River Bars of the Middle Rio Grande
Progress Report
Year II

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By

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The University of New Mexico

New Mexico Natural Heritage Program

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Introduction

This report reviews the work completed in the second year of a multi-year project to study the vegetation of river bars in the Albuquerque reach of the Middle Rio Grande[2] in relation to environmental and biological factors. The river bars occur along the margins of the active channel (alternate bars or pointbars) or in the channel itself (island bars), and typically support young wetland vegetation that is subject to varying stream flows, ground water fluctuations and shifting sediment loads. Because of this continuous natural disturbance, plants that occupy bars tend to be fast-growing, disturbance-tolerant species that also contribute to soil stability by virtue of high stem and root mass density (Hupp 1992). River bars are a critical element in flood plain and terrace development, and possibly the most diverse and biologically active component of the bosque ecosystem.

Historically, river bar biota and configurations have shifted with fluctuating water flow and associated differential depositional events. However, in the last 50 years, flood control structures (Jemez and Cochiti dams, levees, jetty jacks) erected along the Middle Rio Grande have restricted and altered natural flows such that river bars have become much more permanent features of the channel. At the same time, invasions by exotic species such as Russian olive, salt cedar and Siberian elm are also occurring on the bars, potentially leading to a loss of ecological value. In this context of altered hydrological regime and exotic invasion, our study focuses on developing a clear understanding of the range of biological variability on these sites in relation to environmental characteristics. This work will aid conservation and restoration in the riparian zone of the Rio Grande.

In the first year, we designed a study to contrast exotic versus native elements of the system, that is, stands dominated by the native coyote willow (*Salix exigua*) or a mix of coyote willow and the non-native Russian olive (*Elaeagnus angustifolia*). This was followed by extensive reconnaissance and site selection, study plot setup, and the collection of initial data on vegetation and water table characteristics.

In the second year, we added control study plots in the adjacent cottonwood forest (bosque), and initiated a ground arthropod survey. Pitfall traps for arthropods were established at every site, and arthropods were collected three times during the growing season. Vegetation data were collected at all sites in September, and wells were monitored every month.

[1] Project jointly funded by the Bureau of Land Management (Coop. Agreement No. 6-FC-40-109890), and the US Fish and Wildlife Service—Bosque Initiative Group (Grant 1448-20181-98).
[2] Defined as the river and associated riparian area between Cochiti and San Marcial (Whitney 1996)

Methods and Materials

Site Selection and Location In the summer of 1998 we selected and established twelve study sites, six on bars dominated by the native coyote willow (*Salix exigua*) and six on bars dominated by a mix of coyote willow and the non-native Russian olive (*Elaeagnus angustifolia*). (See the 1998 progress report (Wood et al. 1999) for a complete description of site selection criteria.) In 1999 we added six control sites in the bosque adjacent to selected bar sites. The bosque sites were chosen based on their proximity to established bar study sites and on the presence of a mature cottonwood overstory. Figures 1 through 7 are maps showing the locations of all of the study sites. Table 1 is a list of site names and locations cross-referenced to the map figures, and also includes the dominant vegetation type of each site with brief directions.

Sampling Methods The 32-point grids established on the bars in 1998 were maintained and reused in 1999, and identical 32-point grids were established within the new bosque sites. Each gridpoint was monumented with a four-foot rebar stake. Corner stakes were jacketed with white PVC pipe and labeled with aluminum tags for later identification. See Wood et al. (1999) for a complete description of the grid setup method. The layout of a standard study site is shown in Figure 8.

To sample ground active arthropods, a ten-pitfall grid was established at each site. The pitfall grids were centered within the vegetation grids, with five pitfalls, each five meters apart, placed down the two center lines. Traps were positioned midway between the rebar stakes of the vegetation grids, starting between the second and third rebars, and ending between the sixth and seventh. The design had to be slightly modified at Paseo del Norte to fit the modified vegetation grid. At Paseo, traps were placed midway between the stakes of the first and second, and second and third lines of the vegetation grid starting at the fourth stake and ending at the eighth stake. Pitfalls were constructed of two nested 16-oz plastic cups placed in the ground so that the lip of the inner cup was flush with the soil. The inner cup was partially filled with propylene glycol to preserve the insects and to prevent predation among the insects. The trap was then covered with a six-by-six-inch piece of plywood, with three-inch screws drilled into each corner.

