are not met within 5 years, operators must continue attempts to reclaim and the Surface Owners will continue to hold the bond, or the operators must relinquish the reclamation bond to the Surface Owners such that they can undertake alternative reclamation or restoration actions.

C. SCENIC AND RECREATIONAL VALUES

Impacts to priority scenic and recreational values were considered in the planning process. To help minimize the visual impact related to oil and gas development, the viewsheds from the public trail system and the Lindenmeier site were analyzed. The viewshed maps are intended to be used as a supplementary tool to the biological and cultural resource maps assist with the final siting of development in the least visually impactful locations possible. They are not intended to replace on-the-ground scouting to find the best locations for oil and gas development within individual sections. The Technical Team considered creating surface occupancy recommendations (e.g., no surface occupancy) for scenic priorities and combining them with the cultural and

biological analyses, but decided the most appropriate use of the viewshed tool would be to aid in the City and County's efforts in working with operators when siting a specific well pad or other infrastructure.

The Core Team completed three scenic priority analyses and associated maps with data from the City of Fort Collins and Larimer County, as described below. All public trails in the Project Area and the Lindenmeier site were used as the viewpoints.

- Visible/not visible analysis (Maps 16 and 17) – This analysis simply shows all places visible from the trail system and the Lindenmeier site, assuming visibility to 3.5 miles. This analysis did not differentiate between the visibilities of locations close to the viewpoints versus ones that lay farther away. This analysis was completed for the public trails and for the Lindenmeier site.
- Decline in visibility analysis (Maps 18 and 19) – The visible/not visible map was revised to show the decline in visibility as distance from viewpoints increased. As the distance from a viewpoint increased, the visibility decreased to a point at approximately 3.5 miles where the impact became negligible. The decline in visibility analysis was completed for the public trails and for the Lindenmeier site.
- Cumulative viewshed analysis (Map 20) – Building on the decline in visibility analysis, the Core Team completed a cumulative viewshed analysis for the trail system only. This map combines the decline in visibility from the trail network with the reality that some places in the Project Area are of higher scenic priority than others due to the frequency with which they can be seen from each step along the trails.

The Core Team assumed the following to complete these analyses:

- Distance from which one could see an oil rig/pump jack structure: 3.5 miles. Based on research (Upadhyay, 2010) the Core Team decided that the maximum visible distance from any one viewpoint would be 3.5 miles. For reference, the Project Area is 16 miles across.
- Height of observer at viewpoint: 6 feet. The Core Team ran the analysis from the viewpoint of a 6' tall person.
- Height of object viewpoint: 20 feet. The Core Team decided to use the 20-25-foot height of a typical pump jack as the height of the object viewpoint. While much taller at 125 feet, the drilling rig is only in place for about 2 weeks while the pump jack could be in place for many years.
- Distance at which visibility starts to decline: 0.5 miles. The Core Team assumed that visibility is clear from the observer to 0.5 miles, beyond which the visibility is reduced.¹⁰
- Distance at which visibility drops to 50%: 1.75 miles. The previously described maximum distance was 3.5 miles, so the distance at which visibility drops to 50% would be half of that, or 1.75 miles.

The resultant suite of scenic priorities maps show many areas where drilling pads could be built that would minimally impact scenic values. Conversely, there are key areas that will be important to protect. As previously mentioned this analysis is intended to be used as a guide and to inform large scale planning. Site-specific viewshed analyses could be created during siting of an individual drilling pad. Field visits and ground truthing will be vital during the siting of individual drilling pads.

