# 1. Introduction

This addendum report for Rocky Flats National Wildlife Refuge ("the Refuge") was prepared in conjunction with the Eastern Slope and Plains Wildlife Prioritization Study (ESPWPS), which identified regional priorities where targeted wildlife-highway mitigation could have the greatest impact in reducing wildlife-vehicle collisions (WVCs) and maintaining or restoring connectivity for wildlife. Two roadways administered by the Colorado Department of Transportation (CDOT) are alongside the Refuge: State Highway 93 (SH 93) west of the Refuge, and State Highway 128 (SH 128) along the northern side of the Refuge This report describes the prioritization results and wildlife mitigation recommendations for these two roadways. These findings highlight opportunities for reducing WVCs and vehicle-related wildlife mortality and enhancing wildlife connectivity into and out of the Refuge from the west and north. Indiana Street to the east and the roads in the bounding housing development to the south were not evaluated Users of this report should also reference the full ESPWPS report, which fully details the methods used to prioritize highway segments across the Eastern Slope and Plains and provides a decision-support framework for helping CDOT, Colorado Parks and Wildlife (CPW), U.S. Fish and Wildlife Service (USFWS), and other partners integrate wildlife-highway mitigation actions into upcoming transportation plans and projects or to create new, stand-alone projects based on these priorities. The decision-support framework developed for the ESPWPS also provides relevant and practical tools for advancing mitigation projects around the Refuge, including the following:

- Identification of the highest-priority highway segments where mitigation investments will bring the greatest benefits for wildlife and motorists
- Recommendation of preliminary wildlife-highway mitigation that may be used to inform initial project planning and budgeting
- Wildlife valuations and benefit-cost analysis tool for evaluating where wildlife-highway mitigation is most cost effective
- Implementation Considerations Matrix that compiles information about additional considerations that may influence the likelihood of mitigation on a given highway segment, including factors that affect the opportunity, urgency, and feasibility of a mitigation project
- Guidance for integrating mitigation priorities into CDOT planning and project development

This decision-support framework will help users in developing mitigation strategies and identifying potential funding sources.