Arthropods were sampled on June 21-25, August 19-22 and October 5-8, 1999. During each sample period pitfalls were set and left open for 48 hours. To keep out detritus the lids were left propped up on their screws over the traps during sample periods. Between sample periods the lids were pushed down tight over the traps and the inner cups were emptied of propylene glycol to prevent unnecessary kills. The trap contents were collected in vials labeled with the date and location. All beetle specimens were given to entomologist Richard Fagerlund of the University of New Mexico for identification and count. The New Mexico Natural Heritage Program (NMNHP) staff counted isopods and spiders, and identified and counted ants. Although other taxa were collected, they are not being identified due to time and budget limitations.

In September, vegetation at all sites was measured following the 1998 protocol (Wood et al. 1999). Ground water wells, established at the bar sites in November 1998, were read on a monthly basis throughout 1999. The well at the Corrales Preserve site was vandalized and had to be replaced. Wells have not yet been established at the new control sites. All data were entered into a Microsoft Access database following NMNHP quality controls. Plant vouchers were identified using the resources of the UNM Herbarium, where they will be deposited.

Table 1: Site Information and Location

Site Name	*Figure*	*Major Vegetation Type*	*Nearest Access Point*	*Directions*
Coronado	1	Willow	Coronado State Monument	Island bar just south of Coronado State Monument, cross river at pullout on road between the camping area and the Monument.
Corrales	2	Willow	Corrales ditch road	Take SR 448 to north end of Corrales, take ditch side road at boundary between Rio Rancho and Corrales and follow NE to parking lot by river. From parking lot walk south ~ 0.5 miles on riverside trail to bar.
Corrales Control*	2	Bosque	Corrales ditch road	Take SR 448 to north end of Corrales, take ditch side road at boundary between Rio Rancho and Corrales and follow NE to parking lot by river. From parking lot walk south ~ 0.25 miles on riverside trail to meadow with cottonwood overstory.
Alameda	3	Mixed	Alameda Bridge	From Alameda road take eastern riverside drain road north 0.6 miles, cross river to island bar.
Alameda Control*	3	Bosque	Alameda Bridge	From Alameda road take eastern riverside drain road north 0.6 miles. Site in forest ~50m south of trail to river.
Paseo Island	3	Willow	Access road off Rio Grande Blvd.	Access eastern riverside drain road from Rio Grande Blvd. just south of Paseo del Norte overpass. Go 0.5 miles south from Paseo Bridge then follow bosque trail to river edge bar.
I-40	4	Mixed	Central Bridge	Take western riverside drain road north from Central Ave. untill it crosses diversion dam (~ 0.7 miles), then follow bosque trail east to bar.
I-40 Control*	4	Bosque	Central Bridge	Take western riverside drain road north from Central Ave. untill it crosses diversion dam (~ 0.7 miles), then follow bosque trail toward river ~200m, go north under jetty jacks ~25m to site.
Biopark	4	Mixed	Central Bridge	Eastern side of river, just north of Central Ave.
Tingley	4	Willow	Tingley Beach	Take Tingley beach road south from Central Ave. ~0.5 miles, walk in on bosque trail.
Tingley Control*	4	Bosque	Tingley Beach	Take Tingley beach road south from Central Ave. ~0.5 miles, walk in on bosque trail.

Table 1: Site Information and Location (cont.)

Site Name	*Figure*	*Major Vegetation Type*	*Nearest Access Point*	*Directions*
AOP Russian Olive	5	Mixed	Bridge Street Bridge	Take western riverside drain road south from Cesar Chavez Blvd. (Bridge St.) 1.5 miles. Take road into bar, follow trail to weather station north of AOP site, site in Russian Olives north of Willow site.
AOP Willow	5	Willow	Bridge Street Bridge	Take western riverside drain road south from Cesar Chavez Blvd. (Bridge St.) 1.5 miles. Take road into bar, follow trail out to weather station north of AOP site, willows in depression just north of fence.
AOP Control*	5	Bosque	Bridge Street Bridge	Take western riverside drain road south from Cesar Chavez Blvd. (Bridge St.) 1.5 miles.
North Rio Bravo	6	Willow	Rio Bravo Bridge	On eastern side of river, just north of Rio Bravo Bridge
South Bravo	6	Willow	Rio Bravo Bridge	Take western riverside drain road 1.8 miles south from Rio Bravo Bridge to powerline. Follow trail under powerlines to site.
South Bravo Mixed	7	Mixed	Rio Bravo Bridge	Take western riverside drain road 3.1 miles south from Rio Bravo Bridge. Follow trail east to bar.
South Bravo Control*	7	Bosque	Rio Bravo Bridge	Take western riverside drain road 3.1 miles south from Rio Bravo Bridge.

