

CORRALES BOSQUE PRESERVE HABITAT MANAGEMENT PLAN

CORRALES BOSQUE ADVISORY COMMISSION

APRIL 2009

This Management Plan for the Corrales Bosque Preserve draws heavily on the recommendations identified by a Biological Interagency Team [1] appointed by Senator Domenici, further documented in the 1993 report, Middle Rio Grande Ecosystem: Bosque Biological Management Plan [2], and its most recent update, Middle Rio Grande Ecosystem Bosque Biological Management Plan-The First Decade: A Review & Update [3]. A summary of the background to these ongoing initiatives can be found in Appendix G. The Management Plan is also consistent with the recently revised draft Corrales Comprehensive Plan [4].

The recommendations of these sources, some of which cover the entire Middle Rio Grande, have been revised to apply more specifically to the bosque in the Corrales reach of the Rio Grande, which is designated as a nature preserve, the Corrales Bosque Preserve.

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CONTENTS

ACKNOWLEDGEMENTS	2
CONTENTS	3
1 DESCRIPTION OF THE CORRALES BOSQUE PRESERVE.....	7
1.1 General Description	7
1.2 Ecological Description	8
1.3 History	12
1.4 Legal and Administrative Framework	13
2 MISSION AND OBJECTIVES	14
2.1 PROTECT AND PRESERVE THE CORRALES BOSQUE PRESERVE	15
2.1.1 Manage and Encourage Activities Consistent with the Goals of the Preserve	15
2.1.2 Improve and Restore Ecological Resistance and Resilience of the Preserve to Fire.....	16
2.2 RESTORE THE CORRALES BOSQUE PRESERVE	16
2.2.1 Maintain and Promote Riparian Habitat Diversity	17
2.3 BALANCE THESE OBJECTIVES	18
2.4 OBTAIN RESOURCES AND CONTROL IMPLEMENTATION OF THE PLAN	18
3 ACTION PLAN.....	21
3.1 Survey and Assess Vegetation, Wildlife, and Groundwater and Develop Management Strategies	21
3.1.1 Vegetation Surveys	21
3.1.2 Wildlife Surveys.....	22
3.1.3 Groundwater Evaluation	22
3.1.4 Habitat Identification	22
3.1.5 Designated Ecological Units	23
3.1.6 Management Strategies	23
3.1.7 Mapping Software.....	24
3.1.7 CBAC/MRGCD Liaison.....	24
3.2 Fire Protection and Control.....	24
3.2.1 Pre-Attack Fire Suppression Plan	24
3.2.2 Fire Service Vehicle Access.....	24
3.2.3 Hazardous Fuel Breaks	25

3.3 Opportunities for Wetland Restoration	25
3.4 Outreach, Trail Use and Maintenance	25
3.5 Implementation	26
APPENDIX A: MANAGEMENT GUIDELINES AND RECOMMENDATIONS	27
A1 Vegetation, Groundwater, And Wildlife Surveys.....	27
A1.1 Vegetation Surveys	27
A1.2 Groundwater Surveys	28
A1.3 Wildlife Surveys	28
A1.4 Identify Areas for Potential Management	29
A1.5 Assign Designated Ecological Units and Management Strategies	30
A1.6 Regenerate Cottonwoods, Willows and Understory	31
A1.7 Control of Non-Native Species.....	31
A1.8 Improve Management of Edge Areas	31
Additional Basis for the Recommendations of A1	32
A2 Fire Protection And Control	34
A2.1 Remove Dead and Down Wood.....	34
A2.2 Natural Fuel Breaks.....	34
A2.3 Fire Service Access	35
A2.4 Fire Suppression Plan.....	35
A2.5 Closures of the Preserve	35
Additional Basis for the Recommendations of A2	36
A3 Potential For Wetland and Riparian Communities	37
A3.1 Identify Potential Sources and Locations	37
A3.2 Design and Construction.....	38
Additional Basis for the Recommendations of A3	38
A4 Enforcement, Trails, And Outreach	39
A4.1 Regulate Access	39
A4.2 Control Parking	39
A4.3 Forbidden Activities	39
A4.4 Litter Control.....	39
A4.5 Signs	39
A4.6 Trail Use Etiquette	39

A4.7 Trail Maintenance	40
A4.8 Public Outreach.....	40
A4.9 Monitor Usage	41
Additional Basis for the Recommendations of A4	41
A5 Implementation Of The Management Plan	41
A5.1 Planning and Coordination	41
A5.2 Updates to the Plan	41
A5.3 Integrated Actions	41
Additional Basis for the Recommendations of A5	42
APPENDIX B: RESULTS OF RECENT PROJECT ACTIVITIES	44
B1 Vegetation, Animals, and Groundwater	44
B1.1 Monitor Bird Populations.....	44
B2 Fire Protection And Control	44
B2.1 Continue to Remove the Overload of Dead and Down and Non-Native Species	44
B2.2 Improve Safe and Rapid Access for Fire Personnel.....	45
APPENDIX C: TECHNICAL REFERENCES	46
APPENDIX D: GUIDELINES FOR REMOVING DEAD AND DOWN WOOD	54
D1 Requirements for Cavity Trees	54
D2 Requirements for Dead and Down Woody Material.....	55
APPENDIX E: BOSQUE THINNING TREATMENT PRESCRIPTION	57
E1 Tree Removal	57
E1.1 Tier Structure	57
E2 Slash and Downed Material Treatments.....	59
E3 Herbicide Treatment	60
E4 Other Instructions	60
E5 Species Lists.....	61
APPENDIX F: GOVERNING FRAMEWORK FOR THE CORRALES BOSQUE PRESERVE	63
F1: Corrales Village Ordinance 234 - Corrales Bosque Preserve	63
F2: Joint Resolution Between The Village Of Corrales Council And The Middle Rio Grande Conservancy Board Of Directors	67
APPENDIX G: OVERVIEW OF THE MIDDLE RIO GRANDE BOSQUE INITIATIVE AND THE MIDDLE RIO GRANDE ECOSYSTEM: BOSQUE BIOLOGICAL MANAGEMENT PLAN.....	70

APPENDIX H: AGENCY RESOURCES73

1 DESCRIPTION OF THE CORRALES BOSQUE PRESERVE

Guide To This Section: This Section starts with a general description of the boundaries of the Preserve and the main entrances, roads, and trails within the boundaries. It contains a brief account of the history and current status of the hydrology and general ecology of the Middle Rio Grande bosque that serves as an introduction to many of the features that are important to management of the bosque in the Corrales reach of the river. It also includes a listing of significant historical events and milestones that trace the development of the Corrales Bosque Preserve to the present time, a tribute to the past vision and hard work of so many in the Village to protect and preserve this corner of our natural heritage. The section concludes with brief references to the legal and administrative framework through which the Preserve is governed.

1.1 General Description

The Corrales Bosque Preserve (Preserve) encompasses an area of 662.4 acres on the west side of the Rio Grande within the territorial limits of the Village of Corrales. It is a narrow strip of relatively natural habitat along the Rio Grande, bounded by the Corrales Siphon on the north (the source for the Corrales Main Canal), the Alameda Boulevard bridge on the south, the western low water line of the Rio Grande on the east, and on the west by, 1) the western right of way line for the Sandoval Lateral Canal wherever the canal runs parallel to the Corrales Riverside Drain, and 2) the western right of way line for the Corrales Riverside Drain wherever the Sandoval Lateral Canal does not run parallel to the Corrales Riverside Drain (Corrales Village Code, Section 11-3). The Corrales Riverside Drain (known as the Clear Ditch) runs the entire length of the Preserve, whereas the Sandoval Lateral Canal enters the Preserve just south of the Romero Road entrance and departs close to Bernaval Road and Coroval Road.

The Harvey Jones Flood Control Channel drains the Arroyo de los Montoyas at Paseo Thomas Montoya and Calle Contenta in the northern part of the Preserve, bisecting the Preserve from west to east. Rio Rancho waste water flows into the Rio Grande on the south side of the Harvey Jones Flood Control Channel.

There are MRGCD maintenance access roads and primitive trails that run north to south through the entire length of the Preserve, except where temporarily bisected by the Harvey Jones Flood Control Channel:

1. Along the east side of the Corrales Riverside Drain.
2. Along the top of the levee.
3. Primitive trails through the interior of the Preserve between the levee and the Rio Grande.

There are two MRGCD maintenance access roads that run from the Bernaval Road - Coroval Road area in the southern part of the Preserve north to the Harvey Jones Flood Control Channel, along the east and west sides of the Sandoval Lateral Canal.

Finally, there are two shorter maintenance access roads in the southern part of the Preserve:

1. Along the levee on the west side of the Corrales Riverside Drain.
2. Along the west bank of the Corrales Riverside Drain from the southern boundary of the Preserve to the confluence of the Corrales Riverside Drain and the Interior Drain.

Four fire service access points cross over the Corrales Riverside Drain at the Cabezon Road, Dixon Road, and Romero Road entrances, and at the Corrales Siphon at the north end of the Preserve, just north of Camino Corrales del Norte.

1.2 Ecological Description

The information presented here is compiled from several sources: [2]; [6]; [9]; [34]; [35]. The term “bosque” is a Spanish word meaning forest or woodland, used here to describe a forest or woodland on the riparian floodplain.

The Corrales bosque is located within what is known as the Middle Rio Grande region, which stretches from White Rock Canyon and Cochiti Dam in the north to Elephant Butte Reservoir in the south.

Hydrologic History - Prior to substantial human alteration, the riparian floodplain in this region was characterized by a braided river that meandered laterally within the 4-6 km wide floodplain. It was bordered by a mixture of Rio Grande cottonwood (*Populus fremontii* var. *wislizenii*) and willow (*Salix* sp.) stands interspersed with grass meadows, ponds, small lakes, and marshes. Historically, the Middle Rio Grande flooded as a result of spring snowmelt in the northern mountains and late summer monsoons. In a natural riparian system, flood flows are an important factor in affecting the geography of the river (through deposit and removal of sediment, floodplain, bank, and river bottom scouring, and channel realignment) as well as biological processes, plant and animal distribution, and community composition. Depth to ground water in the floodplain is also important. Natural cyclical hydrological disturbances were important drivers of riparian and floodplain processes and determined the riparian ecosystems that were found in the floodplain. Historical overbank flooding, scouring flows, and the movement of the river channel maintained a dynamic floodplain ecosystem that supported high biodiversity in dynamic balance – a patchwork of forest, open meadows, wetlands, and river channels that changed every few years or decades. These hydrologic dynamics were particularly important for cottonwood and willow recruitment. The fluvial action of the river continuously disturbed flow channels, created wetlands, cleared out forest debris and leaf litter or buried it under new layers of sediment, recharged groundwater across the floodplain, and facilitated the reestablishment of young cottonwoods.

Historical human impacts [47] in the 17th, 18th, and 19th centuries were associated with clearing of floodplain vegetation for agriculture, fuel and building materials, diversion of water for irrigation, and grazing by domestic livestock, which would have resulted in increases in sediment in the river and reductions in river discharge [2]. Much more intensive human impacts in the 20th century included: (1) flood control structures such as dams, levees, and jetty jacks; (2) draining of wetlands for both

agriculture and flood control through methods such as drainage canals; and (3) introduction of exotic plants including salt cedar (*Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*) for ornamental and erosion control purposes. All of these human activities have contributed to substantial changes in the Middle Rio Grande bosque and the Corrales Bosque Preserve.

Current Status - The Preserve has not experienced the dynamics of a natural river system for many decades. The fragility of the remaining cottonwood forest is due to increasing control over flooding of the Rio Grande, which has resulted in channelized flow at all seasons of the year and prevention of overbank flooding. Although the river periodically floods the area between the levees and occasionally produces some overbank flooding, the level of water release is restricted so as to protect the integrity of the levees and therefore the magnitude, as well as timing and duration, are not suitable for germination and establishment of native seedlings.

Cottonwoods are not long-lived species, and most of the cottonwoods in the Preserve are large and old. There are relatively few smaller and younger cottonwoods. Failure to regenerate new cottonwood stands, which occurs naturally during periodic overbank flooding, means that large parts of the cottonwood forest in the Preserve will continue to degrade and may eventually disappear. Overall, riparian habitat diversity and the resulting diversity and abundance of flora and fauna are much lower [6] than in the period prior to the construction of upstream dams and other flood control structures, or other flood control activities. In addition, the Rio Grande now deposits much of its silt burden upstream in the impoundments behind the dams, the result being scouring flows without sediment deposition that lower the river bed in the lower reaches of the river, making overbank flooding even less likely over time. It has also resulted in diminished seasonable availability of groundwater and a reduction in the availability of oxygen, dissolved organic carbon, and nitrogen in the soil. Without additional management actions associated with restoration of overbank flooding or availability of alternative sources of water, the cottonwood-dominated bosque will continue to change over time, moving toward a habitat with fewer cottonwoods and with a different community structure and species composition.

In addition to the effects that controlling the flow of the Rio Grande has had on the vegetation community, it has resulted in severe reduction in biodegradation of forest floor litter and increase in downed wood fuel load, resulting in higher fire danger. Fire probably did not play an important role in the evolution of the Rio Grande bosque, but today it usually results in the death of cottonwoods and re-vegetation by exotic tree species [2]. Therefore increases in uncontrolled fires may further accelerate destruction of the bosque [34].

Ecosystem Description

Vegetation - Twenty vegetation classification series and 58 community types have been identified along the Rio Grande [34]. On the 28 ha site sampled in the Corrales bosque, Durkin et al. [34] found forested wetland habitats to predominate, and they identified three community types: (1) Rio Grande cottonwood/coyote willow (*Salix exigua*); (2) Rio Grande cottonwood/New Mexico olive (*Forestiera pubescens*); and (3) Rio Grande cottonwood/Russian olive. Although not recorded in this study, the Rio Grande cottonwood/salt cedar community is also present, and possibly other combinations in the Rio

Grande forest series such as Russian olive/salt cedar, and salt cedar/coyote willow/Goodding's willow (also called tree willow) (*Salix gooddingii*). In addition, although it does not represent a large component in the present Preserve, there are probably regions that would be classified as Rio Grande scrub-shrub wetlands dominated by coyote willow, which dominate sandy bars and in-filled channels, and there may be Rio Grande herbaceous wetland communities that elsewhere in the Middle Rio Grande are dominated by common spikerush (*Eleocharis palustris*), water sedge (*Carex aquatilis*), or broad-leaf cattail (*Typha latifolia*) [34]. These communities can be further defined by their structural characteristics – based on the overall height of the vegetation and the amount of vegetation in the sub-canopy or understory [9]. Additional surveys would be required to further define the documented vegetation communities and to map the locations of the rarer community types.

Wildlife

Amphibians - Several amphibian species have been documented in the Middle Rio Grande bosque [9]: Couch's spadefoot toad (*Scaphiopus cauchii*); Plains and New Mexico spadefoot toads (*Spea bombifrons* and *S. multiplicata*); Red-spotted, Woodhouse's and Great Plain toads (*Bufo punctatus*, *B. woodhousei*, and *B. cognatus*); Western chorus frog (*Pseudacris triseriata*); Northern leopard and Bullfrog (*Rana pipiens* and *R. catesbeiana*); and Tiger salamander (*Ambystoma tigrinum*). However, apparently Northern leopard frog is now only found between Isleta and Los Lunas and south of San Marcial [35].

Reptiles - Hink and Ohmart [9, referenced in [2] documented 3 turtle species, 17 lizard species, and 18 snake species in the Middle Rio Grande Valley, but many of these were upland species and don't commonly occur in riparian habitats. Native turtle species reported in the Middle Rio Grande bosque [9]; [35] include: ornate box turtle (*Terrapene ornata*); painted turtle (*Chrysemys picta*); spiny softshell (*Apalone spinifera*); and snapping turtle (*Chelydra serpentina*). Hink and Ohmart [9] listed the New Mexico whiptail (*Aspidoscelis neomexicana*) and the prairie lizard (*Sceloporus cowlesi*) (listed here with updated names from Cartron et al. [35]), as the most widespread and frequently observed lizards in the Middle Rio Grande bosque, in addition to Great Plains skink (*Eumeces obsoletus*), which favors moist riparian habitats. The only snake references from Hink and Ohmart [9] included in a discussion of reptiles found in the Middle Rio Grande bosque [2] were gartersnake species (*Thamnophis* sp.), which also favor moist riparian habitats.

Mammals – Hink and Ohmart [9] found that the three most common and widespread rodent species in the Middle Rio Grande bosque were: white-footed mouse (*Peromyscus leucopus*), western harvest mouse (*Reithrodontomys megalotis*), and house mouse (*Mus musculus*). Botta's pocket gopher (*Thomomys bottae*) is widespread in deep, sandy soils in the riparian zone. Desert shrew (*Notiosorex crawfordi*) is widespread and perhaps among the most common mammals in the bosque although rarely detected [35]. Eleven species of bats are documented for the Middle Rio Grande Valley [9]. Of these, the Yuma myotis (*Myotis yumanensis*) and Arizona myotis (*M. occultus*) use riparian and aquatic habitats extensively [9] and are listed as widespread and common [35]. Interestingly, maternity roosts for two additional widespread bat species, pallid bat (*Antrozous pallisus*) and Brazilian free-tailed bat (*Tadarida brasiliensis*) have been documented in Corrales [35].

Among larger mammals, beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), and common raccoon (*Procyon lotor*) are dependent on riparian habitat and permanent water and are fairly common. Although beavers were almost eliminated due to trapping, restocking efforts in the 1940s and 1950s were successful. Middle Rio Grande populations are “bank beavers” with dens dug into riverbanks and the banks of drains and ditches, although they also make beaver dams in the Corrales Riverside Drain. Additional mammals with broader habitat associations are also found in the bosque, including desert cottontail (*Sylvilagus audubonii*), rock squirrel (*Spermophilus variegatus*), common porcupine (*Erethizon dorsatum*), and striped skunk (*Mephitis mephitis*). Carnivores include coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and bobcat (*Felis rufus*).

