Wildlife Resource Studies for Cache La Poudre Basin Study Extension

Prepared for

Colorado Water Resource and
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6.0 WILDLIFE RESOURCE STUDIES

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6.0 WILDLIFE RESOURCE STUDIES

6.1 INTRODUCTION

The wildlife resource studies focused on determining effects of the proposed project on game and non-game terrestrial resources and the vegetative and topographic features which comprise their habitat. The objectives of the study were to: (1) characterize wildlife use of the existing environment; (2) assess the potential effects of the proposed project on wildlife; (3) identify possible mitigation measures; and (4) prepare a preliminary estimate of the costs required to mitigate potential impacts. The Habitat Evaluation Procedure (HEP) (Schamberger and Farmer, 1978) was used to characterize the wildlife habitat and assess project effects. The HEP also provided a foundation for mitigation by quantifying the project effects and, therefore, defining the amount and type of mitigation needed. Application of HEP was supplemented by information from the literature, particularly for characterizing habitat for species of special concern identified in the project area by the state and federal wildlife agencies.

The wildlife resource studies comprised was Task 15 of the 1987-1988 Cache la Poudre Basin Study Extension funded by the Colorado Water Resources and Power Development Authority. Task 15 activities were organized in the following subtasks:

Subtask	Description
15a	Literature Review
15b	Cover Type Inventory
15c	Population Studies
15d	Habitat Evaluation
15e	Mitigation Planning
15f	Task Report

Included in Subtask 15e was a preliminary feasibility evaluation, whereby the mitigation costs and environmental sensitivity of the wildlife resources were evaluated in terms of their effect on preliminary project feasibility. This report contains a framework for determining these mitigation costs.

The wildlife resource studies were supported by botanical resource studies (Task 12 of the Basin Study Extension). Detailed methods and results of the botanical resource studies are documented in Section 3.0.

The 1987-88 wildlife resource studies were managed by John J. Brueggeman of Envirosphere Company, Bellevue, Washington, with assistance from M. Colleen McShane, A. David Every, and Ron W. Tressler also of Envirosphere. Eric Berg of Wildlife Management Consultants, Fort Collins, Colorado provided assistance in the field.

Acreage summaries and the color map of the cover types in the study area were produced by Northwest Cartography Inc. of Seattle, Washington. Assistance in gathering cover type field data and evaluating various HEP methods was provided by personnel from the U.S. Fish and Wildlife Service (FWS), Colorado Division of Wildlife (CDOW) and USDA Forest Service (FS). Additional field assistance was provided by the Northern Colorado Water Conservancy District (District) and the Colorado Water Resources and Power Development Authority (Authority).

6.2 STUDY AREA

The District is considering several potential damsites along the mainstem of the Cache la Poudre River. Based on preliminary engineering studies, the preferred damsites for providing a mainstem reservoir are the Grey Mountain 1, Grey Mountain 2, and Poudre sites (Figure 3.1). The Grey Mountain 1 site is located approximately 2.5 miles downstream from the confluence of the mainstem and the North Fork of the Cache la Poudre River. The resulting reservoir would extend approximately 7.5 miles up the mainstem to the town of Poudre Park and approximately 7.5 miles up the North Fork, including the area currently inundated by Seaman Reservoir. The normal maximum reservoir water surface elevation would be 5,630 ft above mean sea level (MSL) and the elevation at maximum flood level would be 5,640 ft MSL. The reservoir formed by dam construction at the Grey Mountain 1 site would inundate about 1,600 acres at normal maximum pool. The Grey Mountain 1 site is the mainstem dam site identified in the FERC preliminary permit granted to the District in September, 1985 (FERC Project No. 9290).

The Grey Mountain 2 damsite is located approximately one-half mile upstream from the Grey Mountain 1 site. This site is identified in the Cache la Poudre Basin Water and Hydropower Resources Study Report (Harza, 1987). Both the normal maximum reservoir water surface elevation and the water surface elevation at flood stage would be the same for a reservoir formed by a dam at the Grey Mountain 2 site as for a reservoir formed by constructing a dam at the Grey Mountain 1 site. In other words, the inundation area resulting from construction of a dam at the Grey Mountain 2 site would be entirely contained within the inundation area resulting from a dam at the Grey Mountain 1 site. Therefore, project effects on wildlife resources for Grey Mountain 1 would be larger than for Grey Mountain 2, representing an upper bound for the Grey Mountain alternatives. Consequently, wildlife studies were conducted for the Grey Mountain 1 alternative only, and all references to "Grey Mountain" in the documentation for wildlife resources studies refer to the Grey Mountain 1 project configuration.

The Poudre damsite alternative is located less than one-half mile downstream from the confluence of the mainstem and the North Fork near the junction of State Highway 14 and the road to Seaman Reservoir. The Poudre Reservoir would extend approximately 5.5 miles up the mainstem and 7.5 miles up the North Fork. The water surface elevations of the Poudre Reservoir at normal maximum and flood level would be the same as for the Grey Mountain alternatives. The Poudre Reservoir would inundate 1,350 acres at normal maximum pool which is 250 acres less than the Grey Mountain Reservoir 1 at normal maximum pool.

The boundary of the study area for the Grey Mountain and Poudre alternatives was defined in consultation with the FWS, FS, and CDOW personnel. The study area included the land potentially impacted by the mainstem Cache la Poudre reservoir, land that could be impacted by projects under future consideration (Glade Reservoir and Poudre Forebay), and a border area for potential mitigation (Figure 6.1). The project areas for the Grey Mountain and Poudre alternatives included the lands that would be inundated by the proposed reservoirs as well as a buffer zone that extends 40 ft in elevation above the maximum reservoir water surface elevation at flood stage (5,640 ft). The buffer zone was established to account for impacts resulting from construction activities such as clearing land, temporary buildings, construction, roads, etc.

The Grey Mountain project area covered approximately 2,400 acres of land between elevation 5,250 ft and elevation 5,680 ft along the mainstem and North Fork of the Cache la Poudre River. The Poudre project area covered approximately 2,000 acres of land between elevation 5,340 ft and elevation 5,680 ft along the mainstem and North Fork.

The study area outside the two project areas included over 37,000 acres. It ranged from an elevation of about 5,200 ft at Hook and Moore Glade to an elevation of approximately 7,500 ft at Grey Rock Mountain. The entire study area was in Larimer County, Colorado, and covered 39,489 acres. Approximately one-half of the area was within the Arapaho and Roosevelt National Forests.

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6.3 METHODS

6.3.1 Inventory of Threatened and Endangered Wildlife and Species of Special Interest

6.3.1.1 Literature Survey

Wildlife species of special interest were identified by the FWS, CDOW, and FS. The wildlife species of interest identified by agency consultation included prominent big game animals, raptors, and species particularly sensitive to development. In addition, wildlife species potentially using the study that are classified as federally threatened or endangered were identified by FWS. An inventory was conducted to describe use of the study area by these species and assess potential effects resulting from the proposed development. This inventory in combination with the HEP analyses provided a comprehensive summary of the wildlife and their habitats in the study area.

Data on wildlife species of special interest were derived from sources of available information and from field studies conducted in 1986 and 1987. Studies conducted prior to June 1987 were part of earlier efforts sponsored by the District (Berg, 1986). These studies plus the published and unpublished literature were primary sources of information. Scientific journals, reports, and field notes prepared by the CDOW, Colorado State University (Department of Fisheries and Wildlife), FS, and FWS were reviewed and summarized. This information was supplemented by computer searches of the Colorado Wildlife Resources Information Service and Scientific Collection databases for the project vicinity. In addition, regional biologists and resource managers from the local wildlife agencies and universities were consulted on specific topics. For several species, information from these sources was supplemented with data from field surveys.

6.3.1.2 Field Surveys

Field surveys were conducted for bald (Haliaeetus leucocephalus) and golden eagles (Aquila chrysaetos). The bald eagle is listed by the FWS as an endangered species in Colorado. These surveys were requested by the CDOW, FS, and FWS because of the sensitive status of these species in Colorado and throughout the United States.

Bald eagle surveys were conducted each week from late October 1986 to late March 1987. This period corresponded to the normal length of occupancy of bald eagles in Colorado. Survey effort was concentrated along the North Fork where bald eagles have been reported to congregate. Fewer surveys were conducted along the Poudre mainstem since bald eagle use of this area is limited because of its proximity to State Highway 14. The survey procedure involved one person searching the rivers and upland areas of the project area from a vehicle or on foot during the early morning or late evening. Data were collected on number, distribution, and potential roost sites.

Aerial surveys were conducted by helicopter on May 8, 1987 and May 25, 1988, to locate golden eagle and other raptor nests in the study area. Each survey involved about 1.5 hr of helicopter time. The survey routes were planned by the FWS and CDOW, with the purpose of locating all potential nesting habitat within and near the study area. Active golden eagle nests identified during the 1987 survey were later visited on foot to determine exact locations and elevations. Elevations were determined with a hand-held altimeter and locations were plotted on USGS topographic maps. Prey remains and fecal samples were collected from three nest sites for food habits analysis. The analysis was conducted by the Composition Analysis Laboratory at Colorado State University.

6.3.2 Habitat Evaluation

The FWS's Habitat Evaluation Procedure (HEP) was used to determine the net effect of the Grey Mountain and Poudre alternatives on wildlife and their habitat (FWS, 1980). This procedure was chosen through consultation with natural resource agencies because of the lack of existing information on the wide variety of wildlife inhabiting the study area and the impracticality of conducting wildlife population studies to develop a comprehensive database. The procedure's advantages are: (1) data are collected in a standardized manner that can be compared between various points in time to determine changes in conditions (i.e., pre-impoundment vs. with-impoundment); (2) it is a

habitat-based approach that is less affected by natural variability than population-based approaches; and (3) it was developed by FWS specifically for assessing wildlife impacts from siting reservoir and thermal power projects. The HEP has been applied to wildlife studies throughout the United States and results have been reported in a number of scientific journals (Urich and Graham, 1983; Rhodes, et al., 1983; Schamberger and Farmer, 1978) and technical reports (Brueggeman et al., 1986; 1988).

The HEP provides a measure of overall habitat quantity and quality for a given evaluation species under specified conditions (typically with and without the project or action being assessed). The final HEP comparisons are based on Habitat Units (HUs) which are the product of the surface area of the habitat under consideration and a habitat quality factor for the given evaluation species. The habitat quality factor is known as a Habitat Suitability Index (HSI) which ranges from 0.0 to 1.0. The HSI is calculated from a model that combines and weights the quality of various habitat components of the species in question. The overall process of determining the quantity and quality of habitat that would be affected by the project is as follows:

(1) First, the species habitat components are determined through consultation with agency personnel, specialists, and from literature accounts. Examples of habitat components are cover type, specific available vegetation, distance from cover, browse height, etc. Data on these habitat components are collected from field measurements, maps, aerial photographs, or literature.

(2) Second, for each habitat component, Suitability Curves are developed which reflect species' preferences for various values of the habitat component. Examples of curves for three mule deer habitat components are shown in Figure 6.2.

(3) Next, measured values for the habitat components are located on the x-axis of their respective curves to determine their Suitability Indices (SI) from the y-axis.

(4) The Suitability Indices of the various habitat components are weighted according to a model (determined during the consultation process) to develop a composite HSI value for the evaluation species in the given habitat type. The HSI (scaled between 0.0 and 1.0) is then multiplied by the surface area of a given habitat to determine HUs for that habitat type.

(5) HUs for all habitat types are summed for existing or without-project conditions and for with-project conditions.

(6) Lastly, HUs are averaged over the life of the project to account for potential changes in habitat quantity and quality due to succession, fire, and project construction or modifications. This process is described in detail in Section 6.3.2.7. The net average annual impact of the project is determined by comparing Average Annual Habitat Units (AAHUs) for with- and without-project conditions. For the Cache la Poudre Project, AAHUs were compared between with- and without-project conditions for both the Grey Mountain and Poudre alternatives to determine the net effect of both alternatives on the wildlife habitat. Consequently, application of the HEP to the Cache la Poudre Project provided a numeric measure of habitat lost or gained for selected wildlife resulting from the proposed Grey Mountain and Poudre project alternatives.

The series of steps involved in applying the HEP to this study are presented in the following subsections as listed below:

- o Selection of an evaluation team;
- o Inventory of vegetation cover types or habitats;
- o Selection of evaluation species;

- o Identification of life requisites for evaluation species;
- o Field measurements of habitat parameters;
- o Assignment of HSIs and calculation of HUs;
- o Selection of target years and calculation of AAHUs

6.3.2.1 Selection of Evaluation Team

The application of the HEP requires the formation of an evaluation team comprised of representatives from the federal and state resource agencies and the project sponsor. The responsibility of the team is to mutually define the approach for completing each step of the HEP. This team concept ensures input by the agencies into the design and execution of the study. Moreover, it minimizes future conflicts between the agencies and project sponsor about the outcome of a study, since their representatives are key participants in the study. Consequently, the study culminates in a product that is acceptable to the project proponent and the resource agencies.

For the Cache la Poudre Project, letters were sent to the FWS, CDOW, and the FS inviting participation in the HEP study. All of these agencies agreed to participate. Representatives from the participating agencies along with those from the District and Envirosphere Company that comprised the team included:

Karl Dreher - Northern Colorado Water Conservancy District
Ann Hodgson - Colorado Division of Wildlife
Ronell Finely/Bill Noonan - U.S. Fish and Wildlife Service
Steve Mighton/Dennis Lowry - U.S. Forest Service
Jay Brueggeman, Colleen McShane, and Dave Every - Envirosphere Company

Meetings were held throughout the study period to define each step in the HEP. The decisions reached at each meeting were documented in formal letters prepared by Envirosphere and sent to the team members. Meeting minutes were reviewed by each participant and revised to

reflect their comments. Each member then signed the letter before Envirosphere executed the decisions. This procedure confirmed that decisions reached at a meeting were acceptable to the respective agencies. Letters documenting team members agreement as representatives of their agencies on decisions followed in the application of the HEP to the Cache la Poudre Project are provided in Appendix C.

6.3.2.2 Vegetation Cover Type Inventory

The cover type inventory is an integral step in the HEP since it defines and quantifies types of wildlife habitat. Wildlife habitat is defined as a distinct combination of vegetation and physical factors that provide one or more life requisites for wildlife species. Vegetation cover types are commonly used to represent the habitat types because many of the physical features of wildlife habitats are related to cover.

The purposes of the cover type inventory for the Cache la Poudre Project were to classify, map, quantify, and describe the cover types in the study area in order to evaluate the net effects of the proposed project alternatives on wildlife habitat. The following steps were used to inventory the cover types: (1) select a cover type classification system, (2) map cover types, (3) calculate cover type areas and produce a cover type map, and (4) describe the cover types. A detailed description of each step of the cover type inventory is provided below.

Cover Type Classification System Selection

The cover type classification system for the Cache la Poudre study was selected by the HEP team. The classification for the upland cover types was based on the classification of vegetation series used in the Roosevelt National Forest Plan (FS, 1984). The system described by Cowardin et al. (1979) was used to classify wetland cover types. The organization of the hierarchical classification system was patterned after Anderson et al. (1976). Sixteen cover types were identified in the study area (Table 6.1).

TABLE 6.1

Cover Types of the Cache La Poudre Study Area

Closed Canopy Conifer Forest
Open Canopy Conifer Forest
Pinyon Pine Forest
Mountain Shrub
Grassland
Rock/Talus
Agriculture
Developed
Disturbed
Riparian Forest
Riparian Shrub
Riparian Grassland
Palustrine Marsh/Meadow
Palustrine Pond
Lacustrine
Riverine

Cover Type Mapping

Cover types were classified and delineated on aerial photographs of the study area. The steps followed in this process were:

Aerial Photograph Selection

The most recent aerial photographs of the study area were taken on October 4, 1986 by the District. These photographs were black and white stereo pairs scaled at 1:12,000. All cover typing was done on mylar overlays using the 1986 aerial photographs. Supplemental information was provided by color infrared aerial photographs from the FS. These photographs were taken in September 1984 at 1:24,000 scale and were used primarily to identify riparian and wetland cover types. Other sets of aerial photographs available from state and federal agencies were reviewed but were not suitable for cover typing due to the age, scale, or quality of the photography.

Photo Interpretation

Aerial photographs were acquired in stereo pairs so that a three dimensional view obtained with a mirror stereoscope could be used for more accurate interpretation. One set of aerial photographs covering the study area was overlaid with mylar drafting film. The study area boundaries, as determined by the HEP team, were marked on the mylar overlays, and the outline of each cover patch or polygon was delineated. A symbol, specific to each cover type, was marked on the mylar within each polygon. The minimum mapping unit agreed on by the HEP team was one acre for riparian and wetland types and five acres for upland types.

Two photo interpretation aids were developed to enhance the accuracy and consistency of the results. The primary aid was a systematic key that defined the photo characteristic of each cover type (Table 6.2). The key was developed by using the aerial photos to define the range of photo characteristics of a particular cover type. The quantitative definitions (i.e., percent tree cover, percent shrub

TABLE 6.2

Key to the Cover Types of the
Cache La Poudre Project

Step		Proceed to Step:	Cover Type
1.a.	Land	2	
1.b.	Permanent water	13	
2.a.	Lands where man's disturbance dominates	3	
2.b.	Lands where "natural character" prevails	5	
3.a.	Lands where vegetative cover is essentially removed or activity essentially precludes wildlife use (mines, quarries, dams, highways)		Disturbed
3.b.	Developed areas with enough vegetative cover to provide habitat value (greater than 20 percent)	4	
4.a.	Residential/commercial areas		Developed
4.b.	Cropland or improved pasture		Agriculture
5.a.	Non-vegetated areas (cover less than 10 percent trees, less than 20 percent shrubs, less than 30 percent herbs)		Rock/Talus
5.b.	Vegetated areas	6	
6.a.	Uplands (not including wetlands or riparian areas)	7	
6.b.	Lands along streams or with saturated soils at least part of the year and with vegetation clearly responding to higher water availability (i.e., wetlands and riparian areas)	10	
7.a.	Forested areas (greater than or equal to 10 percent tree cover)	8	
7.b.	Non-forested areas (less than 10 percent tree cover)	9	
8.a.	Open forest on low foothills where pinyon pines dominate		Pinyon Pine Forest
8.b.	Open canopy forest usually dominated by ponderosa pine (10 to 60 percent tree cover) usually with shrub understory		Open Conifer Forest

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TABLE 6.2 (Continued)

Key to the Cover Types of the
Cache La Poudre Project

Step		Proceed to Step:	Cover Type
8.c.	Closed canopy conifer forest, dominated by ponderosa pine or Douglas fir (greater than 60 percent canopy closure)		Closed Canopy Conifer Forest
9.a.	Shrub cover greater than or equal to 20 percent . . .		Mountain Shrub
9.b.	Grass dominated (less than 20 percent shrubs)		Grassland
10.a.	Lands supporting hydrophytic vegetation, with saturated soils a majority of the growing season (wetlands - Palustrine)	11	
10.b.	Lands along water courses, usually within the floodplain, with vegetation responding to higher water availability at least part of the year (Riparian)	12	
11.a.	Wetlands with greater than 50 percent shallow open water at least part of the growing season (often impounded)		Palustrine Ponds
11.b.	Wetlands dominated by persistent emergent vegetation, with less than 50 percent open water		Palustrine Marsh/Meadow
12.a.	Greater than 10 percent tree cover (either deciduous or conifer)		Riparian Forest
12.b.	Without trees, dominated by shrubs (greater than 20 percent shrub cover)		Riparian Shrubland
12.c.	Without trees and with less than 20 percent shrub cover		Riparian Grassland

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TABLE 6.2 (Continued)

Key to the Cover Types of the
Cache La Poudre Project

Step	Proceed to Step:	Cover Type
13.a. Streams (including gravel bars and flood scour zones)		Riverine
13.b. Lakes or reservoirs		Lacustrine
13.c. Ponds (less than 20 acres and less than 2 meters deep)	See 11a	

cover) of each cover type in the key were developed from the literature. During development of the key, ground verification was conducted to confirm the quantitative definition and specific photo characteristics associated with each cover type. As an additional aid, grid patterns (transparencies with rectangular grids of varying density) were used to estimate the proportion of tree or shrub cover as defined in the photo interpretation key. The key and grid facilitated the ability of the photo interpreter to consistently identify each cover type patch or polygon and delineate its boundaries. For purposes of this report, a cover type patch is defined as a polygon.

Verification of Cover Typing

The initial photo interpretation of cover types was done by one photo interpreter and then checked by a second photo interpreter. The typing was also reviewed by the HEP team. Mapping for the entire study area was verified by a combination of low altitude overflights and on-the-ground checking during the 1987 spring and summer field sampling.

Data Transfer to Orthophoto Maps

Complete orthophoto coverage (1:24,000 scale) of the study area was obtained from the U.S. Geological Survey. The information mapped on aerial photos was transferred to overlays on the orthophotos to correct for angular distortion inherent in aerial photos. This procedure provided an accurate data base for determining the area of each cover type and producing a map.

Map Production and Acreage Calculation

The HEP team decided that a Geographic Information System (GIS) should be used to map and calculate the area of each cover type. A GIS is a computer database management system with the capabilities of resource mapping, accounting, and analysis. The following four steps were required:

Digitizing

The GIS used for this project was an arc-based topological system that stored line data as a series of arcs (line segments). Entering data from a map into the GIS requires digitizing, a mechanical process that involves tracing a line with a computer "mouse". The line is broken into a series of segments or arcs that are then stored in the GIS. Using the mylar data sheets from the orthophoto quadrangle maps the polygon boundaries were digitized. Each polygon in the study area was assigned a unique identifying number that associated it with a specific quadrangle map. The symbol identifying the cover type of each polygon was plotted by the GIS on a map and associated with the polygon number in the digital database. The digital database provided a complete record of the area and cover type of each polygon. These data provided the basis for the HEP.

Map Registration and Checking

The data from separately digitized mylars were linked by the GIS into a single project-wide data set that could be presented at a variety of map scales. This was accomplished by digitizing a master control grid from the USGS 1:24,000 quadrangle orthographic maps. The control grid consisted of section corners and other identifiable land features. A set of working maps or edit plots (line maps with symbols) at 1:24,000 scale was produced for both pre-impoundment and the projected post-impoundment conditions showing the habitat symbol associated with each polygon. The maps were then checked against the original photo-interpreted data to confirm that each polygon had the proper cover type.

Area Calculations

A computer software program was run with the GIS to calculate the area of each polygon and produce summary statistics for pre-impoundment and post-impoundment periods. The data were reported by cover type.

Map Production

The final habitat map was photographically produced using the USGS 1:24,000 quadrangle maps as the base map. Edit plots, registered to the quadrangle maps, were produced by the GIS at 1:25,000 scale for the final map. This scale was chosen so that the final map would be a manageable size. The computerized data were then used to generate the color separation negatives needed to produce a color map.

6.3.2.3 Selection of Evaluation Species

Seven species were selected by the HEP team for evaluation in the Cache la Poudre study area: four bird and three mammal species. These species represented both aquatic and terrestrial animals associated with the range of forested and non-forested habitats in the study area. The species selected were:

- Song Sparrow
- Western Meadowlark
- Black-capped Chickadee
- Great Blue Heron
- Abert Squirrel
- Mule Deer
- Beaver

These species were selected using the following systematic process developed by the HEP team: (1) compile a comprehensive list of species in the study area; (2) rate each species in the study area using five selection criteria; (3) evaluate the capability of the top-ranked species to fulfill the objectives of the HEP; and (4) select the final seven evaluation species. This decision-making process combined technical data with the knowledge of the HEP team to formulate a list of species that best reflected the potential impacts of the proposed project on wildlife.

A list of 328 species of wildlife was compiled for the study area (Appendix Tables D.2 and D.3). The composition included 223 species of birds, 78 species of mammals, and 27 species of amphibians and reptiles. Each species was associated with one or more cover types in the study area and a life form. A life form is a term for grouping species having similar feeding and reproductive habitat requirements

(Thomas et al., 1979). Associating species with cover types was necessary to assess wildlife impacts from habitat changes potentially caused by the project. Associating species with life forms was needed to evaluate impacts on groups of species with similar habitat requirements or guilds. This stage in the species selection process permitted the HEP team to examine which species and species guilds would best reflect changes in the study area habitats.

The second stage in the selection process involved ranking the wildlife species found in the study area according to the following five criteria: (1) seasonality; (2) abundance; (3) availability of information; (4) status of HEP model; and (5) versatility (Appendix Table D.2). Information for these criteria was obtained from the sources used to compile the species list. Seasonality was evaluated in order to rate species use of the study area. Use was rated high for species that were annual residents, moderate for winter or summer residents, and low for migrants. Annual residents were rated highest because all of their life requisites are completed in the study area. Conversely, migrants were rated low because only a part of their life requisites are obtained in the study area and impacts from the project may be less severe than for residents. For example, the Abert Squirrel was rated high because it is an annual resident and project impacts could affect feeding, cover, and breeding habitat.

Abundance was used to judge a species prominence in the study area. Prominence was rated according to four categories: abundant, common, uncommon, and rare. Abundant species received the highest rating since they were considered to be the most successful in the study area. Rare species were considered to be least successful and project impacts on regional populations of rare species would be lower than species more suited to the habitats in the study area. For example, the Black-capped Chickadee was rated abundant in the study area because suitable habitat was available, whereas elk were considered rare because the habitat was not particularly suitable for

them. Species that were federally listed as threatened or endangered were excluded from this evaluation and treated separately by the HEP team.

Availability of information for species in the study area was used to identify the state-of-knowledge. This criterion was rated high if site-specific information was available for a species, low if information had been collected near the study area, and zero if no or only general information was available. This criterion was considered important because there had to be sufficient information available about a species in order to assess the impacts of the project on it. The assessment would be most accurate for species where site-specific data were available and least accurate for species where there was little or no data. For instance, deer were rated high because site-specific information was available, whereas the river otter was rated low because there was very little information on this species.

Species occurring in the study area were also rated according to the availability and status of a HEP model. A species was rated high if a final model was available, moderate if the model was a draft, low if the model was preliminary, and zero if there was no model. This criterion was included because the HEP for this study was designed to incorporate existing models rather than develop new models. Furthermore, confidence in the results would be highest for species with final models, since they have been reviewed by the FWS.

Lastly, species were rated according to their versatility. Versatility was based on the number of plant communities and successional stages used by a species for breeding and feeding. Single cover type species were considered to be specialists in their habitat use patterns. These species would be less likely to adjust to a loss of habitat and more likely to respond to a gain in habitat. Conversely, multi-cover species were considered to be generalists in their habitat use patterns. These species would be less responsive to habitat changes and more adaptable. Consequently, specialist species

like the Abert Squirrel would be more directly affected by changes in ponderosa pine forest characteristics than generalists species like the Black-capped Chickadee.