* sites established in 1999.

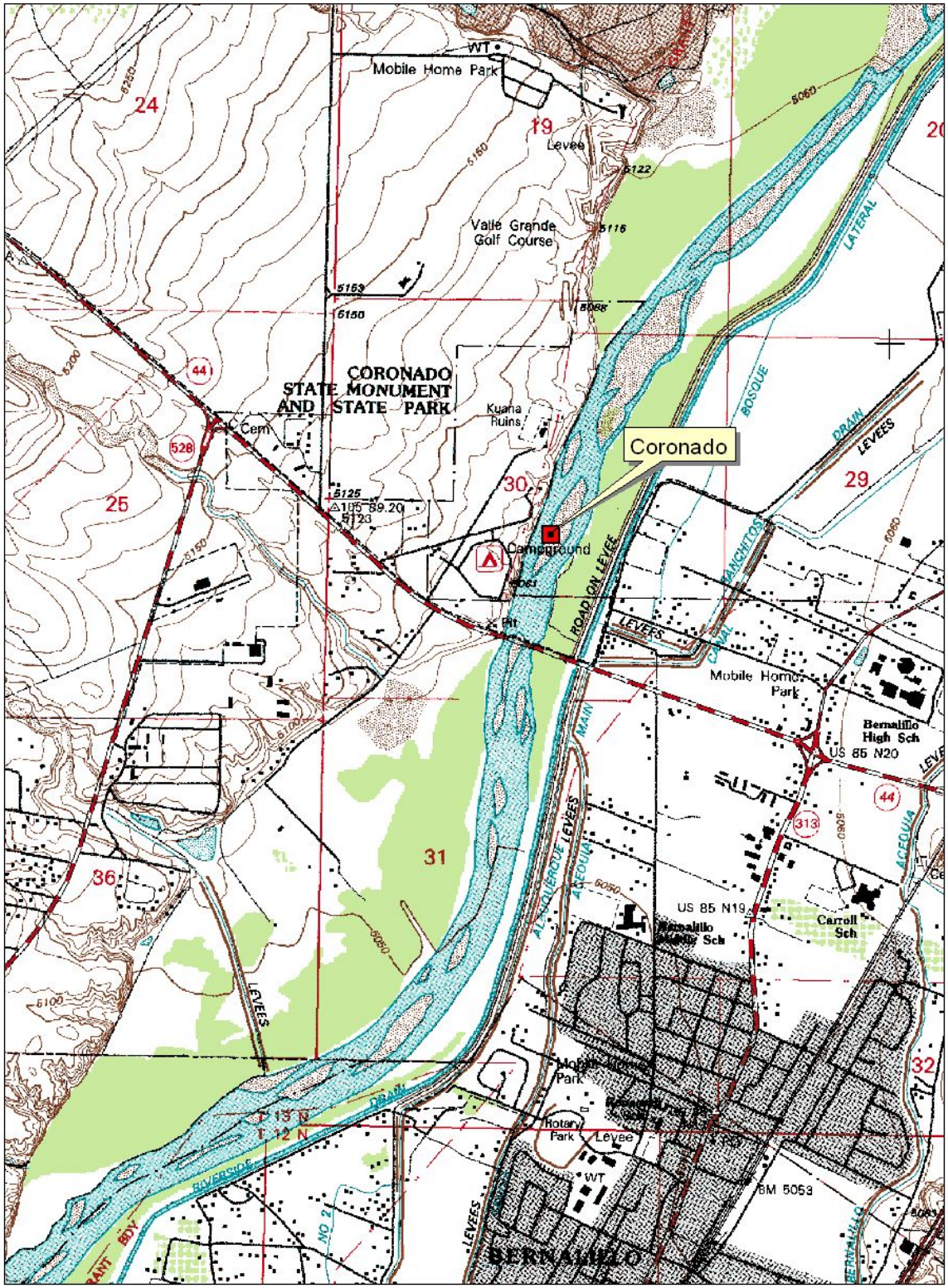

Figure 1: Map showing location of Coronado site (Bernalillo 7.5' quad map)