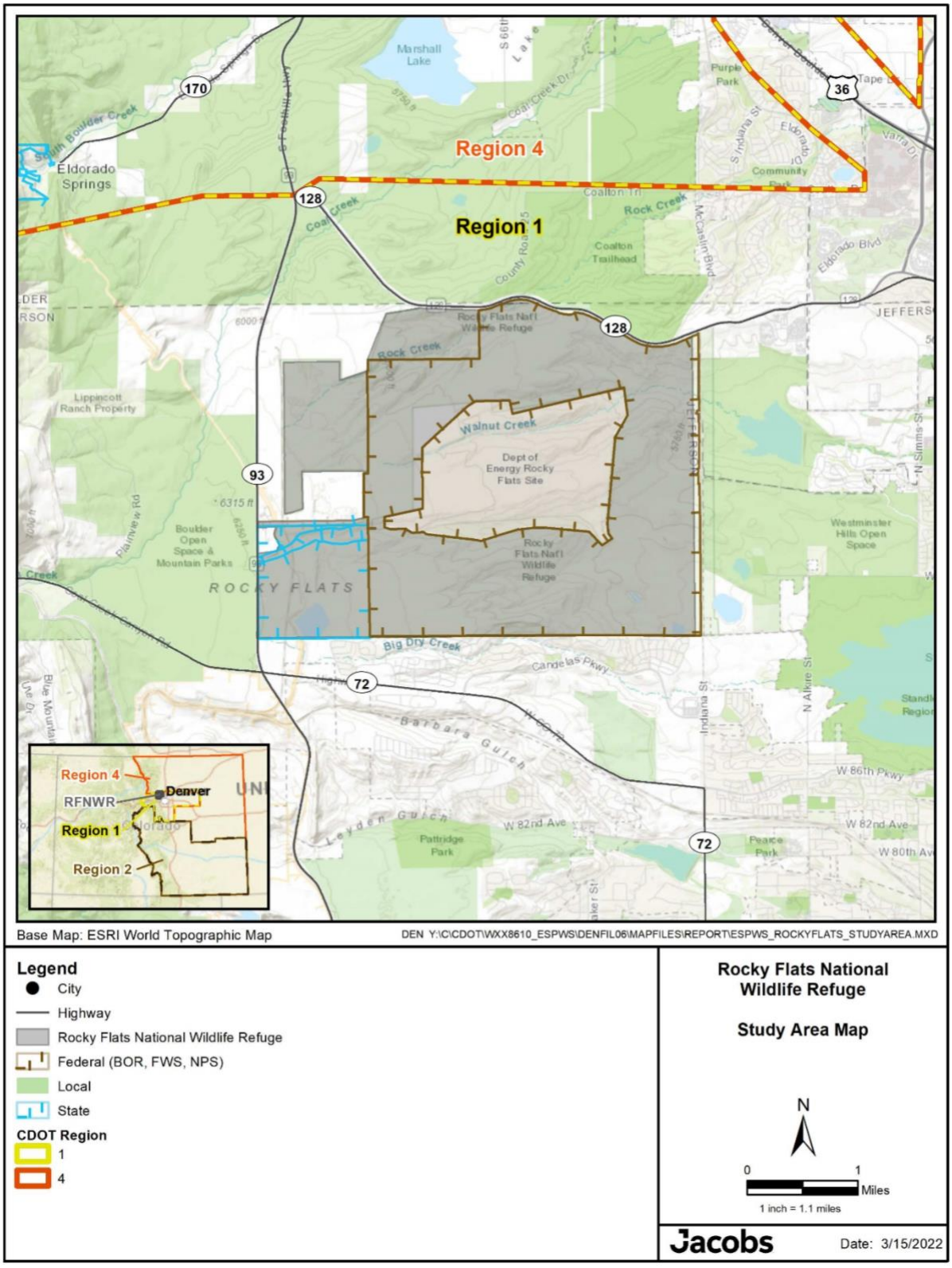
# 2. Study Area and Methods

## 2.1 Study Area

The study area centers on the Refuge. Because lands adjacent to the Refuge to the west and north are integral to wildlife movement into and out of the Refuge, these areas were also considered. Specifically, the focus of this report is the two CDOT-administered roadways that bound the western and northern sides of the Refuge, SH 93 from mileposts (MPs) 7.6 to 11.8 and SH 128 from MPs 0 to 4.2, both of which are within CDOT Region 1 (Figure 2-1). Although another CDOT-administered road lies south of the Refuge (State Highway 72 [SH 72]/Coal Creek Canyon Road), between the highway and the Refuge is a residential area that has been under development since 2014. For this reason, SH 72 was not considered for wildlife-highway mitigation. Indiana Street, which runs along the eastern side of the Refuge, was also not considered in this analysis because this road is not administered by CDOT. Although the lands east of Indiana Street are city and county open space lands, this area lies at the northwestern edge of the Denver metropolitan area and CPW is generally seeking to reduce wildlife activity and the potential for conflict in these suburban areas.

The Refuge is surrounded by a regional network of protected open space, including Boulder County Open Space, Jefferson County Open Space, State Land Board lands, and, east of Indiana Street, City and County of Broomfield and City of Westminster Open Space. Despite the preponderance of natural habitat and protected open space in this landscape, the two highways, as well as ongoing residential development to the south and a gravel mine and concrete company on private lands between the western side of the Refuge and east of SH 93 (from MPs 8.9 to 10.3), act as substantial barriers, inhibiting wildlife access to the Refuge.

Figure 2-1. Study Area Map



### 2.1.1 Wildlife Habitat and Movement Patterns

The Refuge is located within the High Plains ecoregion, at the base of the Front Range foothills. The Refuge is composed primarily of tallgrass and mixed grass prairie in a mosaic of grassland, wetland, and shrubland communities. This landscape provides important habitat for a variety of wildlife, including: migratory and resident herds of mule deer (*Odocoileus hemionus*); elk (*Cervus elaphus*) calving and summer range, with concentration and severe winter range habitat restricted to the western side of SH 93; white-tailed deer (*Odocoileus virginianus*) habitat concentrated along the riparian drainages; and black bear (*Ursus americanus*), mountain lion (*puma concolor*), and other meso-mammal and small mammal species (CPW 2015). Notably, the Rock Creek riparian corridor, which runs through the western and northern portions of the Refuge, has never been farmed or subject to human disturbance in modern history and supports an array of native plant communities and wildlife habitat (F. Tordonato, pers. comm. 2022).