The numeric values assigned for each evaluation criterion were summed to derive a single value for each species. The HEP team evaluated the capability of the top-ranked species in each life form to fulfill the objectives of the HEP. These objectives were to select a set of species that represented: (1) birds, mammals, and reptiles or amphibians; (2) different guilds present in the study area; (3) primarily specialists but also several generalists to reflect juxtaposition of habitats; (4) major feeding strategies (carnivore, herbivore, insectivore); (5) all prominent or sensitive habitats in the study area; and 6) changes in habitat from without-impoundment to with-impoundment conditions. The seven evaluation species selected by the HEP team that most closely met the study objectives are described below:

Song Sparrow

The Song Sparrow (Melospiza melodia) is a specialist that reproduces and feeds in areas of low, dense shrub cover adjacent to streams, ponds, and marshes (Verner and Boss, 1980). The Song Sparrow represents a guild of species that requires dense shrubs near water to meet their life requisites. The red-wing blackbird (Agelaius phoeniceus), MacGillivray's warbler (Oporornis tolmiei), and yellow warbler (Dendroica petechia) represent this guild. Changes in the quantity and structure of riparian habitat in the study area would be reflected by the Song Sparrow.

Western Meadowlark

The Western Meadowlark (Sturnella neglecta) is a specialist that breeds and feeds in open grasslands and pastures. This species requires relatively low, dense grass cover with an abundance of perch sites (tall forbs, fences, trees, etc.) (Verner and Boss, 1980). The Western Meadowlark represents the guild of species that primarily use grasslands to meet their life requisites and includes the savannah

sparrow (Passerculus sandwichensis) and horned lark (Eremophila alpestris). Changes in the quantity and quality of grasslands and pasture in the study area would be reflected by the Western Meadowlark.

Abert Squirrel

The Abert Squirrel (Sciurus aberti) is a specialist that reproduces and feeds primarily in ponderosa pine forests. This species feeds almost entirely on the seeds, inner bark of twigs, terminal buds, and staminate flowers of ponderosa pine trees (Patton, 1975). Nesting occurs in stands of uneven aged ponderosa pine trees with interlocking crowns (Patton, 1975). This species was selected to reflect changes in the quantity and quality of the ponderosa pine forest in the study area.

Great Blue Heron

The Great Blue Heron (Ardea herodias) is a generalist that feeds primarily on aquatic prey and nests in a variety of open forest habitats. This species will feed on a variety of prey but prefers fish (Short and Cooper, 1985). Wetlands and sloughs are the most common foraging areas but riverbanks, riprapped banks, mudflats, and rivers are also used. Forested areas near water are preferred nesting sites for this species (Short and Cooper, 1985). The Great Blue Heron was selected to reflect the changes in habitat resulting from conversion of a river to a reservoir.

Black-capped Chickadee

The Black-capped Chickadee (Parus atricapillus) is a generalist that forages from the ground to the tops of trees and reproduces in small snags in a variety of forest habitats (Schroeder, 1983). The Black-capped Chickadee represents a group of species, including the brown creeper (Certhia americana) and mountain chickadee (Parus gambeli), that use relatively small cavities for nesting and a wide variety of habitats for feeding. Changes in the quantity and quality of forested areas will be reflected by the Black-capped Chickadee.

Mule Deer

Mule Deer (Odocoileus hemionus hemionus) are the most common large game species in the study area. The study area provides winter habitat for this species although a portion of the herd uses the area year around (Loveless, 1967). Deer are generalists and utilize a variety of forest and shrub habitats for food and cover. Deer will reflect changes in quantity, juxtaposition, and quality of these habitats in the study area.

Beaver

The Beaver (Castor canadensis), a highly specialized aquatic fur-bearer, feeds primarily on herbaceous vegetation near or in water. The beaver requires a permanent water supply and trees and shrubs of a diameter suitable for use as food and cover (Allen, 1983). The response of this species to habitat changes will be similar to the American dipper (Cinclus mexicanus) and other aquatic fur-bearers including the river otter (Lutra canadensis) and muskrat (Ondatra zibethica). Originally, the American dipper was included as an evaluation species. However, the HEP team later decided to eliminate the dipper from the analysis because loss of riverine habitat will be represented by the Beaver and by the aquatic and in-stream flow studies that have been conducted in the study area. Consequently, changes in the quantity and quality of riverine, riparian, and palustrine habitats in the study area will be reflected by the Beaver.

6.3.2.4 Identification of Life Requisites for Evaluation Species

Life requisites selected by the HEP team for the seven evaluation species are presented in Table 6.3. Life requisites represent critical elements of habitats that are required by a species to complete its life cycle and survive. These elements are broadly defined as water, food, escape cover, thermal cover, and reproductive cover. The quantity and quality of these elements determine the capacity of an area to support wildlife. Typically, the life requisite in lowest abundance or quality limits the growth of a population.

TABLE 6.3

Life Requisites for the Wildlife Evaluation Species
for the Cache la Poudre Project

Species	Cover Types										
Common Name	Closed Canopy Conifer Forest	Open Canopy Conifer Forest	Pinyon Pine	Mountain Shrub	Rock/ Talus	Grass-land	Agri-culture/ Pasture	Riparian[3]	Riverine	Lacu-strine	Palu-strine[4]
Mule Deer	WF,WC[1]	WF,WC	WF,WC	WF,WC	---[2]	WF	WF	WF,WC	---	---	---
Western Meadowlark	---	---	---	---	---	F,R	F,R	---	---	---	---
Song Sparrow	---	---	---	---	---	---	---	R,C,F[5]	---	---	---
Abert Squirrel	F,C	F,C	---	---	---	---	---	---	---	---	---
Great Blue Heron	---	---	---	---	---	---	---	R	F	F	F[7]
Black-capped Chickadee	F,R	F,R	---	---	---	---	---	F,R[6]	---	---	---
Beaver	---	---	---	---	---	---	---	WF	W	W,WF	W,WF[7]

(1) F = Food; C = Cover; WF = Winter Food; WC = Winter Cover; R = Reproduction; W = Water.

(2) Dash (--) signifies that the cover type does not meet any of the species' life requisites.

(3) Includes riparian forests, shrubs, and grassland.

(4) Includes palustrine pond and marsh/meadow.

(5) Only riparian forest and shrub types provide suitable habitat.

(6) Only riparian forests provide suitable habitat.

(7) Only palustrine ponds provide suitable habitat.

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The life requisites for the evaluation species were obtained from the species models. The HEP team associated the life requisites with habitats used by each species. The life requisite(s) considered by the HEP team to be most limiting to the growth of a population in the study area provided the basis for assessing impacts for the evaluation species. For instance, since the study area provides winter habitat for deer, winter food and cover life requisites were evaluated for this species. Conversely, since Song Sparrow and Western Meadowlark summer in the study area, reproductive cover and summer forage were evaluated for them. This approach is the standard process used in the HEP to confine an impact assessment to those life requisites most limiting the population growth of key wildlife species.

6.3.2.5 Habitat Parameter Measurements

Sampling Design

The nearly 40,000 acres in the study area were divided into four zones to account for variation in habitat characteristics due to elevation: (1) elevation 5,180 to 5,680 ft, (2) elevation 5,680 to 6,280 ft, (3) elevation 6,280 to 6,880 ft, and (4) elevation 6,880 to 7,420 ft. The area potentially impacted by the Grey Mountain and Poudre alternatives was in Zone 1. Zone 1 was further divided into three aspect categories (north, southeast, west). Zones 2, 3, and 4 were not divided into aspect because of the large area, highly varied topography, and the uncertainty of their availability for mitigation. Because Zone 1 would be directly impacted by the proposed project, it was narrowly defined to more accurately quantify habitats used by the evaluation species and to reduce the influence of environmental variability on the habitat quality measurements. Habitats were quantified in the other three zones in order to comprehensively characterize wildlife habitat in the entire study area. The zones also were examined for possible use in mitigation.

A total of 184 sampling sites were randomly distributed in 122 polygons across the four elevational zones in the study area to measure the habitat quality for the seven wildlife evaluation species (Table 6.4 and Figure 6.3). Within the combined Grey Mountain and Poudre project areas, 82 sites were randomly distributed in 56 polygons

TABLE 6.4

Number and Distribution of Sites Sampled in Polygons for Each Cover-Type in the Cache la Poudre Project Study Area (1)

Sampling Locations	Closed Canopy Conifer Forest	Open Canopy Conifer Forest	Mountain Shrub	Grassland	Agriculture	Riparian Forest	Riparian Shrubland	Riparian Grassland	Palustrine Marsh/Meadow	Total
PROJECT AREAS										
Mainstem South										
Polygons	3	3	3	3	--(2)	5	--	--	--	17
Sites	5	5	5	5	--	5	--	--	--	25
Mainstem North/West										
Polygons	1	3	3	3	--	5	3	1	--	19
Sites	3	5	5	5	--	5	3	2	--	28
Mainstem East										
Polygons	3	3	3	3	--	3	3	2	--	20
Sites	5	5	5	5	--	3	3	3	--	29
Subtotal										
Polygons	7	9	9	9	--	13	6	3	--	56
Sites	13	15	15	15	--	13	6	5	--	82
OUTSIDE PROJECT AREAS										
Zone 1										
Polygons	--	3	3	3	3	5	3	--	2	22
Sites	--	5	5	5	7	5	5	--	4	36
Zone 2										
Polygons	3	3	3	3	--	3	3	--	--	18
Sites	5	5	5	5	--	3	3	--	--	26
Zone 3										
Polygons	3	3	3	3	--	--	--	--	--	12
Sites	5	5	5	3	--	--	--	--	--	18
Zone 4										
Polygons	6	6	1	1	--	--	--	--	--	14
Sites	8	8	3	3	--	--	--	--	--	22
Subtotal										
Polygons	12	15	10	10	3	8	6	--	2	66
Sites	18	23	18	16	7	8	8	--	4	102
TOTAL STUDY AREA										
Polygons	19	24	19	19	3	21	12	3	2	122
Sites	31	38	33	31	7	21	14	5	4	184

(1) Pinyon Pine and Palustrine Pond types were not sampled because they were present only outside the project areas and would not be affected by either the project alternative. Riverine and lacustrine cover types were not sampled because the measurements required could be obtained from maps, aerial photographs or the literature.

(2) Dashes signify that the cover type was not sampled because it was either absent or present in very small amounts.

as follows: 25 sites in 17 polygons on south slopes, 28 sites in 19 polygons on north and west slopes, and 29 sites in 20 polygons on east slopes. The other 66 polygons were located outside the project areas: 36 sites in 22 polygons in Zone 1, 26 sites in 18 polygons in Zone 2, 18 sites in 12 polygons in Zone 3, and 22 sites in 14 polygons in Zone 4. Nearly half of the polygons sampled were allocated to the project areas because of the importance of characterizing the habitats to be affected by either proposed project alternative. The number of polygons allocated to each elevation zone outside the project areas was based on the size of the area in each zone and the complexity of cover types. Zone 1 outside the project areas had the largest acreage and most diverse cover types, so it was allocated the highest number of polygons. The other three zones had much smaller areas and fewer cover types.

Five sites were sampled in three polygons for each cover type in the project areas and each elevation zone outside the project areas. One polygon contained three sites, and two polygons contained single sites. The measurements in the polygon with three sites provided information on the local variability of the structural characteristics in a given cover type. The measurements among the three polygons provided information on the spatial variability within the cover type for the project areas and each zone. Sampling intensity was adjusted downward for poorly represented cover types and upward for abundant cover types such as shrublands and upland forests. The small amount of area in poorly represented (riparian and palustrine types) cover types generally limited sampling to a single site in each polygon. Consequently, the sampling program was designed to quantify the quality of cover types for wildlife in the project areas and the study area and to estimate the variability of the measurements used to derive the quality values.

A 25 m x 25 m quadrat was established at each sampling site in a given polygon for measuring the cover type characteristics. The site was located by randomly selecting one quarter of a polygon marked on an aerial photograph, pacing 55 m in a direction perpendicular to the

point of entry, and then 10 m in a randomly chosen direction. The end point represented the first corner of the quadrat. The quadrat was oriented by randomly selecting the first side of the quadrat and flipping a coin to determine the location of the adjacent side. Additional quadrats, required in polygons with multiple sampling sites, were established by pacing 50 m in a random direction from a randomly chosen corner of the previous quadrat. Quadrats were replaced by a 50 m transect line in herbaceous and shrubland cover types because this type did not require density measurements. A 50 m transect line was also used in riparian forest types because the areas were frequently too narrow to randomly place a quadrat or were small enough to sample the entire polygon.

These procedures were adjusted for small polygons. Small polygons were entered from the most accessible point and the 55 m distance to the sampling site was reduced to 30 m to accommodate the quadrat. The distance between multiple quadrats was also reduced in small polygons. Sampling sites were rejected if they were less than 20 m from the edge of the polygon, in a disturbed area, or in a non-representative cover type inclusion.

Field Sampling

The habitat parameters measured in each cover type were defined by the HSI models for the seven evaluation species (Appendix F). Habitat parameters were measured during August 10-14 and August 17-21, 1987. This time period closely corresponded to the peak of vegetal growth when habitat quality was near optimal for most wildlife. Two teams of three to four people collected habitat parameter data during the ten-day field period which represented over 600 hours of sampling effort.

Three basic sampling procedures were used to measure the habitat parameters: (1) quadrat; (2) line intercept; and (3) plot frame (Appendix Tables D.8 and D.9). A quadrat (25 m x 25 m or 0.0625 ha) was used for tree density measurements. Tree and shrub heights and the diameters of live and dead trees were also measured within the

quadrat. Density was determined from visual counts, tree height from a combination of measures taken with a clinometer (vertical angles) and range finder (horizontal distance), and tree diameter at-breast-height (dbh) from a diameter tape. Shrub height was measured with a graduated rod.

The line-intercept procedure was used for measurements of tree and shrub canopy cover (Canfield, 1941). Measurements were made along a tape on two adjacent, randomly selected 25 m sides of the quadrat. Percent cover was estimated by measuring the distance between the outer boundaries of tree and shrub canopies along the tape and calculating the proportion of the total length of tape represented by each parameter.

A 0.1 m^2 plot frame was used for herbaceous cover and height measurements (Daubenmire, 1959). The frame was placed every 5 m along two sides of a quadrat to estimate percent cover. A meter stick was used to measure height of herbaceous material in the plot. Measurements of tree, shrub, and downed woody material were recorded to the nearest 10 cm, percent herbaceous cover to the nearest 5 percent, and shrub height to the nearest 10 cm.

In addition to field sampling, distance between various cover types were measured from maps to calculate interspersion indices needed for the Deer model (Appendix Table D.5). Application of the Beaver, Great Blue Heron, and Deer models also required map measurements to determine the proportion of each cover type within specified distances adjacent to roads, rivers, or other waterbodies (Appendix Table D.6). Although field and map measurements were taken in metric units, the HEP software is based on acres so English units are used for discussing cover type area throughout this report.

6.3.2.6 Assignment of Habitat Suitability Indices and Calculation of Habitat Units

Data Summarization

A computer software program called PCFOCUS (Information Builders Inc., 1982) was used for data summarization and statistical analysis. The mean of each parameter was calculated by polygon (Appendix Tables E.2 through E.4). Parameters having single values, such as percent tree canopy cover, could not be expressed as a mean except where multiple sites were sampled in a polygon. The mean value of each parameter was also determined for each cover type in a stratum by summing the polygon values and dividing by the sample size. The variability around the mean was expressed by the standard error and coefficient of variation. These statistics were calculated to describe the variability of the data entered into the mathematical models to determine the habitat quality (Appendix Tables E-6 through E-9).

Habitat Suitability Indices and Habitat Units

HSI models have been developed by the FWS or other research institutions for each of the evaluation species chosen for the Cache la Poudre study (Appendix F). These models define the parameters that were measured in the field to determine habitat suitability for a given species. An SI was determined for each parameter by assigning the mean polygon value calculated from field measurements a quality value (0.0-1.0) from an SI graph for a particular species HSI model. The graph relates an x-axis parameter value to a y-axis habitat quality value to derive the SI. Each of the HSI models contains an equation or set of equations which mathematically combines the SIs for all the parameters into an index of overall habitat suitability for a given species. A software package called Micro-HSI (FWS, 1987) was used to assign SI values and calculate the average HSI for each cover type. The HSI values were weighted by the area of each cover type in a zone and aspect within the project areas for the Grey Mountain and Poudre alternatives. HSIs were calculated separately for the two alternatives for without-project and with-project conditions.

An HU is a combined measure of both the quality and quantity of habitat available to a given species. HUs for a particular habitat type were calculated by multiplying the HSI by the area (in acres) of the habitat type. The HUs for each habitat type used by that species were then summed by life requisite to obtain the total number of HUs available for conditions with-and without-project for the Grey Mountain and Poudre alternatives.

6.3.2.7 Assignment of Target Years and Calculation of Average Annual Habitat Units

Target Years

The HEP requires estimating the change in HUs over the life of the project due to natural or man-caused disturbance. This is accomplished by weighting intervals of time bracketed by target years. Target years represent events when major changes occur in the habitat quantity or quality. These events typically correspond to the construction, operation, and modification of a water storage project. Other events may include fire, logging, grazing, or development which alter the normal sequence of plant succession. Although succession is a continual process, incremental changes are difficult to calculate for each year. Consequently, successional changes are often represented by one or two distinct target years depending on the project length and cover types involved.

Target years were defined for both the Grey Mountain and Poudre project alternatives. Both configurations were assumed to have identical schedules of development. The initial target year (TY0) always represents the year before disturbance, while TY1 through N are the sequential periods of major change. The last target year is the end of the initial project life. Four target years were selected for the proposed project by the HEP team. TY0 was 1993, the estimated year FERC would grant a license to construct the project. TY1 was 1994, the estimated year before the start of construction and TY12 was 2005, or the estimated year of full project operation. The interval between 1994 and 2005 included the start of construction in 1995, completion of construction in 2000, and full pool operation in 2005. The year in

which full pool is reached would depend primarily on hydrological conditions. Based on historic records, the District estimated that from one to ten years, or an average of five years, would be required to achieve full pool. The last target year (TY50) represented 2043, or the 50-year end of the initial license period.

The HEP team did not establish target years for succession, logging, fire, grazing, or other disturbance. This decision was based on: (1) the slow rate of succession; (2) the virtual absence of logging; (3) the FS policy of fire suppression; (4) the long history of livestock grazing; and (5) the uncertainty of future recreational, industrial, or residential development in the study area. The HEP team agreed that these events did not warrant assigning target years because they did not represent major quantifiable changes in habitat except for development. Development was excluded because the type, rate, and location cannot be accurately determined at this time. However, these events are fully discussed in Section 6.4.1.4.

Average Annual Habitat Units

AAHUs were calculated to determine the average annual net impact of the alternative projects on the evaluation species. The HSIs and associated habitat areas were used to calculate HUs for each target year which were then averaged over the life of the project to obtain AAHUs. This averaging procedure was accomplished by using the FWS's "HEP Accounting" procedure (FWS, 1985) which involves the following equation:

$$AAHUs = \left(\sum_{i=T_2-T_1}^{n-1} \left(T_2 - T_1\right) \left[\left(\frac{A_2H_2 + A_1H_1}{3}\right) + \left(\frac{A_1H_2 + A_2H_1}{6}\right) \right] \right) / P$$

where:
- T_1 = first year of time interval
- T_2 = second year of time interval
- A_1 = habitat area at first target year
- A_2 = habitat area at second target year
- H_1 = HSI at first target year
- H_2 = HSI at second target year
- P = project life
- n = number of target years
- i = time interval in years

6.4 RESULTS

6.4.1 Description of Existing Environment

6.4.1.1 Wildlife

A variety of wildlife including birds, mammals, amphibians, and reptiles inhabit the study area. A literature review and a survey of resource agency staff resulted in very little available site-specific information on game or non-game birds and mammals, and no information on reptiles or amphibians, except for a general species and distribution list for Colorado (Hammerson, 1982). Roberts (1983) conducted winter and summer bird surveys along the proposed Grey Mountain Reservoir site and found higher bird densities in riparian habitats than in upland habitats. Baldwin (1976) maintained a 25-year record of bird species observed during spring and summer around the confluence of the mainstem and North Fork of the Cache la Poudre River and recorded 95 species. The District conducted a preliminary small mammal trapping study covering the mainstem, Glade, and Greyrock areas and identified eight species (Berg, 1986). While these sources of information are useful for developing a comprehensive species list of wildlife, the available information is insufficient for adequately describing use of the study area by wildlife other than threatened or endangered and special interest species.

Because of the insufficient amount of information and the impracticality of conducting wildlife population studies to develop a comprehensive database, the resource agencies in cooperation with the District decided that the HEP was a suitable alternative to describe and assess wildlife use of the area. HEP is a habitat-based approach where indicator species are selected to reflect the habitat use patterns of a broader variety of species. Since wildlife species are dependent on habitat, proper application of HEP provides a comprehensive evaluation of wildlife use in the Cache la Poudre study area. The results of the HEP are described in Section 6.4.2.

Threatened and Endangered Species

Five species that potentially occur in the study area have been listed by the FWS or CDOW as threatened or endangered. The bald eagle, peregrine falcon (Falco peregrine), and least tern (Sterna antillarum), are designated by both FWS and CDOW as endangered species. The piping plover (Charadrius melodus) is listed as a threatened species by both agencies, and the river otter is designated by the CDOW as an endangered species in Colorado. A species is designated endangered by the Federal government when the species requires protection throughout its geographic range to prevent extinction. A species is designated endangered by a state such as Colorado when the species requires protection to prevent extinction in that state. The protected status of these species requires descriptions of their use of the project area.

An estimated 600 to 700 bald eagles winter in Colorado (Craig, 1988). Bald eagles arrive in Colorado during October and depart to breeding areas in Canada during March (Lockhart, 1988). Ten pairs of eagles reportedly nest in Colorado (Craig, 1988; Lockhart, 1988). The closest nesting site to the project area is Fort Morgan, which is 30 to 40 miles east of the study area.

Surveys conducted in the study area indicated that at least seven bald eagles winter on the mainstem and North Fork of the Cache la Poudre River (Table 6.5). Bald eagles were observed between October and March with the highest numbers being observed in February (Figure 6.4). Bald eagles were encountered on the river during 25 of the 35 survey days. Use of the river was most consistent during November through February when eagles were observed on more than 70 percent of the survey days (Figure 6.5). Bald eagles were distributed throughout the river system, but most (52 of 59 observations) were on the lower portion of the North Fork where they fed on fish stranded in pools created by the release of water from Seaman Reservoir.

TABLE 6.5

Number of Bald Eagles Observed on the Mainstem and North Fork of the Cache la Poudre River Between October 2, 1986 and March 30, 1987

Date	Time[1]	Seaman Reservoir	Seaman Reservoir-to Mainstem	Mainstem	North Fork above Seaman Reservoir[2]	Comment
10/21/86	AM	0	0	0		
10/28/86	AM	1	0	0		
11/4/86	PM	0	2	0		
11/7/86	AM	0	0	0	1	
11/11/86	PM	0	4	0		
11/14/86	PM	0	3	0		
11/19/86	AM	0	0	1		
11/29/86	PM	0	5	0		
12/4/86	AM	0	1	0		
12/8/86	PM	1	3	0		Roosting[3]
12/14/86	AM	0	2	0		
12/17/86	AM	0	0	0		
12/18/86	AM	0	1	0		
12/27/86	PM	1	1	0		
12/28/86	AM	0	2	0		
12/31/86	PM	0	2	0		Roosting[3]
1/1/87	AM	0	5	0		
1/9/87	AM	0	2	0		
1/10/87	AM	0	1	0		
1/11/87	PM	0	3	0		Roosting[3]
1/14/87	PM	0	0	0		
1/23/87	AM	0	0	0		
1/27/87	AM	0	1	0		
1/31/87	AM	0	1	0		
2/2/87	PM	0	1	0		
2/4/87	PM	0	1	0		
2/5/87	AM	0	1	0	2	
2/8/87	AM	0	7	0		
2/12/87	PM	0	2	0		
2/18/87	PM	0	0	0		
2/26/87	PM	0	0	0		
3/3/87	AM	0	0	0		
3/12/87	AM	0	1	0		
3/24/87	AM	0	0	0		
3/30/87	AM	0	0	0		

(1) AM = Sunrise to 8:00 a.m.
PM = 3:30 p.m. to sunset.

(2) The North Fork above Seaman Reservoir was inconsistently surveyed because of its inaccessibility.

(3) Date when eagles were observed roosting across from water filtration plan between Seaman Reservoir and the mainstem on the North Fork of the Cache la Poudre River.

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Bald eagles observed in the study area may occasionally roost along the Cache la Poudre River (Table 6.5). Bald eagles were observed perched in a mixed conifer stand along the mainstem across from the Fort Collins Filtration Plant well after sunset on three different days. Two to three eagles were observed in this stand. Roost sites are important because they provide thermal radiation cover which reduces the heat loss for eagles and improves their fitness to survive the winter (Stallmaster and Gessaman, 1984). Consequently, these surveys showed that bald eagles consistently used Grey Mountain and Poudre project areas throughout the late fall to early spring, and may intermittently roost in the project areas near the confluence of the mainstem and North Fork of the Poudre River.

Little information is available on the peregrine falcon, least tern, piping plover, and river otter in the study area. The upper Poudre Canyon is mapped as hunting and nesting habitat for the peregrine falcon (CDOW, 1978). An active nest site exists near Kinikinik, which is about 25 miles west of the study area. There have been unconfirmed sightings of peregrine falcons in the lower canyon, which has been identified by the CDOW as hunting habitat for this species. There have, however, been no confirmed sightings, and it is unlikely any nesting occurs in the study area (Craig, 1988).

The least tern and piping plover are rare migrants in Colorado (CDOW, 1978). There has been one confirmed observation of each of these species in Larimer County outside the study area and no recorded nest sites (CDOW, 1978).

The river otter, a state endangered species, has been observed on the Cache la Poudre River outside the study area. The occurrence of the river otter was recently confirmed along the Cache la Poudre River in Fort Collins (Schoonveld, 1986). The presence of otters in the Cache la Poudre River combined with their reported trait of traveling

long distances within river systems (Field, 1970) indicates that this species may use the study area. However, the CDOW (1978) has not designated any "essential" river otter habitat in the Poudre River Basin.

Species of Special Interest

Big game species and raptors, particularly the golden eagle, were identified by the CDOW, FWS and FS as species of special interest for the Cache la Poudre project. Raptors are of special interest because they: (1) often have very specific nesting habitat requirements; (2) require large areas for feeding; (3) are top carnivores and therefore reflect impacts to small mammals, birds, reptiles, or fish; (4) are sensitive to disturbance, particularly during nesting; and (5) receive high public interest. Big game species are of special interest because they use a wide variety of cover types to meet their life requisites and are also of high public interest.

Golden Eagle

A literature review indicated little is known about the distribution and abundance of golden eagles in the study area. Discussions with the CDOW (Craig, 1988) indicated that seven active and two historic (nest sites that show no sign of use within the past two years) eagle nests may occur within eight miles of the confluence of the North Fork and the mainstem of the Cache la Poudre River. A winter density of 0.2 golden eagles per km^2 was estimated for the study area (Roberts, 1983). Since information on the current distribution and status of golden eagles is not available, surveys were conducted in 1987 and 1988 to locate nest sites in the study area. The data presented in this report are from the 1987 survey. Results of the 1988 survey were not available from the FWS as of the writing date for this report.