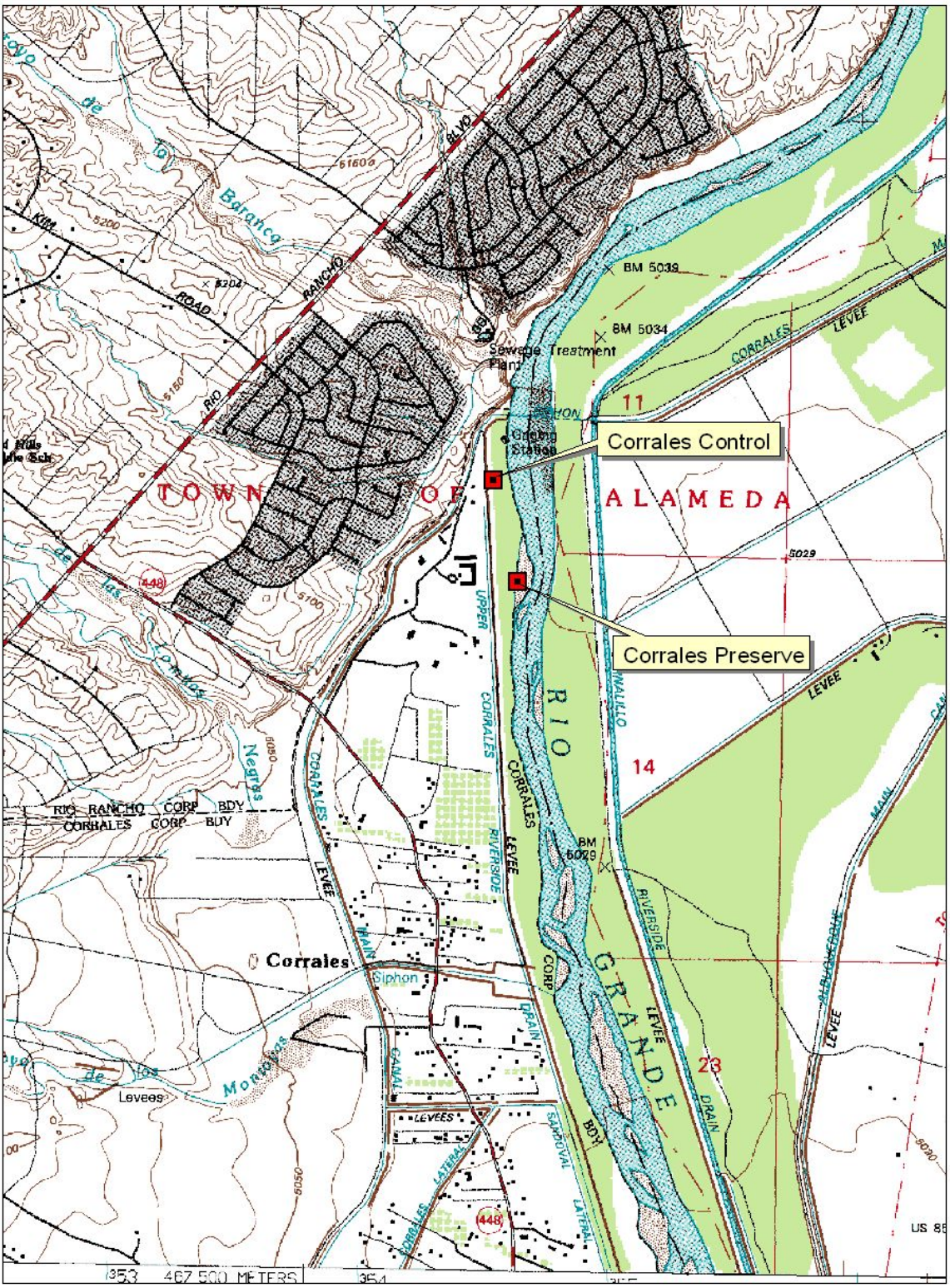

Figure 2: Map showing location of Corrales sites (Bernalillo 7.5' quad map)