For the past several years the USFWS and CPW have been collaring elk cows in the Refuge. While limited, these data validate several elk highway crossing areas by two herds on the Refuge, including a north/south movement corridor across SH 128, east of the National Renewable Energy Lab, and east/west movement corridors across SH 93 around the Woman Creek and Coal Creek drainages. Moose (*Alces alces*) have also been observed making highway crossings at the Woman Creek drainage (D. Lucas, pers. comm., 2022).

In addition, riparian areas throughout the Refuge are identified as occupied range for the federally threatened Preble's meadow jumping mouse (*Zapus hudsonius preblei*) and the Rock Creek, Walnut Creek, and Woman Creek riparian corridors are designated critical habitat. Trapping surveys conducted on the refuge have not detected Preble's meadow jumping mouse on the Refuge since 2003 on Walnut Creek and 2002 on Rock Creek. The USFWS is required to continue to manage for Preble's meadow jumping mouse habitat under the Endangered Species Act.

WVCs on SH 93 are highest for mule deer around MPs 10 to 11 and for elk around MP 9. On SH 128, WVC rates for deer and elk are highest around MPs 2 to 3.

### 2.1.2 Agency Interviews

Interviews with USFWS, CDOT, and CPW were originally conducted in 2016 as a part of the WestConnect Coalition Planning and Environmental Linkages Study (DEA 2017). Additional follow-up interviews were conducted with select agency personnel for this prioritization study (Table 2-1). During these interviews, the Refuge Manager noted that the need for connectivity across SH 93 was a primary reason behind the USFWS's acquisition of additional acreage along the western side of the Refuge.

**Table 2-1. Interviewees from USFWS, CDOT, and CPW**

| Name | Title | Affiliation | Communication Dates |
|---|---|---|---|
| David Lucas | Refuge Manager | U.S. Fish and Wildlife Service | 2016; follow-up interview 2022 |

| Name | Title | Affiliation | Communication Dates |
|---|---|---|---|
| Alison Michael | USFWS/CDOT Liaison | U.S. Fish and Wildlife Service | 2016 |
| Susan Spaulding | Senior Wildlife Biologist | Boulder County Open Space | 2017 |
| Francesca Tordonato | Region 1 Environmental Program Manager/Ecologist | Colorado Department of Transportation | 2016; follow-up interview 2022 |

### 2.1.3 Prioritization Methods

The ESPWPS study area was divided into two analysis areas to account for major differences in geography, ecosystems, target species, and movement patterns between the Eastern Slope portion of the study area and the Plains portion. The Refuge study area was included in the Eastern Slope analysis portion of the larger study area, which was defined as the portions of CDOT Regions 1, 2, and 4 west of and including Interstate 25. Target species used in the Eastern Slope analysis that are relevant to the Refuge include deer (combined mule deer and white-tailed deer) and elk. Pronghorn, bighorn sheep, and Canada lynx were also included as target species in the Eastern Slope analysis area, but these species are not relevant to the Refuge.

Prioritization criteria were developed to comprehensively represent wildlife movement needs of these target species, building on methods originally developed for the Western Slope Wildlife Prioritization Study (Kintsch et al. 2019). The combined prioritization criteria define the need for wildlife-highway mitigation for each 0.5-mile segment based on the safety hazard WVCs present to drivers and the wildlife need for cross-roadway movement during migration, or within seasonal summer and winter range home ranges. These criteria include the following:

- WVC risk models that estimate the probability of WVCs with deer and elk during migration and winter seasons under current and future land use and traffic volume scenarios
- The magnitude of deer and elk herd movements during spring and fall migrations or within winter ranges
- WVC mortality as a proportion of the population (i.e., a surrogate for the impacts of WVC mortality on population health)
- CDOT's wild animal accident pattern recognition analysis by road type

Values for each criterion were scaled between 0 and 1 and attributed to every 0.5-mile segment of CDOT-maintained highways across the analysis area. In addition, each criterion had an assigned priority score calculated using interagency committee–defined weights. Combined, these prioritization criteria were used to identify areas of greatest need for wildlife-highway mitigation for each 0.5-mile segment of CDOT-administered highways in the Eastern Slope and Plains.