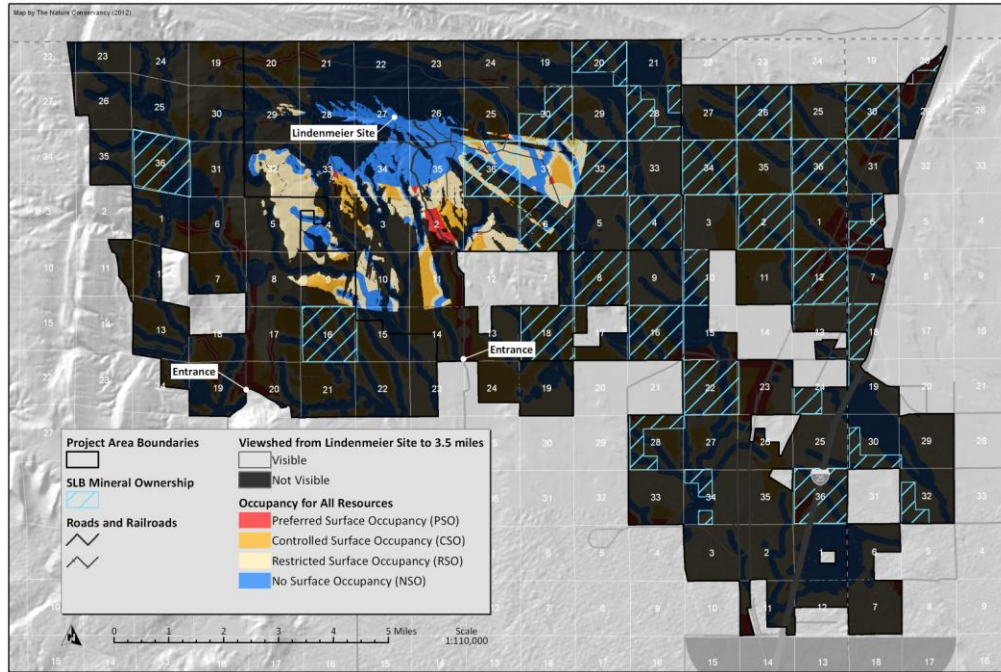
When making decisions about where to locate oil and gas infrastructure, operators should work with the City and County to consider these scenic priority maps alongside existing Management Zone maps that are available for

¹⁰ This assumption was influenced by (Fisher, 1994), who had a suggested value of 1 km, or 0.62 miles. The technical team rounded to 0.5 miles for simplicity.

Red Mountain Open Space and Soapstone Prairie Natural Area. In the respective management plans for both properties, Management Zones have been designated to inform development of infrastructure, signage, and other management concerns. The Management Zones range from a Developed Zone where parking lots and other major infrastructure exist, to a Primitive Zone where development would be minimal and the opportunity for solitude is the highest on the properties. During the Open House held for this planning process, the attendees were asked about viewsheds as a priority in the Project Area and where they would prefer development. The attendees unanimously preferred that development be directed when possible to more developed zones of the properties, even if it was more or very visible, and to make any development in Backcountry or Primitive Zones as invisible as possible. Thus, both the scenic priorities map in this report and the Management Zone in which any given development may reside should be taken into consideration when siting oil and gas infrastructure.

Map 16. Scenic values – Visible/not visible analysis from the Lindenmeier Archaeological Site.

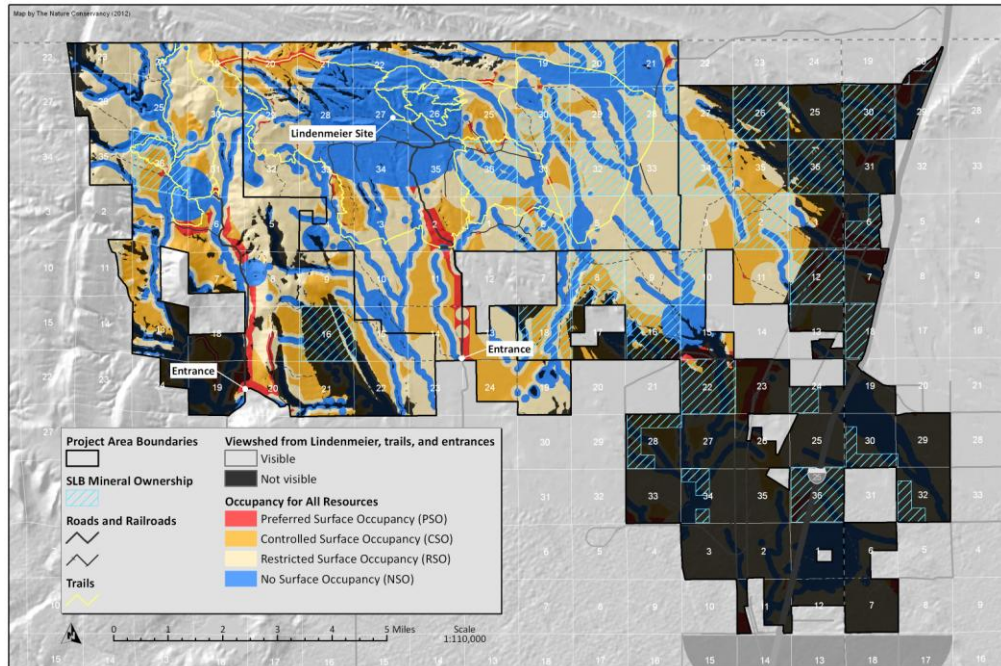
This map shows the surface occupancy areas that are visible from the Lindenmeier site, assuming a sight distance of 3.5 miles.