Birds – Riparian vegetation is particularly important for avian communities in the arid Southwest. Although it comprises less than 1% of the landscape, it provides habitat for more bird species at some time during the year than all other vegetation types combined. It provides habitat for breeding species, as well as stopover habitat for migrants, and habitat for winter resident and winter migrant species. The avian community is arguably the largest and most diverse group of terrestrial vertebrates in the bosque, both in terms of numbers of species, and abundance and density of individuals. Comprehensive details are beyond the scope of this summary. However, Hink and Ohmart [9] recorded 277 bird species during their surveys of the Middle Rio Grande bosque. Cottonwood-dominated communities were found to support greater numbers of bird species than nonnative dominated communities [2]. The following general summary of birds in the Middle Rio Grande bosque is taken from Cartron et al. [35] and personal experience (D. Krueper and J. Ruth). The most abundant birds in the breeding season in mature stands of cottonwood include Black-chinned Hummingbird (*Archilochus alexandri*) and Mourning Dove (*Zenaida macroura*) followed by other species including Downy Woodpecker (*Picoides pubescens*), Bewick’s Wren (*Thryomanes bewickii*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Spotted Towhee (*Pipilo maculatus*) and Western Wood-pewee (*Contopus sordidulus*). In open areas, typical nesting species include the Western Kingbird (*Tyrannus verticalis*) and in wetlands, Red-winged Blackbirds (*Agelaius phoeniceus*). In winter, Canada Goose (*Branta canadensis*) and Sandhill Crane (*Grus canadensis*) occur in high numbers in ponds, wetlands, the river channel, and farm fields near the bosque. In bosque edge habitat or along ditches and drains in winter, White-crowned Sparrow (*Zonotrichia leucophrys*), Song Sparrow (*Melospiza melodia*), and Dark-eyed Junco (*Junco hyemalis*) are abundant. Based on abundance, spring and fall migrations are dominated by Ruby-crowned Kinglet (*Regulus calendula*), Orange-crowned Warbler (*Vermivora celata*), Wilson’s Warbler (*Wilsonia pusilla*), MacGillivray’s Warbler (*Oporornis tolmiei*), Yellow-rumped Warbler (*Dendroica coronata*), Chipping Sparrow (*Spizella passerina*), White-crowned Sparrow, Dark-eyed Junco, and Pine Siskin (*Carduelis pinus*). Common year-round residents include Mallard (*Anas platyrhynchos*), American Coot (*Fulica Americana*), Mourning Dove, Northern Flicker (*Colaptes auratus*), and House Finch (*Carpodacus mexicanus*). In addition, the Preserve supports the highest density of nesting Cooper’s Hawks (*Accipiter cooperii*) in North America.

Invertebrates – Although invertebrate communities are a very important component of riparian habitats, and provide prey for many of the other taxa described here, it is beyond the scope of this summary to provide details of this group. However, arthropods (mostly insects) are known to be the main contributors to invertebrate biodiversity in the Middle Rio Grande riparian zone [2].

In most cases, surveys in the Preserve would be required to determine which of the species in the above taxa are actually currently to be found in the Corrales Bosque Preserve.

1.3 History

- Village of Corrales incorporates, 1971
- Village commissions wildlife study of the Corrales bosque area, by Dane G. Johnson, UNM Dept. of Biology, 1974
- Village annexes previously unincorporated easternmost portion of the Corrales bosque area including the Riverside Drain right-of-way, 1975
- Village declares Corrales bosque area a Protected Area, 1978
- Village enacts Ordinance 90, banning unauthorized vehicular use of the bosque area including the Riverside Drain and Sandoval Lateral rights-of-way, 1979
- Village adopts Resolution 80-6, declaring policy for the Corrales Bosque area as a wildlife preserve and opposing any new river crossing through the bosque between the Alameda and Bernalillo bridges, 1980
- Village establishes Corrales Bosque Advisory Commission, 1980
- Village signs Bosque-Ecosystem Preservation Contract with The Nature Conservancy, 1984
- Villagers establish The Friends of the Corrales Bosque, "to support the agreement for protection of the Corrales Bosque Preserve reached between the Village and The Nature Conservancy, 1985
- Village adopts 1985 Corrales Bosque Preserve Protection Plan, 1985
- Village dedicates Corrales Bosque Preserve, upon completion of first-stage gating and fencing, 1986
- Corrales Bosque Preserve brochure published by James S. Findley, UNM Department of Biology, by direction of the Corrales Bosque Advisory Commission, 1986
- Village completes second-stage gating and fencing for the Preserve, at the south end, 1987
- Village adopts Resolution 87-1, declaring policy for the Preserve and opposing the digging of borrow pits in the Preserve in connection with levee improvements, 1987
- Village enacts the Corrales Bosque Preserve Ordinance 234 in 1990 to regulate its public use and to define its boundaries.
- Village adopts Resolution 90-38 declaring policy for the preserve and requesting restriction of the use of motorized watercraft on the Rio Grande, 1990.
- Village adopts Resolution 91-17 declaring policy for the preserve and opposing highway corridors cutting through the preserve, 1991.
- Village adopts the initial Corrales Comprehensive Plan, calling for careful regulation of the Preserve, 1988, updated in 1996, and again in 2009.
- Village adopts the 1997 Joint Powers Resolution between the Village and MRGCD.
- Village adopts Village Resolution 2005-6 stating its opposition to a paved regional bike trail through the Corrales Bosque Preserve.
- New Mexico State Senate passes Senate Memorial 17 supporting the village in its firm opposition to construction of the regional bike trail through the Corrales Bosque Preserve, 2005.

Copies of the agreements and contracts that form the governing framework for the Corrales Bosque Preserve can be found in Appendix F.

1.4 Legal and Administrative Framework

The MRGCD has ultimate management authority over the land, and maintains the levees, ditches, and drains in the Corrales Bosque Preserve. The MRGCD contracts with the South Sandoval County Arroyo Flood Control Agency (SSCAFCA) for some of these maintenance activities. The Village of Corrales is responsible for the management of the Corrales Bosque Preserve as a wildlife sanctuary pursuant to the 1997 Joint Powers Resolution between the Village and MRGCD [Appendix F2].

Consistent with that Resolution, the Village must not interfere with MRGCD's maintenance and operation of the irrigation ditches and flood control drains within the Preserve, and should avoid actions that could negatively impact the flood control functions of the levees and drains.

The US Army Corps of Engineers (USACE) also has responsibility for flood control on the Rio Grande, especially the construction of the levees. The levees in Corrales have been greatly improved since the 1930's [7], especially over the past decade. The USACE also helps frequently with maintenance issues within the Bosque. It has provided funding for removal of fire hazards (dead and down wood) and jetty jacks, and has helped fund development or improvement of emergency access points to the Bosque, and several surveys of vegetation types and bird populations.

The Bosque-Ecosystem Preservation Contract, signed with The Nature Conservancy in 1984, was instrumental in securing the boundaries and entrances of the Preserve against vehicular access and other unlawful activities such as wood-cutting. Under the agreement, the Village must exercise its local police powers to enforce prohibitions against vehicular access and uses inconsistent with the protection and preservation of the Preserve's natural features, in part by carrying out regular police patrols of the Bosque. The Nature Conservancy undertook a fundraising campaign that established an interest-bearing account that provides funds each year that have historically been used for the maintenance of gates and signage.

Ultimate jurisdiction over wildlife management is the responsibility of the New Mexico Department of Game and Fish, and the U.S. Fish and Wildlife Service (USFWS) in the case of migratory birds and species listed under the U.S. Endangered Species Act.

Liability arising out of the maintenance of the Bosque is governed by the New Mexico Tort Claims Act (Village of Corrales and MRGCD) and the federal Tort Claims Act (Army Corps of Engineers).

2 MISSION AND OBJECTIVES

Guide To This Section: This Section provides a description of the purpose of the Corrales Bosque Preserve as embodied in the historical relationship with The Nature Conservancy, Village Ordinance 234, the Joint Powers Resolution with the MRGCD, and the Corrales Comprehensive Plan. The objectives of this Habitat Management Plan are then developed to serve the stated Mission of the Corrales Bosque Preserve. These objectives are the driving force behind the Habitat Management Plan and motivate its remaining Sections. From this Section the reader will also obtain some idea of the role of the Corrales Bosque Advisory Commission in advising the Mayor and Village Council on management of the Preserve.

The mission of the Village of Corrales in creating the Corrales Bosque Preserve (the Preserve) is to preserve and protect the natural and native conditions, habitat, and wildlife in the Preserve in order to assure that an increasing human population does not adversely affect or otherwise change the Rio Grande bosque within the village, leaving no areas preserved and protected in their natural condition [Village Ordinance 234 – Appendix F1].

The Corrales Bosque Advisory Commission (CBAC) advises the Corrales Village Council on matters of policy to accomplish this mission, and acts under the direction of the Council and in liaison with various government agencies in implementing management activities in the Preserve. This Habitat Management Plan is a statement by the Commission of its objectives and management strategies within the planning horizon of the next three years.

All the land and works included within the boundaries of the Corrales Bosque Preserve are under the ultimate management authority of the Middle Rio Grande Conservancy District (MRGCD) pursuant to legislative acts of the New Mexico State Legislature. Since 1984 the Corrales bosque has been administered as a nature preserve, through a Bosque-Ecosystem Preservation Contract signed in 1984 by the Village of Corrales and the Nature Conservancy, and further by a Joint Resolution agreed between the Village of Corrales and the MRGCD in 1997 (Appendix F2). Thus, the Village of Corrales is committed to maintain the Corrales bosque **as a nature preserve** – the Corrales Bosque Preserve. As a result, it has and will continue to have structural and ecological characteristics that are very different from the Rio Grande Valley State Park in Albuquerque. Providing its ecological integrity is maintained, it will continue to provide outstanding value to Corraleños.

The goals of the partnerships [5] between the Village of Corrales, the Nature Conservancy, and the MRGCD, are stated in the Corrales Bosque Preserve Ordinance 234, Sections 11-1 through 11-5 [Appendix F1], regulating 'Public Use of the Preserve' and defining its boundaries, and also in the September 2, 1997, Joint Resolution between the Village and the MRGCD [Appendix F2]. The Corrales Bosque Preserve Ordinance states that the designated area of the bosque is “to be

protected in order to preserve its natural character for the use and enjoyment of the residents of Corrales in such a manner as will leave it unimpaired for future use and enjoyment in its natural and protected condition".

The Corrales Comprehensive Plan, updated in 2009 [4], elaborates these objectives as follows:

- Protect for posterity one of the best remaining examples of Middle Rio Grande cottonwood forest.
- Preserve significant habitat for migratory, resident, and endangered species of plants and animals.
- Provide opportunities for educational and scientific pursuits and for quiet, passive enjoyment of the natural area.
- Provide an attractive model for the protection of natural values in urbanizing areas, in order to foster a beneficial change of regional environmental attitudes and customs.

In this Corrales Bosque Preserve Habitat Management Plan (the Plan), the Rio Grande is treated only as a boundary to the nature preserve, despite the fact that the river plays a vital role in the health of the bosque. Therefore, this plan does not address aquatic habitat for fish and other purely aquatic species. It also does not include more or less persistent sandbars and islands in the river adjacent to the bosque, even though sometimes they may be accessible from the banks, and may provide protected habitats for non-aquatic species.

The rest of this section states the objectives of the Plan, with introductory notes that explain how the objectives support the purpose and mission of the Corrales Bosque Preserve.

2.1 PROTECT AND PRESERVE THE CORRALES BOSQUE PRESERVE

Specifically, "**Protect and Preserve**" the bosque means protecting and preserving a variety of natural habitats in order to maintain the biologically diverse ecosystem of wildlife populations and native plant communities that are present in the Corrales Bosque Preserve. However, protection and preservation should not mean that we can or should attempt to prevent change in the bosque and maintain the status quo, in an ecosystem that was historically a dynamic system and is now far from its historical dynamic range. In fact the pre-dam bosque was not a uniform or static expanse of cottonwood forest, as discussed in the description of the Corrales Bosque Preserve above. Sections 2.1.1 and 2.1.2 state the objectives relating to protection and preservation in a way that acknowledges that some level of change is unavoidable.

2.1.1 Manage and Encourage Activities Consistent with the Goals of the Preserve

Protection and preservation of the Preserve in some cases involves the prevention of certain activities, and in other cases involves the encouragement of activities that are not deleterious or that will benefit the Preserve.

1. **Prevent activities that are incompatible with a nature preserve, e.g. motorized vehicles, large groups of people, other high intensity public access, commercial activities, camping, the removal, harassment, or killing of wildlife, and the removal or destruction of plants.**

2. **Permit activities that are compatible with a nature preserve and provide regulations where there is potential for negative impacts if the activities are not carried out appropriately, e.g. mountain biking, horseback riding, walking dogs on leash, bird watching.**
3. **Educate the public to understand the value of the Preserve as a nature preserve, and to accept that some amenity values of the Bosque place limits or prohibitions on certain other uses.**
4. **Empower the community to take an active role in the protection and management of the Preserve, e.g., bosque fire patrols, litter clean-up, invasive species removal on private lands adjacent to the Preserve.**
5. **Promote non-destructive research and monitoring activities that will provide valuable information about the bosque for future management.**

2.1.2 Improve and Restore Ecological Resistance and Resilience of the Preserve to Fire

The Preserve is geographically long and narrow. Its orientation with respect to prevailing westerly winds provides some protection against a large scale fire, but access points and the ability of firefighters to move about in the Preserve are severely restricted. A significant number of fire events over the past few years makes the need for continued vigilance obvious.

6. **Reduce the risk of wildfire through public education and fire management activities that provide for the safety of the public, firefighters, and residences adjacent to the Preserve.**
7. **Develop a Preserve pre-attack suppression plan that provides contingencies for wildfire response.**
8. **Ensure strategically placed firefighter vehicle access points along the bosque corridor for rapid and safe response to wildfires, and for ready access to a network of fuel breaks that are in known locations.**
9. **Over time reduce and control non-native species where feasible and ecologically appropriate and establish native, less fire-prone vegetation types.**

2.2 RESTORE THE CORRALES BOSQUE PRESERVE

The Corrales Bosque, although a relatively unique example of cottonwood gallery forest on the Middle Rio Grande, has not experienced the dynamics of a natural riparian floodplain for many decades, as stated in the ecological description of the Corrales Bosque Preserve. Although the MRGCD and US Army Corps of Engineers (USACE) have documented the historical and planning perspectives of their flood control and land improvement missions [7,8], and we recognize the great benefits of their activities to the surrounding agricultural farms and urban communities, these structures and activities have also had negative impacts on the natural functioning of a dynamic floodplain ecosystem. Even under the limited objective of “Preserve and Protect” it is evident that some restoration of the Preserve is required (e.g. removing non-native species and some of the dead and down wood). Certain habitat types also present opportunities for restoration, most notably cottonwood forest regeneration and the re-creation of wetlands.

2.2.1 Maintain and Promote Riparian Habitat Diversity

- 10. Maintain and promote biodiversity and species populations through appropriate creation and management of a mosaic of suitable habitat types, focusing on the following habitat types:**
 - a. Cottonwood gallery forest and woodlands, including the retention of standing snags and appropriate sub-canopy and understory of vegetation.**
 - b. Meadows and shrub lands, incorporating temporary open areas recovering from former burns and from removal of non-native species of vegetation.**
 - c. Wetlands, including areas of damp soil, wet meadows, shrub wetlands, and marshes.**
 - d. Levees and ditch banks along the edges of the Preserve dominated by native, non-invasive species that meet maintenance and operation requirements for those facilities.**
- 11. Monitor and manage all vegetation and wildlife communities in a manner appropriate for a nature preserve, that is, with light-handed strategies that acknowledge and cautiously account for the risks of unintended consequences.**

The alternative to habitat maintenance and restoration in the Preserve is to simply leave the Corrales cottonwood forest “as it is”, which will result in slow habitat degradation and loss (of a cottonwood-dominated bosque ecosystem) due to the limitations imposed by flood control measures. Without some kinds of restoration this change will surely happen, owing to the lack of overbank flooding. If some degree of overbank flooding is achieved in the years ahead through the work of other agencies, it will augment our own efforts at restoration. However, we cannot rely on this occurring, even though we should actively encourage it. If we want our grandchildren to be able to continue to enjoy a cottonwood-dominated Corrales Bosque we need to preserve, protect, *and* restore.

- 12. Actively promote the use of overbank flooding to the agencies that make these decisions and collaborate in joint projects where possible.**

It is important to note that the restoration of wetlands in the Preserve proposed here is modest in scope, would be gradually and cautiously developed, and may ultimately not prove possible or sustainable in most parts of the Preserve (or even at all) because of ecological and economic factors, or because of New Mexico’s restrictions on new water depletions and water rights issues unless they are within the 600 foot river channel. However, the potential for manual and natural native plant regeneration through plantings and increasing availability of water should be determined. The potential result would be greater species diversity, more abundant wildlife populations, and a richer mosaic of habitats that are more similar to those historically present in the bosque when more water was available. Regardless of whether active management or a “laissez faire” approach is taken, the lack of water will continue to be a dominant factor influencing ecosystem dynamics in the Preserve. In fact, a lack of any active management may result in the spread of aggressive non-native species as the cottonwoods decline, which will in turn require more extensive intervention in the long run anyway. Therefore, we suggest that exploring the potential for wetland restoration is warranted.

2.3 BALANCE THESE OBJECTIVES

Implementation of management actions to meet the above objectives will at times result in conflicts. For example, removal of non-native vegetation where it exists in an extensive unbroken stand, will result in a bare area that will not support large native shrubs or sizeable trees for several years, even if replanted. Non-native shrubs, forbs and grasses often colonize such areas, inhibiting the growth of native early successional species. Fire breaks, where appropriate for fire control, deliberately will be kept clear of forest indefinitely. The creation of wet meadows and seasonal ponds, even when successful, will present an appearance that is different from what the Corrales bosque has looked like in living memory.

Understanding the ecological dynamics involved in managing a diverse floodplain ecosystem and the management actions that are required may be a challenge for the lay person. Education of the public regarding these issues, the benefits of management actions, and the need for prohibitions and controls on human uses of the bosque will be required. Even so, conflicts may arise when not everyone agrees with the decisions that are made.

With this in mind, one purpose of the Plan is to ensure that the objectives, recommendations, and project plans can be read and understood by all interested parties. To be effective in this it must contain enough information to clearly illustrate its intent, describe its management recommendations, and evaluate the progress that has been made. The Corrales Bosque Advisory Commission (CBAC) recommends that the Plan should be updated every three years, after input has been gathered from all stakeholders and other interested parties. The Plan will thus be a living document describing work in progress. Achievement of balance will be aided by initial review and consultation with the MRGCD, the Corrales public, the Corrales Village Council, the academic community, and agencies whose past work has formed the technical basis of the plan and whose management missions and legal mandates affect or are affected by actions in the Preserve.

- 13. Review and update this Management Plan every three years to report progress, promote informed debate among stakeholders, and thus maintain an appropriate balance between competing objectives.**

2.4 OBTAIN RESOURCES AND CONTROL IMPLEMENTATION OF THE PLAN

The goal of the Corrales Bosque Advisory Commission is to adequately represent the viewpoints of the various stakeholders so that the Plan will express the collective will and determination of the population of Corrales regarding preservation, protection, and restoration of the Preserve. This Plan will be a consensus blue-print, the technical basis, and a consultative document that can be used to integrate management of the Preserve with policy-making in the village regarding other matters such as wastewater treatment and disposal, groundwater level and quality monitoring, liaison with the Middle Rio Grande Conservancy District, and liaison with owners of adjacent private lands. In

addition, the Plan should serve as a tool to solicit and direct technical assistance, cooperation, and funding from regional, state, and federal government and other agencies, and private sources such as foundations. Actively seeking such support will be necessary to implement the recommendations in the plan and to achieve all of its objectives in a reasonable time frame. Corrales should also make the Preserve available for appropriate research and monitoring projects that will provide valuable information about the Bosque ecosystem for use in management.