Detailed analysis methods are documented in the full ESPWPS report.

# 3. Prioritization Results

None of the highway segments on SH 93 or SH 128 around the Refuge ranked in the 95th percentile at the regional level. However, because of the value of this landscape for wildlife and the interest of the USFWS in maintaining and restoring connectivity for wildlife across these roadways, these prioritization results were extracted from the overall study results to produce a focused, localized prioritization for the Refuge. The prioritization scores and rankings for these highway segments are presented in Table 3-1. Prioritization scores for these two highways around the Refuge ranged from 5.98 to 8.73. Within CDOT Region 1, these segments ranked from the 40th to 60th percentile.

**Table 3-1. Prioritization Scores and Rankings for SH 93 and SH 128 Highway Segments around Rocky Flats National Wildlife Refuge**

| Route | Mileposts | Priority Score | Refuge Percentile Rank | County |
|---|---|---|---|---|
| SH 93 | 8.9–9.3 | 8.73 | 100 | Jefferson |
| SH 93 | 8.3–8.9 | 8.71 | 96 | Jefferson |
| SH 93 | 7.6–7.9 | 8.53 | 86 | Jefferson |
| SH 93 | 9.3–9.7 | 8.51 | 82 | Jefferson |
| SH 93 | 7.9–8.3 | 8.48 | 79 | Jefferson |
| SH 93 | 10.5–10.9 | 8.45 | 75 | Jefferson and Boulder |
| SH 93 | 10.1–10.5 | 8.35 | 68 | Jefferson |
| SH 93 | 9.7–10.1 | 8.25 | 67 | Jefferson |
| SH 93 | 10.9–11.4 | 8.21 | 65 | Boulder |
| SH 93 | 11.4–11.8 | 7.82 | 63 | Boulder |
| SH 128 | 0.8–1.3 | 7.70 | 61 | Boulder |
| SH 128 | 0–0.4 | 7.65 | 59 | Boulder |
| SH 128 | 1.3–1.7 | 7.56 | 57 | Jefferson and Boulder |
| SH 128 | 2.1–2.6 | 7.53 | 55 | Jefferson |
| SH 128 | 1.7–2.1 | 7.37 | 53 | Jefferson |
| SH 128 | 0.4–0.8 | 7.29 | 50 | Boulder |
| SH 128 | 2.6–3.1 | 7.17 | 47 | Jefferson |
| SH 128 | 3.9–4.3 | 6.10 | 18 | Jefferson |
| SH 128 | 3.1–3.5 | 6.10 | 10 | Jefferson |
| SH 128 | 3.5–3.9 | 5.98 | 0 | Jefferson |

At the local scale, all the SH 93 highway segments ranked higher than the SH 128 segments. Highway segments on SH 93 scored between 7.8 and 8.7. In general, the southern portion of SH 93 ranked higher than the northern portion, with the highest-ranking segments from MPs 8.3 to 9.3. The highest-ranking

segments on SH 128 coincided with where the highway crosses over drainages, with the western portions of the segment generally scoring higher than the eastern portions.

The prioritization criteria with the greatest influence on the prioritization scores for these two highway segments included the risk of WVC for elk in winter range and during migration and the risk of WVC for deer during migration. The magnitude of elk and deer movements during migration had a moderate influence on the total prioritization scores. Preble's meadow jumping mouse was not a target species for the ESPWPS and, therefore, did not influence the prioritization results, underscoring the need for integrating local species into mitigation project planning.