Source: (Gaertner, Robertson, & Scharon, 2012)

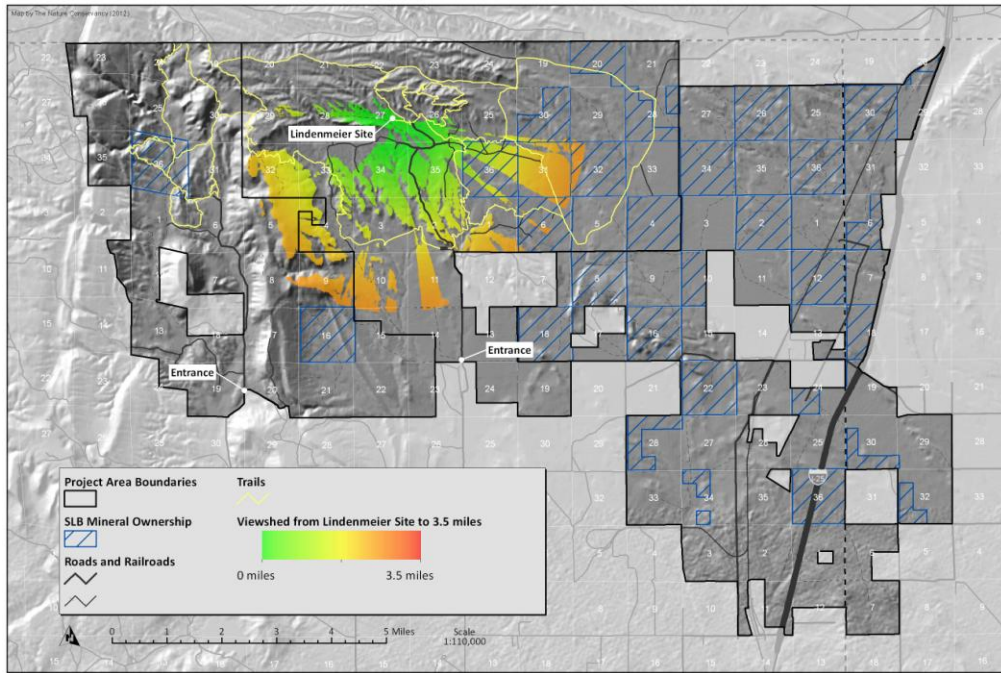
Map 17. Scenic values – Visible/not visible analysis from public trails in the Project Area.

This map shows the surface occupancy areas for biological and cultural resources that are visible from the public trail system in the Project Area, assuming a sight distance of 3.5 miles.