Five active and four alternate (nest sites that have been occupied within the past two years but are not currently used) golden eagle nests were identified during the helicopter survey conducted on May 8, 1987 (Table 6.6 and Figure 6.6). One active and one alternate nest

TABLE 6.6

Active Golden Eagle Nest Site Characteristics[1]

Location	Habitat Type	Elevation (Ft MSL)	Distance from Reservoir[2] (miles)
North Fork #1	Rock/Talus	6,110[3]	0.1
North Fork #2	Rock/Talus	6,140[4]	0.2
Owl Canyon	Rock/Talus	5,740[4]	3.7
Glade	Rock/Talus	5,750[4]	2.2
Hewlett Gulch	Rock/Talus	7,100[3]	2.6

(1) Refer to Figure 6.6 for map showing locations.

(2) Distance in miles from the Poudre or Grey Mountain reservoir as estimated from topographic maps.

(3) Elevation measured using altimeter.

(4) Elevation estimated from USGS topographic maps.

were located just outside the study area about one mile northeast of Owl Canyon. Of the 7 nest sites in the study area, two active and two alternate nests were along the North Fork. All other nests were at least 1.5 miles away from either project area (Figure 6.6). One of the alternate nests along the North Fork was within 100 ft of an active nest on the east side of the river at an elevation of 6,140 ft, which is approximately 440 ft above the river. The other alternate nest was 0.25 miles north of an active nest on the east side of the river. The elevation of the active nest was 6,110 ft (450 ft above the river) and although the alternate nest site was not visited on foot, its elevation was greater than that of the closest active nest. The nests outside the project areas ranged from 5,740 to 7,100 ft elevation. All the nests were located on cliff faces in the rock/talus cover type (Table 6.6). As determined by the cover type inventory, rock/talus occurs in 89 distinct polygons and represents 263 acres in the study area.

At the request of the CDOW, pellets were collected from the golden eagle nests identified in the survey, and a food habits analysis was conducted. The purpose of this analysis was to identify golden eagle prey species to determine the importance of different cover types in the project area as golden eagle feeding habitat. Based on the results of the food habits analyses, golden eagles nesting in the study area feed on a wide variety of prey (Table 6.7). Twenty genera of mammals, five orders of birds, fish, and snake remains were found in 30 pellet samples collected from three eagle nest sites. The results are consistent with the findings of other studies in the western United States, and indicate that jack rabbits (53 percent of the samples contained jack rabbit) and other small mammals, including squirrels and prairie dogs, are important components of the diet (Brown and Amadon 1968; Olendorff 1973; 1976). Prairie dogs, passerine birds, and grouse were especially common in samples from the North Fork nest site. These results suggest that the golden eagles nesting in the study area feed primarily in open upland cover types and less frequently in forested

TABLE 6.7

Composition of Prey Collected from Three Golden Eagle Nests

Taxa	North Fork Nest #2 (n = 14)[1]		Owl Canyon Nest (n = 7)[1]		Glade Nest (n = 9)[1]		Total (n = 30)[1]	
	Freq.	% Freq.	Freq.	% Freq.	Freq.	% Freq.	Freq.	% Freq.
Mammals								
elk (Cervus)	2	14	0	0	0	0	2	7
red-backed vole (Clethrionomys)	1	7	2	29	0	0	3	10
prairie dog (Cynomys)	6	43	2	29	2	22	10	33
chipmunk (Eutamias)	3	21	0	0	1	11	4	13
sagebrush vole (Lagurus)	1	7	1	14	0	0	2	7
jack rabbit (Lepus)	6	43	5	71	5	56	16	53
marmot (Marmota)	2	14	1	14	0	0	3	10
vole (Microtus)	2	14	3	43	2	22	7	23
weasel (Mustela)	0	0	0	0	1	11	1	3
woodrat (Neotoma)	2	14	0	0	0	0	2	7
deer (Odocoileus)	2	14	2	29	1	11	5	17
sheep (Ovis)	2	14	1	14	1	11	4	13
mouse (Peromyscus)	5	36	1	14	4	44	10	33
harvest mouse (Reithrodontomys)	0	0	3	43	1	11	4	13
shrew (Sorex)	1	7	1	14	1	11	3	10
ground squirrel (Spermophilus)	3	21	3	43	3	33	9	30

(a) n = number of castings in sample collected at each nest (casting is defined as prey remains regurgitated in the form of a pellet).

(b) Two of the four castings contained Dendrogapus obscurus (blue grouse)

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TABLE 6.7 (Continued)

Composition of Prey Collected from Three Golden Eagle Nests

Taxa	North Fork Nest #2 (n = 14)(1)		Owl Canyon Nest (n = 7)(1)		Glade Nest (n = 9)(1)		Total (n = 30)(1)	
	Freq.	% Freq.	Freq.	% Freq.	Freq.	% Freq.	Freq.	% Freq.
Mammals (Continued)								
cottontail rabbit (Sylvilagus)	1	7	0	0	1	11	2	7
pine squirrel (Tamiasciurus)	5	36	3	43	2	22	10	33
pocket gopher (Thomomys)	1	7	0	0	0	0	1	3
jumping mouse (Zapus)	0	0	0	0	2	22	2	7
Birds								
ducks and geese (Anseriformes)	1	7	0	0	2	22	3	10
dove (Columbiformes)	0	0	1	14	1	11	2	7
grouse and quail (Galliformes)	4	29 (2)	1	14	0	0	5	17
passerines (Passeriformes)	6	43	1	14	2	22	9	30
woodpeckers (Piciformes)	1	7	0	0	1	11	2	7
Unidentified Aves	1	7	0	0	0	0	1	3
snake (Reptilia)	1	7	0	0	0	0	1	3
fish (Pisces)	1	7	0	0	0	0	1	3

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and riparian types. This analysis was to be used to develop a habitat model for the golden eagle. However, the HEP team later decided not to include the golden eagle as an evaluation species for the Cache la Poudre project because the survey results provided adequate information of the use of the study area by this species.

Other Raptors

A variety of other raptors potentially inhabit the study area. Information on their use of the study area, however, is largely lacking. Osprey (Pandion haliaetus), prairie falcon (Falco mexicanus), and red-tailed hawk (Buteo regalis) occur in or near the study area. Ospreys nest south of the study area near Fort Collins, but none have been reported in the study area. Ospreys typically nest on the broken tops of large trees along rivers and particularly along reservoirs where they feed on fish. Prairie falcons have been reported to nest in the study area outside the Poudre River Canyon (Craig, 1986). Based on previous observations three nests are suspected along the rimrock east of Highway 287 at Hook and Moore Glade and one in the vicinity of Greyrock Mountain. However, the exact locations and use of these nesting areas by prairie falcons have not been confirmed. Red-tailed hawks also nest in the study area but none have been observed in the vicinity of the proposed project (Figure 6.6). Three active nests were found during the May 8, 1987 and May 25, 1988 helicopter surveys. The three nests were all within 2 miles of Owl Canyon; two nests were immediately west of Highway 287 and one was east of the highway. Other raptors that probably nest in the study area, because they are prominent in the Poudre Basin, are the American kestrel (Falco sparverius), rough-legged hawk (Buteo lagopus), and great-horned owl (Bubo virginianus) (Craig, 1986; Roberts, 1983).

Bighorn Sheep

Bighorn sheep (Ovis canadensis) were historically distributed the entire length of the Cache la Poudre River Canyon (Goodsen, 1980). The herd was migratory, moving from high elevation summer ranges to low

elevation winter ranges. Bighorn sheep disappeared from the lower canyon near the proposed reservoir site by the early 1900's and no other sightings were reported after 1935 in the upper canyon (Simmons, 1961). Bighorn sheep were reintroduced to the upper Poudre Canyon in 1946 (Moser, 1962).

Three bighorn sheep herds currently occur along or near the Cache la Poudre River (Figure 6.7). One herd of approximately 255 animals inhabits the area from Joe Wright Creek downstream to Big Narrows, which is approximately six miles west of Poudre Park (Rocky Mountain Bighorn Society, 1984). A second herd, estimated at 40 to 50 bighorn sheep, uses the lower canyon mainly from Big Narrows east towards Hewlett Gulch. The populations of these two Poudre River Canyon herds are increasing, and there seems to be some movement of animals between these two herds (Bear, 1979). A third herd of approximately 15 to 20 animals inhabits the Lone Pine Creek area, about eight miles north of Big Narrows (Goodsen, 1980). The areas occupied by these animals consist of steep, open grasslands, or shrublands that are close to escape terrain (steep, rocky areas) (Simmons, 1961; Tilton and Willard, 1982; and Wakelyn, 1984).

The limited information available on bighorn sheep in the Poudre region suggests that small numbers of sheep may seasonally inhabit the study area. Sheep have been observed in the study area along the mainstem and North Fork during late winter and early spring. They have been primarily observed on steep, rock/talus slopes but probably transit through other habitats. There is no information available to suggest that the study area provides critical lambing habitat or that the animals migrate across the Cache la Poudre River. The animals observed in the study area are probably from the herd that occurs between Big Narrows and Hewlett Gulch (Berg, 1986).

Mule Deer

Mule deer are common in the study area. Most mule deer in the Cache la Poudre Basin are migratory, moving from lower elevation (6,000 to 8,500 ft) winter ranges to higher elevation (greater than 8,500 ft) summer ranges (Anderson, 1972) (Figure 6.7). Deer generally leave the winter ranges in late April to early May and move up in elevation as vegetation green-up progresses (Siglin, 1965). Most deer from the Cache la Poudre herd were on their summer range near Long Draw Reservoir by the second week of June (Dorrance, 1965). Deer generally leave the high elevation summer range before the third week of October (Dorrance, 1965). Although during mild autumn seasons, deer stay on high elevation transition ranges until snow accumulation forces them to move down (Loveless, 1967). About 20 percent of the total wintering population is nonmigratory and remains at lower elevations year-round (Loveless, 1967). Migration (mass movement of animals) does not occur in the lower Poudre Canyon, but deer gradually move between summer and winter ranges depending on the severity of the winter (Schoonveld, 1986). Consequently, while mule deer inhabit the study area year-long, the greatest use is between approximately November and April.

The size of the mule deer population wintering in the Cache la Poudre Basin was estimated at 9,196 animals in 1962-63 and 10,460 animals in 1964-65 (Medin, 1976). CDOW conducted a helicopter census along the lower Cache la Poudre River during the winters of 1985-87. Mule deer densities were estimated from these censuses at 52 deer per square mile during 1985-86 and 62 deer per square mile during 1986-87 in the winter concentration area along the North Fork of the Poudre River. During a January 1984 aerial survey conducted by the CDOW, 636 mule deer were counted in the winter concentration area. Based on these counts, the total deer population wintering along the lower Poudre River was estimated at 800 to 1,000 animals, or about 10 percent of the almost 10,000 deer wintering in the Basin (Schoonveld, 1986).

Deer primarily use south-facing brushy slopes and open timber areas during winter (Loveless, 1963, 1967). Approximately 73 percent of the deer wintering at Sevenmile Creek (15 mi west of study area) were in south-facing shrub communities, 13 percent were in open timber stands, 11 percent were in drainage channels, and 3 percent were in heavy timber stands (Loveless, 1963, 1967). Deer wintering at Stevens Gulch (6 mi west of project area) preferred shrub communities and open timber stands (Dorrance, 1965). North slopes and valley bottoms received the lowest use because of their exposure to more severe weather. A similar pattern of aspect and habitat use by deer would be expected in the study area.

Mule deer forage during the winter consists of approximately 75 percent browse, 15 percent forbs, and 10 percent grasses and other plant materials (Medin, 1976). The most important winter browse species on the Poudre River ranges are fringed sagebrush (Artemesia frigida), antelope bitterbrush (Purshia tridentata), mountain mahogany (Cercocarpus montanus), and skunkbrush sumac (Rhus trilobata). The mountain shrub community is the most important deer habitat during winter because of the abundance of preferred browse plants (Loveless, 1967). Summer diets of the Cache la Poudre mule deer generally contain less browse and more forbs than winter diets, which is typical of mule deer throughout the Rocky Mountains (Wallmo and Regelin, 1981).

Cache la Poudre mule deer breed mainly in November and December on the winter range (Anderson and Medin, 1967). Approximately 96 percent of Poudre mule deer conception dates are between November 17 and December 22 (Medin, 1976). The peak of fawning is between June 12 and June 25, approximately 203 days after conception (Dorrance, 1965). There is no current information available on the population structure or recruitment rate of the Poudre River deer population. However, data from a five-year study conducted from 1961-1965 indicate that the population had good reproductive success (Anderson, 1972; Medin, 1976).

The information summarized above shows that the study area provides winter range for mule deer. Deer use appears to be highest east and west of the North Fork of the Cache la Poudre River which is largely undisturbed by roads. The mountain shrub and open canopy forest, particularly on the south-facing slopes, are the primary deer foraging areas. These areas are used predominantly between November and April, after which most of the deer move to higher elevations outside the study area. A smaller proportion of the wintering deer population inhabit the project area year-long.

6.4.1.2 Cover Type Inventory

Cover Type Descriptions

There were 16 wildlife cover types identified in the 39,489-acre study area that consisted of three upland forest types, three riparian types, two wetland types, three upland non-forested types, two water types, and three disturbed types (Table 6.8). The distribution of these types was influenced by a west to east moisture gradient in the study area. The dry eastern portion of the study area was dominated by grasslands. The western portion was at higher elevation, had more topographic relief, and was dominated by conifer forests. The central portion of the study area represented a transition area and was dominated by shrublands. The cover types and their distribution in the study area are illustrated in Exhibit I (found in the map pocket on the back cover of this report).

Twelve cover types, representing 1,895 and 2,400 acres, were found in the Poudre and Grey Mountain project areas, respectively (Table 6.8 and Figure 6.8). Upland Forest, Shrubland, and Grassland were the dominant cover types and composed approximately 80 percent of the project areas. Seaman Reservoir, Riparian, Riverine, and Rock/Talus types represented approximately 14 percent of the project areas. Five percent of the project areas was classified as developed or disturbed. Palustrine (Marsh/Meadow and Pond), Agriculture, and Pinyon Pine Forest types were not in either of the project areas but they were in the study area. Each of the cover types represented within and outside the Grey Mountain and Poudre project areas is described below.

TABLE 6.8

Area of Cover Types Within and Outside
the Grey Mountain and Poudre Project Areas

Cover Type	Study Area[1]		Grey Mountain Project Area[1]		Outside Grey Mountain Project Area[1]	Poudre Project Area[1]		Outside Poudre Project Area[1]
	Area (ac)	Percent	Area (ac)	Percent	Area (ac)	Area (ac)	Percent	Area (ac)
Closed Canopy Conifer	5,526	14.8	234	9.8	5,293	218	11.5	5,309
Open Canopy Conifer	6,790	17.2	396	16.5	6,394	321	16.9	6,470
Pinyon Pine Forest	178	0.5	0	0.0	178	0	0.0	178
Mountain Shrub	13,469	34.1	972	40.6	12,497	698	36.9	12,771
Grassland	10,276	26.0	334	13.9	9,942	269	14.2	10,007
Rock and Talus	264	0.7	22	0.9	242	14	0.7	250
Agriculture	968	2.5	0	0.0	968	0	0.0	968
Developed	158	0.4	9	0.4	149	8	0.4	150
Disturbed	974	2.5	125	5.2	849	108	5.7	866
Riparian Forest	388	1.0	75	3.1	312	62	3.3	326
Riparian Shrub	121	0.3	17	0.7	104	13	0.7	108
Riparian Grassland	16	0.04	9	0.4	7	8	0.4	8
Palustrine Marsh/Meadow	53	0.1	0	0.0	53	0	0.0	53
Palustrine Pond	53	0.1	0	0.0	53	0	0.0	53
Riverine	178	0.4	127	5.3	51	99	5.2	79
Lacustrine (existing)	77	0.2	77	3.2	0	77	4.0	0
TOTALS	39,489		2,397		37,092	1,895		37,596

(1) Project area includes inundation area (maximum flood pool level of 5,640 feet) and a 40 ft buffer zone to 5,680 ft elevation.

Upland Forested Cover Types

Three upland forested cover types were identified in the study area: Closed Canopy Conifer; Open Canopy Conifer; and Pinyon Pine. These types represented over 31 percent of the study area. Open and Closed Canopy Conifer Forests represented 28 and 26 percent of the Grey Mountain and Poudre project areas, respectively. There was no Pinyon Pine Forest in either of the project areas. Each of these cover types is described below.

- Closed Canopy Conifer Forest: The Closed Canopy Conifer Forest type was defined as forests dominated by ponderosa pine (Pinus ponderosa) or Douglas-fir (Pseudotsuga menziesii) with more than 60 percent tree canopy cover based on aerial photograph interpretation. Closed Canopy Conifer Forest occupied 14 percent of the study area, all in the western half. About one-third of the areas sampled were dominated by ponderosa pine, one-third by Douglas-fir, and one-third were mixed. Douglas-fir-dominated stands occurred in slightly moister microclimates, usually on steep, north-facing slopes. Ponderosa pine and Rocky Mountain juniper (Juniperus scopulorum) were often intermixed with Douglas-fir in these areas, particularly in younger stands (Hess and Alexander, 1986). Ponderosa pine was the climax tree species on drier sites. Understory vegetation in dense stands of Closed Canopy Conifer was usually sparse. Common understory components in the Closed Canopy Forest included mountain mahogany, bitterbrush, currants (Ribes sp.), ninebark (Physocarpus monogynus), Montana wheatgrass (Agropyron dasystachya), mountain muhly (Muhlenbergia montana), spike fescue (Leucopoa kingii), and Ross' sedge (Carex rossii).

  The Closed Canopy Conifer Forest represented about 234 and 218 acres (10 percent) of the Grey Mountain and Poudre project areas, respectively. A total of 98 percent of this cover type was south of the mainstem and east of the North Fork of the Cache la

Poudre River. Average tree canopy cover was 63 percent (excluding two samples that fell in open inclusions). Ponderosa pine was dominant over Douglas-fir in more than 80 percent of the sites sampled in the project areas.

Closed Canopy Conifer Forests occupied about 14 percent of the acreage outside the project areas. Tree, shrub, and herbaceous cover was similar to that measured in the project areas. However, Douglas fir was dominant over ponderosa pine in most of the sites sampled outside the project areas. The project areas were at the lowest edge of the elevational range of this species, and moist sites favoring Douglas fir were less common than at the higher elevations outside the project areas.

- Open Canopy Conifer Forest: The Open Canopy Conifer Forest type was defined as forests dominated by conifer other than pinyon pine with 10 to 60 percent tree canopy cover based on aerial photo interpretation. This type occupied 17 percent of the study area. Ponderosa pine was the dominant tree species. Rocky Mountain juniper, Douglas-fir, and occasionally pinyon pine were associated species. Open Canopy Conifer Forests were primarily on south, east, or west facing slopes where the sites were drier than north-facing slopes which were mainly occupied by Closed Canopy Conifer Forests. The open canopy of this cover type promoted a relatively high understory cover of shrubs, usually dominated by mountain mahogany. Other common shrubs were bitterbrush, chokecherry (Prunus virginiana), wild plum (P. americanus), skunkbrush, currants, snowberry (Symphoricarpos sp.), rabbitbrush (Chrysothamnus nauseosus), and ninebark. Grasses were also a significant component of the understory, and three to nine species were identified in each stand sampled. Forb cover was generally sparse and diverse.

Open Canopy Conifer Forest represented 396 and 321 acres (16 percent) of the Grey Mountain and Poudre project areas, respectively. A total of 56 percent of this cover type in the project areas was east of the North Fork and 27 percent was south of the mainstem. Average tree canopy cover was 18 percent, and ponderosa pine was the dominant tree. Average herbaceous canopy cover was 7 percent, and shrub canopy cover was 20 percent. These values show that the tree, shrub, and herbaceous canopy of this type was open.

Open Canopy Conifer Forest occupied about 17 percent of the land outside the project areas, primarily in the northwestern portion of the study area. Average tree, shrub, and herbaceous canopy cover outside the project areas were similar to that sampled in the project areas.

- Pinyon Pine Forest: There were 178 acres of Pinyon Pine (Pinus edulus) Forest associated with a limestone formation in the northeastern quarter of the study area. This is the northern-most Pinyon Pine Forest in Colorado (Weber, 1976). Pinyon pine was the dominant species, but the stands usually included a few ponderosa pine and Rocky Mountain juniper. Mountain mahogany was the dominant understory shrub, and the herbaceous cover was sparse. There was no Pinyon Pine Forest in either of the project areas.

Non-Forested Upland Habitats.

Three upland, non-forested cover types were identified in the study area: Mountain Shrub, Grassland, and Rock/Talus. These types represented over 60 percent of the study area and 55 and 52 percent of the Grey Mountain and Poudre project areas, respectively.

- Mountain Shrub: The Mountain Shrub cover type was defined as areas with more than 20 percent shrub cover and less than 10 percent tree cover. It represented 13,469 acres or 34 percent of the study area

and was the most abundant cover type. This cover type occupied almost every aspect or slope. Larger shrubs and higher canopy cover were characteristic of mesic sites, generally found on north-facing slopes. Drier sites or ones with poor soil structure had sparser cover and smaller shrubs. The dominant species was mountain mahogany, but in swales and along draws, skunkbrush and wild plum sometimes formed dense thickets. Other shrub species were wax currant (Ribes cereum), chokecherry, ninebark, snowberry, rabbitbrush, and boulderberry. A wide variety of grass and forb species were also found in this cover type. Cheatgrass (Bromus tectorum) often dominated areas disturbed by grazing, and sunflower (Helianthella sp.) was common in sites where the shrub canopy cover was sparse. Cactus (Opuntia sp. and Pediocactus simpsonii) and several semi-shrub plants such as wild buckwheat (Eriogonum sp.), snakeweed (Gutierrezia sarothrae), and fringed sage (Artemisia frigida) were also frequent components of the Mountain Shrub cover type.

The Mountain Shrub cover type represented about 972 and 698 acres (about 40 percent) of the Grey Mountain and Poudre project areas, respectively. A total of 80 percent of the Mountain Shrub was north of the mainstem and along both sides of the North Fork. Shrub canopy cover averaged 35 percent, and herbaceous canopy cover averaged 34 percent. These values show that the vegetation in this type was relatively open because of moderate densities of shrub and herbaceous plants.

Mountain Shrub occupied about 34 percent of the land outside the Grey Mountain and Poudre project areas, respectively. Average shrub and herbaceous canopy cover was similar to that within the project areas.

- Grassland: The Grassland cover type was defined as upland areas with more than 30 percent herbaceous cover, less than 20 percent shrub cover, and less than 10 percent tree cover. It excluded cultivated, disturbed, or developed areas. This type represented about 10,276 acres or 26 percent of the study area. The grassland type included a wide variety of grass and forb species. Dominant grasses were blue grama (Bouteloua gracilis), needle grasses (Stipa sp.), wheatgrasses (Agropyron sp.), bluegrass (Poa sp.), bluestem (Andropogon sp.), and brome (Bromus sp.).

  Grasslands represented 334 and 269 acres (14 percent) of the Grey Mountain and Poudre project areas, respectively. A total of 86 percent of this type was north of the mainstem and along both sides of the North Fork. Herbaceous cover averaged about 50 percent, and the composition was about 80 percent grass and 20 percent forb. Much of the Grassland identified along the mainstem was on disturbed areas along Highway 14 that were revegetated with weedy species.

  Grasslands represented about 25 percent of the land outside the project areas. The majority of the Grassland outside the project areas was in the eastern one-third of the study area below 5,700 ft. Average herbaceous canopy cover and grass/forb composition was similar inside and outside the project areas.

- Rock and Talus: The Rock and Talus cover type was defined as rock outcrops with less than 10 percent tree cover, less than 20 percent shrub cover, and less than 30 percent herbaceous cover. This cover type represented 264 acres (0.6 percent) of the study area and was usually found on steep slopes. Prominent rock types in the study area included granite at Grey Rock, limestone near Hook and Moore

Glade, and metamorphic and igneous rocks of Precambrian age along the river canyon. Vegetative cover was sparse but included trees, shrubs, grasses, and forbs in crevices of rocks. Cliffbush (Jamesia americana) was the most prominent shrub and alumroot (Heuchera bracteata) was a prominent herbaceous species.

The Rock and Talus cover type represented about 23 and 14 acres (1 percent) of the Grey Mountain and Poudre project areas, respectively. It was primarily distributed along the bases of cliffs near the river. Rock and Talus occupied less than 1 percent of the land outside project areas. The majority of this cover type outside the project areas was represented by high cliffs and the peak of Grey Rock Mountain.

Riparian Cover Types.

Riparian cover types were distinguished from upland types by their close association with streams and rivers. Riparian cover types in this study were defined as adjacent to water courses where seasonal flooding influences plant productivity and composition (Roberts, 1983). Riparian vegetation was found along permanent and ephemeral streams, including springs and washes. Three types of riparian cover types were identified in the study area: forest-, shrub-, and grass-dominated. Riparian cover types occupied 1.3 percent of the study area and 104 and 82 acres (4 percent) of the Grey Mountain and Poudre project areas, respectively.

- Riparian Forest: The Riparian Forest cover type was defined as streamside vegetation with more than 10 percent tree canopy cover. This type represented 383 acres (1 percent) of the study area. Individual patches of Riparian Forest were usually small, averaging about 1.7 acres. The most prominent tree species in Riparian Forest areas was either plains or narrowleaf cottonwood (Populus sargentii and P. angustifolia), but peach-leaved willow (Salix amygdaloides), box-elder (Acer negundo), ponderosa pine, Douglas-fir, Rocky Mountain juniper, hackberry (Celtis occidentalis, alder (Alnus tenuifolia), and river birch (Betula

fontinalis) were also found. Shrubs were diverse in the understory and included chokecherry, wild plum, snowberry, skunkbrush, willow (Salix sp.), golden currant (Ribes aureum), wild rose (Rosa sp.), and poison ivy (Toxicodendron rydbergii). Vines, including western virgin's bower (Clematis ligusticifolia) and wild grape (Vitis vulpina) were common. Herbaceous understory cover was usually high and included a wide variety of grasses and forbs such as bluegrass, reed-canary grass (Phalaris arundinacea), redtop (Agrostis gigantea), sedges (Carex sp.), rushes (Juncus sp.), goldenrod (Solidago sp.), stinging nettle (Urtica dioica), hounds tongue (Cynoglossum officinale), milkweed (Asclepias arenaria), ragweed (Ambrosia psilostachya), thistle (Cirsium sp.), and mint (Mentha sp.).

The Riparian Forest cover type occupied about 75 and 62 acres (3 percent) of the Grey Mountain and Poudre project areas, respectively. The Riparian Forest was adjacent to the Cache la Poudre River, the most important permanent natural water source in the study area. Average tree canopy cover was 47 percent and average shrub cover was 23 percent. Shrub height averaged 2.3 meters, almost a meter taller than shrubs in upland cover types. Riparian Forest areas were often severely grazed by cattle because of their proximity to water, high herbaceous cover, and structural diversity.