## 3.1 Wildlife-Highway Mitigation Recommendations

Preliminary wildlife crossing mitigation recommendations were developed for all the portions of SH 93 and SH 128 around the Refuge to provide a comprehensive overview of mitigation opportunities adjacent to the Refuge. Mitigation recommendations are based on the findings of the field surveys and the latest research on the effectiveness of different mitigation strategies. Milepost locations for potential wildlife crossing structures or other recommended mitigation strategies are provided as a starting point for mitigation project planning and budgeting, although recommendations should be reviewed and revised as project development progresses. Ultimately, decisions regarding mitigation siting and design should take the following into consideration:

- Coordination of mitigation needs with the project limits (beginning and ending points) for other transportation projects
- Integration of mitigation with other aspects of a project
- Engineering feasibility
- Landowner support and land use compatibility
- Species-specific design considerations for deer and elk in addition to other species in the landscape with cross-roadway movement needs
- Spacing between crossing structures to provide sufficient passage opportunities
- Project cost

Potential locations for crossing structures are provided for each highway segment as preliminary guidance for project planning and budgeting. Exact structure locations, dimensions, and other design characteristics will need to be determined by CDOT during project development and design. Wildlife-exclusion fencing is always recommended in conjunction with wildlife crossing structures to guide animals to a structure. Escape ramps, deer guards, gates, and fence end treatments are integral components of a wildlife-highway mitigation system; however, specific recommendations for these types of features are not included because they are best addressed at the project level.

## 3.1.1 State Highway 93, Mileposts 7.6 to 11.8, West of the Refuge

### 3.1.1.1 Jefferson and Boulder Counties

**Figure 3-1. SH 93 around MP 8, looking North**

This segment of SH 93 between SH 72 and SH 128 runs to the west of the Refuge along the tablelands at the base of the Front Range foothills (Figure 3-2) and, at the northern portion of the segment, crosses the Coal Creek drainage. In addition to Coal Creek, the highway crosses over several smaller drainages and a canal. Table 3-2 summarizes the general roadway characteristics, target species movement patterns, and impacts of WVCs on these populations. WVCs on SH 93 are highest in the northern portions of the segment from MPs 9 to 11.8, but still average fewer than two reported crashes per mile per year. WVCs with elk are highest around MP 9. Barbed-wire right-of-way fence is present on either side of the roadway, and, on the western side, there is also a long stretch of snow fence.

Mitigation planning on this segment should also consider future roadway improvements and a proposed bike path on the eastern side of SH 93.

**Table 3-2. Segment Characteristics**

| Lanes | AADT (2020) | Future AADT (2041) | Target Species | Primary Movement Type | WVC Population Impacts |
|---|---|---|---|---|---|
| 2 | 16,000 | 18,640 | Elk, Mule Deer | Migration, winter, and year-round | Deer—Low<br>Elk—Low |

AADT = annual average daily traffic

#### 3.1.1.1.1 Preliminary Mitigation Recommendations

Preliminary wildlife mitigation recommendations on SH 93 build on the assessment and recommendations development that was previously conducted for the WestConnect Coalition Planning and Environmental Linkages Study (DEA 2017). Flat terrain and a low road grade make installing wildlife crossings for deer, elk, and other large fauna challenging in this segment. Nevertheless, there are several locations that warrant additional investigation with engineering staff to determine the best locations for wildlife crossings suitable for elk passage. Toward the north end of the segment, an existing culvert where the highway crosses the Coal Creek drainage offers a good opportunity for a larger wildlife crossing. Refer to Figure 3-3 and Table 3-3 for specific locations for potential wildlife crossing structures. Wildlife crossing structures should be combined with wildlife-exclusion fencing to guide wildlife to the structure locations and prevent at-grade crossings. Because of the presence of habitat for Preble's

meadow jumping mouse, mitigation efforts should also focus on restoring riparian and floodplain connectivity under the roadway.

