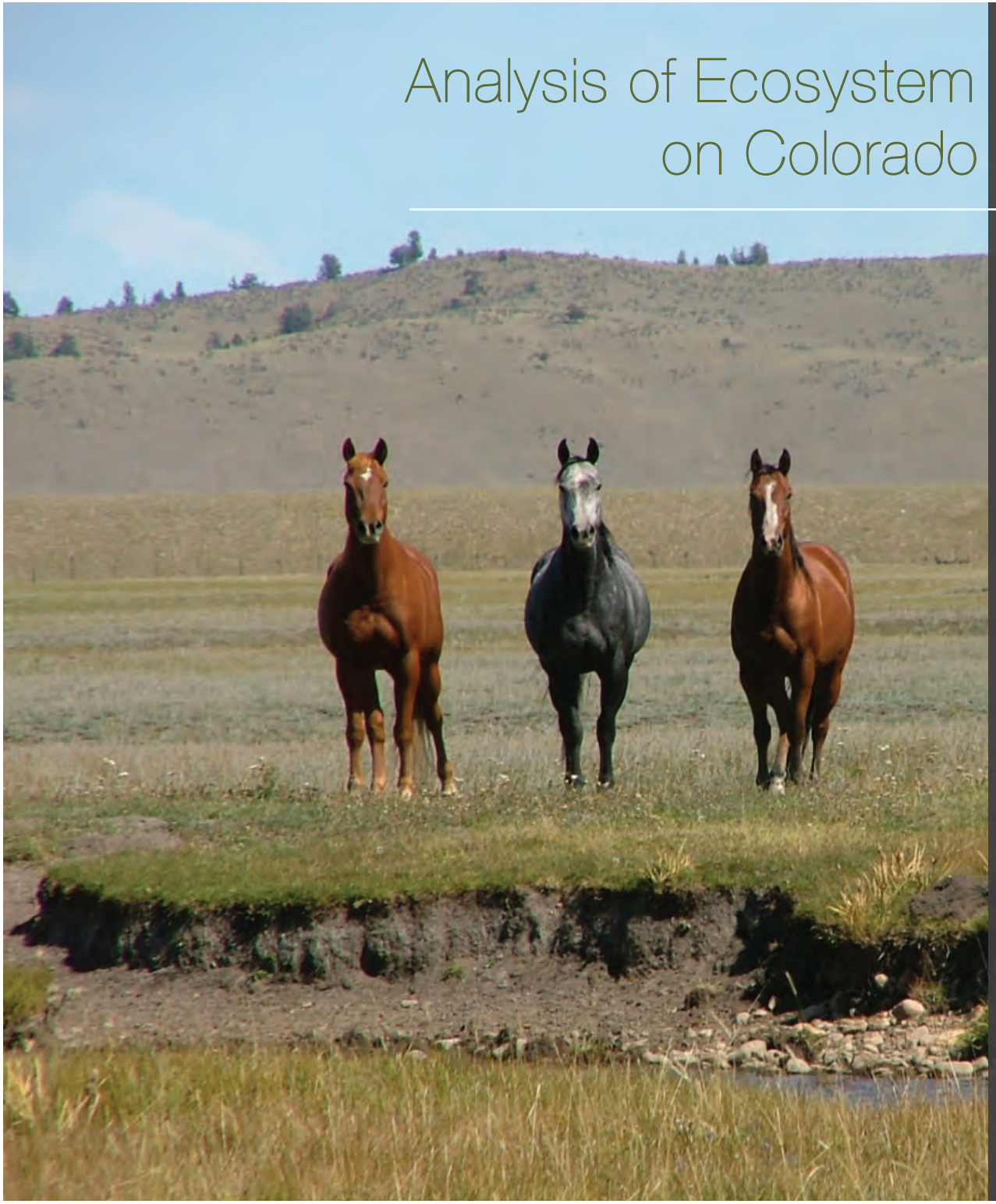

Analysis of Ecosystem Services Potential on Colorado State Trust Lands

Prepared for the Colorado State Board of Land Commissioners by Sonoran Institute, Solano Partners, Inc., and Parametrix

February 2012

Sonoran Institute

The Sonoran Institute inspires and enables community decisions and public policies that respect the land and people of western North America. Founded in 1990, the Sonoran Institute is a nonprofit organization that is working to shape the future of the West. For more information, visit www.sonoraninstitute.org.

Solano Partners, Inc.

Solano Partners, Inc. (SPI) is a consulting firm focused on environmental investment and the financial value of natural systems. SPI supports for profit companies, non profit organizations, government agencies and entities, and academic organizations by assembling teams of nationally recognized thought leaders to focus on environmental value issues. Specific areas of expertise include eco-credit design, registry and trading platform design, environmental market regulatory and policy issues, and environmental investment underwriting criteria.

Parametrix

Helping clients and partners create vibrant, sustainable communities and restoring the health of the planet for future generations.

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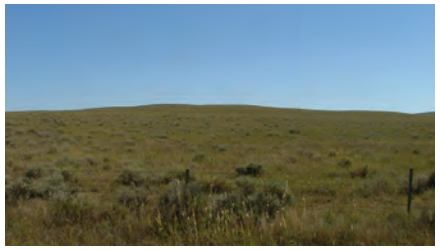

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Executive Summary

The Colorado State Board of Land Commissioners (SLB) recognizes that engagement in the emerging ecosystem services marketplace offers a significant opportunity to increase and diversify its revenue-generating capacity. As a result, this report was commissioned to explore this potential through (1) an overview of current and emerging requirements driving the demand for ecosystem services, including real estate, transportation, and energy development; (2) an assessment of the type and range of compensable ecosystem services on state trust lands, focusing on three trust land parcels within the Stewardship Trust; (3) a policy analysis for the ecosystem services marketing options available to the SLB; and (4) recommendations for structuring an SLB ecosystem services credit program.

Demand Analysis for Ecosystem Services

Sources of demand for ecosystem services include (1) project impacts that require compensatory mitigation under federal or state laws; (2) project impacts that may provide pre-compliance mitigation for species that are of concern but are not yet listed; and (3) downstream water users who may desire up-stream watershed protection. This report's demand analysis focused on five categories of potential demand:

- Highways and other transportation infrastructure
- Up-stream/down-stream links: Denver Water Board purchase of water-related values from U.S. Forest Service (USFS) upstream properties
- Renewable energy, oil and gas development
- United States markets for carbon sequestration
- Status of conservation and mitigation banking in the state of Colorado

Transportation projects must meet a wide range of environmental permit conditions, including compliance with federal regulations rooted in the Endangered Species Act and the Clean Water Act to avoid, minimize and mitigate impacts. To provide a sense of the scale of the potential demand resulting from transportation projects, the Colorado Department of Transportation (CDOT) awarded 154 contracts for highway and bridge construction projects totaling $427.5 million in FY 2010. The Regional Transportation District (RTD) FasTracks project will also build 122 miles of new commuter rail and light rail, 18 miles of bus rapid transit, and 21,000 new parking spaces at light rail and bus stations across an 8-county district.

Programs that offer payments for ecosystem services (PES) from watersheds are in place in the United States and around the world. According to a 2010 publication from Ecosystem Marketplace, there are currently a total of 113 payments for watershed services (PWS) programs in varying stages of activity around the world. PWS demand in Colorado results directly from a Memorandum of Understanding between the Regional Forester of the US Forest Service, Rocky Mountain Region and the CEO of Denver Water. The two organizations agreed to split the cost of a $33 million investment in restoration projects on approximately 38,000 acres of National Forest lands. Denver Water spent more than $30 million on a project to remove 625,000 yards of sediment in reservoirs serving municipal use. The opportunity exists for the SLB to determine if state trust lands upstream of reservoirs could participate in programs that protect water quality.

Over the next 20 years, 100,000 new oil and gas wells and 100,000 new wind turbines are expected to develop in the western United States with a land footprint of two million and twelve million acres respectively. If the Greater Sage Grouse and the Lesser Prairie Chicken, or any other candidate species, are listed as "endangered" under the Endangered

Species Act, they would impact livestock grazing, oil and gas development, and wind development across 17 states. There are also seven completed Wildlife Mitigation Plans developed by the state of Colorado that cover over 320,000 acres in the state. Several companies have agreed to participate, including Encana, Antero, Marathon, Noble, Black Hill, Williams, and ExxonMobil. While the compensatory mitigation requirements are often a form of 'in lieu' payments, which does not require an objective form of measurement relating offsets to impacts, they nonetheless represent the type of habitat conservation value proposition that could be provided by SLB lands in the future.

Revenue from land management practices that provide scientifically verifiable storage or sequestration of carbon continues to flow to forestry and agricultural projects despite the federal government's inability to reach a decision regarding national climate policy. Both voluntary markets and offsets eligible as a compliance option under California's AB32 legislation are sources of demand, including California based emitters who seek compliance credits under the California Air Resources Board standards. Other sources of demand for carbon credits specific to Colorado include the Xcel Energy program, which has allocated funding for offsets on a voluntary basis, as well as pre-compliance credits through the Colorado Carbon Fund (CCF), created by the Governor's Energy Office to measure, reduce, and offset carbon emissions. Finally, buyers seeking credits that meet various voluntary standards are a possible source of demand. For example, Chevrolet has made a commitment to buy $40 million worth of offsets, and has invested in forestry projects as well as wind power, and landfill gas projects.

Site Analysis Findings

With an understanding of the types of state-level demand drivers identified, the report was prepared to identify potential credit generation and/or PES opportunities associated with the three SLB sites: Antero-Salt Creek, Tamarack, and Jimmy Dunn Gulch. The sites selected are located in three very different parts of the State. The Antero-Salt Creek site is located in the Rocky Mountains, near Fairplay; the Tamarack site is located on the Eastern Plains in the sandhills outside of Sterling in the northeastern portion of the state; and finally, the Jimmy Dunn Gulch site is located on the West Slope, in the northwestern part of the state, in the Yampa River watershed. The research was limited to evaluating whether or not the three SLB properties have the physical and biological characteristics conducive to mitigation banking or PES programs. It was not possible to determine the specific numbers of credits potentially available. Additional technical analyses and financial feasibility studies will be required if the SLB desires to move to the next stage of bank site establishment or PES program development.

Antero-Salt Creek Site

The Antero-Salt Creek site and the small property located to the north of the 63 Ranch SWA site contribute, directly or indirectly, to many ecosystem services that benefit society such as wetlands, diverse habitats, and carbon sequestration. Tables outlining the contribution made by the Antero-Salt Creek site can be found on page 22. While the development of PES programs, also known as payments for watershed services (PWS) programs, is in a nascent stage in most parts of the United States, this report calls attention to the ecosystem services provided by the site so that SLB can consider them in development of future management plans.

The primary opportunities for SLB to manage the Antero-Salt Creek site to generate conservation revenue, in the context of traditional environmental markets, include use of the site for (1) conservation banking; (2) wetland banking; and (3) stream banking. Prior to making a determination of whether or not any of these sites can be used for these purposes, additional technical studies would be needed, such as rare plant and wildlife species surveys and habitat restoration feasibility assessment, to determine whether or not credit generation is feasible.

Tamarack Site

The Tamarack site contributes, directly or indirectly, to many ecosystem services that benefit society such as sensitive species habitat and water infiltration. Opportunities for SLB to generate conservation-related revenue from the site include use of the site for either conservation banking or use of the site in a voluntary "payments for habitat conservation" agreement between SLB and entities such as renewable energy site developers. Prior to making a determination of whether or not the site can be used for these purposes, additional technical studies, such as rare plant and wildlife species surveys, would be needed to determine whether or not credit generation and sustainable management is feasible.

Jimmy Dunn Gulch Site

The Jimmy Dunn Gulch site also contributes, directly or indirectly, to many ecosystem services that benefit society Such as perennial streams/springs and sensitive species habitat. The two primary opportunities to manage the Jimmy Dunn Gulch site to generate conservation revenue, in the context of traditional environmental markets, include use of the site for conservation banking and/or stream banking. An additional opportunity for water quality banking, or for a PES program, may exist if the site is found to be a source of sediment or other pollutants that are of concern in Elkhead Lake or the Yampa River watershed.

Given the large size of the site and the diversity of habitats present, it may be possible to generate revenue in multiple market contexts, such as conservation banking and stream/water banking. However, prior to making a determination of whether or not these three sites can be used for any of the aforementioned purposes, additional technical studies including hydrology/water right evaluation, rare plant and wildlife species surveys, and habitat restoration feasibility assessments would be needed to determine whether or not credit generation is feasible.

(Antero-Salt Creek Site)

(Tamarack Site)

(Jimmy Dunn Gulch Site)

Conclusions & Recommendations

There are a variety of paths SLB may take in pursuing ecosystem services transactions. Those discussed in the conclusions section of the report include:

- Development of an ecosystem services asset pool.
- Development of a stewardship lease program to incentivize ecosystem services enhancement on state trust land holdings.
- Mitigation or conservation banking leasing or sales program, where the SLB enables third-party operators to develop ecosystem services credits on their holdings.
- Negotiation of payments for ecosystem services or watershed services (PES/PWS) arrangements with potential buyers.
- Mitigation or conservation banking program operated by SLB, which could provide compliance opportunities for both SLB's own activities on its holdings, or for impacts made by developers on other lands within the regulatory service area.

Each of the approaches examined in this report offers a viable path to developing a program within SLB for conducting ecosystem services transactions. As illustrated through the demand analysis, the site analysis, and the policy analysis in evaluating these transactions against the trust responsibility, significant opportunity exists for generating revenue for ecosystem services on state trust lands. The next step will be for SLB to determine whether development of this new asset pool fits within the agency's long term strategic plan, and choose the most appropriate programmatic path for pursuing those transactions.

Summary of Recommendations for Moving Forward

Recommendation #1: Develop a set of discrete and consistent criteria (metrics), specific to the ecosystem services present on state trust lands, such as wetlands mitigation or endangered species mitigation, to guide identification, evaluation and selection of trust land holdings appropriate for an ecosystem services market asset class.

Recommendation #2: The SLB should conduct a comprehensive inventory of its land holdings to identify the best and most marketable opportunities for ecosystem services.

Recommendation #3: Use ecosystem services market criteria to conduct a strategic assessment of the SLB's Stewardship Trust holdings.

Recommendation #4: The SLB should develop appropriate internal expertise and experience with ecosystem services markets in order to effectively evaluate opportunities and ensure the best return on investment.

Recommendation #5: The SLB should explore the full spectrum of possible approaches for participation in ecosystem service markets, from acting as a principal in mitigation banking to making trust lands available for third party operators involved in the creation and marketing of ecosystem services credits, and determine the appropriate path forward for the SLB in pursuing revenues from these markets.

Recommendation #6: The SLB should consider establishing a policy to guide the use of appropriate real estate instruments, such as conservation easements, on lands within the ecosystem services asset pool to enable them to qualify in providing mitigation banking credits.

Recommendation #7: Cultivate relationships with key regulating agency staff to facilitate access to current and emerging information about demand and opportunities for providing ecosystems services on the market.

Introduction

The opportunities available for large-scale landowners to capitalize on emerging ecosystem services markets spurred the Colorado State Board of Land Commissioners (SLB) to contract with the Sonoran Institute to examine the ecosystem services market potential of its state trust lands. The work embodied in this report was conducted by a consulting team consisting of staff from the Sonoran Institute, Solano Partners, and Parametrix.

The report includes four main elements in the analysis: (1) an overview of current and emerging requirements driving the demand for ecosystem services, including real estate, transportation, and energy development; (2) an assessment of the type and range of compensable ecosystem services on state trust lands, focusing on three trust land parcels within the Stewardship Trust; (3) a policy analysis for the ecosystem services marketing options available to the SLB; and (4) recommendations for structuring an SLB conservation/mitigation credit program.

Increasingly, state and federal agencies require measures to mitigate the negative impacts new development has on ecosystem elements such as threatened species, wildlife habitat, plant communities, and water quality. However, many jurisdictions find that traditional approaches to mitigation, such as on-site, in-kind, and project specific, fail to be cost effective or sustainable. One new method of mitigation – mitigation or conservation banking – allows mitigation to be done at fewer yet larger sites, thereby maximizing ecological benefits while minimizing unsustainable costs.

The use of a regional approach to mitigation on state trust lands in Colorado could result in significant revenue-generating and environmentally beneficial opportunities. The sheer size of the land portfolio under management by the SLB offers a substantial variety of mitigation opportunities.

Increasing the SLB's knowledge and understanding of the range and type of compensable ecosystem services on its trust land holdings serves to:

- Achieve a more complete understanding and analysis of the value of the trust lands portfolio;
- Increase the short and long-term value of its trust lands through better management of its land holdings and their inherent ecosystem services; explore and more fully understand new and emerging market opportunities that have potential for increasing revenue for trust beneficiaries; and
- Strategically position the SLB at the forefront of the emerging ecosystem services marketplaces.

SLB has recognized that the time is ripe for it to explore the opportunities presented by emerging markets for conservation mitigation. The higher level of management of natural values required for its Stewardship Trust parcels are expected to serve as a model for all its land holdings, and may be aligned with criteria that enable trust lands to be marketable for ecosystem services values. Moreover, the SLB's 2011 strategic plan calls for a complete portfolio evaluation of its state trust land holdings that will provide the SLB with a new framework to organize, understand, and manage those assets. The strategic plan specifically identifies ecosystem services markets as a potential new revenue-generating strategy available to the SLB:

Strategic Objective #2.3: Develop creative and diverse ways to produce income from conservation and conservation services.

- *Establish three pilot projects to test prospects for adding value to trust lands through marketing compensable ecosystem services by July 2012.*
- *Generate $10 million in revenue (including non-simultaneous exchange, conservation easements and lease revenue) from all trust lands by July 2016.*[1]

In short, since engaging in the emerging ecosystem services marketplace offers a significant opportunity for the SLB to increase and diversify its revenue-generating capacity, this report was commissioned to explore the types of ecosystem services available on their land holdings, and how programs might be structured within the SLB to pursue successful transactions.

Ecosystem Services Background

According to the Oregon Board of Sustainability, ecological values are defined as the "clean air, clean and abundant water, fish and wildlife habitat and other values that are generally considered public goods," while ecosystem services are "the benefits that human communities enjoy as a result of natural processes and biological diversity."[2] As the overall impact of human industries and activity on these natural values has grown, society has recognized a need to better account for the costs of environmental degradation. An increased interest has emerged on economic tools and systems that internalize these impacts as a cost of doing business.

The most robust ecosystem services markets currently in operation in the United States are those markets driven by regulations that require compensatory mitigation for adverse impacts to particular ecological features or functions. There are two primary federal laws that govern these transactions – the Clean Water Act (CWA), passed by Congress in 1972, and the Endangered Species Act (ESA), which was enacted in 1973. These are the primary regulatory programs that will be evaluated in this report's demand analysis, although ecosystem services demand arising from state programs unique to Colorado will also be reviewed.

As awareness has grown over recent decades regarding the ecological value of wetlands for flood control, water filtration, sediment trapping, and wildlife habitat, a national wetlands policy was developed with the goal of "no net loss" of wetlands areas.[3] In response, the CWA Section 404(b)(1) Guidelines were developed to include a three-step mitigation sequence to be followed by anyone proposing a project with potential impacts to wetlands, streams, and other aquatic resources: avoidance, minimization, and compensation. Under these guidelines, proposed impacts must first be avoided to the maximum extent practicable. If avoidance is impossible or impractical, the developer must minimize the negative impacts through project modification and permit conditions. Finally, appropriate compensatory mitigation is required for unavoidable adverse impacts that remain after all appropriate and practicable minimization has been required.

Similar mitigation for negative impacts of development and habitat disturbance is required under ESA. The ESA's goal is to protect critically imperiled species, and to maintain and ensure recovery of those populations once the species is listed under the ESA by removing or mitigating the threats to their continued persistence.

Like CWA Section 404 on wetlands mitigation banking, conservation banking is a method available under the ESA that allows a permit applicant to purchase credits for mitigation of impacts to endangered species associated with a development project. A conservation bank is a parcel of land that supports the natural habitat of one or more species listed under ESA, and is conserved and managed in perpetuity through a conservation easement.[4] Similarly to mitigation banks, the value of the bank's natural resources are translated into quantified "credits" that may then be purchased to offset impacts to the same resources that occur elsewhere. Credit prices incorporate funding for long-term management and protection of conservation values.[5] The basic objective of the conservation banking program is to reduce the piecemeal approach to conservation efforts that can result from individual projects through establishment of larger reserves and enhanced habitat connectivity within a market framework.[6]

Common Terms

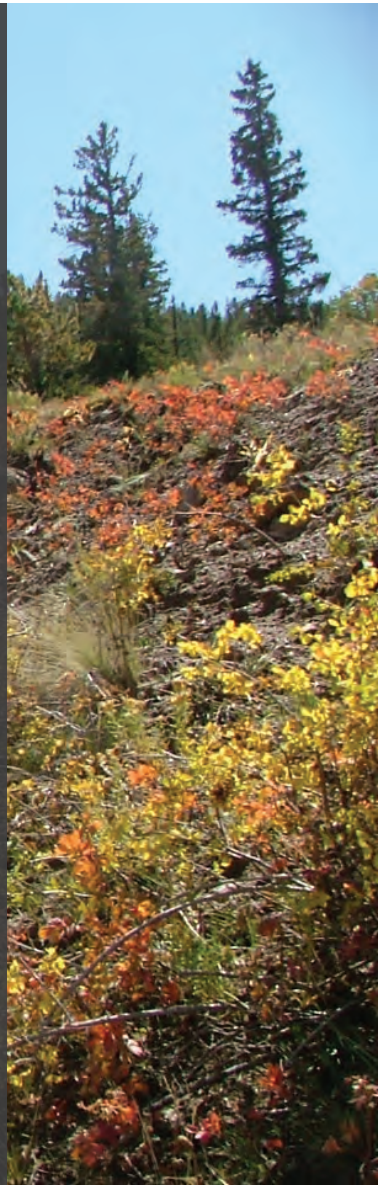
Ecosystem Services - The benefits that accrue to human communities as a result of natural processes and biological diversity.

Mitigation Bank - Mitigation banking is the restoration, creation, enhancement, or preservation of a wetland, stream or habitat conservation area which offsets expected adverse impacts to similar nearby ecosystems.

Conservation Bank - A conservation bank is a single or series of contiguous or non-contiguous parcels of habitat that are managed for their natural resource values, and are used to protect threatened and endangered species habitat.

Payments for Ecosystem Services - Payments for ecosystem services (PES) is broadly defined as the practice of offering incentives to landowners in exchange for managing their land to provide some form of ecosystem service.

Payments for Watershed Services - Payments for watershed services (PWS) are largely recognized as a subset of PES, where the watershed services are at least one of the ecosystem services targeted for provision.



SLB manages 2.88 million surface acres trust lands, which are most heavily concentrated in the eastern grasslands, but also exist in a checkerboard pattern throughout the state. There are a few consolidated parcels of trust land, including large areas near Colorado Springs and Pueblo that encompass several hundred square miles. State trust lands in Colorado contain 17 million linear feet of streams, comprising 4% of the state's stream resources.[7] Additionally, 3% of the wetlands in the state, or 15,000 acres, are located on state trust land holdings.[8] The SLB holds 400 surface water rights and 2,200 well permits.[9] While designated critical habitat for only two of the state's 16 endangered and threatened species has been mapped, Colorado state trust lands provide over 13,000 acres of habitat for those two endangered species: 12,949 acres of habitat supporting the threatened Mexican spotted owl, and approximately 400 acres of habitat for the threatened Preble's meadow jumping mouse.[10]

The demand analysis conducted for the SLB provides detailed information regarding potential sources of demand for ecosystem service related values that could be produced from conservation or restoration actions on SLB properties. Sources of demand include (1) project impacts that require compensatory mitigation under federal or state laws; (2) project impacts that may provide pre-compliance mitigation for species that are of concern, but are not yet listed; and (3) downstream water users who may desire up-stream watershed protection.

Programs in the United States that drive revenue to protect and restore wetlands, streams, species habitat, and source water in addition to various pollution reduction programs have all expanded in the past decade. In fact, precedent for this kind of conservation related income generation has been set in Colorado.

Amendment 16 revisions to the charter of the SLB eliminated the requirement that the school land board manage the school lands in a manner that "will secure the maximum possible amount," replacing it with language that requires the land board manage its holdings "in order to produce reasonable and consistent income over time." This new focus on the intergenerational and perpetual nature of the trust places the SLB in a position to take advantage of new categories of revenue derived from new and emerging environmental markets.

This report's demand analysis is organized into five categories of potential demand, and contains the following sections:

- Highways and other transportation infrastructure
- Up-stream/down-stream links: Denver Water Board purchases of water-related values from U.S. Forest Service (USFS) upstream properties
- Renewable energy, oil and gas development
- United States markets for carbon sequestration
- Status of conservation and mitigation banking in the state of Colorado

Each section provides information on (1) sources of demand; (2) requirements for credit production (or equivalent) for each type of ecosystem service; (3) available pricing and volume information; and (4) market trends for each source.

Demand for compensatory mitigation or other environmental restoration intended to balance the impact of growth is generally affected by economic conditions. Colorado, like the rest of the country, has experienced an economic slowdown during the current recession, and construction and development related impacts requiring mitigation have likewise slowed for the time being.

Still, the state has significant unmet transportation infrastructure needs, and mineral, oil and gas extraction, in addition to renewable energy and energy infrastructure development, continue apace. For example, the 2012-17 State Transportation Improvement Program allocates $8.7 billion for construction, reconstruction, or maintenance projects.[11] Also, more than 100 bridges that are in the worst repair in the state are still awaiting renovation after the state began collecting new fees to fix them. According to the Baker Hughes rig count, the pace of drilling in Colorado is now just short of the 20-year high it reached before the recession, and increased 31% in the past year. Wind projects in particular continue to seek permits following the passage of Amendment 37 – a statewide ballot proposition passed in 2004 - which set the country's first voter-approved renewable energy requirement at 10% by 2015, and the subsequent expansion of this requirement to 30% by 2020 following the signature of HB 1001 in March 2010.

Apart from trends in public sector spending on infrastructure and energy, is the basic fact of population growth. Colorado's population of just over 5.1 million in 2010 is projected to reach over 7.1 million as soon as 2030.[12] This 39% increase over a period of just 20 years will doubtlessly result in significant environmental pressures that will require a variety of offsets. New environmental market mechanisms that enable the sale of verifiable habitat, as well as water and climate related benefits, provide the opportunity for SLB to assist in regional conservation and restoration objectives while fully meeting its fiduciary obligations and diversifying its revenue portfolio.

Analysis of Ecosystem Services Market Demand in Colorado

Highways and Other Transportation Infrastructure

Background

Transportation projects must meet a wide range of environmental permit conditions, including compliance with federal regulations rooted in the Endangered Species Act (ESA) and Clean Water Act (CWA) to avoid, minimize and mitigate impacts. As is the case with state transportation departments across the country, the Colorado Department of Transportation (CDOT) has taken advantage of environmental market options to meet various permit requirements, thus finding innovative ways to accelerate construction project delivery. Generally, purchasing compliance credits from restoration activities that have already met success criteria set by federal and state environmental agencies is faster and less expensive than undertaking a similar restoration project to achieve compliance – a process that may take up to eight years or more to complete because landowners may complete projects in advance of demand for compliance, and then "bank" credits that can be drawn against specific projects as needed.

To provide a sense of the scale of the potential demand resulting from transportation projects, CDOT awarded 154 contracts for highway and bridge construction projects totaling $427.5 million in FY 2010. CDOT is also responsible for multi-modal transportation initiatives of various kinds. The Regional Transportation District (RTD) FasTracks project will build 122 miles of new commuter rail and light rail, 18 miles of bus rapid transit, and 21,000 new parking spaces at light rail and bus stations across an 8-county district. These projects require significant compliance opportunities on which the SLB could capitalize.

The Natural Resources Section within the Environmental Programs Branch of CDOT is responsible for assuring full compliance with the environmental laws that make use of compensatory mitigation structures that could drive demand for values produced through conservation or restoration produced by SLB properties. CDOT's Natural Resources staff for both wildlife and wetlands impacts were interviewed for this study.

Interviewed for this section of the study

Deborah Froeb, The Nature Conservancy, Colorado
Kate Fay, Environmental Protection Agency, Region 8
Forrest Mertens, SunOne Solutions
Ted Toombs, Environmental Defense Fund
Terry Fankhauser, Colorado Cattlemen's Association
Michael Dowling, Colorado Oil and Gas Conservation Commission
Jeff Petersen, Colorado Department of Transportation
Rebecca Pierce, Colorado Department of Transportation

Demand Summary

CDOT has addressed its need for species and habitat related mitigation in the eastern portion of Colorado through the Shortgrass Prairie Initiative, which created advance mitigation for impacts to a number of species including grassland birds, the prairie dog, burrowing owl, swift fox, and ferruginous hawk. A detailed description of this program is provided later in this section. Discussion with CDOT staff responsible for managing wildlife impacts and mitigation programs indicates that there are possible future opportunities to provide habitat mitigation in the central and western portions of the state.

CDOT has been utilizing compensatory mitigation for wetland impacts since 1999 with the development of a CDOT sponsored mitigation bank in the Town of Limon in Lincoln County Colorado, which has a service area that includes much of southeastern Colorado. Service areas, the area in which a mitigation bank is allowed to sell credits, are determined by the United States Army Corps of Engineers (USACE) as part of the bank approval process, and usually are limited to a single defined watershed. CDOT has begun the development of an additional mitigation bank in El Paso County, although a specific location for this bank has not yet been identified. Another project to develop a bank in Clear Creek County between Georgetown and Empire Junction is also in the preliminary stages of permitting. Both of these projects are intended to develop credits solely for use by CDOT.

CDOT has also purchased mitigation credits from several private mitigation banks, particularly in the Metro Denver area. These credits, purchased in bulk from three commercial banks in the Front Range region in 2004, are being drawn down as small individual impacts occur. Additional credits have been purchased by the Grand Junction CDOT office from a bank in the Oak Creek region, and credits have also been purchased for impacts in the Gunnison Valley and the Animus River regions.

CDOT has continued to do some on-site mitigation work, but they are attempting to minimize this in order to get habitat related to mitigation out of transportation corridors. As CDOT pursues this direction as part of developing the agency's mitigation strategy, they have arranged partnership projects that utilize land belonging to other entities. For example, CDOT is financing a mitigation project on a Summit County property for which the County will be the long-term land manager. Other examples of this trend include projects with State Parks and Wildlife and with Boulder County. These partnerships are covered by formal Letters of Intent with the USACE describing the conservation objectives and management requirements for each parcel used for mitigation.

CDOT staff indicated several regions of the state where projects currently in the design phase may require additional mitigation, including the Fort Collins area and Summit County. There are existing mitigation opportunities where the Durango office has had a number of impacts falling outside of the service area of the Animus River commercial bank – between Durango and Wolf Creek Pass. In addition, there are significant projects in the planning phase for bridge repair in various locations around the state. According to CDOT Executive Director Don Hunt, 97 of 121 bridges identified as requiring priority repair are awaiting construction in various stages of the design and permitting process. Combined, these pose a broad range of potential opportunities for the SLB to negotiate with CDOT and USACE to provide compensatory mitigation offsets on appropriate state trust lands within the service areas.

The RTD FasTracks project in the Denver metro area is a multi-billion dollar program developed to expand commuter and light rail lines throughout the region and provide additional transportation options to area residents. The FasTracks manager of corridor planning stated that FasTracks has purchased 2.13 wetland credits to date, and has identified an additional 12.77 credits of probable future demand over the next 10 years. While there are some exceptions to the rule for technical reasons, each 'credit' is generally equivalent to one acre of a particular type of wetland. Thus, in order to achieve CWA goal of "no net loss of wetlands", an impact to an acre of "palustrine emergent wetland," for example, would require an offset of at least one, or more likely, two credits for this same type of wetland. USACE has required that FasTracks purchase credits from the Middle South Platte Mitigation Bank in Johnstown, Colorado for past impacts. In addition, FasTracks has immediate need for access to properties for Prairie Dog relocation in order to meet permit requirements for the east corridor development of the Denver airport. While pricing for permission to relocate Prairie Dogs is not yet clear, initial discussion appears to be in the range of $100 per animal.

Pricing for wetland credits appears to be relatively consistent across the state, with prices ranging from $70,000 to $87,000 per acre in recent sales. In 2004, prices ranged from $59,000 to $65,000 per acre, and appear to have appreciated consistently over time.

The CDOT Shortgrass Prairie Initiative – A regional model for advance mitigation

The Shortgrass Prairie Initiative (SPI) is a Memorandum of Understanding (MOU) between CDOT, the Federal Highway Administration (FHWA), the United States Fish and Wildlife Service (USFWS), the Colorado Department of Natural Resources, the Colorado Division of Parks and Wildlife, and The Nature Conservancy. It was developed in order to identify impacts to the shortgrass prairie ecosystem from CDOT projects listed in the 20 year transportation plan and provide mitigation solutions in advance of their construction.

Species included in the Shortgrass Prairie Initiative habitat management plan include:

Black-tailed Prairie Dog
Botta's Pocket Gopher (rubidus subspecies)
Northern Pocket Gopher (macrotis subspecies)
Swift Fox
Lesser Prairie Chicken
Western Snowy Mountain Plover
Long-billed Curlew
McCown's Longspur
Cassin's Sparrow
Lark Bunting
Loggerhead Shrike
Burrowing Owl
Northern Cricket Frog
Texas Horned Lizard
Massasauga Rattlesnake
Western Box Turtle
Arkansas River Feverfew
Pueblo Goldenweed
Golden Blazing Star
Round-leaf Four-O'clock
Colorado Butterfly Plant
Arkansas Valley Evening Primrose

Shortgrass prairie is one of the most threatened types of ecosystems in the United States due to the cumulative effects of agricultural and other development, development of dams and irrigation systems, invasive species, and other factors. Colorado's portion of the central shortgrass prairie ecosystem covers one-third of the state from approximately Interstate-25 to the Kansas border, totaling over 27 million acres, 91% of which is in private ownership.

The SPI, signed in January 2000, was intended to address in advance CDOT projects that affect critical species habitat – for species formally listed as "endangered" under the ESA or for species at significant risk of listing – and thereby avoid extensive, time consuming, and expensive project-by-project reviews. During a 20 year planning process, CDOT had identified over 15,000 acres of total potential impacts to shortgrass prairie habitat from bridge repairs, resurfacing, road widening, and other safety and capacity construction projects. The Nature Conservancy's ecoregional planning process was used to synthesize the knowledge of federal and state agency, university, and non-governmental organization (NGO) experts to determine viable communities and functional conservation areas, and design preserves and conservation measures.

The result of this process is a formal programmatic ESA Section 7 consultation and conference report to the USFWS that protects multiple species and six aggregated habitat types on approximately 32,000 acres under a habitat management plan. According to The Nature Conservancy, the initiative is expected to save up to $30 million in CDOT project costs over a 20 year period.[13]

The relevance of this model for the SLB is that it demonstrates a large-scale advance mitigation approach whereby multiple impacts in a geographic region, concentrated offsets, and associated revenue form a single 'landscape scale' conservation area. This approach offers clear ecological benefits over fragmented mitigation projects located within highway right-of-way, and it enables a new source of financing for significant conservation in Colorado. As a large landowner in the state, the SLB would be uniquely positioned to conduct mitigation at this scale, and on a long term planning horizon.

Water Quality and Watershed Management

Background

Programs that offer payments for ecosystem services (PES) from watersheds are in place in the United States and around the world. These programs have been expanding in number and size over the past two decades. While the buyer of services is most commonly a government entity, these programs differ from conventional conservation funding in that they pay upstream land managers for behaviors and outcomes intended to protect water quality or quantity for downstream users.

According to a 2010 publication from Ecosystem Marketplace, there are currently a total of 113 payments for watershed services (PWS) programs in varying stages of activity around the world.[14] In 2008, their annual transaction value was approximately $9.3 billion. While the majority of the transaction volume occurs in China and Latin America, 10 programs identified in the United States had a combined 2008 transaction value of approximately $1.35 billion. The programs in the U.S. that pay for watershed services include four municipal programs that protect drinking water services and an infrastructure grant program. However, the preponderance of funding comes from

Farm Bill Conservation Title programs including the Wetland Reserve Program and the Conservation Reserve Program. State governments also play a role in facilitating payments to protect watersheds with funds allocated by US EPA CWA Section 319 program.

The U.S. model for municipal payments used to protect drinking water was pioneered by New York City in the 1990s. The city allocated funds for specific measures including riparian setbacks and planting, fencing to keep livestock out of waterways, and improved animal waste management practices, along with traditional conservation easement purchases, and has put these programs in place for approximately 35% of the Catskills source watershed. Over 91% of the farms eligible for participation voluntarily joined the program.[15] Other regions utilizing a similar approach include the Quabbin and Wachusett watersheds above Boston, the Hetch Hetchy watershed above the San Francisco Bay Area, and the Cedar River watershed above Seattle. Taken together, these programs have spent over $1.6 billion protecting water quality through conservation actions taken on well over two million acres.

In addition, the United States Forest Service (USFS) has initiated the Forests to Faucets project that capitalizes on the connection between forests and water quality by utilizing payments from municipal water authorities to pay for watershed treatments that reduce the risk of catastrophic fire and resultant sediment flows. One example comes from Santa Fe, New Mexico, where the Water Division created a 20-year watershed plan, which included a financial mechanism intended to supplement standard USFS forest management activities to ensure future supplies of high quality water.

Santa Fe is the first city to use a PWS approach to fund the maintenance of forest restoration activities essentially as an insurance policy against future degradation of water supply. The city received a five-year watershed restoration grant from the state to begin payments for watershed treatments, ecological monitoring, and public outreach regarding PWS. During this phase, which began in 2009, the water user billing statement shows the PWS project as a credit. Beginning in 2014, a fee will be assessed to each water user amounting to roughly $6.50 per year for the average household. The city has established a collection agreement with the USFS to transfer the payments, which will cover about 50% of the actual forest management costs.

Demand Summary

In August 2010, Denver Water and the Rocky Mountain Region of the USFS announced a significant joint initiative utilizing the Forests to Faucets approach. PWS demand in Colorado results directly from a Memorandum of Understanding signed in July 2010 between the Regional Forester of the USFS Rocky Mountain Region and the CEO of Denver Water. The two organizations agreed to split the cost of a $33 million investment in restoration projects on approximately 38,000 acres of National Forest lands.

While the USFS conducts thinning and fuel load reduction activities on an ongoing basis, Denver Water wanted these activities to be conducted on specific sites that are critical to water supplies on an expedited timetable. The $16.5 million contribution over a five year period by Denver Water to these activities will accelerate and expand forest treatments around and upstream of Strontia Springs, Gross, Antero, Eleven Mile Canyon, and Cheesman reservoirs, as well as in an area near the town of Winter Park. The projects will reduce the risk of wildfires upstream of Denver Water's reservoirs and other water delivery infrastructure.

Pine bark beetle infestation and fire suppression has greatly increased fuel loads in many Colorado forests, thereby increasing the threat of a crown fire that kills off trees on large tracts of land. After the 12,000 acre Buffalo Creek fire in 1996 and the much larger 138,000 acre Hayman fire in 2002, more than one million cubic yards of sediment accumulated in Strontia Springs Reservoir as a result of erosion and runoff following the fires. Prior to the wildfires, the reservoir had approximately 250,000 cubic yards of sediment, which had been accumulating since 1983 when the dam was completed. The additional sediment that resulted from the fires created operational challenges and water quality issues.

Denver Water spent more than $30 million on a project to remove 625,000 yards of sediment.[16] Compared to the difficulty and expense of this endeavor, watershed treatments are now seen as a realistic and cost-effective threat reduction strategy.

The opportunity exists for the SLB to determine if state trust lands upstream of reservoirs could participate in programs that protect water quality, similar to those put in place by Santa Fe and Denver Water.

Renewable Energy, Oil and Gas Development

Background

Energy infrastructure development and resource exploration pose major threats to natural landscapes, land, and wildlife in the Rocky Mountain West, and these threats are likely to increase dramatically in the near future. Over the next 20 years, 100,000 new oil and gas wells and 100,000 new wind turbines are expected to develop in the western United States with a land footprint of two million and twelve million acres respectively. Energy infrastructure has been and continues to be a major source of habitat loss for many wildlife species, in particular, the Greater Sage Grouse and the Lesser-Prairie Chicken which are indicator species of the overall ecological health of sagebrush and grassland ecosystems.

If the Greater Sage Grouse and the Lesser Prairie Chicken, were listed as "endangered" under ESA, they would impact livestock grazing, oil and gas development, and wind development across 17 states. While listing decisions are subject to many exogenous factors, there is at least some informed opinion that the Lesser Prairie Chicken is likely to be listed within two to three years in the absence of significant near-term conservation action.

The American Wind Wildlife Institute (AWWI) is a non-profit organization that represents both the largest wind power development companies in the United States and many of the leading wildlife and bird conservation groups. As a baseline for future work, AWWI commissioned a comprehensive study by Solano Partners on current compensatory mitigation practices and legal requirements, released in June 2010.[17] Several large wind power companies, including British Petroleum Wind Energy, and Iberdrola, are in the early stages of developing a multi-state Habitat Conservation Plan for the Whooping Crane, Lesser Prairie Chicken, and other species.

Significant oil and gas developers, including Bill Barrot Corp., Encana, and Williams have participated in initial discussions about the idea of investing in conservation activities to benefit threatened species if the specific outcomes of those investments could be recognized by state and federal wildlife agencies as a form of "advance compliance credit". Such an advance compliance credit could theoretically stimulate investment in habitat protection and restoration, and forestall or eliminate the need for listing. Colorado Division of Parks and Wildlife (CPW), Colorado Department of Natural Resources and USFWS have all participated in discussions about this type of crediting for early action, as have the Environmental Defense Fund, Partners for Western Conservation, the National Wildlife Federation and The Nature Conservancy.

In addition, The Nature Conservancy has been using its Energy by Design process in several watersheds in Wyoming and Colorado. Energy by Design uses quantitative assessment techniques to provide offsets that are scientifically relevant to specific impacts from oil and gas development.

Demand Summary

Apart from the SPI discussed above, Colorado has put forward various Wildlife Mitigation Plans (WMP) that provide some level of biodiversity and habitat offsets for impacts. There are seven completed WMP that cover over 320,000 acres in the state, and companies that have agreed to participate include Encana, Antero, Marathon, Noble, Black Hill, Williams, and ExxonMobil. While the compensatory mitigation requirements are often a form of 'in lieu' payment, which does not require an objective form of measurement relating offsets to impacts, they nonetheless represent the type of habitat conservation value proposition that could be provided by SLB lands in the future.

Table 1: Wildlife Management Plans in Colorado

Company	WMP Description	Cost
Encana	Fund CPW Piceance Basin research projects.	$900,000 over five years
Antero	Annually fund projects selected from a list of "mitigation opportunities/projects recommended by the CPW". Options include: yearly contribution of $15,000 to support wildlife rehabilitation center; annual weed treatment in the Valley Farm area for three years; inventory and mapping of noxious weeds in the WMP area; improvements at Burning Mountain on BLM land in the northeast corner of the WMP; and removal of Russian olive and tamarisk along the riparian corridors leading to the Colorado River.	N/A
Marathon	Meet annually to discuss implementation of compensatory mitigation projects.	N/A
Noble	Rehabilitation of the Battlement Mesa Reservoirs south of the project boundary. This funding occurred in 2010 and 2011 and enabled CPW and other agencies to help create a purebred gene pool of cutthroat trout for restocking the Colorado River. Contribution to the Colorado Mule Deer Association to mitigate impacts to big game.	$180,000 initial contribution
Black Hills	Habitat restoration, installation of water sources, weed treatment, and stream improvements – both "on site and off site".	23,420 acre project/ requirement of $200 per acre for "all new disturbance and reoccupation of existing pads"
Williams	Wide variety of activities on nine potential mitigation areas, including hayfield/pasture maintenance, weed control, leaving hay cuttings to benefit deer and elk, and controlled burns.	N/A
ExxonMobil	Hydro-axe removal and reclamation on approximately 1,200 acres for invasive species control and improvement of mule deer habitat.	Up to $565,000

For additional detail on the latest developments that address impacts from oil and gas development on wildlife habitat in Colorado, please see Memorandum from Colorado Department of Natural Resources on Addressing Impacts of Oil and Gas Operations, dated August 12, 2010.[18]

In addition to the formal requirements by CPW, there is also significant interest in credit trading frameworks that could provide significant operational and regulatory benefits to the energy industry, create positive conservation incentives for private landowners, transform how ESA is administered, and create significant net benefit to species speeding their recovery and making listing unnecessary.

More broadly, it is clear that multiple stakeholders across the western United States have a mutual interest in establishing and utilizing credit trading systems to stimulate private investment in conservation in return for greater certainty of future energy development and other commercial land uses. There are various efforts underway to build consensus around the design principles for such a credit trading framework that supports Colorado and other western states' wildlife and range resources in which the SLB could participate with the goal of providing offset credits in the future.

United States Markets for Carbon Sequestration

Background

Revenue from land management practices that provide scientifically verifiable storage, or sequestration, of carbon continues to flow to forestry and agricultural projects despite the federal government's inability to reach a decision regarding national climate policy. Both voluntary markets and offsets eligible as a compliance option under California's AB32 legislation are sources of demand.

At the global level, 2010 total emissions reductions equivalent to 131.2 million tons of CO_2 ($MtCO_2e$) were transacted in voluntary carbon markets. Compared to the 98 $MtCO_2e$ transacted in 2009, volumes grew by 34% to exceed historic volumes. Land-based projects supplied the largest volume (28 $MtCO_2e$) of credits transacted in the over the counter (OTC) market where conservation efforts and international politics directed attention to projects that reduce emissions from deforestation and forest degradation (REDD). REDD projects alone generated 29% of credits transacted in the voluntary market. The OTC market added six new countries to its roster of project locations, extending voluntary carbon finance to a total of 45 countries. North America maintained its top spot among project locations to originate 35% of transacted OTC volume – 94% of which was generated in the United States.

The California cap-and-trade program began implementation in 2011 as other states, such as New Jersey and Arizona, and entire regions, like the Midwest Greenhouse Gas Reduction Accord, shelved plans to engage in regional emissions trading. The program started on January 1, 2012, with an enforceable compliance obligation beginning with 2013 greenhouse gas emissions, but pre-compliance activity is ongoing with suppliers positioning projects to meet projected demand. Despite the legal, regulatory and policy hurdles facing implementation of formal markets for carbon offsets in the U.S., over 6.5 $MtCO_2e$ from forestry and other land use projects was sold in 2010.

Demand Summary

The three specific types of projects that are eligible for credit under the California offset program are: reforestation or afforestation projects; improved management practices that increase carbon stocks over time; and "avoided conversion" projects that prevent forest land from being converted to other uses. Voluntary market transactions may include grassland and soil sequestration projects as well.

Four specific types of demand for carbon offsets from forestry or land use may have relevance to the SLB's strategy of increasing revenue related to conservation actions. The first potential source of demand is the Xcel Energy program that allocated funding for offsets on a voluntary basis. Xcel Energy has made a public commitment to reducing CO_2 emissions 20% below 2005 levels by 2020 and has already reduced 11%, approximately 26 million tons, cumulatively since 2003. The company has been the nation's leading wind energy provider for the past six years, is ranked fifth among U.S. utilities for solar capacity, and boasts the largest U.S. voluntary green energy program by customer participation.

Xcel's Colorado carbon offset pilot program has committed over $4 million for purchase of offsets, and a 2009 RFP process selected three projects, including one that made use of a Climate Action Registry approved forestry project.[19] Xcel has a stated preference to "purchase tonnes from Colorado based projects", and could conceivably be a purchaser of verified offsets produced on SLB lands in the future.

The second opportunity to provide carbon offsets comes from offering pre-compliance credit to the Colorado Carbon Fund (CCF), which was created by the Governor's Energy Office in 2008 to help individuals, business owners, and event planners measure, reduce, and offset their carbon emissions. The CCF is currently one of the few statewide voluntary offset programs in the U.S., and focuses its support on greenhouse gas (GHG) reduction projects in Colorado that produce permanent, verifiable carbon offsets.

The CCF is actively looking for projects around the state that meet its quality and verification standards, and use the Climate Trust – a national leader in voluntary offset programs – to help select projects that improve the environment and result in high-quality carbon offsets. While CCF is not currently prioritizing forestry or land-use based offsets, this program could conceivably purchase verified offsets produced on SLB lands in the future.

The third potential for demand is California based emitters who seek compliance credits under the California Air Resources Board standards. Pacific Gas & Electric, Chevron, PacifiCorp and many others may purchase offsets under the protocols that implement the AB32 legislation as part, up to eight%, of meeting their compliance obligations. Forestry projects are eligible to meet those obligations, and do not necessarily need to originate from California sources to meet compliance obligations.

Finally, buyers seeking credits that meet various voluntary standards are a possible source of demand. Various companies have programs in place to offset emissions from an entire firm or from specific product lines, and brokers and aggregators try to combine demand for offsets and renewable energy certificates. For example, Chevrolet has made a commitment to buy $40 million worth of offsets, and has invested in forestry projects as well as wind power, and landfill gas projects.

While per acre revenues from carbon offsets will vary based on location and the species, age and density of the trees at the project location, the specific certification standard chosen, and competitive issues within the market, a general benchmark for consideration are:

- $1,000 and $3,000 per acre over a 25-year period for avoided conversion to non-forest development; and
- $50/$70 per acre per year for improved management.

Status of Conservation and Mitigation Banking in Colorado

Conservation Banking in Colorado

Conservation banking in the United States is enabled by the legal requirements of the ESA. Specifically, Section 7 requires federal agencies to consult with the USFWS regarding potential impact to threatened and endangered species, and Section 10 requires "incidental take permits" and Habitat Conservation Plans for those impacts. The USFWS is the principal agency that administers the ESA with respect to terrestrial and freshwater species, while the National Marine Fisheries Service is the lead agency with respect to marine and anadromous species.

On May 2003, the USFWS released the official federal guidance for the establishment, use, and operation of conservation banks. This guidance was closely modeled after the State of California's guidance for conservation banks, which has been in place since 1995. While a "Conservation Banking Agreement" is the most standardized mechanism for creating bankable endangered species credits, other legal agreements have been used in the past, such as: wetland banking agreements, safe harbor agreements, habitat conservation plans, and memorandums of agreement.

There are approximately 120 formal conservation banks permitted by the USFWS that provide mitigation credits for listed species. These banks have altogether permanently protected approximately 120,000 acres across 11 states. Colorado has had limited involvement with species banking to date.

In addition to SPI described above in the transportation section, there is one formal conservation bank in the state of Colorado. The East Plum Creek Conservation Bank located in the town of Castle Rock in Douglas County is owned by CDOT. It has protected 25.3 acres specifically for the benefit of the Preble's meadow jumping mouse and the habitat upon which it depends.

Mitigation Banking in Colorado

Mitigation banking is enabled by the Section 404 of CWA to address the unavoidable impacts to water resources, wetlands, and streams from human activities. Development projects are required to first avoid and then minimize any impacts to regulated natural resources. When the proposed impacts have been deemed unavoidable by the USACE, which administers Section 404 of the CWA, the developer must either mitigate the impact on site or purchase credits, typically watershed based, from a mitigation bank located in the same service area.

New regulations governing compensatory mitigation under Section 404 of the CWA are increasing demand for credits from certified wetland or stream mitigation banks. These new regulations, issued April 10, 2008 as the Rule on Compensatory Mitigation for Losses of Aquatic Resources, prioritize the use of credits from mitigation banks as the source of mitigation for impacts to aquatic resources. Credits are allocated to a bank based on a system that evaluates the level of "ecological uplift" accomplished by the bank on that site. These credits can then be sold via arms-length, "willing buyer, willing seller" transactions. The buyers are entities required by the Interagency Review Team to offset unavoidable damages elsewhere within the bank's service area. Credit prices are entirely market driven and are in no way set or directed by the federal, state, or local regulatory agencies.

There are approximately 1,000 formal mitigation banks permitted by the USACE that provide mitigation for wetland and stream impacts. These banks have altogether permanently protected and restored approximately 1,000,000 acres in the United States. As of the date of this report, Colorado has 11 approved wetland mitigation banks, which are described in more detail below.

Colorado is under the jurisdiction of two different USACE Divisions – the South Pacific and the Northwestern Divisions. Within the South Pacific Division, the Sacramento and Albuquerque District oversees the western and southern portions of the state, while the Kansas City and Omaha District within the Northwestern Division oversee the eastern and northern portions of the state. This is significant, because each District has discretion over details important to the implementation of the mitigation banking system. Six Colorado banks have been approved by the Sacramento District, and five by the Omaha District.

Table 2: Sacramento District Approved Mitigation Banks in Colorado

Name	Location	Size (acres)	Comments
Animas River Wetlands	Durango	50	Both wetland and shaded riverine aquatic credits
Finger Rock Preserve	Steamboat Springs	255	
Mesa County Wetland	Grand Junction	8	Owned by Mesa County Department of Public Works
Rocky Mt. Institute	Snowmass	60	
Spring Water Ranch	Grand Junction	60	
WetBank Gunnison	Snowmass	109	
TOTAL		542	

Table 3: Omaha District Approved Mitigation Banks in Colorado

Name	Location	Size (acres)	Comments
Middle South Platte River	Johnstown	63	
Mile High Bank	Brighton	30	Marsh, Meadow and Shrubland subtypes
Riverdale	South Platte	14	
Warm Springs Wetlands	Snowmass	198	Fen, Riparian Shrub and Meadow subtypes
Marshall	Boulder	21	Sold out
TOTAL		326	

A total of 868 wetland acres have been protected and are in the process of being restored through mitigation banking in Colorado. If we assume a retail value of $75,000 per credit, then the market value of this restoration is in the range of $65 million.

Site Selection

The Colorado State Board of Land Commissioners (SLB) wished to examine specific parcels of state trust land holdings for their ecosystem services potential through this study in order to demonstrate the concept on its land holdings. In order to initiate the site selection process for the detailed on-the-ground assessment of ecosystem services potential, SLB staff prepared a list of potential priority sites. Finding new market sources for revenue was identified as an overarching goal of the SLB. With the SLB strategic plan as reference, staff outlined a goal of generating up to $10 million in revenue from conservation and conservation services.

Initially SLB staff was interested in examining ecosystem services on state trust lands that represented a variety of ecosystems, i.e. high plains, montane forest, or perennial streams. However, given the high priority to demonstrate a "proof of concept" of ecosystem services, staff agreed it was more suitable to identify properties with readily marketable ecosystem services that would be able to provide a "proof of concept" upon which to model transactions.

This focused the pilot study's efforts on parcels that could result in an actual transaction, and worked to match supply of marketable ecosystem services values with demand for those services. Demand drivers had already identified three opportunities that would help narrow the site selection process.

Species and Habitat Mitigation Demand from Energy and Transportation Infrastructure

Demand will result from energy and transportation infrastructure development that requires species and habitat mitigation, not just for species already listed under the Endangered Species Act (ESA), but perhaps also for those that are candidates for listing and may soon be officially protected. The potential exists for advance mitigation for species such as prairie chicken and sage grouse, as well as habitat receiving areas for displaced prairie dogs through the Regional Transportation District (RTD) mitigation program. Mitigation for endangered and threatened species will continue to be a major driver of demand for ecosystem services, and cover a range of habitat types.

Water and Carbon Mitigation for Watershed Health

Forested landscapes could offer mitigation potential both for carbon sequestration and for forest management actions that protect watershed health. The Denver Water Board has already implemented a payment for ecosystem services (PES) system to pay upstream forest managers for improved wildfire management and forest treatment practices to improve water quality and reduce sediment load in reservoirs. A forested parcel within Denver Water Board's catch basin could also provide carbon benefits. Such opportunities for "bundling" of ecosystem services, such as water quality, carbon sequestration, and recreation, will be examined, and could assist in helping ecosystem services revenues compete with traditional uses. While state trust land parcels within the catch basin serving the City of Denver's water supply could have potential for serving water quality mitigation, parcels within the catch basin of other cities could also merit exploration.

Offsets for Mineral Leasing

Also discussed was a means to manage Colorado's state trust land assets in a way that could also drive revenue for conservation – where the Stewardship Trust could, in a sense, become a demand driver in and of itself. Mineral leasing arrangements could be structured to require offsets for impacts that disturb critical habitat or environmental features of trust lands and provide revenues for improving the ecological health of other state trust land holdings. The Niobrara formation, a significant oil and gas play, could benefit from making large scale advanced mitigation available to the industry. Also, with the large number of state trust land parcels located on the eastern side of the state, oil and gas development could be a significant demand driver in that region.

The Colorado Department of Transportation's (CDOT) Shortgrass Prairie Initiative was discussed as a mitigation model that has worked well. CDOT currently has a lot of capacity in their bank, so they are not a probable buyer for ecosystem services on state trust lands. However, the system could potentially be a good framework to emulate for other ecosystem values and types. This type of model could be accomplished on some of the larger, contiguous state trust land properties under the right conditions and with the right demand drivers.

Site Selection for In-depth Analysis of Three SLB Properties

In identifying three state trust land parcels to be the subjects of the pilot project, a reverse selection process was recognized as being the most fruitful. The demand driver and criteria would be identified up front, and then sites would be selected to meet those criteria, given that adequate geographic, habitat, and market diversity spread were present. The project goal was to identify the three properties by the end of August 2011 so that the consulting team could conduct on-the-ground site assessments of those properties in September.

Two different types of models or transactions would be explored on these sites as well: the offset type, which is connected to mitigation and conservation banking; and the PES/ payments for watershed services (PWS) type. Transactions on the east and west side of the state were anticipated to take the form of offset type ecosystem services transactions. In the montane region, it was expected that there could be an opportunity for PES/PWS type transactions. The site selection would therefore identify three sites – one on the Western Slope, one on the Eastern Plains, and one in the montane region.

Western Slope site selection attributes: presence of sage grouse habitat, proximity to energy transmission or oil/gas development (perhaps northwest Colorado). There are also other habitat issues near Durango, Colorado – perhaps from shortgrass prairie and CDOT's program. The presence of Columbia sharp-tailed grouse and an energy transmission corridor made Baker's Peak a possibility.

Central mountains site selection attributes: identify a parcel that is up-slope of a reservoir, part of the water supply for a city (Denver would be good since they have an existing market, but other cities worth exploring). Grand County was a possibility with the Windy Mountain water diversion project.

Eastern Plains site selection attributes: presence of prairie dogs, prairie chickens, and proximity to oil/gas development. Identify large, intact, contiguous parcels as good examples of the type of property that can serve as an advance mitigation bank.