14. Develop and/or consider submitted proposals, meet with potential collaborators, and solicit technical assistance, cooperation, and funding from regional, state, and federal government agencies and other sources to implement recommendations in the plan.

15. Ensure that all project work is aligned with the Plan's objectives and that the guidelines are followed by requiring the approval of a project brief before implementation of any project activities; no project work should take place until a permit is issued by the Village Council. A report on the project and its results will be required as part of the permit process.

To ensure that all project work (management, restoration, research, and monitoring) is aligned with the Plan's objectives, and that the guidelines are followed, a project brief should be evaluated by the Corrales Bosque Advisory Commission and approved by the Corrales Village Council before implementation of any project activities. The project brief will be prepared by the Commission, collaborating agency, contractor, or researcher and, where not prepared by the CBAC will be evaluated by them. It will be the basis for submission of the proposed project by the Corrales Bosque Advisory Commission to the Corrales Village Council for approval. Only after Council approval will a permit be issued to the agency, contractor, or researcher by the Village authorizing them to begin working in the Preserve. No work should be permitted in the Preserve by any contractor, government agency or researcher unless and until the project brief has been evaluated and the permit is granted. All work authorized by the Village Council should be coordinated with the MRGCD as per the Memorandum of Agreement with the Village of Corrales.

The project brief should describe:

1. The goals of the project and how they relate to the objectives of this Plan.
2. The location and the size of the area affected.
3. An overview of the proposed work, including methods to be used, and its relationship to other relevant projects in the Preserve.
4. The funding agency, contractor(s), and project manager.
5. The expected start and completion dates, and schedule of work.
6. Relevant best practices to be followed, as per the guidelines of this Plan.
7. The means by which implementation of these best practices and progress of the work is to be monitored and/or controlled by the Village of Corrales.

8. Relevant existing site conditions (e.g. vegetation, hydrology, soils, habitat), including confirmation of compatibility with the Designated Ecological Unit of the area, when that has been defined.
9. Complete contact information (name, affiliation, address, phone number, cell phone number, and email address) for the project contact to ensure that Corrales representatives can reach someone if questions arise before, during and after the project.
10. CBAC's recommendation to the Village Council.

3 ACTION PLAN

Guide To This Section: This Section summarizes all the relatively near term action items that emerge from the guidelines developed in the remaining sections, which support the overall objectives. Consequently, this is the section that a reader should focus on to find out what is actually proposed as actions and projects related to the Preserve over the next three years. Priorities among these actions have been assigned but are not stated here because they are somewhat variable depending on opportunities presented by interactions with other regional, state and federal agencies. In general, all of the action items in this section are important and will be addressed as soon as practical over the next three years. It is important to realize, however, that several of them require longer term commitments before they are completed, and others are expected to require continuing attention over the long term.

This section of the Plan describes specific near term projects that will collectively lead to achieving the objectives stated in Section 2. The Guidelines and Recommendations and Technical Basis information of Appendices A, D, and E should be consulted to obtain a more complete understanding of all that is implied by these activities.

Several of the near term projects proposed in the this section should be completed as quickly as possible, certainly in a two year time frame, as they are critical action items that need to be accomplished before other recommendations can be pursued.

The critical action projects to be completed in a two year time frame are: 1) Vegetation Survey, 2) Groundwater Evaluation, 3) Habitat Identification, 4) Assignment of Designated Ecological Units , and 5) Management Strategies.

3.1 Survey and Assess Vegetation, Wildlife, and Groundwater and Develop Management Strategies

3.1.1 Vegetation Surveys

Map and monitor vegetation types throughout the Preserve, with attention to unusual or sensitive species and vegetative habitat types capable of supporting a high diversity of birds and mammals.

- This requires compiling (in electronic form), and analyzing, the detailed historic vegetation survey data from the original Hink and Ohmart surveys [9] of 1984-9. The raw data has been obtained from the University of Arizona by USACE and requires funding to encode the data in software, and conduct data analysis. The USACE has agreed to fund this task with the intention of completing it during 2009.
- Analysis is also required of detailed new vegetation survey data from 12 transects in the Preserve that were surveyed by Natural Heritage of New Mexico (UNM) during 2006 under

contract to USACE. This task also should be accomplished by USACE during 2009. The data has already been encoded in software. Its analysis will include a comparison with the earlier Hink and Ohmart data to develop an understanding of the historical trend.

- Map areas where Yerba Mansa and other ground moisture ‘indicator’ vegetation are successfully established. This can easily be done at little or no cost (may require purchase of a few handheld geo-positioning units) using volunteer effort.
- After the data have been analyzed and mapped, and used to draw the conclusions required in sections 3.1.2 through 3.1.6, gaps will be identified where additional work on vegetation surveys is still needed.

3.1.2 Wildlife Surveys

Evaluate existing survey data on bird communities in the Preserve.

- To provide for trending of bird populations and the effects on them of thinning of salt cedar and reduction of dead and down fuel overloads, it will be necessary to compile in electronic form, and analyze, the detailed historic bird survey data from the original Hink and Ohmart surveys [9] of 1984-9. This, too, is expected to be accomplished by the USACE during 2009.

3.1.3 Groundwater Evaluation

- Evaluate the groundwater depth at selected points within the Corrales Bosque Preserve using an existing survey completed in 1990 [12], by monitoring wells that already exist, and by taking careful note of the vegetation types that are successful in different areas of the Preserve. There are two wells at the south end that have been monitored by USACE for the past two years, and three more are planned by the USACE between the north boundary and the Harvey Jones flood control channel in the near future. In addition, a few wells exist in the north end as part of a Biological Ecosystem Monitoring Program (BEMP)/Natural Heritage New Mexico monitoring program. Existing data may need to be expanded by establishing a few additional shallow wells. It is likely that the USACE can be persuaded to install additional wells if we can show that they are needed to assist in re-vegetation plans.
- Encourage USACE to complete the wells already planned for the northern sector of the Preserve.
- The Corrales Bosque Advisory Commission’s Technical Resource Group (an informal group of local professionals who have agreed to assist the Commission on the scientific aspects of ecology and hydrology) has access to all the existing hydrological data from these wells and will be able to draw additional conclusions from the vegetation data. These conclusions should address where additional wells may be needed and provide input to work identifying habitats, Designated Ecological Units, and Management Strategies.

3.1.4 Habitat Identification

- Given the historical records and the results of the above vegetation, wildlife, and groundwater surveys, identify and map at least the following:
 - a. Sites suitable for regeneration of cottonwoods, willows, and native understory vegetation.

- b. Areas supporting a high diversity of plant species, including species of special interest such as Yerba Mansa (*Anemopsis californica*).
- c. Sites that support a high diversity of birds.
- d. Sites that should be capable of supporting a variety of small vertebrates, including mammals, reptiles, and amphibians.
- e. Sensitive habitats that need protection from excessive human use, such as extensive areas of cryptobiotic soils (dry sandy soils with a crust of blue-green algae and lichen).
- f. Favorable sites for the development of wetlands based on groundwater availability, topography, and existing vegetation.
- g. Areas still supporting relatively high densities of non-native plant species, especially Russian olive, Siberian elm, and salt cedar.
- h. Remaining areas of high fuel load.

3.1.5 Designated Ecological Units

- Based on the information from sections 3.1.1 – 3.1.4 define a set of Designated Ecological Unit classifications that define areas and the types of activities that are permitted and precluded there. The Designated Ecological Unit classifications should be defined so that the lay person (someone without ecological training) can understand and recognize them.
- Using a planning approach that takes a holistic view of the Preserve, assign each area of the Preserve with an appropriate Designated Ecological Unit classification so as to leave no part of the Preserve without such a designation. Ideally, the unique Designated Ecological Units should not be too numerous and should be large enough to manage activities within them.

3.1.6 Management Strategies

- Develop and adopt management strategies for all of the Designated Ecological Units, especially plans for:
 - a. The regeneration of cottonwoods, willows, and other suitable sub-canopy and understory species.
 - b. Areas that will be required to remain effective as firebreaks.
 - c. Control of Russian olive, because this species provides valuable feed for animals and birds, but spreads quite aggressively to adjacent areas. Russian olive may best be controlled with a clear perimeter where it already occurs in small but dense stands, in combination with eradication of individual occurrences by spot treatment.
 - d. Containment and control of other non-native plant species such as Siberian elm and salt cedar.
 - e. Continuing work with USACE to reduce fuel loads in some areas. There are many such areas of much smaller extent than those that have been treated so far. It may not be necessary to reduce the fuel load in all of them because they may also represent preferred habitat for some wildlife, and areas of limited extent that are also surrounded by areas with low fuel load may not present a significant fire risk.

Most of the work of sections 3.1.2 through 3.1.6 should be able to be accomplished at no additional cost by the volunteer members of the Corrales Bosque Advisory Commission's Technical Resource Group in collaboration with the Corrales Bosque Advisory Commission, MRGCD, USACE, and Hawks Aloft Inc.

3.1.7 Mapping Software

- Explore opportunities to acquire needed mapping capability through a suitable arrangement with an agency that already uses and applies it in the Middle Rio Grande bosque, such as USACE or MRGCD, who will also benefit from the additional detailed information that will be included on such maps. Alternatively, evaluate options and, if necessary, acquire a mapping software application that can import a base map from an outside source in various formats, create copies of it, annotate the copies with new information, and overlay various GIS layers. One requirement that may influence how this mapping capability is to be acquired and managed is that they will need to be available from the proposed Corrales Bosque Preserve web site.

3.1.7 CBAC/MRGCD Liaison

- Develop a formal CBAC liaison with the MRGCD for bosque management, required maintenance along the Riverside Drain (otherwise known as the Clear Ditch), and other ditch bank maintenance activities periodically carried out by the MRGCD. Where possible, such work should be done during known time windows or opportunities to perform vital maintenance effectively with the least possible impact on wildlife.

3.2 Fire Protection and Control

3.2.1 Pre-Attack Fire Suppression Plan

- Develop a pre-attack Fire Suppression Plan in coordination with the Corrales Fire Department that provides GIS database maps of access points and fuel breaks, along with jointly-developed strategies, contingencies, and public awareness efforts regarding suppression of fires in the Preserve under different weather and environmental conditions. This plan will include, among other things, up to date emergency contact information and fire weather trigger points.

3.2.2 Fire Service Vehicle Access

- Develop strategic placement of fire vehicle turn around areas to be located adjacent to the levee trail
- Develop a rationale for additional fire service entrances, if any, that need to be constructed over the Riverside Drain in the future. Access points generally should be evenly spaced along the Preserve to allow rapid access to the bosque ditch and levee roads, fire breaks, and turn-around areas.

3.2.3 Hazardous Fuel Breaks

- In consultation with the Corrales Fire Department, determine the placement, number, and extent of fuel breaks that should be maintained, taking advantage of existing vegetation and trails, jetty jack removal openings, old burn sites, natural and man-made openings, and areas with less-fire-prone vegetation types.
- Map this network of fuel breaks for inclusion in the Fire Suppression Plan.
- Determine the need, if any, for additional fuel breaks, thinning or other fire management treatments.

3.3 Opportunities for Wetland Restoration

- Evaluate the potential to create seasonal or permanent wetlands in the Preserve in an integrated, cautious, and adaptive manner. Such considerations should include:
 - a. Vegetation, groundwater, and habitat survey results and Designated Ecological Units.
 - b. Opportunities to create areas of seasonally moistened soil, seasonal ponds, or wet meadows in places where higher than average groundwater tables exist, or where river water can be introduced during times of high flow into former oxbow sites, old side channels, or borrow pits.
 - c. Opportunities to induce appropriately timed spot flooding along the river banks, or to divert water from areas adjacent to the existing banks, that currently flood at high water levels, into marshes and ponds for a longer period of the year.
 - d. Opportunities to create streams with associated small marshes using pumping from the Riverside Drain, or using Corrales or Rio Rancho waste water. Assistance in the latter may be provided by the Southern Sandoval County Arroyo Flood Control Authority as a means of dealing adequately with Rio Rancho waste water.
 - e. Opportunities to encourage localized overbank flooding by removal of the jetty jacks currently used to modify and stabilize the river channel, replacing them with suitable flow-resistant vegetation such as coyote willows.
 - f. Regulatory requirements for the creation of wetlands. Chief among these are water use restrictions that may prevent pumping from the drains and from the Rio Grande.
 - g. Availability of funding and technical assistance from local, state, and federal agencies.

Most of the work of sections 3.2 (Fire Protection) and 3.3 (Opportunities for Wetland Restoration) should be able to be accomplished at no additional cost by the volunteer members of the Corrales Bosque Advisory Commission's Technical Resource Group in collaboration with the Corrales Bosque Advisory Commission, The Corrales Fire Department, MRGCD, USACE, SSCAFCA, and Hawks Aloft Inc. Clearly there will also be a need to consult with other organizations having expertise on wetland restoration, and local, state, and federal regulatory requirements regarding water use.

3.4 Outreach, Trail Use and Maintenance

The near term focus should be on the following items:

- a. Develop a Corrales Bosque Preserve Web Site.

- b. Define and restore trails that existed before clearing of vegetation for various purposes, and remove other 'emergent' trails so that these areas do not develop into an uncontrolled network of braided trails.
- c. Place trail signage in a few areas to prevent destruction of critical habitat.
- d. Develop a Trail Use Protocol and post it at entrances.
- e. CBAC should closely monitor Corrales Police parking enforcement records and patrol logs in high-use access areas of the Preserve, and ensure that urgent and effective action is taken to address illegal camping and other illegal or high-use activities.
- f. Evaluate the possibility of creating some handicap access points.
- g. Evaluate the possibility of creating an Adopt-a-Trail program.

3.5 Implementation

CBAC and the Village of Corrales should make every effort to network and partner with other agencies, with the objective of encouraging and securing funding and other resource support for action items in this Plan. It appears, however, that no significant funding is required to carry out the most important and immediate items identified above.

CBAC should assign responsibilities to Commission members for liaison with government agencies and other organizations, at least on a semiannual basis. During the next 12 months, it should be a CBAC priority to complete Appendix H of this Plan that identifies the agencies of most interest in accomplishing the goals and objectives of the Plan, their relevant activities, and the best way for CBAC members to interact with them.

There are two objectives of this activity:

- a. Make staff of the various agencies aware of our Plan and needs in a timely way in order proactively to discover new project opportunities that could support this Plan.
- b. Get feedback from published results and recommendations that are relevant to this Plan from ongoing work by these agencies in other parts of the Middle Rio Grande Valley.

APPENDIX A: MANAGEMENT GUIDELINES AND RECOMMENDATIONS

Guide To This Section: The management recommendations and technical guidelines in this Appendix provide information and direction to projects that are undertaken in the Corrales Bosque Preserve in order to achieve the objectives of Section 2 and the actions of Section 3 over a period of years. Some repetition is evident between the general recommendations of this section and the near term actions identified in Section 3, since the near term actions are that subset of the recommendations of this section that can be accomplished over the next two to three years. All project work carried out by any agency or organization should follow the guidance in the relevant parts of this and subsequent Appendices. Each of the main subsections below (e.g. A1) is followed by further explanation and information on the basis for the guidelines in the section.

A1 Vegetation, Groundwater, And Wildlife Surveys

A1.1 Vegetation Surveys

Initially survey and map, and subsequently monitor vegetation types, with special attention to unusual or sensitive species or plant communities as well as threatened and endangered species. Initial surveys will reveal current status and distribution of vegetation types and will update information from previous studies [9,10,11]; this will provide baseline data for any future efforts. Subsequent periodic monitoring is desirable so that CBAC may be aware of changes and trends. As a dynamic ecosystem, the Bosque is expected to change from year to year. The purpose of monitoring is to document distribution, status, and change. Monitoring is a crucial component of all management actions, because it provides information that can be used to inform and improve management, restoration, and research projects in the future.

The following general requirements for monitoring should be observed:

- 1) Monitoring should be properly designed to be used for management purposes.
- 2) Information about past and current monitoring programs and data for the Preserve and other relevant studies should be compiled and updated regularly.
- 3) Monitoring of the effects of restoration and fire management projects should be a crucial component of most projects.
- 4) Recreation uses, types and levels of impact on the Preserve should be monitored to support management decisions.

Initial surveys should include a focus on mapping the following vegetation types or sites of interest:

- a) Stands of mature Rio Grande cottonwoods (*P. deltoides* var. *wislizenii*) and other trees such as Goodding's willow (also called tree willow) (*Salix gooddingii*), Russian olive (*Elaeagnus*

- angustifolia*), Siberian elm (*Ulmus pulmila*), with a dense understory vegetation such as coyote willow (*Salix exigua*), New Mexico olive (*Forestiera neomexicana*), silver buffaloberry (*Shepherdia argentea*), indigo bush (*Amorpha fruticosa*), and salt cedar (*Tamarix sp.*).
- b) Stands of cottonwood and other trees that lack suitable understory structure.
 - c) Differentiate between stands of native species forest and understory and those with significant non-native species.
 - d) Extensive stands of willow or other shrub species.
 - e) Areas with extensive native groundcover, such as the medicinal herb yerba mansa (*Anemopsis californica*), and significant occurrences of native grass meadows composed of Indian ricegrass (*Achnatherum hymenoides*), grama grasses (*Bouteloua sp.*), and salt grasses such as inland saltgrass (*Distichlis spicata*), alkali muhly (*Muhlenbergia asperifolia*), and the following *Sporobolus* grasses: alkali sacaton (*S. airoides*), spike dropseed (*S. contractus*), and sand dropseed (*S. cryptandrus*).
 - f) Areas that have suffered considerable human impact and should be allowed to recover:
 - i. Old burn sites with a high diversity of native and non-native plants and those that are not recovering as successfully.
 - ii. Areas that may be in need of re-vegetation following thinning treatments.
 - iii. Levees and ditch banks supporting native shrubs and annual plants, especially the western bank of the Riverside Drain.

A1.2 Groundwater Surveys

Map, monitor, and evaluate groundwater depth and quality, including seasonal (and more frequent) fluctuations if feasible, at selected points within the Preserve using existing [12] and new observation wells as necessary, with additional input from wells belonging to volunteers on private property adjacent to the bosque if needed and practical. Consideration should also be given to monitoring groundwater chemistry (dissolved oxygen, turbidity, specific conductance, sulfate, bromide, chloride, nitrate, ammonium, and phosphate) in selected groundwater wells as well as in the clear ditch, some wetlands, and specified locations along the river bank, as is done by the BEMP (18). Consult other sources of information on the riparian groundwater sources and flows in this part of the Middle Rio Grande Valley, and their connection with the river level and with the seasonal presence of water in irrigation ditches.

A1.3 Wildlife Surveys

Initially survey and map (or compile existing survey data), and subsequently monitor wildlife, with special attention to species and taxa of management interest as well as any threatened and endangered species. Initial surveys will reveal current presence, status and distribution of wildlife species and will update information from previous studies; this will provide baseline data for any future efforts. Subsequent monitoring is desirable so that CBAC may be aware of changes and trends. As a dynamic ecosystem, the wildlife populations in the Bosque are expected to change from year to year. The purpose of monitoring is to document distribution, status, and change; as before, monitoring is a crucial component of all management actions, because it provides information that can be used to inform and improve management, restoration, and research projects in the future.