**Table 3-3. Preliminary Mitigation Recommendations**

| Milepost | Existing Conditions | Mitigation Recommendation | Milepost Photo |
|---|---|---|---|
| 8.5 | Woman Creek is a small, ephemeral drainage. At this location there is a small pipe in low fill slope. This location is within the highest-ranking segment in the Refuge study area. | Evaluate this location for a low, wide bridge suitable for elk passage. Restore riparian corridor for Preble's meadow jumping mouse. Investments in a crossing structure in this area would also likely require a conservation easement east of the highway. |  |
| 9.2 | Walnut Creek irrigation canal. Culvert is skewed relative to roadway. This location is within the highest-ranking segment in the Refuge study area. | Install a small mammal bench and pipe through the culvert. |  |
| 9.4–9.8 | Flat terrain. Boulder County Open Space—western side; private—eastern side. | Evaluate this area for a wildlife overpass. Investments in a crossing structure in this area would also likely require a conservation easement east of the highway. | N/A |
| 10.9 | Coal Creek three-cell box culvert | Replace with a low, wide bridge to facilitate wildlife movement and accommodate high water flows. Restore riparian corridor for Preble's meadow jumping mouse. |  |

## 3.1.2 State Highway 128, Mileposts 0 to 4.2, North of the Refuge

### 3.1.2.1 Jefferson and Boulder Counties

SH 128 originates at the interchange with SH 93 and travels east, toward Broomfield. This two-lane roadway travels through rolling terrain and crosses multiple drainages. Table 3-4 summarizes the general roadway characteristics, target species movement patterns, and impacts of WVCs on these populations. WVCs on SH 128 are highest in the middle of the segment around MPs 2 to 3, but are still low, averaging less than one reported crash per mile per year. Barbed-wire right-of-way fence is present on either side of the roadway throughout the segment.

**Table 3-4. Segment Characteristics**

| Lanes | AADT (2020) | Future AADT (2041) | Target Species | Primary Movement Type | WVC Population Impacts |
|---|---|---|---|---|---|
| 2 | 9,900 | 13,058 | Mule Deer, Elk | Migration, winter, and year-round | Deer—Low<br>Elk—Low |