Regarding wetlands mitigation, conversations between the SLB and CDOT identified some potential locations where good commercial banking opportunities are not currently available. This was identified as a niche that the SLB could potentially fill. The three relevant areas were Summit County, the Fort Collins area, and the area between Durango and Wolf Creek Pass. All three areas will experience ongoing impacts, yet lack an existing project to meet mitigation needs. State departments of transportation are generally considered to be good partners in mitigation banking efforts, with a sophisticated, long range approach to planning their mitigation needs.

The consulting team also discussed some factors in selecting the sites for the in-depth analysis. Regarding small parcels versus larger aggregations of properties, the team agreed that the project would be more successful in focusing on smaller scale parcels. While a 60,000+ acre range is likely too big, and a single section too small, a 2,000-4,000 acre range is an ideal target. Smaller parcels are easier to manage and guide through the mitigation banking process. Size may also depend on matching supply and demand for the ecosystem services being provided. For example, parcels may be phased in based on projections of demand over time. Also, adjacency of land use is also an important consideration.

The key habitats to identify based on the initial demand research included habitat for prairie chickens, prairie dogs, and sage grouse. For wetlands mitigation, the regions identified were Summit County, the Fort Collins area, and the Durango area. One consideration in identifying habitat, particularly for prairie dogs, was a regulation stating that species cannot be transported across Colorado county lines without the permission of the county commissioners.

Potential Colorado state trust land properties on the eastern plains with prairie chicken habitat included the Red Lion State Wildlife Area and the Tamarack site. Montane, forested parcels include the state trust land holdings of Antero/Salt Creek or Black Creek/Black Mountain. For these types of conservation banking opportunities for endangered/threatened species habitat, contiguous parcels are more promising. On the West slope, Jimmy Dunn Gulch offered potential habitat for both greater sage grouse and sharp-tailed grouse. Baker's Peak also had potential.

Further conversations narrowed the list to the three sites that would be subject to the site visits and ground-truthing by the consulting team:

- Montane: Antero/Salt Creek site
- Eastern Plains: Tamarack site
- West Slope: Jimmy Dunn Gulch site

The site visits were conducted on September 22 and 23 for Antero/Salt Creek, September 27 for Tamarack, and on September 29 and 30 for Jimmy Dunn Gulch. The detailed results of these assessments are contained in the next section of this report.

Parametrix Introduction to the Site Analyses

Parametrix was retained by Solano Partners to assist the Sonoran Institute and the Colorado State Board of Land Commissioners (SLB) with an evaluation of the potential for three SLB properties to generate conservation-based revenue. In the demand analysis portion of this report, Solano Partners identified, at a state-level, multiple demand drivers for mitigation and conservation credits and/or payments for ecosystem services (PES) programs. The primary drivers Solano identified include highway and transportation infrastructure development and maintenance, renewable energy/oil and gas development, and greenhouse gas emissions compliance. These drivers typically create the need for wetland, species/habitat, and water quality/ quantity related credits.

With an understanding of the types of state-level demand drivers Solano identified, this report was prepared to identify potential credit generation and/or PES opportunities associated with three the SLB sites: Antero-Salt Creek, Tamarack, and Jimmy Dunn Gulch. The term "ecosystem services", as used in this report, refers to the benefits that humans receive from the environment, i.e. clean water. As explained in the Millennium Ecosystem Assessment, people depend upon these benefits for survival and quality of life.[20] However, as our population grows and the ecosystem is continuously altered in response to the need for development, many impacts occur to the finite resources that provide these benefits. The Millennium Ecosystem Assessment set the stage for explaining how society depends upon these benefits and identified the consequences of continued loss. As a result, momentum has begun to build around the idea of ecosystem services protection, whether in a regulatory or voluntary context. Frequently, in a regulatory context, protection of resources that provide these benefits involves the sale of credits from a mitigation bank. On the other hand, PES programs often address unregulated resources that need protection, which can sometimes be achieved through development of voluntary, incentive-based land management practices.

This section of the report is a preliminary feasibility assessment. It is limited to evaluating whether or not the three the SLB properties have the physical and biological characteristics conducive to mitigation banking or PES programs. In order to avoid potentially unnecessary expenditures, detailed technical studies were not included in the scope of work. For this reason, it was not possible to determine the specific numbers of credits potentially available and additional technical analyses and financial feasibility studies will be required if the SLB desires to move to the next stage of bank site establishment or PES program development.

Background

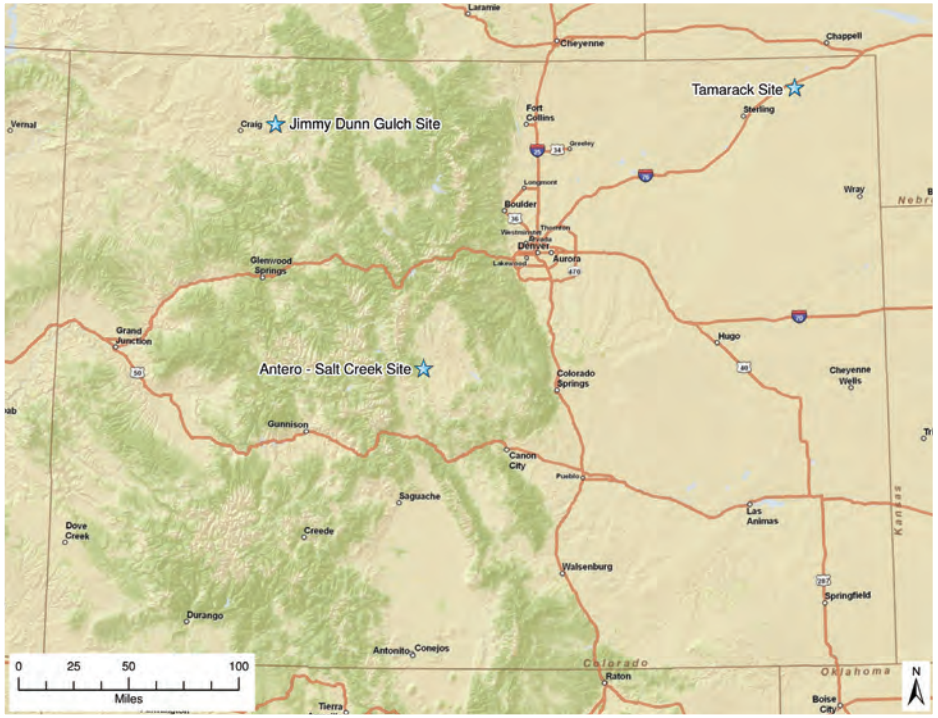
SLB manages 2.88 million acres of state trust land to generate revenue for public education and various institutions in the State of Colorado. The primary revenue source for surface trust lands comes from agricultural leases that enable grazing and crop production. The SLB commissioned this study to evaluate the potential for generating additional revenue derived from natural resource conservation activities.

Working with SLB staff, the project team from Sonoran Institute, Solano Partners, and Parametrix screened multiple potential SLB properties to identify three test sites for evaluation (Figure 1). The Antero-Salt Creek, Tamarack, and Jimmy Dunn Gulch sites were selected based on several key criteria, including diverse geographic distribution, the availability of quality background natural resource data, the presence of natural resources relevant in both traditional environmental credit markets and in payment for ecosystem services contexts (wetlands, streams, listed species, etc.), site size, and local land use.

The sites selected are located in three very different parts of the State of Colorado. The Antero-Salt Creek site is located in the Rocky Mountains, near Fairplay; the Tamarack site is located on the Eastern Plains in the sandhills outside of Sterling, in the northeastern portion of the state; and finally, the Jimmy Dunn Gulch site is located on the West Slope, in the northwestern part of the state, in the Yampa River watershed.

For each site, existing background data were gathered from available resources and site maps were produced for use in the field. Site visits were conducted in late September, 2011 and entailed the project team staff walking and/or driving through accessible portions of each site. In the case of Tamarack, the project team was accompanied by the current lessee's ranch manager, who provided

Figure 1: Site Selections



invaluable information based on his long history with the site and near daily on-site presence during certain times of the year. It is important to note that detailed site investigations such as wetland delineation, rare plant surveys, and species surveys were outside the scope of this study and may be needed in the future if the SLB desires to further investigate revenue generation potential.

Study Findings

Site Location

The Antero-Salt Creek site is located in Park County adjacent to, and east of HWY 285, southeast of the town of Fairplay, in the South Park area of Colorado (Figure 2). It lies at an elevation of approximately 9,000 feet and is approximately 230 acres in size. Spring Creek, rather than Salt Creek, runs through the site. This site, which lies adjacent to large expanses of other state trust land, was chosen because background site information indicated the presence of natural resources potentially capable of generating conservation revenue and because the site is representative of the habitats and natural resources found in this study area. The size of the area reviewed was determined to be adequate for this study because of its representative nature and because, in the project team's opinion, investigating similar adjacent lands was unlikely to reveal additional information that would change the study findings, yet it would increase the cost of this preliminary assessment.

A small portion of the 63 Ranch State Wildlife Area (SWA), owned by the Division of Parks and Wildlife, was also examined during the site visit. The 63 Ranch SWA site, which also lies to the east of HWY 285, is located to the north of the primary study area and is separated from the Antero-Salt Creek site by land owned by the Denver Water Board. Although outside of the scope of the study plan, a brief summary of the 63 Ranch SWA is provided below.

Site Summary

The site visit was performed on September 23, 2011 and was supported by GIS data obtained from several sources.[21] Existing data and the field visit confirmed that the Antero-Salt Creek site displays a high degree of habitat diversity, especially when considered in conjunction with adjacent lands. The GIS data and maps supporting the site analysis work for the Antero-Salt Creek site can be found in Appendix B.

Land Ownership and Site Management

Lands to the north, east, and south of the project site are primarily owned by the SLB, the Denver Water Board, and the Bureau of Land Management (BLM), with some private land adjacent to the southeastern portion of the site (Figure 3). The Denver Water Board's Antero Reservoir lies to the east of the project site. Lands to the west of HWY 285 are largely held in public ownership and the dominant owners are the SLB and the U.S. Forest Service. The site itself has been managed for grazing purposes for decades. The current grazing lease, between the SLB and Salt Works Ranch, runs for an additional two years. The site is also in the Public Access Program, is designated as a Colorado Natural Areas Program site, and is a Colorado State Forest timber management lease area.

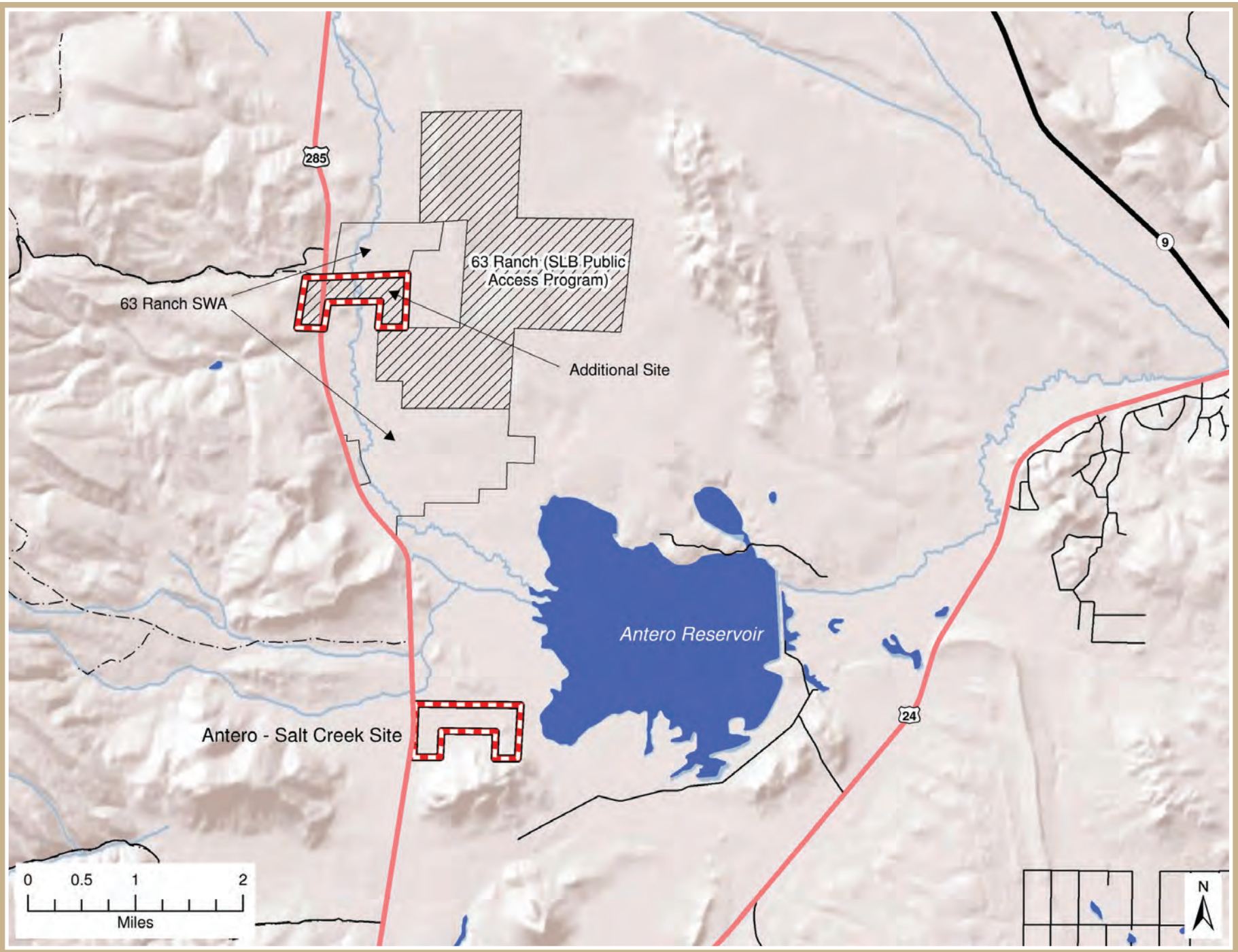
Topography

The project site is located at an elevation of approximately 9,000 feet and is relatively flat with slopes of less than 10%. It is bounded to the south by a forested knoll (owned primarily by the SLB), which has slopes ranging from 10% to 60%.

Habitats

The site contains a diverse array of habitat types and is located in the Natural Resources Conservation Service's (NRCS) designated Grassland Parks ecoregion of the southern Rocky Mountains. The northern, central and eastern portions of the site are primarily herbaceous grassland (Figure 4). The southwestern portion of the site contains Spring Creek, a small stream that flows in a northeasterly direction through the site and salt meadow habitat. The southern portion of the site is located just north of a forested knoll that is in the SLB and BLM ownership.

Existing data compiled for the project indicates that the site is ranked as a potential conservation area with "Very High Biodiversity Significance," that it provides potential bald eagle (Haliaeetus leucocephalus) roost sites and forage areas, and is located within the home range of black bear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63 Ranch (SLB Public Access Program)
63 Ranch SWA
Additional Site
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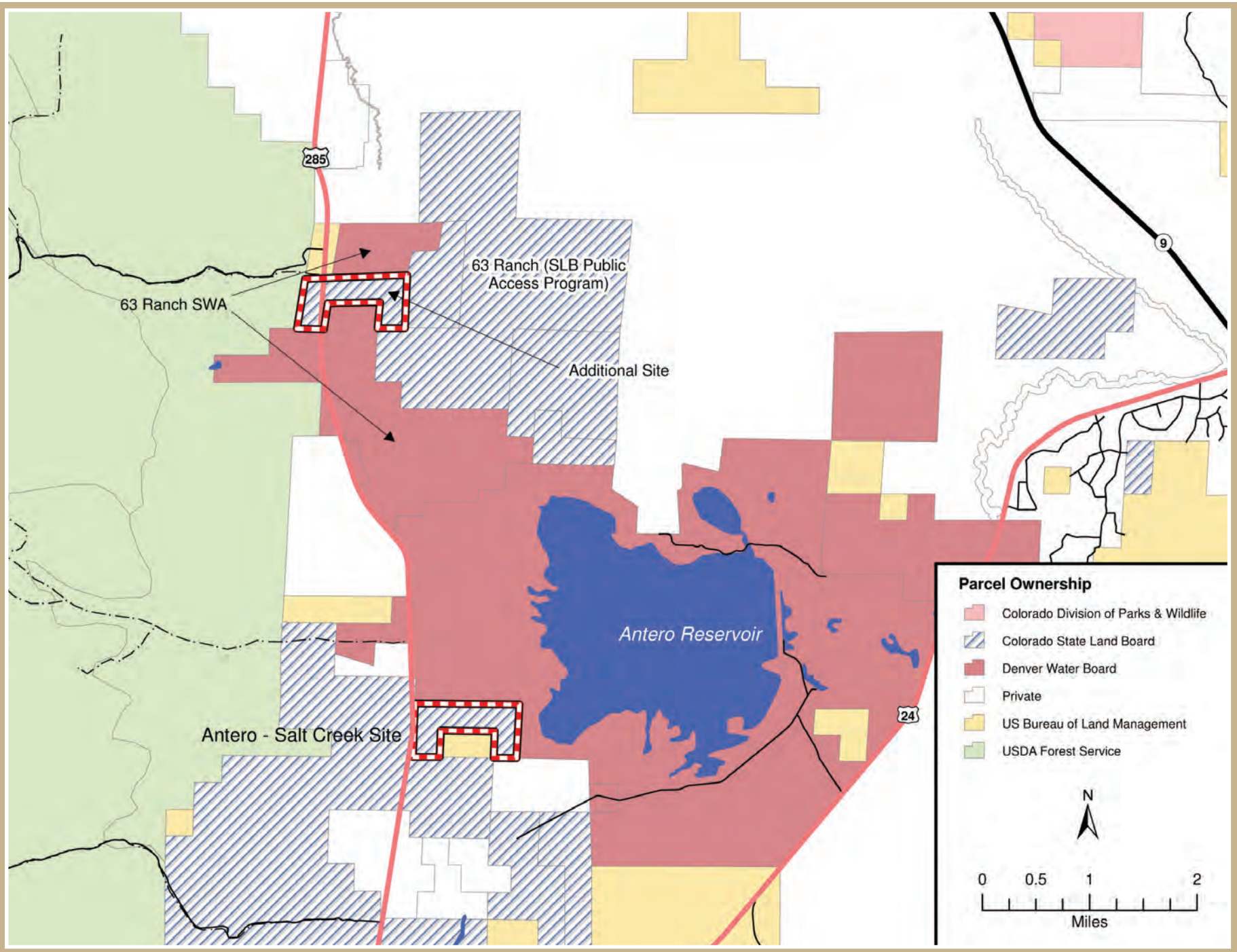
Figure 2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63 Ranch (SLB Public Access Program)
63 Ranch SWA
Additional Site
Antero Reservoir
Antero - Salt Creek Site
9
24
Parcel Ownership
Colorado Division of Parks & Wildlife
Colorado State Land Board
Denver Water Board
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US Bureau of Land Management
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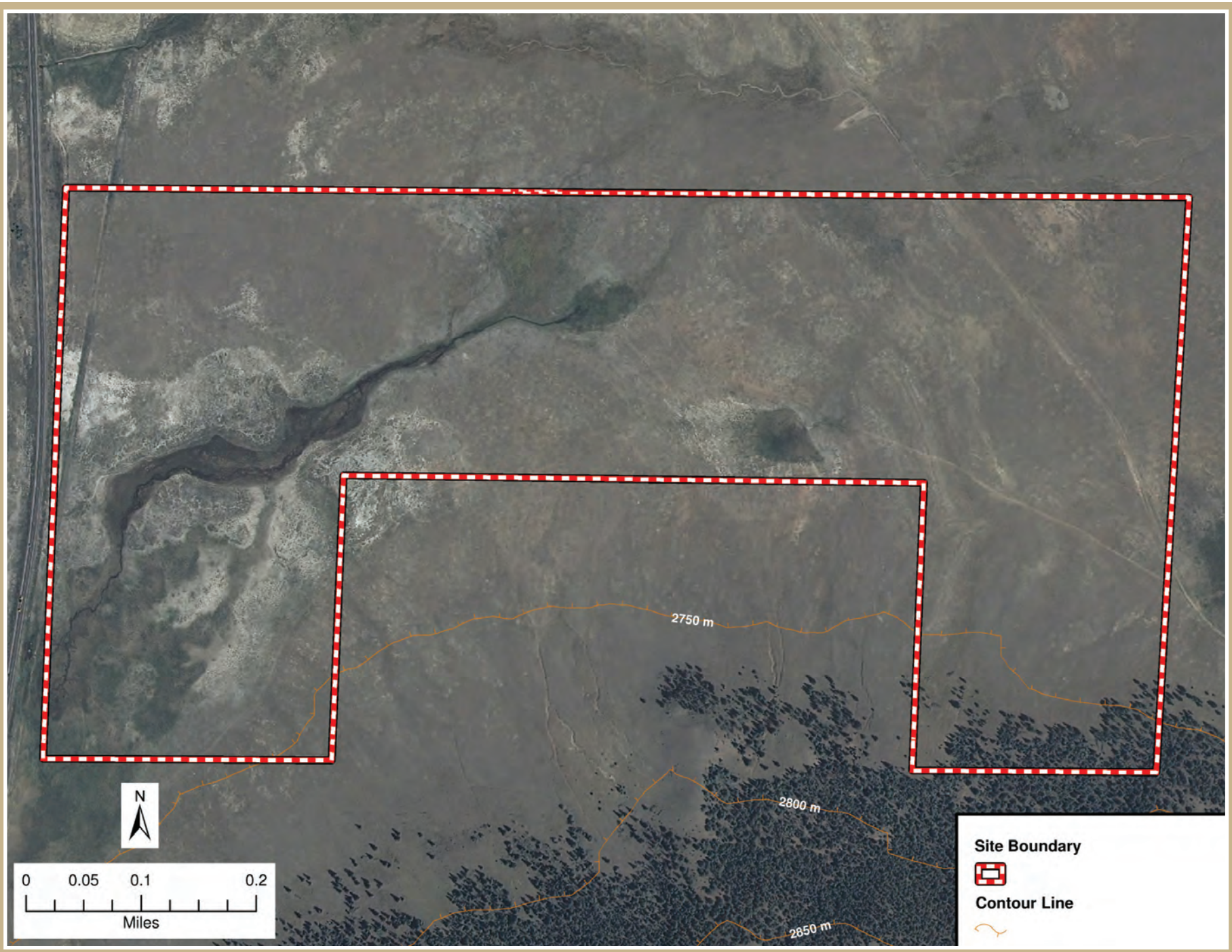
Figure 3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Site Boundary
Contour Line

Figure 4

(Ursus americanus), Gunnison's prairie dog (Cynomys gunnisoni), elk (Cervus Canadensis), mule deer (Odocoileus hemionus), pronghorn (Antilocapra Americana), and mountain lion (Puma concolor). Plant species and communities of concern that may be on the project site include Colorado Tansy-aster (Machaeranthera coloradoensis) (G2, S2), Pale Blue-eye-grass (Sisyrinchium pallidum) (G2G3, S2), Marsh phlox (Phlox kelseyi ssp. salina) (G4, S1), Salt-lick mustard (Thellungiella salsuginea) (G4G5, S1), Few-flowered (Alpine) ragwort (Packera pauciflora) (G4G5, S1S2), mixed foothill shrublands (Artemisia tridentate ssp. wyomingensis) (G2, S2), and Western slope salt meadows (Salicornia rubra) (G3S3).[22]

Herbaceous Grassland Habitat

The northern, central, and eastern portions of the site are largely dominated by herbaceous grassland occasionally interspersed with sagebrush (Photo 1). Most likely due to soil type and management history, soils in these areas are approximately 30-50% exposed (Photo 2). This soil exposure can lead to increased soil erosion and additional review would be needed to determine if these areas are a source of sediment for Antero Reservoir.

Although potentially a source of sediment, the exposed soils and short vegetation in these areas appear to be potential habitat for the Mountain plover (Charadrius montanus), which was recently considered, but rejected, for listing under the Endangered Species Act.[23] Mountain plover, as well as Western snowy plover (Charadrius alexandrines nivosus), have been documented in the general site vicinity and on lands near Antero Reservoir.[24] While the extent of their use of the site is unknown, Mountain plover were present on site during the field visit.

Spring Creek passes under HWY 285 from the west and flows toward the northeast. Emergent wetlands exist along the stream, as well as in several locations downslope of the forested knoll. The stream appears to be perennial, as it contained flowing water at the time of the late-September field visit (Photo 4). It has a very low gradient and does not display evidence of significant channel downcutting or bank erosion.

The majority of wetland areas in this part of the site appear to be salt meadows, based on saline residue found on exposed soils (Photo 5). Soils and vegetation in the salt meadow areas range from being moderately to highly disturbed, primarily in areas adjacent to the stream (Photo 6). Soil exposure and vegetation disturbance in this area are thought to be the result of soil type and compaction caused by large animal grazing and watering uses. The soil exposure may result in soil erosion and additional review would be needed to determine if these areas are a source of sediment for Antero Reservoir.

Photo 1. Typical Grassland Habitat

Photo 2. Example of Vegetation Cover/ Exposed Soils

Photo 3. Pronghorn Antelope Adjacent to Site

Photo 4. Spring Creek

Photo 5. Habitat Typical of Salt Meadow Habitat

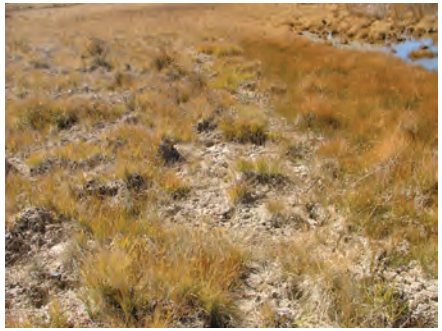

Photo 6. Saline Deposits, Exposed Soil, and Vegetation Disturbance in Salt Meadow Area

Photo 7. Forested Knoll Located on Southern Boundary

Photo 8. Forest Community

Photo 9. Eroded Gully on Western Portion of Knoll

Photo 10. Woodrat Stick Nest on North Side of Forested Knoll

Photo 11. Meandering South Fork of the South Platte River

Photo 12. Potential Contributors to Bank Erosion

Forested Knoll

Lands located to the south of the project site are owned by the SLB and the BLM. Although technically outside of the study area, they are included here because they provide unique, adjacent habitat that increases the biodiversity value of the entire site. The forested knoll contains a mixture of coniferous and deciduous trees, shrubs, and herbaceous vegetation (Photo 7). The central and eastern portions of the knoll are primarily forested (Photo 8). The western portion contains scrub-shrub and herbaceous habitat.

Slopes in this area are generally steep and evidence of surface water runoff and erosion is particularly noticeable in the central and western portions of the site (Photo 9). Surface water leaving the knoll flows north, down eroded gullies, to the wetlands and herbaceous grassland that comprise the majority of the project site. The quantity of stormwater leaving the knoll and reaching the wetland areas is currently unknown, as is whether the stormwater and its associated sediment load reaches Antero Reservoir.

The forested knoll likely provides habitat for a wide array of species, including reptiles, birds, small, medium, and large mammals. The knoll is particularly valuable for wildlife use during various life stages because the forested area provides shelter during all seasons and because the knoll is located adjacent to water. The knoll area appears capable of providing some measure of habitat support for most of the species identified in the background data review (bald eagle, black bear, elk, mule deer, pronghorn, and mountain lion).

An interesting finding on the knoll is the presence of a stick nest, likely created and inhabited by woodrats (Neotoma spp.) (Photo 10). While of no known conservation concern (depending on subspecies), woodrat stick nests provide an interesting elucidation of species diversity on the site, finding such nests can be somewhat uncommon. Interestingly, such stick nests often contain items collected by the woodrat that provide clues as to site history and use by various wildlife species or humans. Nests can contain everything from debris left on site during early settlement days to modern-day manmade shiny objects and bones of other animals. If left undisturbed, they can serve as time capsules as subsequent generations of woodrats continue to build upon an original nest.

63 Ranch State Wildlife Area (SWA) Site

The small SLB property located north of the 63 Ranch State Wildlife Area (SWA) site (and therefore located north of the official study area boundary) can be characterized as a combination of herbaceous meadow, emergent wetland, scrub-shrub, and riparian habitats. The South Fork of the South Platte River meanders unrestricted through the site on its way to joining Antero Reservoir (Photo 11). The stream substrate is moderately embedded with sediment and the stream banks display various degrees of erosion. The site is currently used for grazing and animal access to the stream banks is unrestricted (Photo 12). No GIS data layers were

Photo 14. Severe Bank Erosion

obtained for this site, as it was not originally planned for inclusion in the site visit, however, the site likely provides habitat for a wide array of plant and animal species and further consideration of the site may be warranted in the future.

A primary driver for visiting this site was the discovery of the fact that the stream, a tributary to Antero Reservoir, has an established Total Maximum Daily Load (TMDL) for sediment. This site may be a contributing factor due to moderate to severe bank erosion (Photo 13 and Photo 14).

It is anticipated that many of the plant and wildlife species of interest identified as potentially present on the Antero-Salt Creek site are also relevant to the 63 Ranch SWA site, however, no species surveys were performed during the site visit. During the site walkthrough however, SLB staff identified several Few flowered ragwort (Packera pauciflora) (G4G5, S1S2) specimens growing to the west of the stream (Photo 15).

Photo 13. Moderate Bank Erosion

Photo 15. Few Flowered Ragwort (Photo: M. Gottsegen)

Ecosystem Services

The Antero-Salt Creek site and the small property located to the north of the 63 Ranch SWA site contribute, directly or indirectly, to many ecosystem services that benefit society. While the development of payments for ecosystem services (PES) programs, also known as payments for watershed services (PWS) programs, is in a nascent stage in most parts of the United States, this report calls attention to the ecosystem services provided by the site so that the SLB can consider them in development of future management plans.

For each of the ecosystem services identified in the Millennium Ecosystem Assessment, the means by which the site either positively (+) or negatively (-) contributes to the provision of the service is noted in Table 4. If insufficient information is available to ascertain whether the site is likely to provide a particular service, a "?' is used to indicate uncertainty. In addition, the ability for performance of a given service to be increased, based on future management decisions or restoration actions, is noted with an ▲. While quantifying the specific extent to which the site currently affects these services, and the extent to which various management decisions could change the site's ability to provide services, was outside the scope of this study, at a minimum, the site plays a role in providing the following services:

Provisioning Services	Food
	Freshwater
Regulating Services	Climate regulation
	Erosion control
	Hazard mitigation
	Pollination
	Water purification
	Water regulation
Cultural Services	Aesthetics
	Cultural heritage
	Sense of place
	Social relations
	Recreation
	Education

The site also contributes to the biodiversity, nutrient management, photosynthesis, primary production, and soil formation support services.

Table 4. Antero-Salt Creek Site's Contribution to Ecosystem Services

Provisioning Services	Regulating Services	Cultural Services	Supporting Services
Natural medicines, & pharm.	Air quality	Aesthetic values	Biodiversity support
? Provides key materials for manufacturing	? Plays a role in improving or preserving air quality	+ Visual	+ Highly diverse habitats▲
Food and fiber	Biological control	Cultural diversity	Nutrient management
+ Supports livestock, wild game	? Affects prevalence of crop and livestock pests and diseases	? Supports a diversity of cultures	+ Nutrient cycle intact▲
Fresh water	Climate regulation	Cultural heritage	Photosynthesis
+ Spring Creek and wetlands▲	+ Sequestration	+ Buffers Salt Works Ranch	+ Supports O_2 producers
Fuel	Disease prevention	Sense of place	Primary production
? Provides firewood used for heating or cooking	? Helps prevent disease in humans	+ Unique, serene location	+ Wetland algae, grasses, etc.
Genetic resources	Erosion control	Social relations	Soil formation
? Provides habitat needed to help preserve genetic resources	- Extensive exposed soil ▲	+ Supports ranching culture	+ Retains sediment/organics ▲
	Natural hazard mitigation	Spiritual and religious	
	+ Intact floodplain (flooding) ▲	? Has religious or spiritual meaning	
	Pest regulation	Recreation and ecotourism	
	? Supports predators that help control pests	+ Hiking, fishing, hunting ▲	
	Pollination	Educational values	
	+ Habitat for pollinators	+ Natural systems	
	Water purification	Inspiration	
	+ Water infiltration ▲	? Inspires creativity in art, folklore, architecture, etc.	
	Water regulation	Knowledge systems	
	+ Groundwater recharge ▲	? Helps perpepetuate traditional or formal knowledge of a given society	

Notes:

+ = Positively contributes to service | - = Negatively contributes to service | ? = Unknown whether or not service is performed | ▲ = Uplift potential

Opportunities for Generating Conservation Revenue

The primary opportunities for the SLB to manage the Antero-Salt Creek site to generate conservation revenue, in the context of traditional environmental markets, include use of the site for (1) conservation banking; (2) wetland banking; and (3) stream banking. However, the acreages available, and therefore the number of credits that can be generated, for each of these uses may be relatively small, due to the relatively narrow riparian corridor. Unless other areas surrounding the site are included, engaging in the bank site establishment process (performing technical studies, developing design/management plans, navigating the permitting process, etc.) may be financially untenable if the focus is only on one of the three credit types. However, if multiple revenue streams can be accessed by using the site for a combination of conservation banking, wetland banking, and stream banking purposes, economies of scale may come into play in terms of bank site establishment and construction costs. An additional opportunity for water quality banking or for a payments (PES) program may exist if the site is found to be a source of sediment for Antero Reservoir and if the Denver Water Board has an interest in reducing sediment loads as a means to extend the life of the reservoir. The benefits of establishing such a program, however, will also need to be weighed against the costs of doing so (performing technical studies, establishment of crediting framework, permitting).

Opportunities to generate conservation-based revenue from the small SLB site located north of the 63 Ranch SWA site may also include: (1) wetland banking; (2) stream banking; (3) conservation banking; and (4) the generation of income from water quality banking or a PWS arrangement. Since the site is located on the South Fork of the South Platte River, and the river has an established TMDL for sediment, it may be possible to generate credits by engaging in restoration and management activities that target eroding banks on-site, as well as reduce sediment loads in water reaching the site, and ultimately flowing into Antero Reservoir from upstream sources. As with the Antero-Salt Creek site, in a PWS context, it may be possible to establish an arrangement with the Denver Water Board that would compensate the SLB for restoration improvements and the implementation of management practices that directly benefit the Denver Water Board by protecting the reservoir.

Prior to making a determination of whether or not either of these sites can be used for these purposes, additional technical studies would be needed, such as rare plant and wildlife species surveys and habitat restoration feasibility assessment, to determine whether or not credit generation is feasible.

Tamarack Site

Site location

The Tamarack site is located northeast of Sterling, Colorado. It lies south of Interstate 76, between County Road 55 and County Road 93 in Logan County. The northern boundary abuts the Tamarack Ranch SWA, which is owned and managed by the Colorado Division of Parks and Wildlife (CPW) (Figure 5). The site is approximately 6,420 acres in size.

Site Summary

The site visit was performed on September 26, 2011, and was supported by GIS data obtained from several sources.[25] Existing GIS data and the field visit confirm that the Tamarack site is a fairly homogeneous sand dune complex, dominated by shrubs, primarily sagebrush, and a variety of grass species. Several livestock watering ponds and dirt roads are also present on the project site.

Land Ownership and Site Management

Lands to the north, east, and south of the project site are primarily owned by CPW or the SLB, however some private land does lie adjacent to the southwestern corner of the site and along the southern property boundary (Figure 6). Lands to the west of County Road 55 are privately held, as are a number of the parcels both east and west of County Road 93. The project site has been used for grazing since approximately 1876, the time when Colorado was granted statehood. The current grazing lease, between the SLB and Dinsdale Brothers and George Rober, runs for an additional three years.

Topography

The project site is located at an elevation of approximately 4,000 feet and is characterized by a complex of prairie sand hills. Slopes range from less than 10% to between 30% to 60%. The majority of surrounding lands have slopes of less than 10%.

Habitats

The site is located in the NRCS designated Rolling Sand Plains ecoregion. With the exception of stock pond areas, livestock corrals, and dirt roads, the site provides nearly uniform Northern sandhill prairie (Andropogon hallii) (G3/S2) habitat (Figure 7).[26] The site is dominated by sand sagebrush (Artemisia filifolia), various grass species, and occasional prickly-pear cactus (Opuntia littoralis) (Photo 16).

Photo 16. Sand Sagebrush (Artemisia filifolia)

Pre-existing data compiled for the project indicate that the site has the potential to provide habitat for Black-tailed prairie dog (Cynomys ludovicianus) (G4/S3), Greater prairie-chicken (Tympanuchus cupido pinnatus) (G4T4/S3), Plains sharp-tailed grouse (Tympanuchus phasianellus jamesi) (G4T4/S1), Ring-necked pheasant (Phasianus colchicus), elk, mule deer, white-tailed deer (Odocoileus virginianus), and pronghorn.[27] The potential for these species to use the site today was supported by conversations with the current ranch manager, who is very knowledgeable about the vegetation and wildlife found in the project area. He indicated that he has observed these species and has indeed encountered prairie chicken and grouse nests while on horseback. In addition, during the field visit badger, burrowing owls, raptors, and lizards were noted on site and a female prairie-chicken crossed the road at the northern end of the property.

Photo 17. Easily Disturbed Sandy Soil

Soils in this area are comprised of loose sand that is easily disturbed (Photo 17). The deep-rooted sand sagebrush and various grass species that dominate the site stabilize the sand hills (Photo 18). Although the site is used for cattle grazing, current site management practices target the minimization of soil disturbance by using horses,

Photo 18. Sand Hill Stabilized by Sagebrush

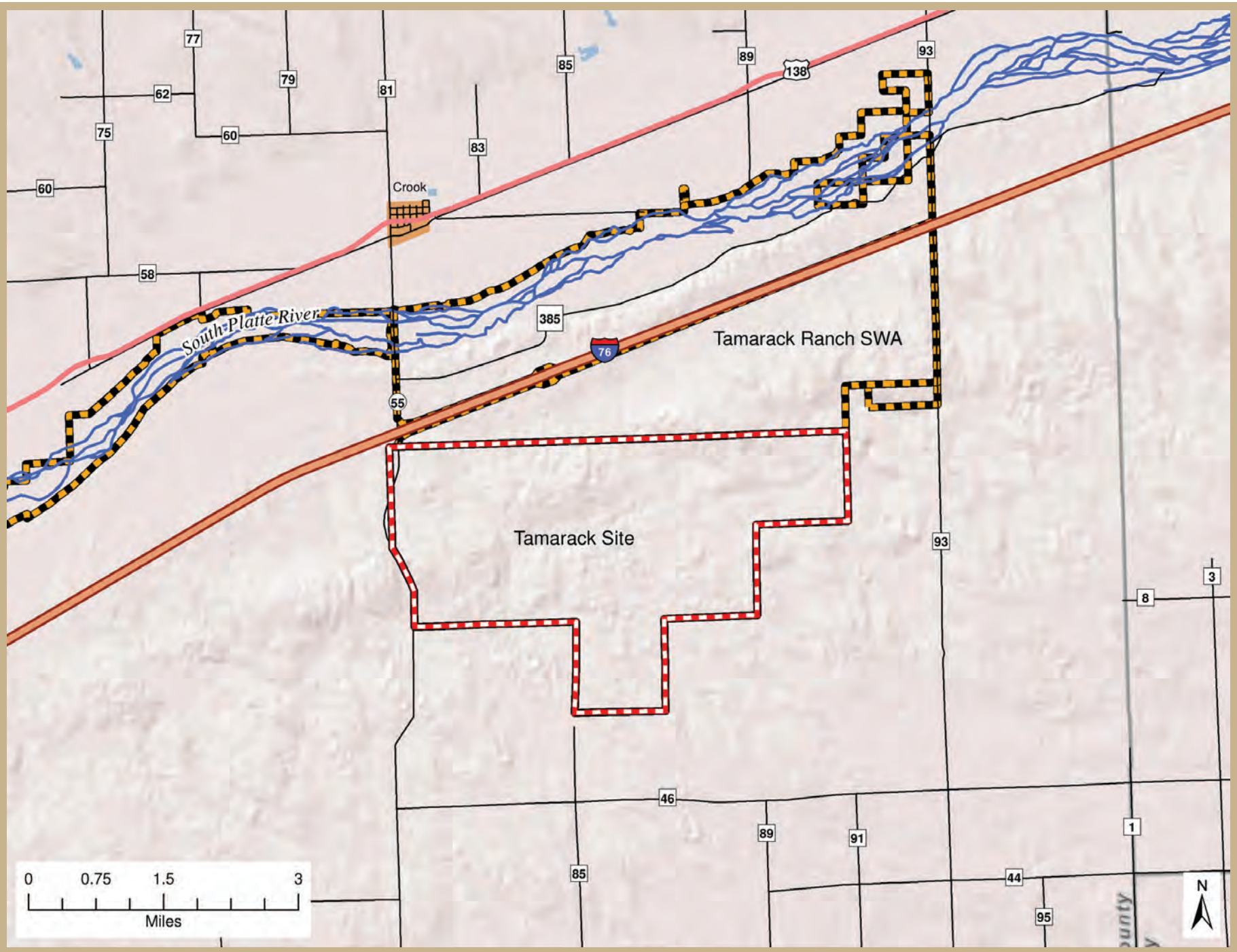
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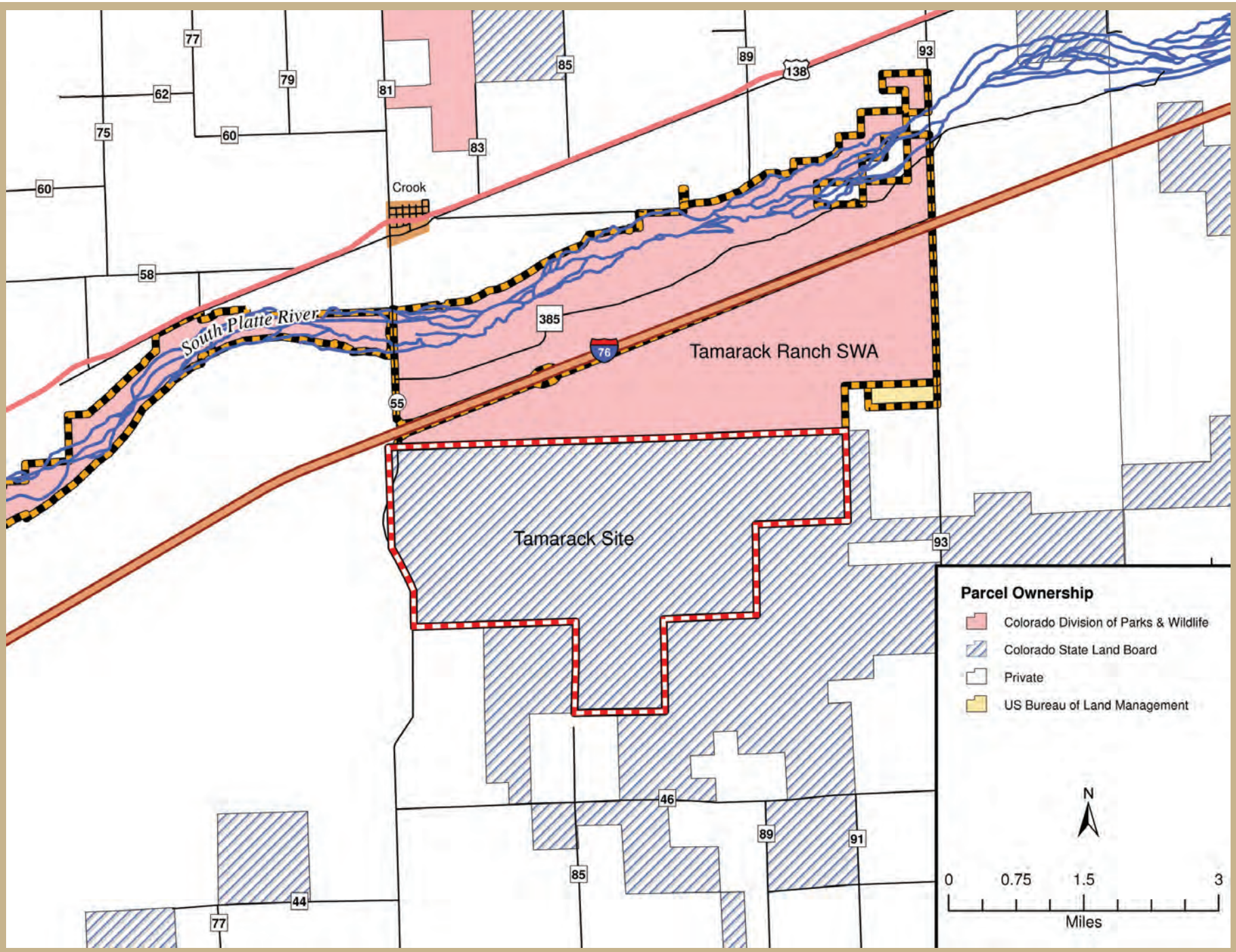
Figure 5


Crook
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Tamarack Site
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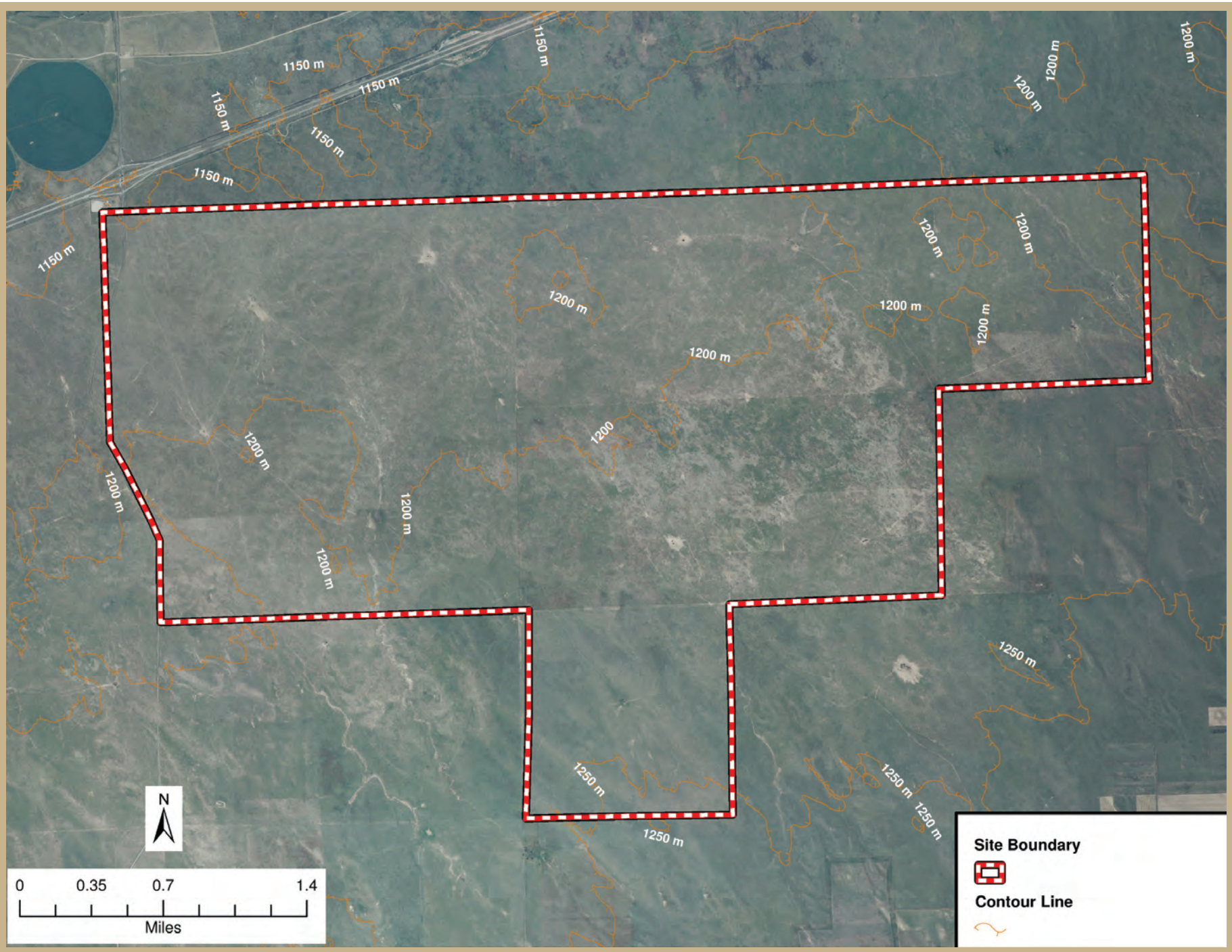
Figure 6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Contour Line

Figure 7

Photo 19. Exposed Soil and Treated Sagebrush on Adjacent Land

rather than vehicles, to drive and work cattle. Vehicles are generally only used on site for checking and maintaining stock watering ponds, which greatly minimizes the potential for soil disturbance.

The effect of grazing on vegetation and soils is closely monitored by the ranch manager, who displays a strong stewardship ethic and knowledge about how to sustainably manage the site. There is a distinctly positive difference between the condition of soils and vegetation on this site and the condition of soils and vegetation present in nearby areas. For example, some lands to the south of the site have been chemically treated to remove sagebrush, thereby increasing the amount of exposed soil and encouraging various weedy species to repopulate the area (Photo 19).

Ecosystem Services

The Tamarack site contributes, directly or indirectly, to many ecosystem services that benefit society. For each of the ecosystem services identified in the Millennium Ecosystem Assessment, the means by which the site either positively (+) or negatively (-) contributes to the provision of the service is noted in Table 5. If insufficient information is available to ascertain whether the site is likely to provide a particular service, a "?' is used to indicate uncertainty. In addition, the ability for performance of a given service to be increased, based on future management decisions or restoration actions, is noted with an ▲. While quantifying the specific extent to which the site currently affects these services (and the extent to which various management decisions could change the site's ability to provide services) was outside the scope of this study, at a minimum, the site plays a role in providing the following services:

Provisioning Services	Food
Regulating Services	Climate regulation
	Erosion control
	Pollination
	Water purification
	Water regulation
Cultural Services	Aesthetics
	Cultural heritage
	Sense of place
	Social relations
	Recreation
	Education

The site also contributes to the biodiversity, nutrient management, photosynthesis, primary production, and soil formation support services. However, opportunities to increase the functional performance of the site are somewhat limited, due primarily to the delicate nature of the soils, the difficulty associated with establishing vegetation in such an environment, and existing beneficial management practices that appear to be successfully controlling weedy species.

Opportunities for Generating Conservation Revenue

Opportunities for the SLB to generate conservation-related revenue from the site include use of the site for either conservation banking or use of the site in a voluntary "payments for habitat conservation" agreement between the SLB and entities such as renewable energy site developers. Prior to making a determination of whether or not the site can be used for these purposes, additional technical studies, such as rare plant and wildlife species surveys, would be needed to determine whether or not credit generation and sustainable management is feasible. On the surface, it appears that the majority of the site would be suitable for inclusion in a conservation or banking program. Regardless of whether or not additional conservation revenue can be generated from the site, the SLB should encourage, and perhaps incentivize, the current ranch manager to continue with his sustainable management practices, as it appears the site is managed in a way that simultaneously supports cattle grazing and use by sensitive wildlife species. Establishment of a payments for ecosystem services (PES) or watershed services (PWS) program may help provide funding to support the beneficial management practices currently in place.

Table 5. Tamarack Site's Contribution to Ecosystem Services

Provisioning Services	Regulating Services	Cultural Services	Supporting Services
Natural medicines, & pharm.	Air quality	Aesthetic values	Biodiversity support
? Provides key materials for manufacturing	? Plays a role in improving or preserving air quality	+ Visual	+ Sensitive species habitat ▲
Food and fiber	Biological control	Cultural diversity	Nutrient management
+ Supports livestock, game	? Affects prevalence of crop and livestock pests and diseases	? Supports a diversity of cultures	+ Nutrient cycle intact
Fresh water	Climate regulation	Cultural heritage	Photosynthesis
? Provides a fresh water source	+ Sequestration	+ Ranching lifestyle	+ Supports O_2 producers
Fuel	Disease prevention	Sense of place	Primary production
? Provides firewod or other material used for heating or cooking	? Helps prevent disease in humans	+ Unique landscape, serene	+ Grasses are dominant
Genetic resources	Erosion control	Social relations	Soil formation
? Provides habitat needed to help preserve genetic resources	+ Managed to minimize erosion ▲	+ Ranching culture	+ Retains soil when vegetated
	Natural hazard mitigation	Spiritual and religious	
	? Helps to minimize or mitigate natural hazards from flooding, landslides, etc.	? Has religious or spiritual meaning	
	Pest regulation	Recreation and ecotourism	
	? Supports predators that help control pests	+ Hunting	
	Pollination	Educational values	
	+ Habitat for pollinators	+ Sustainable agriculture	
	Water purification	Inspiration	
	+ High rate of water infiltration	? Inspires creativity in art, folklore, architecture, etc.	
	Water regulation	Knowledge systems	
	+ Groundwater recharge	? Helps perpetuate traditional or formal knowledge of a given society	
Notes:			
+ = Positively contributes to service;	- = Negatively contributes to service;	? = unknown whether or not service is performed;	▲ = Uplift potential

Jimmy Dunn Gulch Site

Site Location

The Jimmy Dunn Gulch site is located north of Hayden, in Routt County, on the West Slope of the Rocky Mountains in Colorado (Figure 8). The site is approximately 4,177 acres in size and is located in close proximity to other, extensive SLB properties. The stream that runs through the gulch is a tributary to Elkhead Creek, which flows to the southwest, ultimately into Elkhead Reservoir.

Site Summary

The site visit was performed on September 28, 2011 and was supported by GIS data obtained from several sources.[28] Existing data and the field visit confirm that the Jimmy Dunn Gulch site displays a high degree of habitat diversity.

Land Ownership and Site Management

Lands to the northeast of the site are primarily owned by the SLB (Figure 9). Lands bordering the remainder of the site are primarily in private ownership, except for the northwestern corner of the site, which abuts BLM property. The site has been managed for grazing purposes for decades. The current grazing lease, between the SLB and Nottingham Land and Livestock, runs for an additional five years. An oil and gas lease and two right-of-way authorizations are in place and the site is in the state's Public Access Program.

Topography

The project site includes two ridgelines and the gulch that has formed between them, in addition to lands that fall on the far side of the ridgelines. The rim of the gulch is approximately 7,400 feet in elevation, and it drops approximately 900 feet as it crosses the site over a distance of three miles. The study area also includes a southward extension of the ridge that forms the gulch rim. A dirt access road runs through the gulch, roughly paralleling the stream.

Habitats

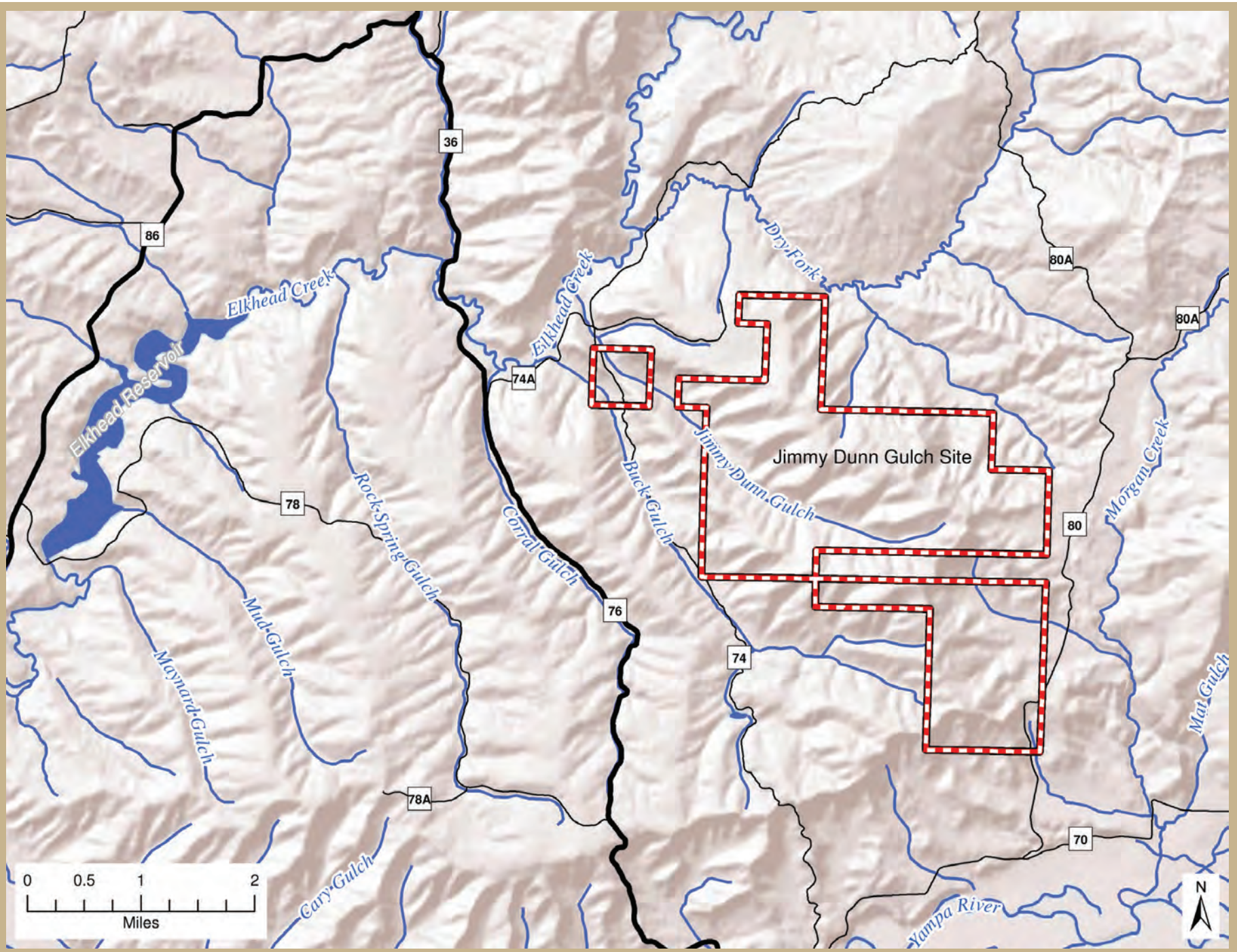
The site, located in the NRCS designated Rolling Sagebrush Steppe and Foothill Shrublands ecoregions, contains three primary habitat types. Located at the bottom of the gulch is a riparian corridor, consisting of wetlands, a perennial stream, and multiple stock ponds. The northern slopes of both ridges can be characterized as deciduous forest with scattered conifers, while the southern slopes are primarily shrub-scrub habitat (Figure 10). Throughout the project site, north facing slopes are generally dominated by scrub oak (Quercus gambelii) communities, while south facing slopes and flat areas are dominated by sagebrush (Photo 20).