Initial surveys should include a focus on the following wildlife taxa:

(a) Birds – year round residents, in transit migrants, summer breeders, and wintering species. Of particular interest are priority species of management concern identified by the New Mexico Avian Conservation Partners (NMACP) in their New Mexico Bird Conservation Plan (<http://www.nmpartnersinflight.org>), species identified in the U.S. Fish and Wildlife Service Birds of Conservation Concern 2008, as well as any threatened and endangered species. Historical data from bird monitoring and research projects are available from several sources [9,32], and Hawks Aloft has established at least 12 bird census transects in the Preserve and continues conducting surveys [14]. However, the detailed bird census data from the original Hink and Ohmart work [9] have not yet been compiled and analyzed for comparison with recent data. As soon as possible, conclusions from all of these sources should be collected and made available to CBAC to inform Bosque management activities.

(b) Mammals - Of particular interest are sites in the Preserve that should be capable of supporting a variety of small mammals, including conditions necessary for species of special interest such as meadow jumping mouse (*Zapus hudsonius*) (wet meadows), and tawny-bellied cotton rat (*Sigmodon fulviventer*) (moist areas of island and riverbanks characterized by herbaceous, non-woody vegetation) [40]. Other small and medium-size mammals of interest regarding their distribution and abundance in the Preserve with well known habitat requirements include: striped skunk (*Mephitis mephitis*), common raccoon (*Procyon lotor*), desert cottontail (*Sylvilagus audubonii*), coyote (*Canis latrans*), American beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), porcupine (*Erethizon dorsatum*), and a variety of bat species. Meadow jumping mouse (*Zapus hudsonius*) and northern leopard frog (*Rana pipiens*) are species of interest that historically were found in the area, but currently may not occur within the Corrales Bosque. A published survey [13] details mammals found in the Rio Grande Valley State Park.

(c) Amphibians and reptiles e.g. western painted turtle (*Chrysemys picta*), various other frogs, toads, and turtles.

(d) Invertebrates - here the focus might be on insects of particular interest and ease of surveying such as butterflies and dragonflies.

A1.4 Identify Areas for Potential Management

Interpret the results of the surveys in sections 3.1.1-3.1.3 of this Appendix, as well as the literature on important habitat types in the Southwest, to identify and map the boundaries of important habitat types. The designation of the best uses of these habitats and the corresponding management treatment for them is addressed in the next section. A few of the most important areas to identify for management treatments are:

a) Sensitive areas that need protection from excessive human use, e.g. existing viable cottonwood forest and areas with young and newly regenerated cottonwoods.

- b) Areas with the potential for regeneration of cottonwoods and willows. These will preferably be open, disturbed sites with available groundwater within 6 feet of the surface, areas that can be made more damp during high spring run-off by facilitating river water entry to old oxbow channels, or sites where water can be artificially introduced for some period by pumping from the river or from the ditches, or by using ditch return flows. Creation of moist soil depressions, especially when done in association with replanting, has been recommended by the U.S. Fish and Wildlife Service in their review of the proposed fuel thinning activities [14].
- c) Areas supporting a high diversity of vegetation types, such as recovering burn sites with some cottonwoods, open and wet grassy areas, native shrubs and trees, and some native-dominated communities with mixed native, and in places, exotic understory plants
- d) Areas where either healthy young or mature cottonwoods exist but without a sub-canopy structure of shrubs and smaller trees.
- e) Habitats supporting a high diversity or high population of mammals and birds. Nesting and migration periods in relation to these habitats would help identify exclusion areas and times of year during which intrusive maintenance work could be deferred with great benefit. However, the entire Preserve is already subject to the requirements of the Migratory Bird Treat Act and the USFWS Empty Nest policy that preclude many activities during the bird breeding season that would constitute a “take” if it disturbed or destroyed nests.
- f) Areas suitable for the maintenance of natural firebreaks.
- g) Areas suitable for the introduction of wetlands.
- h) Areas still requiring removal and control of non-native species such as saltcedar, Siberian elm, and tree of heaven.

A1.5 Assign Designated Ecological Units and Management Strategies

Develop and adopt “Designated Ecological Units” for each section of the Preserve comprising a meaningful combination of existing and intended habitat, as well as the associated management strategies for those purposes. For purposes of illustration these development categories could include “prevent unnecessary human activity”, “limited alteration for wetland development”, “cottonwood regeneration area”, and “manage as grassland and shrub firebreak”. Regional context for establishing “biophysical land units” has been described in the BLU report [15] for planning zones in the Rio Grande Valley State Park, Albuquerque.

All proposals for Designated Ecological Units should be evaluated by the Corrales Bosque Advisory Commission in consultation with the Technical Resource Group and relevant agencies, and take into consideration all available pertinent data. CBAC will base its initial and ongoing recommendations for intended habitats and Designated Ecological Units to the Corrales Village Council on, 1) survey results and existing habitats depicted on maps, 2) practical management considerations, and 3) other evidence and expert advice as referred to above. Decisions on Designated Ecological Units , and associated management strategies, must be made on an integrated basis that takes into account the impact on all parts of this plan.

A1.6 Regenerate Cottonwoods, Willows and Understory

Manual re-vegetation efforts may include pole planting of cottonwoods and willows, with equal emphasis on replanting of other native sub-canopy and understory riparian species using seedlings and seeds where appropriate at suitable sites. Re-vegetation efforts should be supported by suitable watering strategies such as location adjacent to wetlands, presence of seasonally wet soils so that the water table supports their growth and survival, as well manual watering systems or other available methods for bringing water to the replanted area.

A1.7 Control of Non-Native Species

As far as practical, cut to the ground selected non-native species of vegetation such as Siberian elm, salt cedar, and tree of heaven (*Ailanthus altissima*), that are not useful as food sources for wildlife and use application and re-application of herbicides as necessary to prevent their recurrence. For spot treatment of widely distributed elms and salt cedars, cutting and removal should be carried out as much as possible by hand. Denser concentrations should be addressed using a minimum of the lightest practical mechanical equipment, the least damaging routes from the levee, and minimizing destruction of vegetation that otherwise need not be cleared.

The only exceptions to these strict requirements would be in areas designated for wetland restoration where access for non-native species removal and other work might be less restricted if considerable clearing of existing vegetation is already intended during restoration efforts. Because the largest concentrations of non-native species in the Preserve have already been addressed, further actions will most likely consist of spot treatment and management rather than clearing of large areas. On a case by case basis, non-native trees with wildlife value such as Russian olive and mulberry may be left for habitat if surrounded by fuel breaks or more open stands.

It will be important to do periodic maintenance and reapplication of herbicide in cleared areas because cut trees and shrubs and those treated with herbicide frequently re-sprout extensively within a year, requiring multiple treatments. See Appendix E for the detailed treatment prescription for non-native tree and shrub species.

Specific control methods for non-woody, non-native, invasive species such as noxious weeds may also be needed in certain areas.

A1.8 Improve Management of Edge Areas

Assess the health of the ecosystem along the edges of the Bosque, at the north and south ends, along the drains and Harvey Jones flood control channel, and the levees and irrigation ditches, and determine management actions needed for areas that are capable of supporting a dense growth of native shrubs and annual plants.

In principle, the MRGCD is authorized to perform maintenance and control actions in the Preserve without prior authorization from the Village Council. In practice a collaborative and cooperative mode of planning involving the CBAC and/or the Village Council is likely to be more successful at accomplishing the goals of the maintenance activities in harmony with the seasonal needs of species in the Preserve and the interests of Corrales citizens.

To this end, CBAC should develop a close and effective liaison with the MRGCD to proactively plan the extent, frequency, and time of year for periodic maintenance carried out along both sides of the Riverside Drain, the Sandoval Lateral, and other ditch banks and drains. Maintenance must be timely and effective but kept to a practical minimum that avoids extensive disruption to habitats and wildlife at sensitive times and complies with laws and regulations (e.g., Migratory Bird Treaty Act and Empty Nest policy). In the past, this work has involved dredging the channels, removal of branches and trees causing erosion or limiting the flow of water, removal of beaver dams, and repair of bank erosion. During 2008 it involved extensive cutting of the edge vegetation to gain access to the west bank of the Riverside Drain. It is important therefore, to perform this work after careful preparation and planning that addresses, 1) the vital flood control and drainage functions of the levees and drains, and 2) the preservation of habitat and protection of wildlife. Despite these planning initiatives it must be acknowledged that MRGCD staff may occasionally need to act quickly where access or water flows are blocked or properties are threatened, so coordination will not be possible all the time.

It is emphasized that all other activities in the Preserve (such as animal control, surveys, and research) must be authorized by the Village Council even when it is carried out by government agencies, academic researchers, or private organizations. Ironically, the MRGCD and the Village of Corrales do not have jurisdiction over wildlife or wildlife management, which is the responsibility of the New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service in the case of migratory birds or species that are listed under the U.S. Endangered Species Act.

In the past, beaver have posed a threat to the cottonwoods along the Rio Grande, the Riverside Drain, and the Sandoval Lateral. Although this does not appear to be a significant current problem, mature cottonwoods showing signs of beaver damage should be protected by wrapping the base of the trunk with chicken wire to a height of at least five feet. Growth of willows might be encouraged in some areas especially along the floodplain at the edge of the river channel, as willows provide an alternate food source for beaver. If beaver once again become too numerous, there are modern methods [16] of beaver management, that include structural modifications that prevent beaver dam building and live trapping and translocation, that are more humane than kill-trapping or shooting them. It may be possible to develop some wetland areas that, by offering alternative beaver habitat, would make the Riverside Drain comparatively less attractive to them.

Additional Basis for the Recommendations of A1

Effective preservation, protection, and restoration of the Corrales Bosque Preserve requires a clear understanding of the habitats, vegetation, and wildlife communities that currently exist, the riparian ecosystem and hydrological dynamics of the middle Rio Grande, how these components are different from or similar to ecosystem components measured in past surveys, and how they are likely to change in the future. Such information and predictions are fundamental to our ability to manage specific habitats and communities in an appropriate manner. Management of the bosque requires an understanding of groundwater availability and quality in different areas, particularly those areas that may be targeted for pole planting cottonwoods and willows or the recreation of wetlands, and areas where groundwater depletion rates exceed recharge rates in a way that endangers existing vegetation. In general this type of survey work and continued monitoring will take place through targeted, stratified

sampling of selected areas and transects, rather than by intensive censusing or assessments of the entire Preserve.

Hink and Ohmart [9] developed detailed vegetation maps of the Corrales Bosque Preserve as part of their Middle Rio Grande Biological Survey in 1984. Some additional work [10] was completed in 1990, and the original survey was updated to some degree [11] in 2004 and specifically in the Corrales Bosque Preserve during 2006. There also exist historical aerial surveys of the Corrales cottonwood forest [17].

To ensure continued monitoring of the Preserve into the future, 12 permanent vegetation transects have been established since 2006, using the method of Hink and Ohmart and other recognized methods developed from them. There may be a need for additional transects to adequately characterize vegetation types in selected areas of the Preserve and to provide information on long-term changes in the composition of plant communities. The location of additional transects should be determined in a strategic manner, based on the need for stratified random sampling of all key habitat types in the Preserve. Data on the number and size of each perennial species of plant has been gathered on all transects during 2006. Conclusions from this work need to be augmented by continuing studies of these and additional vegetation transects. All transects should be monitored every 2 or 3 years. Design and conduct of useful surveys requires professional workers, but can be supplemented by trained volunteers (e.g. the Biological Ecosystem Monitoring Program (BEMP) conducted by the University of New Mexico [18, 30]) or, perhaps, by members of a Bosque biology class at UNM, supervised by a field biologist.

In advance of all cases of re-vegetation, suitable sites need to be evaluated [15] and mapped, by considering the availability of groundwater, its seasonal variation, additional practical watering programs, soil type and preparation, and compatibility with existing adjacent vegetation. Re-vegetated sites should also be monitored before and after management actions to evaluate success.

Pole planting can be quite successful in establishing cottonwood and willow saplings. Tree New Mexico's web site explains the cottonwood and willow pole-planting process as follows: "Cottonwood and willow tree "poles" are cut and planted during the dormant winter season. Poles are usually suckers that come up from the base of an older, established tree. The poles are fairly straight, stripped of most of their lateral branches (leaving the top 15-25 percent), and run from 10 to 18 feet long and from two to four inches in caliper. There are no roots. Holes six to ten feet deep (reaching the water table) are drilled along waterways and the poles are "planted," and the holes backfilled by the volunteer groups. When spring hits, the poles send out new leaves along the remaining branches, and roots along the shaft of the buried part of the pole. As the tree establishes its new and more traditional root system, the buried part of the pole begins to rot away. This restoration method is very cost effective, establishing a forest of six to twelve foot tall trees in a few years time with an estimated survival rate of about 85 percent" (Note added:presumably in areas of suitable groundwater availability or irrigation). Additional information is available from USDA NRS "Guidelines for Planting Longstem Transplants for Riparian Restoration in the Southwest," although the document applies mainly to understory woody species. The Los Lunas Plant Materials Center (505-865-4684) is a useful resource.

Areas recovering from fire, non-native removal, and dead and down fuel removal and other similar open areas will tend to be filled in by non-native species unless growth of native groundcovers, grasses, sub-canopy and understory species, as well as cottonwoods and willows, are actively encouraged. The grasses and shrubs provide necessary food, cover, and nesting opportunities for a wide range of wildlife, as well as preventing the invasion of non-native species. Where practical, re-vegetation should be carried out using local genetic stock of native species obtained from multiple locations (e.g. taking cuttings from many different trees). Local sources of cottonwood and willow poles are easily obtained (from local Plant Material Centers of the USDA Natural Resources Conservation Service [NRCS]), although the same does not seem to be true of wetland plant species. In addition, supplies of shrubs, herbaceous forbs, and grasses may also be needed. Records of planting dates, species, numbers, locations, and size must be kept and monitored over long periods of time, and adequate protection and water must be provided for young plants. Root sprouting may be an effective additional method for cottonwoods, using existing aging trees. Cut stumps of fire-killed cottonwoods often produce stump and root sprouting. The Partners for Fish and Wildlife program of the US Fish and Wildlife Service, The Nature Conservancy, and the NM Natural Lands Protection Act Committee may be additional sources of information on this little-studied restoration method for cottonwoods.

Bird populations in the Corrales Bosque have for some time been monitored by Hawks Aloft [13]. Hawks Aloft intends to continue these surveys through at least 2013, with a study objective of documenting how individual bird species change in status over the length of the study through effects of restoration efforts. These should be compared with older results from bird population studies conducted in the Rio Grande Valley State Park in Albuquerque [19] and other available bird survey data.

A2 Fire Protection And Control

There is some risk of cumulative effects of multiple projects when vegetation is removed to control invasive species or to reduce the risk of fires. Therefore, any invasive species management projects should take into consideration all related projects (past, present, and future), their combined footprint, and wider-spread effects. This will in most cases provide better wildlife habitat, habitat that is less-prone to future exotic species invasions, and less-prone to fires.

A2.1 Remove Dead and Down Wood

Reducing the risk of high intensity fires and severe fire effects requires the continued removal of the *overload* of dead and down wood according to published information [2,12,21,22,24,43]. See also Appendix D, [23] that takes into account the amount, type, and distribution of downed trees and standing snags that should remain for wildlife. This should be accomplished by hand except in areas of exceptionally high fuel overload. In each case, a professional biologist should advise on the extent and method of dead wood removal.

A2.2 Natural Fuel Breaks

To limit the total area of the Preserve threatened by any one fire event it is important to determine the required number, location, and extent of ‘natural’ fuel breaks, taking advantage of existing cleared or

open areas, old burn sites, and potential wetlands. The following kinds of sites should be mapped and evaluated:

- a) Existing areas that have been cleared by removal of non-native species or jetty jacks.
- b) Areas that are already sufficiently open (e.g. previously cleared areas that are only partially recovered) that could be effective fire breaks.
- c) Potential sites for new wetlands according to the results of B3.
- d) Determine (with reference to the management strategies) the degree to which areas outlined in (a) to (c) could be effective as fuel breaks if maintained in an appropriate manner.
- e) Determine the need, if any, for creating additional fuel breaks of similar kinds to those above.

Permanent hazardous-fuel breaks create defensible space for firefighters to enhance containment and control efforts of any wildfire. These fuel breaks should be designed to create a balance between managing for defensible space for the firefighters while also maintaining ecological function and integrity of the Preserve. For example, shaded fuel breaks could be used in some areas to provide safe firefighter access while still maintaining large-tree over-story canopies.

A2.3 Fire Service Access

Continue to improve safe and rapid access to and egress from the Preserve for fire protection vehicles and personnel, and determine the number and location of turn-around areas that need to be created at the edge of the levee road. In addition, develop a rationale to control and limit the need for further fire access entrances in the future. The whole topic of drain crossings, turn-arounds and fire breaks across from drain crossings and access points, and along interior bosque roads such as two-tracks, should ultimately become part of a Pre-Attack Fire Suppression Plan.

A2.4 Fire Suppression Plan

A pre-attack Fire Suppression Plan would need to be coordinated with the Corrales Fire Department. It should provide GIS database maps of access points and fuel breaks, strategies, contingencies, and public awareness measures for suppression of fires in the Preserve under different weather and environmental conditions. This plan should include up to date emergency contact information and fire weather trigger points. The plan would be used for training as well as delivering a more safe and effective wildfire emergency response. This pre-attack Fire Suppression Plan must be updated regularly and be included as an appendix to this Habitat Management Plan.

A2.5 Closures of the Preserve

The Corrales Fire Chief, in consultation with CBAC, will continue to implement Preserve closures based upon trends and forecasts of fire weather, fuel moisture, and other environmental (e.g., wind forecasts) and cultural (e.g., July 4th) measures of fire risk. These measures should be incorporated into the Fire Suppression Plan, as a step-up plan, thus when fire risk indices increase, firefighter preparedness and public awareness will be enhanced commensurately. Continue limited closures of the Preserve at critical times, coordinated by the Corrales Fire Department, including the practice of using the CBAC Fire Watch Patrol Teams to increase authorized presence in the Preserve during fire closure periods.

Consider using these teams in certain areas at other times that present elevated fire risk or evidence of prohibited activity.

Additional Basis for the Recommendations of A2

Bosque riparian communities are less fire-adapted than other forest types, so fire can be especially damaging to them [20]. High intensity fires may kill cottonwood trees even when crown fires are not involved, whereas salt cedar and Russian olive are more resistant to fire in the first place and sprout new growth quickly afterwards. The destructive effect of salt cedar as an understory to cottonwood is enhanced by the fact that, depending upon conditions, dense stands of salt cedar can produce high intensity fire storms. Most of the extensive stands of salt cedar in the Preserve have already been removed but locally dense patches remain to be addressed. Historical records show that Fourth of July fireworks, spring ditch burning, and other human sources of ignition produce almost all the fires in the Middle Rio Grande bosque.