AADT = annual average daily traffic

#### 3.1.2.1.1 Preliminary Mitigation Recommendations

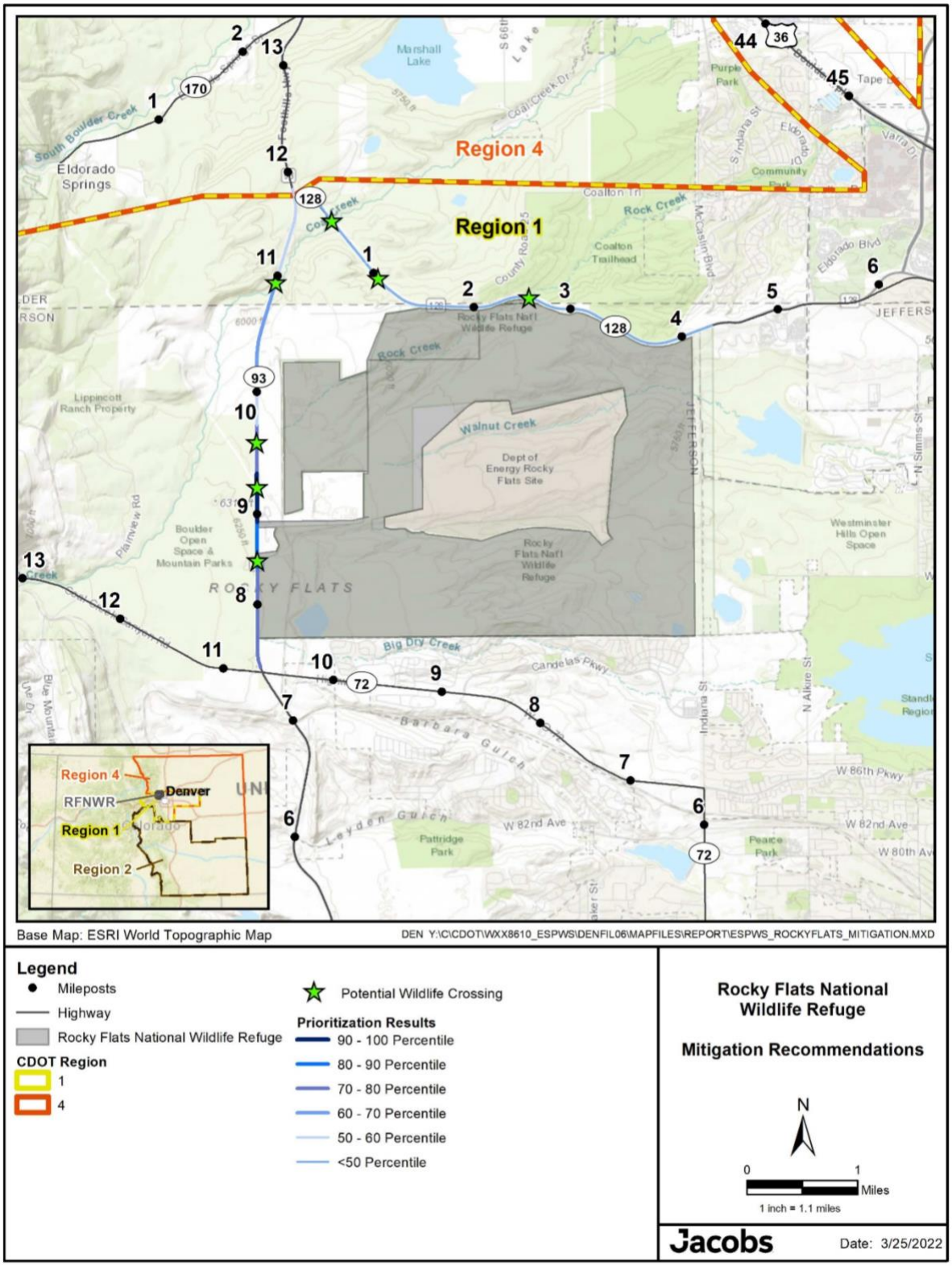
Rolling terrain through this segment and the presence of extensive protected lands on either side of the highway render this segment highly suitable for wildlife crossing mitigation. Refer to Figure 3-3 and Table 3-5 for specific locations for potential wildlife crossing structures. Increasing traffic volumes further indicate a need for wildlife crossings to maintain and restore connectivity as the highway barrier effect increases in the coming years. Wildlife crossing structures should be connected with wildlife-exclusion fencing through the segment to guide wildlife to the structure locations and prevent at-grade crossings. Because of the presence of habitat for Preble's meadow jumping mouse, mitigation efforts should also focus on restoring riparian connectivity under the roadway.

Pending the construction of wildlife crossings and wildlife-exclusion fencing in this segment, remove and, where needed, replace barbed-wire right-of-way fence with wildlife-permeable fence to prevent wildlife from becoming trapped inside the right-of-way and to reduce their exposure to potential WVCs.

**Table 3-5. Preliminary Mitigation Recommendations**

| Milepost | Existing Conditions | Mitigation Recommendation | Milepost Photo |
|---|---|---|---|
| 0.4 | Coal Creek three-cell box culvert. This location is within one of the highest-ranking segments in the Refuge study area. | Replace with a low, wide bridge to facilitate wildlife movement and accommodate high water flows. Restore riparian corridor for Preble's meadow jumping mouse. |  |
| 1.1 | Low fill slope at small drainage. This location is within one of the highest-ranking segments in the Refuge study area. | Potential location for a large or small/medium fauna crossing. |  |
| 2.5 | Large fill slope at Rock Creek drainage with small concrete box culvert. This culvert has been identified as a movement barrier to Preble's meadow jumping mouse across SH 128. | Install a large bridge underpass suitable for deer, elk, and other wildlife. Restore riparian corridor for Preble's meadow jumping mouse. |  |

Figure 3-2. Map of. Prioritization Results and Wildlife-Highway Mitigation Recommendations for SH 93 and SH 128 around the Rocky Flats National Wildlife Refuge



# 4. References

Colorado Parks and Wildlife (CPW). 2015. Google Earth (KMZ) Species Maps. Colorado Parks and Wildlife. https://cpw.state.co.us/learn/Pages/KMZ-Maps.aspx.

David Evans and Associates (DEA). 2017. *WestConnect Coalition Planning and Environmental Linkages Study. Final Environmental Scan Report*. Colorado Department of Transportation Region 1, Denver, Colorado.

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