Existing data compiled for the project indicate that it provides potential bald eagle (G5/S1B, S3N) forage areas, and is located within the home range of black bear, pronghorn, and mountain lion. It is also mapped as overall range and a production area for Columbian sharp-tailed grouse (Tympanuchus phasianellus columbianus) (G4T3/S2), as overall range and a brood area for Greater sage grouse (Centrocerus urophasianus) (G4/S4), as overall range and a severe winter range/concentration area for elk, and as a summer and critical winter range and concentration area for mule deer.[29] Background data searches did not identify specific plant species or communities of concern.

Photo 20. Primaty Habitat Types (Scrub Oak Dominated North Slopes, Riparian Corridor, and Sagebrush Dominated South Slopes)

Photo 21. Riparian Corridor

Photo 22. Late Summer Streamflow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Elkhead Reservoir
Elkhead Creek
Dry Fork
Jimmy Dunn Gulch
Buck Gulch
Corral Gulch
Rock Spring Gulch
Mud Gulch
Maynard Gulch
Cary Gulch
Morgan Creek
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N

Figure 8

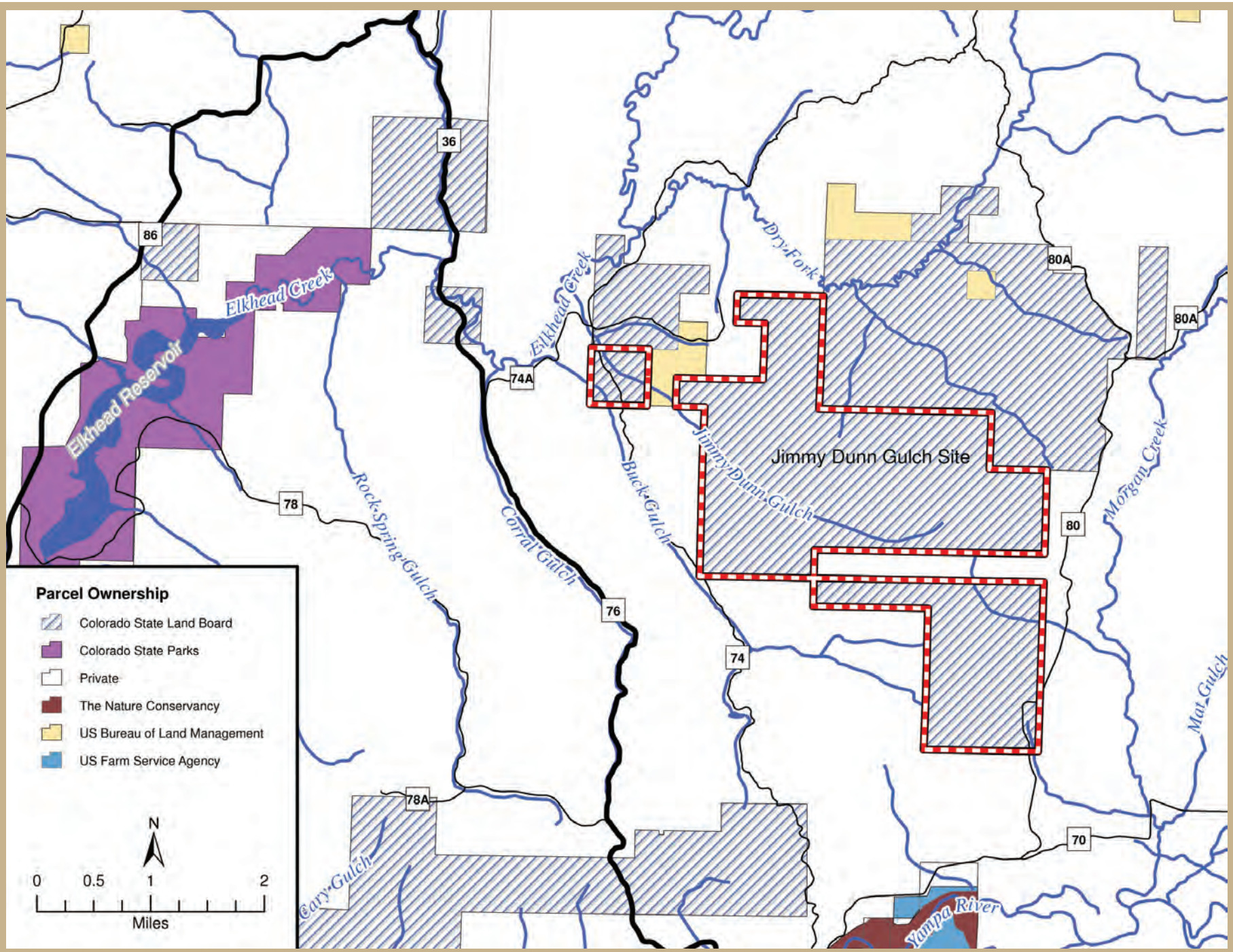

Jimmy Dunn Gulch Site
Elkhead Creek
Elkhead Reservoir
Rock Spring Gulch
Corral Gulch
Buck Gulch
Jimmy Dunn Gulch
Dry Fork
Morgan Creek
Mat Gulch
Cary Gulch
Yampa River
36
86
74A
78
76
74
78A
80A
80
70
Parcel Ownership
Colorado State Land Board
Colorado State Parks
Private
The Nature Conservancy
US Bureau of Land Management
US Farm Service Agency
N
0
0.5
1
2
Miles

Figure 9

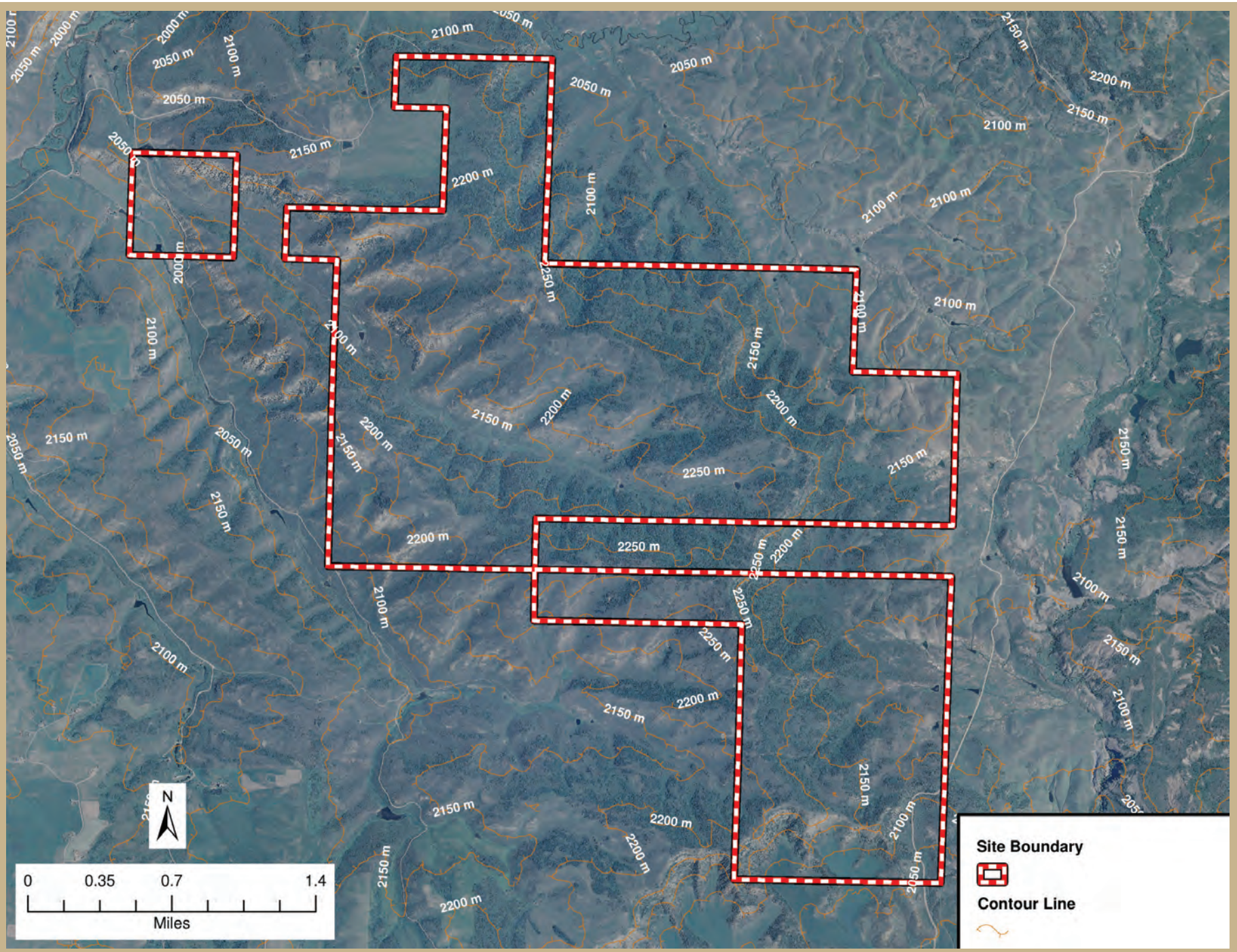

2100 m
2050 m
2150 m
2200 m
2250 m
2000 m
N
0
0.35
0.7
1.4
Miles
Site Boundary
Contour Line

Figure 10

Photo 23. Stock Watering Pond, Berm, and Downstream Riparian Corridor

Riparian Corridor

The Jimmy Dunn Gulch riparian corridor that runs through the central portion of the site is dominated by grasses, rushes, sedges, with occasional shrubs such as snowberry (Photo 21). The stream appears to be spring fed and perennial, as it was flowing strongly during the late September site visit (Photo 22). Its flow is interrupted by a minimum of five manmade berms, constructed for stock watering purposes, as it moves across the site (Photo 23). Below each berm, water flow in the channel quickly rebuilds; it is not clear whether the berms pass water at their base or whether spring water is produced at high enough rates to quickly replenish the flow. In places, channel downcutting has contributed to bank erosion. Soils around the stock ponds and berms are heavily disturbed, exposed, and weed infested.

In terms of habitat, it is anticipated that the stream and stock watering ponds provide a water source for a wide array of wildlife species including amphibians, reptiles, birds, small, medium, and large mammals, and domestic livestock. In addition to providing a water source, the riparian corridor is of high value to wildlife in terms of providing cover and foraging opportunities.

Scrub Oak Dominated North Slopes

The north-facing slopes on the project site are characterized by a mix of sagebrush at lower elevations and dense scrub oak communities farther up the slope (Photo 24). Occasional conifers are also present. The dense scrub oak provides significant cover for wildlife and livestock during all seasons and is of very high wildlife value. At the time of the site visit, the scrub oak habitat was being used as cover by elk during the heat of the day and elk bugling was heard. It is assumed that the north slopes provide habitat (nesting, foraging, and/or cover) at some point during the year for reptiles, small, medium, and large mammals, and a variety of bird species, including grouse, passerines, and raptors. Based on existing topographic mapping, numerous small draws appear to run down the slopes; it is not known whether they convey water.

Photo 24. North-facing Slope, Dominated by Scrub Oak

Big Sagebrush Dominated South Slopes and Flats

South slopes and flat areas on the site are generally dominated by Big sagebrush (Artemisia tridentata ssp. vaseyana) and grasses, though scrub oak shrubs occur intermittently (Photo 25). Vegetation cover and soil exposure in the sagebrush areas are typical of that found in other sagebrush communities that are moderately grazed by wildlife and livestock. Consistent with background data obtained for the site, the sagebrush appears to be suitable habitat for Columbian sharp-tailed grouse and Greater sage grouse. A female Greater sage grouse was observed on the project site, while several Columbian sharp-tailed grouse were observed near the site along an access road.

An additional feature of note is a fenced-off spring that occurs on the south slope, just north of the dirt road (Photo 26). Soils in this area are almost entirely exposed and are encrusted with salt deposits. Based on the presence of wetland vegetation, salt deposits, cracked soils, and evidence of overland flow, it is assumed that the spring flows intermittently and likely dries out in mid to late summer.

Table 6. Jimmy Dunn Gulch Site's Contribution to Ecosystem Services

Provisioning Services	Regulating Services	Cultural Services	Supporting Services
Natural medicines, & pharm.	Air quality	Aesthetic values	Biodiversity support
? Provides key materials for manufacturing	? Plays a role in improving or preserving air quality	+ Visual	+ Sensitive species habitat ▲
Food and fiber	Biological control	Cultural diversity	Nutrient management
+ Supports livestock, wild game	? Affects prevalence of crop and livestock pests and diseases	? Supports a diversity of cultures	Uncertain of water quality
Fresh water	Climate regulation	Cultural heritage	Photosynthesis
Uncertain of water quality ▲	+ Sequestration	? Historically important landscape	+ Supports O_2 producers
Fuel	Disease prevention	Sense of place	Primary production
? Provides firewood used for heating or cooking	? Helps prevent disease in humans	+ Unique, serene location	+ Grasses are prevalent, algae
Genetic resources	Erosion control	Social relations	Soil formation
? Provides habitat needed to help preserve genetic resources	- Exposed soil at ponds/berms ▲	? Influences types of social relations that are established in particular cultures	+ Retains soil/high organics
	Natural hazard mitigation	Spiritual and religious	
	+ Ponds reduce flooding	? Has religious or spiritual meaning	
	Pest regulation	Recreation and ecotourism	
	? Supports predators that help control pests	+ Hiking, hunting	
	Pollination	Educational values	
	+ Habitat for pollinators	+ Natural systems	
	Water purification	Inspiration	
	Uncertain of water quality	? Inspires creativity in art, folklore, architecture, etc.	
	Water regulation	Knowledge systems	
	+ Perennial stream/springs ▲	? Helps perpetuate traditional or formal knowledge of a given society	
Notes:			
+ = Positively contributes to service	- = Negatively contributes to service	? = Unknown whether or not service is performed	▲ = Uplift potential

Ecosystem Services

The Jimmy Dunn Gulch site contributes, directly or indirectly, to many ecosystem services that benefit society. For each of the ecosystem services identified in the Millennium Ecosystem Assessment, the means by which the site either positively (+) or negatively (-) contributes to the provision of the service is noted in Table 6. If insufficient information is available to ascertain whether the site is likely to provide a particular service, a "?' is used to indicate uncertainty. In addition, the ability for performance of a given service to be increased, based on future management decisions or restoration actions, is noted with an ▲. While quantifying the specific extent to which the site currently affects these services (and the extent to which various management decisions could change the site's ability to provide services) was outside the scope of this study, at a minimum, the site plays a role in the provisioning of providing the following services:

Provisioning Services	Food
Regulating Services	Fresh water
	Climate regulation
	Erosion control
	Natural hazard mitigation
	Pollination
	Water purification
	Water regulation
Cultural Services	Aesthetics
	Cultural heritage
	Sense of place
	Social relations
	Recreation
	Education

The site also contributes to biodiversity, photosynthesis, primary production, and soil formation support services. Opportunities to increase the functional performance of the site are highest along the stream corridor in areas degraded by grazing and livestock and wildlife watering.

Opportunities for Generating Conservation Revenue

The two primary opportunities to manage the Jimmy Dunn Gulch site to generate conservation revenue, in the context of traditional environmental markets, include use of the site for conservation banking and stream banking. An additional opportunity for water quality banking, or for a PES program, may exist if the site is found to be a source of sediment or other pollutants that are of concern in Elkhead Lake or the Yampa River watershed.

It may be possible to simultaneously pursue conservation banking and stream/water banking on this site. Given the large size of the site and the diversity of habitats present, it may be possible to generate revenue in multiple market contexts. However, prior to making a determination of whether or not this site can be used for these purposes, additional technical studies, like hydrology/water right evaluation, rare plant and wildlife species surveys, and habitat restoration feasibility assessment) would be needed to determine whether or not credit generation is feasible.

Photo 25. Big Sagebrush Dominated Flats and South Slope

As with the other two sites, significant effort will be required to establish either a formal bank or a PES program, due to the need for technical studies, developing design/management plans, and navigating the permitting process). The status of water rights and the potential to generate revenue related to in-stream flow is not currently known, but water rights could be a complicating factor and should be investigated early in the process.

Photo 26. Fenced-Off Spring with Salt Deposits

Recommendations and Next Steps Based on Site Analyses

The site analyses represent a key first step in determining whether or not the SLB may be able to generate conservation-based revenue from any of the sites reviewed. Based on the information known to date, each site appears to have the potential to generate conservation-based revenue in one or more markets or contexts (Table 7):

- Wetland banking – the sale of mitigation credits to satisfy Clean Water Act (CWA) regulatory obligations resulting from impacts to wetlands and waterways.
- Conservation banking – the sale of conservation credits to satisfy regulatory obligations established by the Endangered Species Act (ESA) for impacts to listed species and their habitats.
- Stream banking – the sale of mitigation credits to satisfy Clean Water Act (CWA) or local regulatory obligations resulting from impacts to streams.
- Water banking – the sale of credits to offset water quality or water quantity impacts, often in a cap and trade context, and/or the sale of credits for a beneficial use.
- Payments or ecosystem services (PES) or payments for watershed services (PWS) – incentive payments provided to land managers in exchange for improved stewardship practices that benefit ecosystem services and society.

However, additional research is needed prior to making any decisions about land management, as it will be critical to determine not only if credit generation is feasible from a technical standpoint, but also whether or not the amount of anticipated revenue will sufficiently offset the costs associated with implementation.

Table 7. Conservation-based Revenue Generation Potential

Site	Wetland Banking	Conservation Banking	Stream Banking	Water Banking	PES/ PWS
Antero-Salt Creek/63 Ranch SWA	M	M	M-H	M-H	M-H
Tamarack	NA	M-H	NA	NA	NA
Jimmy Dunn Gulch	L-M	H	M-H(?)	M-H(?)	M-H(?)
Notes:					
L = Low	M = Moderate	H = High	NA = Not Applicable		

The Antero-Salt Creek site has the potential to generate conservation-based revenue in several market sectors, although the amount available from any one sector may be somewhat limited by the extent of the particular resource opportunity on the site since most of the opportunities are concentrated around the somewhat narrow stream corridor. However, simultaneous pursuit of multiple market opportunities might be an option. In addition, if combined with the 63 Ranch State Wildlife Area (SWA), the acreages available for consideration increase greatly. Additional technical studies and a watershed specific demand assessment are recommend to assess the feasibility of wetland banking if adequate restoration potential can be identified in conjunction with 63 Ranch SWA; flora/fauna conservation banking, if Mountain plover is listed in the future and potentially other species on 63 Ranch site for which data were not available; stream banking; and water quality-related banking (TMDL, PWS).

The Tamarack site has the potential to generate revenue in a conservation banking context for Greater prairie-chicken and Plains sharp-tailed grouse. The acreage available for these two species is quite large. Management strategies would need to complement current grazing practices, or, if grazing ceases, other management activities will be needed to control weedy species. Additional technical studies, including bird surveys and a species range-specific demand analysis are recommended.

Jimmy Dunn Gulch has the potential to generate revenue in the wetland banking, conservation banking, stream banking, and water quality/quantity banking contexts.

Acreages available for wetland banking are dependent upon management decisions made in regard to the stock ponds. For example, if the ponds were to be removed and wetlands restored or created in their location, significant acreages may be available for credit generation along the stream corridor. Acreages available for conservation banking are significant for Columbian sharp-tailed grouse and Greater sage grouse. Credit generation potential associated with water quality and water quantity issues, in-stream flow, for example, is unknown at this time due to the uncertainty of water rights. Additional technical studies, including bird surveys, water rights assessment, and wetland mitigation design/feasibility assessment are recommended, in addition to watershed-specific and species range-specific credit demand analyses.

In the end, these sites may or may not have the ability to generate enough revenue to attract a private-sector mitigation banker focused on traditional markets. However, the SLB is in a unique position to generate revenue from multiple sources, including both regulatory markets as well as PES. If the SLB can work with current lessees to develop conservation plans that not only allow the SLB to continue collecting lease fees, but also to generate revenue from conservation management, then the SLB can potentially obtain revenue in both a regulatory context as well as an ecosystem services context. Indeed, if the SLB ultimately decides that the establishment of formal mitigation or conservation banks is untenable either due to costs or the need to provide conservation easements that stand in perpetuity, an alternative revenue generation strategy may be to focus on PES. In that case, the SLB would quantify the ecosystem services benefits that a given site provides, identify the beneficiaries of those services, and develop funding strategies whereby resource beneficiaries contribute to the sustainable management of SLB properties.

With the completion of the Solano Partners and Parametrix work, the SLB is now aware that mitigation and conservation credit demand drivers exist in the general study areas. The SLB is also aware that the Antero-Salt Creek, Tamarack, and Jimmy Dunn Gulch sites have natural resources conducive to generating conservation-based revenue in response to credit demand. If the SLB is interested in further defining the opportunity, the next step is to perform detailed financial and technical analyses to determine: (1) the costs/benefits associated with creating a bank or PES program on any, or all sites; and (2) the regulatory climate in each study area and the willingness of the natural resource agencies to support, and ultimately approve, establishment of a given bank and or program.

Conclusions and Recommendations

As shown through the course of this report, ecosystem services markets have the potential to generate revenue on state trust land holdings in Colorado. In the analysis of demand drivers for ecosystem service markets in the state, the research findings indicate that, in spite of a slumping economy at the national level, compensatory mitigation demand for ecosystem services is present in Colorado based on population growth, expanded infrastructure needs, and the boom in energy resource development activities. Also, the pilot effort to evaluate the ecosystem services potential on a selected set of state trust land parcels within the Colorado State Board of Land Commissioners (SLB) Stewardship Trust demonstrated that marketable ecosystem services were present on all parcels selected for the study.

The consulting team believes that this report provides a suitable "proof of concept" that ecosystem services markets have the potential to generate revenue on the SLB trust land holdings. This section will examine some of the policy options available to the SLB in participating in ecosystem services markets, implications of the trust responsibility in pursuing these transactions, and a series of next steps and follow-up work that the SLB may choose to initiate in structuring a program within the agency to undertake successful ecosystem service market transactions.

The Trust Responsibility in Pursuing Ecosystem Service Markets

The trust responsibility governing the management of state trust land assets for the beneficiaries includes clear fiduciary duties by the trustee, the SLB. These responsibilities include duty of prudence, of loyalty, and the duty to preserve and protect the assets of the trust. In essence, the SLB is required to manage the corpus of the trusts in a manner that ensures that they can satisfy both the present and future needs of the trusts' beneficiaries. In the context of a perpetual trust, this implies that the corpus of the trusts – the land holdings in this case – be managed in a manner that ensures that the trusts will remain undiminished to serve the needs of future beneficiaries in perpetuity. This notion is affirmed in the constitutional language established by Amendment 16, where the SLB is encouraged to look past simple notions of achieving "maximum financial return" on every transaction, and instead look at ways to manage trust assets in a sustainable, preservation-oriented fashion that will maintain a healthy trust corpus for future generations. "Income maximization" is replaced with a mandate to "produce reasonable and consistent income over time."

Past court decisions have also indicated that the perpetual nature of the state trust requires that the trust manager not only meet the financial objectives of the trust, but also consider a variety of non-monetary values, including environmental values, that are associated with trust lands, and identify ways to obtain revenues for trust beneficiaries without diminishing the non-monetary values on those lands.[30] So long as the SLB's efforts to participate in ecosystem

service markets are based on conclusions of fact – for example, that determinations are made that particular land holdings are suitable for such use, or that participation would be a reasonable investment as part of the management of the larger trust portfolio and otherwise in the best interests of the trust – this standard would clearly be met. Therefore, pursuit of ecosystem service transactions which generate reasonable revenues to the SLB would be consistent with the trust responsibility, and achieve strategic objectives in diversifying asset management and preserving long term values of the trust lands.

The SLB's case for participation in either a mitigation or conservation banking program or a payments for ecosystem services/watershed services (PES/PWS) program would be strengthened were they to develop a comprehensive, objective strategy to identify ecosystem services opportunities on trust lands. Since mitigation uses of trust lands may foreclose other opportunities for a given trust parcel as well as consume limited staff and budget resources, it is recommended that the SLB identify high-opportunity lands throughout the state by developing an inventory of mitigation values associated with the state trust portfolio. The three sites that were a part of this initial investigation have demonstrated that marketable ecosystem services are present on trust land holdings in Colorado. However, this limited sampling of parcels is unlikely to have identified the best, or most timely, available opportunities within the SLB's entire portfolio of lands. Additionally, since this report looked primarily at mitigation and conservation banking potential and payments for ecosystem/watershed services arrangements, other, alternative revenue generating opportunities connected with ecosystem services values may be present once a broader suite of lands are examined.

Recommendation #1: Develop a set of discrete and consistent criteria (metrics), specific to the ecosystem services present on state trust lands, such as wetlands mitigation or endangered species mitigation, to guide identification, evaluation and selection of trust land holdings appropriate for an ecosystem services market asset class.

While this may be a significant project for the SLB to undertake, there are methods that can simplify the process and provide an initial set of priorities for the agency. If the SLB chooses to focus on the Stewardship Trust lands, the universe of lands will be limited to the 300,000 or so acres currently within the Stewardship Trust that have already been identified as having significant natural values. A coarse-scale screening of the lands could then eliminate parcels that are non-qualifying from the inventory and assessment process.

A set of discrete site selection criteria would be valuable in examining the rest of the SLB's trust land holdings in a more comprehensive, rigorous manner, and would assist in identifying and evaluating the most appropriate lands to include in an ecosystem services market asset class. Developing a set of defensible criteria and conducting a thorough inventory of land holdings could have some additional benefits to the SLB as well. An inventory of this type could be used to identify parcels that would be subject to significant constraints due to Clean Water Act (CWA) §404 and Endangered Species Act (ESA) regulations, and thus already have limited revenue generating potential for non-ecosystem services management activities.

Recommendation #2: The SLB should conduct a more comprehensive inventory of its land holdings to identify the best and most marketable opportunities for ecosystem services markets.

Amendment 16 outlines the requirements for the Stewardship Trust nomination process, calling out lands valuable for their "long term benefits and returns to the state," and requiring the management of those lands to protect and enhance the "… beauty, natural values, open space, and wildlife habitat." The SLB has already taken steps to create a more analytic and rigorous process for assessing Stewardship Trust lands. Evaluating Stewardship Trust lands using an ecosystem services market lens would provide the SLB with another tool to continue to align the goals of preservation of beauty, natural values and wildlife with the fiduciary obligations of revenue generation. Discrete and consistent criteria could also be applied more broadly throughout the the SLB's trust land holdings to identify lands which would be included in an ecosystem services asset class.

Recommendation #3: Use ecosystem services market criteria to conduct a strategic assessment of the SLB's Stewardship Trust holdings.

Most importantly, a criteria-based inventory and evaluation process could be used to pre-identify a suitable land base of ecosystem services opportunities where the SLB could engage directly in developing mitigation and conservation banks, or identify lands that could be marketed for sale or lease to developers or mitigation banking enterprises. The SLB could also identify mitigation banking areas that would be suitable for operation to mitigate the SLB's management or development activities on its own land holdings, or use them as part of a holistic planning process. The SLB would then be able to establish a new asset management class, identify a universe of suitable trust lands to include within it, and create a program within the agency to pursue the appropriate and highest value transactions for those ecosystem services attributes.

Options for Developing a SLB Program for Ecosystem Services Markets

As discussed throughout the report, there are a variety of paths the SLB may take in pursuing ecosystem services transactions. Ultimately, achieving success in developing programs for ecosystem services (ES), establishing mitigation or conservation banks or other ES credits, marketing those credits to buyers, and generating revenue from transactions depends largely upon acquiring or developing expertise in ES markets and in conducting these types of transactions, particularly as these are emerging markets that are less mature and still evolving. But as with any other real estate transaction, an adequate level of expertise, experience, and understanding of the market is essential to successful navigation of the field, identification of the right opportunities, and positioning the agency to generate the most income from those markets.

This may be achieved in several ways: the SLB could hire an ES expert to work for the agency in this capacity; the SLB could develop internal, in-house expertise through training and staff development opportunities for current staff; the SLB could contract with knowledgeable consultants to either provide or supplement the required expertise; or any combination of those options. Regardless of the path chosen, the SLB would be well served to acquire the needed expertise in order to effectively ascertain the best return on investment and guide agency activities in pursuing transactions.

Recommendation #4: The SLB should develop appropriate internal expertise and experience with ecosystem services markets in order to effectively evaluate opportunities and ensure the best return on investment.

Develop an Ecosystem Services Asset Pool

As discussed above, an inventory of trust land holdings throughout the state could identify a pool of lands with existing, marketable ecosystem services potential. These holdings could form the basis of a new asset class for revenue generation within the SLB's larger portfolio. Focusing the initial inventory effort on evaluating the Stewardship Trust lands, which have already received some level of review and evaluation through the nomination process, has some advantages. This approach has the advantage of building upon work that has already been completed by the SLB, or which is currently underway, and could jump start the identification of opportunities for marketing ecosystem services. A detailed inventory of the types of ecosystem services available for transactions on the SLB land holdings would facilitate the identification of likely buyers for those services, as well as the best types of instruments to use to market those services.

A Stewardship Lease Program to Incentivize Ecosystem Service Enhancement

Another promising tool that is available to the SLB is the Stewardship Lease program. Currently, it is used primarily at the District Manager level as a reward for lessees already conducting good stewardship on state trust land holdings. However, the lease program could be re-tooled to create incentives for a broader group of lessees for improved management activities that would preserve, maintain or enhance marketable ecosystem services values in exchange for longer lease periods and/or discounted lease rental rates.

Such an incentive program could yield benefits to the SLB by allowing current, compatible lease activities, such as grazing and agriculture, to continue on the land, while improved management activities may create marketable ecosystem services values as well. Current lease revenues would be supplemented with additional revenues from ecosystem services; at a minimum the option for future, long term revenue generation from ecosystem services could be preserved.

Mitigation Program for the SLB's Management Activities

The SLB, as a land management agency, is subject to the same regulatory constraints as private landowners. A variety of factors in the West are causing environmental resources to become increasingly stressed, either through development pressures, energy resource exploration, and climate impacts to name a few. As the footprint of human activities continues to expand, compliance needs for regulatory frameworks such as the CWA and the ESA will continue to grow, and the likelihood that new frameworks will be established to manage and sustain vital ecosystem services will increase. In the last year, settlements between environmental groups and the U.S. Fish and Wildlife Services (USFWS) have required consideration of nearly 1,000 candidate species for endangered species listing. Moreover, as drought conditions persist through much of the arid, Intermountain West, wetlands mitigation requirements may continue to present challenges to development interests.

As a large scale landowner in the state, the SLB is in a unique position to be able to provide appropriate and high quality compensatory mitigation for ecosystem services – not only for private development interests, but also for management activities on the SLB's own holdings. The current energy exploration boom in the state could create a significant opportunity in this respect. Some of the SLB's holdings have oil, natural gas, coal, wind, or solar resources that could generate significant revenues for the trust beneficiaries. However, these activities will inevitably have impacts that will need to be offset through mitigation. If the SLB has proactively implemented an internal program to provide for such mitigation needs, it could make state trust lands an attractive place for investment by energy companies. Mitigation would be provided up front to those lessees, lowering their costs for exploration and development, and shortening their project timelines. Some of those savings in operational costs could be transferred to the SLB, perhaps as lease surcharges, to cover the cost of providing the appropriate mitigation on other trust lands in the portfolio.

Recommendation #5: The SLB should explore the full spectrum of possible approaches for participation in ecosystem service markets, from acting as a principal in mitigation banking to making trust lands available for third party operators involved in the creation and marketing of ecosystem services credits, and determine the appropriate path forward for the SLB in pursuing revenues from these markets.

Operation of Mitigation or Conservation Banks under Commercial Lease Arrangement

Another approach that may be effective in pursuing a mitigation or conservation banking effort would be for the SLB to allow a third party to operate a bank on state lands pursuant to a commercial lease. The flexibility afforded to the SLB through commercial leasing could allow the SLB to design and draft a commercial leasing instrument specific to conservation or mitigation banking that would offer a third party bank operator extensive use of the bank lands, but also provide sufficient protection to the SLB by clearly specifying the intended use of the lands, providing preference for the development of mitigation credits needed for development projects on other state lands, and even incorporating a complete, agency-approved banking plan and banking instrument.

This method could simplify the normally detailed process of agency consultations and agreements. The advantage to the bank operator is the greater degree of certainty they would have than if they were required to negotiate a detailed banking plan on their own with the regulatory agencies. Under such an agreement, the bank operator could obtain the use of the state lands at a relatively low annual cost and at minimal risk, allowing them to engage in a mitigation or conservation bank project on a more speculative basis – and thus do more of the work required to bring the bank into actual operation. The advantage to the SLB is that it would receive the revenues associated with the leased land intended for mitigation or conservation banking use, while the bank operator took responsibility for improvements, management, and ongoing monitoring of the lands intended to provide mitigation credits. The drawback, however, is that the SLB would have less control over the operation of the bank on its land holdings, and, in order to make the project attractive to third party bank operators, may see less revenue from the sale of credits than would result from operation of the bank itself.

Each of these strategies are viable options for the SLB to pursue – however, further study and more extensive evaluation of the advantages and disadvantages of each is needed to determine the best path forward for the SLB.

This report specifically examined three main types of ecosystem services markets that the SLB could explore. The analysis below summarizes a few of the logistical considerations around structuring some of these instruments for participating in ES markets, whether or not the mitigation is for activities occurring on the SLB lands or providing compliance credits for impacts on other lands.

Mitigation Banking for Clean Water Act §404 Permitting

The 2008 compensatory mitigation rule established by U.S. Army Corps of Engineers (USACE) and Environmental Protection Agency (EPA) shifts agency priority for mitigation to a watershed-based approach, recognizing that it is more desirable to replace certain aquatic resource functions off-site, especially when the mitigation project will replace hydrologic and water quality functions in a manner that creates the maximum ecological benefit to the watershed.

Under this new rule, off-site mitigation projects, such as mitigation banks, will be evaluated on the basis of: (1) likelihood for success; (2) ecological sustainability; (3) practicability of long-term monitoring and maintenance or operation and maintenance; and, (4) relative costs of mitigation alternatives.[31] Therefore, an analysis of all available information regarding watershed conditions and needs must be considered in determining whether a given parcel is suitable for the development of a mitigation bank.

There are four distinct components of a mitigation bank:

- The bank site: the physical acreage restored, established, enhanced, or preserved;
- The bank instrument: the formal agreement between the bank owners and regulators establishing liability, performance standards, management and monitoring requirements, and the terms of bank credit approval;
- The Mitigation Bank Review Team: the interagency team that provides regulatory review, approval, and oversight of the bank, commonly comprised of representatives from the USACE, EPA, USFWS, National Marine Fisheries Service (if applicable), and Natural Resources Conservation Service (if applicable); and
- The service area: the geographic area in which permitted impacts can be compensated for at a given bank.

Establishing a mitigation bank requires preparation of a site selection and feasibility analysis, as well as the development of a conceptual design for regulatory review and approval. This is followed by negotiations with the regulatory agency regarding details of the plan, preparation of construction design drawings and specifications, contractor selection, construction implementation and oversight, and as-built reports. Once the bank is established, annual monitoring reports must be prepared for the regulatory agency for a three- to five-year period. The mitigation bank operator must also provide for any necessary post-construction maintenance and corrective measures, and a final report demonstrating permit compliance.

The process begins with a site investigation by the District USACE representative to determine the ecological and economic suitability of the site for a mitigation bank. Following the site investigation, the USACE requires submission of a draft compensatory mitigation site design, including: a description of the project complete with project goals, a detailed description of the site and implementation plan, financial assurances, as-built conditions, monitoring plans, and a plan for completion of the project. Upon approval of the final compensatory mitigation and monitoring plan, construction may begin. Once the construction is complete, an "as-built" drawing must be provided to the agencies within 45 days of completion and the long-term compensatory mitigation site maintenance and monitoring plan will immediately go into effect to ensure proper development of the project. Finally, once the monitoring phase is complete, the applicant must notify the USACE in writing that monitoring is complete and that the Corps-approved success criteria have been met. The compensatory mitigation will not be considered complete without an on-site inspection by a USACE District Project Manager and written confirmation that approved success criteria have been achieved.

As noted above, a "mitigation banking instrument" is an agreement for the establishment of a mitigation bank. Two basic types of banking instruments exist. The first, a traditional banking instrument, establishes a single bank at a single site. The second, called an "umbrella agreement," sets up a regional banking program for the establishment of multiple banks at multiple sites, all managed by the same entity. An umbrella agreement might ultimately be an ideal instrument for a SLB mitigation program. However, a single-site mitigation banking agreement may be more appropriate for initial pilot efforts.

Federal guidance for mitigation banks issued in 1995 outlines the considerations that need to be addressed within the banking instrument.[32] These items are as follows:

- Bank goals and objectives
- Ownership of bank lands
- Bank size and classes of wetlands and/or other aquatic resources proposed for inclusion in the bank, including a site plan and specifications
- Description of baseline conditions at the bank site
- Geographic service area
- Wetland classes or other aquatic resource impacts suitable for compensation
- Methods for determining credits and debits
- Accounting procedures
- Performance standards for determining credit availability and bank success
- Reporting protocols and monitoring plan
- Contingency and remedial actions and responsibilities
- Financial assurances
- Compensation ratios
- Provisions for long-term management and maintenance

The guidance breaks down the phases of a mitigation bank's existence into its "operational life" and the time that follows its operational life—perpetuity. The operational life of a bank terminates when (1) mitigation credits have been exhausted or banking activity is voluntarily terminated, with notice; and (2) the bank is determined to be "functionally mature and/or self-sustaining to the degree specified in the banking instrument."[33]

Ultimately, the mitigation banking process requires that the mitigation lands "be protected in perpetuity with appropriate real estate arrangements," such as a conservation easement or the transfer of title to a federal or state resource agency or non-profit conservation organization.[34] The 2008 rule requires that the site be protected by an appropriate real estate instrument and that the real estate instrument should restrict or prohibit incompatible uses. Should the SLB choose to pursue the establishment and management of mitigation banks to provide compensatory mitigation credits for wetlands, the SLB may wish to create a policy that would enable appropriate real estate instruments, such as conservation easements, to be used on those lands identified for an ecosystem service asset pool.

Recommendation #6: The SLB should consider establishing a policy to guide the use of appropriate real estate instruments, such as conservation easements, on lands within the ecosystem services asset pool to enable them to qualify in providing mitigation banking credits.

As an alternative, state trust lands could be protected by the transfer easement or by transfer of title to a conservation entity. Conversely, the land itself could be sold to the client, with the requirement that it be re-deeded to the SLB and protected with a covenant or an easement held by a third party. Either of these mechanisms could allow two different parties to, respectively, sponsor and assume long-term responsibility for the land rather than the SLB itself.

Conservation Banking for Endangered Species Act Compliance

A conservation bank for endangered species is a parcel of land that provides natural habitat for one or more species listed under the Endangered Species Act. The land is conserved and managed in perpetuity through a conservation easement. The value of the bank's natural resources for supporting endangered species is translated into quantified

"credits." These credits may then be purchased to offset impacts occurring elsewhere to the same resources. Establishing conservation banks helps to reduce the piecemeal approach to conservation efforts that can result from individual projects, and enables the creation of larger reserves and enhances habitat connectivity – all within a market framework.

The concept and process in establishing conservation banks and mitigation banks are similar. While the focus for establishing a wetland mitigation bank is to maintain functions and values present in a particular watershed, conservation banking is intended to offset the loss of isolated and fragmented habitat, which has no functional value to a species, with habitat that does benefit the imperiled species.

Per information provided by the U.S. Fish and Wildlife Service (USFWS), a conservation bank can be created in a number of different ways:

- Acquisition of existing habitat;
- Protection of existing habitat through conservation easements;
- Restoration or enhancements of disturbed habitat;
- Creation of new habitat in some situations; and
- Prescriptive management of habitats for specified biological characteristics.[35]

Conservation banks may be established on tribal, local, private, or state lands not already designated for conservation purposes. Location, size, configuration, topographic features, habitat quality, compatibility of existing and future land use activities within and surrounding the bank, species use of the area, and ecological suitability of the proposed bank are all considerations that the USFWS will use in evaluating a potential conservation bank. The service area of a proposed site, which is the area in which the bank's credits may be used to offset impacts, is crucial to the bank's marketability and potential for success. Conservation banks should ideally be located within areas designated in species recovery plans, or other applicable recovery focal area.

The credit value of a conservation bank is based on the biological values of the bank at the time the bank agreement is established, which poses a risk to both the USFWS and the credit provider should the land be over- or under-valued when the bank is created. If the amount of credits depends upon the number of individuals or nesting pairs on the property, that number could turn out to be falsely high or low, depending upon population fluctuations. Careful studies are necessary to identify the average population of the species of interest prior to establishment of the conservation bank.

Once the first credit in a conservation bank is sold, the entire area is automatically and legally protected, regardless of whether the rest of the credits in the bank are sold. To manage the potential risk entailed for conservation banking entities, banks may be divided into sub-areas and implemented in phases. This is a useful approach in areas where the level of future biological need or potential for customer demand is uncertain. It is also a good strategy for bankers who can only afford to enhance or manage a portion of the entire habitat area until revenue from the first phase is received. This enables the banker to limit the amount of up-front costs associated with creation of a bank.

An essential element to a conservation bank's success is the incorporation of a good management plan into the bank agreement. A conservation bank agreement is a legal instrument between the conservation bank owner and the participating regulatory agency such as the USFWS, or other participating state or federal agency. The goal of a management plan is to maintain the habitat for the continued use by the listed species and may include prescribed burns, prevention of trespass traffic, removing trash, and other habitat enhancing activities. Typically, the banker has a great deal of flexibility when developing management plans and activities to preserve the species or habitat on which the bank credits are based, as the USFWS's primary concern is with outcomes rather than the methods to achieve those outcomes when evaluating banks and authorizing issuance and sale of mitigation credits.

Conservation bank agreements must incorporate a monitoring program that measures progress toward meeting bank goals, as well as provisions for dispute resolution should the owners of the bank fail to meet their obligations under the banking agreement. Lastly, the bank agreement must identify and include proof of adequate funding for the bank's perpetual operation, management, monitoring, and documentation costs.

One key to successful development of either a mitigation or conservation bank involves building positive working relationships with the regulating entities, primarily the District Managers for USACE and USFWS. Cultivating such relationships can be important in learning about the market, new buyers seeking permitting and regulatory compliance, and in developing more detailed knowledge of what each District may be seeking in mitigation or conservation banking opportunities. Such relationship building can also help overcome bureaucratic inertia. The 2008 rule giving preference for off-site mitigation through banks or similar instruments is relatively new, and agency staff may have some level of uncertainty and risk aversion to new or innovative approaches to providing mitigation.

Recommendation #7: Cultivate relationships with key regulating agency staff to facilitate access to current and emerging information about demand and opportunities for providing ecosystems services on the market.

Payments for Ecosystem Services/Watershed Services (PES/PWS)

PES, discussed in this report in the context of the Denver Water Board as a demand driver as well as the market potential present on the Antero-Salt Creek site, are voluntary transactions using market-based mechanisms to create more efficient and sustainable use of environmental resources, and are typically structured to achieve specific environmental goals. Unlike mitigation or conservation banking, which are driven by federal regulatory frameworks, PES/PWS transactions in the United States are largely driven by self-organized private deals between the ecosystem services buyer and the provider. The advantage to PES/PWS structured agreements is that they can be negotiated to fit the needs of both the ecosystem service provider and buyer, and tailored for specific local contexts.

Becoming a provider of ecosystem services under a PES/PWS framework, however, requires detailed understanding of the range of ecosystem services that the provider is able to supply, and the marketable value of those services. Buyers for those services must then be identified, and an agreement or contract is then developed that outlines the ecosystem service delivery and management, and the payment plan for provision of those services.

In most PES/PWS agreements in the United States, market value of the ecosystem services is negotiated based upon what the buyer is willing to pay for those services, and what the service provider is willing to accept in exchange. Important considerations for the SLB to factor into estimates of the value of ecosystem service provision would be the cost of conducting any land management improvements or enhancements to ecological functions, and the impact those activities would have on future earnings from the transaction. As with any type of land transaction, administrative costs for developing and executing the agreement should be considered as well. Since PES/PWS agreements are often voluntary in nature, and the availability of the ecosystem services generally exceeds demand, the price point may be low. However, for specific environmental values which are rare or present only in certain geographies, such as riparian lands within watersheds that provide drinking water to urban areas, PES/PWS may pencil out favorably.

Identification of prospective buyers for PES/PWS transactions can be the most challenging element of developing a PES/PWS transaction. However, the range of potential buyers can be extensive, each with their own set of distinct needs and motivations for seeking a PES/PWS arrangement. They can include government entities, such as a municipality seeking preserve drinking water quality at reduced costs, private corporations looking to improve their brand or better manage their operations through ecosystem services investment, and nonprofit organizations with a conservation-based mission to preserve environmental values.

Since most PES/PWS agreements are negotiated contracts between a service provider and a buyer, there is a substantial amount of flexibility associated with this type of transaction. That can be a benefit to both parties, but can also increase the amount of time and resources necessary to reach and implement an agreement. There are ways to reduce these transaction costs, and the SLB may be in an advantageous position relative to other service providers. As a state agency, the SLB already has significant data on the resource values of its holdings, and as a large landowner, can achieve economies of scale in providing ecosystem services over a large service area.

In developing a PES/PWS contract, there are a number of elements that should be included to clearly delineate the value that is being provided in terms of the ecosystem services, and the compensation that will be returned to the service provider. A contract should outline the terms, type and timing of the payments, as well as any management obligations, monitoring and/or reporting that the service provider must meet. The contract should also ideally address how risks, such as catastrophic events like wildfires that can affect the provision of the ecosystem services, will be handled and addressed by the parties. Forest Trends, the Katoomba Group, and United Nations Environment Programme collaborated to publish an excellent primer on organizing PES/PWS agreements. It outlines typical contract components for PES/PWS transactions and checklists for developing these agreements, and could be a good source for further, more detailed information.[36]

Each of the approaches examined in this report offers a viable path to developing a program within the SLB for conducting ecosystem services transactions. As illustrated through the demand analysis, the site analysis, and the policy analysis in evaluating these transactions against the trust responsibility, significant opportunity exists for generating revenue for ecosystem services on state trust lands. The next step will be for SLB to determine whether development of this new asset pool fits within the agency's long term strategic plan, and choose the most appropriate programmatic path for pursuing those transactions.

Endnotes

[1]Colorado State Board of Land Commissioners Strategic Plan 2011. http://trustlands.state.co.us/Documents/SLB_Strategic_Plan_2011_Final.pdf.

[2]Senate Bill 513 Ecosystem Services and Markets: Report from the Oregon Sustainability Board to the 2011 Oregon Legislative Assembly. December 2010. http://oregon.gov/OWEB/SB513.shtml.

[3]Memorandum of Agreement between the Department of the Army and the Environmental Protection Agency, The Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines. Feb. 6, 1990.

[4]United States Department of the Interior, Fish and Wildlife Service, Guidance for the Establishment, Use, and Operation of Conservation Banks. May 2, 2003.

[5]*Id.*

[6]*Senate Bill 513 Ecosystem Services and Markets: Report from the Oregon Sustainability Board to the 2011 Oregon Legislative Assembly.* December 2010. http://oregon.gov/OWEB/SB513.shtml.

[7]U.S. Geological Survey (USGS). 2011. National Hydrography Dataset. http://nhd.usgs.gov/.

[8]U.S. Fish and Wildlife Service (US FWS). 2011a. FWS Wetlands WMS CONUS. http://www.data.gov/raw/1914.

[9]Personal communication via email with Tobin Follenweider, Deputy Director, Colorado State Board of Land Commissioners, August 1, 2011.

[10]U.S. Fish and Wildlife Service (US FWS). 2011b. Critical Habitat Portal http://criticalhabitat.fws.gov/.

[11]State Transportation Improvement Program (2012-17 STIP). http://www.coloradodot.info/business/budget/stip/stip-plan-and-stip-amendments.html.

[12]Colorado Department of Local Affairs http://cwcb.state.co.us/public-information/publications/Documents/ReportsStudies/SWSIAppendices/Appendix%20A%20State%20of%20Colorado%20Population%20Projections%202000%20to%202030.pdf.

[13]http://www.mnn.com/local-reports/colorado/nature-conservancy/colorado-grasslands-and-taxpayers-get-boost-from.

[14]http://forest-trends.org/publication_details.php?publicationID=2438.

[15]www.infoandina.org/system/files/recursos/44_Isakson_R.pdf.

[16]http://www.thedenverchannel.com/news/28542179/detail.html.

[17]Enabling Progress: Compensatory Mitigation Scenarios for Wind Energy Projects in the U.S., www.awwi.org.

[18]http://wildlife.state.co.us/SiteCollectionDocuments/DOW/LandWater/BRMemo-RpttoCOGCConWildlife-081210II.pdf.

[19]https://www.dora.state.co.us/pls/efi/efi_p2_v2_demo.show_document?p_dms_document_id=104029.

[20]Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington DC. (www.millenniumassessment.org/documents).

[21]Data Sources: Colorado Department of Transportation; the Colorado Division of Parks and Wildlife; Colorado State Board of Land Commissioners; Colorado Ownership, Management, and Protection v8 Database; Natural Resources Conservation Service; US Geological Survey; Colorado Natural Heritage Program; Conservation Biology Institute; US Environmental Protection Agency; US Fish and Wildlife Service; ESRI; and National Renewable Energy Laboratory.

[22]"G" rankings are global rankings that characterize the relative rarity or endangerment of the element worldwide; "S" rankings indicate state status. Global ranks are derived by NatureServe, unless CNHP has lead responsibility for that element (e.g., state endemics). G1/S1 = critically imperiled, G2/S2 = imperiled, G3/S3 = vulnerable, G4/S4 = apparently secure, G5/S5 = secure, U = unknown. See Appendix A for full coding key.

[23]The Mountain plover has been proposed for listing under the Endangered Species Act (ESA) twice since 1999. In 2003, the USFWS determined that the species did not warrant listing at that time. In 2006, the USFWS was again asked to review species status and again, in 2010, decided that the Mountain plover did not warrant listing under the ESA. The bird's status in Colorado is currently a state candidate species and populations will continue to be monitored.

[24]Colorado Field Ornithologists, Colorado County Birding, 2006.

[25]Data Sources: Colorado Department of Transportation; the Colorado Division of Wildlife; Colorado State Board of Land Commissioners; Colorado Ownership, Management, and Protection v8 Database; Natural Resources Conservation Service; US Geological Survey; Colorado Natural Heritage Program; Conservation Biology Institute; US Environmental Protection Agency; US Fish and Wildlife Service; ESRI; and National Renewable Energy Laboratory.

[26]See Appendix A for status ranking coding key.

[27]Plains sharp-tailed grouse and Greater prairie chicken were reintroduced in the prairie habitat located to the south of the Tamarack Ranch SWA (http://www.coloradocountybirding.com/county/bird_a_county.php?name=Logan).

[28]Data Sources: Colorado Department of Transportation; the Colorado Division of Wildlife; Colorado State Board of Land Commissioners; Colorado Ownership, Management, and Protection v8 Database; Natural Resources Conservation Service; US Geological Survey; Colorado Natural Heritage Program; Conservation Biology Institute; US Environmental Protection Agency; US Fish and Wildlife Service; ESRI; and National Renewable Energy Laboratory.

[29]"G" rankings are global rankings that characterize the relative rarity or endangerment of the element worldwide; "S" rankings indicate state status. Global ranks are derived by NatureServe, unless CNHP has lead responsibility for that element (e.g. state endemics). G1/S1 = critically imperiled, G2/S2 = imperiled, G3/S3 = vulnerable, G4/S4 = apparently secure, G5/S5 = secure, U = unknown. See Appendix A for ranking code definitions.

[30]See National Parks and Conservation Association v. Board of State Lands, 869 P.2d 909 (Utah 1993) finding that the state trustee was required to consider and preserve unique scenic, archeological, and paleontological values on state lands where it was possible to do so, Id. at 920-21; see also Branson School District v. Romer, 161 F.3d 619 (10th Cir. 1998) upholding a "stewardship principle" that required protection of ecological values on trust lands that was adopted by Colorado voters as consistent with a perpetual trust responsibility, Id. at 638.

[31]USACE Regulatory Guidance Letter No. 02-2, December 24, 2002.

[32]Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, 60 Fed. Reg. 58,605,58,609 (Nov. 28, 1995), available at http://water.epa.gov/lawsregs/guidance/wetlands/mitbankn.cfm.

[33]*Id.*

[34]Federal Guidance for the Establishment, Use and Operation of Mitigation Banks, 60 Fed. Reg. at 58,612.

[35]United States Department of the Interior, Fish and Wildlife Service, Guidance for the Establishment, Use, and Operation of Conservation Banks.

[36]"Payments for Ecosystem Services: Getting Started, A Primer." Forest Trends, the Katoomba Group, and UNEP. ISBN # 978-92-807-2925-2. May 2008.

Appendix A: Colorado Natural Heritage Program Tracking List Column Definitions

Data Dictionary for Element Occurrence Transcription Reports from the Colorado Natural Heritage Program

Data Dictionary for Element Occurrence Transcription Reports from the Colorado Natural Heritage Program This Data Dictionary defines terms used in Element Occurrence (EO) Reports exported by the Colorado Natural Heritage Program (CNHP) from our Biodiversity Tracking and Conservation System (BIOTICS) database.

Introduction to Element Occurrence
The Element Occurrence (EO) file contains information on the occurrence of priority Elements in a Natural Heritage Program/Conservation Data Centre inventory. An Element is defined below.
Each record in the Element Occurrence file represents a different EO, which is defined as a specific example of an Element at a geographic location characterized by a habitat capable of sustaining or contributing to the survival of the species, or by a landscape that supports the ecological integrity of the community.

Element
A biodiversity unit of conservation attention and action for which a Heritage Conservation Status Rank is assigned.

Elements may be recognized at any taxonomic level (although typically are only recognized at the species level and below for organisms, and the Ecological System, Alliance, and Association levels for communities).

Elements may also be recognized for biodiversity units for which there is no systematic hierarchy (e.g., animal assemblages, community Complexes).

Elements may be native or exotic at a particular location and collectively represent the full array of biological and ecological diversity for the geographic area covered. Elements may serve as the targets of Heritage inventory. Typically, these targets include native, regularly occurring vulnerable species (including infraspecific taxa and populations) and exemplary ecological communities.

REPORT HEADER

State Scientific Name
State scientific name for an Element.

EO ID
Unique identifier for an EO.

State Common Name
State common name for an Element.

EO Code
Unique identifier for an Element previously used in the Biological and Conservation Data system (BCD). The EO Code is a combination of the element code (ELCODE) and the EO number.

BASIC INFORMATION

Higher Taxonomy
Proper code for the organism at the specified level of the taxonomic hierarchy (i.e., kingdom, phylum, class, order, family, or genus). Codes are used for sorting, for quick assessment of hierarchical placement, and for shorthand communication.

Not every level of the taxonomic hierarchy will have a specific code assigned to it, either because it is not needed at this time (many invertebrates are only coded to the phylum level) or because it is included at a different level (e.g., the higher taxonomy code for vascular plants starts at the division or class level, but the class level code starts with P for vascular plant).

Shape ID
Features developed within BIOTICS Mapper are identified using a sequential system generated number that uniquely identifies each feature. The Feature ID is the Shape ID.

State Element ID
Unique state identifier for an Element.

Global Imperilment Rank
The global element rank that best characterizes the relative rarity or endangerment of the element worldwide. Factors other than the number of occurrences may be considered when assigning a global rank. Global ranks are derived primarily by staff at the Central Heritage Conservation Science Department, unless CNHP has lead responsibility for that element.

Domain values for Global Imperilment Rank are:

G1	Globally critically imperiled; typically 5 or fewer occurrences
G2	Globally imperiled; typically 6 to 20 occurrences
G3	Globally vulnerable; typically 21 to 100 occurrences
G4	Globally apparently secure; usually > 100 occurrences
G5	Globally demonstrably secure although it may be rare in parts of its range
G#G#	A range between two of the numeric ranks; indicates uncertainty about the rarity of the element
G?	Unranked; element is not yet ranked globally
GU	Unrankable; not enough information is known
GH	Historically known with hopes of rediscovery
GX	Extinct; unlikely to be rediscovered
T#	Rank applies to a subspecies or variety
Q	Taxonomic status is questionable
C	Element is extant only in captivation or cultivation
GNR	Not ranked globally

State Imperilment Rank
The state element rank that best characterizes the relative rarity or endangerment of the element statewide. Factors other than the number of occurrences may be considered when assigning a state rank. State ranks are derived by CNHP staff.

Domain values for State Imperilment Rank are:

S1	State critically imperiled; typically 5 or fewer occurrences
S2	State imperiled; typically 6 to 20 occurrences
S3	State vulnerable; typically 21 to 100 occurrences
S4	State apparently secure; usually > 100 occurrences
S5	State demonstrably secure
S#S#	A range between two of the numeric ranks; indicates uncertainty about the rarity of the element
S?	Unranked; element is not yet ranked in the state
SU	Unrankable; not enough information is known
SH	Historically known with hopes of rediscovery
SX	Extinct; unlikely to be rediscovered
SE	An exotic established in the state; native to a nearby region
SA	Accidental; includes species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or thousands of miles outside their usual range
B	Rank refers to the breeding population of the element
N	Rank refers to the nonbreeding population of the element
C	Element is extant only in captivation or cultivation
SNR	Not ranked in the state

Basic EO Rank

Value that indicates the relative value of the EO with respect to other occurrences of the Element, based on an assessment of estimated viability (species) or ecological integrity (communities), i.e., the probability of persistence (based on condition, size, and landscape context) of occurrences of a given Element. In other words, EO ranks provide an assessment of the likelihood that if current conditions prevail the occurrence will persist for a defined period of time, typically 20-100 years.

EO ranks may be used effectively in conjunction with Heritage Conservation Status Ranks for the Element to guide which occurrences should be recorded and mapped, and to help prioritize EOs for purposes of conservation planning or action, both locally and rangewide.

Domain values for Basic EO Rank are:

A	Excellent estimated viability/ecological integrity
A?	Possibly excellent estimated viability/ecological integrity
AB	Excellent or good estimated viability/ecological integrity
AC	Excellent, good, or fair estimated viability/ecological integrity
B	Good estimated viability/ecological integrity
B?	Possibly good estimated viability/ecological integrity
BC	Good or fair estimated viability/ecological integrity
BD	Good, fair, or poor estimated viability/ecological integrity
C	Fair estimated viability/ecological integrity
C?	Possibly fair estimated viability/ecological integrity
CD	Fair or poor estimated viability/ecological integrity
D	Poor estimated viability/ecological integrity
D?	Possibly poor estimated viability/ecological integrity
E	Verified extant (viability/ecological integrity not assessed)
F	Failed to find
F?	Possibly failed to find
H	Historical
H?	Possibly historical
X	Extirpated
X?	Possibly extirpated
U	Unrankable
NR	Not ranked

Occurrence Type

Defines whether the EO is a principal or sub- EO.