The removal of some of the overload of dead and down wood is also a priority. Detailed guidelines exist [21,22,23,24,27] on the degree to which dead and down wood should be removed, and on the size, number, and distribution of logs that should be retained for ecological purposes. The first two of these references apply to areas that are not specifically nature preserves, but more recent work that takes this into account [23] should be followed by anyone conducting future efforts at removal of dead and down wood. Appendix D presents an update of these guidelines that has been developed recently by USACE [private communication], and which does indeed apply to a wildlife preserve. Standing snags, burned or not, are very important to cavity-nesting birds [25,26], and should normally be retained according to prescriptions that balance habitat needs with fire management and safety objectives. Deadfalls of whole trees should only have parts removed where they impact existing trails, but further cutting and removal of the wood should follow the same guidelines.

Access to the Preserve for fire service vehicles is currently very limited because the only entrances are at the north and south ends, and at Romero and Dixon Roads. Additional entrances have been planned for many years by the Mayor, Village Council, and the Army Corps of Engineers, at least at Andrews Lane and Alary Road, plus one or two others. A new entrance over the Riverside Drain at Dixon road was completed in 2007, and a second new entrance at Andrews Lane was approved by the Corrales Village Council in 2008, both with funding from the Army Corps of Engineers. CBAC, in consultation with the Corrales Fire Chief, needs to develop a rationale to determine the number of entrances ultimately required, and to prioritize them.

Such a rationale could employ existing fire service recommendations or even one of several fire risk models that ideally would take account of the size of area to be protected, its habitats and access restrictions, the average number of people in different parts of the area, the probability that individuals would ignite a fire, and the probability of early detection and suppression. These factors should be incorporated into the Fire Suppression Plan.

Natural firebreaks may coincide with open areas recovering from, 1) prior burns, 2) the clearing of non-native species, and 3) removal of the jetty jacks, as well as the Harvey Jones Flood Channel, and sites of

potential wetlands. Proper management of all of these areas may result in little need for additional artificial firebreaks. However, not all of these areas will remain available as natural firebreaks because some of them may be replanted with cottonwoods or be allowed to recover with natural vegetation types. Since proper management of the understory vegetation can contribute significantly to fire-resistance [23] it is apparent that control of fire in the Bosque should be thoroughly integrated with management of the vegetation types.

A3 Potential For Wetland and Riparian Communities

Historically, river flooding had such a strong influence over habitat diversity that the loss of this engine of change has dramatically changed the structure and composition of the bosque habitats and has reduced species diversity and populations compared to the pre-dam era. The loss of overbank flooding and lower ground water tables are unquestionably the major challenge to be faced.

A3.1 Identify Potential Sources and Locations

Using the results of the surveys of A1.1-1.3, evaluate the potential to create seasonal or permanent wetlands in the Preserve and plan to introduce them in an integrated, cautious, and adaptive manner where they are feasible, and where they complement the other habitats in the Bosque. These wetlands would ideally be a mixture of wet meadows, ponds, streams, and marshes. Some opportunities for creating wetlands might conceivably include:

- a) Creation of seasonally moistened soil, seasonal ponds, or wet meadows in areas with higher than average water table, or areas where river water can be introduced during times of high flow into former oxbow sites, old side channels, or borrow pits. During restoration activities, utilize opportunities to create depressions that may passively serve as ephemeral sources of moisture, and, if they exist *and* interrupt the hydrology within some portions of the bosque, flatten old (unused and grown over) irrigation berms. Reconnect old channels so that they flood seasonally, depending on available water supply and water rights.
- b) Conversion of existing river channels adjacent to the existing banks, that are currently flooded only at high water levels, into marshes and ponds for a longer portion of the year.
- c) Creation of streams and ponds with associated small marshes through the use of wasteways and drain flows or Rio Rancho and Corrales waste water.
- d) Modification of the river banks in certain areas to induce localized overbank flooding by removal of the jetty jacks currently used to modify and stabilize the river channel, and replacement of the jetty jacks by suitable flow-resistant vegetation. In some cases there may be a potential for bank lowering to induce cottonwood/willow establishment after flooding.
- e) Creation of temporarily flooded areas through the temporary use of portable pumps to move water from drains, waste water streams, or the river into appropriate areas in the Preserve.

A3.2 Design and Construction

Develop designs for such wetlands according to published guidelines, evaluate the potential impacts of such wetlands on all aspects of the Plan and surrounding landowners, and ultimately construct them, if approved, using native species of vegetation that are local if possible, and otherwise regional.

Additional Basis for the Recommendations of A3

Apart from their beneficial influence on habitat diversity, the presence of wetlands is also a link in the restoration of cottonwoods. Cottonwood restoration will depend in part on taking advantage of ways to increase groundwater availability in the Preserve. Native trees and shrubs in the riparian zone are more susceptible to the lowering of groundwater levels than are non-native species, so any means by which the water table can be stabilized or increased, even if only in a few sites, will benefit adjacent communities of native vegetation and the animals and birds that live there.

Controlled flows from the dams still partially resemble the seasonal flows, at least as far as late spring run-off is concerned, opening the possibility of using some of the spring run-off [3] to moisten soils, improve the accessibility of groundwater, and to assist the reintroduction of some kinds of wetlands.

Potentially created wetlands in the Preserve could use diverted waste water flows from Rio Rancho at the Harvey Jones Flood Control Channel, and from waste water advanced treatment units that have been proposed as alternatives to a central sewer system in the Corrales business district and for new construction all over the village. Additional treated waste water may be available in the future from Rio Rancho via the Arroyo de los Montoyas, potentially pre-filtered by wetlands along that arroyo. Use of these sources of water by a system of wetlands and riparian forest in the Corrales Bosque Preserve could result in the removal of additional impurities from the surface water and could improve the quality of ultimate discharge to groundwater and the Rio Grande.

Given a suitable source of water, the creation of wetlands is achievable and there is extensive literature [30,31,32,33] available to support doing it correctly. The Bosque del Apache National Wildlife Refuge, the Rio Grande Nature Center, the Sandia Pueblo fishing ponds, the Alameda Wetlands, and the recently constructed BioPark wetlands are examples of local successes. They are also sources of information on creating and managing wetlands in and adjacent to the Rio Grande bosque. In this way, marshes, wet meadows, and seasonal ponds with cattails, bulrush, sedges, other rushes, saltgrass, pond weed, milfoil, and watercress could once again become an integral part of the Corrales Bosque ecosystem. Additional approaches could involve either mild excavation into groundwater in high water table areas, or creating floodplain wetlands using a waterproof liner where the groundwater is below 6 feet. Construction costs are estimated to be relatively moderate, maintenance costs are low, and some government agencies may assist with funding for wetland construction. Wetland areas do not need to be large, and are beneficial even on a scale as small as 10m x 100m.

Additional information of a more general nature can be found in references [33]-[46].

A4 Enforcement, Trails, And Outreach

A4.1 Regulate Access

CBAC and Corrales Village departments should continue to guide and regulate access to the Bosque in order to:

- a) Prevent all unauthorized vehicular access.
- b) Prevent access that could adversely and significantly impact wildlife, vegetation, or trails.
- c) Close access to the Bosque at times of high fire risk, following the recommendation of the Corrales Fire Chief, in consultation with the MRGCD and New Mexico Forestry Division.

A4.2 Control Parking

Control parking at access points and enforce open/closure times to prevent use of the Preserve at night. Corrales Police should conduct extra patrols of high use access areas of the Preserve, such as the Alameda, Cabazon, E. Meadowlark, Romero, and North End access points particularly during evenings and weekends. The Corrales Police should enforce parking violations at all access areas of the Preserve. The CBAC should obtain Computer Aided Dispatch (CAD) printouts, and a file copy of Bosque Preserve Prohibited Acts citations, from the police communications center and the CAD records office every 6 months, and review them to detect trends concerning patrol activities. All users of the Preserve should be encouraged to report violations of the Corrales Bosque Preserve Ordinance to the police.

A4.3 Forbidden Activities

The following activities are not permitted at any time anywhere in the Preserve: motorized vehicles, commercial ventures, outdoor concerts or musical events, large social functions, meetings, rallies or sports events (including paint ball), or any other activity involving large groups of people or high intensity public access, camping, camp fires, camping stoves, unleashed pets, guns, hunting or trapping, nighttime activity, the dumping of refuse or animals, and the removal or destruction of plants or wildlife. The removal of firewood is not permitted except as periodically organized by the Corrales Fire Department and CBAC.

A4.4 Litter Control

Provide for litter pickup and garbage removal at popular access points.

A4.5 Signs

Provide adequate signs at access points and possibly at other points in the Preserve to inform the public of Preserve regulations, trail use etiquette, and seasonal trail restrictions. Interpretive signs could be quite important to inform users about the purpose and special features of the Preserve, such as wildlife. An interpretive loop trail could accomplish this while minimizing the area of the bosque with signs.

A4.6 Trail Use Etiquette

Update and publicize trail use etiquette, including the need for only low speed bicycling and the exercise of extreme caution by bicyclists in the interior of the Preserve, and for horse riders and cyclists to avoid damaging trails by keeping off the trails for a few days after heavy rains. Continued use of the interior trail by cyclists needs to be reviewed as there are many places where the trails are being made

excessively wider by cyclists using the shoulder of the trail at times when sand or mud makes cycling difficult.

In most places in the Preserve space along the trails is very limited and injuries can easily occur when free running dogs chase cyclists and frighten horses. Enforcement of the dogs-on-leash law is therefore extremely important for public safety, in addition to the danger that dogs themselves occasionally pose to people and wildlife. The trail use etiquette provisions should be available in the Village Office, on web sites and on signs.

Ways to provide handicap access in at least one or two places should be studied and evaluated. An “Adopt-a-Trail Program” could be an effective way to get needed maintenance done and involve more citizens in learning about and caring for the bosque.

A4.7 Trail Maintenance

Maintain trails where erosion is occurring due to excessive widening or braiding of the trails and prevent a proliferation of trails in the Preserve. Trails in the interior of the Preserve should be maintained as single tracks and not be permitted to widen into dirt roads. There are a very few but significant areas in the Preserve where sensitive soils and habitat should be protected by signs and closures. Exercise temporary trail closures as needed to protect sensitive habitats during key periods. CBAC members or volunteers arranged by CBAC should continue to perform minor trail clearing and maintenance as needed.

The strategy should be to support a very few trails that would normally be used by the majority of those in the Preserve. Users should be engaging in only low-impact activities such as walking (with pets on leash), jogging, bird watching, fishing, horseback riding, and bicycling. Off-trail use should not be universally banned, but should be discouraged, since in general, even trails represent an invasion into what should be a natural preserve dedicated to the animals and birds that live there. No new trails should be constructed, except where trails have been destroyed by clearing. It appears that the majority of users do stay on the trails. Off-trail use, if widely dispersed, normally should have little adverse impact. Evidence to the contrary should cause this policy to be reviewed. Mapping of the trail system within the Preserve is recommended in order to show accurately where trail restoration is needed, and to indicate areas for seasonal closure and maintenance.

A4.8 Public Outreach

Using this management plan and its objectives, develop outreach to the public, Corrales municipal departments, and the MRGCD, on the value of maintaining the Corrales bosque as a nature preserve. This outreach should make clear the quality of life benefits that are produced by improving the land and carefully maintaining a nature preserve of this size and quality as an integral part of the life of the village. This activity may be promoted, in part, by supporting the following existing publicity material and activities:

1. Bird Watch List authored by Dr. Jim Findley, biologist.

2. An additional bird list is being prepared by Hawks Aloft and an annotated List of Birds of Corrales is in preparation by Dr. Janet Ruth, USGS.
3. Corrales Bosque Preserve Brochure authored by Dr. Jim Findley
4. Recent “Nature Series Lectures” and other public education sponsored by CBAC. Examples include coyote safety, benefits of bat houses, and ongoing research of bird populations and beaver management.
5. Guided bird walks
6. Guided nature walks
7. Interpretive signs placed in strategic locations such as the new signs placed at major entrances.
8. A Corrales Bosque Preserve web site to provide access to this Management Plan and to all the information referenced in it.
9. An “Adopt-a-Trail” Program to enable citizens of Corrales to help with maintenance and learn more about the Preserve.

A4.9 Monitor Usage

Monitor recreational use in the Preserve. Some effort should be made to monitor the number of people entering and leaving the Preserve by the various entrances and whether they are walkers, runners, horse riders or cyclists. This information would be helpful in managing the access points, and the interior trails.

Additional Basis for the Recommendations of A4

None needed at present.

A5 Implementation Of The Management Plan

A5.1 Planning and Coordination

The Corrales Bosque Advisory Commission (CBAC), in conjunction with MRGCD staff, should be responsible for developing the Plan and its proposals and projects, and for coordination with the Village Council, the MRGCD, and with other agencies

A5.2 Updates to the Plan

CBAC should review and update the Corrales Bosque Management Plan every three years, including the presentation of a report to the Village Council and the MRGCD Board of Directors on progress towards the objectives and new project plans.

A5.3 Integrated Actions

Each action recommended by CBAC and authorized by the Village Council should be considered in relation to this Plan as a whole. It is very important that management of the vegetation and animal

communities, Designated Ecological Units, wetland development, fire service access and firebreaks, trail and ditch maintenance, and public use restrictions should be part of an integrated planning process.

Additional Basis for the Recommendations of A5

The CBAC can receive input from citizens or other sources at its normal meetings or at any other time. The CBAC should be responsible for setting near term priorities in accordance with this plan. These priorities should address the parts of the plan that are expected to be achieved in a three year period, together with the means proposed for achieving them. The priorities and progress towards them should be regularly reviewed by CBAC, but the priorities and plans should remain flexible, because teaming with other agencies means that we must be prepared to be opportunistic.

The Village of Corrales currently does not have the resources to implement most aspects of this plan other than those of A4. However, the Middle Rio Grande Bosque Initiative (MRGBI - see Appendix G), the Army Corps of Engineers, and many other county, state, and federal agencies are funded to implement a wide variety of projects that could contribute directly to the plan (e.g. BEMP [18]), providing the Village is proactive in taking the lead. Taking the lead requires CBAC to be proactive in at least the following three elements:

- 1) Developing a clear vision of what it wants to achieve
- 2) Incorporating that vision into this plan
- 3) Making proposals and outlining desired projects to implement specific parts of the plan.

Following is an incomplete list of the agencies that can assist implementation of the Plan or provide valuable information/expertise:

University of New Mexico, Department of Biology
University of New Mexico, Natural Heritage New Mexico
University of New Mexico, Museum of Southwestern Biology
New Mexico Natural Lands Protection Act Committee
New Mexico Water Resource Research Institute
New Mexico State Forestry and Resources Conservation Division
New Mexico Department of Game and Fish
New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division
New Mexico State and County Legislators
New Mexico Federal Legislators
Southern Sandoval County Arroyo Flood Control Authority - SSCAFCA
Middle Rio Grande Conservancy District
Middle Rio Grande Bosque Initiative
Hawks Aloft, Inc.
Tree New Mexico
Animal Protection of New Mexico
US Army Corps of Engineers
USDA Forest Service, Management Divisions and Rocky Mountain Research Station

US Bureau of Reclamation

US Fish and Wildlife Service, Partners for Fish and Wildlife Program, Migratory Bird Management Office, and Ecological Services

US Geological Survey, Biological Resources Division and Water Resources Division

USDA Natural Resources Conservation Service, Los Lunas Plant Materials Center

The Nature Conservancy

A significant number of past projects and studies have been conducted by these agencies over the past 30 years. This extensive body of work by environmental and ecology professionals forms the technical basis for the guidance and recommendations in this Plan. CBAC needs to continue to monitor relevant results and information reported by these agencies and to maintain a library of relevant plans, recommendations, guidelines, and research results that should be available to the Corrales public through the Corrales Library.

CBAC should establish contacts with these agencies and organizations in order to collaborate on projects that will benefit the Preserve; liaisons should contact them at least on a semiannual basis. The focus should be on two activities:

- a) The potential for new project activities that are of interest to the target organization and support this Plan.
- b) Receiving and reviewing reports on relevant results from ongoing regional work by these agencies.

APPENDIX B: RESULTS OF RECENT PROJECT ACTIVITIES

Guide To This Section: This Section relates the actions taken in the Bosque Preserve over recent years and describes their most important results. It thus is backwards-looking, but brings to the reader's attention aspects of past activities that are important and likely to be repeated to some degree in the future.

B1 Vegetation, Animals, and Groundwater

B1.1 Monitor Bird Populations

Continue to encourage existing bird population monitoring by Hawks Aloft

a) Raptors

Personnel from Hawks Aloft have been monitoring raptor populations in the Corrales Bosque since 2004, from Corrales and Sandia Pueblo south to Belen and Los Lunas. The work [14] has been funded mostly by the Army Corps of Engineers, but Hawks Aloft recently received a grant from New Mexico Game and Fish to support this work. Raptor populations were also studied at several sites in the Albuquerque area and at other sites in the Middle Rio Grande Valley since 2002. Populations were trended over time and compared with similar data obtained by Hink and Ohmart in 1984. A significant result for the Corrales Bosque is the high nesting rate of Cooper's hawks (*Accipiter cooperii*) (2.85/100acres with average inter-nest distance of 799m) and the high productivity rate of 2.8 young fledged per nest. These rates are the highest in the USA for this species, equivalent to one other site in Wisconsin, and significantly higher than in the other parts of the Mid Rio Grande Valley (1.27nests/100 acres, inter-nest distance 1578m, and 1.2-2.6 young/nest).

b) Song Birds

Between December 2003 and November 2007, Hawks Aloft monitored [14] avian abundance and species richness at 61 transects representing 17 vegetation communities. The study area extended from the Bernalillo Bridge to the La Joya State Game Refuge, near the Rio Grande 57 miles south of Albuquerque. Twelve of the 61 transects were in the Corrales Bosque. Areas where non-native vegetation species had been removed for fuel load reduction supported the lowest song bird populations, a relationship already noted in the Hink and Ohmart work of 1984. The highest bird densities corresponded to dense stands of Russian olive and New Mexico olive.

B2 Fire Protection And Control

B2.1 Continue to Remove the Overload of Dead and Down and Non-Native Species

In 2007 the Army Corps of Engineers removed an extraordinarily high fuel load including, but not limited to, dead and down wood and non-native species from 60 acres north of the Harvey Jones Flood Channel. Previous clearings of this type had occurred in 2001 (using inmate labor) at 2 sites each of 5 acres,

opposite the Cabezon and Romero entrances, and 20 acres near the Dixon entrance, and during 2004, on 46 acres south of the Cabezon entrance. A further area of 21 acres opposite Via Oreada has been thinned recently. The activities completed in 2004, 2007, and 2009 were performed by the US Army Corps of Engineers.