The Riparian Forest type occupied about 1 percent of the land outside the project areas. Tree canopy cover averaged 70 percent and shrub cover averaged about 7 percent. Shrub cover was lower than in the project areas probably because most of the streams outside the project areas are ephemeral. The higher tree canopy cover in Riparian Forests outside the project areas may be an artifact of the difficulty of defining the boundaries of riparian areas adjacent to ephemeral streams.

- Riparian Shrub: The Riparian Shrub cover type was defined as streamside vegetation with less than 10 percent tree cover and more than 20 percent shrub cover. This type represented 121 acres (0.3 percent) of the study area. Common shrubs were hawthorn (Crataegus succulenta), wild plum, chokecherry, coyote willow (Salix exigus), snowberry, and skunkbrush. Many of the vines, forbs, and grasses common in Riparian Forest were also found in Riparian Shrub habitats.

  Riparian Shrub represented 17 and 13 acres (0.7 percent) of tne Grey Mountain and Poudre project areas, respectively. Shrub canopy cover averaged 69 percent and herbaceous cover averaged 64 percent, suggesting the vegetation was moderately dense. Much of this habitat type was disturbed by grazing.

  The Riparian shrub type occupied only 0.3 percent of the land outside tne project areas. Shrub canopy averaged 60 percent cover outside the project areas, and herbaceous canopy cover averaged 34 percent. These values are lower than in the project areas, probably because most of the streams outside the project areas were only seasonally wet.

- Riparian Grassland: This type was defined as streamside vegetation with more than 30 percent herbaceous cover, less than 20 percent shrub, and less than 10 percent tree cover. This type was found in only a few locations which represented about 16 acres in the study area. These patches were generally on flat areas next to river bends where silt had been deposited. These sites were dominated by herbaceous plants. Dominant grasses were Kentucky bluegrass (Poa pratensis), smooth brome (Bromus inermus), red top, and timothy (Phleum pratense). Other grasses, sedges, and rushes were common, as were forbs such as thistle, sweet-clover (Melilotus sp.), mullein (Verbascum thapsus), stinging nettle, clover (Trifolium sp.), goldenrod, scouring rush (Equisetum sp.), and ragweed. Shrub cover was low, and consisted primarily of coyote willow, snowberry, and wild rose.

About half the Riparian Grassland in the study area (8 to 9 acres) was in the project areas. Herbaceous cover averaged 64 percent, and 79 percent of the herbaceous cover was grass. Tree and shrub cover were less than one percent. Because of its proximity to water and the high palatability of herbaceous cover, this cover type was heavily grazed by cattle throughout the study area.

Palustrine or Wetland Cover Types

Wetlands were areas dominated by plants adapted to growing on seasonally saturated soils (Cowardin et al., 1979). Two wetland types were identified in the study area: Palustrine Marsh or Meadow and Palustrine Pond. They represented about 106 acres or 0.3 percent of the study area. There were no wetlands in the Grey Mountain or Poudre project areas.

- Palustrine Marsh and Meadow: The Palustrine Marsh and Meadow cover type was defined as herbaceous vegetation restricted to perennially wet sites associated with low or flat areas adjacent to springs or seeps. There were about 53 acres (0.1 percent) of this type in the study area. The largest patch of Palustrine Marsh/Meadow was in Grey Rock Meadow. Smaller patches were found on the eastern portion of the study area. This type was dominated by sedges, red top grass, mannagrass (Glyceria sp.), foxtail barley (Hordeum sp.), timothy, bluegrass, rushes, cattails (Typha latifolia), and bulrushes (Scirpus sp.). Common forbs were smartweed (Polygonum sp.), watercress (Rorippa nasturtium-aquaticum), sticktights (Bidens sp.), water parsley (Oenanthe sarmentosa), and willow herb (Epilobium sp.). The herbaceous cover was generally high because water was plentiful during the growing season.

- Palustrine Pond: The Palustrine Pond cover type consisted of shallow ponds with little emergent vegetation. There were 13 ponds in the study area, representing about 53 acres. Most of the ponds were man-made impoundments that served as water sources for cattle. The largest one was a settling pond for a cement operation. Several of these ponds were perennially wet and others were dry by the end of summer.

Riverine

The Riverine cover type included the mainstem and the North Fork of the Cache la Poudre River. It consisted of the river, pools, riffles, cliff bases, boulders, and sand bars within the normal high water mark. There were about 178 acres (0.4 percent) of the Riverine cover type in the study area. The Riverine cover types represented 99 and 127 acres (56 and 71 percent) of the Poudre and Grey Mountain project areas, respectively.

Lacustrine

The only Lacustrine (lake) cover type in the study area and the project areas was Seaman Reservoir. Seaman Reservoir occupies 150 acres at full pool and about half that at normal maximum drawdown (77 acres). Only the area of Seaman Reservoir at normal maximum drawdown represents permanent water and only this acreage was classified as Lacustrine. The 73 acres in the drawdown area were classified as Disturbed. The reservoir has little rooted or emergent vegetation because of fluctuations in water level.

Developed Types

Developed cover types were defined as areas where man's activities dominated the landscape. These represented about 5 percent of the study area and 134 and 115 acres (6 percent) of the Grey Mountain and Poudre project areas, respectively. Three developed types were identified in the study area.

- Agriculture: Agriculture occupied 968 acres (2.5 percent) of the study area. None of this cover type was identified in the Grey Mountain or Poudre project areas. Agricultural areas were at low elevations (below 5,400 ft) in the southern part of the study area. The predominant crops were alfalfa and pasture grasses. All other crops combined occupied less than 10 acres. All areas with signs of active cultivation were labeled as Agriculture even though some were not being cultivated at the time of this study.

- Developed: Developed land was defined as areas other than agricultural with human use as a dominant factor, but with some vegetative cover. Developed areas included residences with yards and outbuildings. This type occupied about 158 acres in the study area and 9 and 8 acres in the Grey Mountain and Poudre project areas, respectively.

- Disturbed: Disturbed land was defined as areas with little or no vegetation as a result of intensive human activity. Disturbed areas included roads, canals, mines, industrial sites, and the drawdown zone of Seaman Reservoir. This type represented about 974 acres (2.5 percent) of the study area when Seaman Reservoir was at normal maximum drawdown. Disturbed lands occupied 108 and 125 acres (5 percent) of the Poudre and Grey Mountain project areas, respectively. About 60 percent of this type in the Grey Mountain project area was the drawdown zone of Seaman Reservoir. For the Poudre project area, about 71 percent of the disturbed land was in this drawdown zone. Most of the remaining disturbed areas were along the mainstem.

Disturbance and Ecological Succession

The major sources of disturbance to wildlife habitat in the study area include fire, logging, grazing, and development. Succession is the natural process of change in the habitat that follows a disturbance event. HEP requires adjusting the habitat quantity and quality for man-caused and natural disturbances. The adjustment provides a more accurate measure of the value of wildlife habitat for determining the net impact of the project during the 50-year license period.

Fires occur every year in the study area. Lightning fires are probably more frequent than man-caused fires (Biastock, 1988). The fires, though fairly frequent, have been relatively small because there is a fire suppression policy for the National Forest, private, and State lands. On the 2.3-million-acre Arapahoe and Roosevelt National Forests, about 65 fires per year burn a total of 1,064 acres (FS, 1984). The fires commonly occur in open areas along ridge tops, and

are low in intensity. Many plant species in the study area, such as ponderosa pine, mountain mahogany, and rabbitbrush, are adapted to fire and will survive low intensity burns.

Fires in the area are surface fires that remove the understory but seldom kill forest stands. They remove or thin the above-ground parts of grasses, forbs, shrubs, and young ponderosa pines. The vegetation that grows after such a fire is mainly composed of annual grasses and forbs whose seeds survive in the soil, perennials that sprout from underground parts, and the plants that survive the fire. Fires are generally not sufficiently intense to kill the larger ponderosa pine trees. Fire-adapted shrubs such as mountain mahogany resprout from underground parts. Vegetation will usually reestablish quickly to the type that burned. Consequently, the HEP Team decided not to consider fire in this evaluation because small, low-intensity fires characteristic of the study area would not have a long-term influence on the vegetation over the life of the project.

Timber harvesting has not been of major importance in the study area since before the turn of the century. There have been no timber sales on National Forest land in the study area (Winkler, 1988). A small number of trees have been harvested on private land, some of which was probably removed because of a mountain pine beetle outbreak south of the Cache la Poudre River (Winkler, 1988). Timber harvesting, therefore, has had only a minor effect on wildlife habitat in the study area, and the harvest rate is not expected to change in the foreseeable future. The HEP Team decided to exclude timber harvesting from this evaluation.

Cattle grazing has historically been extensive in the study area. After the Forest Service reduced grazing allotments and tightened control of the length of the grazing period in the early 1960s, overgrazing on Federal lands was less widespread. Since grazing policies have not changed substantially in more than 20 years, the HEP Team decided to exclude the effect of grazing in the habitat evaluation.

Little information exists concerning development trends in the study area. However, much of the study area is in the National Forest or includes lands owned by the State of Colorado. It is unlikely that privately owned land will be developed in parcels less than 35 acres because of present state laws. Therefore, the rate of industrial, residential, and recreational development associated with and without the proposed project is expected to be low over the term of the 50 year license.

The rate of plant succession in the study area is very slow because of the arid climate. Changes in successional stages from grassland to shrubland or shrubland to forest require long periods of time. Moreover, factors responsible for reversing succession (i.e., logging, fire, grazing) do not apply to the study area except for development which is expected to be slow. Since the rate of succession is slow and there are few factors to interrupt long-term successional trends, the HEP team decided to exclude succession from the evaluation.

Because of these factors, the results of the HEP documented in this report do not incorporate habitat changes from fire, logging, grazing, succession, or development. The HEP team decided that the small size of fires, small amount of logging, long-term history of grazing, and slow rate of succession would not differentially influence wildlife habitat whether or not the project was built. Likewise, the rate of development is expected to be low and similar for with and without project conditions. Development was not included in the HEP because it will occur slowly, and differential impacts are not significant.

6.4.2 Effects Assessment

As described in previous sections, the HEP was used to determine potential effects of the Poudre and Grey Mountain alternatives on wildlife habitat. The HEP combines measures of habitat quality and quantity into a single value termed a Habitat Unit (HU). HUs are compared between conditions with-the-project and without-the-project to determine the net effects. The quantity of wildlife habitat affected by the proposed project was derived from the cover type inventory. The

cover type inventory also described the structure and characteristics of the habitats. Habitat quality for the seven wildlife species selected by the HEP team was derived from field measurements of these habitat characteristics. These quality and quantity measures were combined into HUs to determine the effects on the set of evaluation species. Effects were also evaluated for species of special concern. This assessment of effects on wildlife and their habitat is provided in the following sections.

6.4.2.1 Effects on Wildlife Habitats (Habitat Evaluation)

For each species, project effects, as defined by the HEP (Habitat Evaluation Procedures), are expressed as AAHUs (Average Annual Habitat Units). However, HSI (Habitat Suitability Index) values are also reported as an indicator of habitat quality in the project area and in the entire study area. HSI values are reported for each cover type that provides habitat for the Black-capped Chickadee, Song Sparrow, Western Meadowlark, and Abert Squirrel. These species are able to feed and reproduce in a single cover type, thus the quality of each cover type used is reported. The acreage and HSI for each cover type in the two project areas (by aspect), in the land outside the project areas (by elevation zone) in the total study area were used to calculate average HSI values for these three areas. Conversely, habitat quality cannot be reported by cover type for the Great Blue Heron, Mule Deer, and Beaver. These species use a variety of different cover types to meet their feeding, cover and reproductive requirements. Habitat quality is dependent on the quality, amount, and interspersion of the required cover types. As a result, HSI values often differ between with- and without-project conditions and are reported for these conditions for both the Grey Mountain and Poudre alternatives. All acreages are from Appendix Tables D.10-D.12. HSI values for the project areas (by aspect), and for the land outside the project areas (by elevation zone) are from Appendix G.

The results of the HEP analysis show that the Grey Mountain and Poudre alternatives would have negative effects on all seven evaluation species (Table 6.9). Losses, expressed as AAHUs, would be highest for Mule Deer; intermediate for Black-capped Chickadee, Abert Squirrel, and

TABLE 6.9

Net Effects of Cache la Poudre Project on Wildlife Habitat[1]

Evaluation Species	Study Area without the Project	Study Area with Grey Mountain Dam			Study Area with the Poudre Dam		
	AAHUs	AAHUs	Net Change	Percent Change	AAHUs	Net Change	Percent Change
Mule Deer	25,530	24,433	-1,097	-4.3	24,623	-908	-3.6
Western Meadowlark	5,588	5,410	-177	-3.2	5,447	-140	-2.5
Black-capped Chickadee	4,554	4,431	-123	-2.7	4,443	-111	-2.4
Abert Squirrel	1,690	1,598	-92	-5.4	1,602	-88	-5.2
Beaver	127	51	-75	-59.1	56	-70	-55.1
Song Sparrow	359	301	-58	-16.2	313	-46	-12.8
Great Blue Heron	91	62	-29	-31.9	59	-32	-35.2

(1) Impacts are expressed as AAHUs.

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Western Meadowlark; and lowest for Song Sparrow, Great Blue Heron, and Beaver. The areas affected by either of the project alternatives provide relatively high quality (HSI=0.67 to 1.0) habitat for the Beaver and Song Sparrow; moderate quality (HSI=0.33 to 0.66) habitat for the Mule Deer, Western Meadowlark, and Black-capped Chickadee; and low quality (HSI=0.0 to 0.32) habitat for the Great Blue Heron and Abert Squirrel (Figure 6.9). Habitat quality for these species was similar for the Grey Mountain and Poudre project areas as well as for the land in the study area outside the project areas. The effects of the Grey Mountain and Poudre alternatives on these species are described below.

Black-capped Chickadee

The Black-capped Chickadee was chosen as an evaluation species because it represents birds that reproduce in small cavities and forage from the ground to the top of the forest canopy. The year-round food supply for the Black-capped Chickadee is primarily associated with foraging in trees (Brewer, 1963). Optimum habitat consists of forests with 50 to 75 percent tree canopy closure and overstory trees at least 15 m tall (Schroeder, 1983). The Black-capped Chickadee can only excavate cavities in soft, rotten wood, and the preferred nesting sites are snags between 10 and 25 cm (Odum, 1941a,b; Brewer, 1963). The HEP team decided to evaluate the three forest cover types in the study area, since they met the habitat requirements for the Black-capped Chickadee.

The study area provided moderate quality (HSI=0.37) habitat for the Black-capped Chickadee (Table 6.10). Habitat quality was similar within the project areas for both the Grey Mountain and Poudre alternatives. Habitat quality was higher in the project areas (HSI=0.46) than outside the project areas (HSI=0.37). In the project areas, habitat quality was moderate for Closed Canopy Forest (HSI=0.51), low for Riparian Forest (HSI=0.30), and zero for Open Canopy Forest (HSI=0.0). Closed Canopy Conifer and Riparian Forests with south or east facing slopes consistently provided higher quality habitat (HSI=0.34 to 1.00) than did sites on west-facing slopes

TABLE 6.10

Average HSI Values for the Black-capped Chickadee

Location	HSIs			
	Closed Canopy Conifer Forest	Open Canopy Conifer Forest	Riparian Forest	Weighted Average (1)
Grey Mountain Project Area				
East	0.33	0.00	0.19	0.32
South	0.67	0.00	0.31	0.61
North/West	1.00	0.00	0.34	0.42
Weighted Average[(1)(4)]	0.51	0.00	0.30	0.46
Poudre Project Area				
West	0.33	0.00	0.19	0.32
North	0.67	0.00	0.31	0.62
South/East	1.00	0.00	0.34	0.42
Weighted Average[(1)(4)]	0.50	0.00	0.21	0.45
Outside Project Areas[(2)]	0.51	0.26	0.24	0.37
Study Area[(3)]	0.51	0.24	0.24	0.37

(1) Weighted average is based on the area of each cover type, by aspect, in the project area. Differences in average HSIs for the two project areas are due to different acreages, by aspect, in each project area.

(2) HSIs are weighted averages of the HSIs and acreage of each cover type, by elevation band, outside the project areas.

(3) HSIs are weighted averages of the HSIs and acreage inside and outside the project areas.

(4) Open Canopy Conifer was not considered Black-capped Chickadee habitat in the project areas (HSI=0.00). Consequently, it was not factored into the weighted average calculations for the project areas.

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(HSI=0.19 to 0.33). Microclimatic conditions, possibly due to lower soil moisture typical of east and south-facing slopes, may have contributed to higher tree mortality in these areas and resulted in more snags for Black-capped Chickadee nesting. Conversely, aspect did not seem to influence tree mortality in Open Canopy Forests which lacked suitable nesting sites for chickadees.

Habitat quality for cover types outside the project areas was similar to that within the project areas, except for the Open Canopy Conifer Forest (Table 6.10). Open Canopy Conifer sites outside the project areas, particularly those at higher elevations, contained enough snags to provide at least minimal nesting habitat for the Black-capped Chickadee. The primary factor responsible for poor quality Black-capped Chickadee habitat throughout the entire study area was the low number of suitably-sized snags for nesting.

Construction of Grey Mountain Dam would result in a net loss of 123 AAHUs of Black-capped Chickadee habitat from the study area (Table 6.11, Appendix H). Construction of the Poudre Dam alternative would cause a net loss of 111 AAHUs. These losses would be primarily due to the inundation or disturbance of approximately 218 to 234 acres, respectively, of Closed Canopy Conifer Forest.

Song Sparrow

The Song Sparrow was chosen as an evaluation species because it represents birds that reproduce and feed in shrubs and make extensive use of riparian areas and wetlands (Verner and Boss, 1980). Optimal habitats for the Song Sparrow are areas adjacent to water with scattered groups of dense shrubs (FWS, 1978). Preferred foraging areas are low shrub thickets with abundant clearings (Tompa, 1964). Nesting areas must have abundant perch sites elevated above the shrub canopy (Miller, 1942). The HEP team decided to evaluate riparian shrub and forest cover types because they met the habitat requirements for the Song Sparrow.

TABLE 6.11

Summary of AAHUs for the Black-capped Chickadee [1]

Cover Type	Without Project AAHUs	With Project AAHUs	Net Change AAHUs
Closed Canopy Conifer			
Grey Mountain	2805.85	2702.34	-103.51
Poudre	2805.85	2711.66	-94.19
Open Canopy Conifer			
Grey Mountain	1650.45	1650.45	0.00
Poudre	1650.45	1650.45	0.00
Riparian Forest			
Grey Mountain	98.01	78.56	-19.46
Poudre	98.01	81.56	-16.45
Total			
Grey Mountain	4554.31	4431.35	-122.96
Poudre	4554.31	4443.67	-110.64

(1) See Appendix H for calculations of Habitat Units and Average Annual Habitat Unit.

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The study area provided relatively high quality habitat (HSI=0.71) for the Song Sparrow (Table 6.12). Habitat quality was essentially the same for both the Gray Mountain and Poudre project areas. Habitat quality was similar within (HSI=0.75) and outside the project areas (HSI=0.70). In the project areas, habitat quality was higher for Riparian Shrub (HSI=0.83) than for Riparian Forest (HSI=0.73). Aspect did not have a significant effect on habitat quality, since most riparian areas are generally narrow and along stream corridors, where aspect does not influence microclimatic conditions. Habitat quality outside the project areas was similar to that within the project areas for all cover types (Table 6.12). Elevation did not appear to influence habitat quality for the Song Sparrow. The primary factor limiting the quality of Song Sparrow habitat in the entire study area was shrub density.

Construction of Grey Mountain Dam would result in a net loss of 58 AAHUs of Song Sparrow habitat from the study area. Construction of the Poudre alternative would cause a net loss of 46 AAHUs (Table 6.13, Appendix H). These losses would be primarily due to the inundation of approximately 75 to 92 acres, respectively, of the Riparian Forest and Shrub habitats in the study area.

Western Meadowlark

The Western Meadowlark was chosen as an evaluation species because it represents birds that feed and reproduce in open grasslands and pastures (Verner and Boss, 1980). Optimal habitats are grasslands with an abundance of perch sites provided by rocks, grass stems, or other elevated structures. Preferred nesting areas have abundant perch sites, no shrub cover, and an average grass/forb canopy height of 12 to 35 cm (Schroeder and Sousa, 1982). The HEP team decided to evaluate agriculture and grassland cover types since they met these habitat requirements for the Western Meadowlark.

TABLE 6.12

Average HSI Values for the Song Sparrow

Location	HSIs		
	Riparian Forest	Riparian Shrub	Weighted Average (1)
Grey Mountain Project Area			
East	0.70	0.83	0.75
South	0.69	0.74	0.69
North	0.77	0.83	0.80
Weighted Average[1]	0.73	0.83	0.75
Poudre Project Area			
East	0.70	0.83	0.75
South	0.69	0.74	0.69
North	0.77	0.83	0.78
Weighted Average[1]	0.74	0.83	0.76
Outside Project Areas[2]	0.66	0.82	0.70
Study Area[3]	0.67	0.82	0.71

(1) Weighted average is based on the area of each cover type, by aspect, in the project area. Differences in average HSIs for the two project areas are due to different acreages, by aspect, in each project area.

(2) HSIs are weighted averages of the HSIs and acreage of each cover type, by elevation band, outside the project areas.

(3) HSIs are weighted averages of the HSIs and acreage inside and outside the project areas.

TABLE 6.13

AAHU Summary for the Song Sparrow[1]

Cover Type	Without Project AAHUs	With Project AAHUs	Net Change AAHUs
Riparian Forest			
Grey Mountain	260.07	214.02	-46.05
Poudre	260.07	222.73	-37.35
Riparian Shrub			
Grey Mountain	98.76	87.09	-11.67
Poudre	98.76	90.02	- 8.74
Total			
Grey Mountain	358.83	301.11	-57.72
Poudre	358.83	312.74	-46.09

(1) See Appendix H for calculations of HUs and AAHUs.

The study area provided moderate quality (HSI=0.50) habitat for the Western Meadowlark (Table 6.14). Habitat quality was essentially the same for both the Grey Mountain and Poudre project areas. Habitat quality was higher in the project areas (HSI=0.60) than outside the project areas (HSI=0.50). In the project areas habitat quality was similar for upland (HSI=0.60) and Riparian (HSI=0.57) Grasslands. There was no Agriculture in the project areas. Aspect did not have a significant effect on habitat quality for the Western Meadowlark. Since most grasslands were generally in areas with low slopes, aspect had little influence on microclimatic conditions. Riparian Grasslands along the north and west sides of the project areas provided higher quality Meadowlark habitat than those along the east or south sides. The lower quality of Riparian Grassland along east and south sides was probably the result of human disturbance from recreation along the mainstem. Most of the Riparian Grasslands on north and west sides were along the North Fork and were less disturbed. Habitat quality of Upland and Riparian Grasslands outside the project areas was similar to that within the project areas (Table 6.14). Agriculture habitat quality was low. The primary factor responsible for limiting habitat quality in the study area was less than optimal herbaceous canopy cover.

Construction of Grey Mountain Dam would result in a net loss of 177 AAHUs of Western Meadowlark habitat from the study area (Table 6.15, Appendix H). Construction of the Poudre alternative would cause a net loss of 140 AAHUs. These losses would be primarily due to the inundation or disturbance of approximately 269 to 335 acres, respectively, of Grassland habitat.

Great Blue Heron

The Great Blue Heron was chosen as an evaluation species because it represents birds that forage in water and reproduce in large trees adjacent to water. Preferred foraging areas are shallow water areas of rivers, wetlands, and reservoirs with small fish, although Herons will feed elsewhere (Bayer, 1978; Burleigh, 1958). Herons generally nest in colonies, particularly in forested sites within 250 m of water. The tree species is not as important as its height and distance from human

TABLE 6.14

Average HSI Values for the Western Meadowlark

Location	HSIs			
	Grassland	Riparian Grassland	Agriculture	Weighted Average (1)
Grey Mountain Project Area				
East	0.58	0.51	---(4)	0.58
South	0.65	0.51	---	0.65
North	0.59	0.87	---	0.59
Weighted Average(1)	0.60	0.57	---	0.60
Poudre Project Area				
East	0.58	0.51	---	0.57
South	0.65	---	---	0.65
North/West	0.59	0.87	---	0.59
Weighted Average(1)	0.59	0.58		0.58
Outside Project Areas(2)	0.51	0.51	0.34	0.50
Study Area(3)	0.51	0.55	0.34	0.50

(1) Weighted average is based on the area of each cover type, by aspect, in the project area. Differences in average HSIs for the two project areas are due to different acreages, by aspect, in each project area.

(2) HSIs are weighted averages of the HSIs and acreage of each cover type, by elevation band, outside the project areas.

(3) HSIs are weighted averages of the HSIs and acreage inside and outside the project areas.

(4) Dashes indicate that cover type was absent.

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TABLE 6.15

AAHU Summary for the Western Meadowlark[1]

Cover Type	Without Project AAHUs	With Project AAHUs	Net Change AAHUs
Grassland			
Grey Mountain	5,250.86	5,078.77	-172.09
Poudre	5,250.86	5,114.03	-136.83
Riparian Grassland			
Grey Mountain	7.72	2.53	-5.19
Poudre	7.72	4.42	-3.31
Agriculture			
Grey Mountain	328.93	328.93	0.00
Poudre	328.93	328.93	0.00
Total			
Grey Mountain	5,587.51	5,410.23	-177.28
Poudre	5,587.51	5,447.38	-140.13

(1) See Appendix H for calculations of HUs and AAHUs.

activity (Miller, 1943). Optimal habitat consists of areas with large trees for nesting that are free of human disturbance and in close proximity to shallow water with available prey (Short and Cooper, 1985). The HEP Team agreed to evaluate the Riparian and Open Canopy Conifer forests within 250 m of water as potential nesting habitat because they met the habitat requirements of the Great Blue Heron. The HEP team also agreed to evaluate the Riverine and Lacustrine cover types in the study area as potential foraging habitat.

Under without-project conditions, Great Blue Heron nesting and forage habitat quality was evaluated only for the North Fork. The mainstem area was too disturbed by Highway 14 to provide habitat for this species. Under with-project conditions, nesting habitat quality was evaluated for the Open Canopy Conifer and Riparian Forest within 250 m of the entire reservoir shore at normal maximum pool level (elevation 5,630 ft MSL). Forage habitat quality for the Heron was evaluated only for the North Fork portion of the proposed reservoir, since the sides of the reservoir along the mainstem area will be too steep to provide enough shallow water required for Heron forage habitat. Since nesting and forage habitats both must be present for herons to successfully reproduce, the quality of each habitat was combined into a single HSI value for each alternative.