Principal EO

For species Elements, a principal EO represents the full occupied habitat (or previously occupied habitat) that contributes, or potentially contributes, to the persistence of the species at that location. Generally, a species principal EO corresponds to a population or metapopulation. Principal Eos are typically separated from each other by barriers to movement or dispersal, or by specific distances defined for each Element across either unsuitable habitat, or suitable but apparently unoccupied habitat.

For community Elements, a principal EO represents a defined area that contains (or contained) a characteristic species composition and structure. Principal EOs are separated from each other by barriers to species interactions, or by specific distances defined for each Element across adjacent areas occupied by other natural or semi-natural community types, or by cultural vegetation.

A principal EO may not necessarily provide knowledge of the full extent of the Element at that location. In such cases, only the portion of the occupied habitat or area that is known should be recorded from the evidence available (without extrapolation to include unsurveyed proximate habitat or area). The EO record should indicate whether the full extent of habitat or area occupied by the Element is known to be included in the principal EO using the Confidence Extent field.

Sub-EO

A smaller geographically distinct area contained within a principal EO of the same Element can be a sub-EO. A sub-EO is an EO created to track information that could be useful for conservation planning, monitoring, or management at local levels. A sub-EO will not be developed for a component patch of a multi-part (complex) EO representation unless significant information is to be tracked for the patch that would warrant the creation and maintenance of an EO record.

Sub-EOs are most typically developed to track areas utilized by species for discrete behaviors or life history functions (e.g., feeding areas, dens, nest sites). Areas of differing composition, or higher density, quality, or conservation concern (e.g., demes or subpopulations, different age stands or successional phases, old growth patches, concentrated breeding areas) are also frequently tracked as sub-EOs.

*Records for principal EOs and sub-EOs have a parent-child relationship. A principal EO record may be linked to one or more sub-EO records. However, a sub-EO record cannot stand alone; there must be a link between the sub-EO record and its parent record.

Mapping Precision

Precision refers to the accuracy of the location of the EO. CNHP compiles data from a variety of sources including published and unpublished literature, herbaria and museum labels, personal communication, and documentation of actual field surveys conducted by CNHP staff and other knowledgeable individuals. The level of spatial uncertainty, therefore, varies from EO to EO.

A single-letter code for the precision used to map the EO on a U.S. Geological Survey (USGS) 7.5' (or 15') topographic quadrangle map.

Domain Values for Mapping Precision are:
S – Seconds: essentially an "X" marks the spot"; mappable to within approximately 3 arc seconds of latitude and longitude
M – Minutes: mappable within approximately 1 mile in any direction
G – General: any occurrence whose locational uncertainty exceeds approximately 1 mile

Principal EO ID
In cases when this EO is a sub-EO, the unique identifier (i.e., Element Occurrence ID) for the parent principal EO that contains it.

Principal EO Number
In cases when this EO is a sub-EO, the EO number assigned to the parent principal EO that contains it.

CNHP POTENTIAL CONSERVATION AREA

Potential Conservation Area
In order to successfully protect populations or occurrences, it is necessary to delineate conservation areas. These potential conservation areas focus on capturing the ecological processes that are necessary to support the continued existence of a particular element of natural heritage significance. Potential conservation areas may include a single occurrence of a rare element or a suite of rare elements or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is hypothesized that some activities will cause degradation to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the preliminary conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based.

Site ID
Unique identifier for the PCA that supports this EO.

Site Code
Unique identifier previously used in the BCD for a site record.

Potential Conservation Area Name
Name of PCA associated with this EO.

EO Driving Biodiversity Rank
Yes or No, indicates whether this EO is the EO which is driving the biodiversity rank of this PCA. A combination of Global Imperilment Rank, State Imperilment Rank, and EO Rank factors determine if a given EO drives the biodiversity rank of a PCA that supports it.

LOCATORS

EO Directions *[provided with Level 1 Data only]*
Specific directions to the EO as provided by the data source.

Latitude *[provided with Level 1 Data only]*
Degrees, Minutes, Seconds Datum is NAD 27. Calculated in GIS.

Longitude *[provided with Level 1 Data only]*
Degrees, Minutes, Seconds Datum is NAD 27. Calculated in GIS.

County Name
Calculated in GIS.

Watershed
U.S.G.S. 8-digit hydrologic unit code and name. Calculated in GIS.

Township/Range/Section (TRS) - Public Land Survey System
Calculated in GIS.
Township/Range
Section
Meridian
TRS Note

USGS 7.5 Minute Quadrangle
Calculated in GIS.
Quad Code
Quad Name

MAPPING INFORMATION

Estimated Representation Accuracy
Value that indicates the approximate percentage of the Element Occurrence Representation (EO Rep) that was observed to be occupied by the Element (versus area added for locational uncertainty). Use of estimated representation accuracy provides a common index for the consistent comparison of EO reps, thus helping to ensure that aggregated data are correctly analyzed and interpreted.

Domain values for Estimated Representation Accuracy are:
Very high (>95%)
High (>80%, <= 95%)
Medium (>20%, <= 80%)
Low (>0%, <= 20%)
Unknown
(null)Not assessed

Calculated Representation Accuracy
A calculated percentage for the area of the EO rep that was observed to be occupied by the Element (versus area added for locational uncertainty).

Confidence Extent
Value that indicates whether the full extent of the Element is known (i.e., has been determined through field survey) at that location and, therefore, is represented by the EO.

Domain values for Confidence Extent are:

Y Confident full extent of EO is known
N Confident full extent of EO is NOT known
? Uncertain whether full extent of EO is known
(null) Not assessed

Old Mapping Methodology
Specifies whether or not the EO boundaries were designed using new methodology or old methodology (see below for explanations).

Old Method:
Data were compiled onto 7.5 minute U.S.G.S. topographic maps. Point coordinates, representing the centrum of the occurrence, were measured manually in degrees, minutes, and seconds of longitude and latitude. Coordinates were converted to decimal degrees and used to generate a GIS point coverage with single precision.

During the data conversion process, all point data had to be converted to polygons. Points were buffered by mapping precision, the spatial uncertainty of the element occurrence, in order to capture the maximum extent of the occurrence (ex. EO with seconds mapping precision) OR to represent the entire area in which an EO could fall (ex. EOs with minutes or general mapping precision). Natural community polygons were created differently. Least rectangles, the bounding box of an occurrence, were generated using the northernmost, southernmost, westernmost and easternmost coordinates of the community. Any natural community without least rectangle coordinates was entered into the system as a point and buffered by mapping precision.

New Method:
For EOs with seconds mapping precision:

1) Any EO larger than 12.5 meters (CNHP's minimum mapping unit) in length and width is digitized as a polygon,
2) Any EO greater than 12.5 meters in length but less than 12.5 meters in width is digitized as a line and buffered 6.25 meters for a total width of 12.5 meters, and
3) Any EO less than 12.5 meters in length and width is entered as a point and buffered by 6.25 meters (for a diameter of 12.5 meters) if the coordinates were captured via GPS and differentially corrected. Points not captured via GPS are given larger buffer distances. These distances are based on the information provided by the data source or the best estimate of CNHP's information managers.

EOs with minutes or general mapping precision cannot be accurately mapped since the data source did not provide specific directions. CNHP might know an EO is within a county, PLSS Township or a State Wildlife Area. In these examples, CNHP would use GIS layers of counties, Townships and managed areas to represent the possible location of the occurrence. Hence, polygons of minutes and general EOs represent the area in which the EO could occur.

Boundaries
Value that indicates whether a map sketch or other information on the boundaries of the EO is available.

Domain values for Boundaries are:

? Questionable; Information on the boundaries of the EO is available, but is questionable or disputed
N No; information on the boundaries of the EO is not available
Y Yes; information on the boundaries of the EO is available
(null) Unknown whether boundary information is available, or not assessed

Mapping Precision
Precision refers to the accuracy of the location of the EO. CNHP compiles data from a variety of sources including published and unpublished literature, herbaria and museum labels, personal communication, and documentation of actual field surveys conducted by CNHP staff and other knowledgeable individuals. The level of spatial uncertainty, therefore, varies from EO to EO.

A single-letter code for the precision used to map the EO on a U.S. Geological Survey (USGS) 7.5' (or 15') topographic quadrangle map.

Domain Values for Mapping Precision are:
S – Seconds: essentially an "X" marks the spot"; mappable to within approximately 3 arc seconds of latitude and longitude
M – Minutes: mappable within approximately 1 mile in any direction
G – General: any occurrence whose locational uncertainty exceeds approximately 1 mile

SURVEY INFORMATION

Survey Site Name
Name of the survey site where the EO is located, usually corresponding to a geographic feature or local place name.

Survey Date
Date EO was last searched for at the site.

First Observation
Date that the EO was first reported at the site.

Last Observation
Date that the EO was last observed to be extant at the site.

EO Data
For species Elements, data collected on the biology of this EO including the number of individuals, vigor, habitat, soils, associated species, peculiar characteristics, etc.

For community Elements, summary text (i.e., capsule) description of the vegetation of the EO, including structure (strata) and composition (dominant/characteristic species), heterogeneity, successional stage/dynamics, any unique aspects of the community or additional noteworthy species (including animals).

Monitoring Needs
Comments related to any monitoring needed on the EO.

Research Needs
Comments related to any research needed on the EO.

[ADDITIONAL REPORT SECTIONS/DATA FIELDS HERE FOR COMMUNITY EOs ONLY]

EO RANK

Basic EO Rank
Value that indicates the relative value of the EO with respect to other occurrences of the Element, based on an assessment of estimated viability (species) or ecological integrity (communities), i.e., the probability of persistence (based on condition, size, and landscape context) of occurrences of a given Element. In other words, EO ranks provide an assessment of the likelihood that if current conditions prevail the occurrence will persist for a defined period of time, typically 20-100 years.

EO ranks may be used effectively in conjunction with Heritage Conservation Status Ranks for the Element to guide which occurrences should be recorded and mapped, and to help prioritize EOs for purposes of conservation planning or action, both locally and rangewide.

Domain values for Basic EO Rank are:

- A Excellent estimated viability/ecological integrity
- A? Possibly excellent estimated viability/ecological integrity
- AB Excellent or good estimated viability/ecological integrity
- AC Excellent, good, or fair estimated viability/ecological integrity
- B Good estimated viability/ecological integrity
- B? Possibly good estimated viability/ecological integrity
- BC Good or fair estimated viability/ecological integrity
- BD Good, fair, or poor estimated viability/ecological integrity
- C Fair estimated viability/ecological integrity
- C? Possibly fair estimated viability/ecological integrity
- CD Fair or poor estimated viability/ecological integrity
- D Poor estimated viability/ecological integrity
- D? Possibly poor estimated viability/ecological integrity
- E Verified extant (viability/ecological integrity not assessed)
- F Failed to find
- F? Possibly failed to find
- H Historical
- H? Possibly historical
- X Extirpated
- X? Possibly extirpated
- U Unrankable
- NR Not ranked

Origin Subrank
Value that indicates whether the EO is not (or is possibly not) native to that location or natural in origin, if appropriate.

Domain values for Origin Subrank are:

- i Introduced
- i? Possibly introduced
- r Reintroduced/restored
- r? Possibly reintroduced/restored

EO Rank Date
Date EO Rank was assigned.

EO Rank Comment
Comments justifying assigned rank.

Rank Considerations

- Condition of EO
- Condition Comment
- Size of EO
- Size Rating
- Landscape Context
- Landscape Context Rating

DESCRIPTION

EO Type
According to previous Heritage methodology, the type name used in the Biological and Conservation Data system (BCD), that describes this EO for species (typically migratory animals) that manifest different types of occurrences (e.g., breeding site, nursery colony, roosting area).

General Description
General description or word picture of the area where the EO is located (i.e., the physical setting/ context surrounding the EO), including a list of adjacent communities. Also, when available, information on surrounding land use.

Environment Comments

[ADDITIONAL REPORT SECTIONS/DATA FIELDS HERE FOR COMMUNITY EOs ONLY]

PROTECTION/MANAGEMENT

U.S. Endangered Species Act Status
The federal legal status of the species as assigned by the U.S. Fish and Wildlife Service (USFWS). Blank values indicate no state legal status per USFWS.

Domain values for U.S. Endangered Species Act Status:

- C ESA Candidate
- LE Listed Endangered
- LE, LT Listed as Endangered in a portion of the species' range and listed as Threatened] in the rest of the species' range
- LT Listed Threatened
- PT Proposed Threatened
- LE-PDL Listed Endangered, proposed delisting
- LE, XN All of the species' infraspecific taxa worldwide are listed as Endangered or as a nonessential experimental population

State Protection Status (CDOW)
The state legal status of vertebrate or invertebrate species as assigned by the Colorado Division of Wildlife (CDOW). Blank values indicate no state legal status per CDOW.

Domain Values for State Protection Status are:

- E State endangered; elements of native wildlife whose prospects for survival or recruitment within this state are in jeopardy
- T State threatened; elements that are not in immediate jeopardy of extinction, but are vulnerable due to small numbers, restricted throughout its range, or experiencing low recruitment or survival
- SC Special concern

Protection Comments *[provided with Level 1 Data only]*
Summary of the general level of protection currently afforded the Site that indicates the current protection status of component Tracts.

Management Comments *[provided with Level 1 Data only]*
Comments on any management needed to ensure continued existence of the EO as well as the chances and means of fulfilling those needs.

ADDITIONAL TOPICS

General Comments
General comments concerning the EO that have not been addressed in other fields in this record.

DOCUMENTATION/VERSION

Reference Code
The identifier for a reference available for this EO.

Citation
Formal citation for a reference associated with the EO.

Primary
Indicates that the reference entered in the associated Reference Code column is the primary source for information on this EO.

Specimen
Any specimen information associated with the EO including museum/herbarium, collector, year and collection number if available.

OTHER ATTRIBUTES

Min. Elevation
Minimum elevation provided by the data source.

Max. Elevation
Maximum elevation provided by the data source.

EO Observation Area
Estimated size of the EO provided by the data source.

Calculated Attributes

- Acreage
- Ecoregion – TNC's ecoregions, modified version of Bailey's
- Hectares
- Latitude_DD
- Longitude_DD
- Land_Status – 1998 Gap Analysis Land Cover Map produced by Colorado Division of Wildlife (CDOW)
- UTM_Easting
- UTM_Northing
- UTM_Zone

Data Dictionary for Potential Conservation Area Transcription Reports from the Colorado Natural Heritage Program

This Data Dictionary defines terms used in Potential Conservation Area (PCA) Reports exported by the Colorado Natural Heritage Program (CNHP) from our Biodiversity Tracking and Conservation System (BIOTICS) database.

Introduction to Potential Conservation Areas
In order to successfully protect populations or occurrences, it is necessary to delineate conservation areas. These potential conservation areas focus on capturing the ecological processes that are necessary to support the continued existence of a particular element of natural heritage significance. Potential conservation areas may include a single occurrence of a rare element or a suite of rare elements or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is hypothesized that some activities will cause degradation to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the preliminary conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based.

Element Occurrence
An Element Occurrence (EO) is defined as a specific example of an Element at a geographic location characterized by a habitat capable of sustaining or contributing to the survival of the species, or by a landscape that supports the ecological integrity of the community.

Element
A biodiversity unit of conservation attention and action for which a Heritage Conservation Status Rank is assigned.

Elements may be recognized at any taxonomic level (although typically are only recognized at the species level and below for organisms, and the Ecological System, Alliance, and Association levels for communities).

Elements may also be recognized for biodiversity units for which there is no systematic hierarchy (e.g., animal assemblages, community complexes).

Elements may be native or exotic at a particular location and collectively represent the full array of biological and ecological diversity for the geographic area covered. Elements may serve as the targets of Heritage inventory. Typically, these targets include native, regularly occurring vulnerable species (including infraspecific taxa and populations) and exemplary ecological communities.

REPORT HEADER

Name
The official CNHP site name, usually corresponding to a local place name or nearby geographic feature.

Site Code
Unique identifier previously used in the BCD for a site record.

IDENTIFIERS

Site ID
Unique identifier for a site.

Site Class
Value that indicates whether a site is a Potential Conservation Area (PCA) or Network of Conservation Areas (NCA).

Domain values for Site Class are:
PCA
NCA

Site Alias
Other names commonly associated with the PCA. These can include informal names, old site names, names used by other offices or cooperating organizations, or the original survey site name.

Network of Conservation Areas (NCA)
A Network of Conservation Areas (NCA) will fit one of the following definitions:

A. A landscape area that encompasses Potential Conservation Areas (PCAs) that share similar species or natural communities and ecological processes. NCAs include unoccupied or unsurveyed areas that are within the same ecological system that the species or natural communities require. NCAs contain PCAs with an obvious repeating pattern (that is, the same species or natural communities are in each associated PCA).

B. A mostly intact, lightly fragmented landscape that supports wide-ranging species and large scale disturbances. NCAs include unoccupied or unsurveyed areas that demonstrate the connectivity of the landscape. NCAs contain PCAs that may occur at a variety of ecological scales.

NCA Site ID
Site ID of the NCA associated with this PCA.

NCA Site Code
Site code of the NCA associated with this PCA.

NCA Site Name
Official CNHP site name of the NCA associated with this PCA.

Site Relations
Comments that explain the relationship between this site and any nested, overlapping, or adjacent sites.

LOCATORS

Nation
State

Latitude
Degrees, Minutes, Seconds. Datum is NAD 27. Calculated in GIS.

Longitude
Degrees, Minutes, Seconds. Datum in NAD 27. Calculated in GIS.

USGS 7.5 Minute Quadrangle
Calculated in GIS.
- **Quad Code**
- **Quad Name**

County
Calculated in GIS.

Watershed Code
8 digit U.S.G.S. hydrological unit code. Calculated in GIS.

Watershed Name
U.S.G.S. watershed name. Calculated in GIS.

Township/Range/Section (TRS) - Public Land Survey System
Calculated in GIS.
- **Township/Range**
- **Section**
- **Meridian**
- **TRS Note**

Site Directions *[provided with Level 1 data only]*
Specific directions to the site provided by the designer or version author.

SITE DESCRIPTION

Minimum Elevation
Minimum elevation provided by the designer or version author.

Maximum Elevation
Maximum elevation provided by the designer or version author.

Site Description
General visual description (or word picture) of the principal physical and natural features on the site.

Key Environmental Factors
Description of the driving factors or key environmental variables that are known to exert a major influence on the biota at the site (e.g., seasonal flooding, wind, soil type).

Climate Description
General comments concerning climate and weather patterns, wind patterns, seasonal and annual variations, as well as temperature and precipitation patterns characteristic of the site.

Land Use History
Comments concerning past land uses on this site (such as mining, logging, shifting cultivation, etc.).

Cultural Features
Comments concerning any historic, cultural, or archaeological features found on the site (e.g., pictographs, petroglyphs, burial mounds, prehistoric artifacts).

SITE DESIGN

Site Map
Indicates whether a site boundary was field verified or drawn from desktop references.

Domain values for Site Map are:
- P – partial; drawn from desktop references
- Y – field verified by CNHP personnel

Mapped Date
Date site boundary was last redrawn.

Designer
CNHP biologist responsible for drawing the site boundary.

Boundary Justification
Explanation of the biological rationale used to determine the ecological boundaries for the site.

Primary Area
Area of PCA polygon. Calculated in GIS.

SITE SIGNIFICANCE

Biodiversity Significance Rank
Value that indicates the rating that best describes the significance of the site in terms of its biological diversity.

Domain values for Biodiversity Significance are:
- B1: Outstanding Biodiversity Significance
- B2: Very High Biodiversity Significance
- B3: High Biodiversity Significance
- B4: Moderate Biodiversity Significance
- B5: General interest/open space
- B?: Unknown

Biodiversity Significance Comments
Comments that justify the rating assigned for the site in the Biodiversity Significance field.

Other Values Rank
Value that indicates the rating that best describes the significance of the site in terms of its aesthetic, recreational, open space, and other ecological values; this includes its role in maintaining ecosystem health (e.g., by providing game and wildlife habitat, aquifer recharge functions, erosion control).

Domain values for Other Values are:

V1 Outstanding values
V2 High values
V3 Moderate values
V4 No known values
V5 Negative or counter values
V? Unknown
(null) Not assessed

Other Values Comments
Comments that justify the rating assigned for the site in the Other Values field.

Protection Urgency Rank *[provided with Level 1 data only]*
Value that indicates the rating that best describes the urgency to protect the site. The urgency for protection action (not to be confused with the urgency for management action) will generally increase with impending threats to the site until legal, political, or other administrative measures are taken.

Domain values for Protection Urgency are:

P1 Immediately threatened/outstanding opportunity
P2 Threat/opportunity within 5 years
P3 Definable threat/opportunity, but not within 5 years
P4 No threat or special opportunity
P5 No action to be taken on this site
P? Unknown

Protection Urgency Comments *[provided with Level 1 data only]*
Comments that justify the rating assigned for the site in the Protection Urgency field.

Management Urgency Rank *[provided with Level 1 data only]*
Value that indicates the rating that best describes the urgency to manage one or more Elements at the site. The urgency for management action (not to be confused with the urgency for legal protection action) requires stewardship intervention in order to maintain EOs at the site.

Domain values for Management Urgency are:

M1 Essential within 1 year to prevent loss
M2 Essential within 5 years to prevent loss
M3 Needed within 5 years to maintain quality
M4 Not needed now; no current threats; may need in future
M5 Not needed; no threats anticipated
M? Unknown

Management Urgency Comments *[provided with Level 1 data only]*
Comments that justify the rating assigned for the site in the Management Urgency field.

LAND MANAGEMENT ISSUES

Land Use Comments
Description of the current and past land use, improvements, and structures on the site.

Natural Hazard Comments
Description of the potential natural hazards (e.g., cliffs, caves, waterfalls) on the site, along with any precautions that should be taken by stewards.

Exotics Comments
Description of potentially damaging exotic (i.e., alien) flora and fauna (e.g., kudzu, honeysuckle, purple loosestrife, periwinkle, English ivy, feral goats, pigs) on the site.

Offsite
Description of off-site land uses (e.g., farming, logging, grazing, dumping, watershed diversion), and how these uses might affect the site, Elements on the site, and management of the site.

Information Needs
Summary of the information that is still needed in order to effectively manage the site and Elements on it.

Management Needs *[provided with Level 1 Data only]*
Summary of the expected management needs for the site and the Elements on it.

Managed Area Relations *[provided with Level 1 Data only]*
Explanation of the site/Managed Area relationship, if a Managed Area has been (or will be) established to protect the site.

Protection Comments *[provided with Level 1 Data only]*
Summary of the general level of protection currently afforded the site that indicates the current protection status of component Tracts.

ASSOCIATED ELEMENTS OF BIODIVERSITY

(Tracked Elements known from the area of a given PCA.)

Element
A biodiversity unit of conservation attention and action for which a Heritage Conservation Status Rank is assigned.

Elements may be recognized at any taxonomic level (although typically are only recognized at the species level and below for organisms, and the Ecological System, Alliance, and Association levels for communities).

Elements may also be recognized for biodiversity units for which there is no systematic hierarchy (e.g., animal assemblages, community Complexes).

Elements may be native or exotic at a particular location and collectively represent the full array of biological and ecological diversity for the geographic area covered. Elements may serve as the targets of Heritage inventory. Typically, these targets include native, regularly occurring vulnerable species (including infraspecific taxa and populations) and exemplary ecological communities.

Element State ID
Unique state identifier for an Element.

State Scientific Name
State scientific name for an Element having occurrences associated with this PCA.

State Common Name
State common name for an Element having occurrences associated with this PCA.

Global Rank
The global element rank that best characterizes the relative rarity or endangerment of the element worldwide. Factors other than the number of occurrences may be considered when assigning a global rank. Global ranks are derived primarily by staff at the Central Heritage Conservation Science Department, unless CNHP has lead responsibility for that element.

Domain values for Global Rank are:

- G1 Globally critically imperiled; typically 5 or fewer occurrences
- G2 Globally imperiled; typically 6 to 20 occurrences
- G3 Globally vulnerable; typically 21 to 100 occurrences
- G4 Globally apparently secure; usually > 100 occurrences
- G5 Globally demonstrably secure although it may be rare in parts of its range
- G#G# A range between two of the numeric ranks; indicates uncertainty about the rarity of the element
- G? Unranked; element is not yet ranked globally
- GU Unrankable; not enough information is known
- GH Historically known with hopes of rediscovery
- GX Extinct; unlikely to be rediscovered
- T# Rank applies to a subspecies or variety
- Q Taxonomic status is questionable
- C Element is extant only in captivation or cultivation
- GNR Not ranked globally

State Rank
The state element rank that best characterizes the relative rarity or endangerment of the element statewide. Factors other than the number of occurrences may be considered when assigning a state rank. State ranks are derived by CNHP staff.

Domain values for State Rank are:

- S1 State critically imperiled; typically 5 or fewer occurrences
- S2 State imperiled; typically 6 to 20 occurrences
- S3 State vulnerable; typically 21 to 100 occurrences
- S4 State apparently secure; usually > 100 occurrences
- S5 State demonstrably secure
- S#S# A range between two of the numeric ranks; indicates uncertainty about the rarity of the element
- S? Unranked; element is not yet ranked in the state
- SU Unrankable; not enough information is known
- SH Historically known with hopes of rediscovery
- SX Extinct; unlikely to be rediscovered
- SE An exotic established in the state; native to a nearby region
- SA Accidental; includes species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or thousands of miles outside their usual range
- B Rank refers to the breeding population of the element
- N Rank refers to the nonbreeding population of the element
- C Element is extant only in captivation or cultivation
- SNR Not ranked in the state

Driving Site Rank
Yes or No, indicates whether this EO is the EO which is driving the biodiversity rank of this PCA. A combination of Global Imperilment Rank, State Imperilment Rank, and EO Rank factors determine if a given EO drives the biodiversity rank of a PCA that supports it.

REFERENCES

Reference ID
The identifier for a reference available for this PCA.

Full Citation
Formal citation for a reference associated with the PCA.

ADDITIONAL TOPICS

Additional Topics
Specific comments on any significant additional nonstandard topics that have not been formally addressed by one of the standard fields in this record.

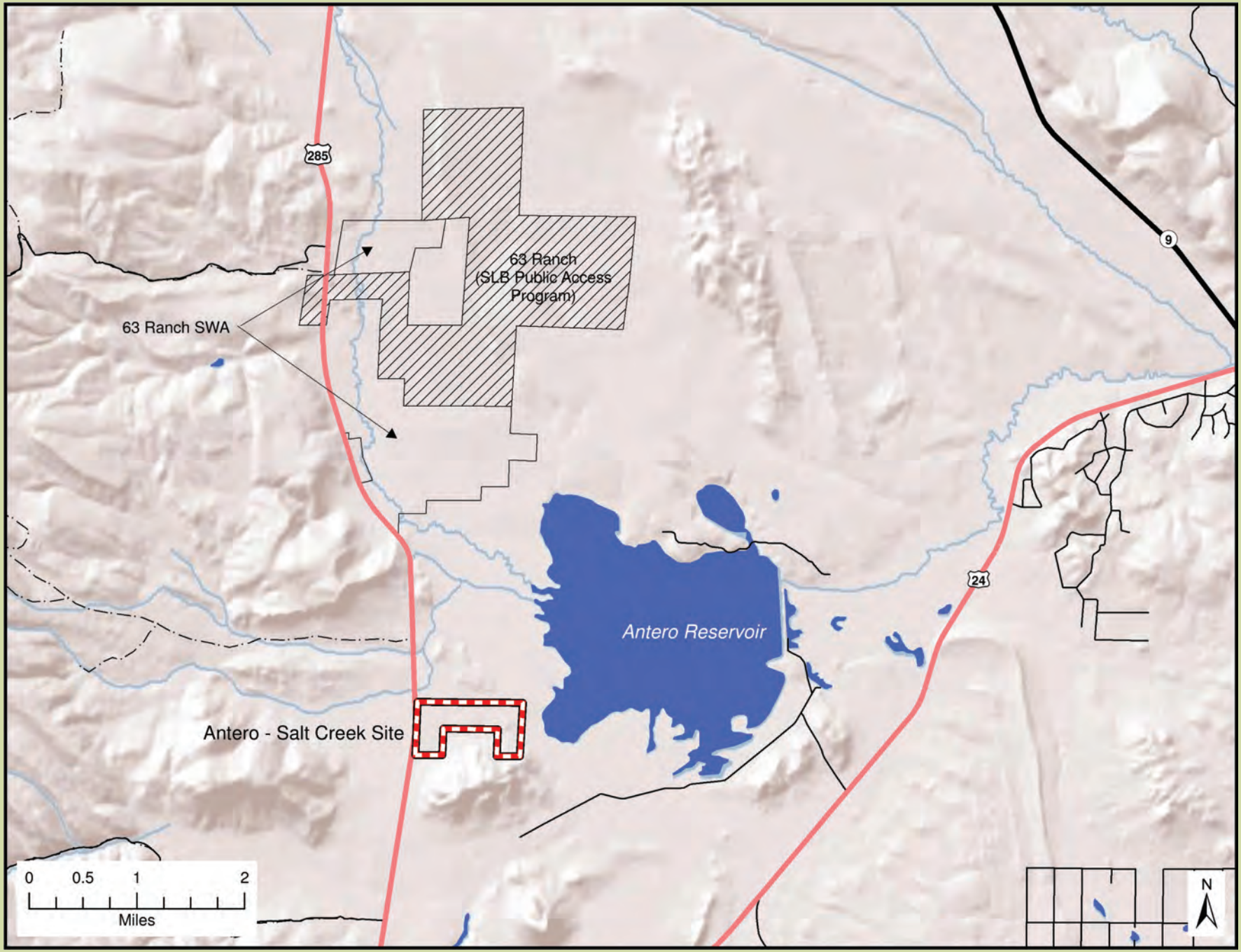
VERSION

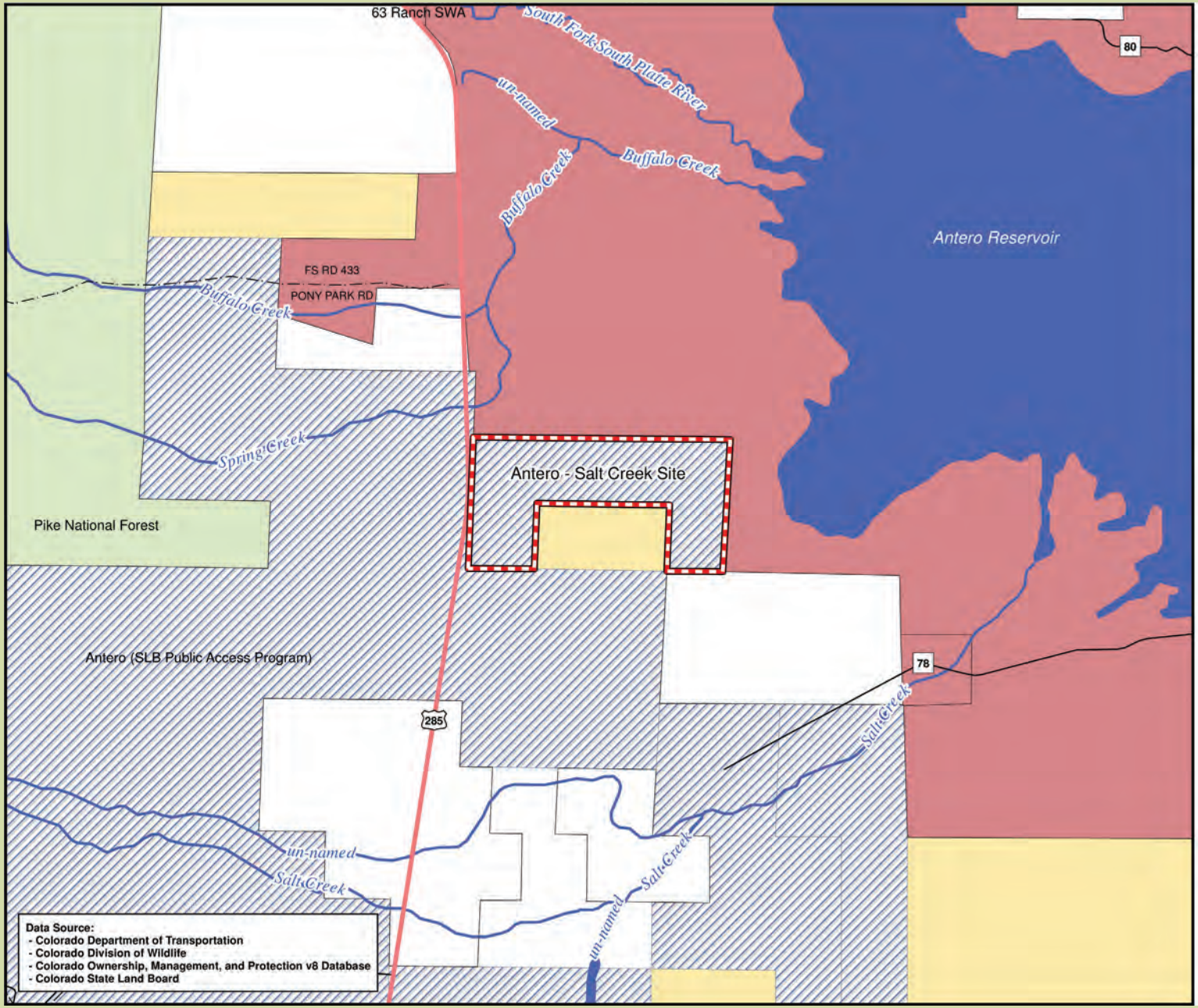
Version Date
Date report information for the PCA was last reviewed or updated.

Version Author
Author of the current version of the transcription in this report.

Appendix B: Site Mapping/GIS Data

Antero-Salt Creek Site


285
63 Ranch
(SLB Public Access
Program)
63 Ranch SWA
9
24
Antero Reservoir
Antero - Salt Creek Site
0
0.5
1
2
Miles
N



Ownership

CSLB Field Survey Site

Parcel Ownership

- Colorado State Land Board
- Denver Water Board
- Private
- US Bureau of Land Management
- USDA Forest Service

Transportation Routes

- US Highway
- Local Roads
- Forest Roads

Lake/Pond/Reservoir

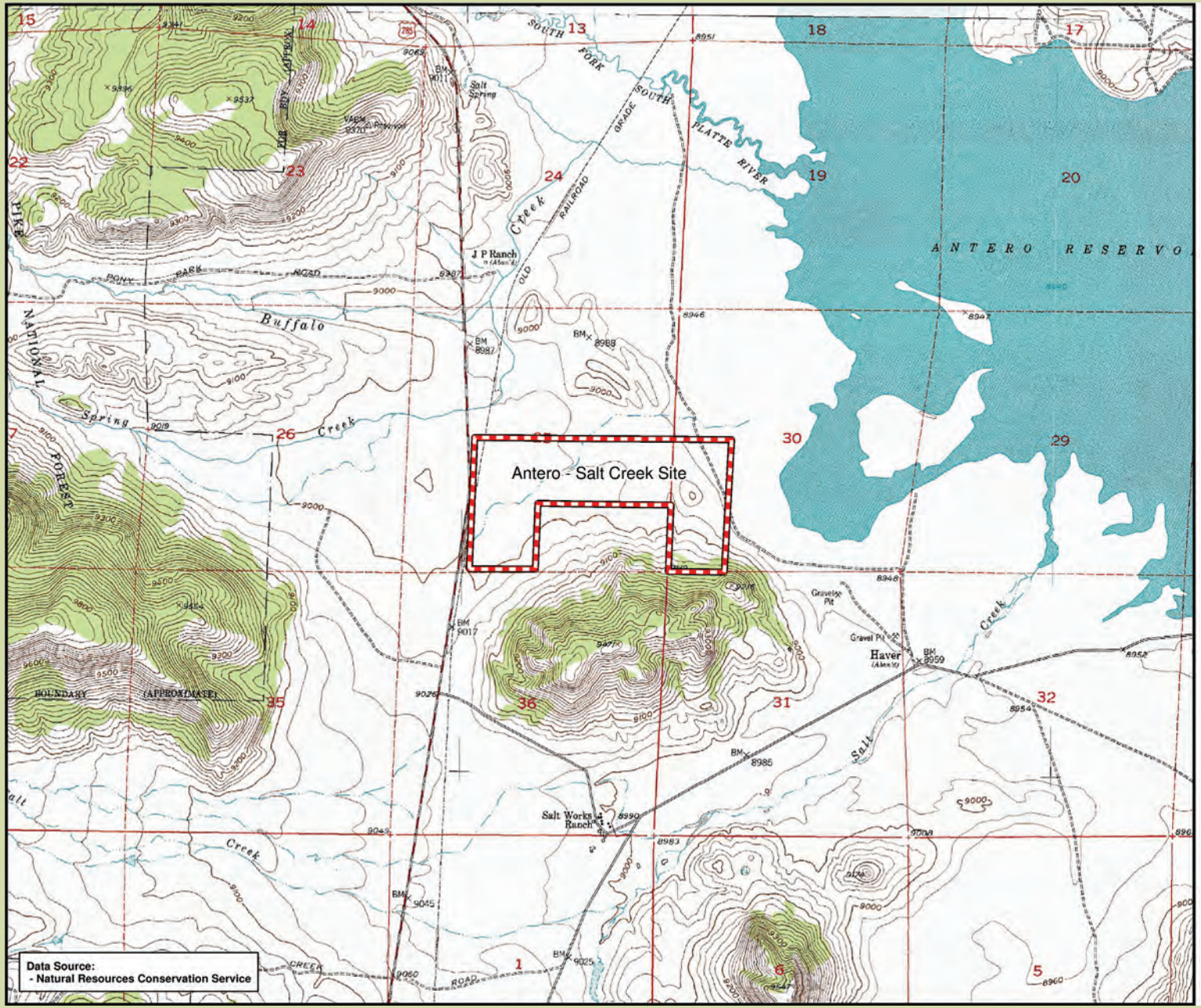
River/Streams

N

0 0.25 0.5 1

Miles

Parametrix



Topo Map

CSLB Field Survey Site

N

0 0.25 0.5 1

Miles

Parametrix

National Land Cover Database

National Land Cover Database

- Open water
- Developed, Open space
- Developed, Low intensity
- Barren land [rock/sand/clay]
- Deciduous forest
- Evergreen forest
- Mixed forest
- Shrub/scrub
- Grassland/herbaceous
- Pasture/hay
- Cultivated crops
- Woody wetlands
- Emergent herbaceaous wetlands

Transportation Routes

- US Highway
- Local Roads
- Forest Roads

Lake/Pond/Reservoir

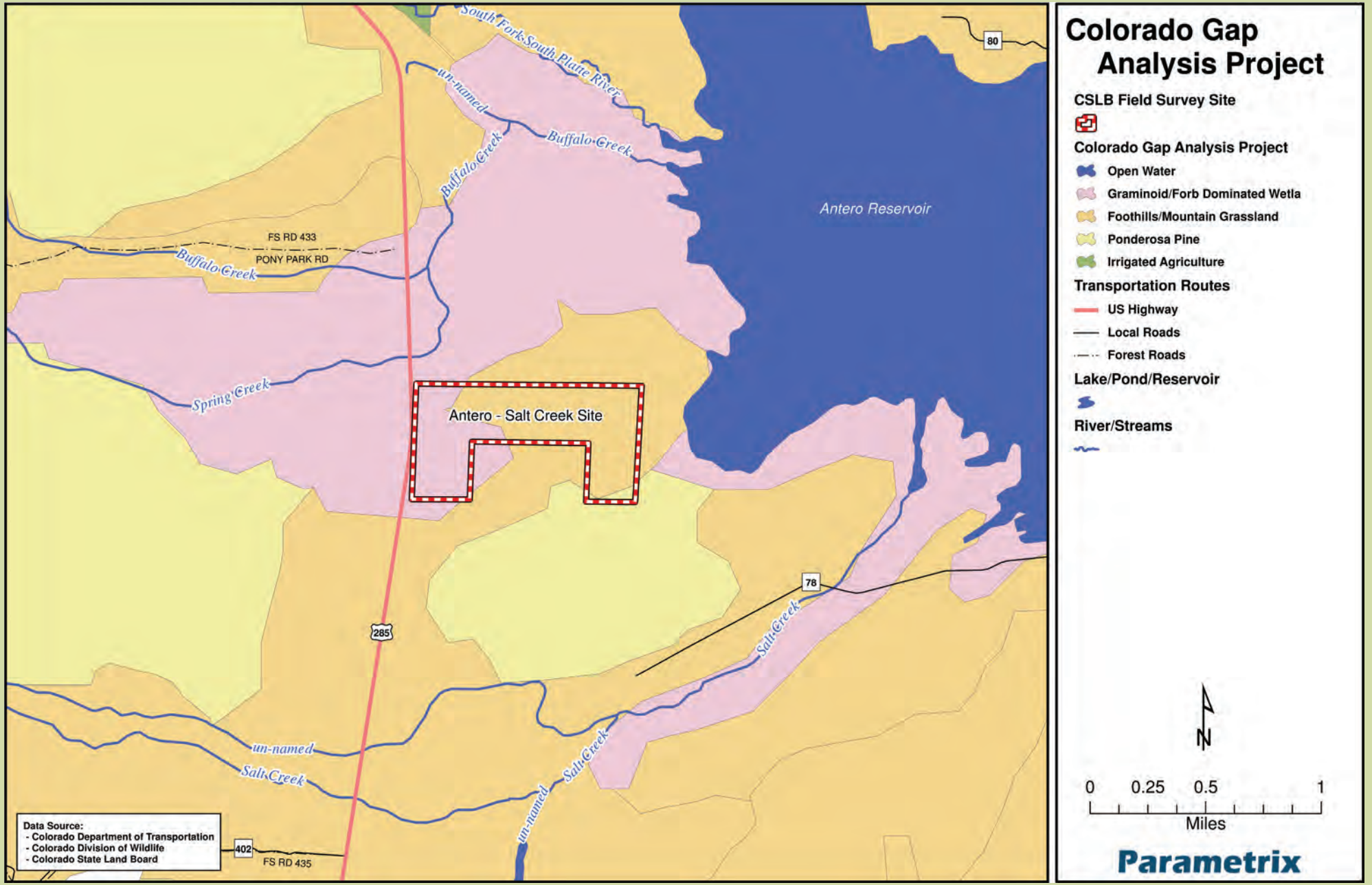
River/Streams

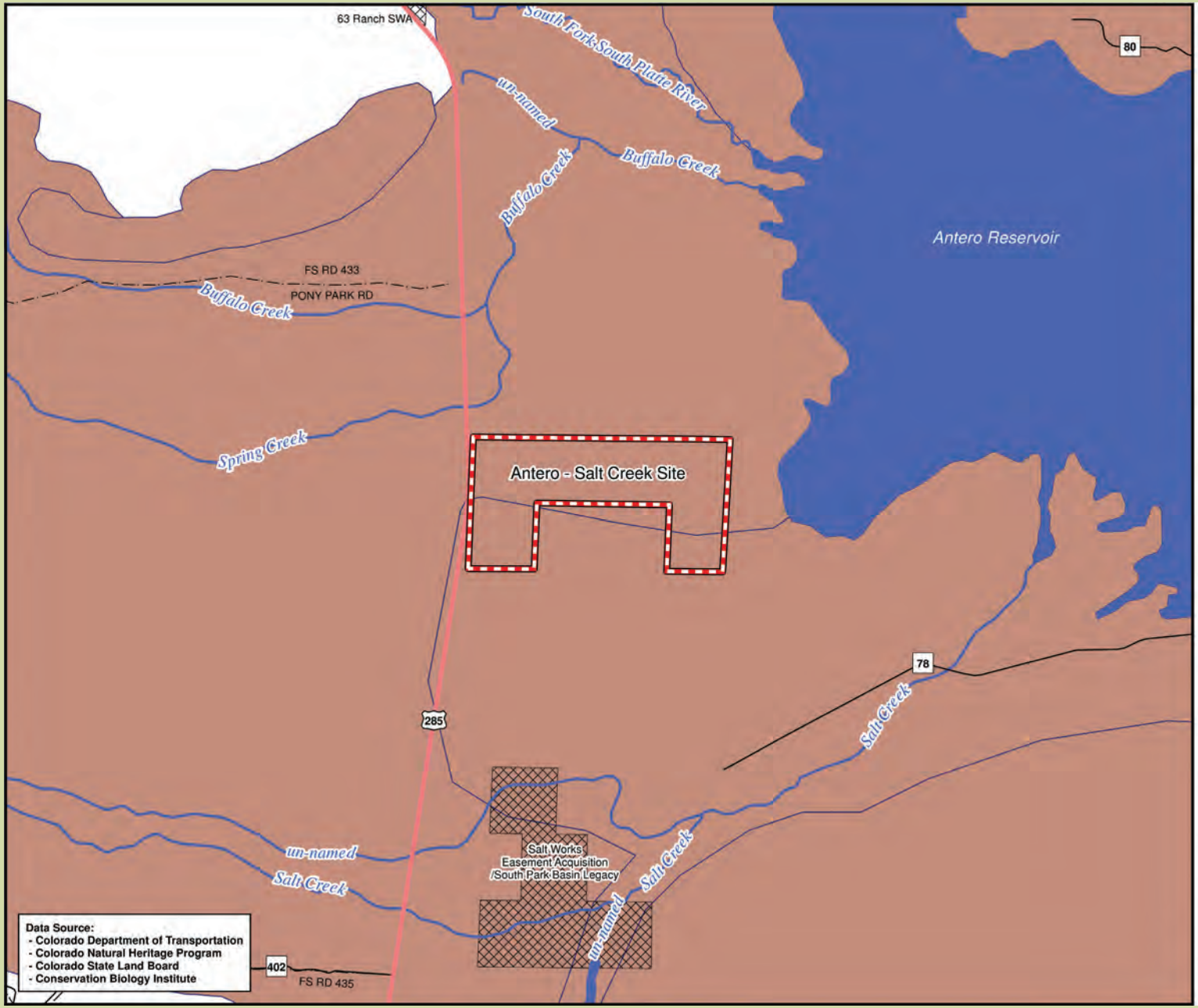
N

0 0.25 0.5 1

Miles

Parametrix


Colorado Gap Analysis Project
CSLB Field Survey Site
Colorado Gap Analysis Project
Open Water
Graminoid/Forb Dominated Wetla
Foothills/Mountain Grassland
Ponderosa Pine
Irrigated Agriculture
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero Reservoir
Antero - Salt Creek Site
South Fork South Platte River
un-named
Buffalo Creek
FS RD 433
PONY PARK RD
Spring Creek
Salt Creek
80
78
285
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
0 0.25 0.5 1
Miles
Parametrix



Conservation Areas

CSLB Field Survey Site

Conservation Easement Lands

Privately Owned

Potential Conservation Areas

Biodiversity Significance Rank

Very High Biodiversity Significance

Transportation Routes

US Highway

Local Roads

Forest Roads

Lake/Pond/Reservoir

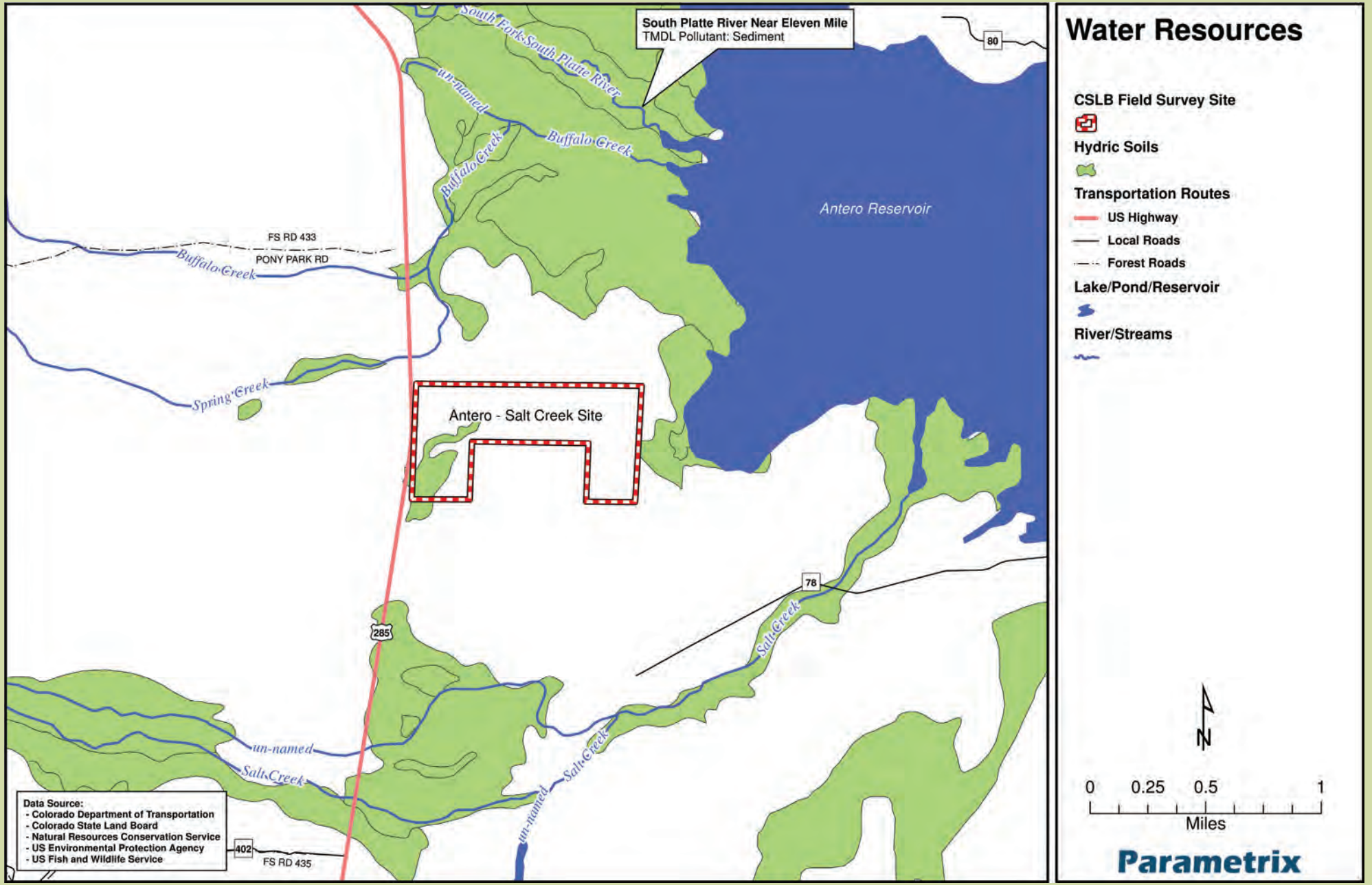
River/Streams

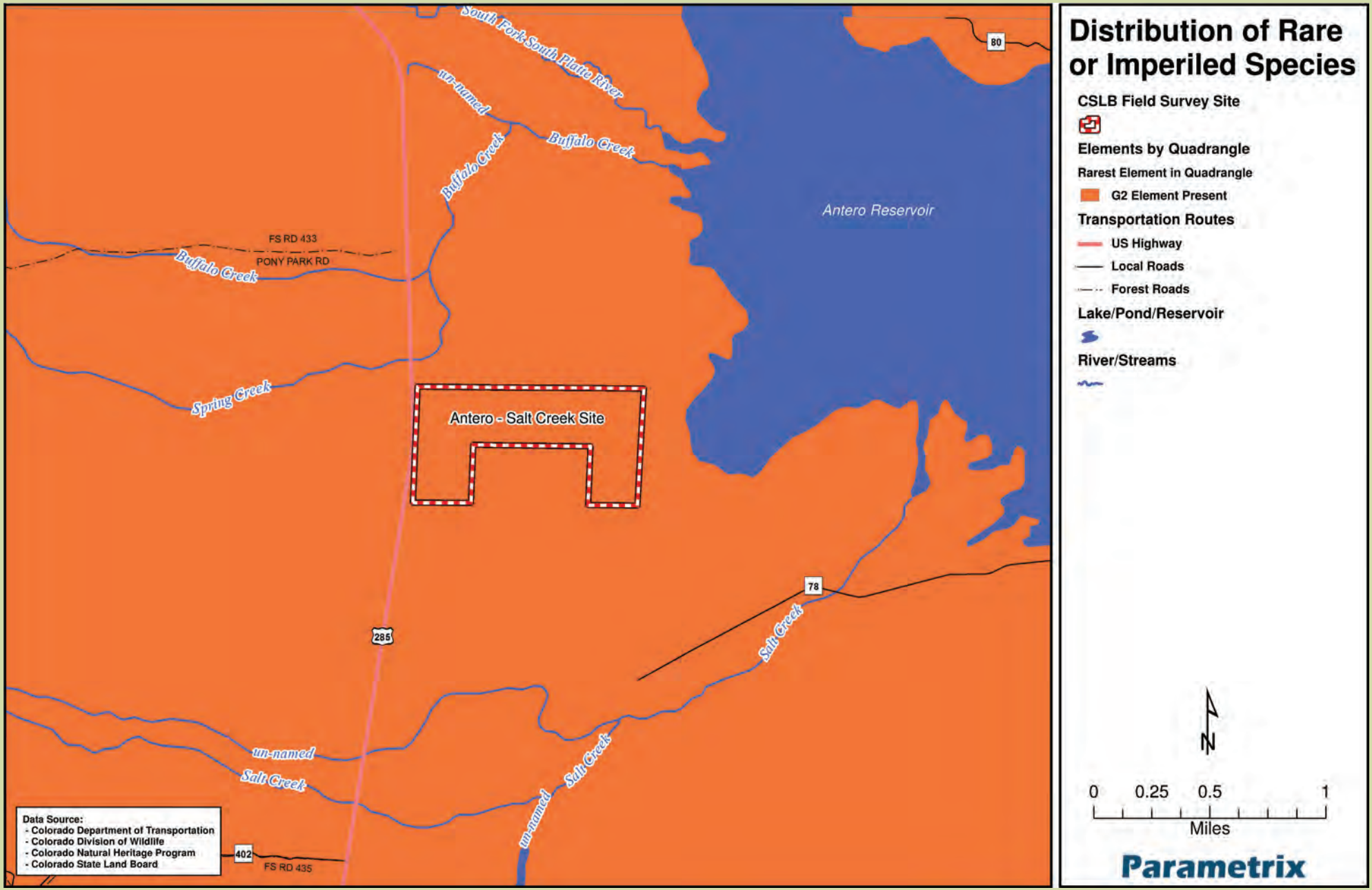
N

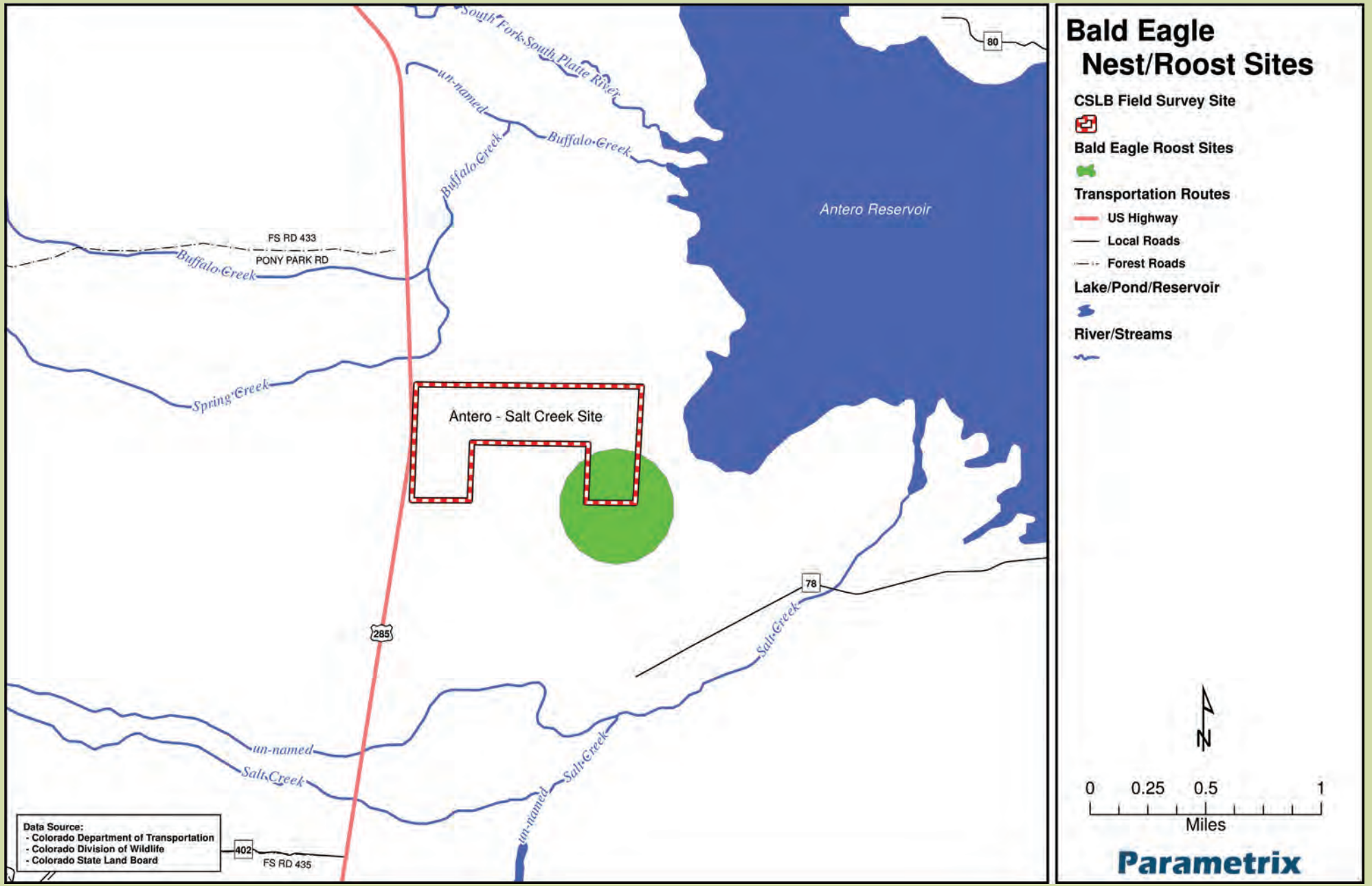
0 0.25 0.5 1

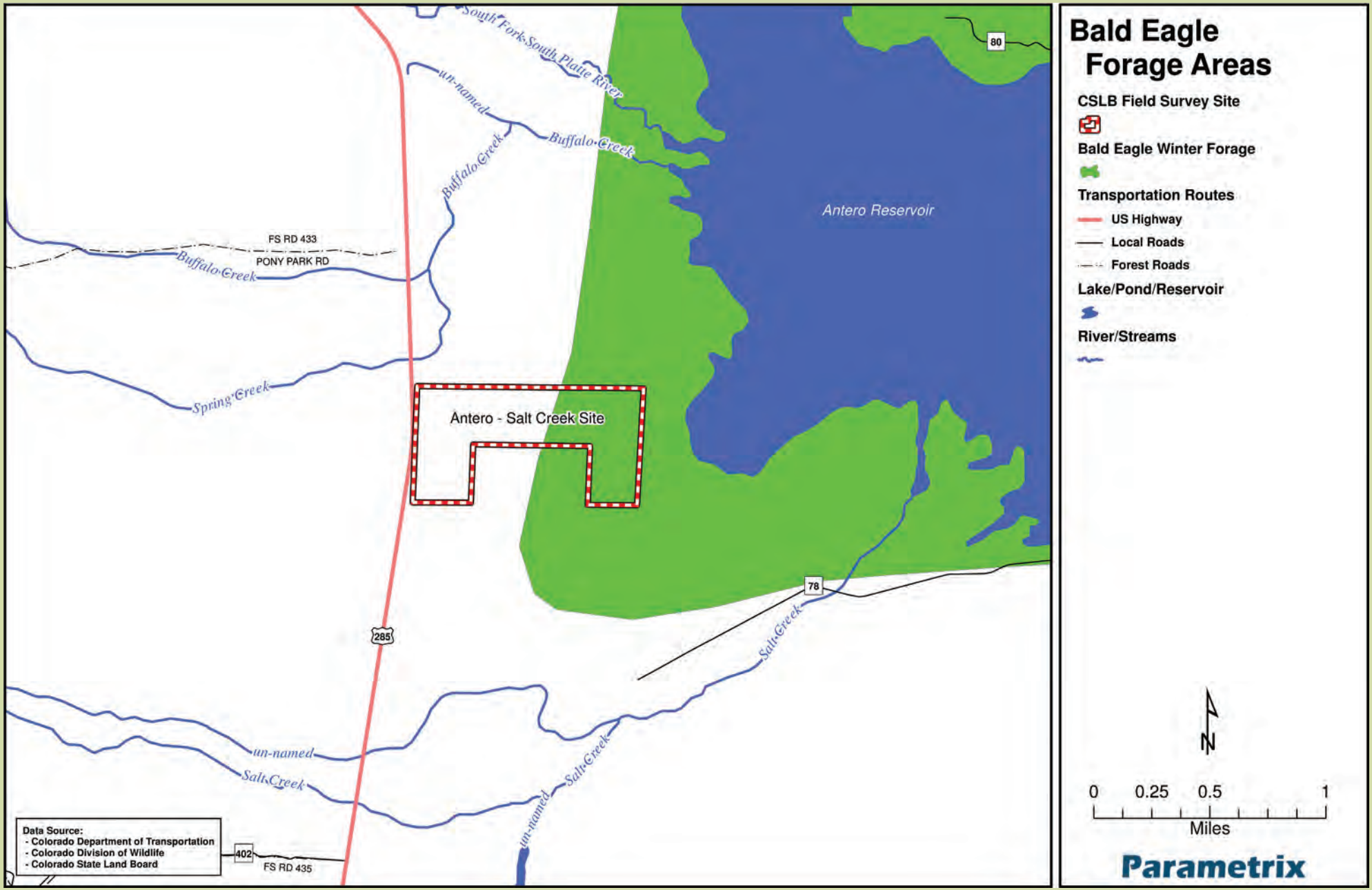
Miles

Parametrix


South Platte River Near Eleven Mile
TMDL Pollutant: Sediment
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Buffalo Creek
Antero Reservoir
80
FS RD 433
PONY PARK RD
Spring Creek
Antero - Salt Creek Site
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
- US Environmental Protection Agency
- US Fish and Wildlife Service
Water Resources
CSLB Field Survey Site
Hydric Soils
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
N
0
0.25
0.5
1
Miles
Parametrix