Follow up action to prevent re-establishment of the exotics, and to monitor for potential spread of more arid-adapted species, such as prickly pear (*Opuntia* sp.) is planned and funded by the USACE. It is essential to replant these areas with an appropriate mix of native species and to take measures to prevent the reintroduction of undesirable non-natives. This cannot be overestimated because both woody and herbaceous non-natives can colonize cleared and burned areas rapidly. The latter action should be taken as soon as necessary, but replanting should be undertaken only after development of an overall re-vegetation plan that takes into account groundwater availability, and planning for habitat management and diversification.

Because of the dependency of bird populations on the degree and type of dead and down wood, all future clearing in the Preserve will be required to follow the guidelines provided in Appendix D of this Plan.

B2.2 Improve Safe and Rapid Access for Fire Personnel

Jetty Jacks north of the Dixon Road entrance were removed by the US Army Corps of Engineers during 2008. This action resulted in removal of vegetation from approximately 20 acres to provide access for the heavy equipment involved. Management of re-infestation by non-native species needs to proceed immediately. However, replanting of native species should be conducted only after development of an overall re-vegetation plan that takes into account planning for habitat management. In addition, jetty jacks have also been removed between Cabezon & Alameda and between the north end and the Harvey Jones Flood Control Channel.

During 2006 a steel bridge was installed at Dixon Road to enable fire service vehicles and personnel faster access to fires between the Cabezon entrance and the Romero entrance.

APPENDIX C: TECHNICAL REFERENCES

Guide To This Section: This Section provides the technical references in published sources that are referenced in the previous sections. Ondrea Hummel, biologist with the US Army Corps of Engineers, kindly permitted us to use her summaries of most of these sources that are the scientific rationale for the guidelines and recommendations of earlier sections.

1. Rio Grande Bosque Conservation Committee and Office of Senator Pete Domenici. 1991. Recommendations for Conservation of the Middle Rio Grande Bosque; Final Report.

2. C. Crawford, A. Cully, R. Leutheuser, M. Sifuentes, L. White and J. Wilber. 1993. Middle Rio Grande Ecosystem: Bosque Biological Management Plan, US Fish and Wildlife Service, Region 2, Albuquerque, NM. <http://www.fws.gov/southwest/mrgbi/Resources/BBMP/Bbmp.pdf>

The Middle Rio Grande Ecosystem: Bosque Biological Management Plan was developed to bring change to the way the biological resources of the riparian ecosystem in the Middle Rio Grande are managed. The Biological Interagency Team, a group of scientists and agency members, authored the report under the direction of the Rio Grande Bosque Conservation Committee “as a first step toward restoring the Bosque's health.” The plan reviews the history and evolution of the existing Bosque ecosystem, and portrays the basic ecosystem functions and services provided by the floodplain hydrologic regime, the cottonwood riparian woodland and riparian wetlands. The report also describes changes in the hydrologic regime resulting from human interventions and the corresponding changes in aquatic, wetland and forest habitat over time. The report concludes with 21 recommendations: These recommendations range from proposed ecological restoration goals, processes and techniques to basic parameters for recreation, hunting and other human use of the Bosque. A few recommendations focus on potential education and outreach initiatives aimed at increasing awareness of the resource, furthering research, and engaging the community in restoration efforts. Some of these recommendations have been implemented by the Albuquerque Open Space Division (AOSD) in their management of the bosque via the Bosque Action Plan and other ongoing restoration and education efforts with respect to the bosque. Cliff Crawford, the senior author, as well as other Non-Governmental Organizations (NGO's), such as Rio Grande Restoration and Tree New Mexico, have also acted separately to implement some of the recommendations.

3. Robert, L. 2005. Middle Rio Grande Ecosystem Bosque Biological Management Plan -The First Decade: A Review & Update. Middle Rio Grande Bosque Initiative and the Bosque Improvement Group. http://www.fws.gov/southwest/mrgbi/Resources/BBMP/BBMP_Update_2005.pdf

The Update chronologically records progress made over the decade 1994-2004. It also describes an integrated "ecosystem approach" to restoration, and suggests a number of avenues for future action, embodied in the 21 original recommendations plus one addition.

4. Village of Corrales Comprehensive Plan, 2009.

5. Corrales Bosque Preserve Ordinance, Village of Corrales Ordinance No. 234, 1990; Bosque-Ecosystem Preservation Contract between the Village of Corrales and the Nature Conservancy, 1984; and the Joint Resolution between the Village of Corrales and the MRGCD, 1997.

Village Ordinance 234 is a comprehensive ordinance regulating 'Public use of the Preserve', defining its boundaries, and stating the goals of the agreements between the Village of Corrales, the Nature Conservancy, and the MRGCD. The Ordinance was further supported and clarified by a Joint Resolution between the Village of Corrales Council and the MRGCD Board of Directors during 1997.

6. Seasonal Flooding and Riparian Forest Restoration in the Middle Rio Grande Valley (1996) - U.S. Fish and Wildlife Service

This report prepared by L. Ellis, C. Molles and C. Crawford describes in detail the impacts of water management and flow regulation on vegetation and wildlife communities along the Middle Rio Grande. The report discusses various impacts of overbank flooding on abiotic factors, forest primary production, forest floor litter, and various consumers. The report ends with recommendations for further ecosystem monitoring as well as overbank flooding as a tool for partial restoration.

7. Historical Documentation of Middle Rio Grande Flood Protection Projects (Corrales to San Marcial) (1997) - U.S. Army Corps of Engineers

This report was prepared to meet the requirement to comply with section 106 of the National Historic Preservation Act of 1966 for a project to upgrade the existing levees. The report documents the MRGCD spoil embankment levees that date back to the 1930's prior to proposed re-engineering of these levees to withstand a 270-year flood frequency level. The report also documents the construction process of various flood control interventions that exist in the floodway, in addition to the levees, as well as the impacts of these interventions on the hydrologic system and the valley as a whole.

8. Middle Rio Grande Conservancy District Water Policies Plan: Working Document (1993) - MRGCD

This document begins by explaining the mission and operations of the MRGCD and relating the evolution of the Conservancy District as a steward of water and open space resources. The report further describes the nature, quantity and uses of these resources and assesses their future. The report concludes with a series of draft resolutions, including a new mission statement and a resolution regarding the recreational uses of water and the protection of riparian habitat, all of which have been adopted.

9. Hink, V.C., and R.D. Ohmart. 1984 (and 1989) Middle Rio Grande Biological survey. Center for Environmental Studies, Arizona State University, Tempe, AZ (U.S. Army Corps of Engineers, Albuquerque District, New Mexico. Contract No. DACW47-81-C-0015). 193 pp.

This report prepared by Hink and Ohmart is the seminal biological survey for the Middle reach of the Rio Grande. The report documents the type and status of vegetation and wild life communities and sets out recommendations for conservation, restoration and further research.

10. Botanical inventory of the Middle Rio Grande Bosque, Robert Sivinski, Greg Fitch, and Anne Cully, 1990.

Provides an updated and accurate vegetation community type map, begins to assess vegetative trends within the area, identifies impacted and sensitive areas that should be considered in the management of the area, and documents the present floristic composition.

11. Callahan, D. 2004, Hink and Ohmart Vegetation Classification Map Update – Velarde to Elephant Butte Dam, NM, US Bureau of Reclamation, Denver, CO.

Presents the latest update to the original Hink and Ohmart vegetation survey. Although the report date is 2004, the surveys were apparently conducted during 2002.

12. Sivinski, R, G. Fitch, and A. Cully. 1990. Botanical inventory of the Middle Rio Grande Bosque. New Mexico Energy Minerals, and Natural Resources Conservation Division, Santa Fe, New Mexico. Report submitted to City of Albuquerque Open Space Division .
Includes information on a groundwater survey in the Corrales Bosque Preserve.

13. Campbell, M. L., J. N. Stuart, and J. B. M Miyashiro. 1997. A Survey of Mammal Populations in the Middle Rio Grande Valley State Park: Albuquerque, New Mexico 1996-97. Bosque Environmental Consulting, Albuquerque, New Mexico.

14. Raptor Monitoring In The Middle Rio Grande Bosque Of Central New Mexico, June 2008, and Bird and Vegetation Community Relationships in the Middle Rio Grande Bosque: 2007 Interim Report, July 2008, Hawks Aloft, Albuquerque, New Mexico 87184.

The reports provide the results and descriptions of monitoring raptor and song bird populations, nest densities, and fledging success at many sites in the Middle Rio Grande Valley, including many in the Corrales Bosque from 2002 to 2007.

15. City of Albuquerque Open Space Division. 1992. Rio Grande Valley State Park Biophysical Land Unit Analysis and Management Implications.

The BLU report describes a method of establishing geographically based "biophysical land units" that are intended to serve as planning zones in Rio Grande Valley State Park. The BLUs are ecotypes based on soils, vegetation, landform and drainage patterns. The GIS-based mapping of BLUs indicated areas of native species, potential wetlands, sensitive woodland, woodland on deep loose soils, cottonwood woodland, existing wetland, upland and open meadow/low woodland.

Note: There are more recent and better classification systems available that will later replace the above reference.

16. Beaver Management – to be added.

17. Thomas Mann and Associates, 1979, 1987.

18. Eichhorst, K.D., M.C. Steuver, D.C. Shaw, and C.S. Crawford. 2001. Biological Ecosystem Monitoring Program (BEMP): First Report 1997-2000. (Together with First Annual Supplement: 2001, Second Annual Supplement: 2002-2003 and Third Annual Supplement: 2004-2005), University of New Mexico Open File Reports 01-1, 02-2, 04-3 and 06-4. See also www.bosqueschool.org.

The reports are based on BEMP's two main objectives: 1) to involve citizen volunteers (mainly K-12 students) and site representatives (mainly their teachers) in monitoring key variables that reflect bosque ecosystem structure, functioning and biodiversity at sites with different flooding histories; and 2) to track environmental trends and make this information available to resource agencies that deal with the Rio Grande Bosque. BEMP sites are used to monitor fuel loading, ground and canopy cover, vegetation diversity, precipitation, groundwater depth and chemistry, plus other ecosystem variables.

19. Hoffman, Stephen W. 1990. Bosque Biological Monitoring Program. Bird Population Surveys in Rio Grande Valley State Park (1987-1990).

20. Stuever, M.C. 1997. Fire Induced Mortality of Rio Grande Cottonwood. Masters thesis, University of New Mexico, Albuquerque, NM. Also:

Stuever, M.C., C.S.Crawford, M.C. Molles Jr., C.S. White, and E. Muldavin. 1997. Initial assessment of the role of fire in the Middle Rio Grande bosque. In Proceedings: First Conference on Fire and Endangered Species and Habitats, ed. by J.M. Greenlee, pp. 275-283. International Association of Wildland Fire, Fairfield, WA.

This 10-year study described January to July as the "bosque fire season," and March to April as the most intense fire period. It also identified human activity as a strongly related cause of bosque fires, and the dominant native species, Rio Grande cottonwood, as very susceptible to fire mortality.

21. Effects of Fuels Reduction and Exotic Plant Removal on Vertebrates, Vegetation and Water Resources in the Middle Rio Grande Bosque: Final Environmental Assessment, US Fish and Wildlife Service, and MRGCD, 2002. In addition, annual reports and pre- and post-thinning treatment reports are available up to 2006.

This report summarizes the effects of fuel reduction on the Bosque ecosystem. The report found no significant negative impact. This study was a precursor to a multipronged effort to reduce fuels in the Middle Rio Grande Bosque, which is currently being implemented by the MRGCD in several areas.

22. Draft Prescription Guide for the Rio Grande Bosque – New Mexico Energy, Minerals and Natural Resources Department (2001) - Forestry Division & MRGCD

This report summarizes, synthesizes and applies much of the research regarding fuels reduction and restoration of the cottonwood gallery flood plain forest. The report has a series of guidelines, which

have been created to assist local governments and resource managers in their efforts to enhance the Bosque's ecological health and public safety in terms of fire protection.

23. Draft Prescription Guide for the Rio Grande Bosque, 06/03/2005, Charles Wicklund, EMNRD Forestry Division, New Mexico State Forestry, with edits and additions from Yasmeen Najmi, MRGCD.

This is the most useful compilation of information on requirements for retention of dead and down wood to ensure a healthy forest ecosystem when the overload of excess fuel is to be removed, as well as the removal of non-native species. These guidelines were used to develop Appendix D of this Plan.

24. City of Albuquerque Open Space Division. 1992. Bosque Fire Management Study.

This study was undertaken for the AOSD to come up with management recommendations for reducing the fire hazard of the Bosque within the Rio Grande Valley State Park. The report maps the Bosque by fuel type and identifies high fuel load areas. There is a series of recommendations to prioritize and manage fuels in the Bosque. Parts of this study are currently being implemented in areas identified for restoration by the AOSD. Fuel load reduction is a management goal of the AOSD in the Bosque.

25. Sedgwick, J.A. and F.L. Knopf. 1986. Cavity-nesting birds and the cavity-tree resources in plains cottonwood bottomlands. *Journal of Wildlife Management* 50: 247-252. Importance of snags for birds (see also Crawford et al. 1993).

26. Brush *et al.*, 1983. Cottonwood and Willow snags are more important for cavity nesters than non-native species as well as cavity use by secondary cavity-nesting birds and response to manipulation. *Condor* 1985: 461-466.

27. Ellis, L.M. 1993. Floods and fire along the Rio Grande: the role of disturbance in the riparian forest. Doctoral Dissertation, University of New Mexico, Albuquerque, NM.

Looks at Influence of experimental flooding on litter dynamics, and on surface-active arthropods and short term vegetative response to fire.

28. Habitats and Biological Seasonal Flooding and Riparian Forest Restoration in the Middle Rio Grande Valley, Lisa M. Ellis, Manuel C. Molles, Jr. and Clifford S. Crawford, Jun-96.

Investigates the effects of flooding on both structural and functional components of the Rio Grande riparian ecosystem.

29. Programmatic Biological Assessment of Bureau of Reclamation's Discretionary Actions Related to Water Management, U.S. Army Corps of Engineers Water-Operation Rules, and Related Non-Federal Actions 011 the Middle Rio Grande, New Mexico (2001) - U.S. Bureau of Reclamation and U.S. Army Corps of Engineers

This is the first report issued on the monitoring program of the Bosque initiated by faculty and researchers at UNM in tandem with students from UNM and the Bosque Prep School. It is an ongoing multi-year effort begun in 1996 to track environmental trends in the Bosque and make this information

available to the public. policy makers, planners and other researchers. Abiotic and biotic factors are tracked at a series of research stations along the middle reach of the Rio Grande.

30. United States Army Corps of Engineers and Santa Ana Pueblo. 2000. Riparian and Wetland Restoration, Pueblo of Santa Ana Reservation, New Mexico.

This study describes the proposed restoration of the Bosque along the portion of the Rio Grande within the Santa Ana Pueblo. This project is currently being implemented by the Pueblo with assistance from the Corps of Engineers, U.S. Fish and Wildlife Service, Bureau of Reclamation, and MRGCD.

31. City of Albuquerque, Parks and General Services. Department and Design and Development Division. Open Space Division. 1996. San Antonio Oxbow Biological Management Plan.

This management plan documents existing conditions and describes management strategies for maintaining the oxbow marsh habitat on the west side of the Rio Grande near the confluence of the San Antonio Arroyo. The plan contains information about resident wildlife in the area. The plan recommends sediment management strategies to protect the wetland from impacts of recurrent siltation at the outlet of the San Antonio Arroyo.

32. Arthropods, Birds and Beavers at the Albuquerque Overbank Project Site, Lisa M. Ellis, 2001.

This is a report to the City of Albuquerque on an evaluation of the effectiveness of bank clearing and lowering to re-establish native woody vegetation in the Middle Rio Grande Bosque, and to monitor some animal activity at the site.

33. Riparian and Wetland Restoration, Pueblo of Santa Ana Reservation, New Mexico, US Army Corps of Engineers, 2002.

Due in part to sediment retention upstream of Jemez Canyon and Cochiti Dams, the Rio Grande channel through the Pueblo of Santa Ana Reservation has incised from 5 to 10 feet over the past 25 years. The corps of engineers will install two grade restoration facilities within the channel.

34. Durkin, P., M. Bradley, S.E. Carr, E. Muldavin, and P. Mehlhop. 1995. Riparian/wetland vegetation communities of the Rio Grande: a classification and site evaluation, New Mexico Natural Heritage Program, Albuquerque, NM.

35. Cartron, J-L. E., D.C. Lightfoot, J.E. Mygatt, S.L. Brantley, and T.K. Lowry. 2008. A field guide to the plants and animals of the Middle Rio Grande bosque. University of New Mexico Press, Albuquerque, NM.

Other Mid Rio Grande Policy Initiatives and Management Plans

36. Draft Environmental Assessment of the Bosque Action Plan for the Rio Grande Valley State Park, Resource Technology, Inc. Mar-94.

To retard the past neglect of the riverine corridor and promote the values of the existing natural and recreational resources provided by the Bosque. To implement site-specific recreational -oriented projects and promote sound environmental policies for future management.

37. City of Albuquerque Parks and General Service Department, City of Albuquerque, OSD. 1993. Bosque Action Plan, Rio Grande Valley State Park.

The Bosque Action Plan identifies the Rio Grande Valley State Park as one of the few remaining intact riparian habitats in the southwest and one whose value has increased as a recreational amenity because of its location in the heart of Albuquerque. The purpose of the Bosque Action Plan was to identify specific environmental and recreational improvements for the Rio Grande Valley State Park. The Bosque Action Plan establishes a framework specifying how to effectively manage the Rio Grande Valley State Park as a public park without neglecting the ecological system function of the Bosque. The policy framework was developed using issues and concerns identified by the Citizen and Technical Planning Teams as well as comments received from the public and recommendations from the contemporaneous inventories and studies completed before or during the planning process. The Plan describes the park and management policies and then lists specific actions and projects to be taken to implement these policies. Under the plan, the agency that became the Albuquerque Open Space Division was to implement the plan in coordination with the Middle Rio Grande Conservancy District, State Highway Department, Albuquerque Metropolitan Arroyo Flood Control Authority, Corp of Engineers (USACE), and the Bureau of Reclamation (BOR). Some but not all of the projects have been completed.

38. Middle Rio Grande Conservancy District. 1995. Middle Rio Grande Conservancy District Bosque Protection Master Plan - Final Scoping Report.

This study's objective was to develop a management master plan for the Bosque in the middle reach of the Rio Grande that would guide municipalities and Pueblos in the development of local Bosque management plans as a part of their open space, land use and resource planning efforts. The plan focused primarily on human impacts that are incompatible with protection of the Bosque ecosystems. Existing levels of disturbance and human-caused impacts are assessed and listed by type. The report concludes with recommendations for interim and permanent restrictions on access to the Bosque, as well as for a process to develop a planning procedure for the development of a comprehensive master plan for the Middle Rio Grande Bosque.