The study area provided relatively low habitat quality for the Great Blue Heron (Table 6.16). Habitat quality was similar for with-project (HSI=0.26, 0.28) and without-project (HSI=0.32) conditions for both the Grey Mountain and Poudre alternatives. The factor most responsible for poor quality Heron habitat in the study area was the large distance between potential and active heron colonies. Reservoirs or rivers with appropriate feeding and nesting habitat that are more than 25 km from an active rookeries are not readily colonized (Short and Cooper, 1985). The nearest active Great Blue Heron colony is at Fossil Creek Reservoir which is more than 25 km from the study area.

Construction of Grey Mountain Dam would result in a net loss of 29 AAHUs of Great Blue Heron habitat from the study area (Table 6.16, Appendix H). Construction of the Poudre Dam alternative would cause a net loss of 32 AAHUs. These would be due primarily to the loss of the shallow water feeding areas and the inundation of most of the Riparian Forest in the study area. Although Grey Mountain Reservoir would be larger than the Poudre Reservoir, the loss of Great Blue Heron habitat would be less. Grey Mountain Reservoir would have more shoreline and consequently, more nesting habitat.

Mule Deer

The Mule Deer was selected as an evaluation species because it represents mammals that use a wide variety of cover types. Furthermore, the study area is part of the Cache la Poudre Basin which provides winter range for a herd of about 10,000 Mule Deer (Schoonveld, 1986). Mule Deer require three kinds of habitat: forage; hiding cover; and thermal cover. Forage is primarily provided by brushlands where browse is preferred to forbs or grasses (Thomas et al., 1976). Stands of conifer or dense evergreen shrubs 250 to 500 m wide provide optimal hiding and thermal cover for Mule Deer (Thomas et al., 1976). Optimal Mule Deer winter range is assumed to be 60 percent forage and 40 percent cover (FWS, 1982). Slope, aspect, road density, and average snow depth, however, affect the quality of deer winter range.

The HEP team decided to evaluate all terrestrial cover types in the study area as Mule Deer habitat except the Palustrine, Rock/Cliff, Disturbed, and Developed types. Forest types were assumed to provide winter cover habitat for Mule Deer, while Shrublands, Grasslands, and Agriculture (pastures) were assumed to provide winter forage habitat. The HEP team also agreed that slope, aspect, and roads influenced deer use of an area. The team decided to exclude slopes greater than 80 percent from the HEP analyses since they have no habitat value for deer. This modification to the model was derived from a study that found deer rarely used areas with slopes greater than 80 percent (Ganskopp and Vavra, 1987). The team also decided to downweight north-facing slopes in the project areas. North-facing slopes usually

TABLE 6.16

Summary of HSI Values and AAHUs for the Great Blue Heron[1]

Location	Without Project[2][3]		With Project[2][3]		Net Change
	HSI	AAHUs	HSI	AAHUs	AAHUs
Grey Mountain	0.32	90.89	0.26	61.64	-29.25
Poudre	0.32	90.89	0.28	59.33	-31.56

(1) See Appendix H for calculations of HUs and AAHUs.

(2) HSI values are a combination of the quality of both the feeding (Open Canopy Conifer and Riparian Forest) and forage (Riverine and Lacustrine) habitats in the project areas and are therefore not reported by cover type.

(3) HSI values are dependent on the amount of each cover type in the study area used for feeding and reproduction and therefore differ between with and without project conditions.

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accumulate more snow and retain it longer than other aspects. Observations by CDOW biologists suggest that deer use of north-facing slopes in the Cache la Poudre Basin is about 20 percent less than other slopes during winter (Hodgson, 1988). East, west, and south facing slopes and slopes between 0 and 79 percent were not weighted in the analysis, since they were assumed to be equally available to wintering deer.

Roads have been shown to significantly influence deer use of adjacent areas (Thomas et al., 1976; Rost and Bailey, 1979). A study on the east slope of the Colorado Rockies indicated that deer use of shrublands was three times greater beyond 300 m from a road than within 100 m of a road. Deer use of forested areas was less influenced by roads (Rost and Bailey, 1979). The HEP team agreed to downweight the habitat value of areas within 100 m and 100 to 200 m of State Highway 14 and U.S. Highway 287. Values were weighted from data reported by Rost and Bailey (1979) that compared average pellet group densities for these distance intervals (Table 6.17). Because roads affect deer use of shrublands differently than forests, different values were developed to weight the quality of each cover type. The weighted values derived for forests were applied to all forest cover types and the values for shrublands were applied to all appropriate non-forest types.

The study area provided moderate to high quality habitat for Mule Deer (Table 6.18). Winter cover habitat quality (HSI=0.75) was higher than forage habitat quality (HSI=0.68). Habitat quality was essentially identical for both the Grey Mountain and Poudre project areas and outside the project areas. Habitat quality was determined for each cover type and weighted by area to derive the average HSI for cover and forage in the project areas, outside the project areas, and the study area.

Nine cover types provided winter forage habitat for Mule Deer and six of these also provided winter cover habitat (Appendix H). The habitat quality of winter cover for Mule Deer ranged from 0.33 to 1.00 HSI. Closed Canopy Conifer provided the highest quality winter cover (HSI=0.77 to 1.00), while the other upland forest types provided intermediate

TABLE 6.17

Values Used to Weight Habitat Quality for Mule Deer Within 200 m of Roads

Distance From Road	Forest Cover Types		Shrublands and Open Cover Types	
	Number of Deer Pellet Groups[1]	Weight[2]	Number of Deer Pellet Groups[1]	Weight[2]
0 - 100 m	2.5	0.50	3.5	0.32
100 - 200 m	4.0	0.80	9.0	0.82
Greater than 200 m	5.0	1.00	11.0	1.00

(1) As reported by Rost and Bailey (1979)

(2) Weights for distances less than 200 m are the proportion of pellet groups counted for that distance divided by the number of pellet groups counted at distances greater than 200 m. The HEP team assumed that deer use was not influenced in areas beyond 200 m from the road.

TABLE 6.18

Average HSI Values for Mule Deer

Location	HSIs	
	Food[1]	Winter Cover [2]
Grey Mountain Project Area		
East	0.63	1.00
South	0.49	0.49
North	0.91	0.58
Weighted Average[3]	0.70	0.71
Poudre Project Area		
East	0.61	1.00
South	0.39	0.60
North	0.91	0.59
Weighted Average[3]	0.72	0.75
Outside Project Areas[4]	0.68	0.75
Study Area[5]	0.68	0.75

(1) Winter feeding habitat quality for the Mule Deer is dependent on the quality, interspersion and amount of cover types providing forage. Consequently, HSIs are not calculated by cover type.

(2) Winter cover habitat quality for the Mule Deer is dependent on the quality, interspersion and amount of cover types providing winter cover. Consequently, HSIs are not calculated by cover type.

(3) Weighted average is based on the area of each cover type, by aspect, in the project area. Differences in average HSIs for the two project areas are due to different acreages, by aspect, in each project area.

(4) HSIs are weighted averages of the HSIs and acreage of each cover type, by elevation band, outside the project areas.

(5) HSIs are weighted averages of the HSIs and acreage inside and outside the project areas.

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quality (HSI=0.58 to 0.80). The Shrubland and Riparian Forest types provided the lowest quality winter cover habitat (HSI=0.33 to 0.56). The primary factor responsible for limiting the quality of winter cover habitat in the study area was less than optimal evergreen shrub or conifer cover.

The quality of winter forage habitat for Mule Deer ranged from 0.14 to 1.00 HSI. Shrubland types had the highest quality forage (HSI=0.74 to 1.00) and Closed Canopy Conifer consistently had the lowest (HSI=0.14 to 0.20). Winter forage quality for the other cover types was variable (HSI=0.20 to 0.43). The primary factor responsible for limiting the quality of forage habitat in the study area was the availability of palatable deer browse in the forested cover types.

Aspect and roads had a significant influence on habitat quality in the project areas. Winter forage and cover habitat quality was lowest on the south side of the project areas primarily because of aspect (north-facing slopes were down-weighted by 20 percent) and disturbance from Highway 14. Forage habitat quality on the north/west side of the project areas was the highest because the dry soils on these slopes (south and east facing) are more suitable for growing shrubs (52 percent) than dense forests which shade out winter deer browse. The lower quality of winter cover habitat on south and east-facing slopes was due to the small area of conifer forest (20 percent). Conversely, west-facing slopes were nearly 40 percent forested and provided optimal winter cover for Mule Deer.

HEP requires using the most limiting life requisite to evaluate effects. Since winter forage habitat quality was more limiting (lower HSI) in the study area than winter cover habitat quality, the AAHUs for the forage life requisite were used to evaluate the effects of the Grey Mountain and Poudre alternatives on deer. Construction of Grey Mountain Dam would result in a net loss of 1,097 AAHUs of Mule Deer habitat from the study area (Table 6.19, Appendix H). Construction of

TABLE 6.19

Summary of AAHUs for the Mule Deer[1]

Life Requisite	Without Project AAHUs	With Project AAHUs	Net Change AAHUs (2)
Winter Forage			
Grey Mountain	25,530.07	24,432.73	-1,097.34
Poudre	25,530.07	24,622.56	-907.51
Winter Cover			
Grey Mountain	28,331.63	27,242.72	-1,088.91
Poudre	28,331.63	27,367.29	-964.34

(1) See Appendix H for calculations of HUs and AAHUs.

(2) Since winter forage habitat quality was most limiting in the study area (HSI=0.68), the AAHUs for forage were used to evaluate the effects of each project alternative.

the Poudre Dam alternative would cause a net loss of 908 AAHUs. These losses will be primarily due to the inundation or disturbance of 698 to 972 acres of Shrubland in the study area.

Abert Squirrel

The Abert Squirrel was chosen as an evaluation species because it serves as an indicator of wildlife species affected by the loss of ponderosa pine forests from the project. Optimal habitat for the Abert Squirrel is uneven-aged stands of ponderosa pine trees with crowns that interlock. Preferred feeding areas have several large (greater than 21 cm dbh) ponderosa pine trees. Preferred nesting areas have relatively dense stands of ponderosa pine trees with crowns that interlock and an average dbh of over 28 cm. The HEP team decided to evaluate the Open and Closed Conifer Forest cover types because they met the habitat requirement of the Abert squirrel.

The study area provided low quality (HSI=0.13) habitat for the Abert Squirrel (Table 6.20). Habitat quality was essentially the same for both the Grey Mountain and Poudre project areas. Habitat quality was similar inside (HSI=0.17 and 0.19) and outside (HSI=0.13) the project areas. In the project areas, habitat quality was low for both Open and Closed Canopy Forest (HSI=0.12 to 0.20). Forests on west-facing slopes consistently provided higher quality habitat than did sites with other aspects. Microclimate conditions, possibly associated with the higher moisture typical of west-facing slopes with adequate soil, may have contributed to growing denser stands of larger trees in this area. North-facing slopes also typically have higher soil moisture but in the project areas the slopes with a northern aspect were very steep and rocky and may not be conducive to tree establishment and growth. South-facing slopes were typically dry, and those in the project areas supported only a few small patches of forest. Habitat quality outside the project areas was similar to that within the project areas for both cover types. Elevation had no noticeable effect on Abert Squirrel habitat quality. Tree size and basal area were responsible for the poor quality of Abert Squirrel

TABLE 6.20

Average HSI Values for the Abert Squirrel

Location	HSIs		
	Closed Canopy Conifer Forest	Open Canopy Conifer Forest	Weighted Average
Grey Mountain Project Area			
West	0.25	0.35	0.31
North	0.00	0.00	0.00
South/East	0.00	0.00	0.00
Weighted Average[1]	0.12	0.20	0.17
Poudre Project Area			
West	0.25	0.35	0.31
North	0.00	0.00	0.00
South/East	0.00	0.00	0.00
Weighted Average	0.13	0.23	0.19
Outside Project Areas[2]	0.10	0.16	0.13
Study Area[3]	0.10	0.16	0.13

(1) Weighted average is based on the area of each cover type, by aspect, in the project area. Differences in average HSIs for the two project areas are due to different acreages, by aspect, in each project area.

(2) HSIs are weighted averages of the HSIs and acreage of each cover type, by elevation band, outside the project areas.

(3) HSIs are weighted averages of the HSIs and acreage inside and outside the project areas.

habitat in the entire study area. In upland forest sites, tree basal area and diameter were generally too low to provide nesting habitat for this species.

Construction of Grey Mountain Dam would result in a net loss of 92 AAHUs of Abert Squirrel habitat from the study area (Table 6.21, Appendix H). Construction of the Poudre Dam alternative would cause a net loss of 88 AAHUs. These losses would be primarily due to the inundation or disturbance of approximately 538 to 630 acres of upland forest.

Beaver

The beaver was chosen as an evaluation species because it serves as an indicator of wildlife species affected by the loss of Riverine and Riparian habitat when a reservoir replaces a free-flowing river. Optimal beaver habitats are wetlands, ponds, and streams having a slope gradient below six percent and a small annual water fluctuation. Reservoirs with extreme water fluctuations are not used by beaver because their burrows become exposed part of the year (Slough and Sadleir, 1977). Preferred foraging habitats are wetlands, ponds, or streams adjacent to dense stands of small trees and moderately dense shrubs dominated by aspen, willow, cottonwood, or alder (Allen, 1983). Since beavers are herbivorous and will forage up to 200 m from water, the quality of beaver habitat depends on the wetland and also forage composition and density within 200 m (Allen, 1983). Similarly, the quality of riverine and lacustrine habitats depends on the adjacent riparian or upland cover types meeting the forage requirements of the beaver.

The HEP team decided to evaluate only the mainstem and North Fork rivers and adjacent lands as beaver habitat. The ponds in the study area are used for irrigation and they dry-up during part of the year. Similarly, the pool level of the proposed reservoir could be significantly lower during drought years. The HEP team agreed that

TABLE 6.21

Summary of AAHUs for the Abert Squirrel[1]

Cover Type	Without Project AAHUs	With Project AAHUs	Net Change AAHUs
Closed Canopy Conifer			
Grey Mountain	570.26	545.75	-24.51
Poudre	570.26	545.75	-24.51
Open Canopy Conifer Forest			
Grey Mountain	1,120.18	1,052.60	-67.58
Poudre	1,120.18	1,056.51	-63.67
Total			
Grey Mountain	1,690.44	1,598.35	-92.10
Poudre	1,690.44	1,602.26	-88.18

(1) See Appendix H for calculations of HUs and AAHUs.

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Seaman Reservoir, the ponds in the study area, and the proposed reservoir are unsuitable beaver habitat because of existing or proposed fluctuations in water levels.

Studies of beaver habitat suggest that slope and roads limit the availability of food (Rutherford, 1964; Slough and Sedleir, 1977; Hoover and Wills, 1984). A study in California found no active beaver colonies in streams adjacent to slopes greater than 30 percent (Beier and Barrett, 1987). In addition, areas bordering or bisected by highways act as barriers for beaver to access food (Slough and Sadleir, 1977). Consequently, the HEP team agreed to evaluate beaver habitat for only those segments of the Cache la Poudre River adjacent to slopes less than 40 percent and not crossed by Highway 14.

Under without-project conditions, the study area provided quality beaver habitat (HSI=0.71) (Table 6.22). Approximately 70 percent of the area within 200 m of the Cache la Poudre River was available to beaver for feeding and the quality of this habitat was optimal. Almost 30 percent of area within 200 m of the river was eliminated as beaver forage habitat because it was along Highway 14 or on steep slopes. Therefore, the primary factor responsible for limiting the quality of beaver habitat in the study area was the amount of area available for feeding.

Construction of the project will eliminate all beaver habitat in the project areas. A small amount of Riverine habitat will remain in the study area outside the project areas. Under with-project conditions, forage habitat quality will be limited in the remaining Riverine habitat. The quality of the feeding habitat in the area remaining after construction of Grey Mountain Dam is expected to be relatively high (HSI = 0.78). More feeding habitat would be available if Poudre Dam were constructed, but its overall quality would be moderate (HSI = 0.59) because of the influence of slope and roads on the remaining area.

TABLE 6.22

Summary of HSI Values and AAHUs for the Beaver[1]

Location	Without Project[2]		With Project[2]		Net Change
	HSI	AAHUs	HSI	AAHUs	AAHUs
Grey Mountain	0.71	126.56	0.78	51.25	-75.31
Poudre	0.71	126.56	0.59	56.22	-70.34

(1) See Appendix H for calculations of HUs and AAHUs.

(2) HSI values are a combination of the quality of both the feeding and cover habitats in the project areas and are therefore not reported by cover type.

Construction of Grey Mountain Dam would result in a net loss of 75 AAHUs of beaver habitat from the study area (Table 6.22, Appendix H). Construction of the Poudre alternative would cause a net loss of 70 AAHUs. These losses would be primarily due to the inundation of 128 and 100 acres, respectively, of Riverine habitat in the study area.

6.4.2.2 Effects on Threatened and Endangered Wildlife and Species of Special Interest

Assessment of project effects on wildlife species of concern can only be made where there is a direct loss of habitat. Indirect effects are not possible to determine with a high degree of certainty. Moreover, assessing the capacity of a species to adjust to the development of the proposed reservoir is not possible since the predictions cannot be substantiated by data. Indirect impacts on wildlife species of concern will have to be determined through discussions with appropriate resource agencies, and the resulting mitigation negotiated on a species-specific basis.

Although this study was not designed to evaluate wildlife populations but rather wildlife habitat, some limited assessment of effects can be stated for species for which we have data.

Threatened and Endangered Species

Bald Eagle

The proposed reservoir would inundate trees currently used by bald eagles for perching and intermittent roosting at night. The loss of these trees would affect at least seven bald eagles observed wintering in the project areas. These eagles represent approximately 1 percent of the 600-700 bald eagles wintering in Colorado. Effects on bald eagles would be the same for both the Grey Mountain and Poudre alternatives. A Biological Assessment and close coordination with FWS will be required for this species under Section 7(c) of the Endangered Species Act (1973). Depending on the results of the Biological Assessment, a formal FWS Section 7(c) consultation may be required.

Peregrine Falcon, Least Tern, Piping Plover, and River Otter

There is no information available on use of the project areas by these species to evaluate effects. Information, however, is available to suggest the project areas are not regularly or intensively used by these species.

Species of Special Interest

Golden Eagle

The proposed reservoir would not flood the five active and four alternate golden eagle nests located in the study area. The two active nests along the North Fork would be 0.2 miles from the proposed reservoir while the other three active nests would be over 2 miles from the proposed reservoir. The two nests along the North Fork would be visible from the proposed reservoir but they would be over 400 ft above the maximum pool elevation, and access by people would be difficult.

Although the proposed project would not inundate any known golden eagle nests, it would reduce the amount of available foraging and nesting habitat. Approximately 14 and 22 acres of rock/talus habitat would be inundated by the Poudre and Grey Mountain alternatives, respectively. All the nests in the study area are in the rock/talus cover type, but whether the habitat that would be inundated would otherwise be suitable for additional nests cannot be determined. In addition, approximately 1,310 and 1,734 acres of potential foraging habitat would be inundated by the Poudre and Grey Mountain alternatives, respectively. Foraging habitat includes mountain shrub, rock/talus, grassland, and open canopy conifer. Although these cover types are available for foraging, the quality of the prey base for golden eagles in available areas is not known.

The proposed project would affect golden eagles to some degree, primarily by reducing the foraging area available to the local population. However, effects on golden eagles would be the same for both the Grey Mountain and Poudre project alternatives.

Mule Deer

The proposed reservoir would inundate approximately 1,500 to 2,000 acres of mule deer winter range. This represents about 5 percent of the winter range within the study area. The impact would, however, be particularly important during severe snow years when deer concentrate in the Poudre Canyon. The reduced amount of winter range could increase grazing pressure on the remaining range areas which could affect the physical condition of the animals.

The proposed reservoir could also interfere with mule deer movement patterns on the winter range. Mule deer currently winter on both sides of the Cache la Poudre River, particularly along the North Fork. The reservoir could alter the distribution of deer by increasing the travel distance around the reservoir to the area east and south of the river. Deer may, consequently, respond to the reservoir by increasing the intensity and period of use in the area north and west of the river. The area east and south of the river would probably also be used, but possibly not until the other portions of the winter range have been heavily browsed by the animals. Heavy browsing may reduce the quantity and potentially affect the physical condition of the animals. Another potential effect from the proposed project could occur when the reservoir freezes during winter periods. Deer can fall through thin ice during freezeup or become trapped on ice during the spring thaw (Martin et al., 1985).

The results of the HEP determined the quality and quantity of mule deer habitat that would be inundated by the project. The HEP results, however, do not account for secondary effects that may change mule deer use patterns elsewhere in the study area. These effects should be determined through consultation with the resource agencies and included in species-specific mitigation. Effects on deer would be similar for both the Grey Mountain and Poudre project alternatives.

Bighorn Sheep

Small numbers of bighorn sheep have been infrequently observed in the study area from late winter to early spring. This suggests that the study area is not an important bighorn sheep range, but it does provide habitat to a small number of animals. The importance of the area to these animals is not possible to determine from the available data. The effects of the project, however, to the populations of bighorn sheep associated with the Poudre River Canyon will not be significant (i.e., will not reduce the reproductive viability of the populations), since their ranges are largely outside the study area and their migration routes will not be interrupted by the proposed reservoir.

6.5 DISCUSSION

In general, the effects of reservoirs on wildlife include: (1) loss of habitat; (2) disturbance; (3) disruption of migration routes; and (4) direct mortality due to clearing or flooding. The major effects of the Cache la Poudre Project on wildlife would be loss of habitat (Figure 6.8). Grey Mountain Dam would inundate or alter approximately 2,186 acres of habitat including 972 acres of Shrubland, 630 acres of Upland Forest, 334 acres of Grassland, 127 acres of Riverine, 101 acres of Riparian, and 22 acres of Rock and Talus. Poudre Dam would affect approximately 1,702 acres of habitat including 698 acres of Shrubland, 539 acres of Upland Forest, 269 acres of Grassland, 99 acres of Riverine, 83 acres of Riparian, and 14 acres of Rock and Talus. Regional impacts would be greatest for the Riparian and Riverine habitats which are generally not abundant and are presently vulnerable to development and recreation. There are no designated wetlands in the project areas.

Effects on upland forest habitat in the study area were evaluated by using the Abert Squirrel, Black-capped Chickadee, and Mule Deer as indicator species. The Open and Closed Canopy Conifer Forests in the Grey Mountain and Poudre project areas provide high quality winter

cover habitat for the Mule Deer. Mature Closed Canopy Conifer Forests also provide moderate quality feeding and nesting habitat for the Black-capped Chickadee. This species depends on snags usually present in mature forest stands to complete its life cycle. The Closed Canopy Conifer Forest, dominated by ponderosa pine, provides the only habitat used by the Abert Squirrel, but the quality is relatively low because of low basal area and small tree size. Loss of Upland Forests would also affect other animals dependent on these forests for food, cover and reproduction. Representative species that require conifer trees for food include the dark-eyed junco (Junco hyemalis), evening grosbeak (Coccothraustes vespertina), Swainson's thrush (Cartharus ustulata), and mountain chickadee. Species that require snags for reproduction include the mountain chickadee, white-breasted nuthatch (Sitta carolinensis), northern flicker (Colaptes auratus), and Lewis' woodpecker (Melanerpes lewis). The proposed Grey Mountain Dam would affect 234 acres of Closed Canopy Conifer which represents a loss of 123 AAHUs for the Black-capped Chickadee and 92 AAHUs for the Abert Squirrel. Construction of Poudre Dam would impact 218 acres of Closed Canopy Conifer and result in a loss of 111 AAHUs for the Black-capped Chicadee and 88 AAHUs for the Abert Squirrel. Other species dependent on Upland Forests, including Mule Deer, would also be affected by the project.

Effects on Shrubland habitat in the study area were evaluated by using the Mule Deer as an indicator species. Shrublands in the Grey Mountain and Poudre project areas provide high quality Mule Deer winter forage habitat, except along the mainstem where Highway 14 significantly reduces deer use. The Shrublands in the project areas have a high proportion of shrubs palatable to deer that provide important winter forage. Loss of this habitat will impact the Mule Deer and other species dependent on Shrublands for food, cover, and reproduction. Shrublands support a wide variety of small mammals, reptiles, and birds such as the rufous-sided towhee (Pipilo erythrophthalmus) and several species of sparrow. The construction of Poudre or Grey Mountain dams would affect approximately 698 or 972 acres of Shrubland, respectively, which represents a loss of habitat for all species dependent on this type. The effects on

Shrublands and other foraging areas from the Grey Mountain or Poudre alternatives would result in the loss of 1,097 or 908 AAHUs, respectively, of Mule Deer winter forage habitat.

Effects on Grassland habitat in the study area were evaluated by using the Mule Deer and the Western Meadowlark as indicator species. The Grey Mountain and Poudre project areas provide moderate quality Meadowlark habitat. The Meadowlark requires a dense grass canopy for nesting cover and depends on the insects associated with this habitat for food. Grasslands in the project areas provide moderate quality forage habitat for Mule Deer. Data collected in the Cache la Poudre area indicate that deer prefer Grasslands for foraging and resting at night (Kufeld, 1986). Loss of this habitat type would impact the Western Meadowlark, Mule Deer, and other animals dependent on Grasslands for food, cover, and reproduction. Grasslands support a wide variety of small mammals such as the grasshopper mouse (Onychomys leucogaster), deer mouse (Peromysus maniculatus), long-tailed vole (Microtus longicaudus), pocket mouse (Perognathus sp.), and golden-mantled ground squirrel (Spermophilus latoralis). These small mammals are common prey species for several raptors including the red-tailed hawk, rough-legged hawk, and golden eagle. Consequently, raptors are also dependent on Grasslands for food. Construction of the Poudre or Grey Mountain projects would affect approximately 269 or 334 acres, respectively, of Grassland which represents a loss of 140 or 177 AAHUs of Western Meadowlark habitat. Also affected would be the Mule Deer, and other species associated with this habitat type.

Effects on Riparian shrubland and forest habitats in the study area were evaluated by using the Song Sparrow as an indicator species. The Grey Mountain and Poudre project areas provide high quality habitat for the Song Sparrow, particularly in areas that have not been disturbed by grazing and recreation. This species requires dense shrubs adjacent to water for feeding and nesting. Regionally, riparian areas comprise a small amount of acreage but provide habitat to a wide variety of wildlife (Roberts, 1983). Other species dependent on this habitat include the yellow warbler, striped skunk (Mephitis mephitis), grey

catbird (Dumetella carolinensis), and western kingbird (Tyrannus verticalis). Construction of the proposed Poudre or Grey Mountain project would affect 75 or 92 acres of Riparian Shrubland and Forest, respectively, which represent a loss of 46 or 58 AAHUs for the Song Sparrow and other species dependent on this habitat.