Distribution of Rare or Imperiled Species
CSLB Field Survey Site
Elements by Quadrangle
Rarest Element in Quadrangle
G2 Element Present
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
80
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado Natural Heritage Program
- Colorado State Land Board
N
0
0.25
0.5
1
Miles
Parametrix


Bald Eagle
Nest/Roost Sites
CSLB Field Survey Site
Bald Eagle Roost Sites
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero Reservoir
Antero - Salt Creek Site
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
80
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
0
0.25
0.5
1
Miles
Parametrix


Bald Eagle
Forage Areas
CSLB Field Survey Site
Bald Eagle Winter Forage
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
80
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
78
285
Salt Creek
un-named
Salt Creek
Salt Creek
un-named
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
402
FS RD 435
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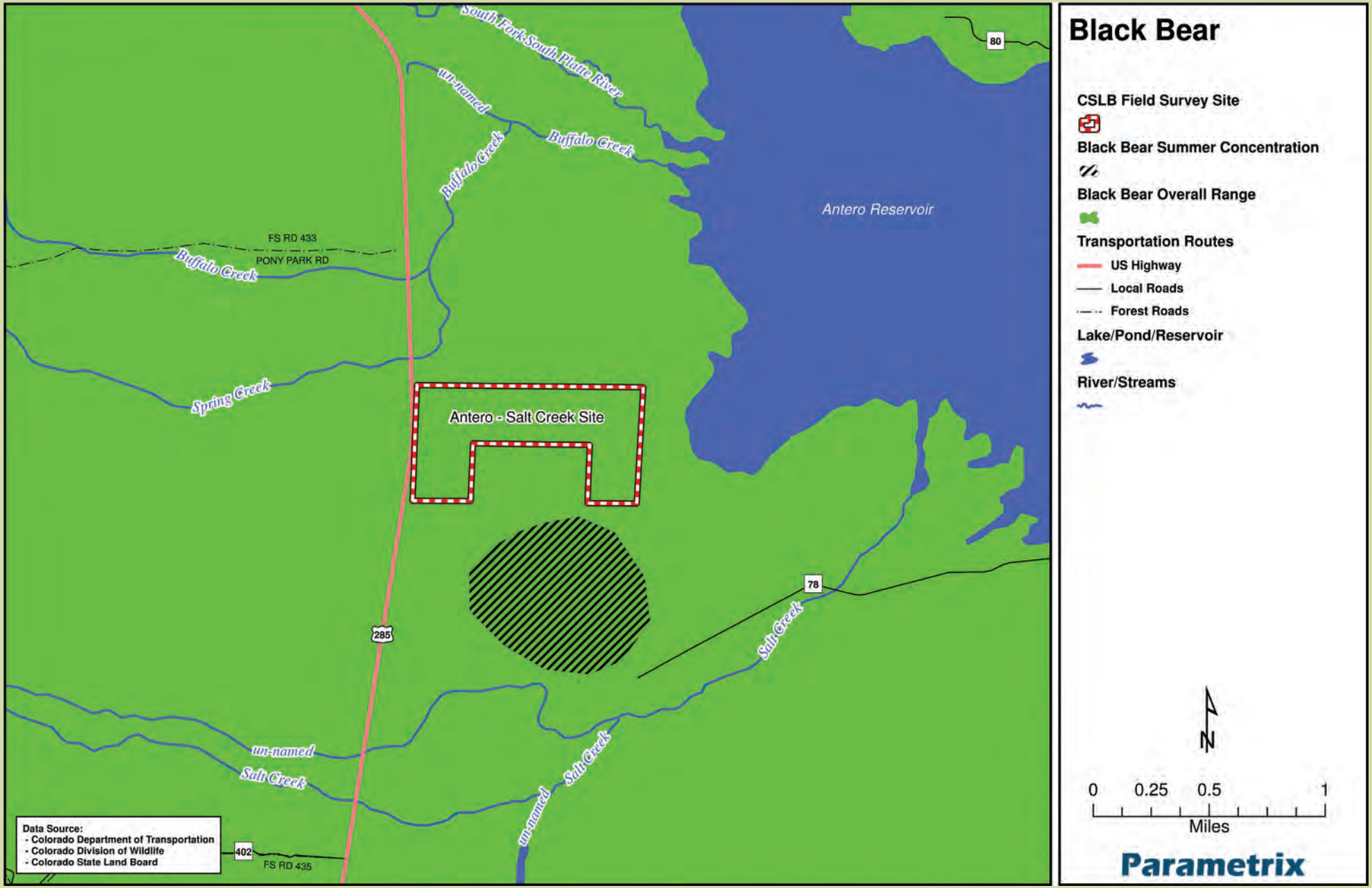
Miles
Parametrix


Black Bear
CSLB Field Survey Site
Black Bear Summer Concentration
Black Bear Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
80
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
78
285
Salt Creek
un-named
Salt Creek
Salt Creek
un-named
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
402
FS RD 435
N
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Miles
Parametrix


Gunnison's Prairie Dog
CSLB Field Survey Site
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
80
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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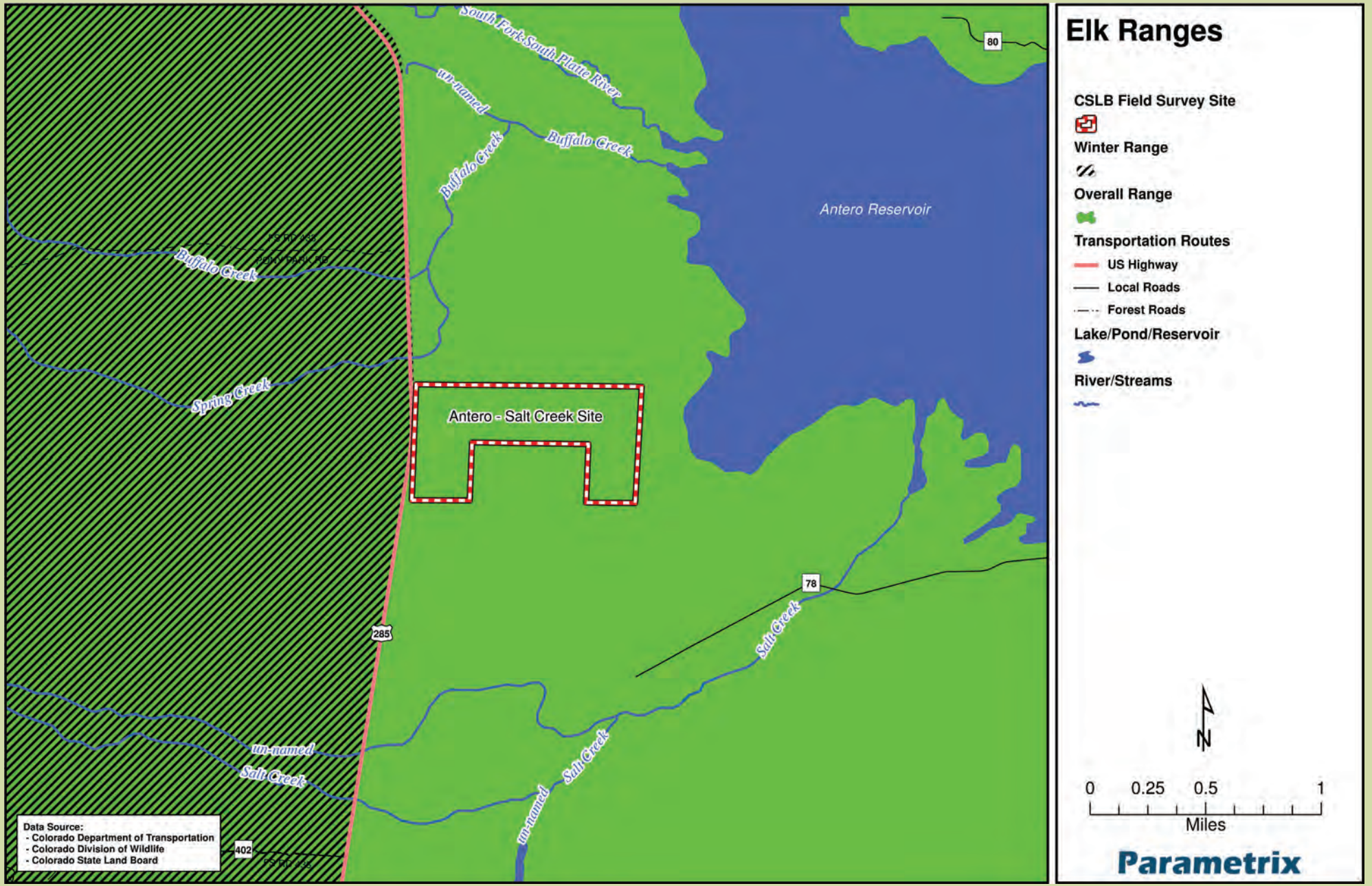
Miles
Parametrix


Elk Ranges
CSLB Field Survey Site
Winter Range
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero - Salt Creek Site
Antero Reservoir
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Buffalo Creek
FS Rd 43
Jolly Rock Rd
Spring Creek
80
78
285
Salt Creek
Salt Creek
un-named
un-named
Salt Creek
402
FS Rd 34
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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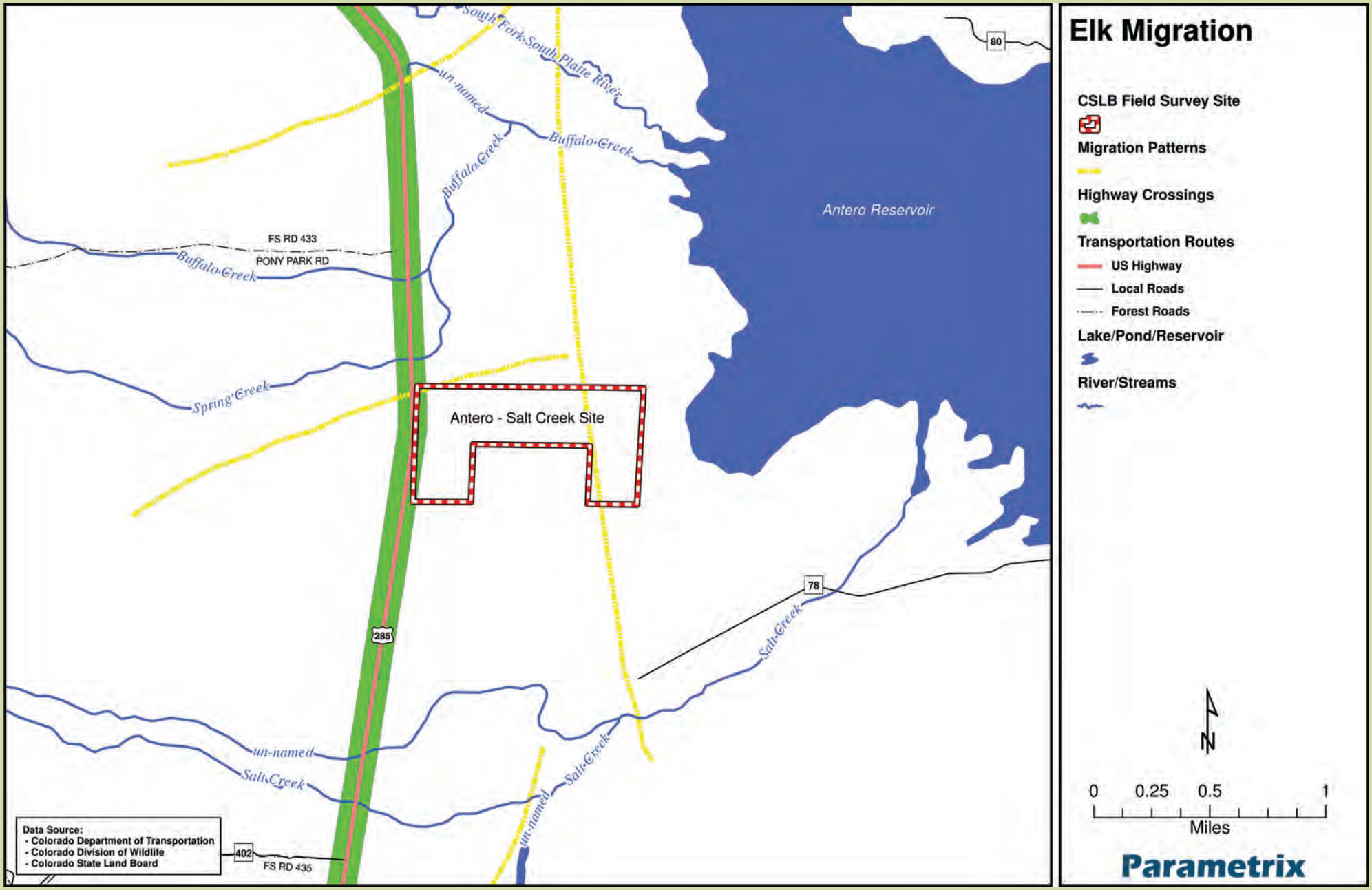
Parametrix


Elk Migration
CSLB Field Survey Site
Migration Patterns
Highway Crossings
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero Reservoir
Antero - Salt Creek Site
South Fork South Platte River
un-named
Buffalo Creek
FS RD 433
PONY PARK RD
Spring Creek
285
80
78
Salt Creek
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FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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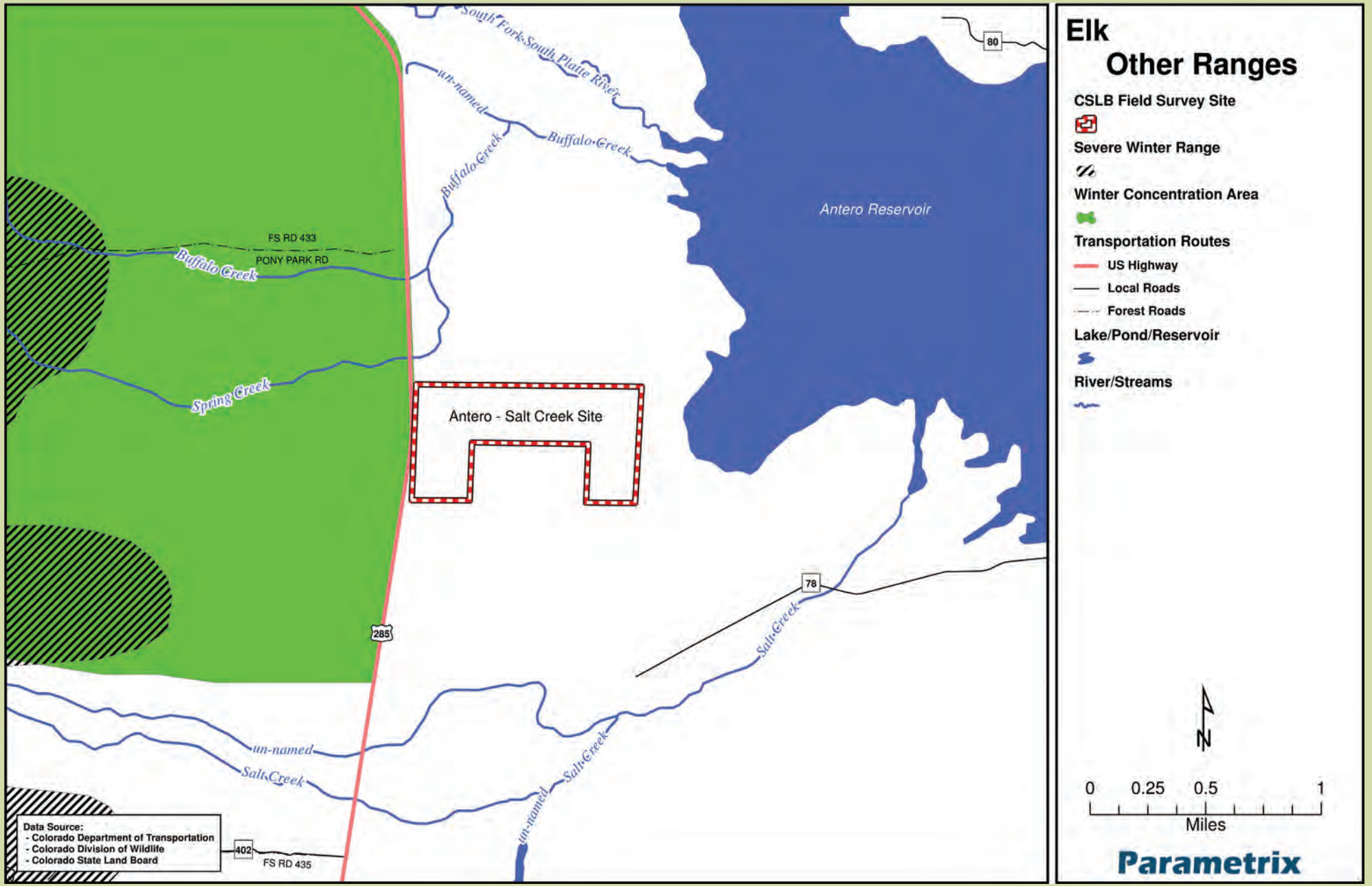
Miles
Parametrix


Elk
Other Ranges
CSLB Field Survey Site
Severe Winter Range
Winter Concentration Area
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
80
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
78
285
Salt Creek
un-named
Salt Creek
Salt Creek
un-named
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
402
FS RD 435
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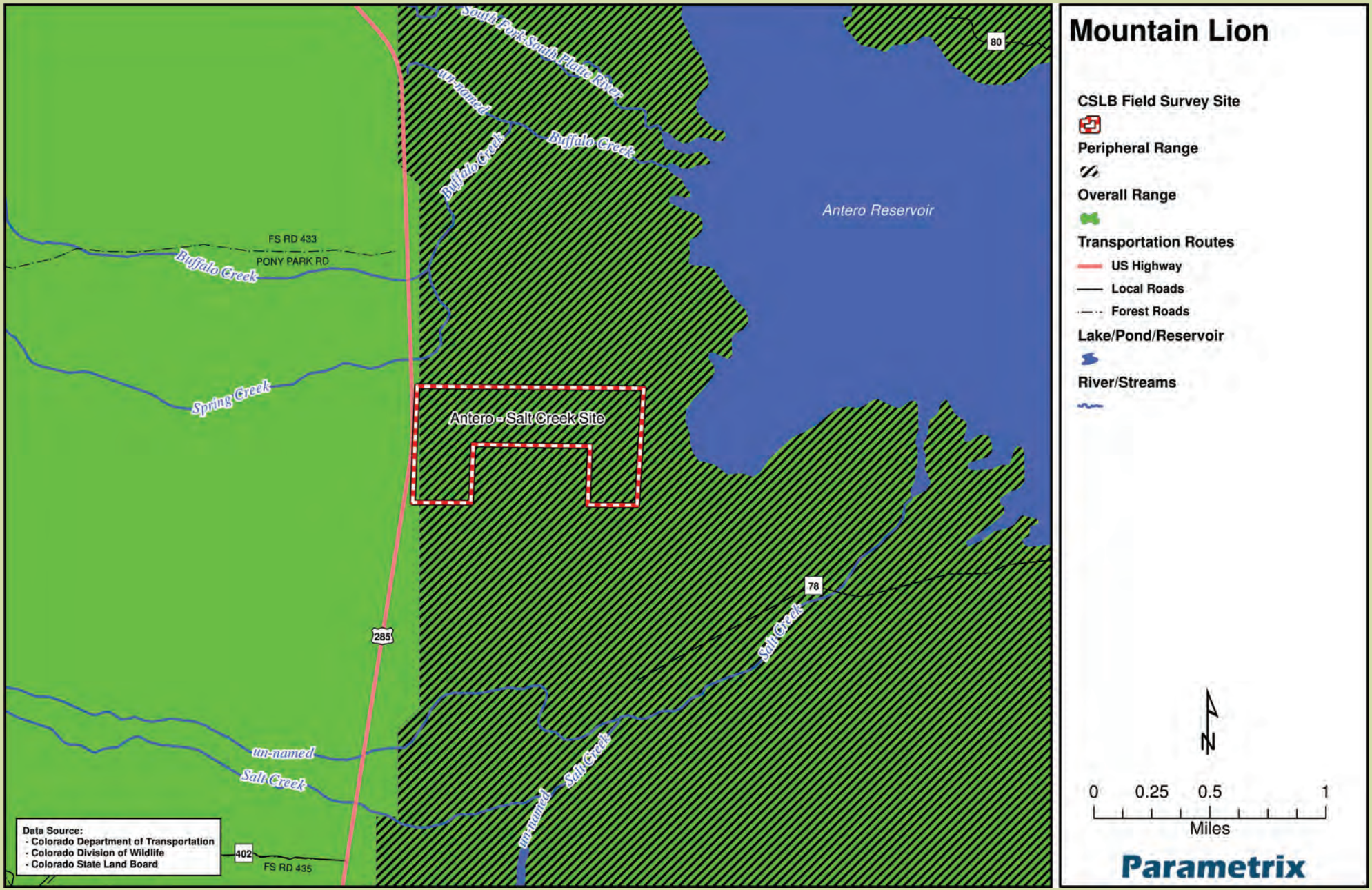
Parametrix


Mountain Lion
CSLB Field Survey Site
Peripheral Range
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero Reservoir
Antero - Salt Creek Site
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
80
78
285
402
FS RD 435
un-named
Salt Creek
un-named
Salt Creek
Salt Creek
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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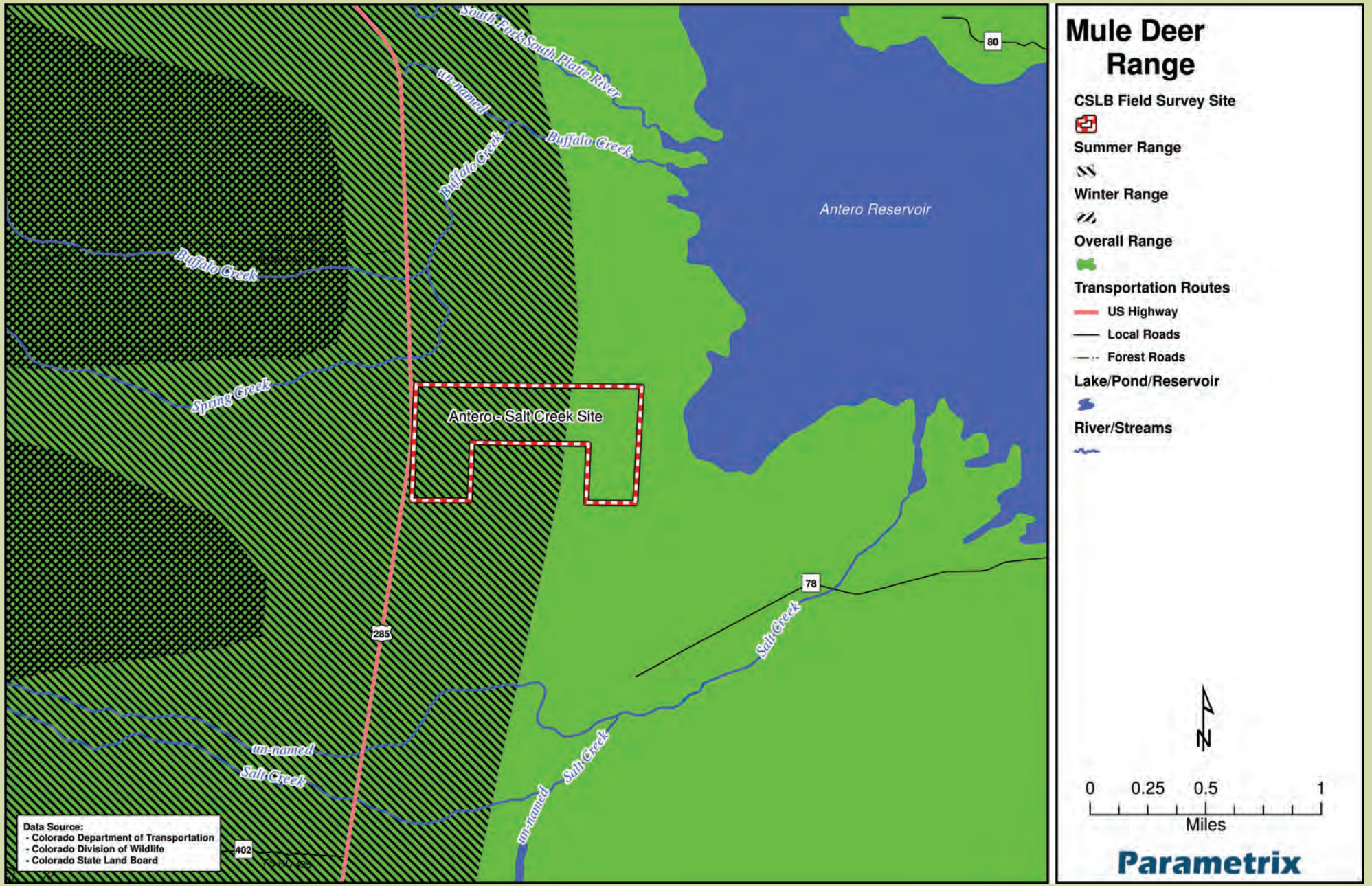
Parametrix


Mule Deer Range
CSLB Field Survey Site
Summer Range
Winter Range
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Buffalo Creek
Antero Reservoir
Spring Creek
Antero - Salt Creek Site
80
78
285
402
Salt Creek
Salt Creek
un-named
un-named
Salt Creek
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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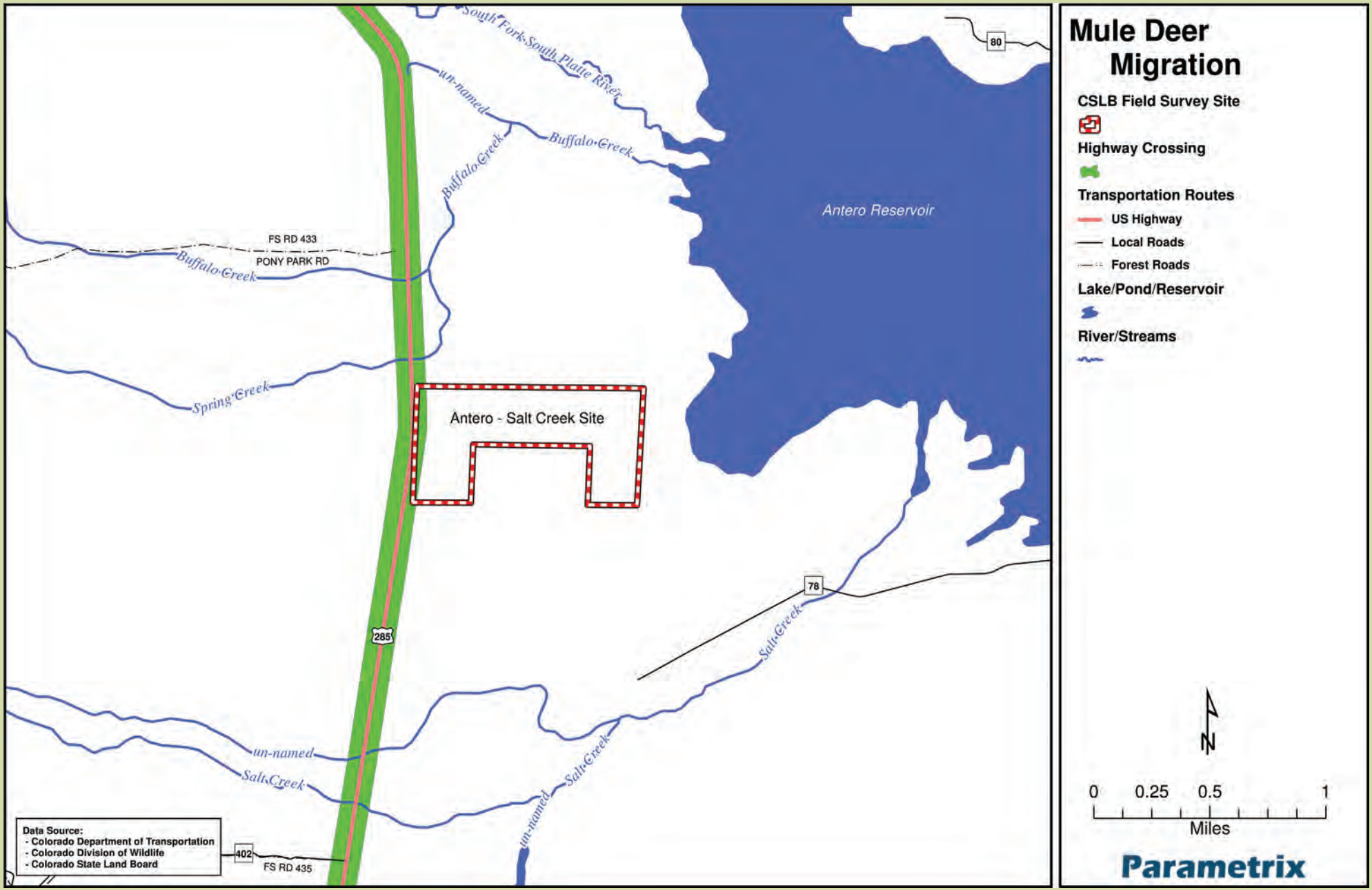
Miles
Parametrix


Mule Deer Migration
CSLB Field Survey Site
Highway Crossing
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Antero Reservoir
80
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
Antero - Salt Creek Site
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
402
FS RD 435
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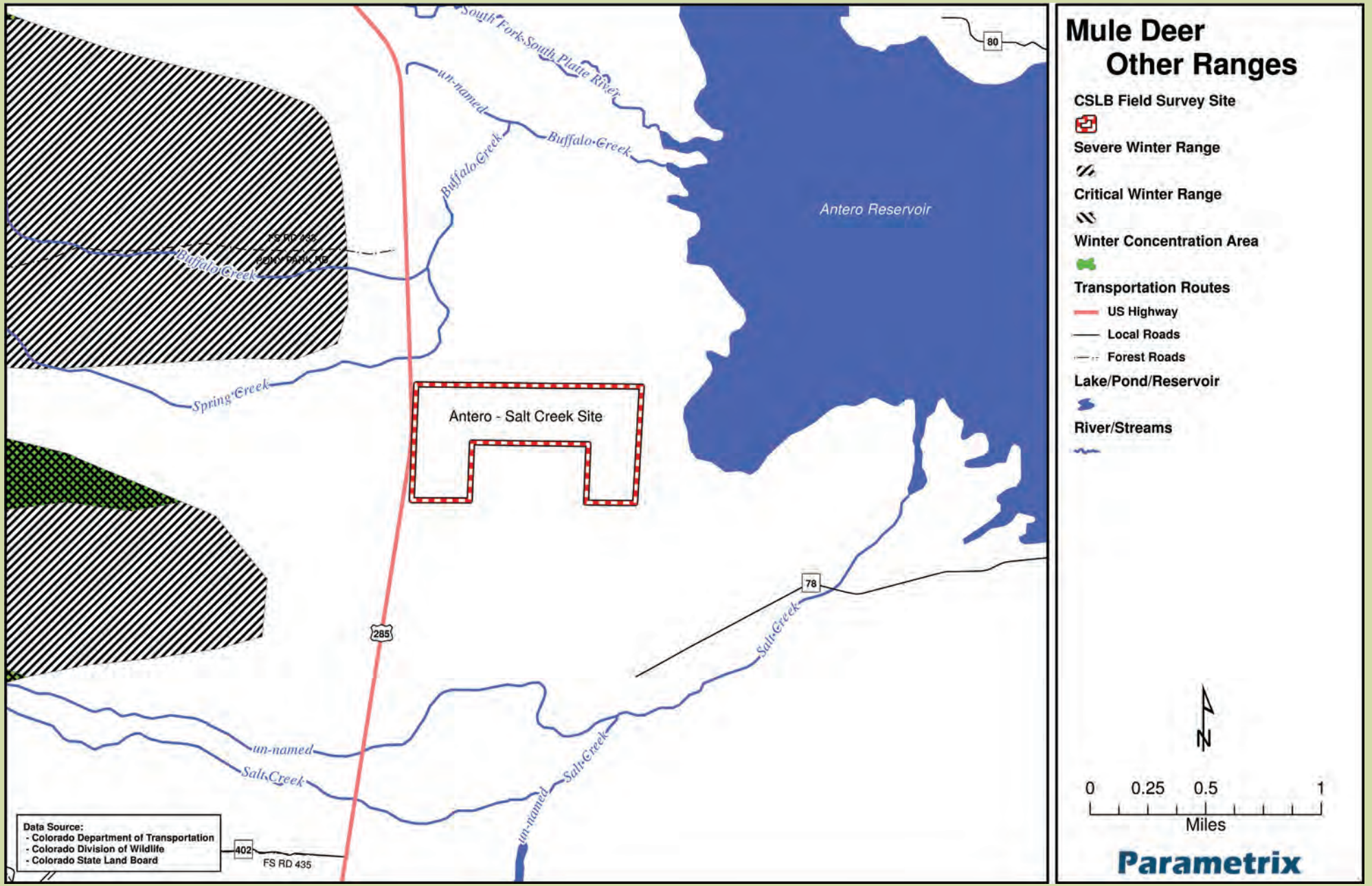
Miles
Parametrix


Mule Deer
Other Ranges
CSLB Field Survey Site
Severe Winter Range
Critical Winter Range
Winter Concentration Area
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Buffalo Creek
FS RD 435
FS RD 435
Antero Reservoir
Antero - Salt Creek Site
Spring Creek
80
78
285
Salt Creek
un-named
Salt Creek
Salt Creek
un-named
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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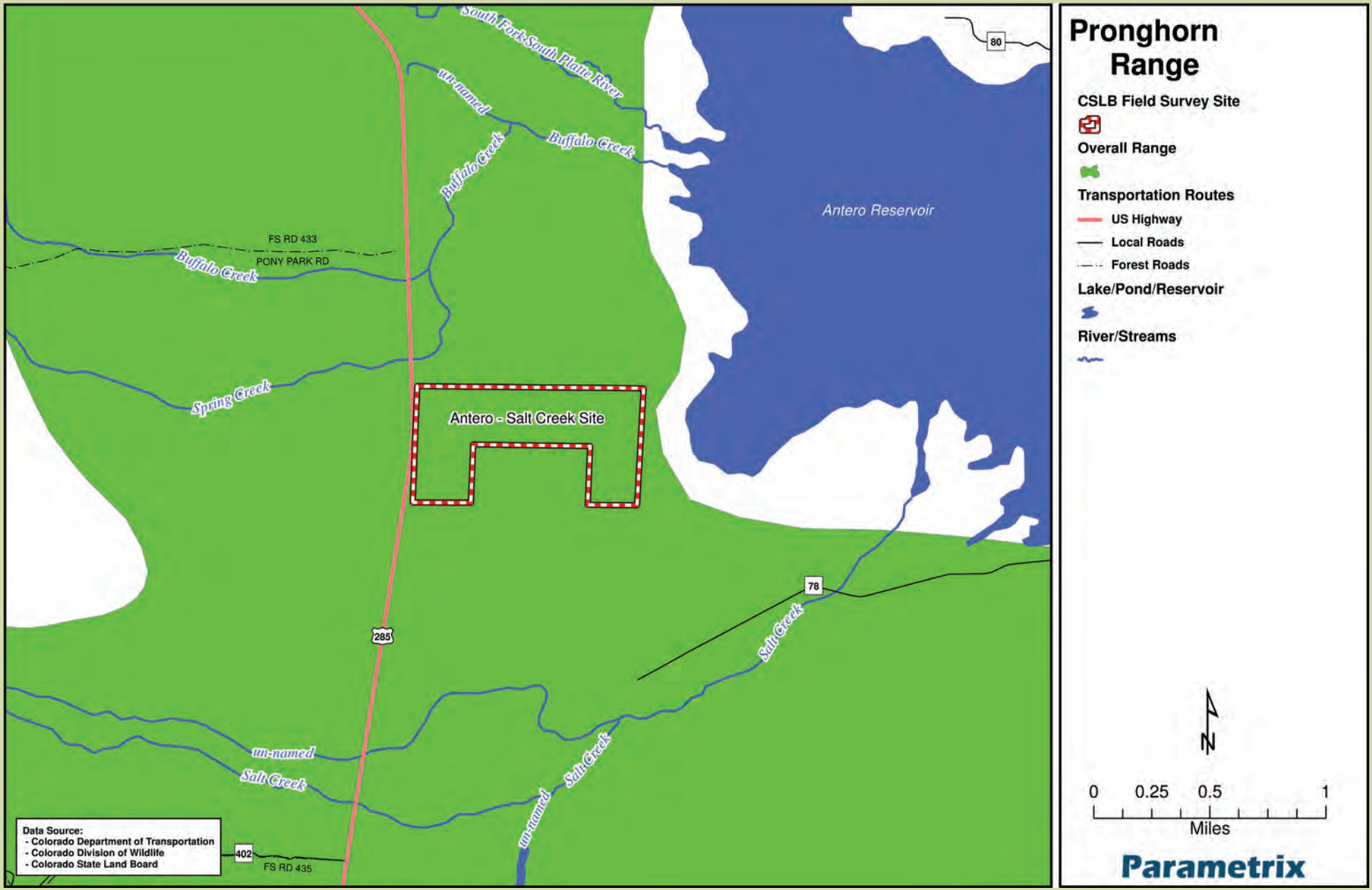
Miles
Parametrix


Pronghorn Range
CSLB Field Survey Site
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
Buffalo Creek
FS RD 433
PONY PARK RD
Antero Reservoir
Spring Creek
Antero - Salt Creek Site
80
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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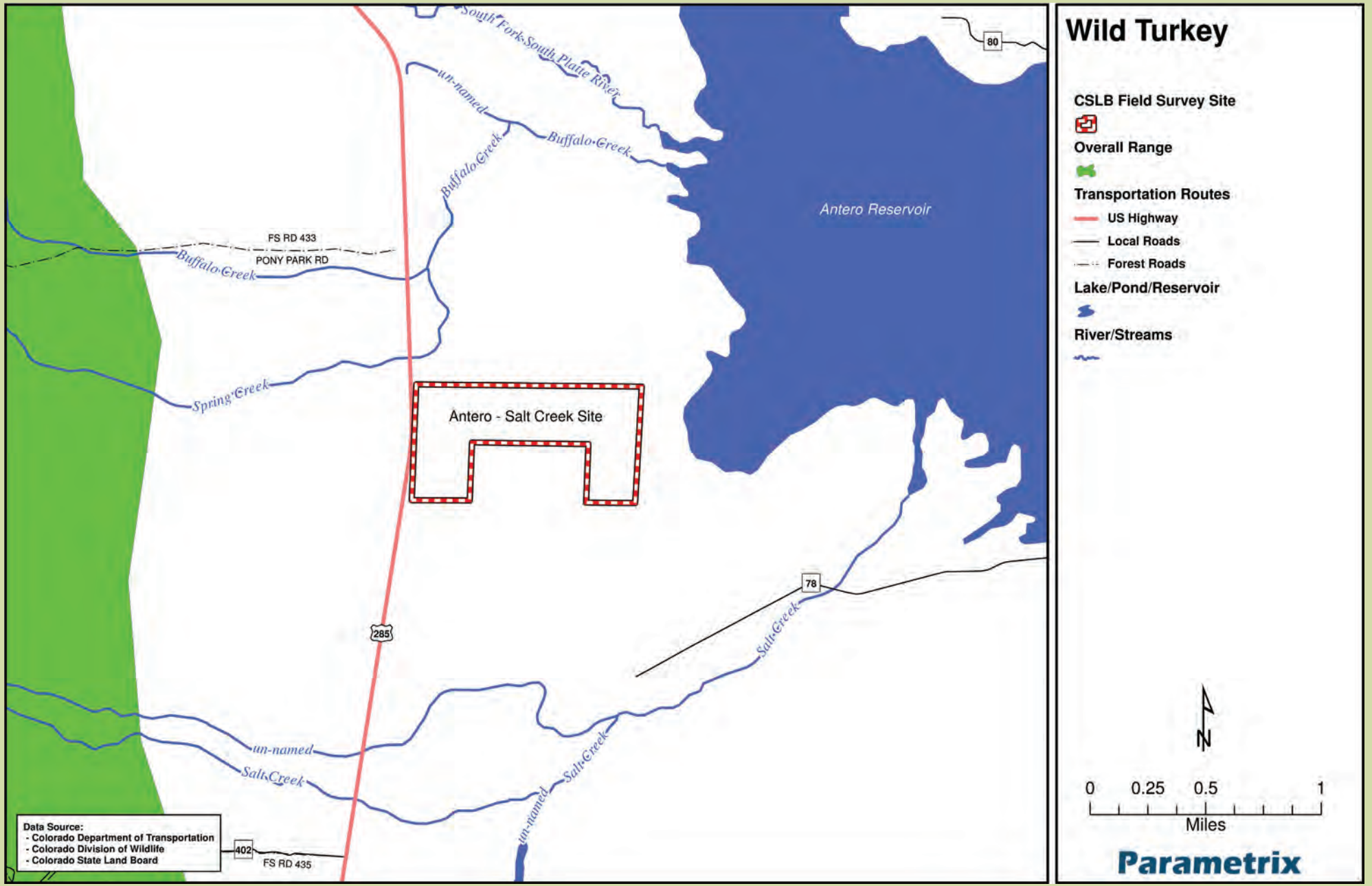
Miles
Parametrix


Wild Turkey
CSLB Field Survey Site
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Antero Reservoir
Antero - Salt Creek Site
South Fork South Platte River
un-named
Buffalo Creek
Buffalo Creek
FS RD 433
PONY PARK RD
Buffalo Creek
Spring Creek
80
78
285
Salt Creek
un-named
Salt Creek
un-named
Salt Creek
402
FS RD 435
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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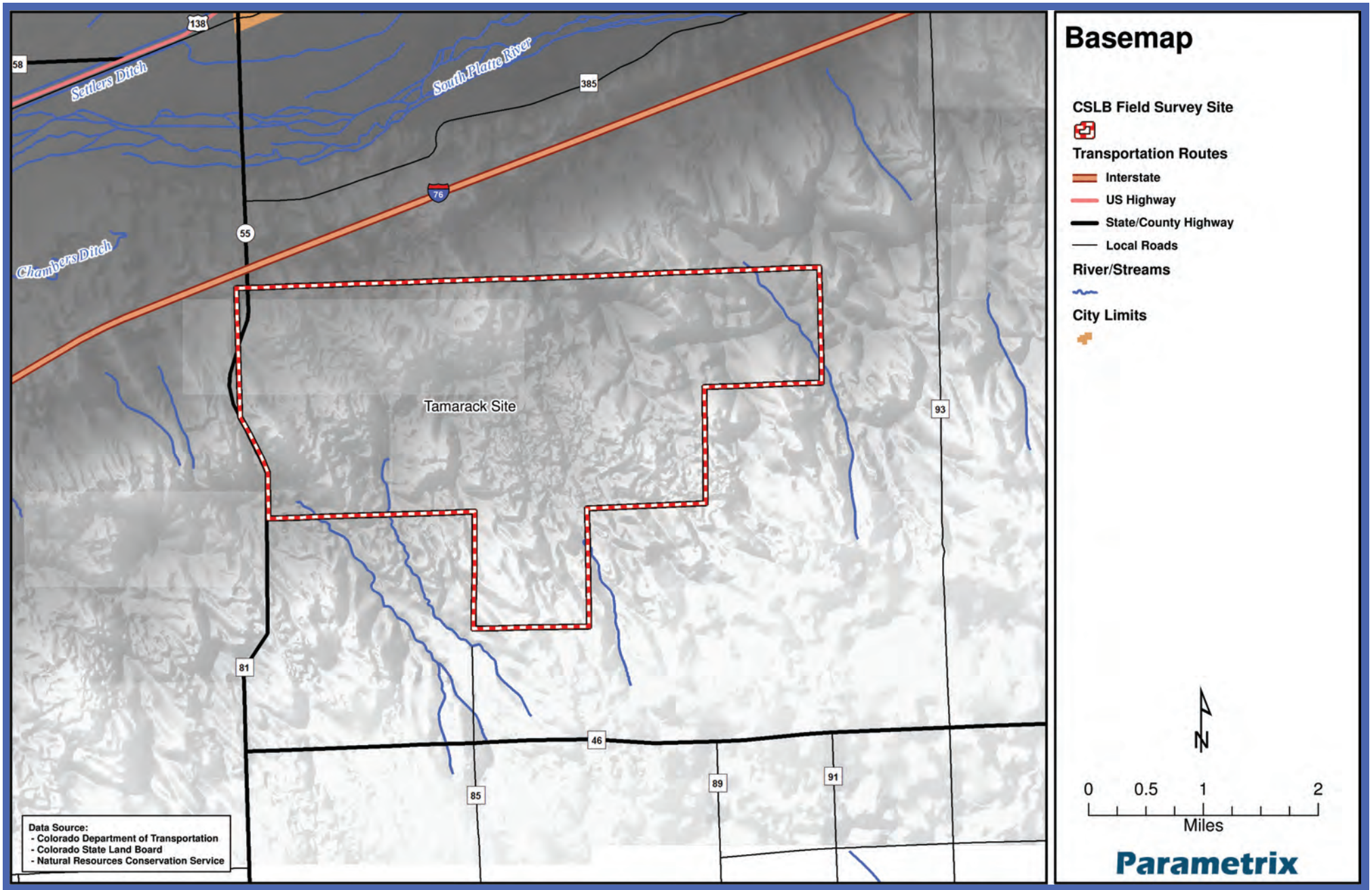
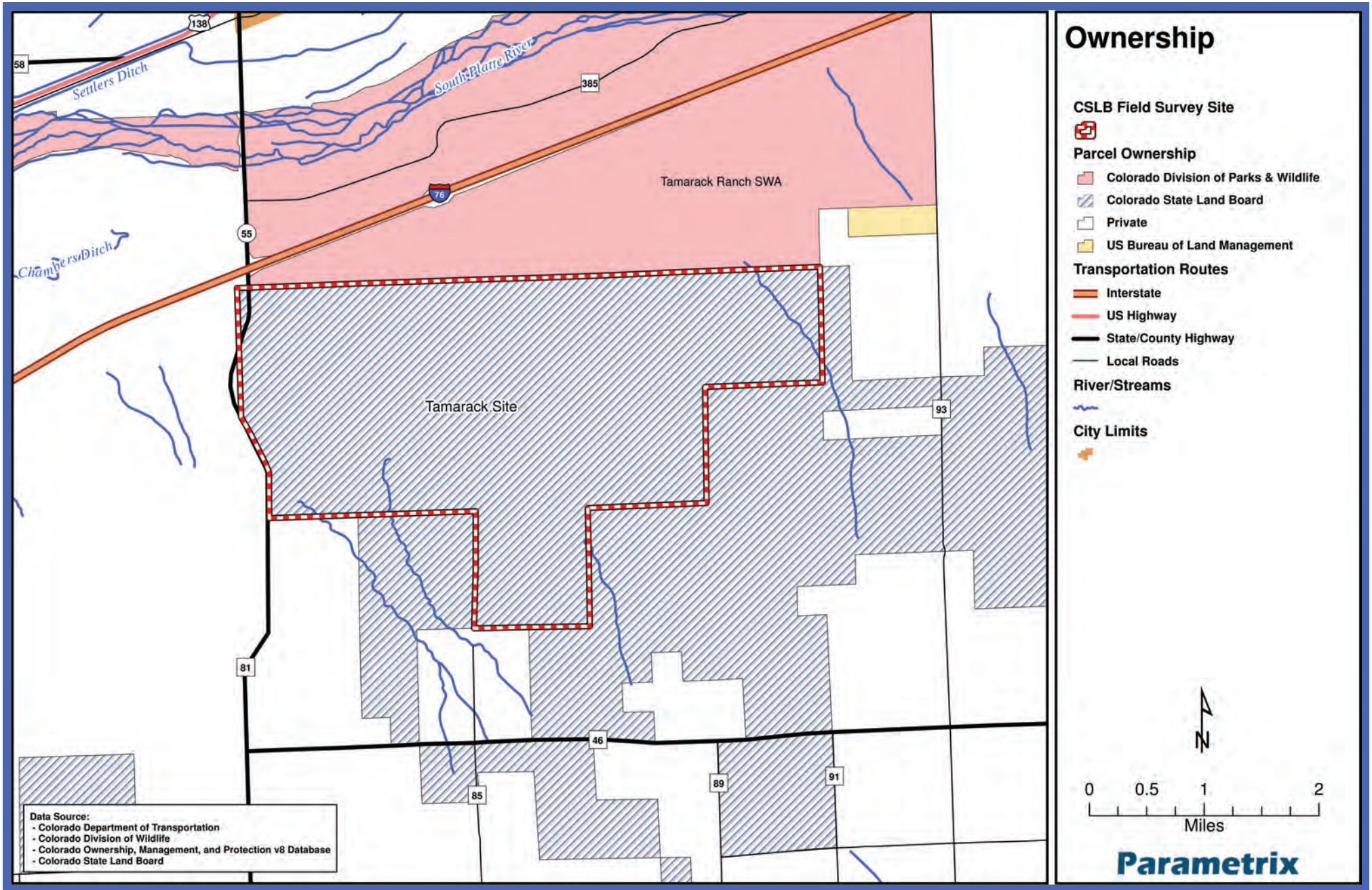
Miles
Parametrix

Tamarack Ranch Site


Basemap
CSLB Field Survey Site
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
55
93
81
46
85
89
91
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
N
0 0.5 1 2
Miles
Parametrix


Ownership
CSLB Field Survey Site
Parcel Ownership
Colorado Division of Parks & Wildlife
Colorado State Land Board
Private
US Bureau of Land Management
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Ranch SWA
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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385
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N
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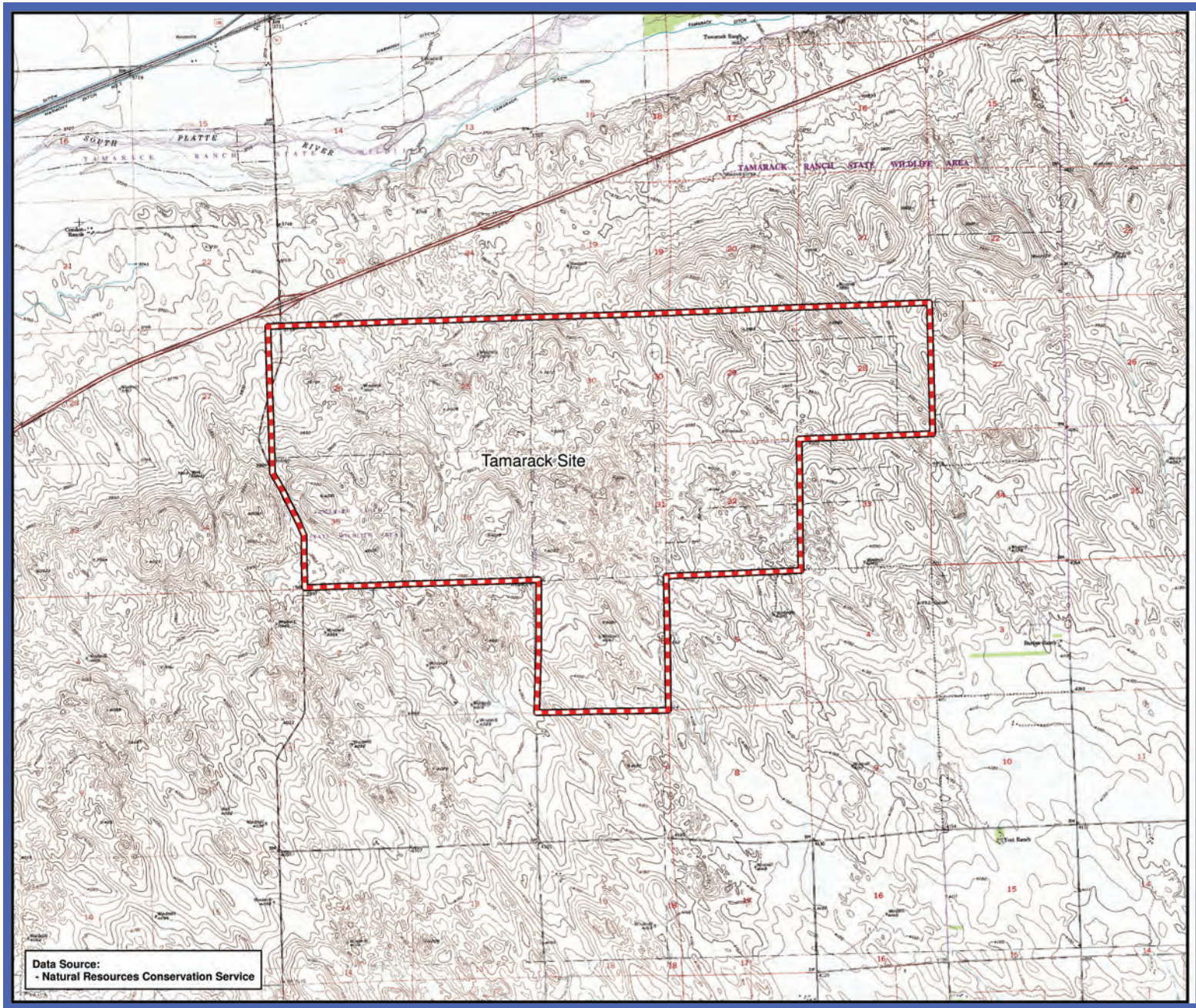
Miles
Parametrix
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado Ownership, Management, and Protection v8 Database
- Colorado State Land Board