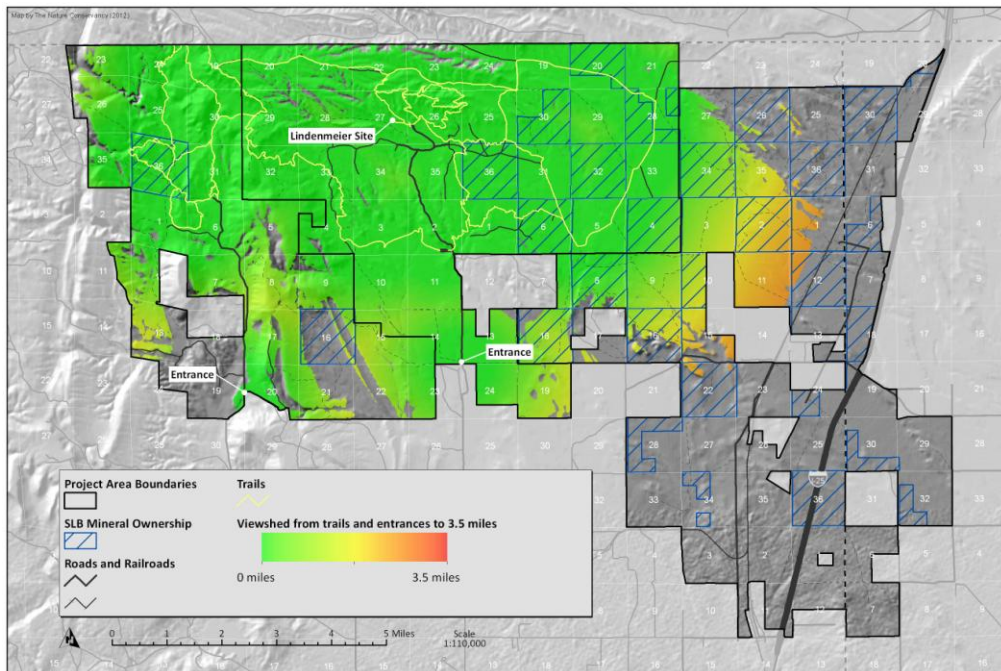
Source: (Gaertner, Robertson, & Scharon, 2012)

Map 18. Scenic values – Decline in visibility analysis from the Lindenmeier Archaeological Site



Source: (Gaertner, Robertson, & Scharton, 2012)

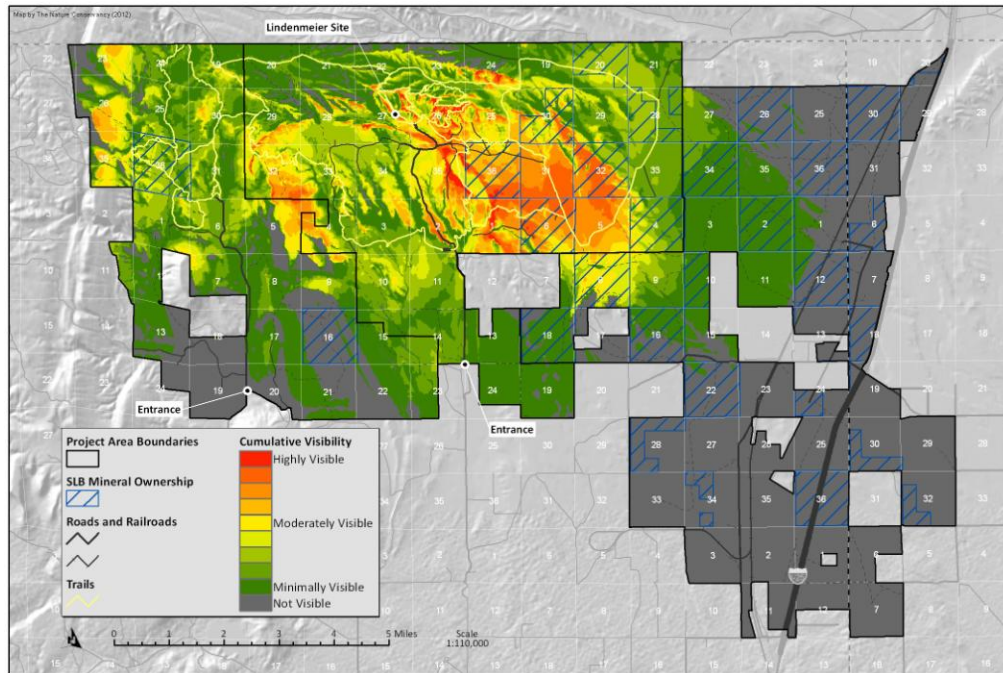
Map 19. Scenic values – Decline in visibility analysis from all public trails in the Project Area



Source: (Gaertner, Robertson, & Scharton, 2012)

Map 20. Cumulative viewshed analysis from the public trails in the Project Area

This map shows the scenic priorities of the Project Area based on two inputs -- the decline in visibility from the trail network (to a distance of 3.5 miles away) and the frequency with which any one location within the Project Area can be seen from each step along the trails.