Effects on Riverine habitat in the study area were evaluated by using the Beaver and Great Blue Heron as indicator species. The Grey Mountain and Poudre project areas provide moderate quality beaver habitat. Beaver use the river proper for travel and escape cover. The adjoining riparian habitat provides food from plants such as willow, alder, and other shrubs or small trees. Conversely, the Great Blue Heron uses the river for feeding and the adjacent riparian and upland forests for nesting. The project areas provide low habitat quality for the Heron. Loss of river segments affect the Beaver and Great Blue Heron, as well as other animals dependent on the river for food, cover, and reproduction. Representative mammals include mink (Mustela vison), river otter, and raccoon (Procyon lotor) which feed on fish. Representative birds include dipper, kingfisher (Ceryle alcyon), and common merganser (Mergus merganser) which feed in the water and reproduce in the adjacent riparian cover. Rivers in the region comprise a small amount of area but provide habitat to a variety of wildlife. Construction of the Poudre or Grey Mountain alternatives would affect approximately 99 or 127 acres of river, respectively, which represents a loss of 70 or 75 AAHUs for beaver and 32 or 29 AAHUs for the Great Blue Heron, respectively. Other species associated with the riverine-riparian complex, will also be affected by the loss of available habitat.

None of the species evaluated by the HEP were positively affected by the proposed project. However, a number of species, particularly water birds, may benefit from the reservoir. Migrating waterfowl may use the reservoir as a resting area during the fall or spring, depending on the water level. The reservoir may also provide seasonal habitat for coots, rails, sandpipers, gulls, and ospreys.

In summary, both the Grey Mountain and Poudre project areas provide moderate to high quality habitat for five of the seven species evaluated by the HEP and their associated guilds. Disturbance from historical grazing, recreation, roads, and housing developments influenced the quality of the habitat available in the project areas for all the evaluation species except the Black-capped Chickadee and Abert Squirrel. Although construction of the project would have significant effects on local wildlife habitats, the effects will be much less severe in a regional context except for the Riparian and Riverine habitats. These two habitats are regionally important because they support a high diversity of wildlife and are currently represented by a small amount of area. Specialists, such as the Beaver, Song sparrow, and Abert Squirrel, depend on specific cover types to meet their life requisites and would be more affected by the proposed project than generalists.

The habitat quality provided by the Grey Mountain and Poudre project areas is similar for all the species included in the HEP. In general, effects on wildlife from construction of Grey Mountain Dam will be greater than those from the Poudre alternative because of the larger amount of acreage affected (Figure 6.10). The larger size of Grey Mountain Reservoir (2,397 acres versus 1,895 acres) would result in greater habitat losses for all species, with the exception of the Great Blue Heron. The longer shoreline of the Grey Mountain Reservoir would provide more nesting habitat for this species than would the Poudre Reservoir. The HEP results do not account for secondary effects that may change wildlife use patterns in the study area. These effects should be determined through consultation with the resource agencies and included in site-specific mitigation.

6.6 MITIGATION

6.6.1 Conceptual Mitigation Plan

Preparation of a mitigation plan requires resolution of at least the following four issues: (1) mitigation debt; (2) compensation; (3) period for fulfilling debt; and (4) monitoring program. Mitigation policies of Colorado state and federal resource agencies do not clearly address these issues. Consequently, resolution must be achieved through negotiations of each issue to obtain a mitigation plan that is satisfactory to the District and resource agencies. These negotiations have not been initiated on the Cache la Poudre Project as of the writing of this report. The purpose of this section, therefore, is to provide a framework for discussion of the development of a mitigation plan with the resource agencies that is acceptable to FERC.

The first issue requiring resolution is the mitigation debt. The HEP was used to determine the project effects on wildlife habitat. The net effect, defined as net AAHUs, is the basis for establishing the mitigation debt. The debt can be expressed in three forms of mitigation commonly used to balance effects: in-kind, out-of-kind, and trade-off. In-kind mitigation, or replacement of lost habitat with habitat of similar type and quality, is normally preferred by the resource agencies. Replacement of lost habitat with habitat of a different type is out-of-kind mitigation. Acquisition of unusual, unique, or scarce habitats to replace regionally abundant habitat represents one application of out-of-kind mitigation accepted by resource agencies. The last and most broadly defined form of mitigation is trade-off mitigation. Trade-off mitigation is replacement of wildlife habitat losses with benefits gained from recreation, fisheries, or other resources provided from the project. The final mitigation debt is a negotiated decision that combines all three forms of mitigation.

A second issue requiring resolution is the degree to which the mitigation debt for each habitat unit must be repaid. This compensation may be lower, higher, or equal to the area of habitat lost by the project depending on the importance of the habitat to wildlife.

Numeric values should be assigned to each unit of habitat acquired by the District to reduce the mitigation debt. Compensation values should be defined for wildlife habitat deemed: (1) critical; (2) rare or unusual; (3) threatened by future development; and (4) high quality. Critical habitat may include areas vital to the survival of a wildlife population such as deer winter range. Rare or unusual habitat may include wetlands, riparian communities, or unique complexes of wildlife habitat. Habitats threatened by future development may include areas vulnerable to disturbance by industrial, residential, or recreational development. Other areas may contain high quality wildlife habitat that fall outside these categories but offer little opportunity for improvement through mitigation. Compensation for protecting these categories of habitat through acquisition may be higher than other categories and may result in more costly habitat improvement programs.

The third issue requiring resolution is the period to fulfill the mitigation debt. This period could range from a few years to the 50-year term of an initial FERC license. Intermediate benchmarks should be established to identify years to complete components of the mitigation plan. The interval of years between benchmarks will depend on the magnitude of the mitigation debt, the availability of suitable replacement habitat, and the process followed for acquiring property and securing financing. Property acquisition could take the form of purchase, lease, easements, or other types of agreements. Acquisition agreements must be coordinated with local governmental entities since purchase of lands may marginally impact a jurisdiction's tax base. Consequently, a reasonable amount of time must be available for the District to fulfill the mitigation debt, but benchmarks must also be established to document the progress realized by the District toward canceling the debt.

The fourth issue requiring resolution is the monitoring program. Once properties have been acquired for mitigation, a long-term biological program should be established to monitor effectiveness of the mitigation. The monitoring program should contain at least the

following elements: (1) management goals; (2) sampling plan; (3) schedule; and (4) costs. The management goals should clearly define the purpose of the management which may include habitat manipulation or protection to achieve or maintain high quality wildlife habitat for a species or group of species. The goals should be quantifiable in order to monitor the success of management. A sampling plan should be formulated that identifies the habitat characteristics requiring measurement and defines the sampling design, sampling procedures, and acceptable levels of statistical significances to detect change in habitat quality. A schedule should be prepared to identify the interval of time and the season of the year required to field monitor mitigation. Annual labor and equipment costs should be incorporated into cost estimates for the monitoring program.

Preparation of a mitigation plan and determination of the associated costs to complete mitigation will require resolution of at least these four issues. The issues will have to be discussed with the resource agencies and negotiated by the District. Several meetings will be required to negotiate a site-specific mitigation plan that balances the project effects on wildlife habitat.

Steps have been taken during the studies described in this report to initiate the mitigation and negotiation processes. These steps included: (1) delineation of a potential area for mitigation; (2) measurement of habitat quality; and (3) calculation of AAHUs. The HEP team selected an area adjacent to the project areas for potential mitigation. In addition to lands that may be required for future stages of the Cache la Poudre Project, this area comprised almost 33,000 acres or almost 5 times the amount of area potentially affected by combined stages of the project. The area was mapped into a GIS, typed by habitat, and enumerated by habitat area. Habitat characteristics were measured in the field and the AAHUs were calculated for the seven evaluation species selected for the effects assessment. The information presented in this report was developed to

provide a basis for discussing mitigation alternatives with appropriate resource agencies. Consequently, the detailed studies completed for the study area should expedite the mitigation and negotiation processes by concentrating discussions on implementation issues rather than steps to develop baseline data.

6.6.2 Preliminary Cost Estimates For Mitigation

The following section describes preliminary cost estimates for wildlife mitigation associated with the proposed Poudre and Grey Mountain alternatives. These preliminary costs will be incorporated into total cost estimates for the two project alternatives to further evaluate economic feasibility. Final costs and mitigation actions can not be determined until the steps described in Section 6.6.1 are completed.

The Poudre and Grey Mountain alternatives for forming the proposed mainstem reservoir will effect approximately 1,900 and 2,400 acres of wildlife habitat, respectively (Table 6.8). The 33,000 acres of land in the study area, but outside the project areas for the Stage 1 project as well as future project stages, will be targeted for possible mitigation. Mitigation for project effects should concentrate on improving the habitat quality to increase the capacity of the remaining habitats to support wildlife. This section, therefore, describes potential mitigation actions and costs which would balance the debts for the Poudre and Grey Mountain alternatives given the information presently available.

The approach used to estimate mitigation costs was based on maximizing the habitat quality of the land inside the study area but outside project areas. Potential improvement of the habitat quality was derived for the seven evaluation species since they were chosen by the HEP team to reflect wildlife use of each habitat type in the study area. Each evaluation species represented a broader group of species or guilds characteristic of a specific habitat type or set of habitat

types. Calculation of the potential habitat quality and resulting area required for mitigation of wildlife effects involved the following steps: (1) identification of the current HSI outside the project areas from the present studies; (2) determination of the differences between the current HSI and 1.0 (optimal) to derive the maximum potential change in HSI achievable through habitat improvement; and (3) determination of the area required for mitigation by dividing this difference or delta (%) into the total AAHUs affected by the projects for each evaluation species. Since this procedure assumes that optimum habitat quality can be obtained from mitigation, the costs presented in this section are considered preliminary estimates only.

The mitigation debt is summarized in Table 6.23. The table identifies the amount of area required to balance the effects for each evaluation species by habitat type assuming that the HSI can be increased to 1.0 through habitat improvement. Improvements should be aimed at the habitat characteristics or parameters described in the HSI models offering the greatest opportunity for improvement. Improvement for most species should involve application of standard mitigation actions followed by wildlife agencies.

Mitigation costs and actions are described below for each habitat type. This approach was taken because multiple species occurred in certain habitat types. Consequently, more than one species could benefit from a single mitigation action such as fencing from livestock. This approach also assumed that habitat types would be obtained in the proper juxtaposition and configuration for multicover species (i.e., deer). Costs of the various mitigation actions were primarily obtained from Elmblad (1988) and based on actual mitigation efforts. Costs of land were obtained from local real estate companies. Separate costs were used for lands near the Poudre River ($2,000 per acre) compared to those away from the Poudre River ($1,200 per acre). Irrigation costs were provided by the Army Corps of Engineers from an existing mitigation project (Christianson, 1988). Fencing/gating costs were provided by the FS.

TABLE 6.23

Area Estimated to Balance Project Effects on Wildlife Habitat

Habitat Type/ Location	Area Available (Acres)	Black-capped Chickadee			Song Sparrow			Western Meadowlark			Great Blue Heron			Mule Deer[5]			Abert Squirrel			Beaver		
		ΔHSI[2]	Acres[3]	AAHU[4]	ΔHSI	Acres	AAHU	ΔHSI	Acres	AAHU	ΔHSI	Acres	AAHU	ΔHSI	Acres	AAHU	ΔHSI	Acres	AAHU	ΔHSI	Acres	AAHU
Closed Canopy Forest																						
Grey Mt.	5,293	0.49	211	104	--	--	--	--	--	--	--	--	--	0.84	49	41	0.90	28	25	--	--	--
Poudre	5,308	0.49	191	94	--	--	--	--	--	--	--	--	--	0.84	45	38	0.90	28	25	--	--	--
Open Canopy Forest																						
Grey Mt.	6,394	--	--	--	--	--	--	--	--	--	--	--	--	0.67	164	110	0.84	81	68	--	--	--
Poudre	6,470	--	--	--	--	--	--	--	--	--	--	--	--	0.67	130	87	0.84	76	64	--	--	--
Mountain Shrub																						
Grey Mt.	12,496	--	--	--	--	--	--	--	--	--	--	--	--	0.20	4,025	805	--	--	--	--	--	--
Poudre	12,771	--	--	--	--	--	--	--	--	--	--	--	--	0.20	3,325	665	--	--	--	--	--	--
Grassland																						
Grey Mt.	9,942	--	--	--	--	--	--	0.49	351	172	--	--	--	0.69	148	102	--	--	--	--	--	--
Poudre	10,007	--	--	--	--	--	--	0.49	280	137	--	--	--	0.69	120	83	--	--	--	--	--	--
Riparian Forest																						
Grey Mt.	312	0.56	25	19	0.34	135	46	--	--	--	--	--	--	0.79	31	24	--	--	--	--	--	--
Poudre	326	0.56	21	16	0.34	109	37	--	--	--	--	--	--	0.79	25	20	--	--	--	--	--	--
Riparian Shrub[6]																						
Grey Mt.	104	--	--	--	0.18	67	12	--	--	--	--	--	--	0.02	653	13	--	--	--	--	--	--
Poudre	108	--	--	--	0.18	50	9	--	--	--	--	--	--	0.02	613	12	--	--	--	--	--	--
Riparian Grassland																						
Grey Mt.	7	--	--	--	--	--	--	0.49	10	5	--	--	--	0.73	3	2	--	--	--	--	--	--
Poudre	8	--	--	--	--	--	--	0.49	6	3	--	--	--	0.73	3	2	--	--	--	--	--	--
Riverine																						
Grey Mt.	51	--	--	--	--	--	--	--	--	--	0.68	43	29	--	--	--	--	--	--	0.22	341	75
Poudre	79	--	--	--	--	--	--	--	--	--	0.68	47	32	--	--	--	--	--	--	0.31	226	70

(1) Assumes that habitat quality can be improved to an optimum condition.

(2) ΔHSI equals the potential for improving habitat quality of lands in the study area outside the project boundaries from the current value to the optimal value.

(3) Acres equals the estimated number of acres to achieve the number of AAHUs necessary to balance the loss of AAHUs. Acres were calculated by dividing the AAHU by the HSI.

(4) AAHU equals the estimated number of AAHUs to balance the loss in AAHUs to wildlife habitat from the projects if constructed.

(5) The distribution of AAHUs by habitat type is an estimate since the total loss of AAHUs for mule deer was derived by combining habitat types into forage or cover and weighting them by area, slope, aspect, and road disturbance.

(6) Potential for habitat improvement is too low to justify mitigation of representative areas of this habitat type that would exist if the project is constructed.

1211K

6.6.2.1 Closed Canopy Forest

If the Grey Mountain Dam alternative is constructed, approximately 211 acres of Closed Canopy Forest would have to be acquired outside the project area to balance habitat losses to wildlife. Construction of the Poudre Dam alternative would require acquisition of 191 acres to offset habitat losses. Areas obtained should include a configuration and vegetation characteristics similar to those that would be affected by the project. Particular emphasis should be placed on acquiring areas containing the Closed Canopy Forest type with a high potential for improvement such as sites disturbed by domestic grazing or human activities. Over 5,000 acres of this type occur outside the project areas in the study area for potential mitigation.

The Black-capped Chickadee, Abert Squirrel, and Mule Deer were the species selected by the HEP team to evaluate project effects on wildlife in Closed Canopy Forest. Approximately 191 to 211 acres of Closed Canopy Conifer Forest would have to be improved for Black-capped Chickadee to offset effects of the project. This represents the maximum amount of Closed Canopy Forest required for any of the three species. Black-capped Chickadee represents species that excavate nests and forage in trees. The number of snags in this type was generally the key factor in limiting the habitat quality for this group of wildlife. Improvements to the Closed Canopy Forest could include placement of next boxes. Nest boxes are effective for providing nesting sites until forests sufficiently mature to naturally provide snags. Once snags are available in the sufficient numbers to provide optimum quality for cavity nesting wildlife, the nest boxes should no longer be necessary. Other mitigation actions include killing mature trees to create snags, but this could reduce habitat quality for other groups of wildlife.

The Abert Squirrel represents a group of species that requires mature stands of Closed Canopy Forest dominated by ponderosa pine. Approximately 25 acres of the total Closed Canopy Forest area acquired for mitigation would have to be dominated by ponderosa pine to offset

the effects of the project on this group of wildlife. Improvement actions beyond the protection of existing areas through land purchase would be impractical. Habitat quality is a function of the size and density of trees, which are controlled by climate and soil conditions. These variables cannot be readily manipulated artificially. Consequently, the only mitigation action considered appropriate at this time is the purchase of timbered areas which would otherwise be commercially harvested or developed. Preservation of such areas will provide the opportunity for the forest to mature and develop high quality habitat for species dependent on older-aged stands of ponderosa pine.

The Mule Deer represents a group of species that forage in the understory of Closed Canopy Forest. Approximately 45 to 60 acres of the total Closed Canopy Forest type acquired for mitigation would have to be improved for Mule Deer and related wildlife to offset the effects of the project. The primary mitigation action suggested would be to manage domestic animal grazing or human activity to obtain optimal wildlife use of the area. This may include excluding or reducing livestock grazing to provide high quality forage for deer. Control of grazing would probably require fencing of lands if there are not existing barriers. Fences are available that exclude livestock but not deer or other wildlife from an area. Similarly, roads can be gated and locked to control access of vehicular traffic on secondary roads. These actions would reduce disturbance to deer and their habitats. Some additional actions may be necessary to stimulate understory growth including limited thinning of young timber to open the tree canopy.

The estimated cost for mitigating the loss of Closed Canopy Forest habitat type at the Grey Mountain alternative is $40,636 compared to $36,926 for the Poudre alternative (Table 6.24).

Table 6.24

Estimated Mitigation Costs for Closed Canopy Forest

Item	Grey Mountain Project (211 ac)	Poudre Project (191 ac)
Purchase Land ($1,200 per acre)	$ 25,320	$ 22,920
Fence/Gates ($2,400 per mile)	2,656	2,546
Nest Boxes ($12 per box at 5 boxes per acre)	12,660	11,460
Total	$ 40,636	$ 36,926

6.6.2.2 Open Canopy Forest

If the Grey Mountain Dam alternative is constructed, approximately 164 acres of Open Canopy Forest would have to be acquired outside the project area to offset effects on wildlife. Construction of the Poudre Dam alternative would require acquisition of approximately 130 acres to balance wildlife habitat losses. Over 6,000 acres of Closed Canopy Forest occur in the study area for potential mitigation.

The Abert Squirrel and Mule Deer were the species selected by the HEP team to evaluate project effects on wildlife in the Closed Canopy Forest type. Mitigation actions suggested for wildlife represented by these two species in the Closed Canopy Forest type would also apply to the Open Canopy Forest. Fencing of land and gating of roads would increase the habitat quality of the understory vegetation for deer and other species. This could be done for the entire 164 acres and 130 acres of mitigation for the Grey Mountain and Poudre alternatives, respectively. Moreover, approximately 80 acres of the total area acquired would have to be dominated by ponderosa pine and protected from harvest to offset the effects of tne projects on wildlife represented by the Abert Squirrel. Mitigation efforts should be directed at acquiring forest stands which are deemed vulnerable to disturbance or provide a reasonable opportunity for improvement through the aforementioned mitigation actions.

The estimated cost for Open Canopy Forest mitigation for the Grey Mountain alternative is $201,660, compared to $160,327 for the Poudre alternative (Table 6.25).

6.6.2.3 Mountain Shrub

If the Grey Mountain Dam alternative is constructed, approximately 4,025 acres of Mountain Shrub habitat would have to be acquired to offset the effects on wildlife habitat. Construction of the Poudre Dam alternative would require acquisition of 3,325 acres of this habitat to balance project effects. Over 12,000 acres of Mountain Shrub habitat currently exist in the study area for possible mitigation.

Table 6.25

Estimated Mitigation Costs for Open Canopy Forest

Item	Grey Mountain Project (164 ac)	Poudre Project (130 ac)
Purchase Land ($1,200 per acre)	$ 196,800	$ 156,000
Fence/Gates ($2,400 per mile)	4,860	4,327
Total	$ 201,660	$ 160,327

1902K

The Mule Deer was selected by the HEP team to evaluate effects of the proposed project on Mountain Shrub habitat. The Mule Deer represents wildlife that forage in the shrub and understory vegetation of this habitat. Opportunities to improve the quality of this habitat type would be limited since the quality is already relatively high. The primary action suggested to improve quality would be to exclude or control grazing by livestock. Livestock have reduced the herbaceous canopy and compete with species such as deer for forage. Fencing the areas from livestock would, therefore, improve the quality of this habitat to wildlife dependent on this habitat type. In addition, gating of secondary roads would control vehicular traffic and reduce disturbances to Mule Deer and other species. Furthermore, mitigation should include acquisition of areas having southern or eastern exposures and low to moderate slopes near the proposed reservoir, in order to offset the effects on Mule Deer with areas recognized by CDOW as preferred winter range.

The estimated cost for Mountain Shrub mitigation for the Grey Mountain alternative is $4,854,075, compared to $4,011,881 for the Poudre alternative (Table 6.26).

6.6.2.4 Grassland

If the Grey Mountain Dam alternative is constructed, approximately 351 acres of Grassland habitat would have to be acquired to compensate for effects on wildlife habitat. Construction of the Poudre alternative would require acquisition of 280 acres to offset effects on wildlife. Approximately 10,000 acres of this habitat type is present in the study area for possible mitigation.

The Western Meadowlark and the Mule Deer are species selected by the HEP team to evaluate effects of the project on wildlife in the Grassland habitat type. These species represent wildlife that forage or nest in grasslands. The quality of Grassland habitat could be increased by improving the herbaceous (grass and forb) cover which has

Table 6.26

Estimated Mitigation Costs for Mountain Shrub

Item	Grey Mountain Project (4025 ac)	Poudre Project (3325 ac)
Purchase Land ($1,200 per acre)	$ 4,830,000	$ 3,990,000
Fence/Gates ($2,400 per mile)	24,075	21,881
Total	$ 4,854,075	$ 4,011,881

been reduced largely by livestock grazing. Mitigation actions most likely to increase herbaceous cover should include fencing to exclude livestock, burning, fertilizing, and seeding the existing Grassland habitat. Lands obtained should target grasslands with a high potential for improvement such as those that have been heavily grazed by livestock.

The estimated cost for mitigating loss of Grassland habitat type is $478,224 for the Grey Mountain alternative, compared to $378,955 for the Poudre alternative (Table 6.27).

6.6.2.5 **Riparian Forest**

If Grey Mountain Dam alternative is constructed, approximately 135 acres of Riparian Forest would have to be acquired to offset the effects on wildlife habitat. Construction of Poudre Dam alternative would require the acquisition of 109 acres of this habitat to mitigate the project effects. Over 300 acres of this habitat is available in the study area for potential mitigation.

The Song Sparrow, Black-capped Chickadee, and Mule Deer were selected by the HEP team to evaluate the effects of the proposed project on wildlife in the Riparian Forest habitat type. Mitigation should focus on protecting the existing habitat. Riparian habitat occurs in close association with the river and the resulting lush vegetation makes it highly preferred forage for livestock. Moreover, its proximity to the river makes it attractive to people for camping and other forms of recreation. Consequently, much of the area comprising this habitat type is very disturbed, and protection should improve the quality of the cover and forage for understory species represented by the Song Sparrow and Mule Deer. Removing livestock through fencing should permit the vegetation to recover. Removing human disturbances will be difficult except in locations where roads can be gated.

Table 6.27

Estimated Mitigation Costs for Grassland

Item	Grey Mountain Project (351 ac)	Poudre Project (280 ac)
Purchase Land ($1,200 per acre)	$ 424,800	$ 336,000
Fence/Gates ($2,400 per mile)	7,050	6,275
Burn ($16 per acre)	5,664	4,480
Fertilize ($40 per acre)	14,160	11,200
Seed ($75 per acre)	26,550	21,000
Total	$ 478,224	$ 378,955

Mitigation for cavity nesting species represented by the Black-capped Chickadee would involve placement of nest boxes in the Riparian Forest. This forest type does not have a sufficient density of snags to provide optimum habitat for cavity nesting wildlife. Nest boxes could be used to supplement the existing snags to achieve optimum habitat quality. Nest boxes would be removed as the stands age and snag density naturally approaches an optimum condition for wildlife. Removal of nest boxes would decrease annual maintenance costs.

The estimated cost for Riparian Forest mitigation is $282,509 for the Grey Mountain alternative compared to $228,502 for the Poudre alternative (Table 6.28).

6.6.2.6 Riparian Shrub and Grassland

Approximately 17 and 13 acres of Riparian shrub habitat would be affected if the Grey Mountain or Poudre alternatives were constructed, respectively. Although over 100 acres of this habitat type occurs outside the project area for possible mitigation, the habitat quality is currently near optimum condition for the evaluation species selected by the HEP team. Consequently, mitigation costs would be disproportionately high for a small improvement of habitat quality.

Consequently, mitigation should center on the establishment of Riparian Shrub habitat in new areas. Placement and irrigation of suitable plants would be necessary to establish new areas of this habitat type. Sites with relatively flat topography and seasonally moist soils should be targeted for irrigation. These sites could be cleared of vegetation, fertilized, seeded, or planted, and configured for irrigation. Plants should be riparian species including willow and other native species. Irrigation should continue until plants are old enough to be naturally sustained. It is estimated that 21 to 26 acres, irrigated for 2 to 5 years, should be sufficient for mitigation. Approximately 8 to 9 acres of the total area should also be planted

Table 6.28

Estimated Mitigation Costs for Riparian Forest

Item	Grey Mountain Project (135 ac)	Poudre Project (109 ac)
Purchase Land ($2,000 per acre)	$ 270,000	$ 218,000
Fence/Gates ($2,400 per mile)	4,409	3,962
Next Boxes ($12 per box at 5 per acre)	8,100	6,540
Total	$ 282,509	$ 228,502

with grasses to offset the effects on the Riparian Grassland habitat type from the project, since the amount of this type that would remain in the study area if the projects were built is too small to fulfill the mitigation requirements. These newly established areas of habitat should be initially fenced from deer and permanently fenced from livestock to ensure that plants develop and become self-sustaining for the life of the project.

The estimated cost for mitigating the Riparian Shrub and Grassland habitat types is $222,935 for the Grey Mountain alternative compared to $180,239 for the Poudre alternative (Table 6.29).

6.6.2.7 Riverine

If the Grey Mountain Dam alternative is constructed, approximately 344 acres of Riverine habitat would have to be acquired to offset the effects on habitat for aquatic furbearers and other river-related wildlife. Construction of the Poudre Dam alternative would require acquisition of 226 acres to compensate for project effects. The amount of area potentially available for mitigation, however, is insufficient, since less than 80 acres of Riverine habitat would exist in the study area if either project alternative was constructed.

The Beaver and Great Blue Heron were selected by the HEP team to evaluate effects of the project alternative on Riverine habitat. These species represent wildlife that require riparian habitat in association with a river. The Beaver was selected to target species that utilize the shrub vegetation layer, while the Great Blue Heron was selected to focus on species that nest in mature trees in riparian habitat. Since these habitat associations would be uncommon if either project alternative is constructed, the mitigation options would be largely limited to those of improving or establishing riparian habitat as identified in subsection 6.6.2.6.

Table 6.29

Estimated Mitigation Costs for Riparian Shrub and Grassland

Item	Grey Mountain Project (26 ac)	Poudre Project (21 ac)
Purchase Land ($2,000 per acre)	$ 52,000	$ 42,000
Fencing ($2,400 per mile)	1,935	1,739
Irrigate ($6,500 per acre)(1)	169,000	136,500
Total	$ 222,935	$ 180,239

(1) Cost includes irrigation system, site preparation, plant material, plus a contingency for 30 percent plant mortality. Costs were provided by the U.S. Army Corps of Engineers based on irrigation systems it operates for wildlife mitigation (Christianson, 1988).