Topo Map

CSLB Field Survey Site

N

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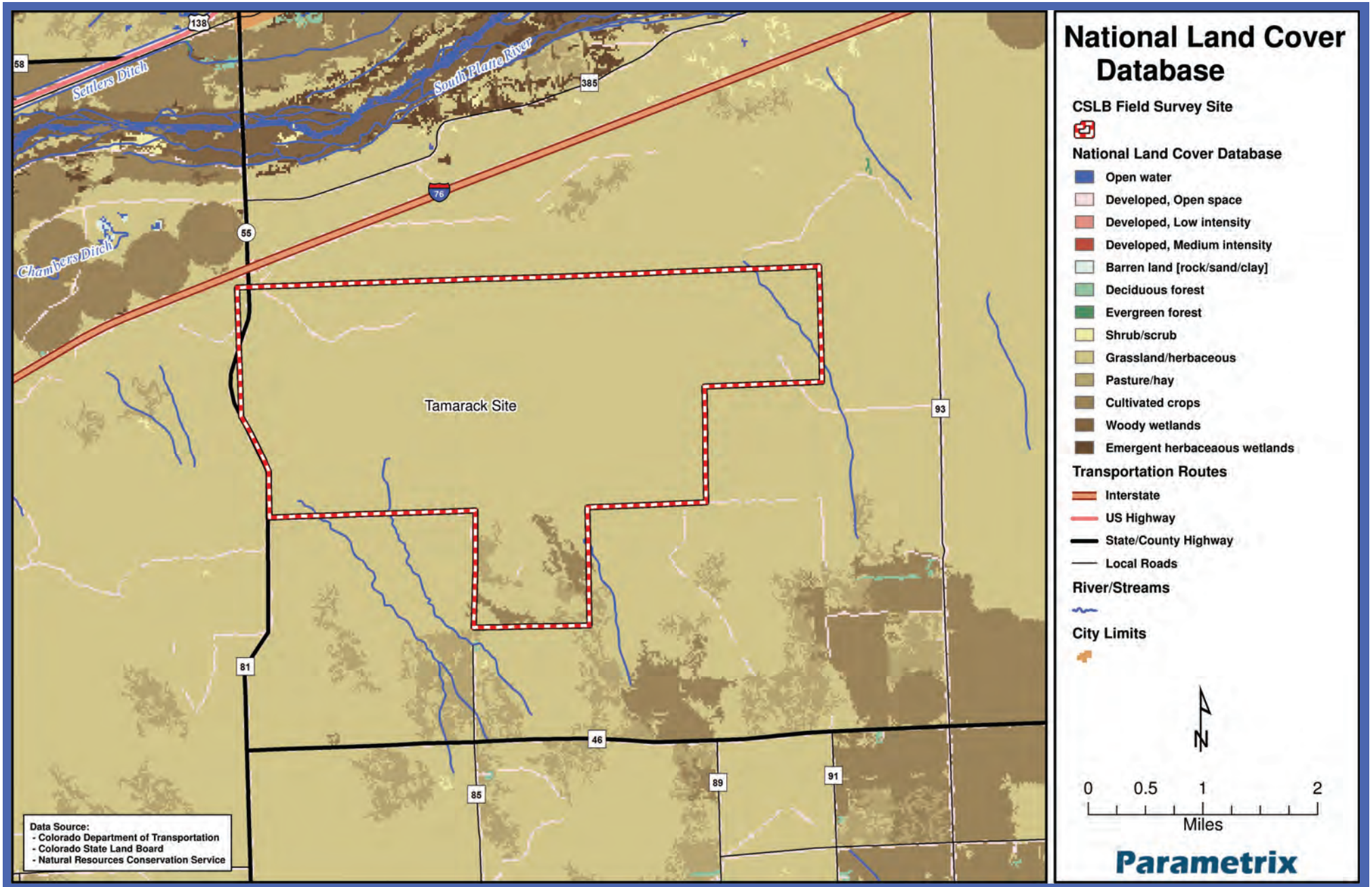
Miles

Parametrix


National Land Cover Database
CSLB Field Survey Site
National Land Cover Database
Open water
Developed, Open space
Developed, Low intensity
Developed, Medium intensity
Barren land [rock/sand/clay]
Deciduous forest
Evergreen forest
Shrub/scrub
Grassland/herbaceous
Pasture/hay
Cultivated crops
Woody wetlands
Emergent herbaceaous wetlands
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
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93
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46
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91
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
N
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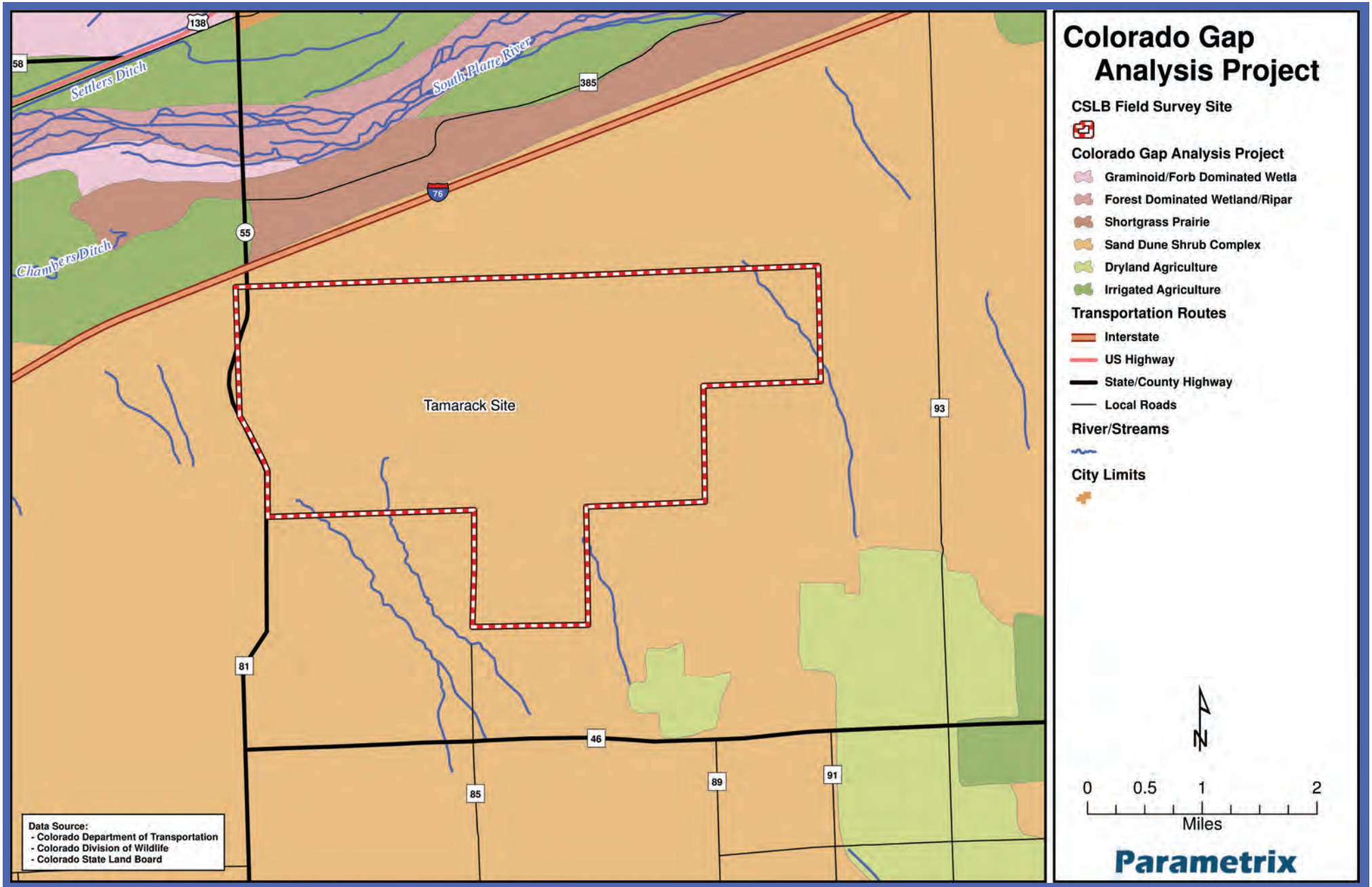
Miles
Parametrix


Colorado Gap Analysis Project
CSLB Field Survey Site
Colorado Gap Analysis Project
Graminoid/Forb Dominated Wetla
Forest Dominated Wetland/Ripar
Shortgrass Prairie
Sand Dune Shrub Complex
Dryland Agriculture
Irrigated Agriculture
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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385
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93
81
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85
89
91
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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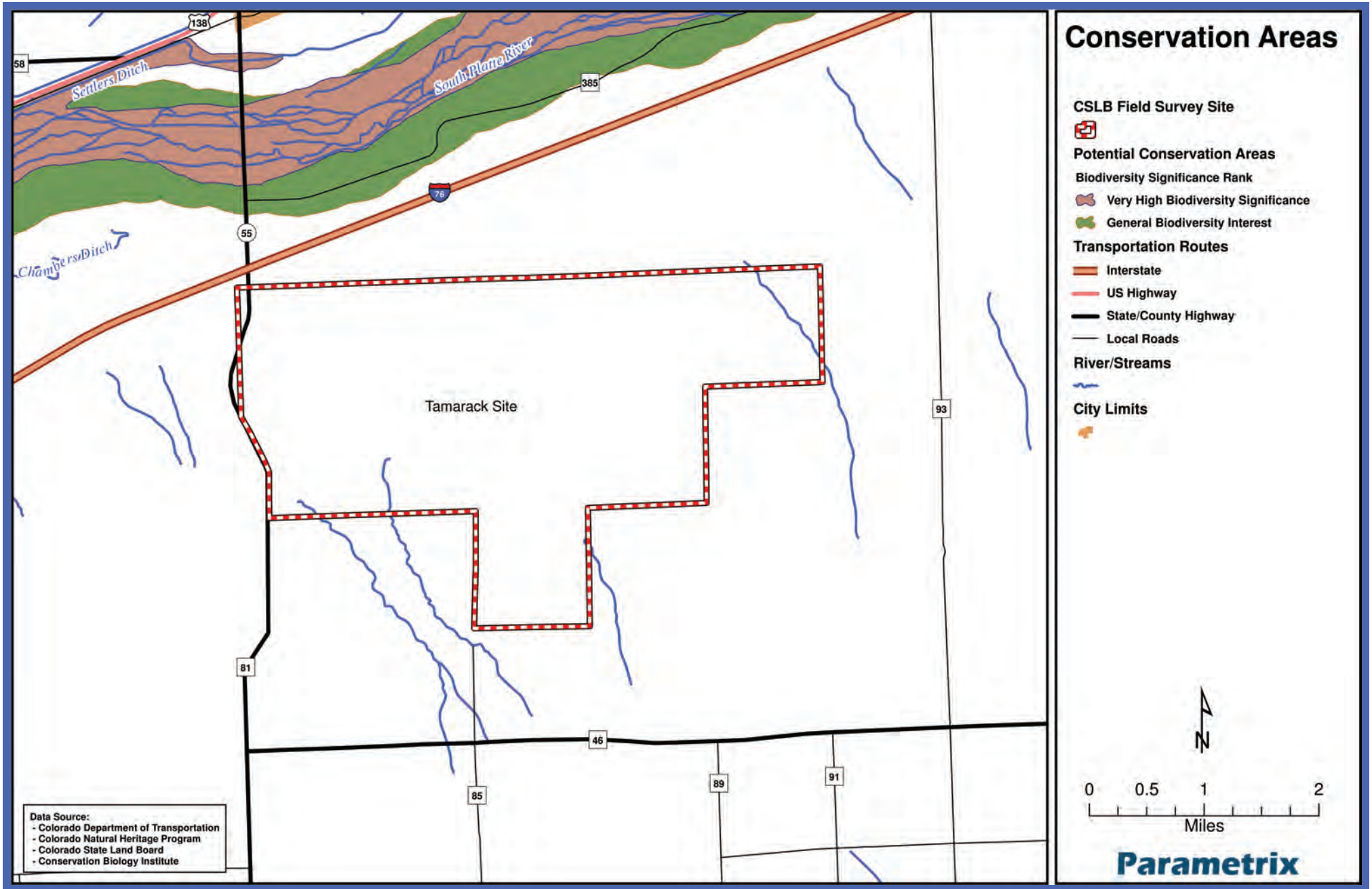
Parametrix


Conservation Areas
CSLB Field Survey Site
Potential Conservation Areas
Biodiversity Significance Rank
Very High Biodiversity Significance
General Biodiversity Interest
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
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93
81
46
85
89
91
Data Source:
- Colorado Department of Transportation
- Colorado Natural Heritage Program
- Colorado State Land Board
- Conservation Biology Institute
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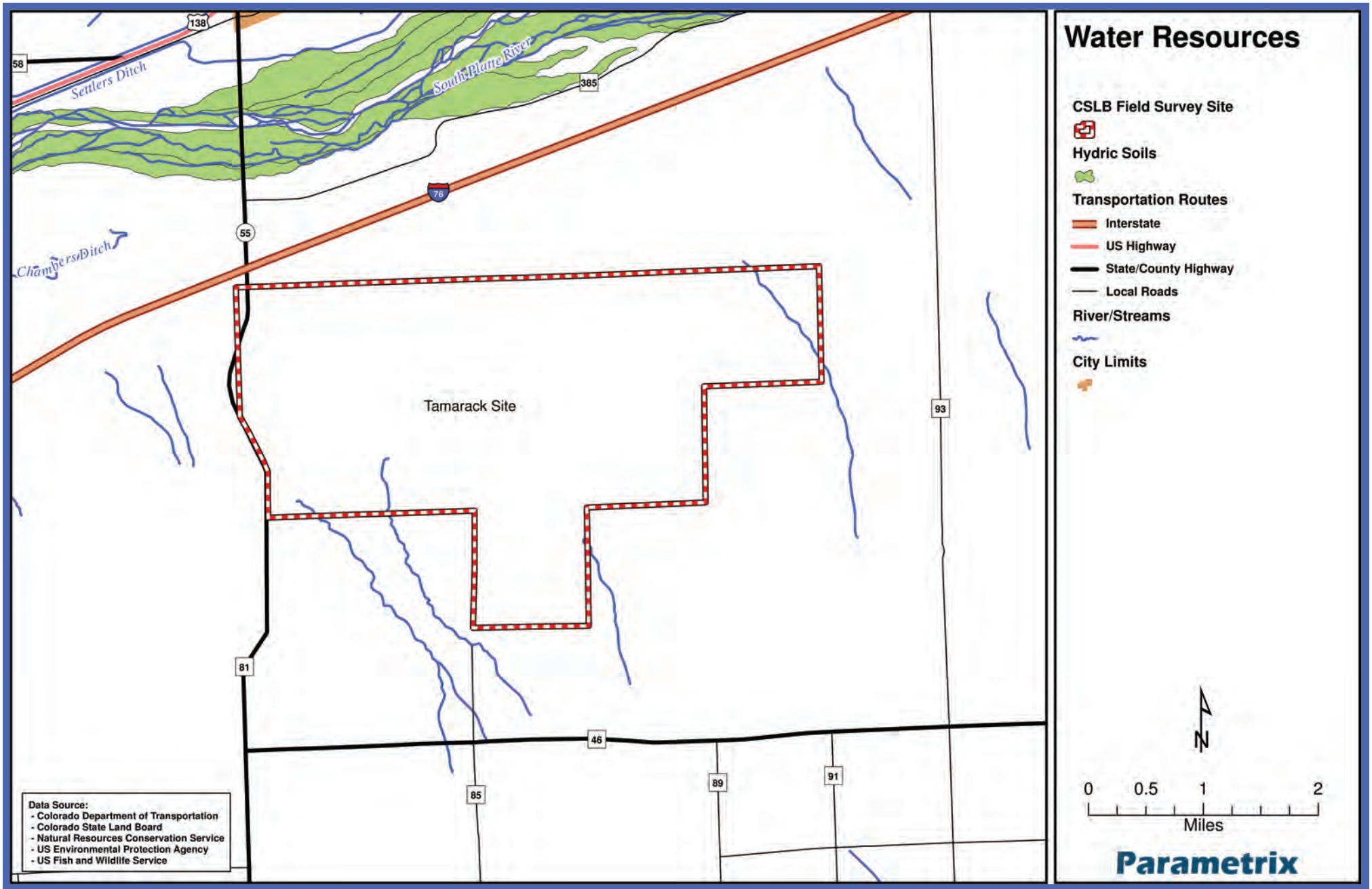
Parametrix


Water Resources
CSLB Field Survey Site
Hydric Soils
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Settlers Ditch
South Platte River
Chambers Ditch
Tamarack Site
138
58
385
76
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93
81
46
85
89
91
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
- US Environmental Protection Agency
- US Fish and Wildlife Service
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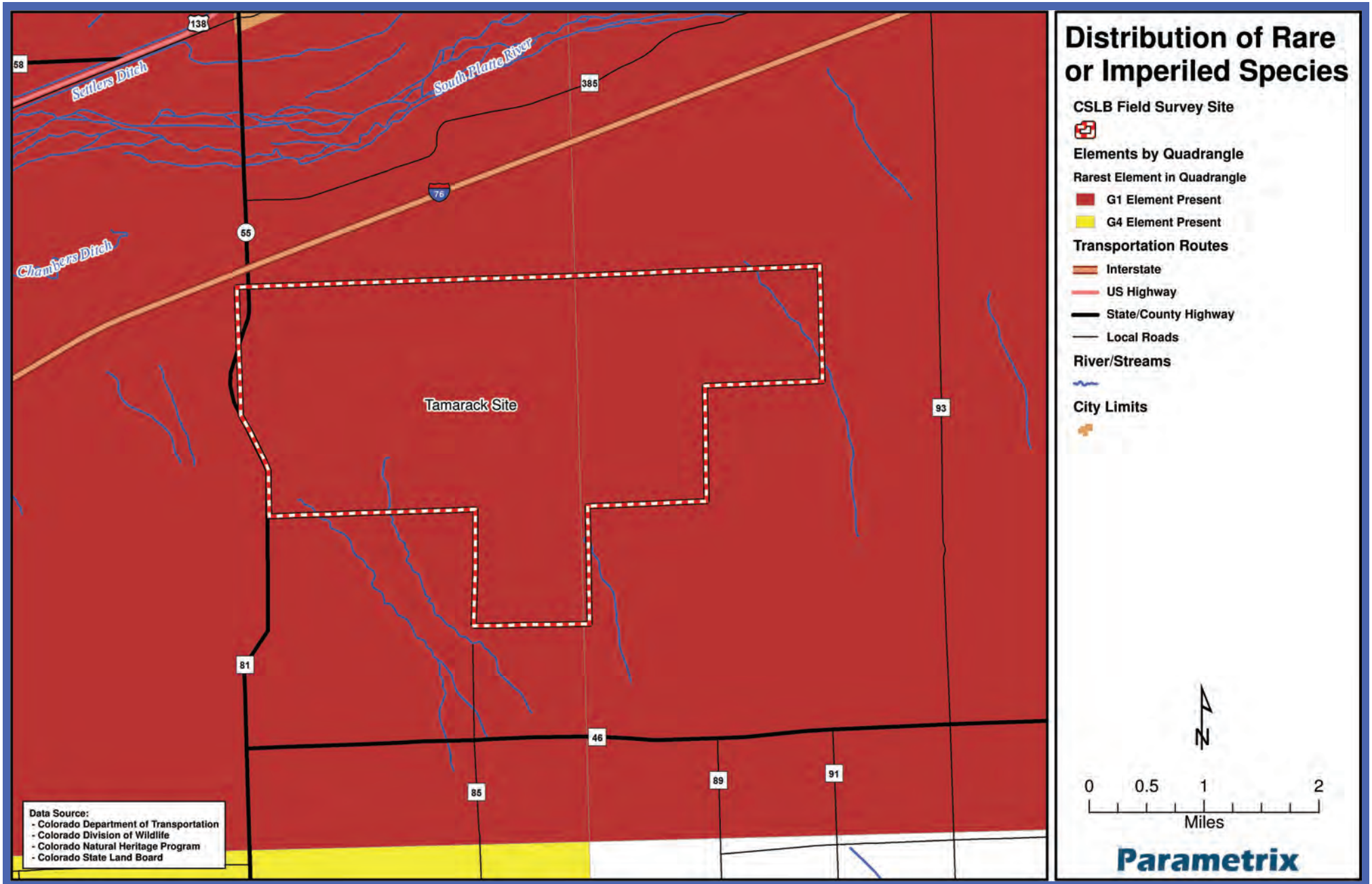
Miles
Parametrix


Distribution of Rare or Imperiled Species
CSLB Field Survey Site
Elements by Quadrangle
Rarest Element in Quadrangle
G1 Element Present
G4 Element Present
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
55
93
81
46
85
89
91
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado Natural Heritage Program
- Colorado State Land Board
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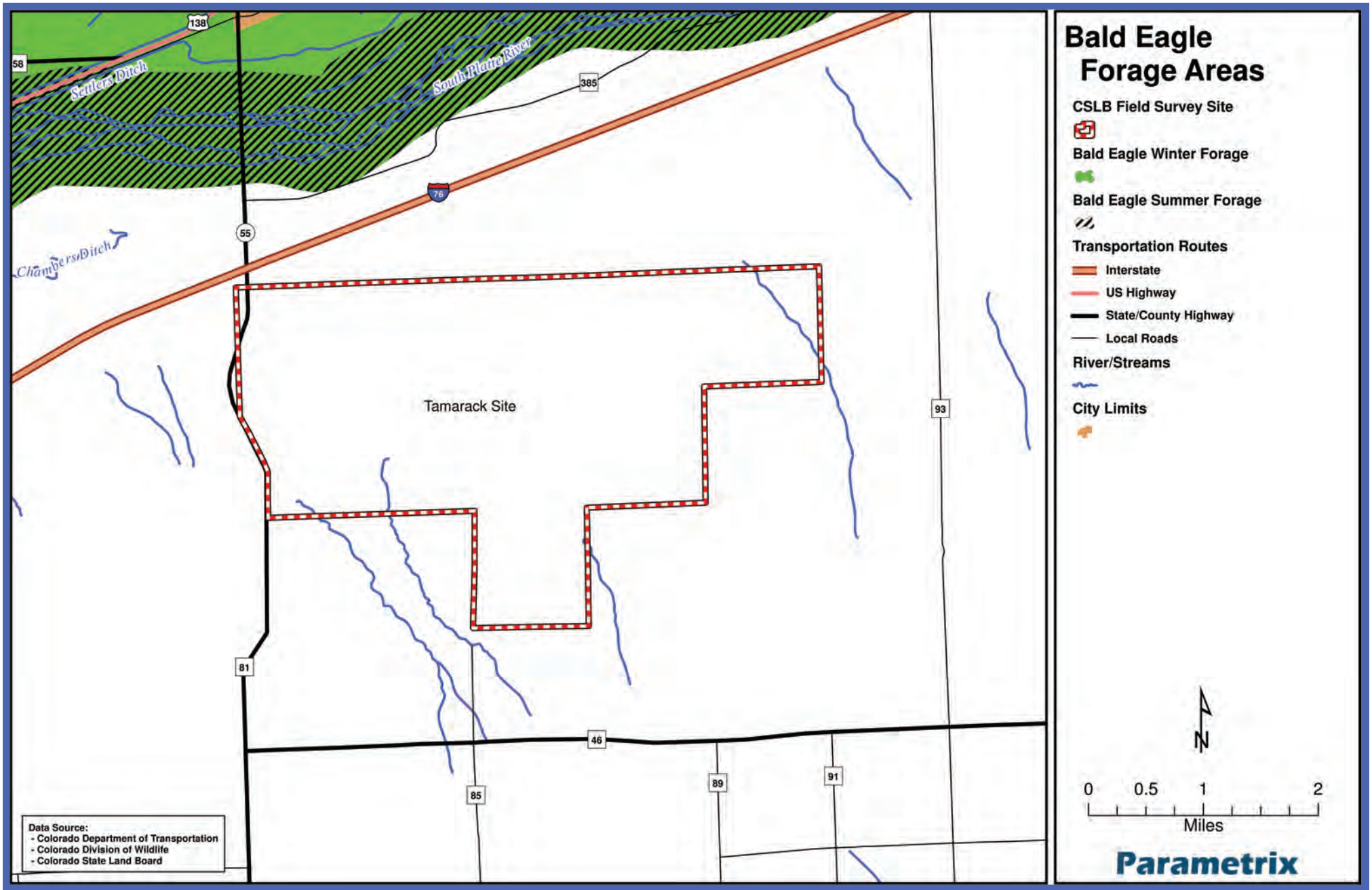
Miles
Parametrix


Bald Eagle Forage Areas
CSLB Field Survey Site
Bald Eagle Winter Forage
Bald Eagle Summer Forage
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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385
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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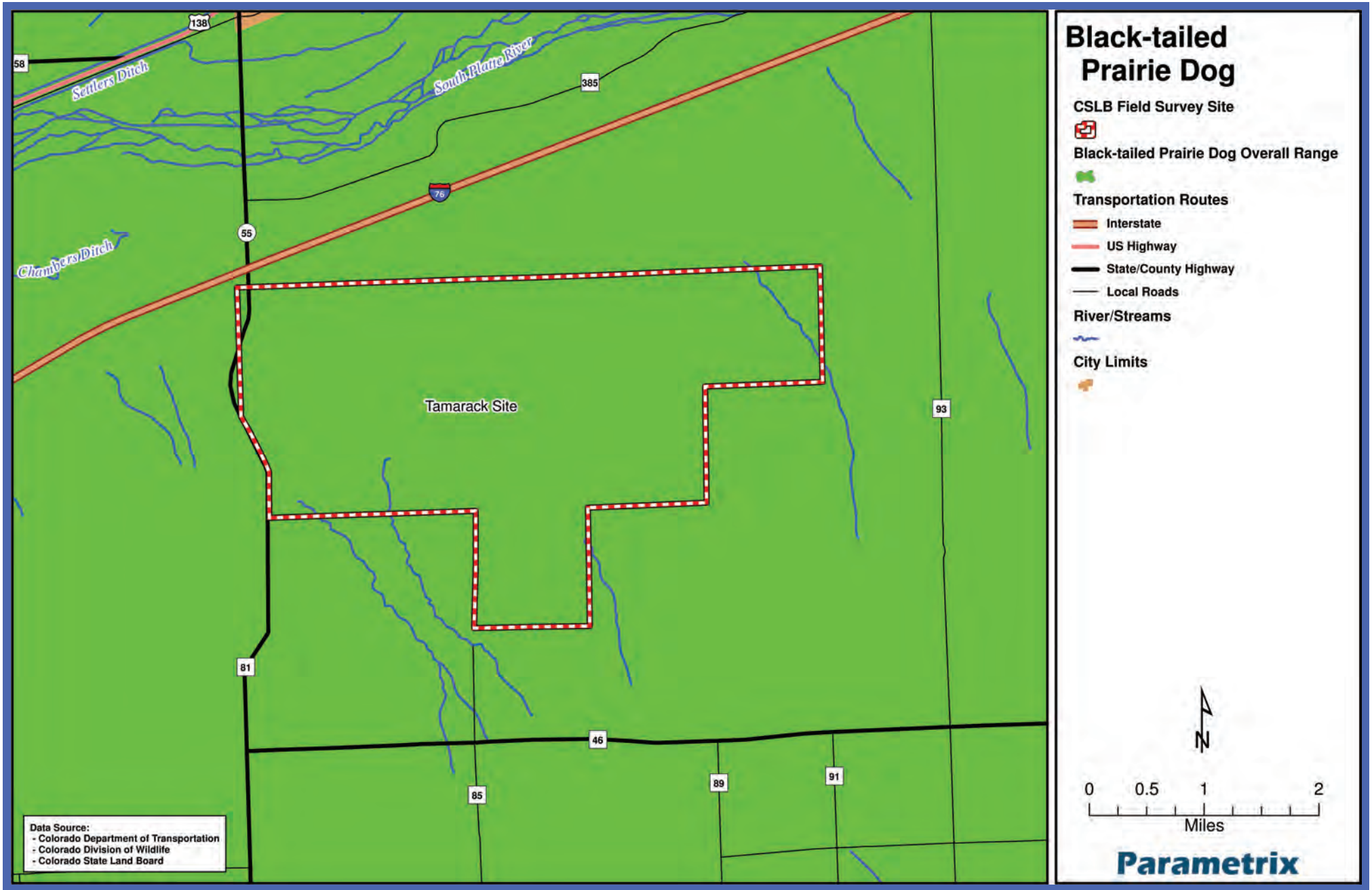
Miles
Parametrix


Black-tailed Prairie Dog
CSLB Field Survey Site
Black-tailed Prairie Dog Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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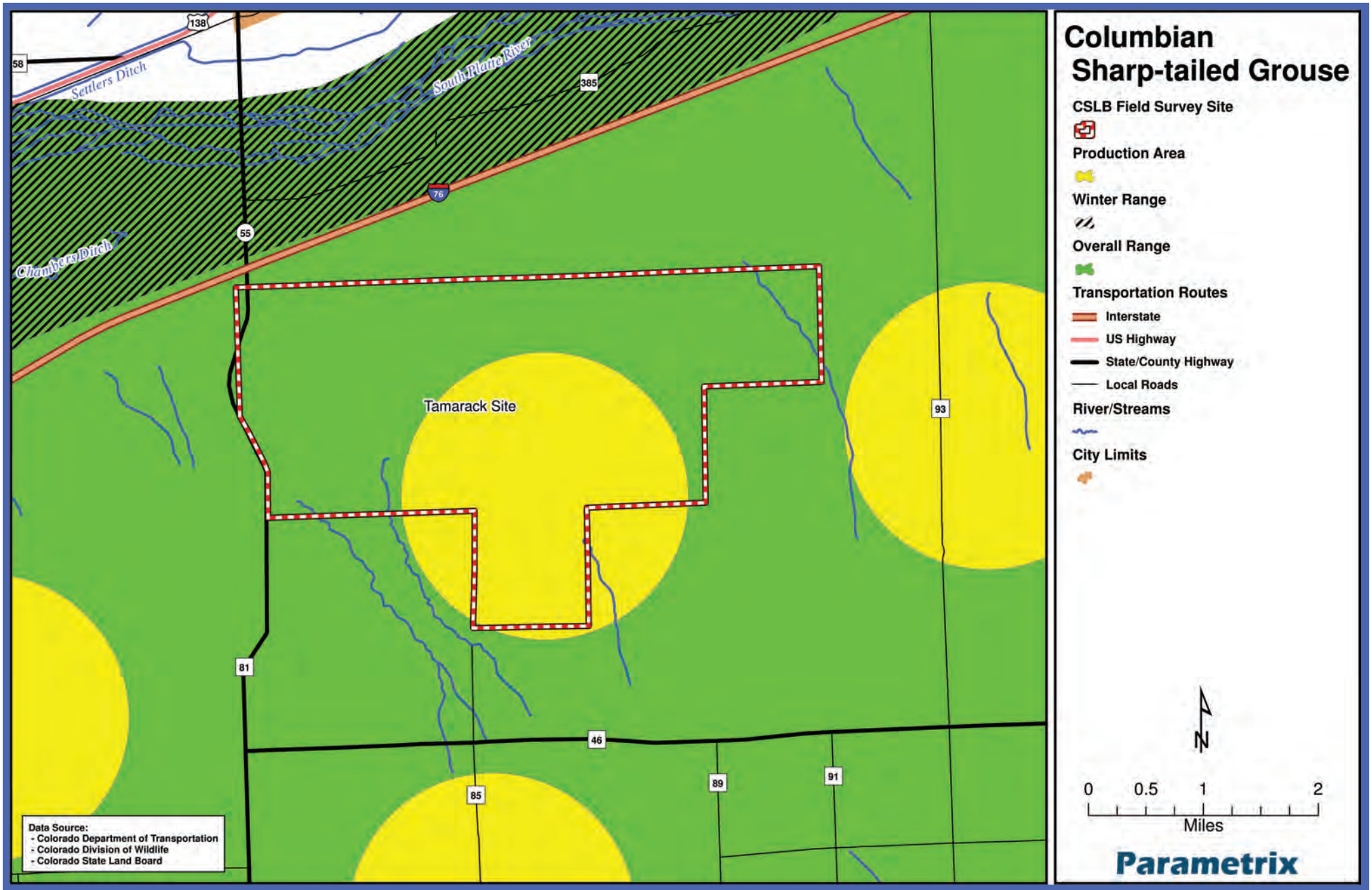
Miles
Parametrix


Columbian Sharp-tailed Grouse
CSLB Field Survey Site
Production Area
Winter Range
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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385
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93
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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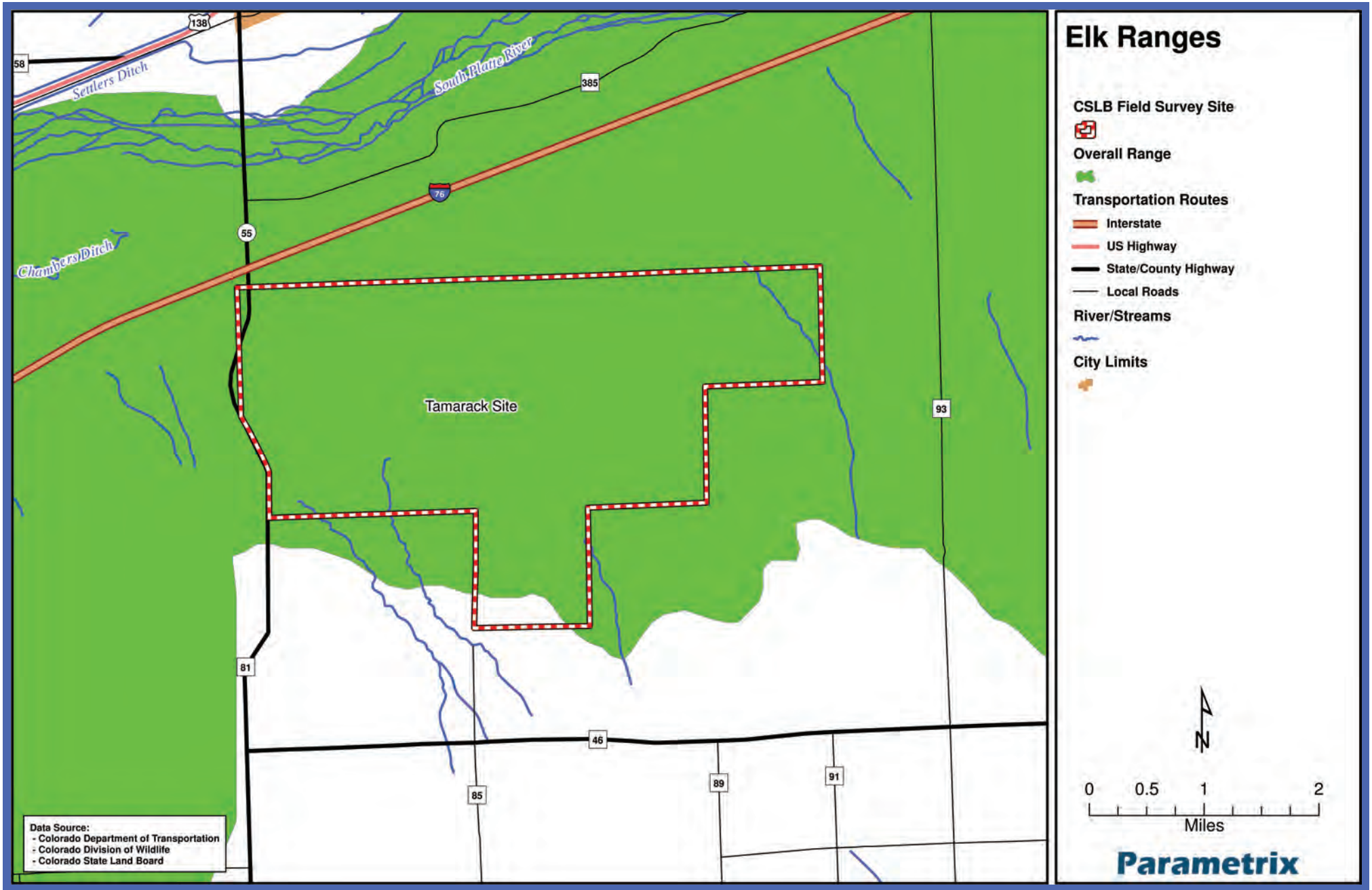
Miles
Parametrix


Elk Ranges
CSLB Field Survey Site
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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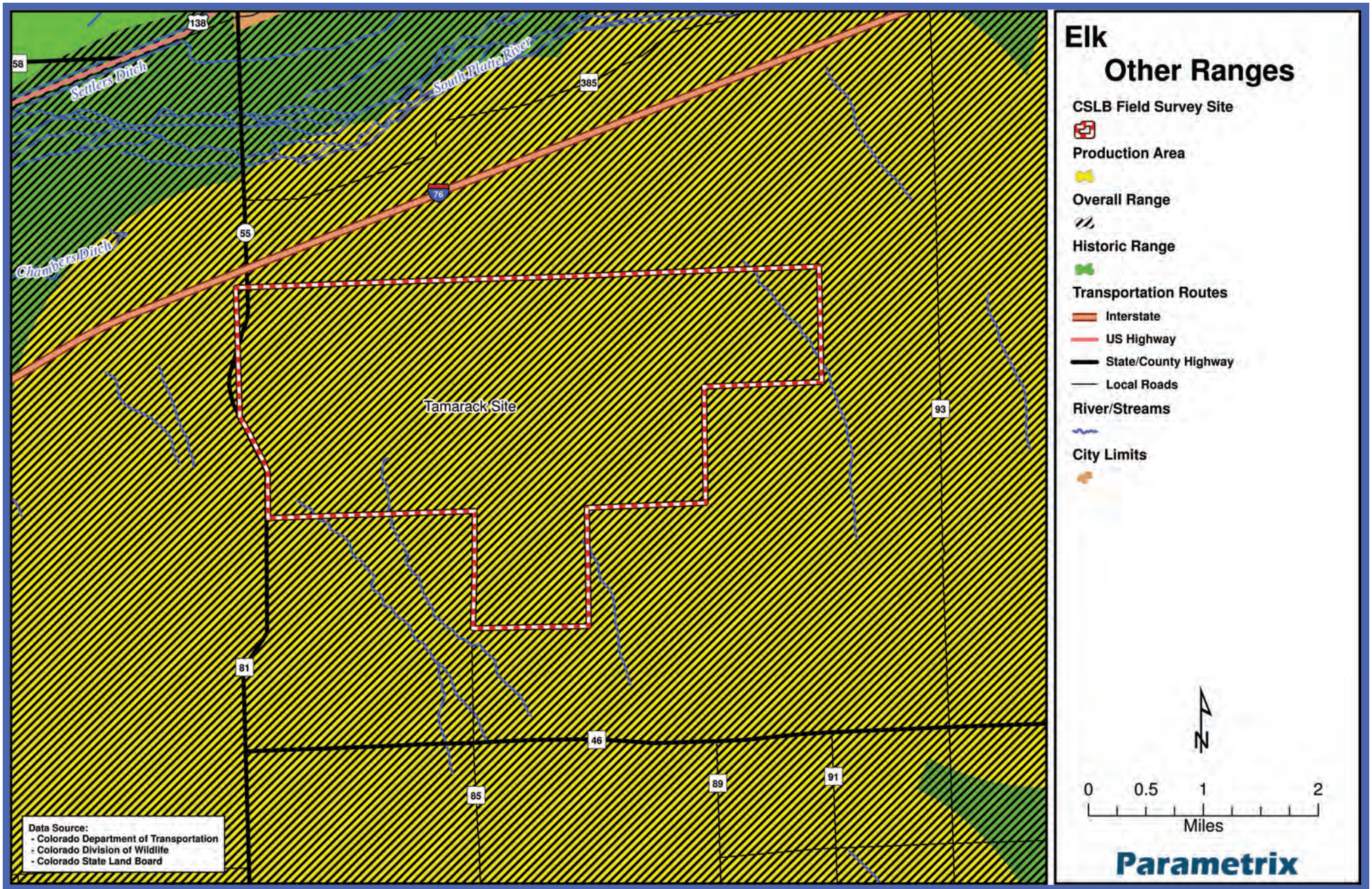
Miles
Parametrix


Elk
Other Ranges
CSLB Field Survey Site
Production Area
Overall Range
Historic Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
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93
81
46
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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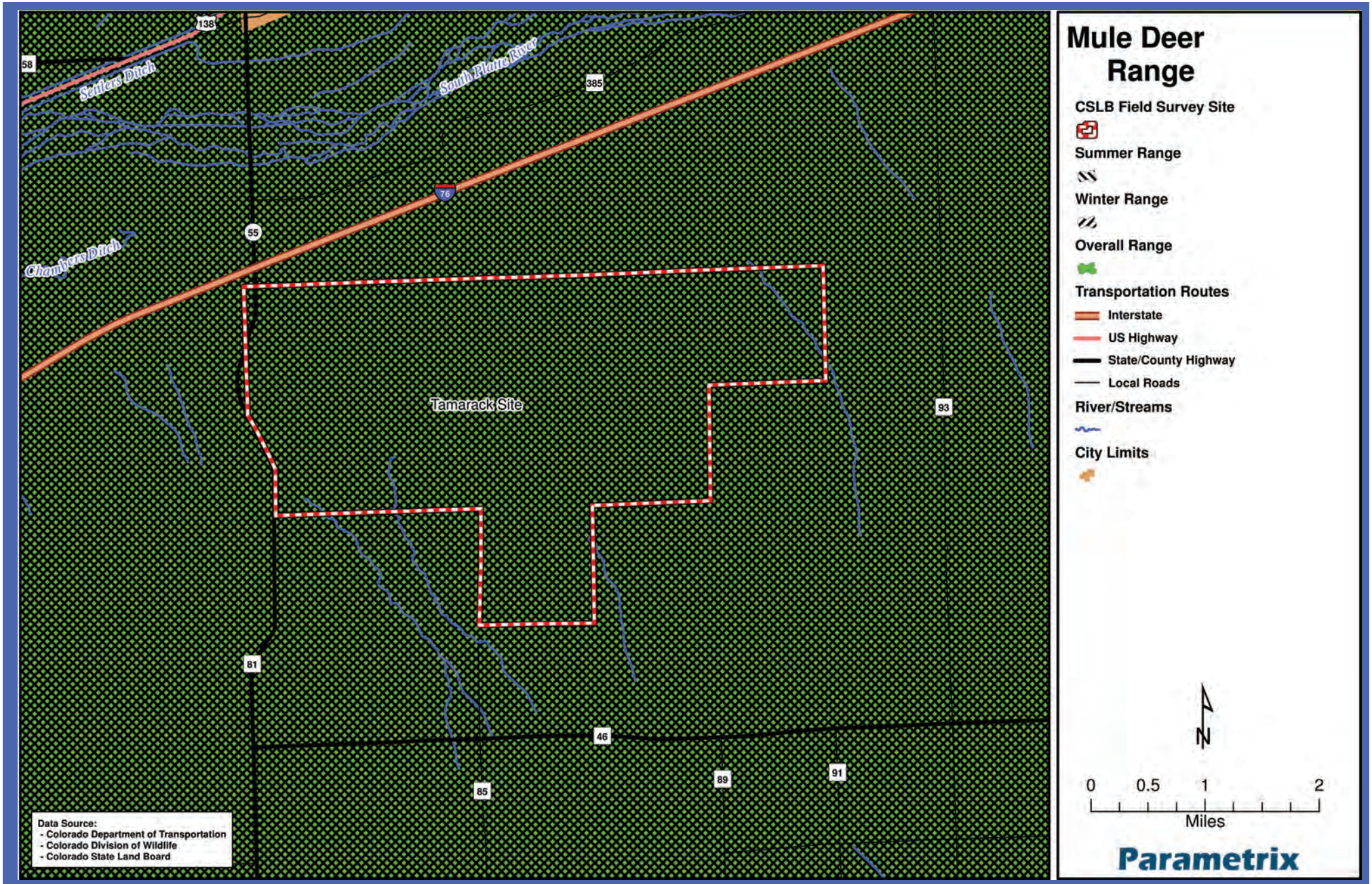
Miles
Parametrix


Mule Deer Range
CSLB Field Survey Site
Summer Range
Winter Range
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
58
385
76
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93
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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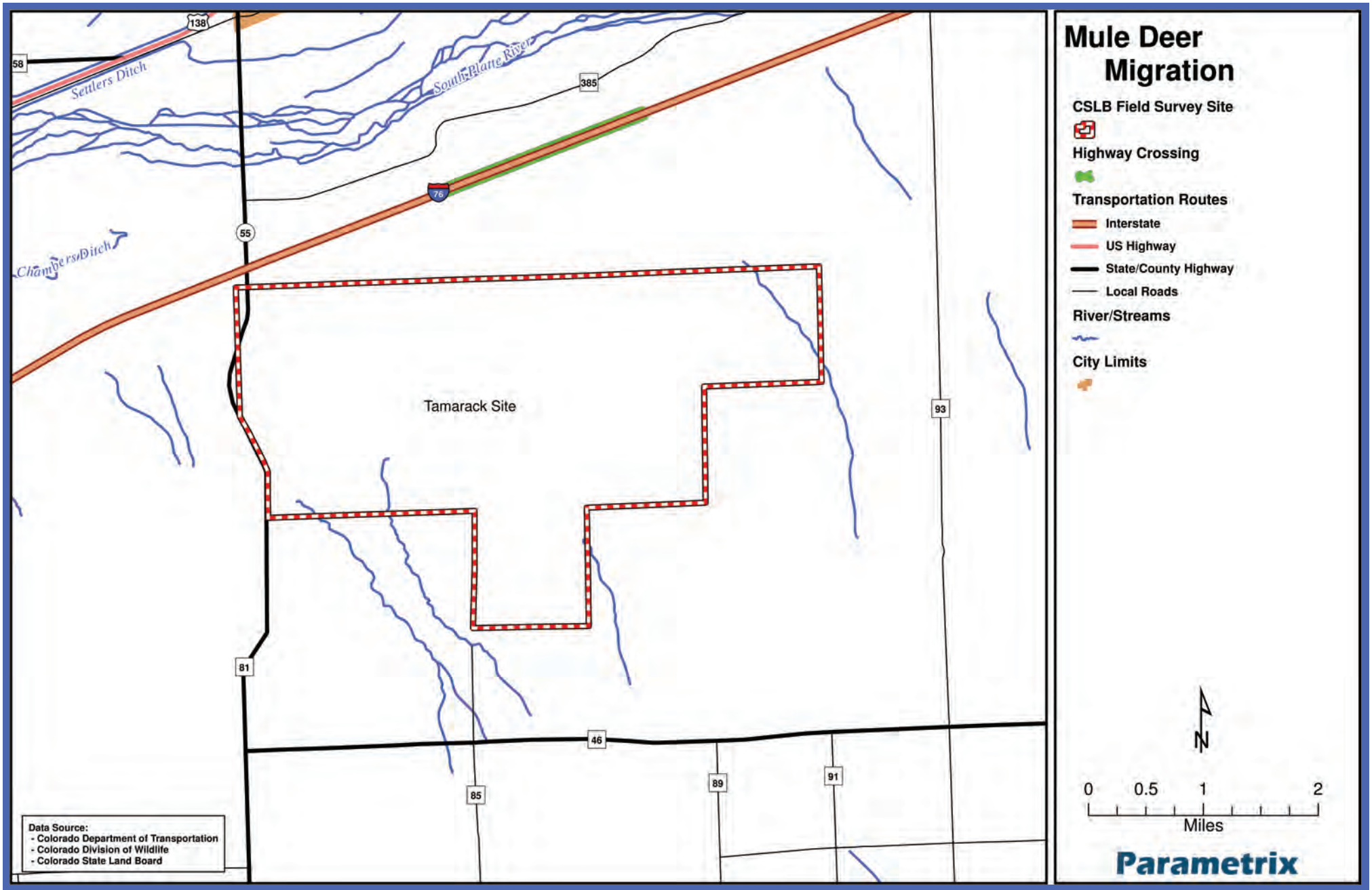
Miles
Parametrix


Mule Deer Migration
CSLB Field Survey Site
Highway Crossing
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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385
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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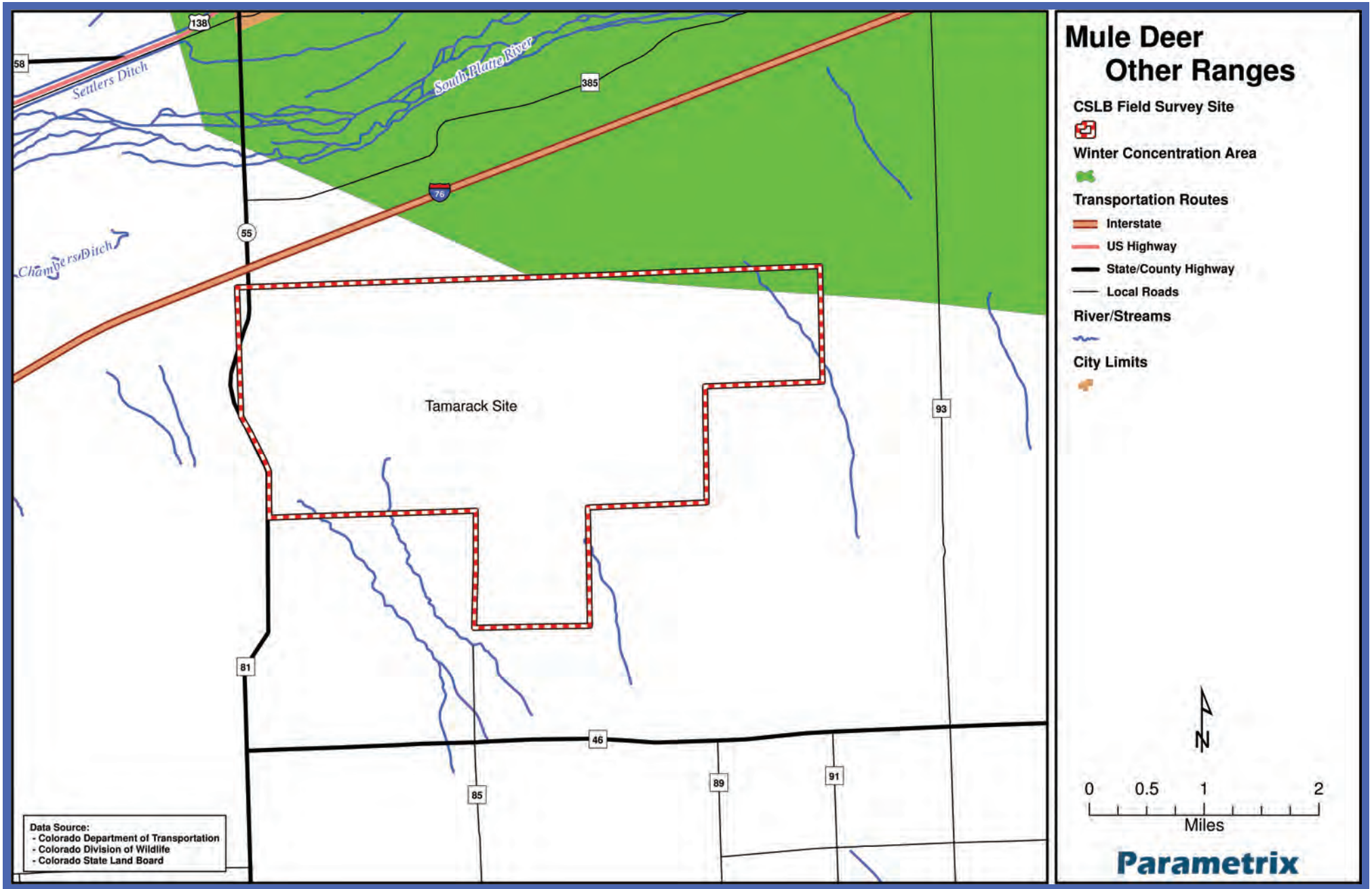
Miles
Parametrix


Mule Deer
Other Ranges
CSLB Field Survey Site
Winter Concentration Area
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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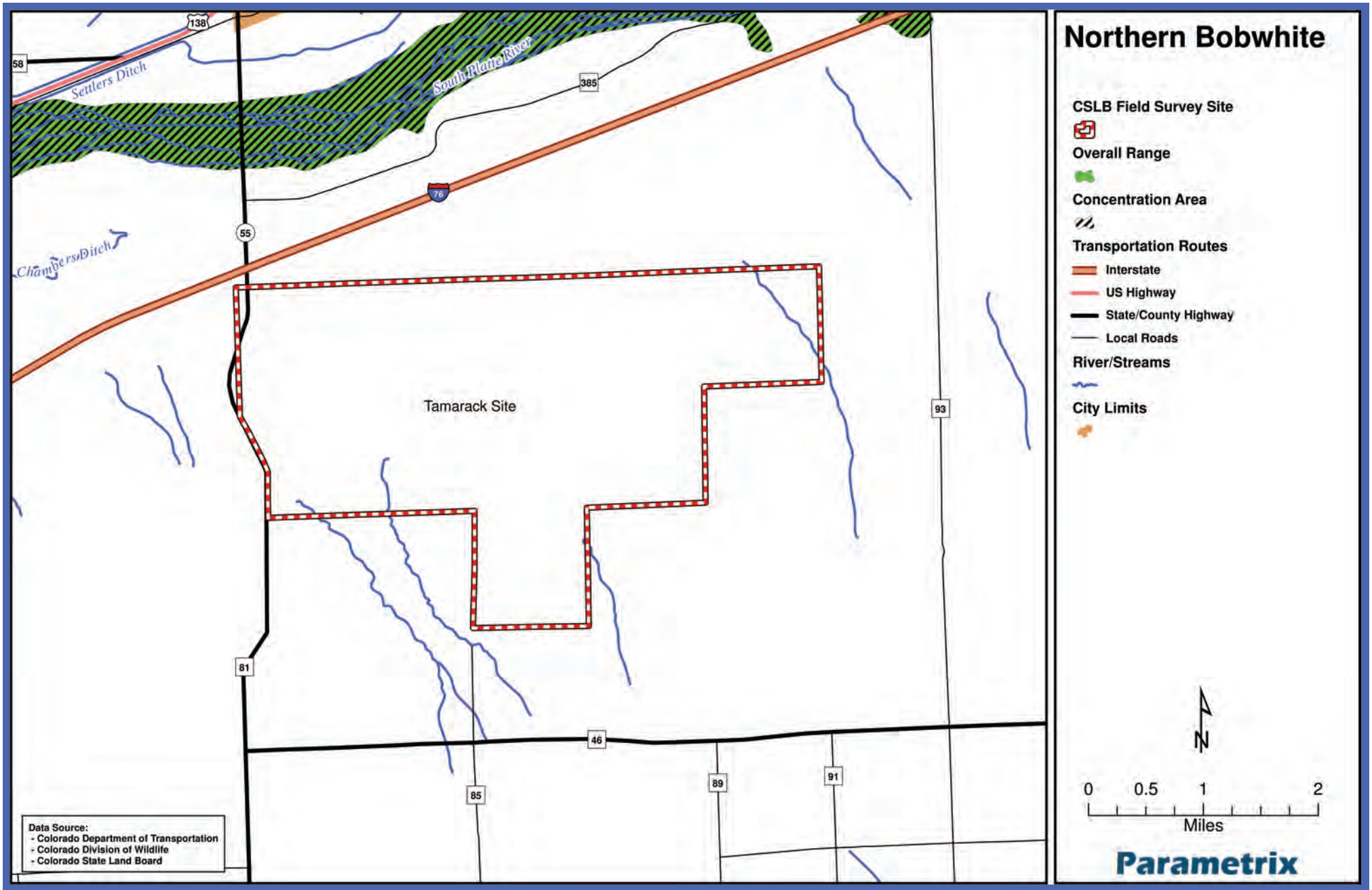
Miles
Parametrix


Northern Bobwhite
CSLB Field Survey Site
Overall Range
Concentration Area
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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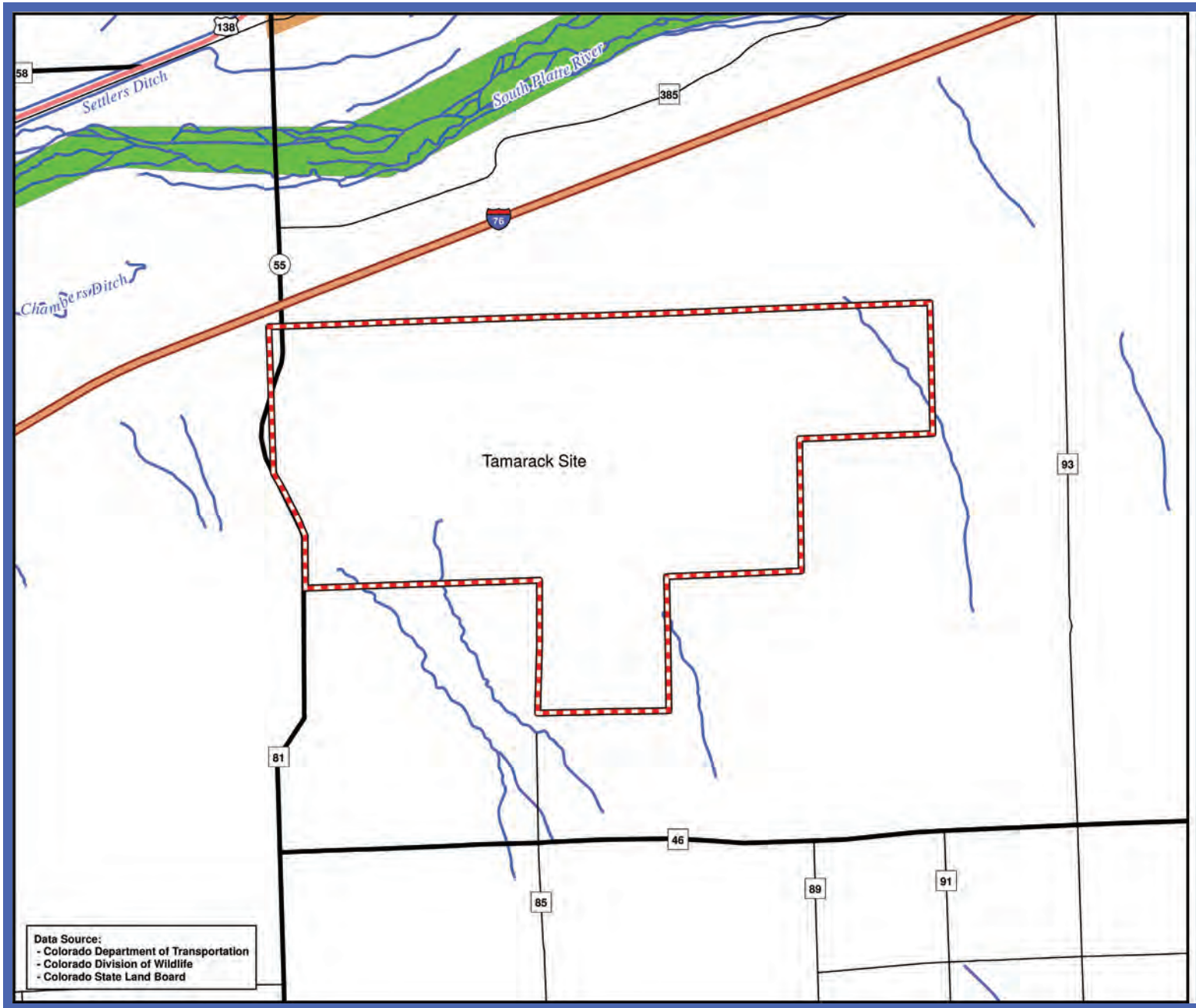
Parametrix