Source: (Gaertner, Robertson, & Scharton, 2012)

D. CULTURAL RESOURCE POTENTIAL

Approximately twenty-five percent (25%) of the Project Area has been surveyed for cultural resources. To help predict the chances of finding cultural resources on the remaining 75% of the Project Area, CSU created a predictive map of cultural values across the Project Area that lies in Larimer County. **The cultural resource potential maps are provided separately to the SLB due to the sensitivity of the information.** CSU used its knowledge of known locations for cultural resources to statistically predict where cultural resources could be found elsewhere throughout the site. CSU mapped likely locations for finding 40 or more “flakes,” tools, hearths and other thermal features, stone circles, and rock piles based on the elevation, slope, topography, distance to water, aspect, landcover, and soil characteristics of known sites for these cultural resources. CSU created a predictive map of each cultural value and combined them to create the final map of cultural resource potential.

Importantly, this predictive model only addresses sites that might be present on the surface. The area contains many buried archaeological sites that are more difficult to detect and will likely only be found during construction and archaeological monitoring. Pre-survey of construction areas would obviously examine areas of deep exposure, such as arroyos, where soil sequences might yield cultural remains dating back thousands of years and buried meters below the present day surface.

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PART IV. DISCUSSION

A. USE OF RESULTS IN NEXT STEPS

The information provided in this report completes the first of three phases in the EBD process for the Mountains to Plains project. The information about priority biological and cultural resource values, the recommendations for surface occupancy areas, and the supplementary recommendations are intended to aid in its creation of an Oil and Gas Leasing Plan (Phase II) and in the City and County's creation of a Surface Use Agreement (Phase III). The SLB will use this report to develop a leasing plan for SLB holdings that respects the goals and values of the surface owners and includes an oil and gas lease. The plan may include a leasing plan and lease stipulations. It may also set expectations for surface use agreements with the City of Fort Collins and Larimer County. To develop the plan, the SLB may engage the City of Fort Collins, Larimer County, TNC, and ideally other mineral owners and potential lessees. The plan would be predicated on the rigorous scientific approach taken by this project to understand the kinds and distribution of resources on the site and potential impacts from oil and gas development. Implementation of the plan will rely on the commitment of the project partners to utilizing the findings in the report and to support the recommendations made herein.

B. STRENGTHS & LIMITATIONS OF MOUNTAINS TO PLAINS ENERGY BY DESIGN

Energy by Design is not a one-size-fits-all solution to energy or development planning. The context of any given energy development project may or may not lend itself to EBD. In the case of the Mountains to Plains Energy by Design Project, several factors supported the EBD approach. The surface overlaying the minerals estate were largely publicly-owned and were acquired for a variety of natural, cultural, and recreational values at a time when there was little expectation of any recoverable resource under the property. The outstanding biological, cultural, scenic, and recreational resource values and their ownership by public entities merit greater care when planning minerals development. Additionally, the high value that the residents of the County and City place on the subject properties attracted scrutiny of and opposition to mineral development. Finally, the full recognition by local government and other stakeholders of the SLB's right to develop minerals underlying the property for their beneficiaries and their desire to work with the SLB to reach a mutually agreeable plan for their extraction set the stage for a successful collaboration based on respect for each organization's rights and obligations, strong science, and a robust process.

By virtue of its scientific rigor and the engagement of credible stakeholders in the analysis and planning process, Energy by Design requires a significant commitment of time and resources to complete. The benefit of this investment is several-fold. First and foremost, the stakeholder engagement engenders strong, broad based support for project outcomes. In the context of this project, this means that minerals owners and developers will have higher than normal confidence that their leasing operations can proceed smoothly. This certainty in the context of public open space in northern Larimer County should be of real value to owners and lessees. Second, broad support by stakeholders provides for public agency endorsement and recommendation of the plan to constituents and prepares them to answer questions from other groups based on solid science and thorough analysis. This should enhance the public profile of participants and smooth the leasing and development process. Finally, successful implementation of Energy by Design can raise the standard for mineral development by other owners and lessees, contributing to an optimal mix of resource development and natural resource protection throughout the state.