Wildlife represented by the Beaver and Great Blue Heron would benefit from the proposed mitigation actions for Riparian Shrub and Forest habitats located near waterbodies. Benefits would be greatest if the sites selected for mitigation were closely associated with the free-flowing sections of the river that would occur outside the project areas. Some benefit would also occur to wildlife at sites located along the proposed reservoir, particularly where the water depth near riparian habitat is sufficiently shallow for wading birds to feed. Riparian habitat located away from waterbodies such as the ephemeral streams at Hook and Glade would not be suitable for mitigation because the habitat would not fit the habitat configuration affected by the project. Completion of offsetting the mitigation debt for wildlife associated with Riverine habitat may be possible by improving habitat for other species such as bald eagles and osprey which utilize the Riparian Forest-water complex of habitats.

As discussed in Section 6.4.1.1, Bald Eagles winter along the Poudre River in the project areas. Osprey have also been observed along the river, outside the study area during the summer, and they probably use the river in the project areas. These species utilize the river for foraging and typically perch on large trees with dead tops situated along the river. Several mitigation actions could be implemented to improve habitat for these species, since studies have shown that bald eagles and ospreys will use reservoirs (Brueggeman et al., 1988). Perching sites could be established by topping live trees or placing artificial structures (i.e., poles with crossbars) along the reservoir. These structures or tree tops would also provide a platform for osprey to nest. It is recommended that ten new perching/nesting sites be established to supplement the large trees that would border the reservoir if either project alternative is constructed.

The estimated cost for Riverine mitigation is $1,000 for either the Grey Mountain or Poudre alternatives.

6.6.2.8 Monitoring Programs

A monitoring program should be established to evaluate the mitigation plan selected for implementation. It is estimated that $50,000 would be necessary for monitoring each year for the first five years of operation, and for every fifth year thereafter for the following twenty years. Monitoring should then be performed every tenth year for the remaining 50-year assumed life of the FERC license. The total cost of the monitoring program is estimated to be $550,000.

6.6.2.9 Summary

In summary, the total estimated cost for wildlife mitigation is $6,631,039 for the Grey Mountain alternative and $5,547,830 for the Poudre alternative (Tables 6.30 and 6.31). Mitigation costs could possibly be substantially reduced if land could be leased instead of purchased.

Table 6.30

Total Estimated Wildlife Mitigation Costs

Habitat Type	Grey Mountain Project	Poudre Project
Closed Canopy Forest	$ 40,636	$ 36,926
Open Canopy Forest	201,660	160,327
Mountain Shrub	4,854,075	4,011,881
Grassland	478,224	378,955
Riparian Forest	282,509	228,502
Riparian Shrub and Grassland	222,935	180,239
Riverine	1,000	1,000
Monitoring Program	550,000	550,000
Total[1]	$ 6,631,039	$ 5,547,830

(1) Does not include escalation.

Table 6.31

Summary of Estimated Wildlife Mitigation Costs

Item	Grey Mountain Project	Poudre Project
Purchase Land	$5,798,920	$4,764,920
Fence/Gate	44,985	40,730
Nest Boxes	20,760	18,000
Irrigation	169,000	136,500
Burn	5,664	4,480
Fertilize	14,160	11,200
Seed	26,550	21,000
Perching/Nesting Structures	1,000	1,000
Subtotal	6,081,039	4,997,830
Monitoring Program	550,000	550,000
Total[1]	$ 6,631,039	$ 5,547,830

(1) Does not include escalation.

6.7 REFERENCES

Allen, A.W. 1983. Habitat suitability index models: Beaver. U.S. Fish Wildl. Serv. FWS/OBS-82/10.30 Revised. 20 pp.

Anderson, A.E. 1972. Summary of results of the Poudre deer study. W-105-R, Colo. Div. Wildl. 23 pp.

Anderson, A.E. and D.E. Medin. 1967. The breeding season in migratory mule deer. Colorado Game Fish and Parks Dept. Game Info. Leafl., No. 60, 4 pp.

Anderson, J.R., E.E. Hardy, J.T. Roach, and R.E. Witmer. 1976. A Land Use and Land Cover Classification for Use with Remote Sensor Data. U.S. Geological Survey Professional Paper 964.

Baldwin, P.H. 1976. Summary of birds recorded in the vicinity of the Fort Collins Filter Plant, 1952 to 1976. Unpubl. Rep. Dept. Zool., Colo. St. Univ., Ft. Collins.

Bayer, R.D. 1978. Aspects of an Oregon estuarine great blue heron population. Wading birds. Natl. Audubon Soc. Res. Rep. 7L213-217.

Bear, G.D. 1979. Evaluation of bighorn transplants in two Colorado localities. Colo. Div. Wildl. Spec. Rep., No. 45 12 pp.

Berg, E. 1986. Summary report of the fall 1986 terrestrial studies for the Cache la Poudre Water and Power Project. Prepared for the Northern Colorado Water Conservancy District. Loveland, Colorado.

Biastock, Bill. 1988. Personal communication. U.S. Forest Service, Arapaho-Roosevelt National Forest, Fort Collins, Colorado. Telephone conversation with A.D. Every (Envirosphere Co.), January 29, 1988.

Brewer, R. 1963. Ecological and reproductive relationships of black-capped and Carolina chickadees. Auk 80(1):9-47.

Beier, P. and R.H. Barrett. 1987. Beaver habitat use and impact in Truckee River Basin, California. J. Wildl. Manage. 51(4):794-799.

Brown, L., and D. Amadon. 1968. Eagles, Hawks and Falcons of the World, Parts 1 and 2. McGraw-Hill Book Co., New York, NY. 945 pp.

Brueggeman, J.J., A.D. Every, and M.C. McShane. 1986. Wildlife Habitat Studies, Cowlitz River hydro project. Prepared for City of Tacoma Light Division.

Brueggeman, J.J, M.C. McShane, A.D. Every, J.A. Knutzen, and R.W. Tressler. 1988. Study of Skagit Dams original impacts on wildlife and fish habitats and populations. Prepared for Seattle City Light.

Burleigh, T.D. 1958. Georgia birds. Univ. Oklahoma Press, Norman. 76 pp.

Canfield, R.H. 1941. Application of the line-intercept method in sampling range vegetation. J. For. 39:388-394.

Christianson, C. 1988. Personal communication. U.S. Army Corps of Engineers, Washington. Telephone conversation with G. Green (Envirosphere Co.), August 1988.

Colorado Division of Wildlife. 1978. Essential habitat for threatened and endangered wildlife in Colorado. Denver, Colorado. 84 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service Botanical Services Program, FWS/OBS-79/31.

Craig, G. 1986. Personal communication. Colorado Division of Wildlife, Fort Collins Colorado. Telephone conversation with E. Berg (Wildlife Management Consultants), November 1986.

Craig, G. 1988. Personal communication. Colorado Division of Wildlife, Fort Collins, Colorado. Telephone conversation with J.J. Brueggeman (Envirosphere Co.), January 1988.

Crane, M.F. 1982. Fire ecology of Rocky Mountain Forest habitat types. Final Report to USDA Forest Service, Region Two. Contract No. 43-82X9-1-884.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. Northwest Science 33:43-46.

Dorrance, M.J. 1965. Behavior of Rocky Mountain mule deer on winter and summer ranges. M.S. Thesis. Colo. St. Univ., Ft. Collins. 136 pp.

Elmblad, W. 1988. Personal communication. Colorado Division of Wildlife, Colorado. Telephone conversation with J.J. Brueggeman (Envirosphere Co.), August 1988.

Field, R.J. 1970. Winter habits of the river otter in Michigan. Michigan Academician. 3:49-58.

Fish and Wildlife Service. 1978. Habitat suitability index models: Song sparrow in deciduous woodlands, Ecoregion 2410, Draft. U.S. Dept. Int., Fish Wildl. Serv.

Fish and Wildlife Service. 1982. Habitat suitability index models: Mule deer. Draft. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS.

Fish and Wildlife Service. 1985. A users manual for HEP accounting program for microcomputer users, version 2. Fort Collins, Colorado.

Fish and Wildlife Service. 1987. Micro-HSI version 2 users manual. National Ecology Center, Fort Collins, Colorado.

Fish and Wildlife Service. 1980. Ecological services manual - habitat as a basis for environmental assessment. 101 ESM Division of Ecological Services, Dept. of Interior. Washington, D.C.

Forest Service. 1984. The Arapaho and Roosevelt National Forests Land and Resource Management Plan. Rocky Mountain Region, USDA Forest Service.

Ganskopp, D. and M. Vavra. 1987. Slope use by cattle, feral horses, deer, and bighorn sheep. Northwest Science 61(2):74-81.

Goodsen, N.F. 1980. Bighorn sheep in north-central Colorado: Past, present, and future. Pages 190-209. In: Proc. of the Biennial Symposium of the North America Wild Sheep and Goat Council.

Hammerson, G.A. 1982. Amphibians and reptiles in Colorado. Colo. Div. of Wildl., Denver. 130 pp.

Harza. 1987. Cache la Poudre Basin study and hydropower resources report. Prepared for the Colorado Water Resources and Power Development Authority. Denver, Colorado.

Hess, Karl, and Robert R. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt National Forests in Central Colorado: a habitat type classification. USDA Forest Service Research Paper RM-266, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Hodgson, A. 1988. Personal Communication. Colorado Division of Wildlife. Fort Collins, Colorado. Telephone Conversation with J.J. Brueggeman (Envirosphere Co.), February 12, 1988.

Hoover, R.L. and D.L. Wills, ed. 1984. Managing forested lands for wildlife. Colorado Division of Wildlife in Cooperation with USDA Forest Service, Rocky Mountain Region, Denver, Colorado. 459 pp.

Information Builders Inc. 1982. FOCUS User's Manual, 1982 Edition, Information Builders Inc., New York, NY.

Johnston, Barry, C. 1987. Plant Associations of Region Two, Edition 4, USDA Forest Service, Rocky Mountain Region, R2-ECOL-87-2, Lakewood, Colorado.

Kufeld, R.C. 1986. Winter habitat selection and activity patterns of mule deer in Front Range shrubland and forest habitats. CDOW Wildlife Report Project 01-03-047.

Laven, R.D., P.N. Omi, J.G. Wyant, and A.S. Pinkerton. 1980. Interpretation of fire scar data from a ponderosa pine ecosystem in the central Rocky Mountains, Colorado. In: Proc. of the Fire History Workshop, Tucson, Arizona. USDA Gen. Tech. Rep. RM-81. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colorado.

Lockhart, M. 1988. Personal communications. U.S. Fish and Wildl. Serv. Grand Junction, Colorado. Telephone conversation with J.J. Brueggeman (Envirosphere Co.), February 1988.

Loveless, C.M. 1963. Ecological characteristics of a selected mule deer winter range. Colo. Coop. Wildl. Res. Unit, Final Rep. of Environ. Studies. U.S. Atomic Energy Comm. 318 pp.

Loveless, C.M. 1967. Ecological characteristics of a deer winter range. Colo. Game, Fish and Parks Dept., Tech. Publ. No. 20. 124 pp.

Marr, John W. 1967. Ecosystems of the east slope of the Front Range in Colorado. University of Colorado Studies, Series in Biology, No. 8. 134 pp. University of Colorado Press. Boulder, Colorado.

Martin, R.C., L.A. Mohrhoff, J.E. Chaney, and S. Sather-Blair. 1985. Status review of wildlife mitigation at Columbia Basin hydroelectric projects, Idaho facilities. Final report. Idaho Department of Fish and Game and Fish and Wildlife Service, Boise, Idaho.

McCullough, S. n.d. Habitat suitability index models: Abert squirrel. Colorado State University, Fort Collins, Colorado.

Medin, D.E. 1976. Modelling the dynamics of a Colorado mule deer population. Ph.D. Thesis. Colorado State Univ., Fort Collins. 167 pp.

Miller, A.H. 1942. Habitat selection among high vertebrates and its relation to intraspecific variations. Am. Nat. 76:25-35.

Miller, R.F. 1943. The great blue herons: the breeding birds of the Philadelphia region (Part II) Cassinia 33:1-23.

Moser, C. 1962. The bighorn sheep of Colorado. Colo. Game and Fish Dept., Tech. Bull. No. 10, 49 pp.

Odum, E.P. 1941a. Annual cycle of the black-capped chickadee - I. Auk 58(3):314-333.

Odum, E.P. 1941b. Annual cycle of the black-capped chickadee - II. Auk 59(4):499-531.

Olendorff, R.R. 1973. The ecology of the nesting birds of prey of northeastern Colorado. Int. Biol. Program Grassland Biom. Tech. Rep. 211, 233 pp.

Olendorff, R.R. 1976. The food habits of North American golden eagles. Am. Midl. Nat. 95(1):231-236.

Patton, D.R. 1975. Abert squirrel cover requirements in southwestern ponderosa pine. USDA Forest Service Research Paper RM 145. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Ramaley, F. 1927. Colorado Plant Life. University of Colorado Press. Boulder, Colorado.

Rhodes, M.J., T.J. Cloud, and D. Haag. 1983. Habitat evaluation procedures for planning surface mine reclamation in Texas. Wildl. Soc. Bull. 11:222-232.

Roberts, L.D. 1983. Riparian habitat in the proposed Grey Rocks reservoir. M.S. Thesis. Colo. St. Univ., Ft. Collins. 135 pp.

Rocky Mountain Bighorn Society. 1984. A guide to sheep hunting in Colorado. Denver, CO.

Rost, G.R. and J.A. Bailey. 1979. Distribution of mule deer and elk in relation to roads. J. Wild. Manage. 43(3);634-641.

Rutherford, W.H. 1964. The beaver in Colorado, its biology, ecology, management and economics. Technical Publication Number 17. Game Research Division. Colorado Game, Fish, and Parks Department.

Schamberger, M. and A. Farmer. 1978. The habitat evaluation procedure; their application in project planning and impact evaluation. Trans. N. Am. Wildl. and Nat. Resour. Conf. 45:274-283.

Schoonveld, G. 1986. Personal communications. Senior Biologist. Colorado Division of Wildlife, Fort Collins, Colorado. Telephone conversation with E. Berg (Wildlife Management Consultants), November 1986.

Schroeder, R.L. 1983. Habitat suitability index models: Black-capped chickadee. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.37. 12 pp,

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Schroeder, R.L. and P.J. Sousa. 1982. Habitat suitability index models: Eastern meadowlark. U.S. Dept. Int., Fish and Wildl. Serv. FWS/OBS-82/10.29.

Short, J.L. and R.J. Cooper. 1985. Habitat suitability index models: Great blue heron. U.S. Fish and Wildl. Serv. Biol. Rep. 82(10.99). 23 pp.

Siglin, R.J. 1965. Seasonal movements of mule deer in the Cache la Poudre drainage. M.S. Thesis, Colo. St. Univ., Ft. Collins, CO.

Simmons, N.M. 1961. Daily and seasonal movements of Poudre River bighorn sheep. M.S. Thesis. Colo. St. Univ., Ft. Collins. 179 pp.

Slough, B.G., and R.M.F.S. Sadleir. 1977. A land capability classification system for beaver (Caster Canadensis). Can. J. Zool. 55(8): 1324-1335.

Stallmaster, M.V., and J.A. Gessaman. 1984. Ecological energetics and foraging behavior of overwintering bald eagles. Ecological Monographs. 54:407-428.

Thomas, J.W. 1979. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. U.S. Department of Agriculture, Forest Service. Agriculture Handbook No. 554. 512 pp.

Thomas, J.W., R.J. Miller, H. Black, J.E. Rodiek, and C. Maser. 1976. Guidelines for maintaining and enhancing wildlife habitat in forest management in the Blue Mountains of Oregon and Washington. Trans. N. Am. Wildl. Nat. Resour. Conf. 41:452-476.

Tilton, M.E., and E.E. Willard. 1982. Winter habitat selection by mountain sheep. J. Wildl. Manage. 46:359-366.

Tompa, F.S. 1964. Factors determine the numbers of song sparrows, Melospiza melodia (Wilson), on Mandarte Island, British Columbia, Canada. Actu. Zool. Fenn. 109:1-73.

Urich, D.L. and J.P. Graham. 1983. Applying habitat evaluation procedures (HEP) to wildlife area planning in Missouri. Wildl. Soc. Bull. 11:215-221.

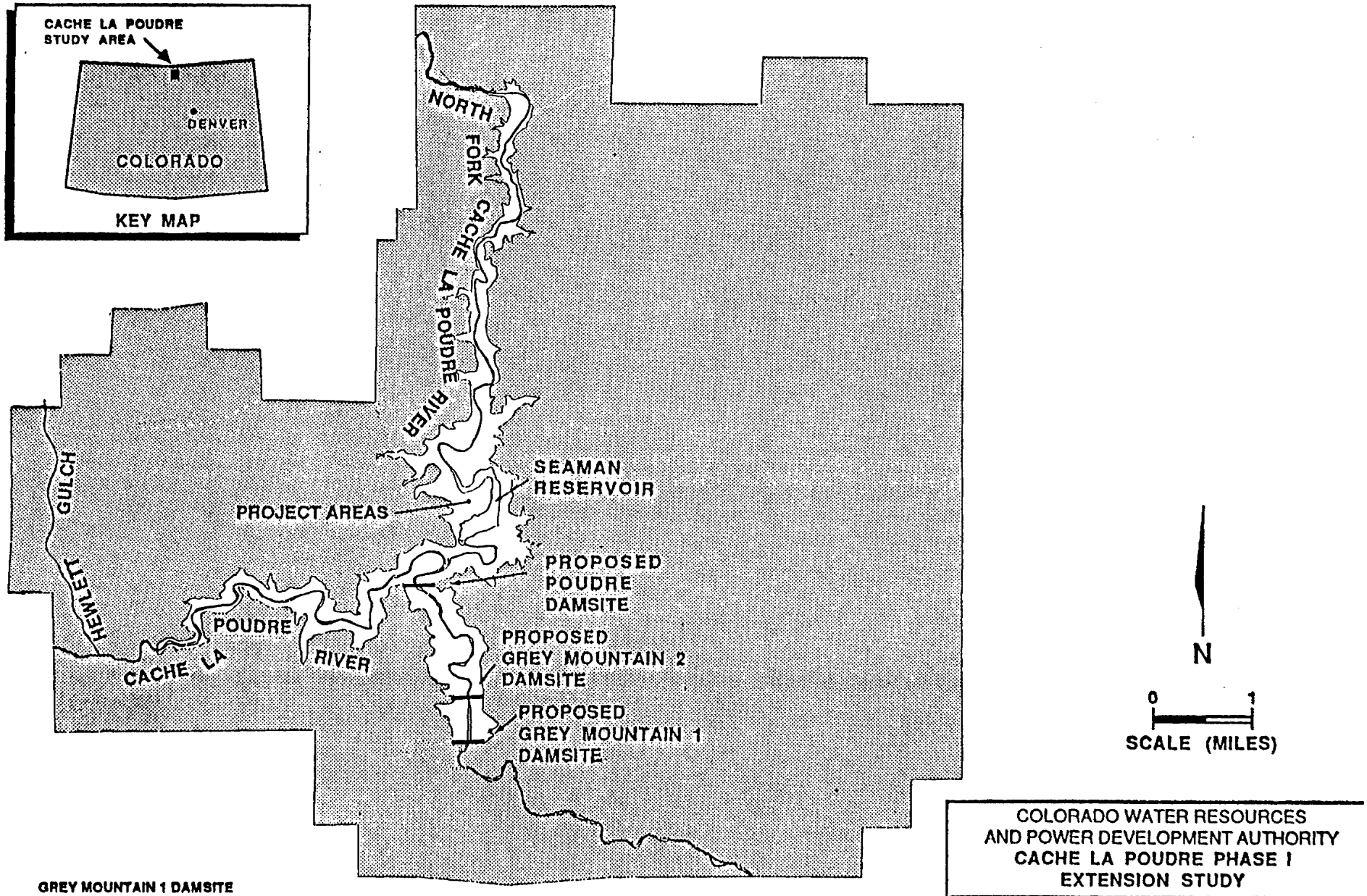
Verner, J. and A.S. Boss, technical coordinators. 1980. California wildlife and their habitats: Western Sierra Nevada. Gen. Tech. Rep. PSW-37, 439 p. Pacific Southwest Forest and Range Exp. Stn. Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

Wakelyn, L.A. 1984. Analysis and comparison of existing and historic bighorn sheep ranges in Colorado. M.S. Thesis. Colo. St. Univ., Ft. Collins. 274 pp.

Wallmo, O.C. and W.L. Regelin. 1981. Rocky Mountain and intermountain habitats. Part 1. Food habits and nutrition. Pages 387-398. In: Wallmo, O.C. (ed.) Mule and black-tailed deer of North America. Univ. Neb. Press, Lincoln, 605 pp.

Weber, W.A. 1976. Rocky Mountain flora. Colorado Associated University Press. Boulder, Colorado.

Winkler, F. 1988. Personal communication. U.S. Forest Service, Arapaho-Roosevelt National Forest, Fort Collins, Colorado. Telephone conversation with A.D. Every (Envirosphere Co.), February 4, 1988.



GREY MOUNTAIN 1 DAMSITE
IS DEFINED IN PRELIMINARY PERMIT

GREY MOUNTAIN 2 DAMSITE IS DEFINED
IN CWRPDA BASIN STUDY (Harza, 1987)

COLORADO WATER RESOURCES
AND POWER DEVELOPMENT AUTHORITY
CACHE LA POUDRE PHASE I
EXTENSION STUDY

STUDY AREA

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DATE 10/24/88

FIGURE 6.1

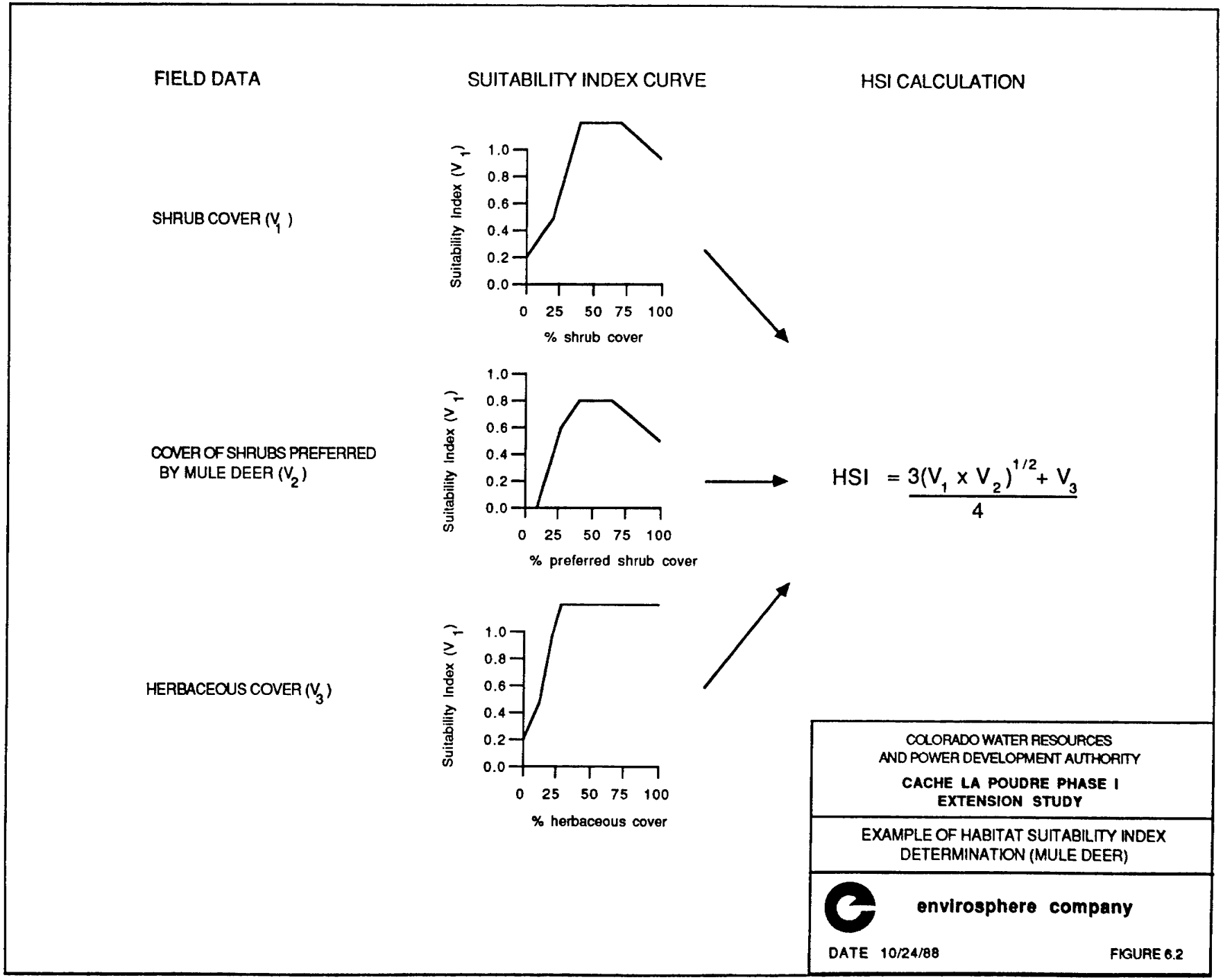
FIELD DATA
SUITABILITY INDEX CURVE
HSI CALCULATION
SHRUB COVER (V_1)
COVER OF SHRUBS PREFERRED BY MULE DEER (V_2)
HERBACEOUS COVER (V_3)
Suitability Index (V_1)
1.0
0.8
0.6
0.4
0.2
0.0
0 25 50 75 100
% shrub cover
% preferred shrub cover
% herbaceous cover
$HSI = \frac{3(V_1 \times V_2)^{1/2} + V_3}{4}$
COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY
CACHE LA POUDRE PHASE I EXTENSION STUDY
EXAMPLE OF HABITAT SUITABILITY INDEX DETERMINATION (MULE DEER)
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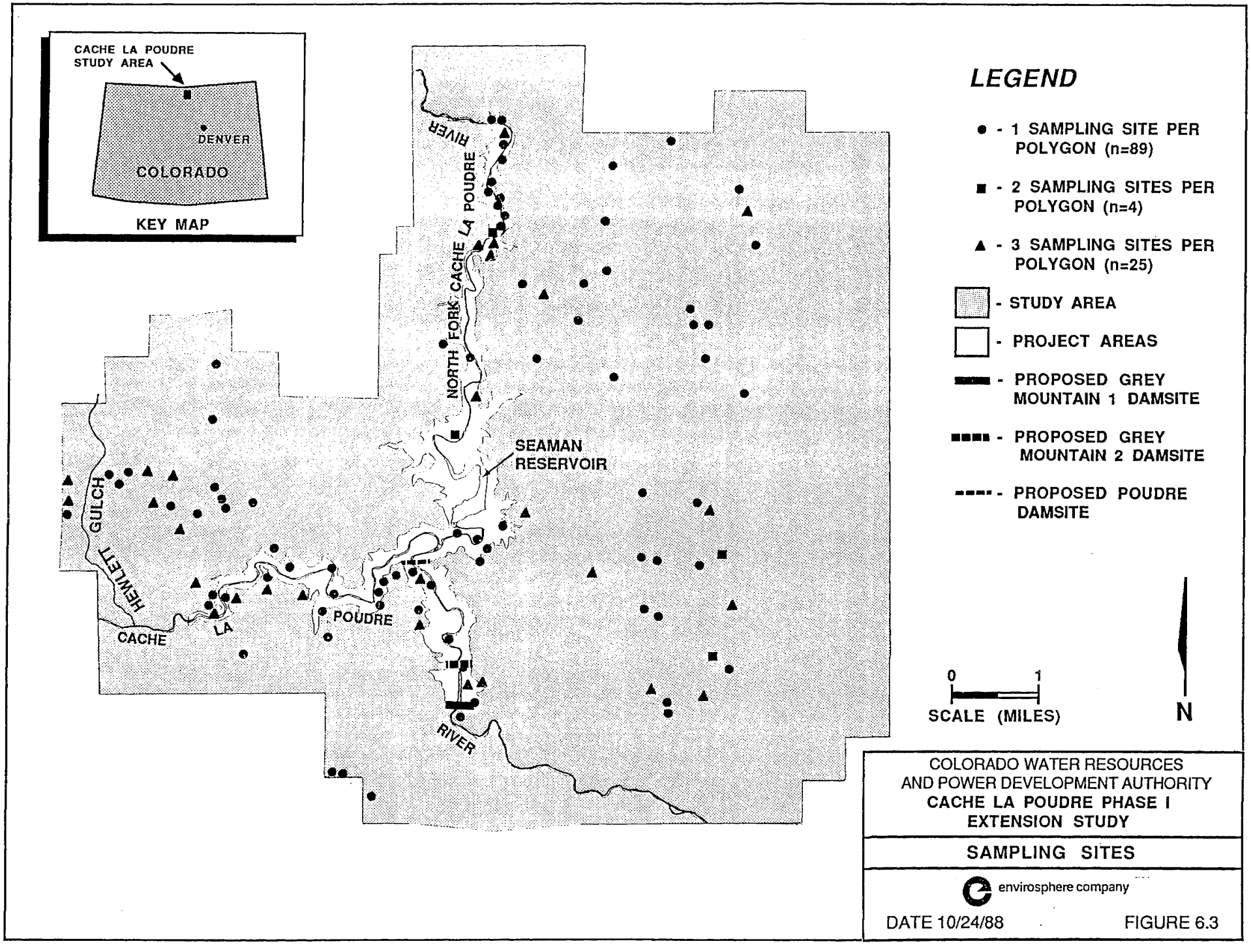
FIGURE 6.2



COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY
CACHE LA POUDRE PHASE I EXTENSION STUDY

SAMPLING SITES

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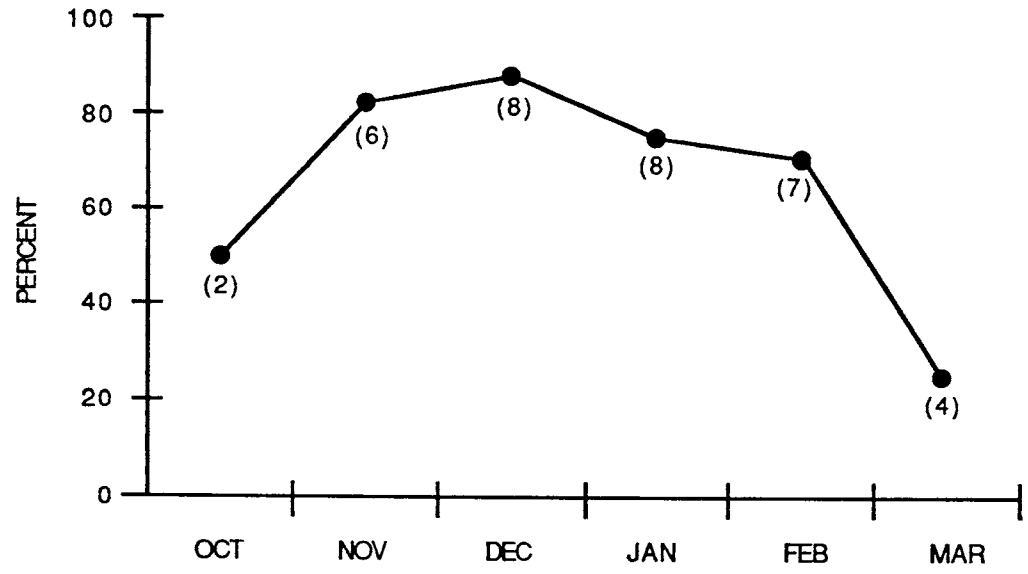
DATE 10/24/88 FIGURE 6.3



COLORADO WATER RESOURCES
AND POWER DEVELOPMENT AUTHORITY

**CACHE LA POUDRE PHASE I
EXTENSION STUDY**

PERCENT OF SURVEY DAYS BALD EAGLES WERE OBSERVED ON THE MAINSTEM AND NORTH FORK OF THE CACHE LA POUDRE RIVER

Parenthesis designates number of survey days.

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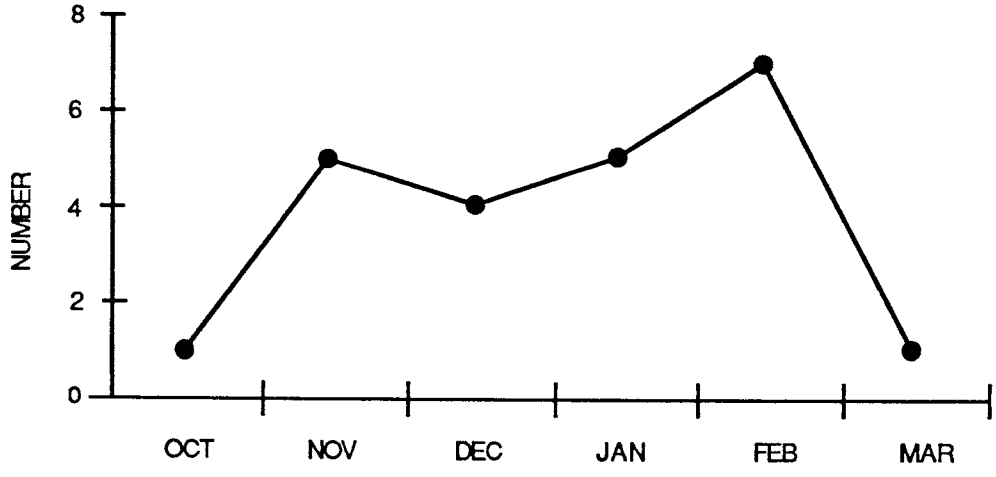
FIGURE 6.4



COLORADO WATER RESOURCES
AND POWER DEVELOPMENT AUTHORITY

**CACHE LA POUDRE PHASE I
EXTENSION STUDY**

MAXIMUM NUMBER OF BALD EAGLES
OBSERVED ON THE MAINSTEM AND NORTH FORK
OF THE CACHE LA POUDRE RIVER, 1986-1987

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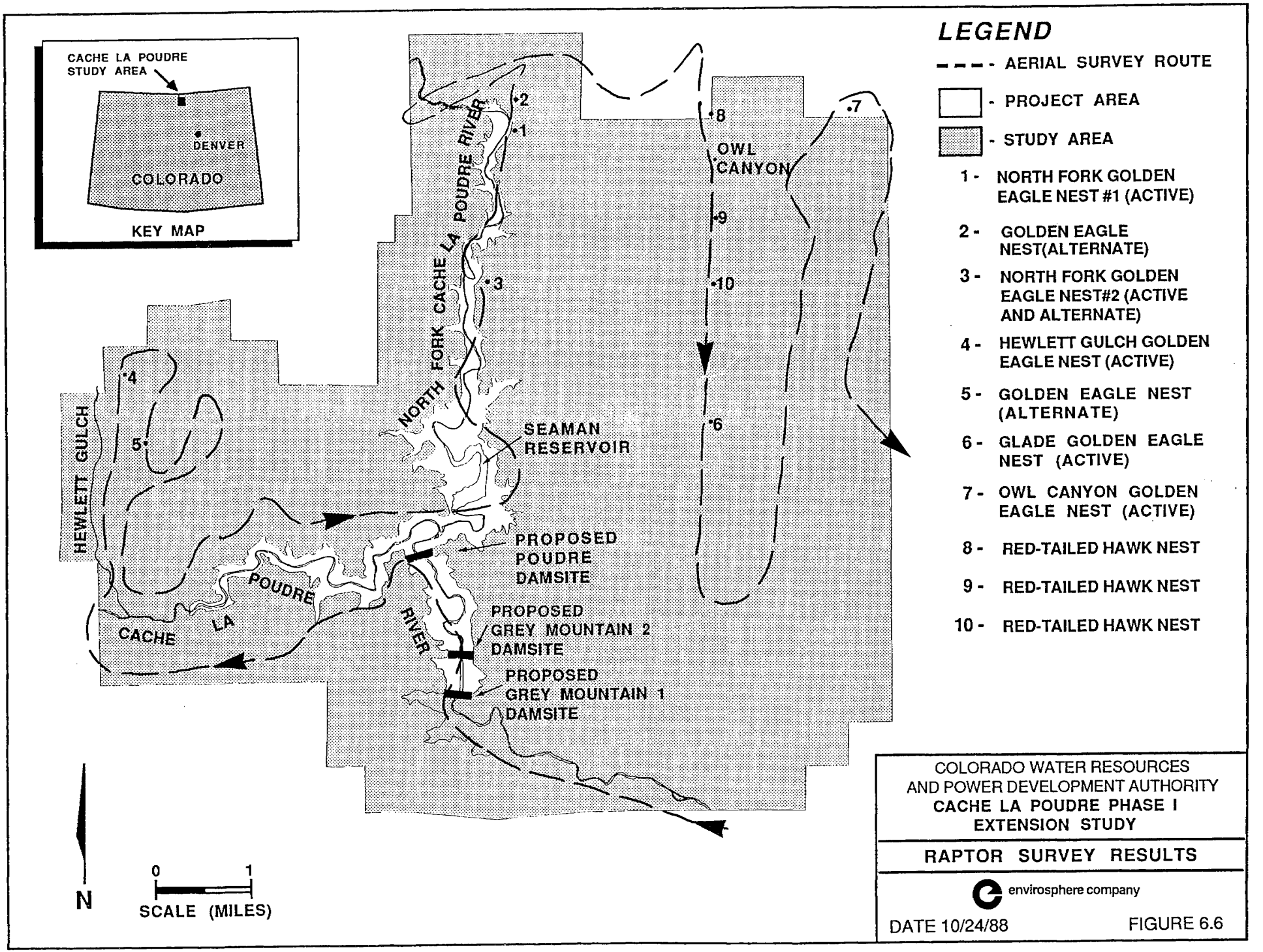
DATE 10/24/88 FIGURE 6.5



COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY
CACHE LA POUDRE PHASE I EXTENSION STUDY

RAPTOR SURVEY RESULTS

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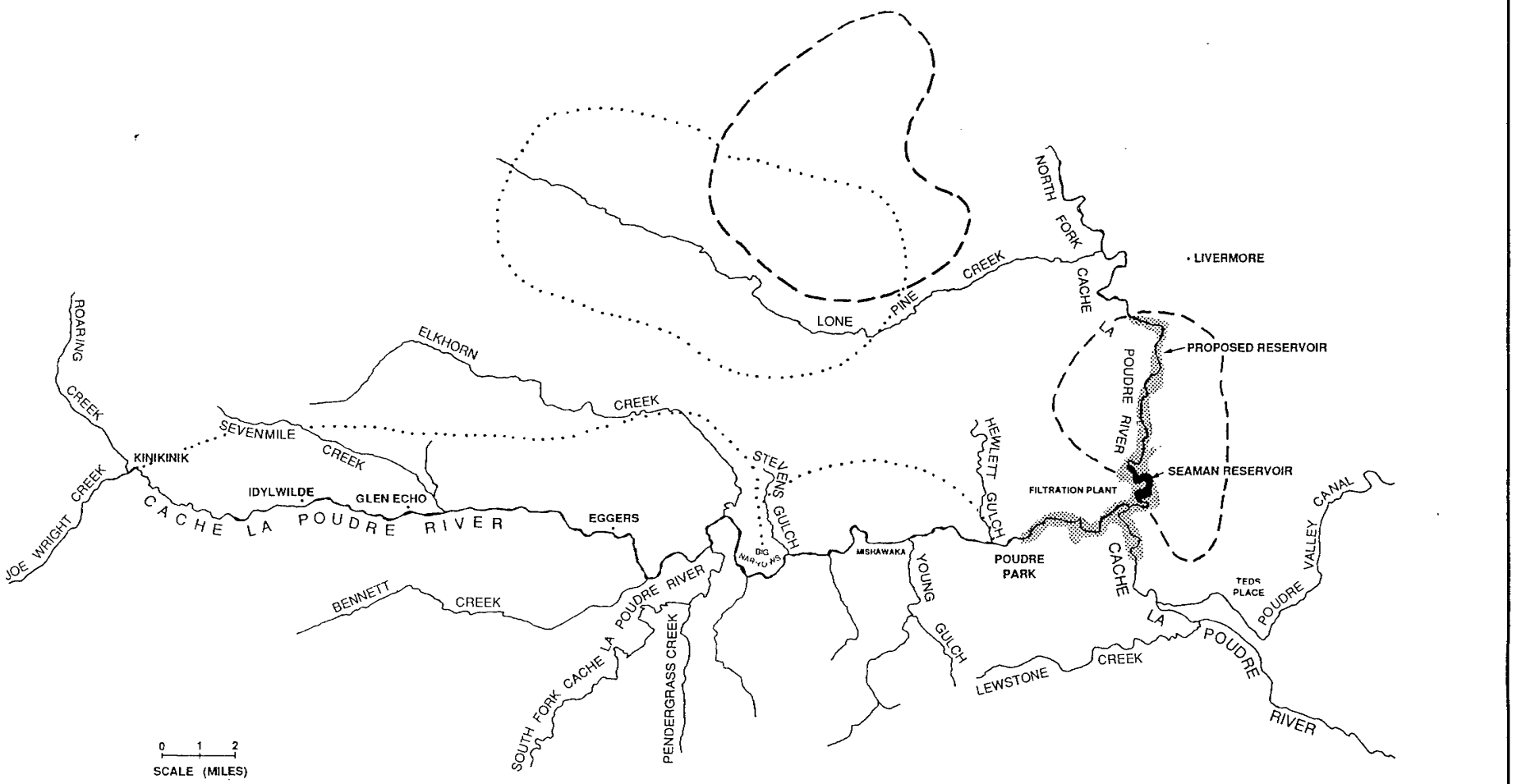
DATE 10/24/88 FIGURE 6.6



COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY
CACHE LA POUDRE PHASE I EXTENSION STUDY

BIG GAME LOCATIONS

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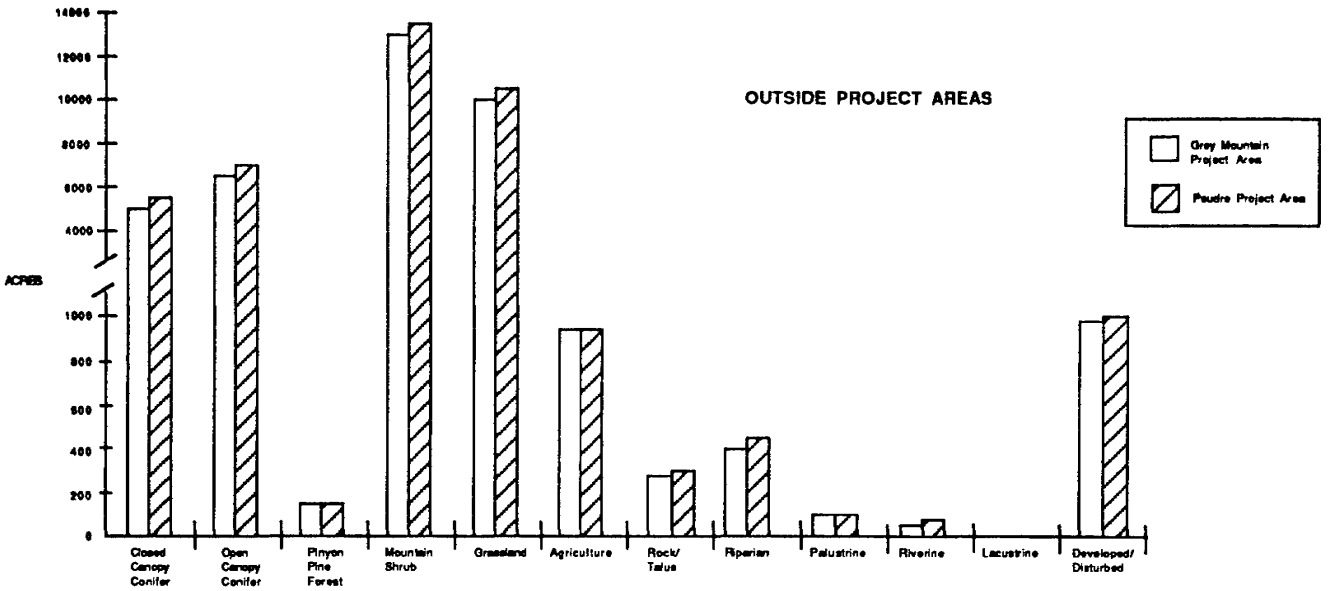

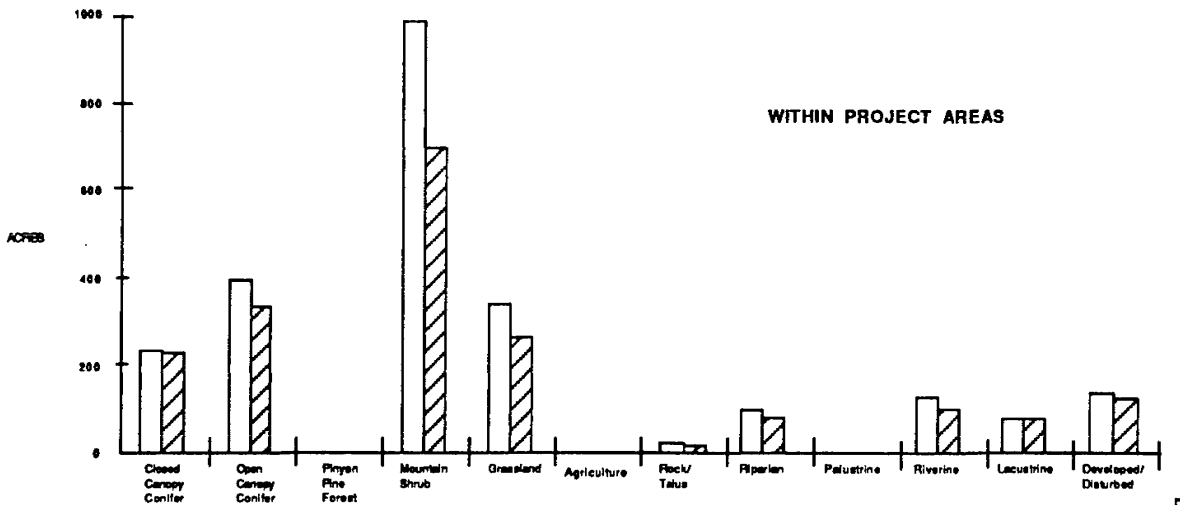

COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY

CACHE LA POUDRE PHASE I EXTENSION STUDY

AREA OF EXISTING HABITATS WITHIN AND OUTSIDE THE PROJECT AREAS

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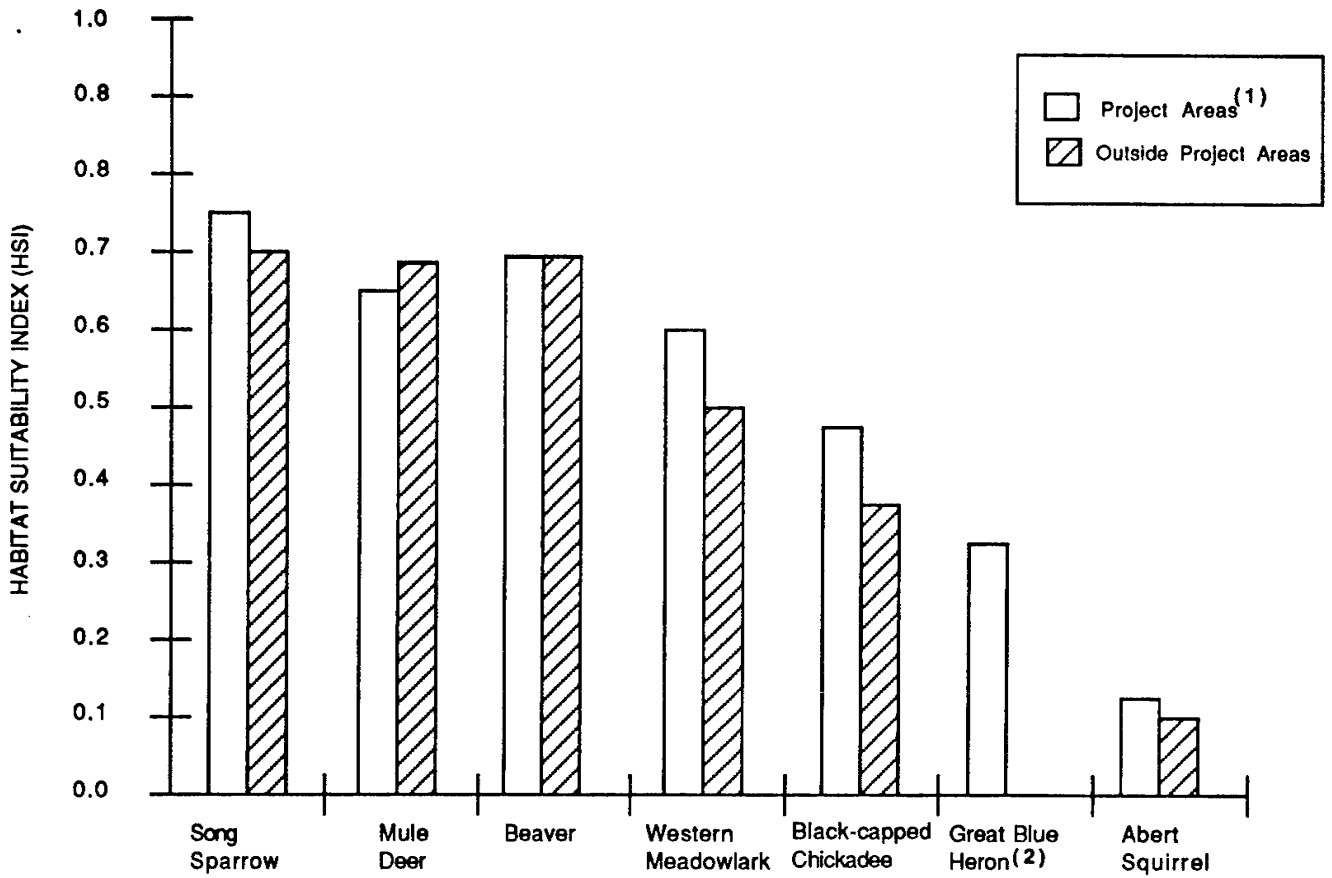
DATE 10/24/88 FIGURE 6.8



(1) Habitat quality is essentially identical for all species in both the Grey Mountain and Poudre project areas

(2) No Great Blue Heron habitat outside project areas

COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY

CACHE LA POUDRE PHASE I EXTENSION STUDY

CACHE LA POUDRE STUDY AREA HABITAT QUALITY

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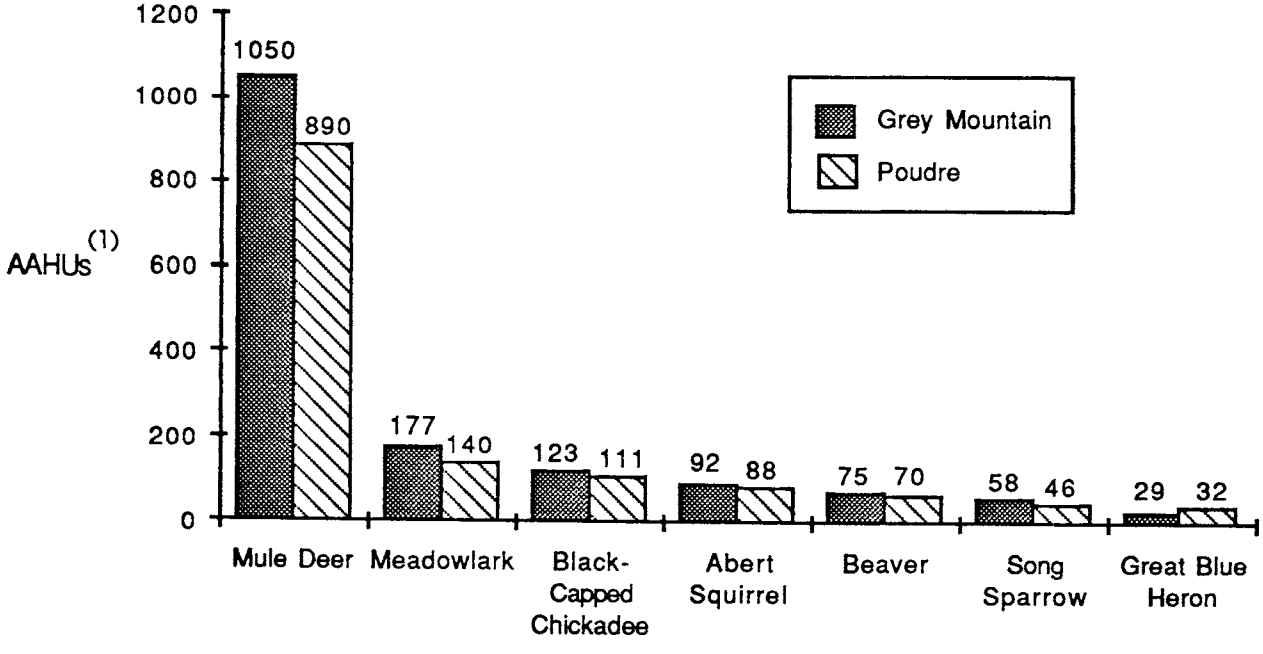
FIGURE 6.9



(1) Exact number of AAHUs for each species is indicated for each alternative

COLORADO WATER RESOURCES AND POWER DEVELOPMENT AUTHORITY

CACHE LA POUDRE PHASE I EXTENSION STUDY

COMPARISON OF NET EFFECTS FROM THE GREY MOUNTAIN AND POUDRE ALTERNATIVES

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FIGURE 6.10