Settlers Ditch
South Platte River
Chambers Ditch
Tamarack Site
138
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
Northern River Otter
CSLB Field Survey Site
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
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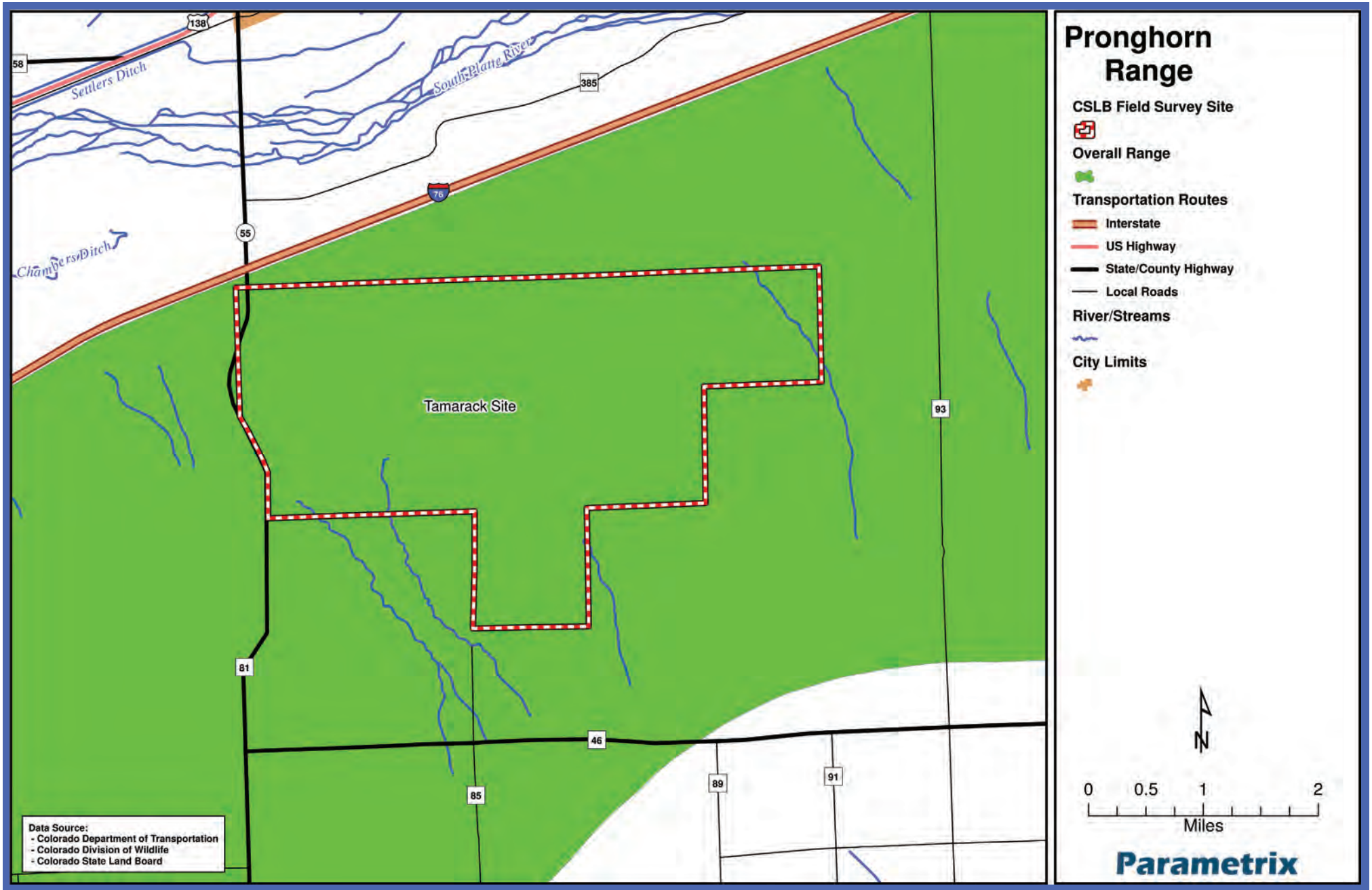
Miles
Parametrix


Pronghorn Range
CSLB Field Survey Site
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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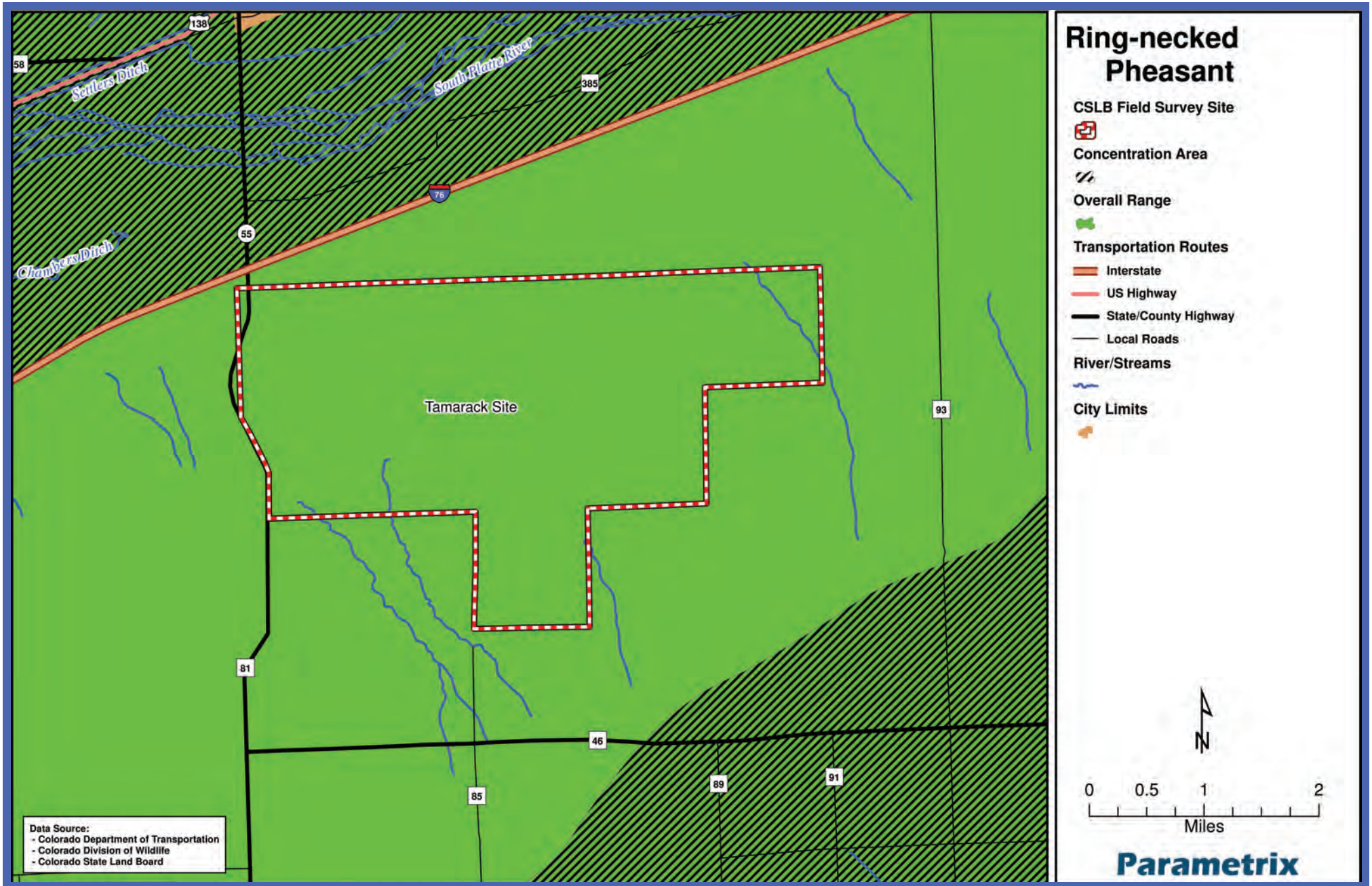
Miles
Parametrix


Ring-necked Pheasant
CSLB Field Survey Site
Concentration Area
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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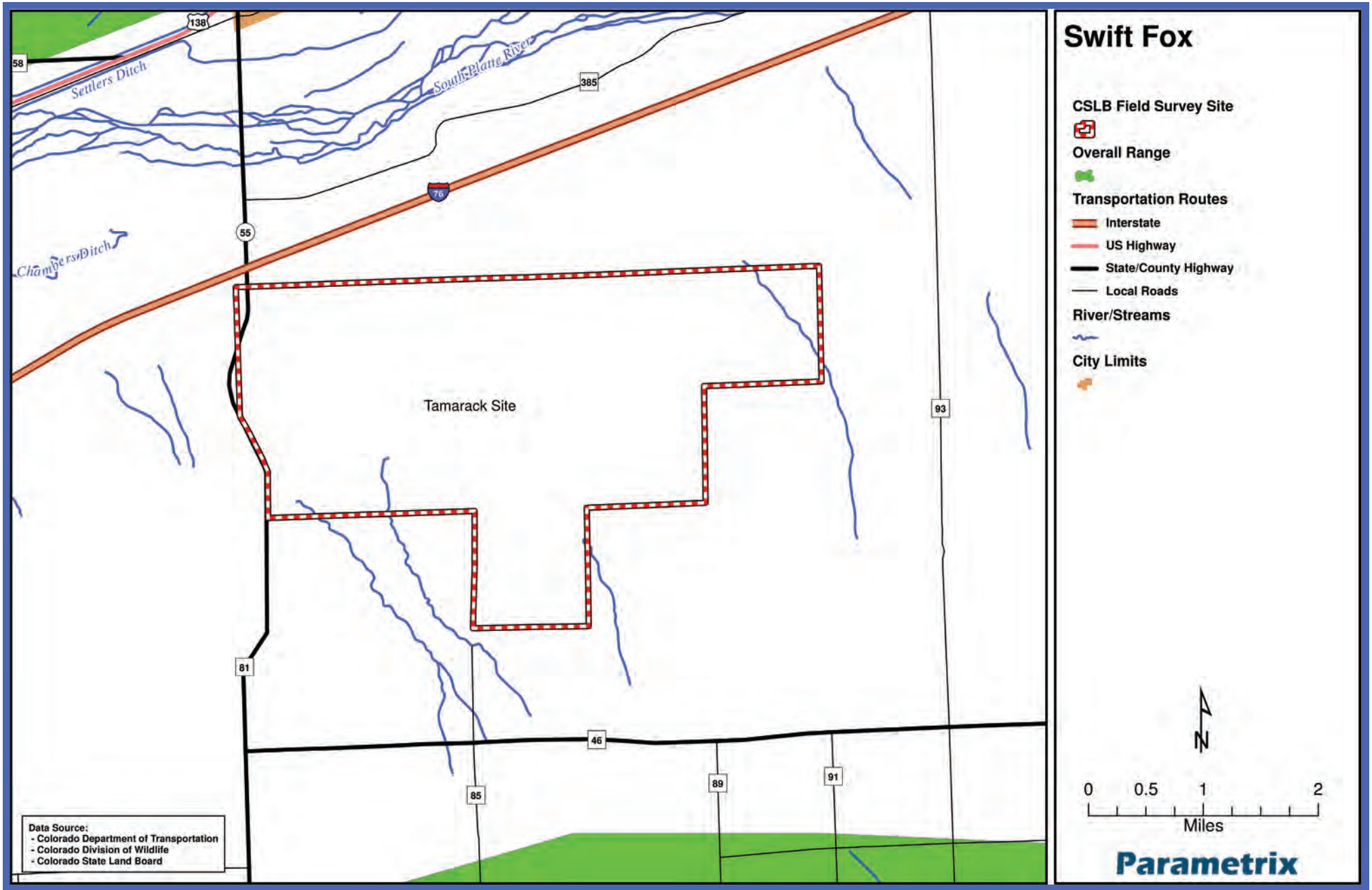
Miles
Parametrix


Swift Fox
CSLB Field Survey Site
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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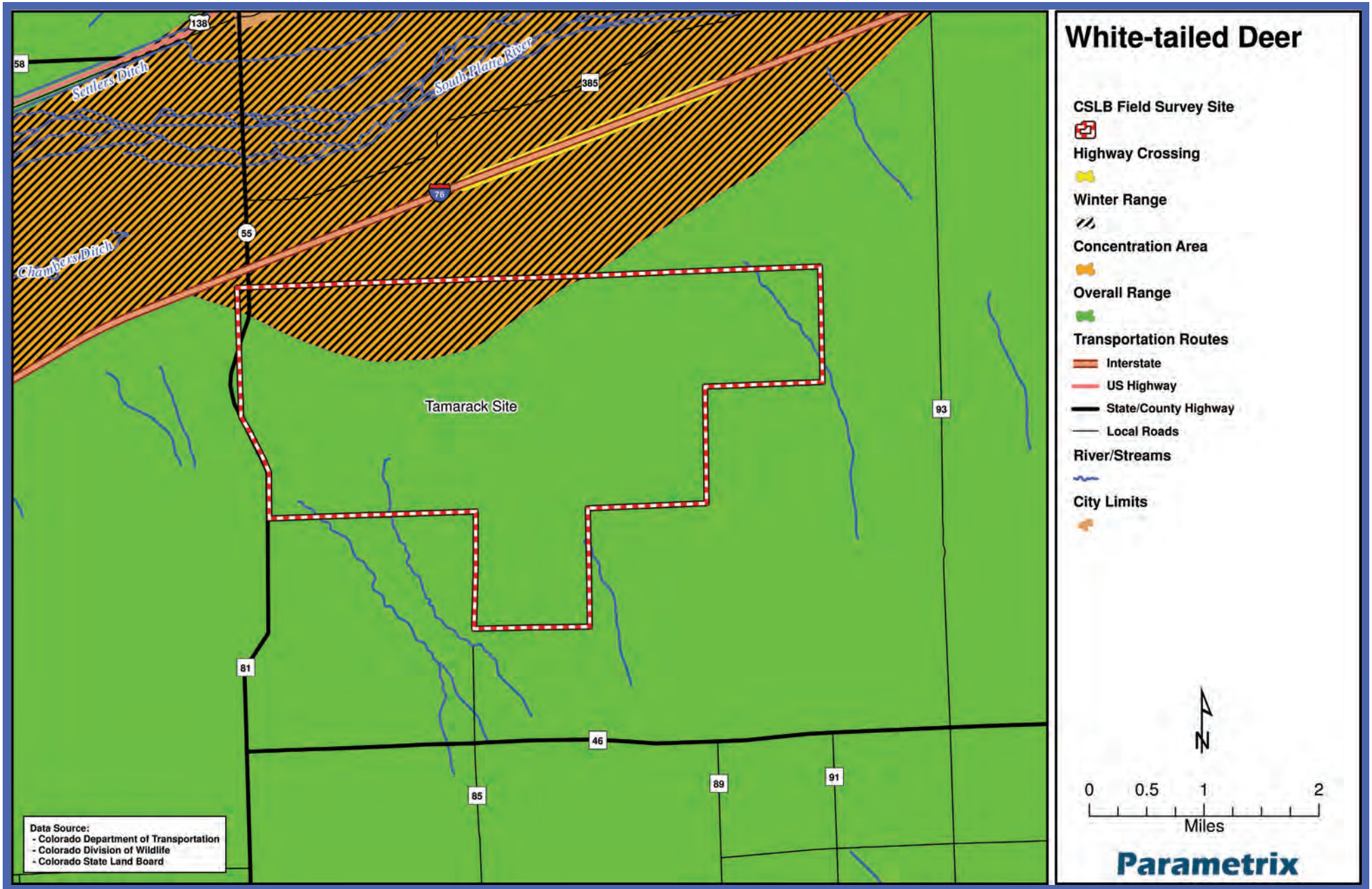
Miles
Parametrix


White-tailed Deer
CSLB Field Survey Site
Highway Crossing
Winter Range
Concentration Area
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
138
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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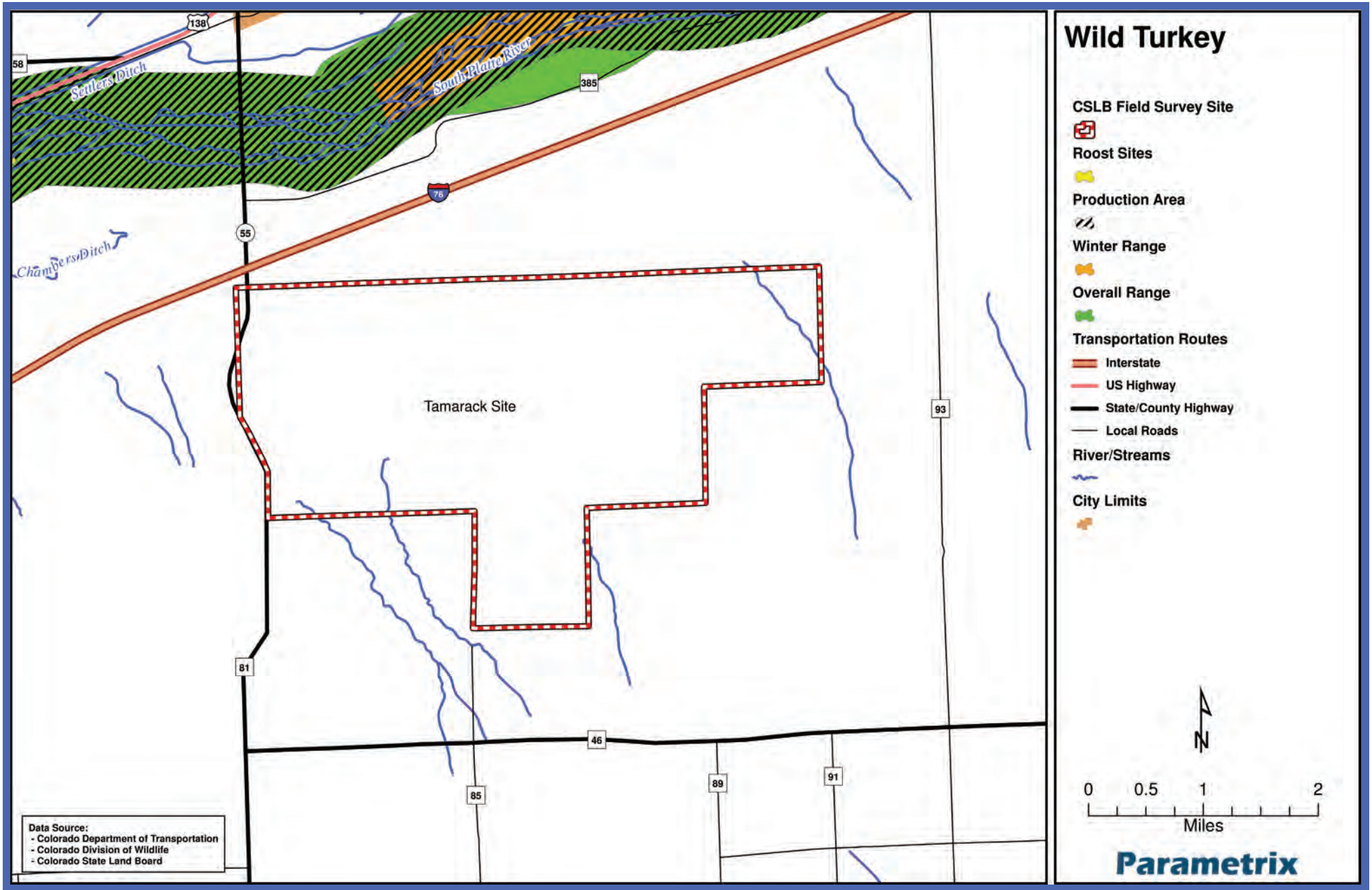
Parametrix


Wild Turkey
CSLB Field Survey Site
Roost Sites
Production Area
Winter Range
Overall Range
Transportation Routes
Interstate
US Highway
State/County Highway
Local Roads
River/Streams
City Limits
Tamarack Site
Settlers Ditch
South Platte River
Chambers Ditch
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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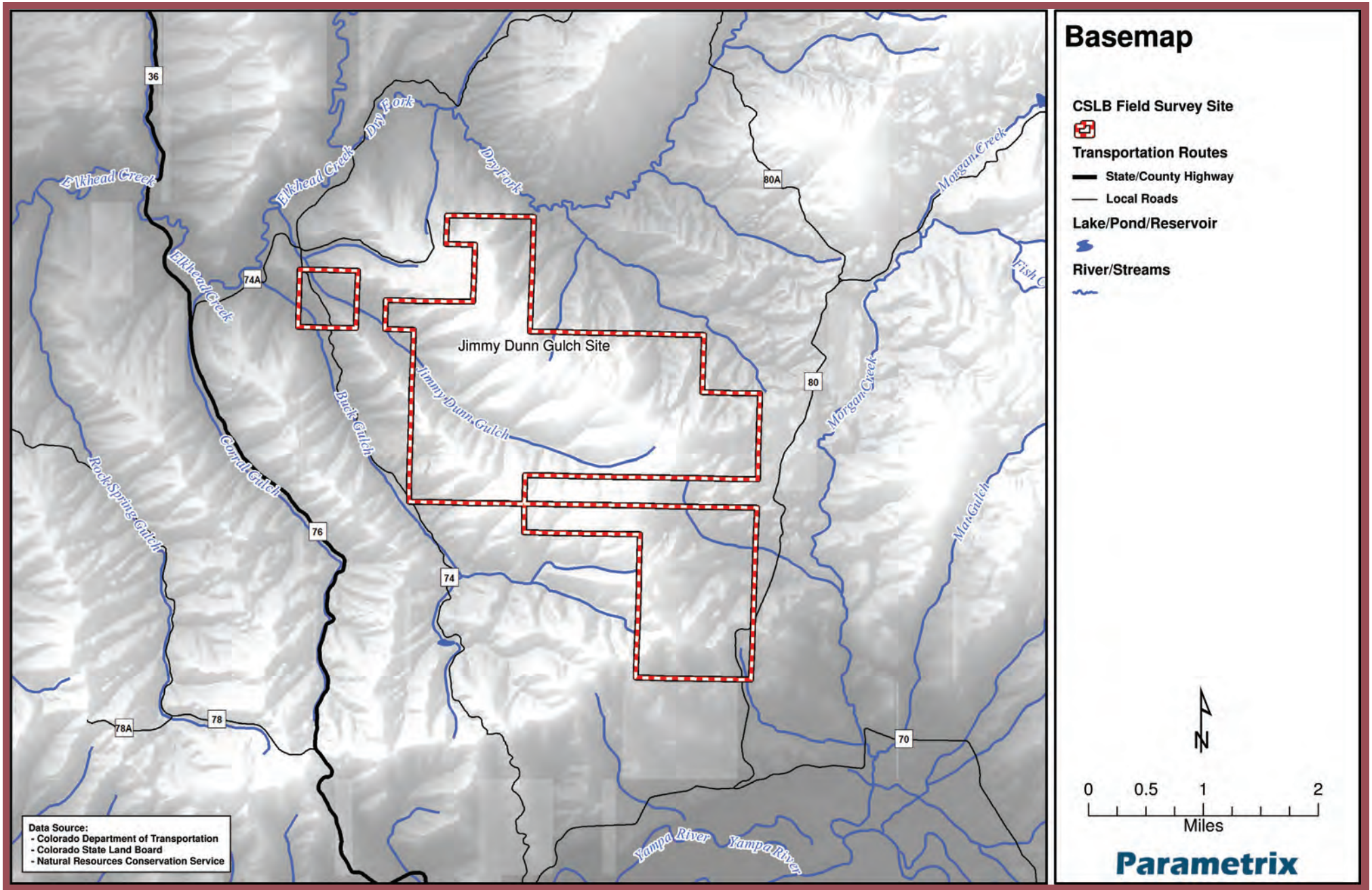
Parametrix

Jimmy Dunn Gulch Site


Basemap
CSLB Field Survey Site
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Coral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
36
74A
80A
80
76
74
78
78A
70
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
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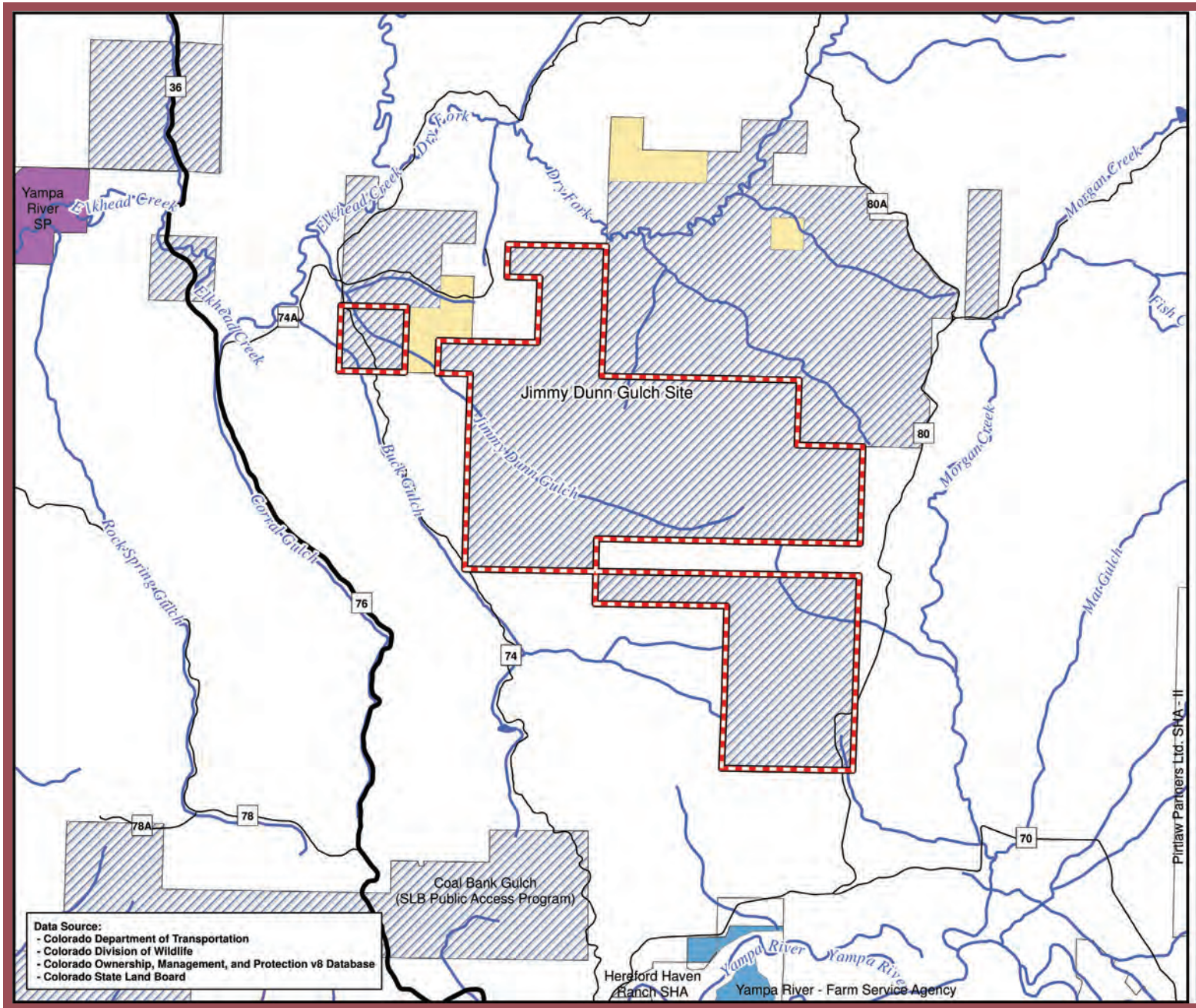
Miles
Parametrix


Ownership
CSLB Field Survey Site
Parcel Ownership
Colorado State Land Board
Colorado State Parks
Private
US Bureau of Land Management
US Farm Service Agency
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Yampa River SP
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Corral Gulch
Rock Spring Gulch
Mar Gulch
Fish C
Pintlaw Partners Ltd. - SHA - II
Coal Bank Gulch
(SLB Public Access Program)
Hereford Haven
Ranch SHA
Yampa River
Yampa River - Farm Service Agency
36
74A
80A
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74
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78A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado Ownership, Management, and Protection v8 Database
- Colorado State Land Board
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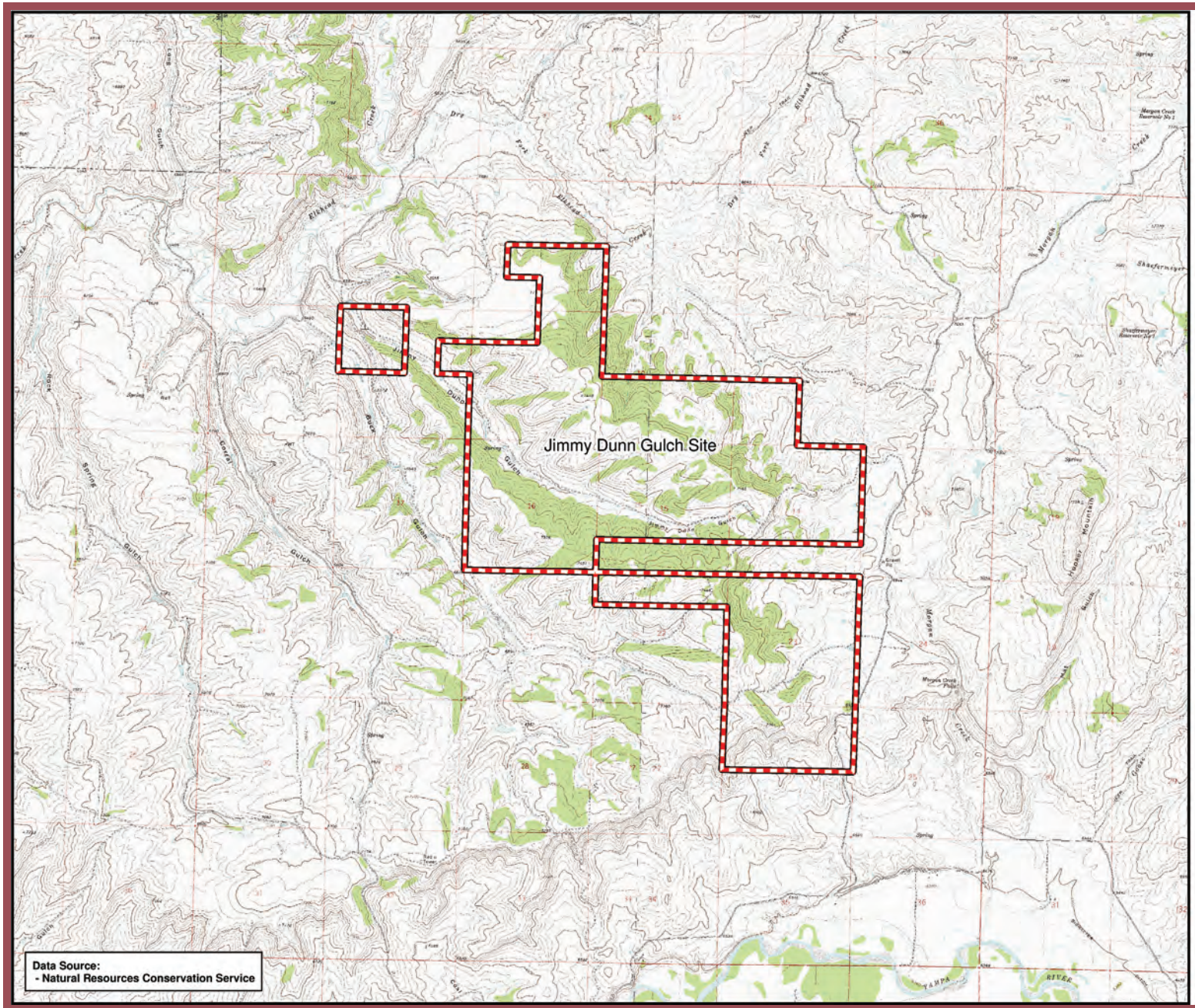
Miles
Parametrix



Topo Map

CSLB Field Survey Site

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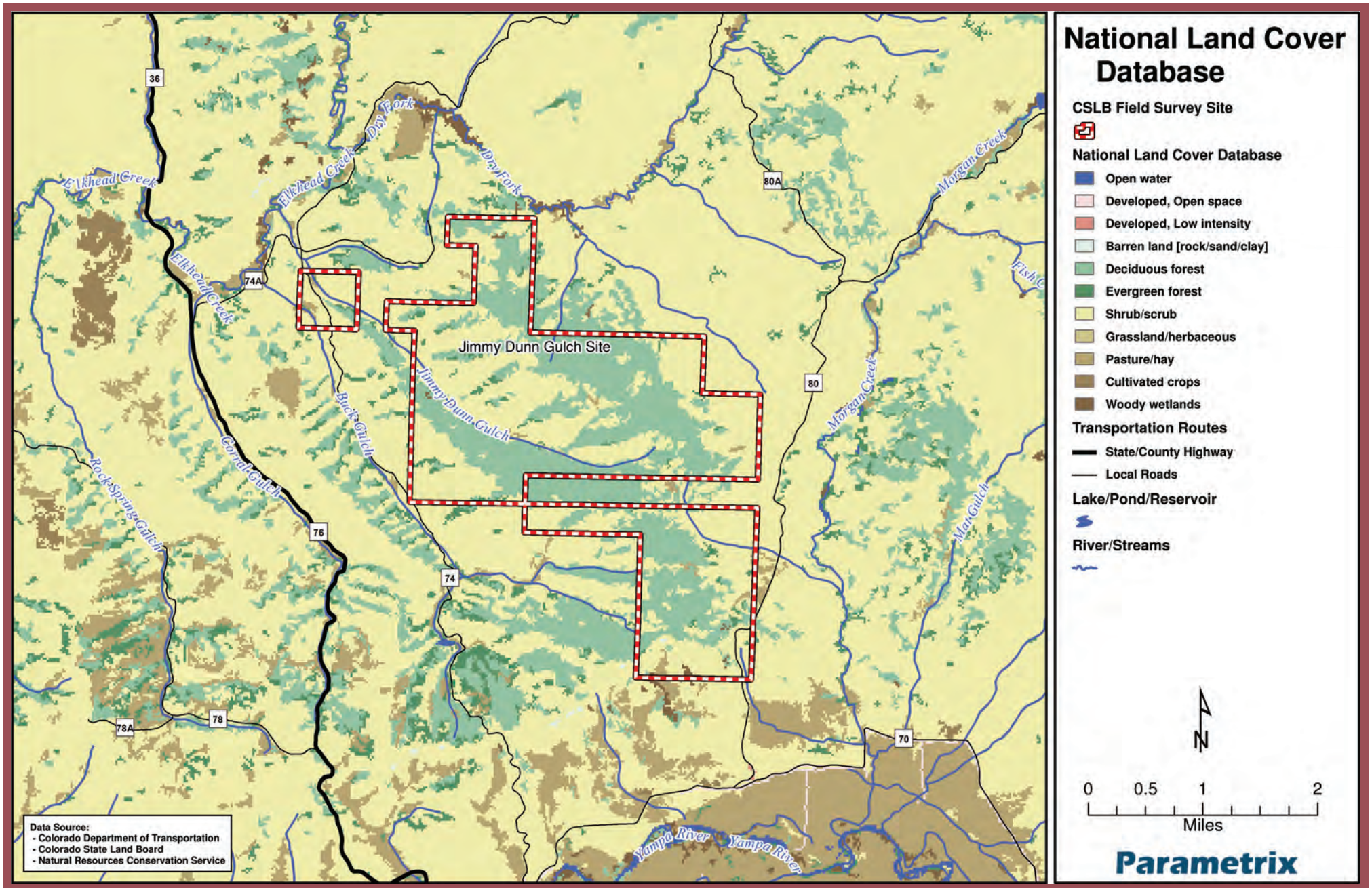
Parametrix


National Land Cover Database
CSLB Field Survey Site
National Land Cover Database
Open water
Developed, Open space
Developed, Low intensity
Barren land [rock/sand/clay]
Deciduous forest
Evergreen forest
Shrub/scrub
Grassland/herbaceous
Pasture/hay
Cultivated crops
Woody wetlands
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Rock Spring Gulch
Corral Gulch
Mat Gulch
Yampa River
36
74A
80A
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76
74
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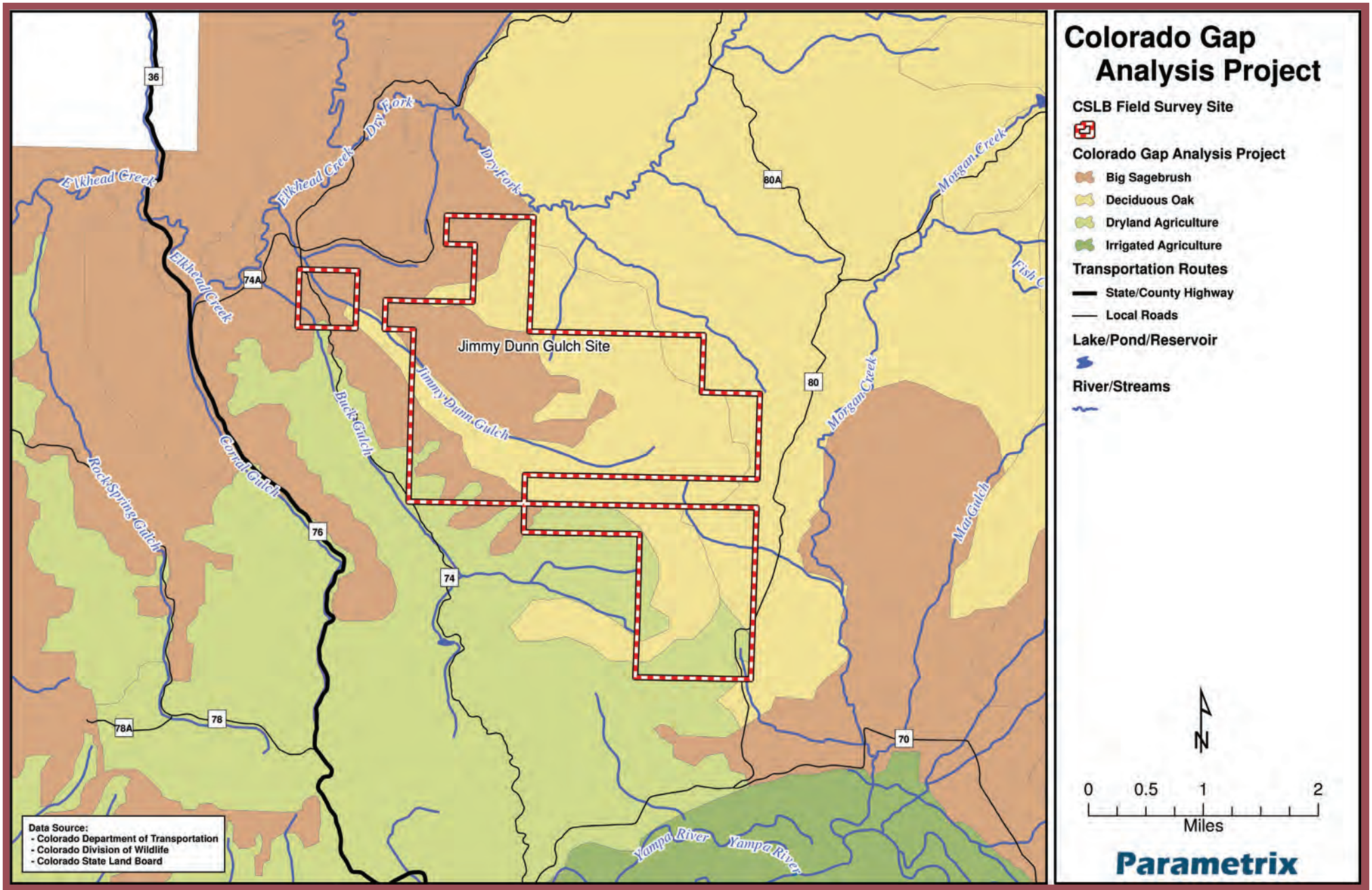
0 0.5 1 2
Miles
Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
Parametrix


Colorado Gap Analysis Project
CSLB Field Survey Site
Colorado Gap Analysis Project
Big Sagebrush
Deciduous Oak
Dryland Agriculture
Irrigated Agriculture
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Rock Spring Gulch
Coral Gulch
Mar Gulch
Yampa River
36
74A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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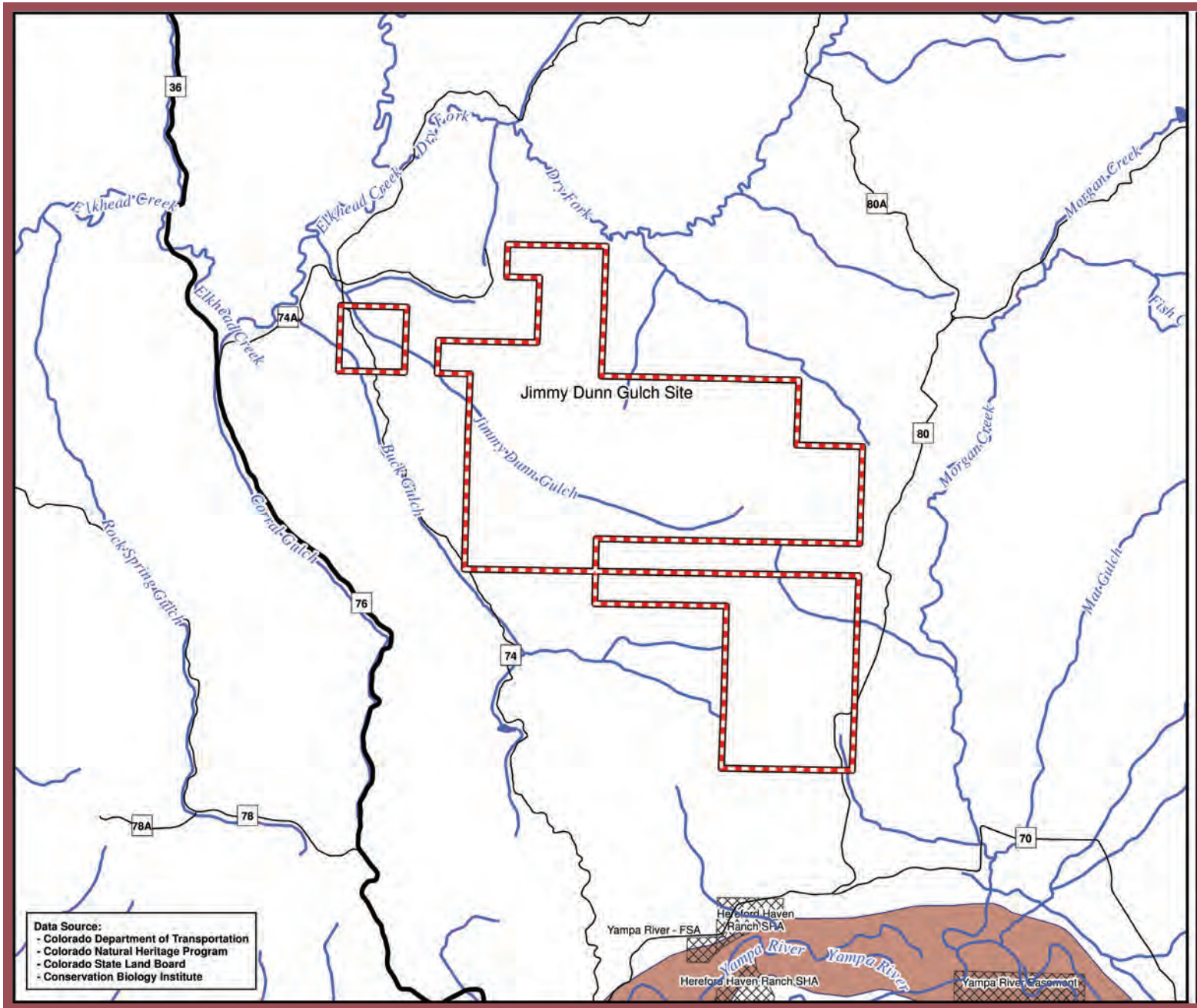
Miles
Parametrix



Conservation Areas

CSLB Field Survey Site

Conservation Easement Lands

Potential Conservation Areas

Biodiversity Significance Rank

Very High Biodiversity Significance

Transportation Routes

State/County Highway

Local Roads

Lake/Pond/Reservoir

River/Streams

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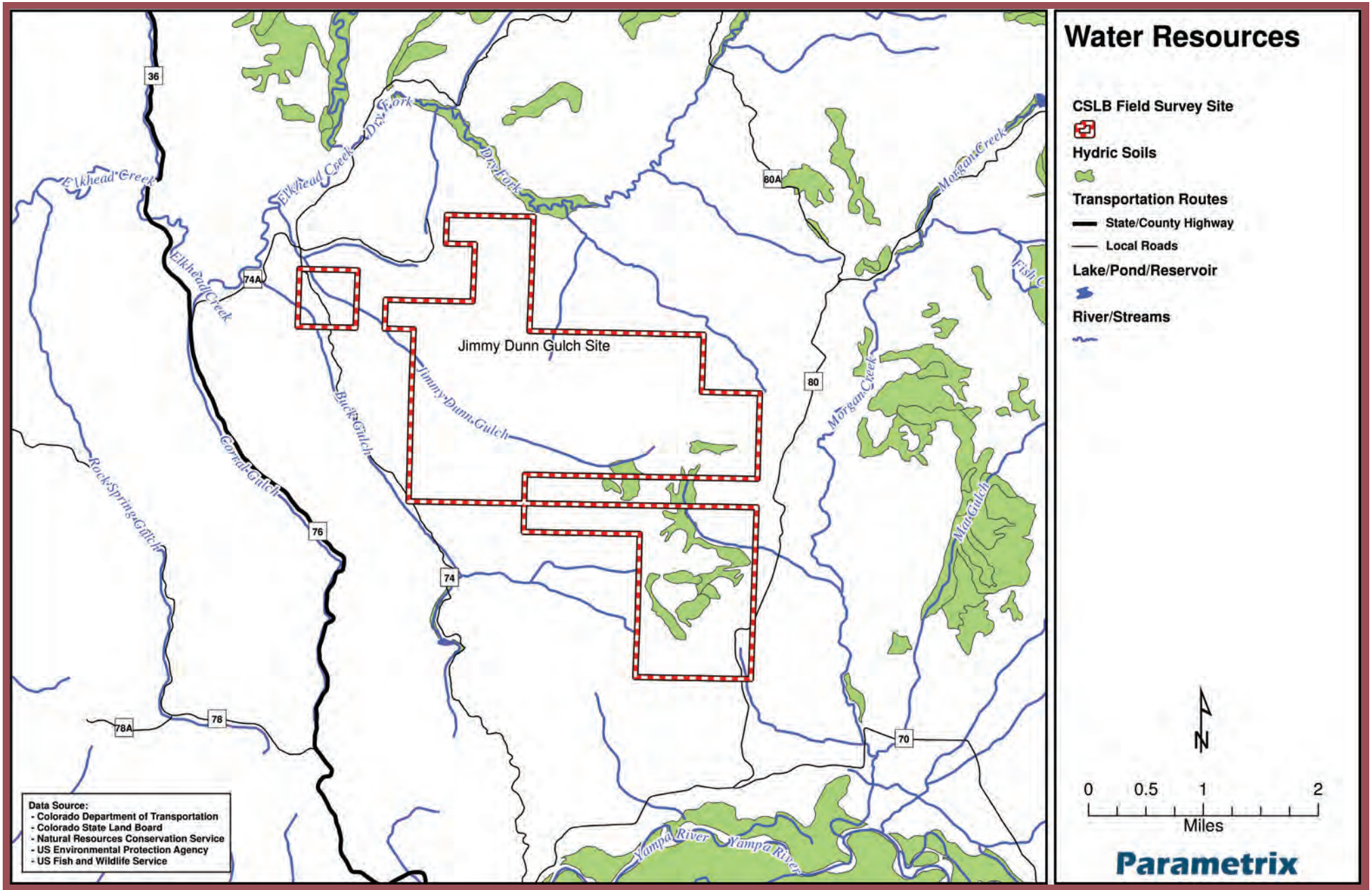
Parametrix


Water Resources
CSLB Field Survey Site
Hydric Soils
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Elkhead Creek
Elkhead Creek
Dry Fork
Dry Fork
Morgan Creek
Morgan Creek
Fish C
Buck Gulch
Jimmy Dunn Gulch
Corral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
Yampa River
36
74A
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Data Source:
- Colorado Department of Transportation
- Colorado State Land Board
- Natural Resources Conservation Service
- US Environmental Protection Agency
- US Fish and Wildlife Service
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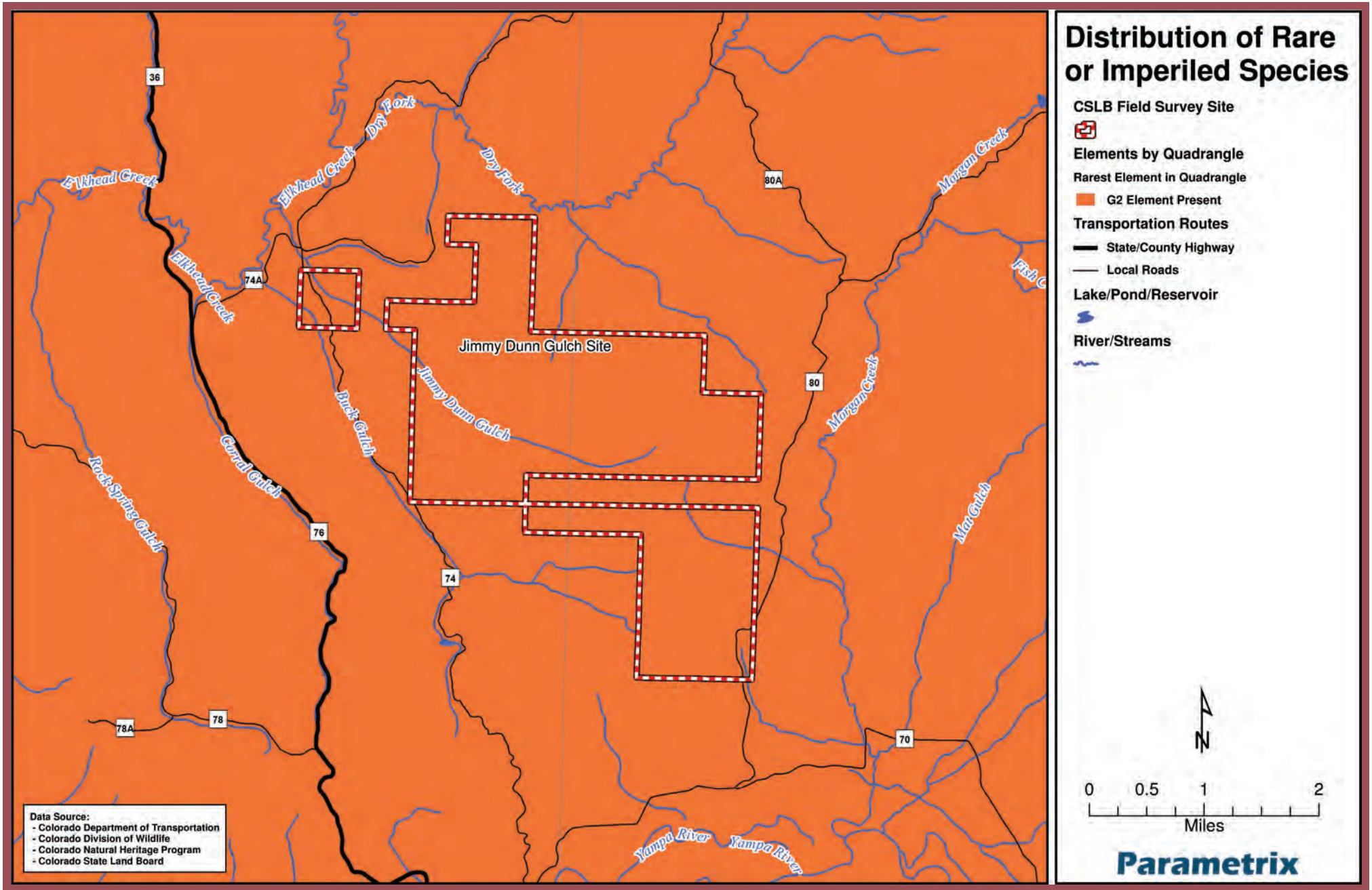
Parametrix


Distribution of Rare or Imperiled Species
CSLB Field Survey Site
Elements by Quadrangle
Rarest Element in Quadrangle
G2 Element Present
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Coral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
36
74A
80A
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74
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78A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado Natural Heritage Program
- Colorado State Land Board
N
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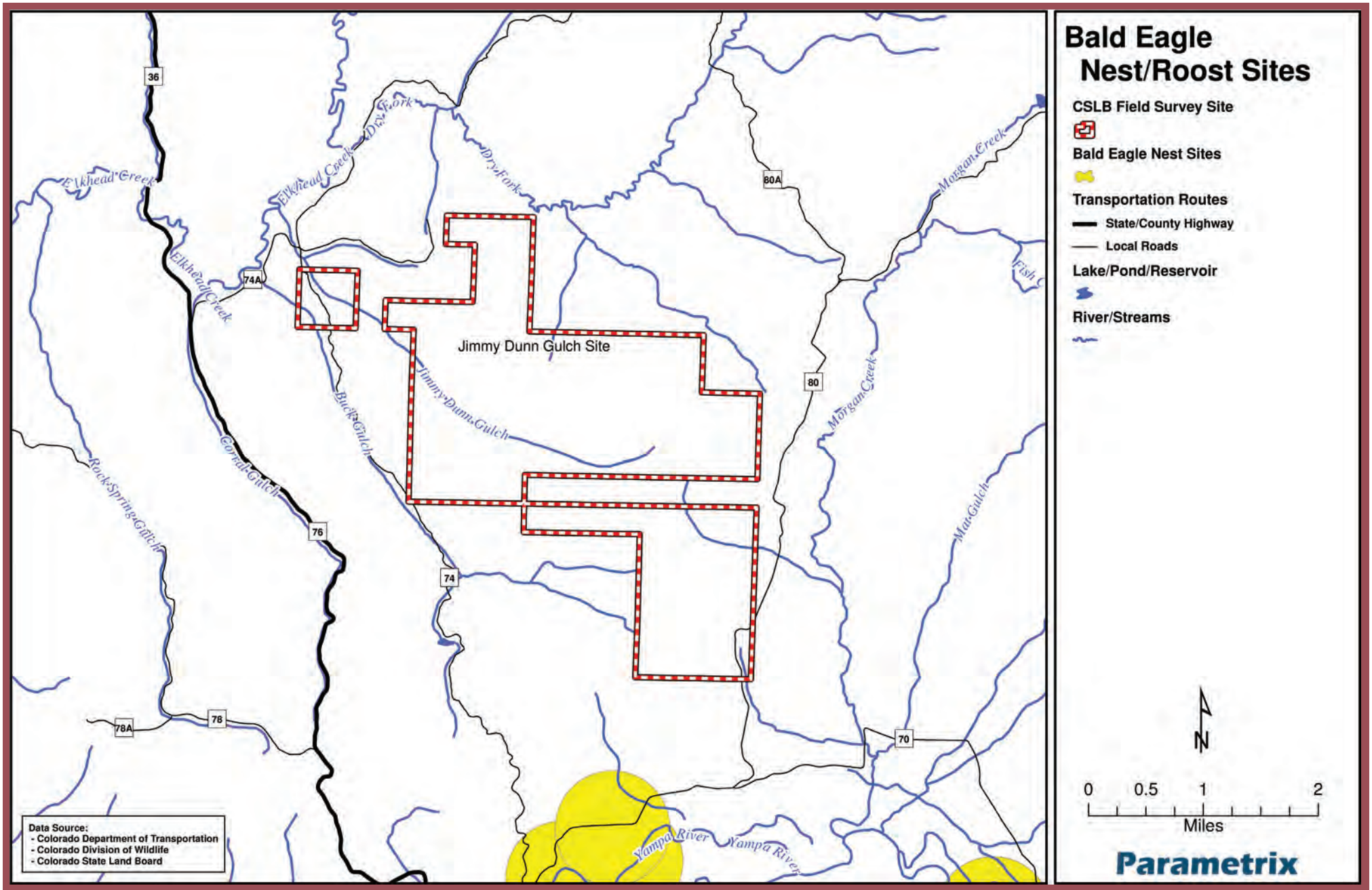
Miles
Parametrix


Bald Eagle
Nest/Roost Sites
CSLB Field Survey Site
Bald Eagle Nest Sites
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Jimmy Dunn Gulch
Buck Gulch
Goose Gulch
Rock Spring Gulch
Mar Gulch
Yampa River
36
74A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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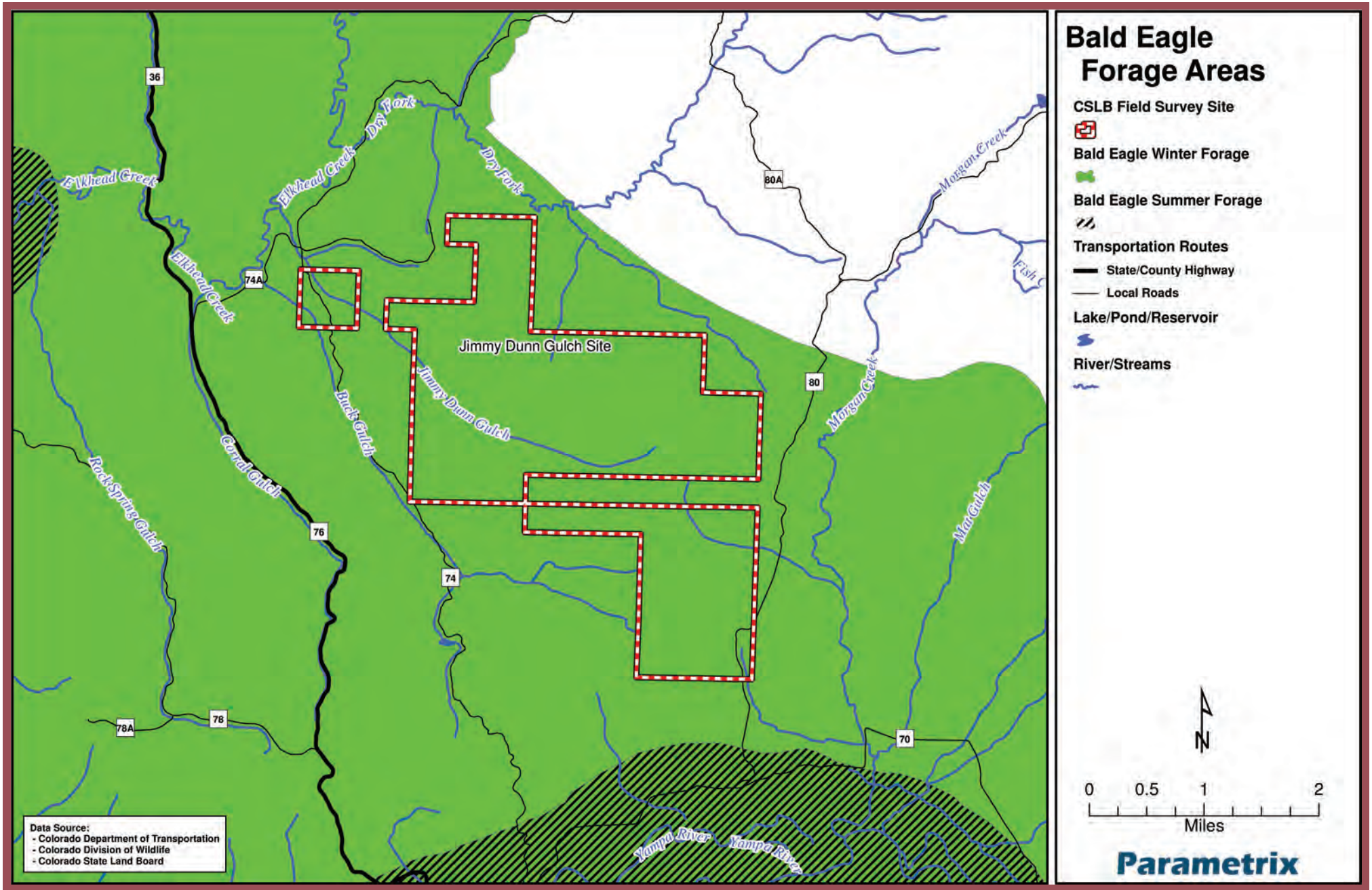
Miles
Parametrix