39. State of New Mexico Department of Natural Resources and Albuquerque Parks and Recreation Division. 1979. Rio Grande Nature Center and Preserve Master Plan.

The Rio Grande Nature Center is located adjacent to the Bosque on the east side of the Rio Grande in the North Valley. The master plan provides environmental data and social/historical information for this part of the Bosque.

Other Surveys and Progress Reports

40. United States Department of Agriculture, Soil Conservation Service and Forest Service and United States Department of the Interior Bureau of Indian Affairs and Bureau of Land Management in cooperation with New Mexico Agriculture Experiment Station, 1977. A Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico.
41. United States Army Corps of Engineers, 1989. Middle Rio Grande Biological Survey.
42. United States Bureau of Reclamation and United States Army Corps of Engineers, 2001. Bosque Biological Environmental Monitoring Program Annual Report.
43. United States Army Corps of Engineers, 2002. Rio Grande Habitat Restoration Project at Los Lunas.
44. United States Army Corps of Engineers, 2002. Middle Rio Grande Bosque Restoration in a 905(b) Reconnaissance Study.
45. United States Army Corps of Engineers (USACE), 2004. Environmental Assessment for the Bosque Wildfire Project, Bernalillo and Sandoval Counties, New Mexico, September 2004. Prepared by the USACE, Albuquerque District, Albuquerque, New Mexico.
46. Bosque Landscape Alteration Strategy, Objectives Basic Requirements and Guidelines, Yasmeen Najmi, Sterling Grogan, Cliff Crawford, June 2005.
47. From the Rio to the Sierra: An Environmental History of the Middle Rio Grande Basin, D. Scurlock, Rocky Mountain Research Station, US Department of Agriculture, Fort Collins, Colorado, May 1998.

APPENDIX D: GUIDELINES FOR REMOVING DEAD AND DOWN WOOD

Guide To This Section: This Section presents the current guidelines that are basically incorporated into US Army Corps of Engineering contracts used for the removal of excessive dead and down wood in the Corrales Bosque Preserve. The description is an update of the latest field work, and will continue to be updated as more is learned about the topic.

The following recommendations are generic and limited, in that they are high level directives that are generally applicable to riparian forest in the Middle Rio Grande Valley. However, these recommendations do not take detailed account of specific habitats within this wide region. Researchers are continuing to learn more about this topic. The most recent available compilation of information, from which this appendix is adapted, is provided in, 1) "PRESCRIPTION GUIDE FOR THE RIO GRANDE BOSQUE", Draft 06/03/2005, Charles Wicklund, EMNRD Forestry Division, New Mexico State Forestry, with edits and additions from Yasmeen Najmi, MRGCD, and 2) updates from Ondrea Hummel, USACE (2008 – private communication). In the referenced report, detailed variations from the recommendations of this appendix are given for each of the Hinck and Ohmart vegetation classes, depending also on size (area) of stand. Most of the differences from what has been extracted for this appendix affect only the degree to which large diameter downed logs should be protected from fire by having smaller diameter logs cleared away from them, and the distribution of such logs outside the drip-line of native trees.

More detailed guidelines will be developed for the Corrales Bosque Preserve as knowledge accumulates.

D1 Requirements for Cavity Trees

Cavity trees are *standing* dead trees (snags) and trees with dead limbs. Both provide the majority of substrate for animals that use cavities. A variety of animals forage and find shelter in tree cavities. For example, in cottonwood riparian habitats, cavity-nesting birds comprise 32-43% of the birds. Snags and dead limbs of cottonwood and willows have more value for cavity nesters than do some introduced tree species. The value of Siberian elm and Russian olive to cavity nesters in the bosque is unknown.

To support a diversity of plants and animals associated with snags, riparian forest habitats should include a component of dead and decadent standing trees. In general, a cottonwood-willow community with a wide range of tree heights, diameters, and age classes would accommodate the entire community of cavity dependent species. The following are general guidelines to maximize the value of the riparian forest habitats for cavity animals.

For maximum diversity and abundance of cavity nesting species, a minimum of 5 cavity trees per acre should be present in mature forest habitats, preferably with bark intact. Consequently, it is likely that no cavity trees should normally be felled, even in areas of high fuel load. Smaller diameter fuels usually

provide the most flammable materials in such areas. These trees should be as large as possible with a minimum of 2.5 cavity trees per acre at least 12 inches dbh (diameter at breast height). An occasional cavity tree should be at least 21 inches dbh. Regardless of trunk dbh, cavity trees with dead limbs greater than 6 inches in diameter should be retained. As a general rule, larger trees and limbs are more valuable because they meet requirements of a greater number of species.

Cavity trees should be well distributed throughout forest stands to meet the territorial requirements of different species. It is also important to protect areas with clusters of cavity trees to maintain habitat for species that require secondary nest sites.

Snags or dead limbs near water that have potential for rookeries or perch sites for fish-eating birds should be protected. If Siberian elm and other non-native trees along the banks of the Rio Grande are ringed (debarked around the trunk) instead of being removed, they can usefully serve as perch sites.

D2 Requirements for Dead and Down Woody Material

Dead and downed logs also provide a vital biological component. To maintain a healthy riparian forest ecosystem the dead and down component must be maintained. Fuel load reduction and firewood gathering should be coordinated with plans for maintaining dead, woody material on the forest floor.

Clearing of non-native species, thinning to reduce excessive fuel load, and firewood gathering should be monitored to ensure the appropriate number, size, and placement of downed logs in different stages of decomposition, well distributed over the forest floor. The following guidelines should therefore be observed during all thinning operations.

1. Dead and down wood less than 4 inches in diameter should be chipped or removed.
2. Dead and down wood greater than 4 inches in diameter should also be removed subject to the following restrictions.
3. Downed logs on the riverbank and in the water should not be removed.
4. Unless the excess fuel load is extreme, downed cottonwood and willow logs should not normally be removed. If it is necessary to remove them from some areas, they should be relocated to other areas that may not have the minimum numbers that are required.
5. An average of five to ten large logs, brush piles, or small piles of logs per acre are recommended. Three to five logs of 12 inches or greater diameter should be left per acre for wildlife habitat, where they exist. These logs should be well spaced out to avoid a concentration of fuel that would threaten native trees, and should preferably have bark attached. For maximum benefit to wild life, these logs should also have good contact with the ground. This means that dead-falls that are not high enough to serve as perches or snags, but that have large diameter branches a few feet from the ground should be cut so that the logs lie on the ground.
6. Dead and down wood and slash more than 4 inches diameter should be moved outside the driplines of cottonwoods and other native trees where possible or at least ten feet from the base of the trees

7. Protect dead and down logs over 8 inches in diameter outside the canopy drip line by reducing the fuel loading from other smaller material to be a minimum of 8 feet away.
8. If there are insufficient large logs, leave a larger number of smaller logs in their place. For example leave 6 logs 8 inches or more in diameter in place of 3 logs 12 inches in diameter. If there are no 8 inch logs, leave a larger number of 4 to 6 inch logs.
9. If dead and down logs are not present in areas, some trunks of larger diameter non-native trees could be left on the ground intact.
10. In any event, always leave at least 6 logs that are about 4 inches in diameter in addition to the larger ones.
11. Logs that are already visibly in a state of decomposition should always be retained in place.
12. Gradually reduce the number of dead and down logs to lower numbers than described above (i.e. 'feather' the distribution) close to the edges of dense stands, and at the edges of firebreaks.
13. When removing non-native species, leave 2 to 5 stumps per acre greater than 12 inches and less than 30 inches above the ground to serve as plucking posts for raptors, and feeding and lookout stations for small rodents.

APPENDIX E: BOSQUE THINNING TREATMENT PRESCRIPTION

Guide To This Section: This Appendix describes the general procedures and methods recommended for thinning concentrations of dead flammable materials that exceed 10 tons per acre, for removal of non-native species, the production and distribution of wood chips, and the treatment of residual stumps with herbicide.

The normal organization of the work will involve four parties: 1) The Corrales Bosque Advisory Commission (CBAC), 2) a general management and funding agency (e.g. USACE– the Agency), 3) a site contractor to perform the clearing (Contractor), and 4) an environmental monitoring contractor (Environmental Monitor).

E1 Tree Removal

Remove all non-native trees except for those designated by CBAC and Agency staff as “elective” trees to remain (see trees listed at the end of this Prescription for species) and retain all native tree and shrub species. Leaving healthy elective species provides food for wildlife, helps to avoid fragmentation, and promotes a healthy three tier canopy for wildlife. However, remove elective species when they are isolated, old, unhealthy, or when they create ‘ladder’ fuels as a fire hazard to the crowns of cottonwoods. Russian Olive, because of its ability to spread rapidly, should be maintained in dense stands if possible, rather than as individual trees.

E1.1 Tier Structure

- a. The first tier generally consists of mixture of native species such as *Amorpha fruticosa*, *Ribes baccharis*, *Lycium*, *Salix*, and *Forestiera*. These species are the shrubs and brushes that grow to height of around ten feet and provide forage and cover for wildlife. These species should not be pruned or cut.
- b. The middle tier could consist of those species mentioned in the first tier plus other non-native species such as *Morus*, *Tamarix*, *Elaeagnus*, *Acer*, *Robinia*, and *Catalpa*. The fruiting mulberry and Russian olive provide wildlife food.
- c. The upper tier will be the highest level of the canopy and usually but not always consists of cottonwoods. Hink and Ohmart’s C-5 stand is a good example of a non-cottonwood canopy. Native trees should generally be retained and non-natives like Siberian elm removed.
- d. There is a fourth tier in the bosque that is often given little attention in management but is very important in the Corrales Bosque Preserve. This tier consists of the grasses and forbs. Prescription work should use care to minimize damage to areas that have grasses or forbs under the canopy, and should also take care where little groundcover exists to avoid spread of invasive weeds. Yerba Mansa is a fragrant herb that is known to exist in the Preserve in several extensive stands that should always be preserved.
- e. Soil type can also be a factor. At many places in the Preserve there exists a silty/sandy soil that support a crust of blue-green algae and fungi. These soils should be preserved wherever they are located in the bosque, and should be avoided during thinning operations.

It will be critical at times to be able to identify species year round as much of the work is done during the winter. Because of the Migratory Bird Treaty Act (MBTA), tree removal should not occur between mid - April and the end of August. The MBTA provides a year-round no hunting season for non-game birds and prohibits the taking of migratory birds, nest, and eggs. The majority of tree species are deciduous and characteristics other than foliage are needed to identify leave trees. It will prove beneficial to pre-mark leave trees prior to having an inexperienced crew work in the bosque and it is good practice to do this regardless of the experience level of the Contractor.

1. Prescription Areas
 - a. The cutting unit boundary will be designated in advance by CBAC and Agency staff and will be marked with an appropriate flagging that is clearly visible to the equipment operators.
 - b. Flagged cutting unit boundaries shall be maintained to prevent public access into the work site. The work site area shall also be marked with caution signs informing the public of the presence of heavy equipment and other related hazards.
 - c. The Agency will provide maps to the Contractor.
2. Manually and mechanically extract or mulch non-native trees in the contracted area in the following manner:
 - a. Manually treat non-native trees in sensitive areas as designated by Agency staff (adjacent to native vegetation or designated preserve locations). Flagging for protection should mark "Leave trees".
 - b. Mechanically extract or cut down non-native trees that may be present in existing bosque forest. When extracting trees, all root material must be removed as well (root ripping). Equipment or personnel must not damage native vegetation. "Leave trees" should be marked by flagging for protection.
 - c. Mechanically mulch or chip removed trees on-site. Mulched material left on site must not exceed 3 inches in diameter and any single piece may not exceed 6 inches in length.
 - d. If using extraction method, Contractor shall ensure that any resulting holes will be backfilled to original grade.
 - e. Trees removed manually (prescriptive cutting or cut-stump method) will be cut as close to the ground as possible. No stumps may be left higher than 8 inches above the ground surface (except when "high-stumping" as needed - 2 to 5 stumps per acre greater than 12 inches and less than 30 inches above the ground may be left to serve as plucking posts for raptors, and feeding and lookout stations for small rodents).
 - f. All stumps greater than 1 inch in diameter and any stems less than 1 inch in diameter will be treated as described in the Herbicide section, E3, of this prescription.
 - g. Trees within the levees or within 30 feet of the toe of the slope should remain unless otherwise directed.
3. On sites where applicable, cut and remove dead and down wood (including 'jackstraw' trees lodged in jetty jacks) to achieve total average dead and down fuel depths of 10 tons per acre or less.
4. If fuel wood removal applies to the specific site, the woody material cut greater than 6 inches small-end diameter will be treated as fuel wood. Fuel wood must be cut into lengths not to exceed 4 feet and be stacked separately from slash pile(s) at a location(s) specified by CBAC and the Agency.

5. Dead and down rotting logs may be left on the ground surface for wildlife habitat, generally following the guidelines of Appendix D. An average of five to ten large logs, brush piles, or small piles of logs per acre are recommended. Three to five logs of 12 inches or greater diameter should be left per acre for wildlife habitat. This is in addition to rotting logs. If dead and down logs are not present in areas, some trunks of larger diameter non-native trees could be left on the ground intact. Logs may be broken up or stacked to facilitate machinery operations. Any finished operation may not have high concentrations of logs, piled brush, or woody debris that will add significant fuel loading to the cleared site. Dead and down wood and slash more than 4 inches diameter should be moved outside the drip lines of cottonwoods and other native trees where possible or at least ten feet from the base of the trees to see how it may affect fire behavior. Contractors should also rake piles of chips and duff away from the base of native trees to avoid heat kill in a fire.
6. Where they exist, the contractor will leave a minimum of five snags (standing dead trees) of 12 inch or greater diameter per acre, preferably with bark intact, for wildlife habitat. This prescription applies primarily to burn areas. Larger diameter trees that do not overhang trails, roads, or gathering areas will be retained. All cottonwood snags along the bank of the river will remain.
7. The Contractor will use directional felling to prevent damage to native trees, shrubs, and significant groundcover and will avoid damaging any research equipment or other designated areas on site.

E2 Slash and Downed Material Treatments

1. For techniques using hand-work such as chain-saws and chippers, all slash less than 3 inches in diameter will be chipped. Contractor is encouraged to chip slash as it is generated. If chipping lags behind cutting, slash will be placed in piles no larger than 6 feet in diameter and no higher than 3 feet to be chipped.
2. All slash will be cut into lengths of no more than 4 feet for fire wood.
3. Chips will be spread out over the ground surface so that a thickness of no more than 2 inches in depth cover the ground surface. If material generated is greater than this amount then chips will be hauled to an approved site.
4. To the extent possible, mechanical mulching operations will be performed uniformly over the project site. This will allow mechanical operations to distribute mulched material uniformly over the ground surface.
5. If large mobile chipping machinery (such as horizontal grinders) is used for wood disposal, chipped material may be temporarily stockpiled but must be spread over the ground surface or removed before completion of the project.
6. On sites with excessive downed material (between 4 inches small-end diameter and 10 inches small-end diameter), the downed material shall be chipped or mulched to reduce fuel loading of the site. If excessive chipped or mulched material is anticipated to exceed 2 to 3 inches in depth, considerations must be made to remove the material from site.

E3 Herbicide Treatment

Treat all cut stumps and/or whips according to the following methods:

1. Cut stumps greater than 1 inch in diameter (if using Garlon® at the specification of the Agency):
 - a. Apply Garlon® 4 in a 30% Garlon®/70% vegetable oil mixed with blue pigment dye within 15 to 20 minutes of the original cutting in a sufficient amount to completely cover the cut surface.
 - b. Individual and/or groups of stumps can be left “high-stumped” and then re-cut and sprayed later to facilitate herbicide uptake.
2. Whips less than 1 inch in diameter (if using Garlon® at the specification of the Agency):
 - a. Apply Garlon® 4 in a 30% Garlon®/70% vegetable oil mixed with blue pigment dye.
 - b. Apply mix directly to stem between 2” and 18” above the ground surface.
3. Cut stumps greater than 1 inch in diameter (if using Arsenal® at the specification of the Agency):
 - a. Apply Arsenal®/Round-Up® in 30% or greater concentration mixed with blue pigment dye within 15 to 20 minutes of the original cutting in a sufficient amount to completely cover the cut surface.
 - b. Individual and/or groups of stumps can be left “high-stumped” and then re-cut and sprayed later to facilitate herbicide uptake.
4. Whips less than 1 inch in diameter (if using Arsenal® at the specification of the Agency):
 - a. Apply Arsenal®/Round-Up® in 30% or greater concentration mixed with blue pigment dye.
 - b. Apply mix directly to stem between 2” and 18” above the ground surface.
5. Contractor will be required to re-treat stumps and whips that are missed during initial herbicide treatment following site inspection by the contracting agency.
6. Contractor will be responsible for follow-up herbicide treatment or mechanical removal of any root sprouts that occur as a result of using extraction method.

E4 Other Instructions

1. Contractor shall obtain appropriate Special-Use Permits from the Village of Corrales and licenses from the Middle Rio Grande Conservancy District to perform work. Contractor shall adhere to stipulations of permits or licenses, including vehicle control and access control.
2. Equipment access to the work site must be done using existing roads to the extent possible. Prior approval must be granted by the contracting agency or land-owner to transport equipment down any levee road or gain access to the levee. If the levee road is the only access due to jetty jacks being on the site location during treatment, the equipment must enter one time and exit one time to avoid ruts being created on the levee slope. Any significant damage to the levee slope, as determined by the contracting agency, must be repaired.

3. As part of the No Smoking Policy within the Corrales Bosque Preserve, no smoking will be allowed in any area of the Preserve. Smoking shall be confined to inside of vehicles. No exceptions shall be granted, and fines will be imposed for violations of the above by the Village of Corrales Police Department or Fire Department.
4. No vehicles may be parked on levee roads at any time to ensure roadways are open for emergency vehicles and law enforcement.
5. Contractors shall observe a 15 m.p.h. speed limit on the levee roads and safely yield to all public trail users.
6. All gates must be closed and locked after each entry into the work site.
7. If any transient camp or shelter is found within the work site, the Contractor shall inform Agency staff. Officials will inspect the area and make determinations as to any further course of action. Contractor and contracting Agency will be authorized to continue treatment operations based upon law enforcement decisions.
8. All construction activities would be in compliance to all applicable Federal, State, and local regulations. All appropriate permits as described in the documentation above would be obtained.

E5 Species Lists

Native Woody Species include:

Rio Grande Cottonwood
 Black Willow/Goodding's Willow
 Peach-leaf Willow
 New Mexico Olive
 Coyote Willow
 Seepwillow
 Golden currant
 Wolfberry
 Skunkbush
 Silver Buffaloberry
 False indigo bush
 Virginia creeper

Populus deltoides var. *wizlesnii*
Salix gooddingii
Salix amygdaloides
Foresteria neomexicana
Salix exigua
Baccharis salicina
Ribes aureum
Lycium andersonii
Rhus trilobata
Shepherdia argentea
Amorpha fruticosa
Parthenocissus inserta

Non-Native Tree Species include:

Salt Cedar
 Russian Olive
 Siberian Elm

Tamarix spp.
Eleagnus angustifolia
Ulmus pumila

Tree-of-Heaven
Catalpa

Ailanthus altissima
Catalpa spp.