Bald Eagle
Forage Areas
CSLB Field Survey Site
Bald Eagle Winter Forage
Bald Eagle Summer Forage
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Coral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
36
74A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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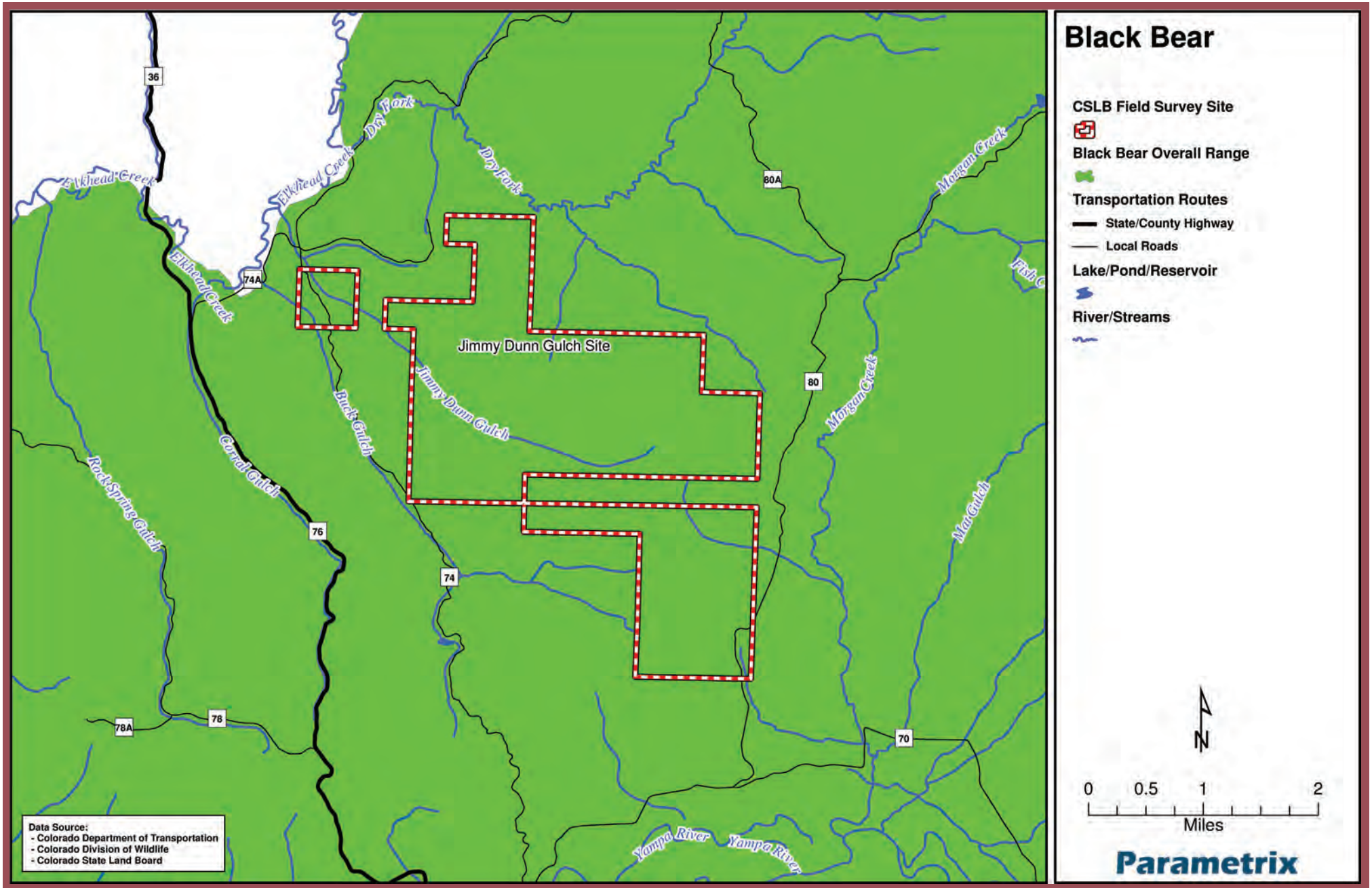
Parametrix


Black Bear
CSLB Field Survey Site
Black Bear Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Coral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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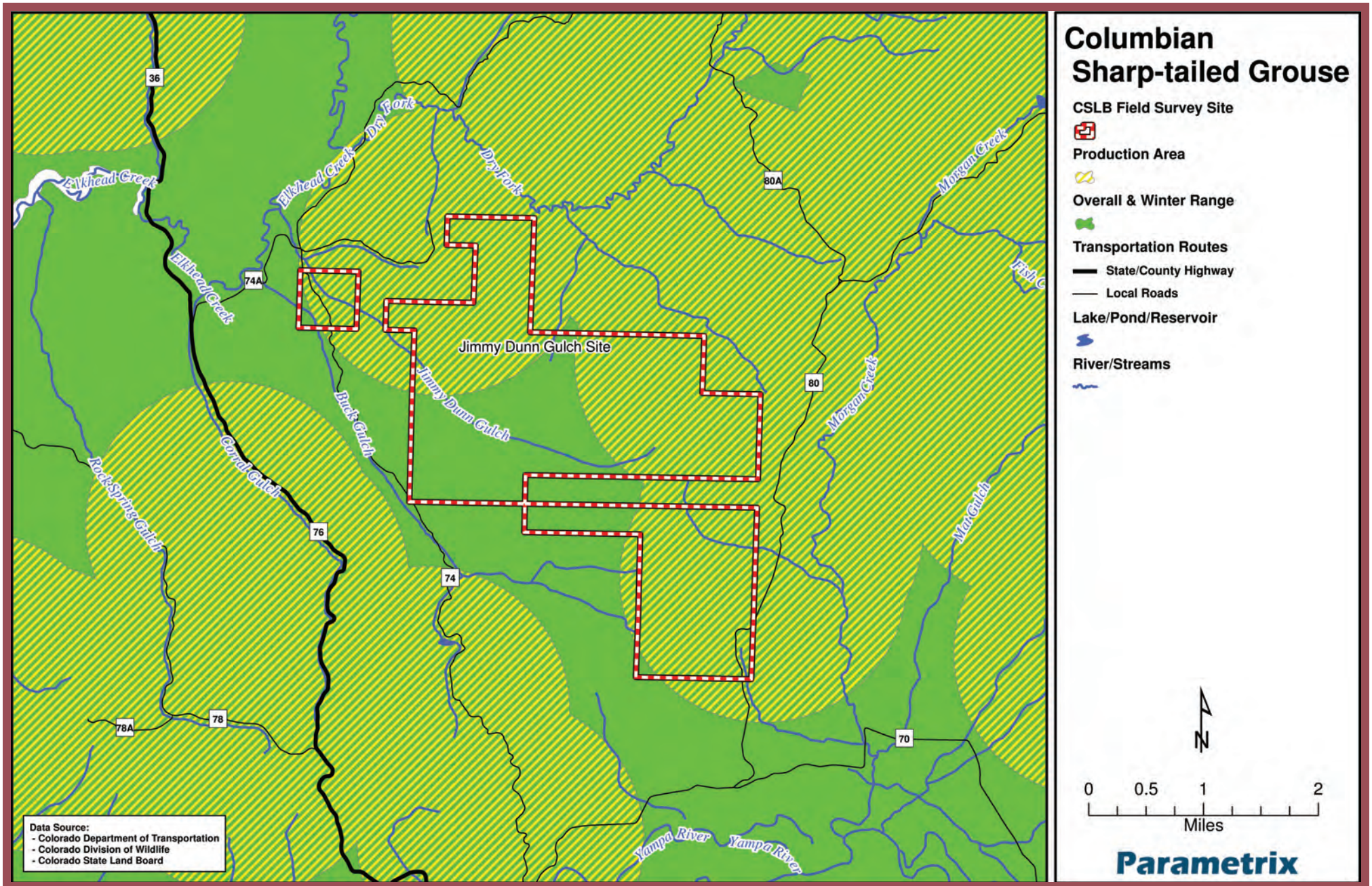
Miles
Parametrix


Columbian Sharp-tailed Grouse
CSLB Field Survey Site
Production Area
Overall & Winter Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Corral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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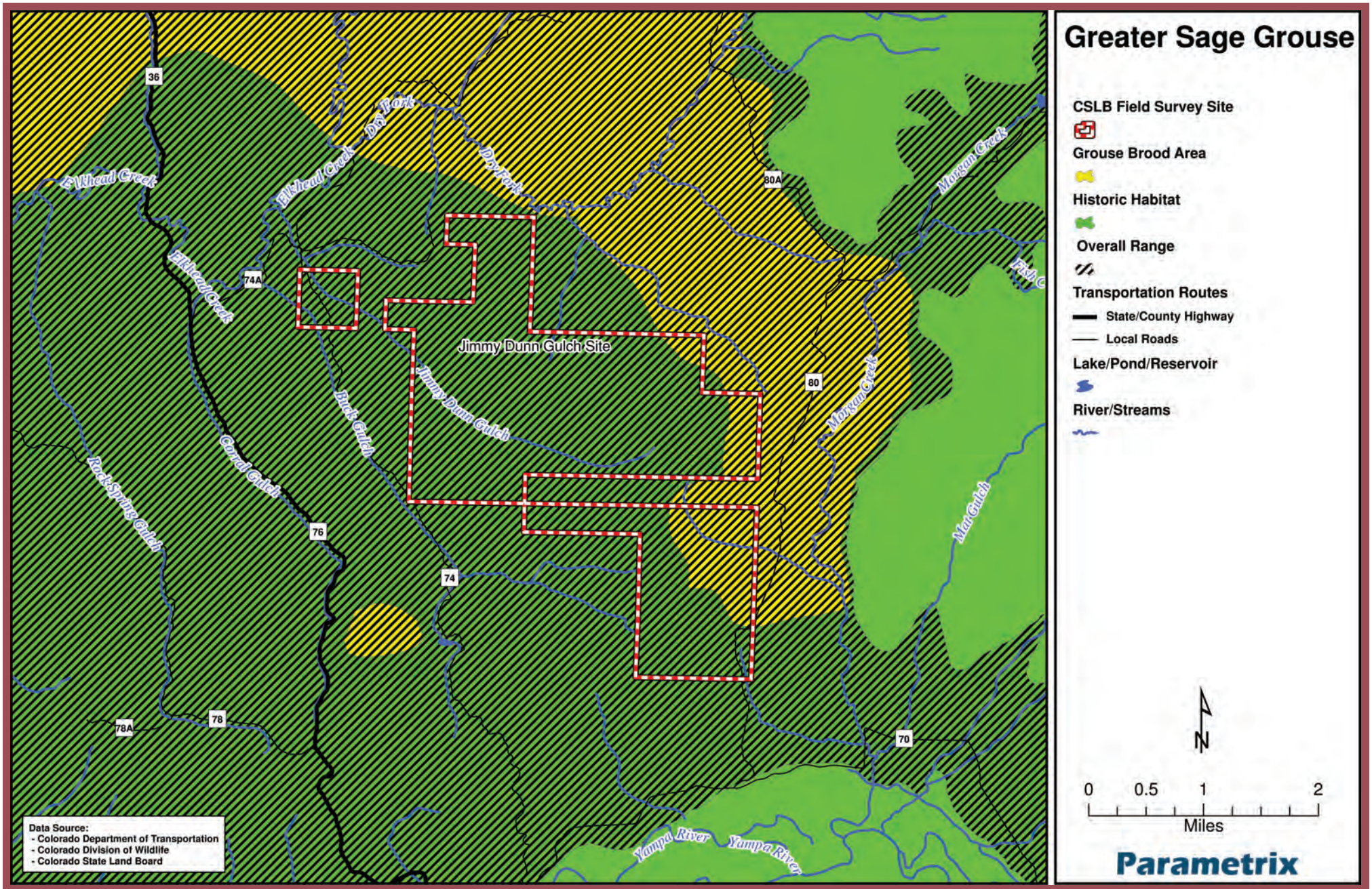
Parametrix


Greater Sage Grouse
CSLB Field Survey Site
Grouse Brood Area
Historic Habitat
Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Maryan Creek
Mot Gulch
Coral Gulch
Rock Spring Gulch
Yampa River
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Miles
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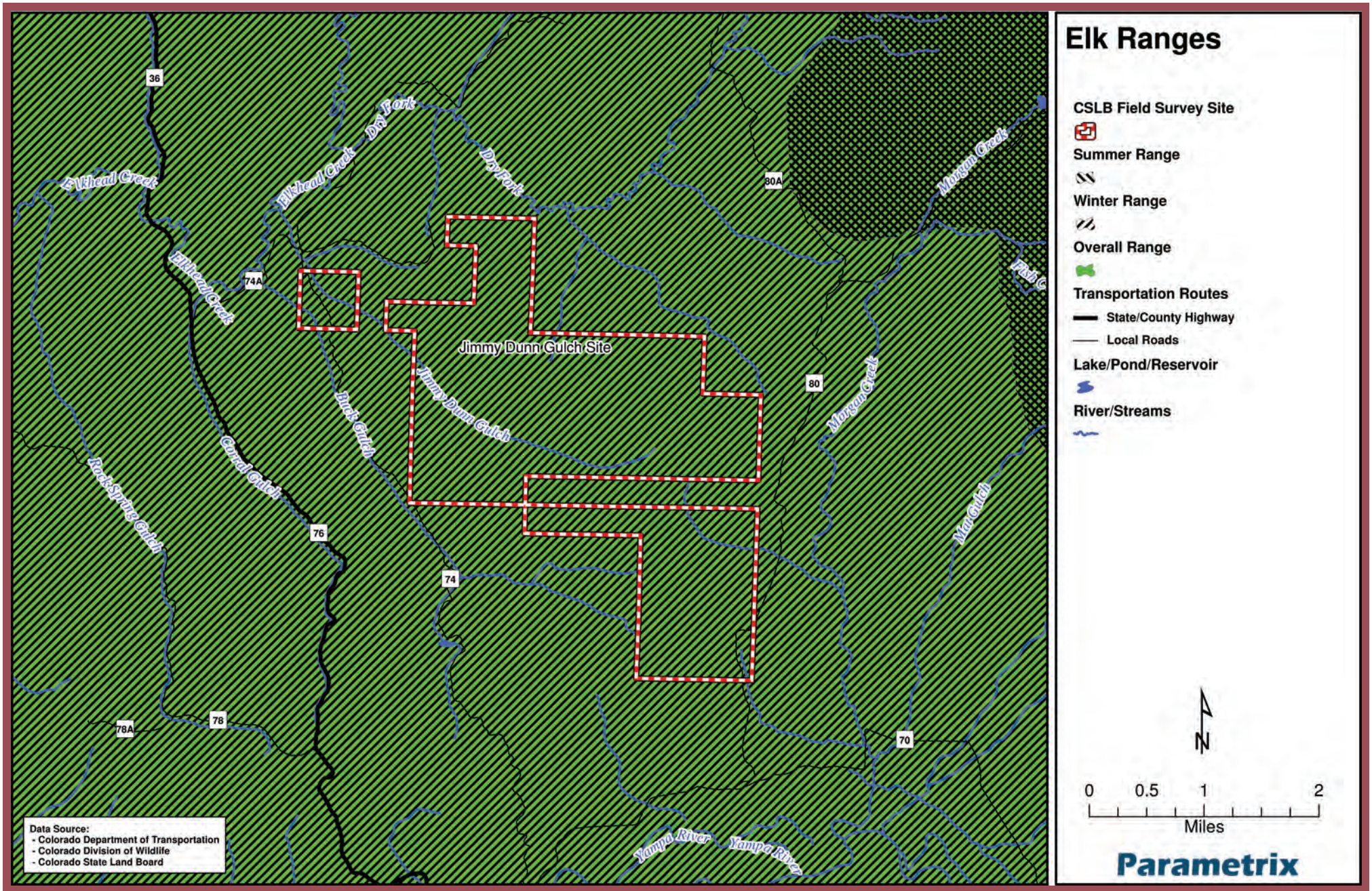
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
Parametrix


Elk Ranges
CSLB Field Survey Site
Summer Range
Winter Range
Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Coal Gulch
Rock Spring Gulch
Buck Gulch
Jimmy Dunn Gulch
Marsh Gulch
Yampa River
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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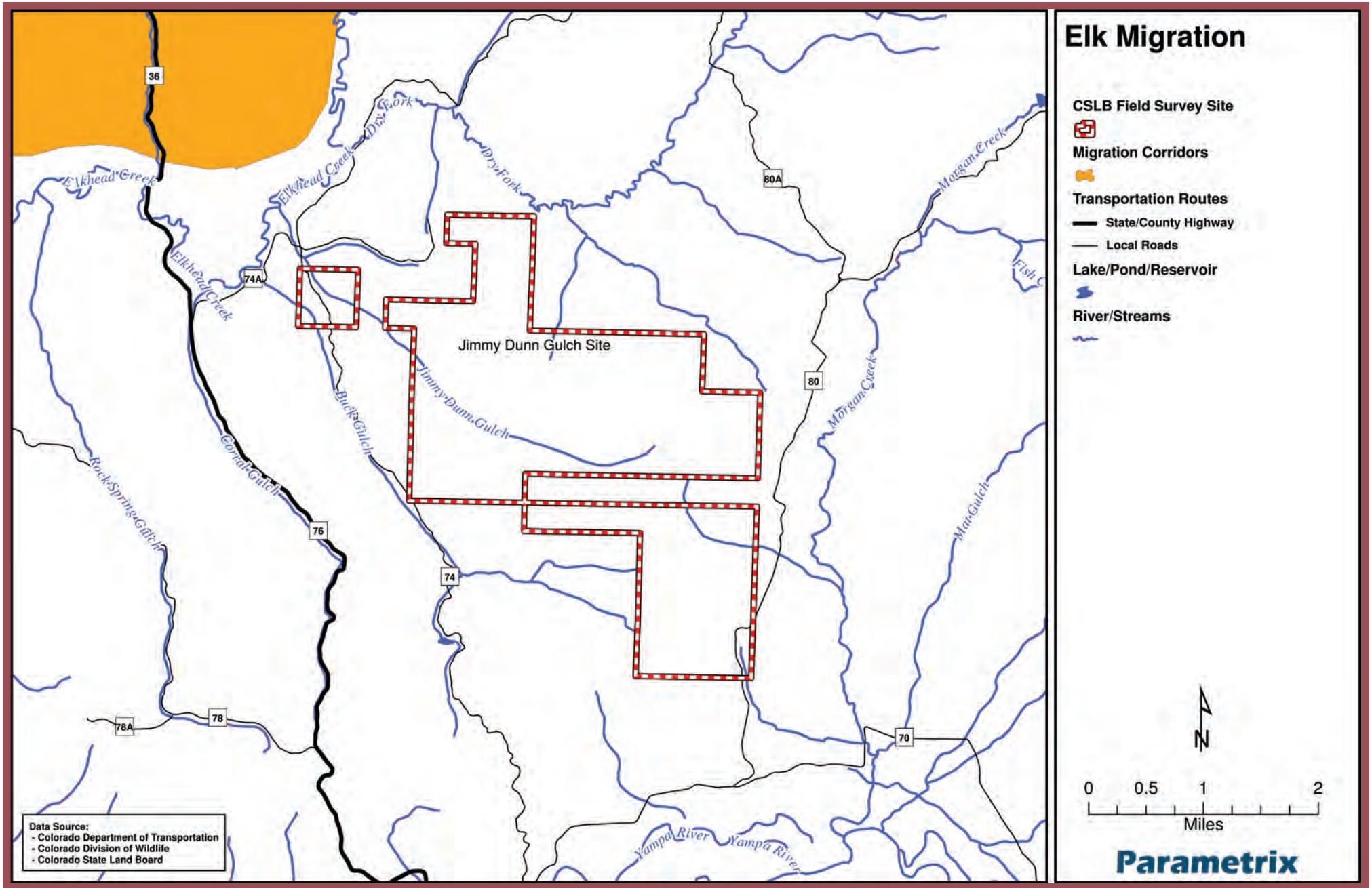
Parametrix


Elk Migration
CSLB Field Survey Site
Migration Corridors
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Coral Gulch
Buck Gulch
Jimmy Dunn Gulch
Rock Spring Gulch
Mar Gulch
Yampa River
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Miles
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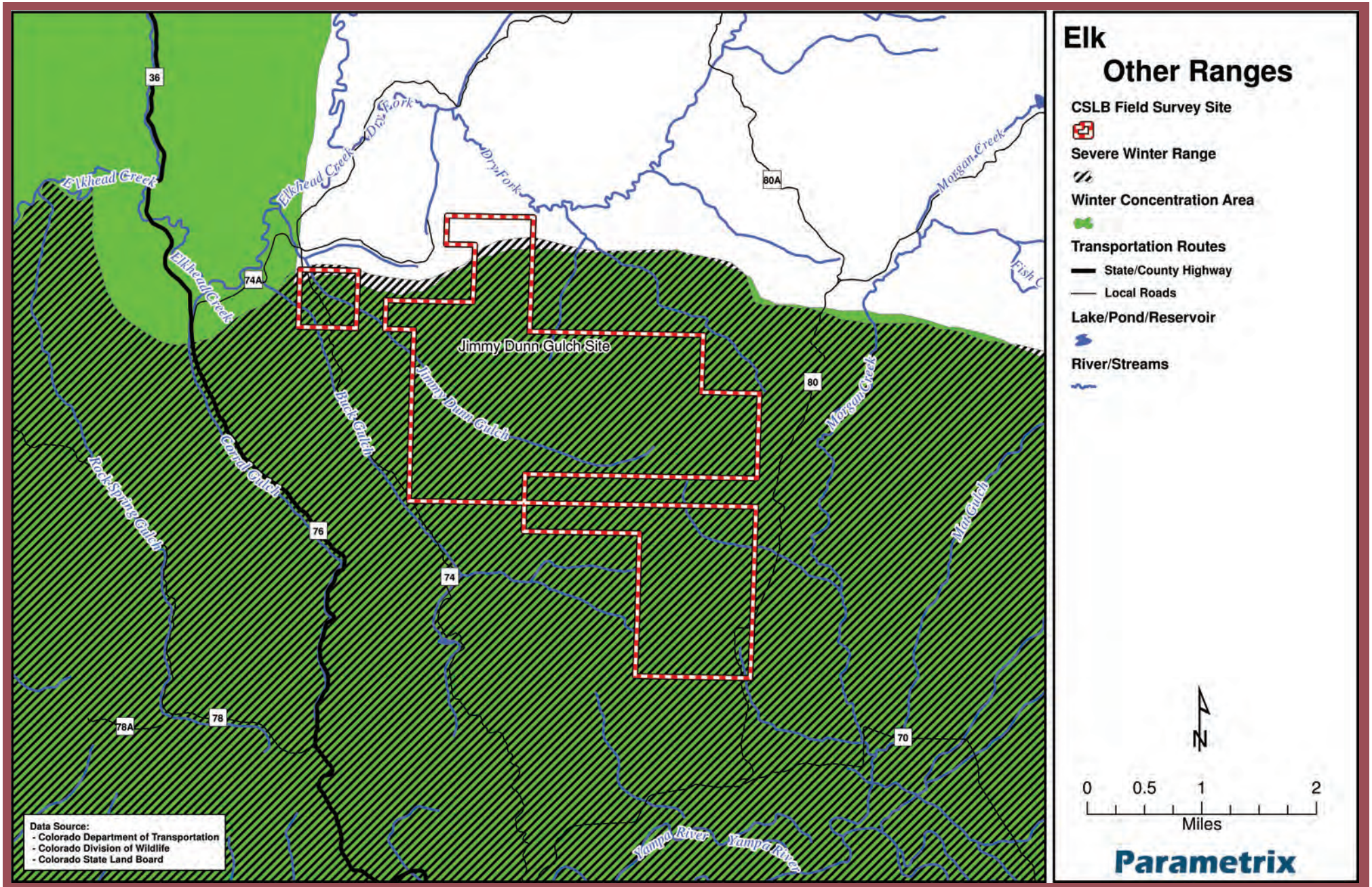
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
Parametrix


Elk
Other Ranges
CSLB Field Survey Site
Severe Winter Range
Winter Concentration Area
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
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Jimmy Dunn Gulch
Buck Gulch
Corral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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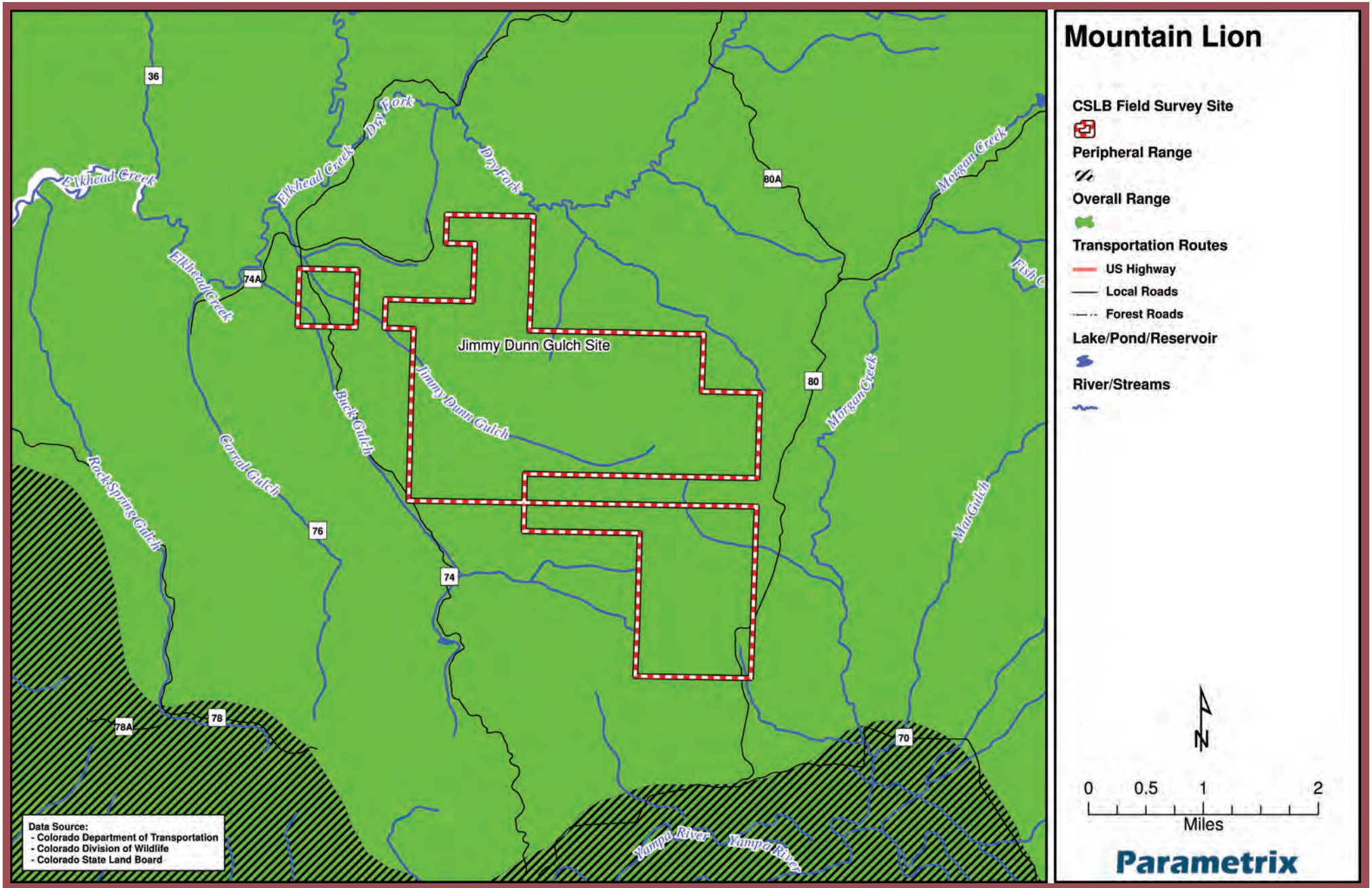
Parametrix


Mountain Lion
CSLB Field Survey Site
Peripheral Range
Overall Range
Transportation Routes
US Highway
Local Roads
Forest Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Coral Gulch
Rock Spring Gulch
Mat Gulch
Yampa River
36
74A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
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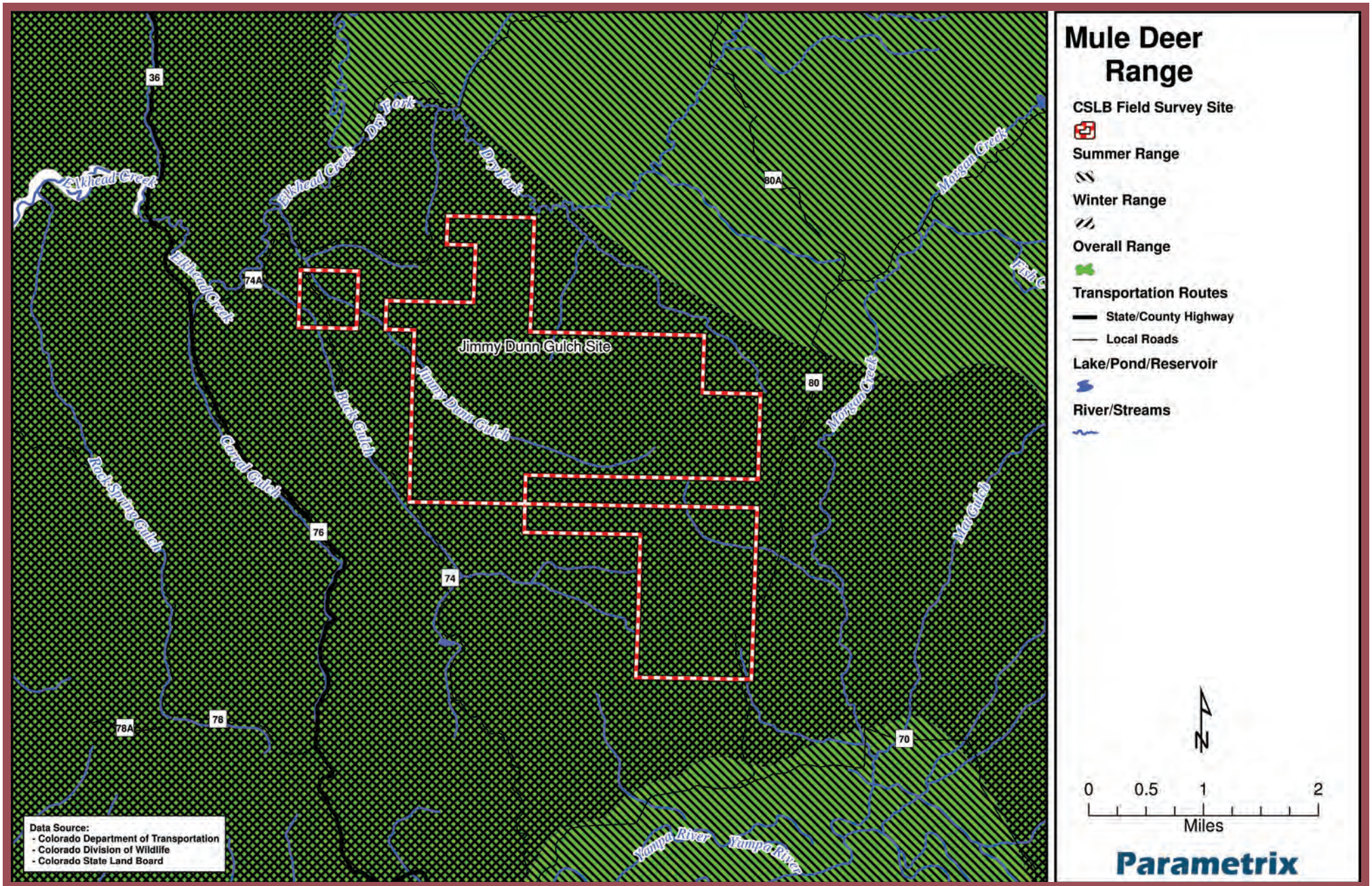
Miles
Parametrix


Mule Deer Range
CSLB Field Survey Site
Summer Range
Winter Range
Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Park
Morgan Creek
Rock Spring Gulch
Corral Gulch
Rock Gulch
Jimmy Dunn Gulch
Mud Gulch
Yampa River
36
74A
30A
80
76
74
78
78A
70
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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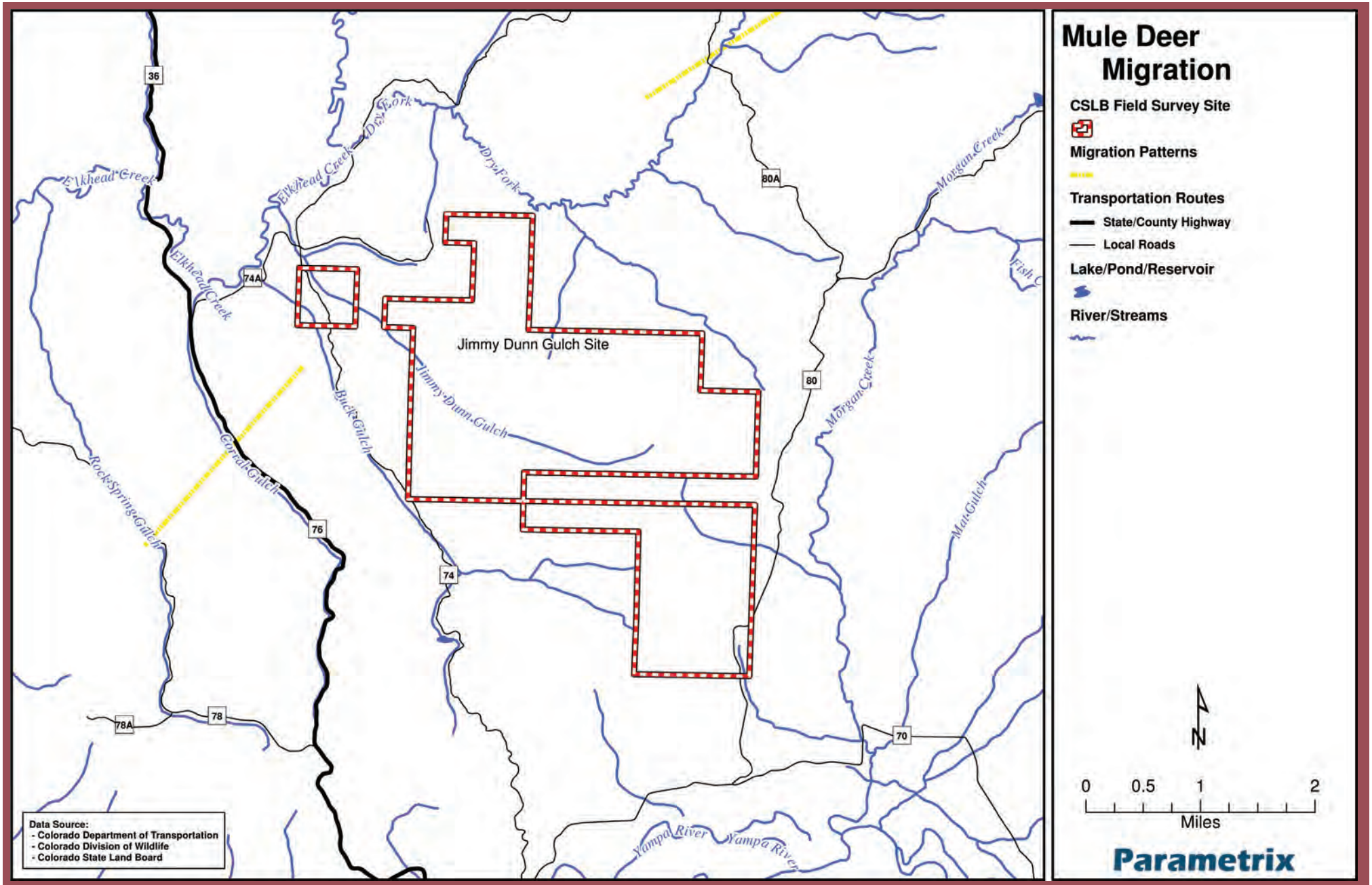
Miles
Parametrix


Mule Deer Migration
CSLB Field Survey Site
Migration Patterns
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Rock Spring Gulch
Gorah Gulch
Mat Gulch
Yampa River
36
74A
80A
80
76
74
78
78A
70
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
0
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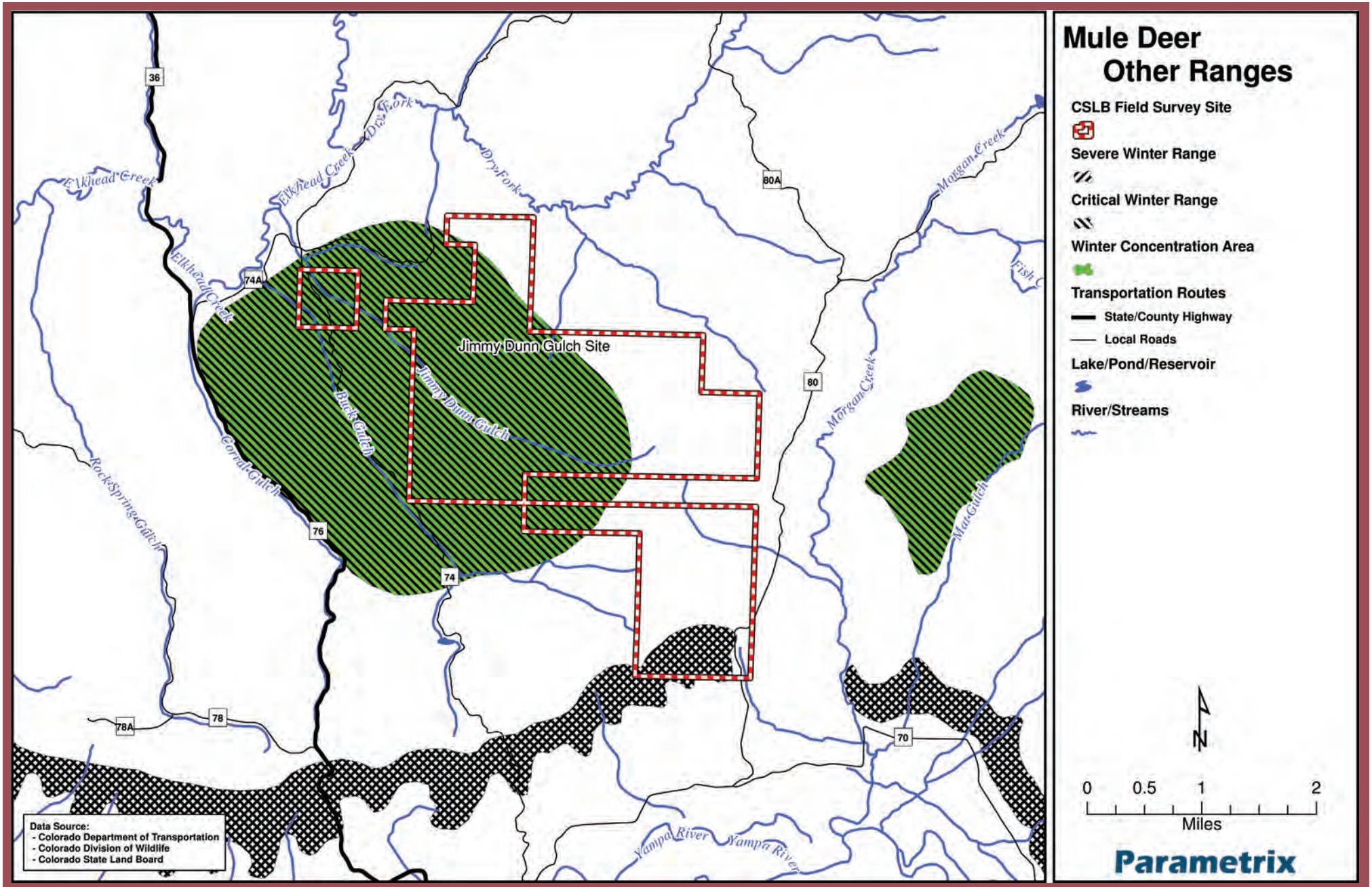
1
2
Miles
Parametrix


Mule Deer
Other Ranges
CSLB Field Survey Site
Severe Winter Range
Critical Winter Range
Winter Concentration Area
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Jimmy Dunn Gulch
Buck Gulch
Corral Gulch
Rock Spring Gulch
Elkhead Creek
Elkhead Creek
Dry Fork
Morgan Creek
Morgan Creek
Mat Gulch
Yampa River
Yampa River
36
74A
76
74
78
78A
80
80A
70
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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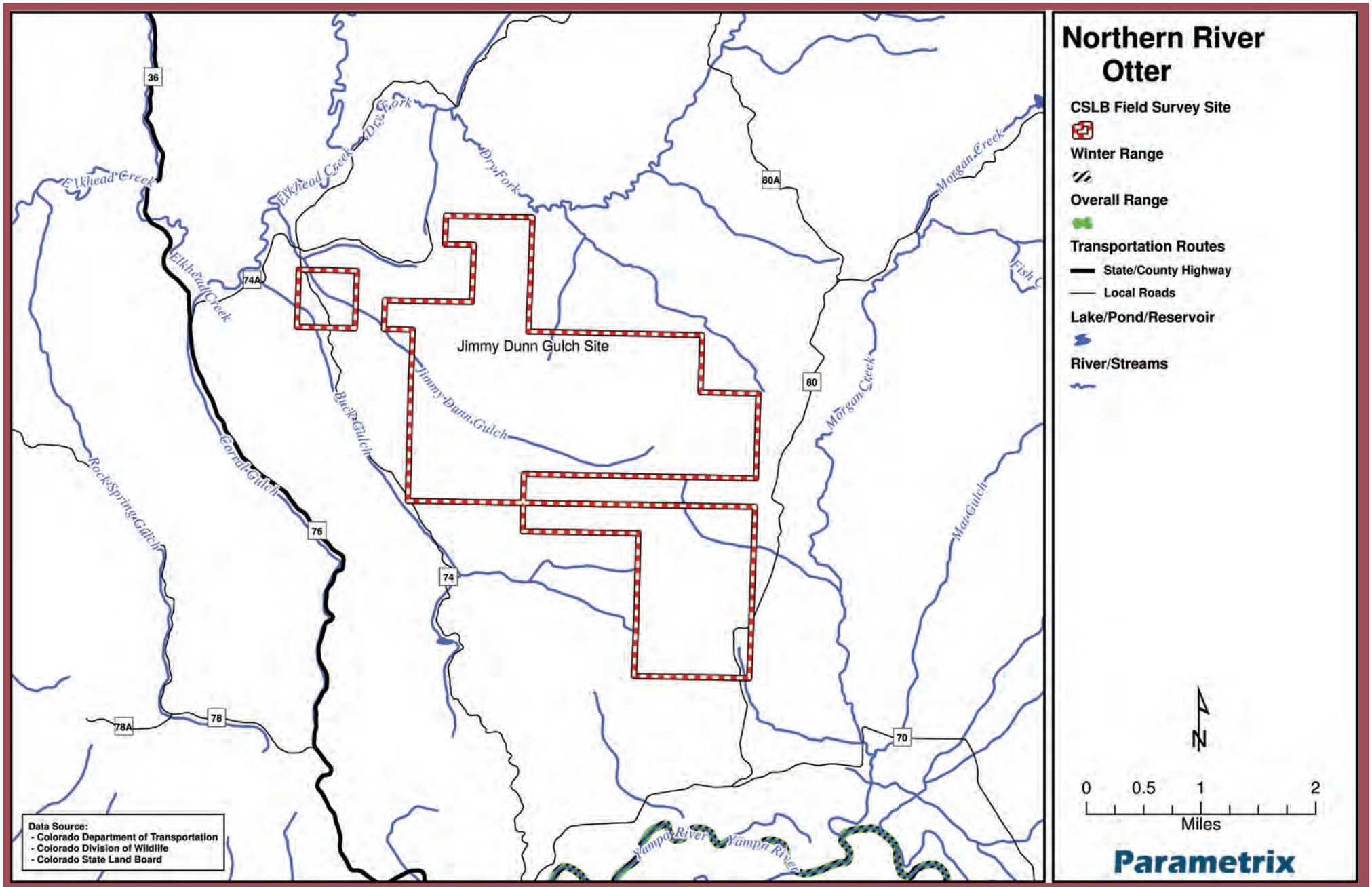
Miles
Parametrix


Northern River Otter
CSLB Field Survey Site
Winter Range
Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Jimmy Dunn Gulch
Buck Gulch
Rock Spring Gulch
Corral Gulch
Mar Gulch
Yampa River
36
74A
80A
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74
78A
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Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
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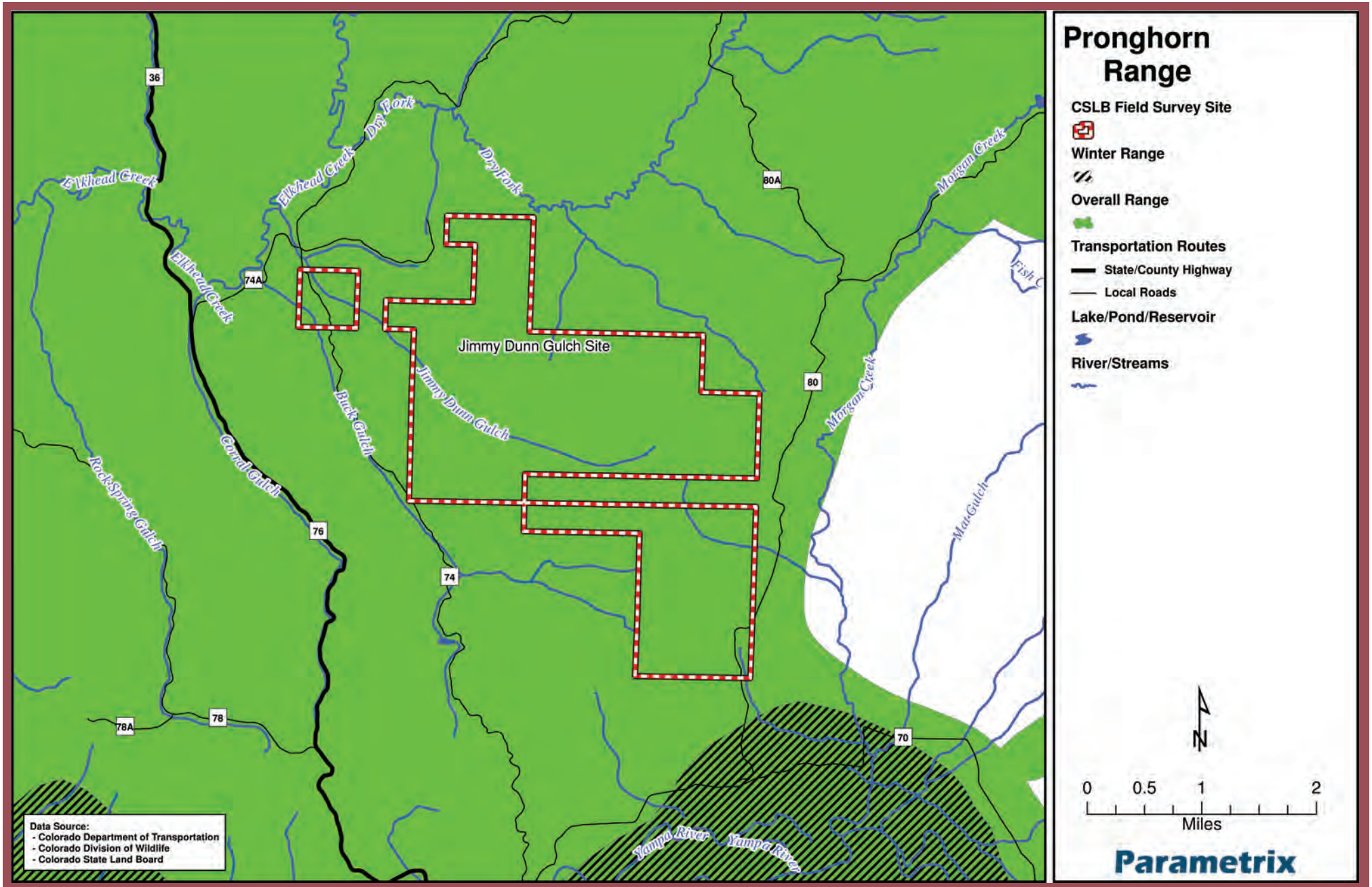
Miles
Parametrix


Pronghorn Range
CSLB Field Survey Site
Winter Range
Overall Range
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Coyral Gulch
Rock Spring Gulch
Mac Gulch
Yampa River
36
74A
80A
80
76
74
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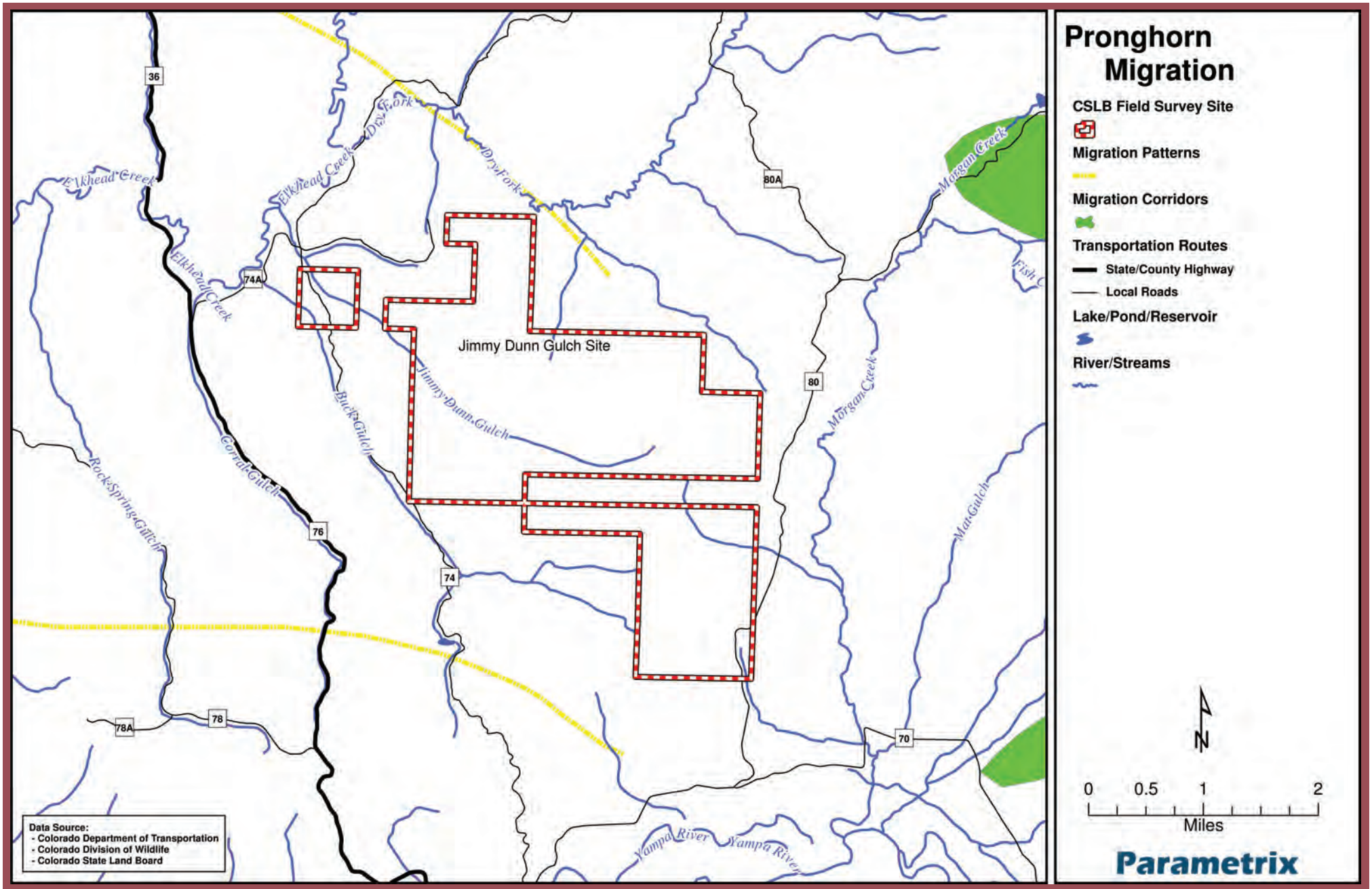
70
Data Source:
- Colorado Department of Transportation
- Colorado Division of Wildlife
- Colorado State Land Board
N
0 0.5 1 2
Miles
Parametrix


Pronghorn Migration
CSLB Field Survey Site
Migration Patterns
Migration Corridors
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Dry Fork
Morgan Creek
Buck Gulch
Jimmy Dunn Gulch
Corral Gulch
Rock Spring Gulch
Mar Gulch
Yampa River
36
74A
80A
80
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78A
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Data Source:
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- Colorado Division of Wildlife
- Colorado State Land Board
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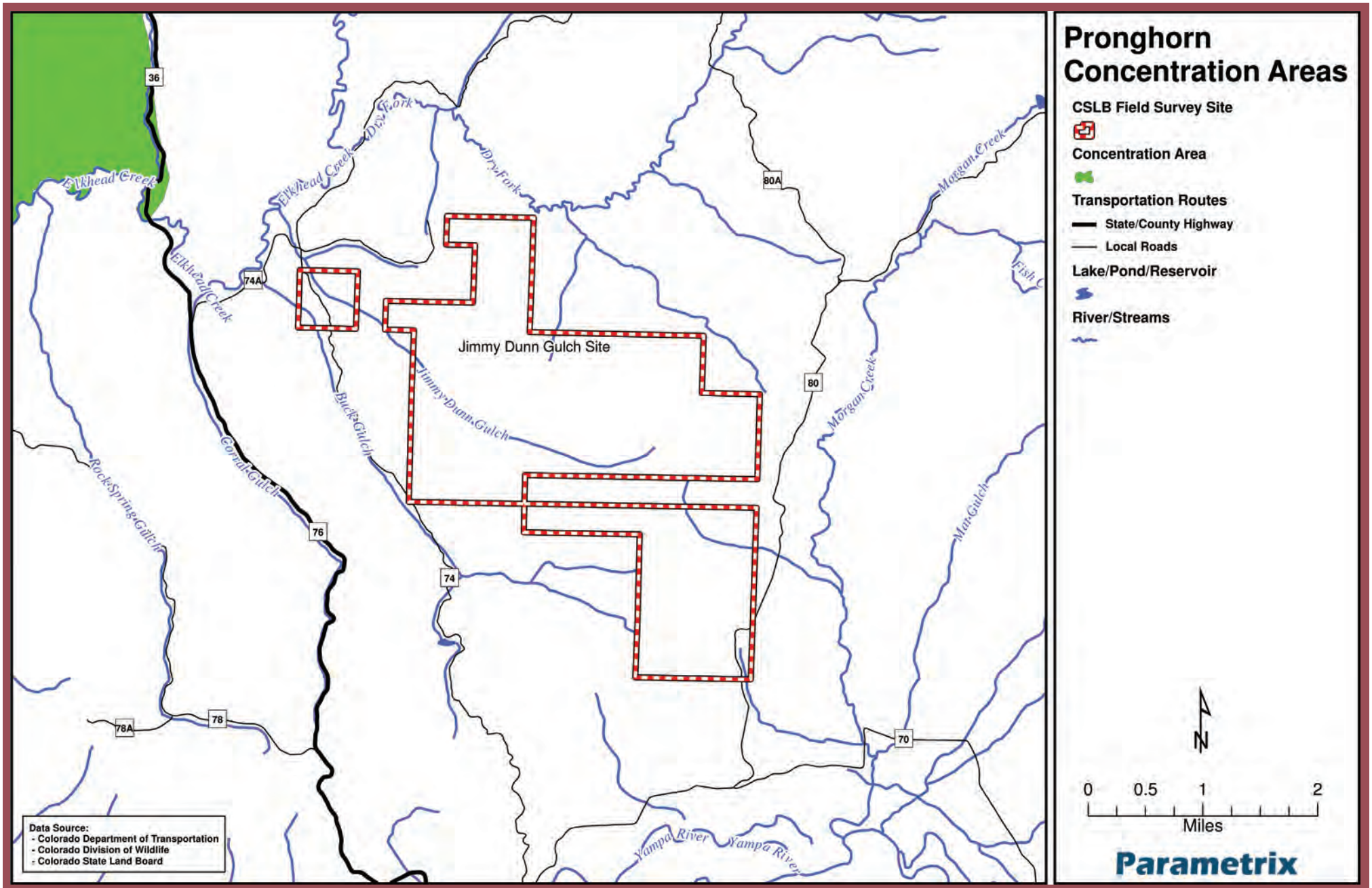
0 0.5 1 2
Miles
Parametrix


Pronghorn Concentration Areas
CSLB Field Survey Site
Concentration Area
Transportation Routes
State/County Highway
Local Roads
Lake/Pond/Reservoir
River/Streams
Jimmy Dunn Gulch Site
Elkhead Creek
Elkhead Creek
Dry Fork
Morgan Creek
Elkhead Creek
Jimmy Dunn Gulch
Buck Gulch
Morgan Creek
Rock Spring Gulch
Corral Gulch
Mar Gulch
Yampa River
Yampa River
36
74A
80A
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Data Source:
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- Colorado Division of Wildlife
- Colorado State Land Board

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