"Elective" Tree and Shrub Species include:

Russian Mulberry

Morus alba var. *tataria*

Black Locust

Robinia pseudoacacia

Honey Locust

Gleditsia triacanthos

Osage Orange

Maclura pomifera

Russian Olive (healthy young adults)

Eleagnus angustifolia

Maple

Acer spp.

Ash

Fraxinus spp.

Wild cherry

Prunus spp.

Apple

Malus spp.

Oregon grape

Mahonia spp.

Honeysuckle

Lonicera spp.

APPENDIX F: GOVERNING FRAMEWORK FOR THE CORRALES BOSQUE PRESERVE

Guide To This Appendix: Appendix F contains the text of Corrales Village Ordinance 234 - Corrales Bosque Preserve, which is the document defining the mission and boundaries of the Preserve. The appendix also includes the text of the Joint Resolution Between The Village Of Corrales Council And The Middle Rio Grande Conservancy Board Of Directors.

F1: Corrales Village Ordinance 234 - Corrales Bosque Preserve

CORRALES BOSQUE PRESERVE

Section 11-1. Declaration of policy; establishment of Corrales Bosque Preserve; protection and preservation in its natural condition; public use and	enjoyment. Section 11-2 Penalty for violation of article. Section 11-3 Boundaries. Section 11-4 Prohibited activities Section 11-5 Exemptions.
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Whereas, for the purpose of preserving and protecting the natural and native conditions and wildlife in the Corrales Bosque, and to provide for the safety, health, order, comfort and well-being of the village and its inhabitants, an ordinance should be [has been] enacted to create, preserve and protect the Corrales Bosque Preserve and to prohibit and make unlawful certain activities therein:

History: Ord. No. 234, adopted 10-23-90.

Section 11-1. Declaration of policy; establishment of Corrales Bosque preserve; protection and preservation in its natural condition; public use and enjoyment.

In order to assure that an increasing population does not adversely affect or otherwise change the Rio Grande Bosque within the village, leaving no areas preserved and protected in their natural condition, it is hereby declared to be the policy of the Governing Body to secure for the present and future residents of the village the benefits of the enduring resource of the Rio Grande Bosque. For this purpose, there is hereby established a Corrales Bosque Preserve, to be protected in order to preserve its natural character for the use and enjoyment of the residents of the village in such manner as will leave it unimpaired for future use and enjoyment in its natural and protected condition. *History: Ord. No. 234. § 2 (6-13-1), adopted 10-23-90.*

Section 11-2. Penalty for violation of article.

Any person convicted of violating any of the provisions of this chapter shall be punished in accordance with section 1-6.

History: Ord. No. 234, § 2 (6-13-5), adopted 10-23-90.

Section 11-3. Boundaries.

The Corrales Bosque Preserve comprises that area within the territorial limits of the village extending from the Corrales Siphon at its north end to the Alameda Boulevard bridge at its south end, bounded on the east by the western low water line of the Rio Grande and on the west by (1) the western right-of-way line for the Sandoval lateral ditch wherever such ditch runs parallel to the Con-ales riverside drain, and by (2) the western right-of-way line for the Con-ales riverside drain wherever the Sandoval lateral ditch does not run parallel to the Corrales riverside drain; any other area so designated by ordinance, conservation easement, legal agreement or acquisition; and any other area so designated at the time of municipal annexation by the village or subsequently.

History: Ord. No. 234. §2(6-13-2), 10-23-90)

Section 11-4. Prohibited activities.

It shall be unlawful for any person to engage in any of the following activities in the Corrales Bosque Preserve:

- (1) Hunting, trapping, snaring or collecting any mammal, bird, reptile or amphibian, or the eggs or young of such animals;
- (2) Cutting wood or digging up, cutting or removing any trees, plants or soil;

- (3) Marking or defacing in any way any tree, shrub, rock or surface;
- (4) Discharging any firearm, air gun, gas-operated gun, spring gun or slingshot;
- (5) Bow and arrow shooting;
- (6) Starting or maintaining any fire, including in cook stoves or cooking containers, or igniting any fireworks;
- (7) Camping;
- (8) Using the Corrales Bosque Preserve in or for any commercial enterprise;
- (9) Possessing or consuming alcoholic beverages;
- (10) Dumping or littering;
- (11) Operating any motorized vehicle;
- (12) Driving any animal-drawn vehicle except on the west side of the Sandoval lateral ditch;
- (13) Staging concerts or other musical events, rallies or sports events;
- (14) Erecting or constructing any facility or shelter, including but not limited to picnic tables, campgrounds, chemical toilets, sports fields, horse jumps, shacks, or tree houses;
- (15) Permitting any pet or livestock to be stray or run at large;
- (16) Playing any radio, television, sound-amplifying equipment or any recordings without using a headphone or similar device to contain the amplified sound;
- (17) Being in the preserve between the hours of 10:00 p.m. and 5:00 a.m. except in the course of agricultural use of the Sandoval lateral ditch; and

(18) Smoking.

History: Ord. No. 234. § 2 (6-13-3). adopted 10-23-90.

Section 11-5. Exemptions.

The following exemptions are hereby allowed, provided that any person exempted under this section shall exercise reasonable care to honor the spirit and intent of the policy and regulations declared in this article:

- (1) Collecting of plants or animals for scientific research may be allowed pursuant to prior written authorization of the Mayor following a review of the request by the Corrales Bosque advisory commission and a biologist working with the commission.
- (2) Law enforcement officers, fire department and emergency rescue unit personnel, authorized agents and employees of the Middle Rio Grande Conservancy District, and other authorized officers, agents and employees of the federal state and local governments acting within the scope of their duties shall be exempt from the provisions of section 11-4.

(3) Farmers may drive farm tractors or vehicles on the west side of the Sandoval lateral ditch in the course of carrying out their agricultural operations.

History: Ord. No. 234, §2 (6-13-4), adopted 10-23-90.

**F2: Joint Resolution Between The Village Of Corrales Council And The Middle
Rio Grande Conservancy Board Of Directors**

JOINT RESOLUTION BETWEEN
THE VILLAGE OF CORRALES COUNCIL
AND
THE MIDDLE RIO GRANDE CONSERVANCY BOARD OF DIRECTORS

WHEREAS, the Village of Corrales Council ("Village") and the Middle Rio Grande Conservancy District Board of Directors ("Conservancy") by this "Joint Resolution" agree as follows:

1. The Conservancy supports the efforts of the Village to preserve and maintain Conservancy Bosque land in Corrales;
2. The Village agrees that, as claimed based on documents on file with the Conservancy and Sandoval and Bernalillo Counties, the Conservancy is the fee simple owner of the Bosque in Corrales including all the land and works included within the boundaries of the "Corrales Bosque Preserve;
3. The Village agrees that past annexations of Conservancy land by the Village does not in any way effect the Conservancy's fee simple title to any annexed lands;
4. The Village agrees that the Conservancy is the fee simple owner of the Bosque land in Corrales, and that the Conservancy has ultimate management authority over the Bosque; by this resolution the Village and Conservancy agree that it would benefit both parties to permit the Village to continue management of Conservancy Bosque land in Corrales, subject to the approval of the Conservancy Board of Directors;
5. This "Joint Resolution" supercedes any previous resolutions or agreements to the extent that such resolutions conflict with this Joint Resolution. The resolutions passed by the Conservancy District Board on March 11, 1975, and November 8, 1977, remain in effect which provide for "furnishing police surveillance" for Conservancy Land in Corrales which has been annexed by the Village and enforcing the laws of the Village subject to the provisions of paragraphs 6, 11, and 12 of this resolution; the Conservancy agrees to abide by Ordinance No. 234 and this "Joint Resolution" does not supercede nor dissolve Ordinance No. 234;
6. The Village and Conservancy agree that the Village of Corrales ordinance, regulations or rules pertaining to the Bosque in Corrales shall not pertain to the Conservancy or its agents or employees in the course of the Conservancy, its agents or employees acting in the official line of business or otherwise carrying out any and all of their necessary duties, responsibilities and obligations pursuant to the Conservancy Act or rules or regulations promulgated thereunder;
7. The Village agrees that it shall not adopt, subsequent to the of execution of this Agreement, ordinances, resolutions or regulations which purport in any way to regulate the Conservancy's Bosque property without prior written approval by the Conservancy Board and that the Village shall not enter into any agreements with third parties regarding the Conservancy's Bosque property without prior written approval of any agreement by the Conservancy Board; the Village and Conservancy agree to work in good faith to manage the Bosque;
8. The Village and the Conservancy agree that the parties will elevate the level of communication and cooperation regarding management of the Conservancy's Bosque land in Corrales to ensure that each party is apprised of plans, progress, reports and general activity regarding the Bosque in Corrales;
9. The Village shall post signs in locations at entrances to the Bosque designated by the Conservancy which state that the Bosque is owned by the Conservancy and managed jointly by the Conservancy and the Village;
10. The Village and Conservancy agree that the its agents and employees shall have unfettered access to the Bosque in Corrales in the course of any official line of business as set forth in paragraph 6 above, and the Village shall erect no gates, fencing or other barricades of any kind without prior written approval of the Conservancy;
11. The Village shall take no action which in any way affects or impairs the access of Conservancy agents or employees to the Bosque or otherwise affects the manner in which Conservancy employees conduct their work.

The Conservancy may make reasonable efforts to notify the Village of the location of non-routine activity in the Corrales Bosque;

12. The Village and Conservancy agree that nothing in this agreement shall waive or interfere with the Conservancy's statutory right to dispose of or lease all or part of its in the Village of Corrales;

13. Village and the Conservancy agree that either party can seek relief to enforce the terms of this agreement in the Conservancy Court pursuant to N.M.S.A. § 73-14-4 1978; and

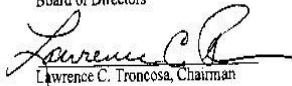
14. Village shall hold the Conservancy harmless for any and all liability arising out of the Village's activities undertaken pursuant to this agreement

NOW THEREFORE IT IS RESOLVED THAT THE VILLAGE OF CORRALES AND MIDDLE RIO GRANDE CONSERVANCY DISTRICT:

Shall work together to implement the agreement and understanding embodied in this resolution to manage and preserve Conservancy Bosque lands within Corrales:

IN WITNESS WHEREOF, the parties have executed this Agreement as of the 4 day of September 1997.

The Middle Rio Grande Conservancy
Board of Directors



Lawrence C. Troncoso, Chairman


Gus Wagner, Vice Chairman


Hector Gonzalez, Board Member

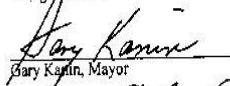

Andy Padilla, Board Member

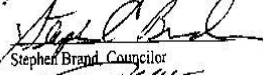

Joseph Gallego, Board Member

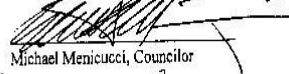

Jose U. Otero, Board Member



Gary Perry, Board Member

The Village of Corrales
Village Council


Gary Kamin, Mayor

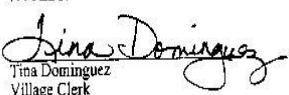

Stephen Brand, Councilor


Michael Menicucci, Councilor


Melanie Scholer, Councilor


Lawrence Vigil, Councilor

ATTEST:


Tina Dominguez
Village Clerk

9-2-97
Date Approved

APPENDIX G: OVERVIEW OF THE MIDDLE RIO GRANDE BOSQUE INITIATIVE AND THE MIDDLE RIO GRANDE ECOSYSTEM: BOSQUE BIOLOGICAL MANAGEMENT PLAN

Guide To This Appendix: Appendix G was extracted from the MRGBI Middle Rio Grande Bosque Initiative web site at: <http://www.fws.gov/southwest/mrqbi/>. The MRGBI has been the source of many research and restoration efforts along the Middle Rio Grande that have benefited from and contributed to much of the knowledge about riparian habitats in the arid Southwest. Some of the lessons learned and recommendations from this work are relevant to preservation and protection of the Corrales Bosque Preserve.

Overview

The Middle Rio Grande Bosque Initiative (MRGBI) is an ongoing, congressionally supported, interagency ecosystem management effort to coordinate activities related to the ecological restoration and management of the Middle Rio Grande. For this initiative, the Middle Rio Grande is defined as the 180-mile Rio Grande corridor within central New Mexico extending from Cochiti Dam to the headwaters of Elephant Butte Reservoir.

The objective of the MRGBI is to protect, enhance, and restore biological values by addressing ecological functions within the Middle Rio Grande. The MRGBI implements recommendations identified by a Biological Interagency Team and documented in the report **Middle Rio Grande Ecosystem: Bosque Biological Management Plan** (Crawford et.al. 1993) (pdf 24.5 MB, 312 p.). These recommendations provide guidance for project implementation resulting in long-term protection of the bosque.

The MRGBI receives Federal funds that are appropriated annually to the U.S. Fish and Wildlife Service to support new and ongoing projects. The MRGBI annually sends out a Request for Project Proposals to a wide array of organizations and entities that have interest in bosque improvement within the Middle Rio Grande corridor. Proposals are received and presented at an annual meeting of the Bosque Improvement Group (BIG). BIG is an informal non-exclusive "think tank" which provides a forum for those interested in bosque management. The MRGBI has been guided by BIG since 1995. BIG participants are numerous and include federal, state, tribal, city, county, and local government agencies, private industry, private organizations, private individuals, and others who have interest in bosque improvement activities.

At the annual meeting of BIG, participants review and discuss proposals presented. A proposal review committee is identified. Proposals are reviewed and ranked by the review committee. Funding of priority proposals is allocated on an annual basis. Total funding of projects is dependent on annual congressional appropriations.

Final products from MRGBI funded projects include: interim reports; final reports; video documentaries; on-the-ground habitat improvement; community involvement/participation; networking; and web sites.

The MRGBI is administered by a full-time coordinator. The coordinator is responsible for participating in and leading activities to achieve the goals of the Initiative. Primary duties of the coordinator include: coordinating BIG meetings; reviewing all projects funded through the MRGBI; managing the funding of projects and day-to-day coordination with BIG participants; and developing and maintaining collaboration and participation with diverse entities in a variety of projects and decisions designed to manage, maintain, protect, and enhance the bosque.

History of the Middle Rio Grande Bosque Initiative

In September 1991, Senator Pete Domenici (R-NM) appointed the Rio Grande Bosque Conservation Committee (Committee). He asked that the nine citizen-based members examine the problems affecting the Middle Rio Grande bosque, to solicit broad public involvement, and to make recommendations for the long-term protection of the bosque and the benefits it provides. The Committee worked on the Senator's charge for almost two years before presenting him with a committee report (pdf 1.4 MB, 9 p.) in June of 1993. The report recommended that a biological management plan for the Middle Rio Grande be developed as "the first step towards restoring the Bosque's health". An interagency technical team was formed to create the **Middle Rio Grande Ecosystem: Bosque Biological Management Plan (BBMP)** (Crawford et.al. 1993) (pdf 25 MB, 312 p.), which was released in October 1993. The BBMP includes historic information regarding hydrologic conditions, aquatic and terrestrial resources and organisms, climate, river morphology, population trends, land use, and water management practices of the Middle Rio Grande. This information provided the basis for twenty-one recommendations designed to guide future management of the river and its riparian corridor. The BBMP also recommended that a central coordinating structure be formed to ensure integration of management activities. Beginning in Federal fiscal year 1994, funds were appropriated to the U.S. Fish and Wildlife Service to create and support a central coordinating structure, the MRGBI.

Since the release of the 1993 BBMP, there has been a continued surge of interest and activity among management agencies, stakeholders and the public, based on the concept of the river and the bosque as an ecosystem. The 20th recommendation of the BBMP was for periodic updating of the BBMP. October 2005 marked the publication and release of the **Middle Rio Grande Ecosystem Bosque Biological Management Plan-The First Decade: A Review & Update (Update)** (Robert, L, 2005) (pdf 7.9 MB, 140 p.). The Update chronologically records progress made over a decade (1994-2004). It also describes an integrated "ecosystem approach" to restoration, and suggests a number of avenues for future action. The original 21 recommendations were reviewed and retained and a 22nd recommendation was added. The **Twenty-Two Recommendations** continue to guide future management of the river and its riparian corridor. For a free CD of the Middle Rio Grande Ecosystem Bosque Biological Management Plan-The First Decade: A Review & Update contact Cyndie Abeyta at 505-761-4738 or Cyndie_Abeyta@fws.gov.

Roles of the Middle Rio Grande Bosque Initiative



Serving as a clearinghouse for receiving, transmitting, and storing management-related information.



Facilitating meetings of an active, representative council of managers and concerned citizens.



Distributing information and organizing meetings to update and summarize ongoing and planned management activities along the Middle Rio Grande.



Funding research, monitoring, habitat enhancement, and outreach efforts within the Middle Rio Grande and its bosque.

Coordinator

Cynthia G. Abeyta, Hydrologist
U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road, NE
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APPENDIX H: AGENCY RESOURCES

Guide To This Appendix: Appendix H will become a compendium of contact and related information that should facilitate future efforts of the Bosque Advisory Commission in keeping abreast of research developments and in finding opportunities for joint activities that can benefit the Corrales Bosque Preserve. It the intention to develop this information over the next few months.

It should be the responsibility of CBAC to complete this section of the plan over the next few months using the following template:

Agency Name:

Agency Department (if appropriate):

Street Address:

Contact Person:

Title:

Telephone:

E-mail:

Relevant Purpose and Typical Activities:

Budget and Planning Cycles:

Suggested Mode of Liaison:

This becomes our lead resource on when and how to liaise with them and find win-win opportunities to the benefit of all parties.

Example:

Southern Sandoval County Arroyo Flood Control Agency (SSCAFCA)

Street Address: 1041 Commercial Dr. SE, Rio Rancho, NM 87124

Contact Person: Jim Service

Position: Field Operations Coordinator

Telephone: (505) 892-RAIN (7246)

e-mail: jservice@sscafca.com

Relevant Purpose/Typical Activities: Southern Sandoval County Arroyo Flood Control Authority is an independent corporate political body with an elected board entrusted with flood and storm water control. They acquire, improve, maintain and operate flood and storm water control facilities on streams and watersheds that enter, originate in or cross their area of authority. SSCAFCA's typical

activities that may impact the Corrales Bosque Nature Preserve include sediment removal, beaver pond clean-up, and brush clearing at the Harvey Jones Outlet. The frequency is dependent on beaver activity and the build-up of sediment in the channel. They coordinate any hauling activity with NM Game and Fish so that they do not disturb the bald eagle or the willow fly catcher.

At some point in the future, they will be rebuilding the outlet; however, there is no set date.

Budget and Planning Cycles: SSCAFCA's budget cycle is from June to July annually and that is when they do their planning as well.

Suggested Mode of Liasion: E-mail is the preferred method of contact.