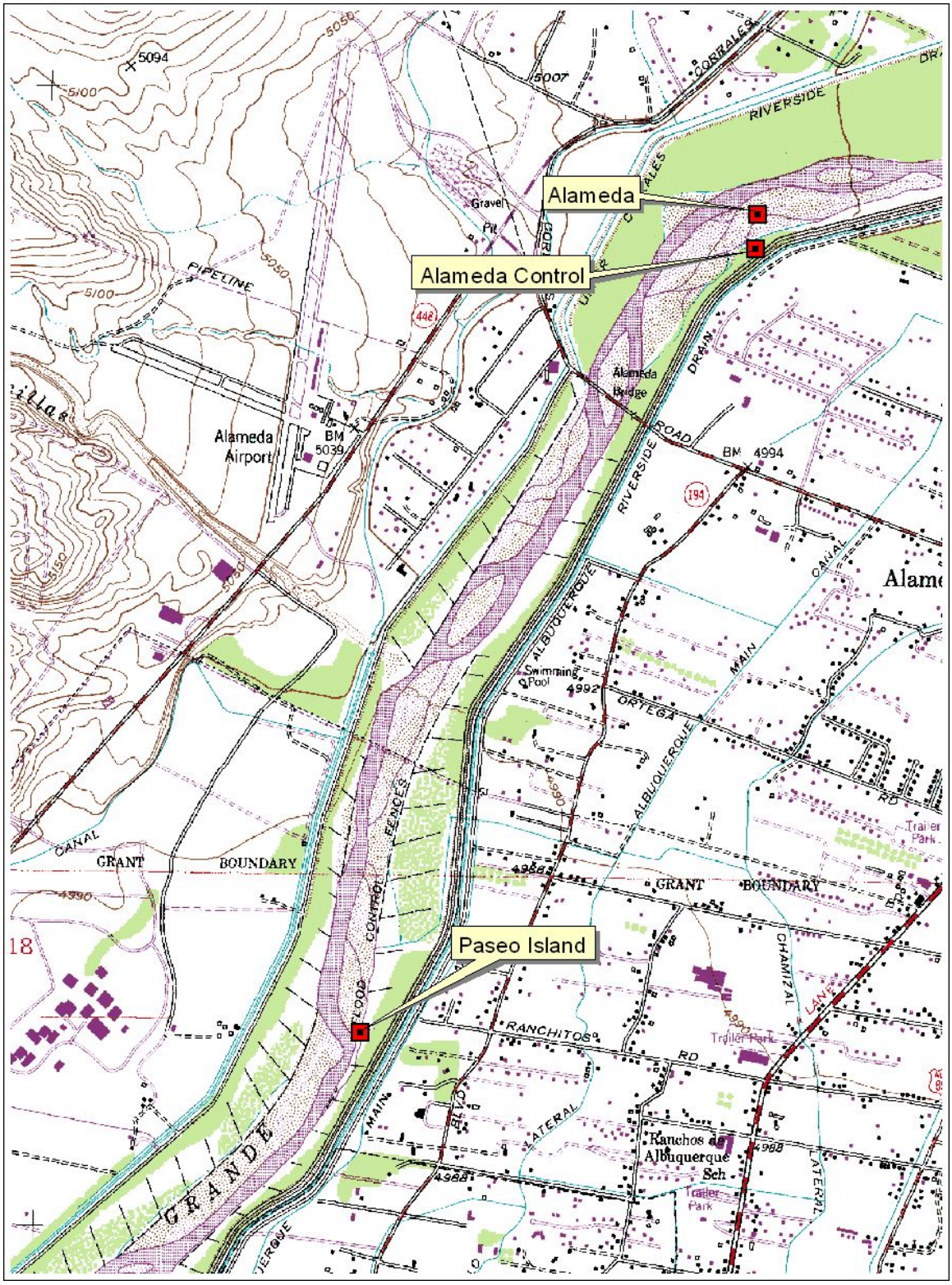

Figure 3: Map showing location of Alameda and Paseo Island sites (Los Griegos 7.5' quad map)

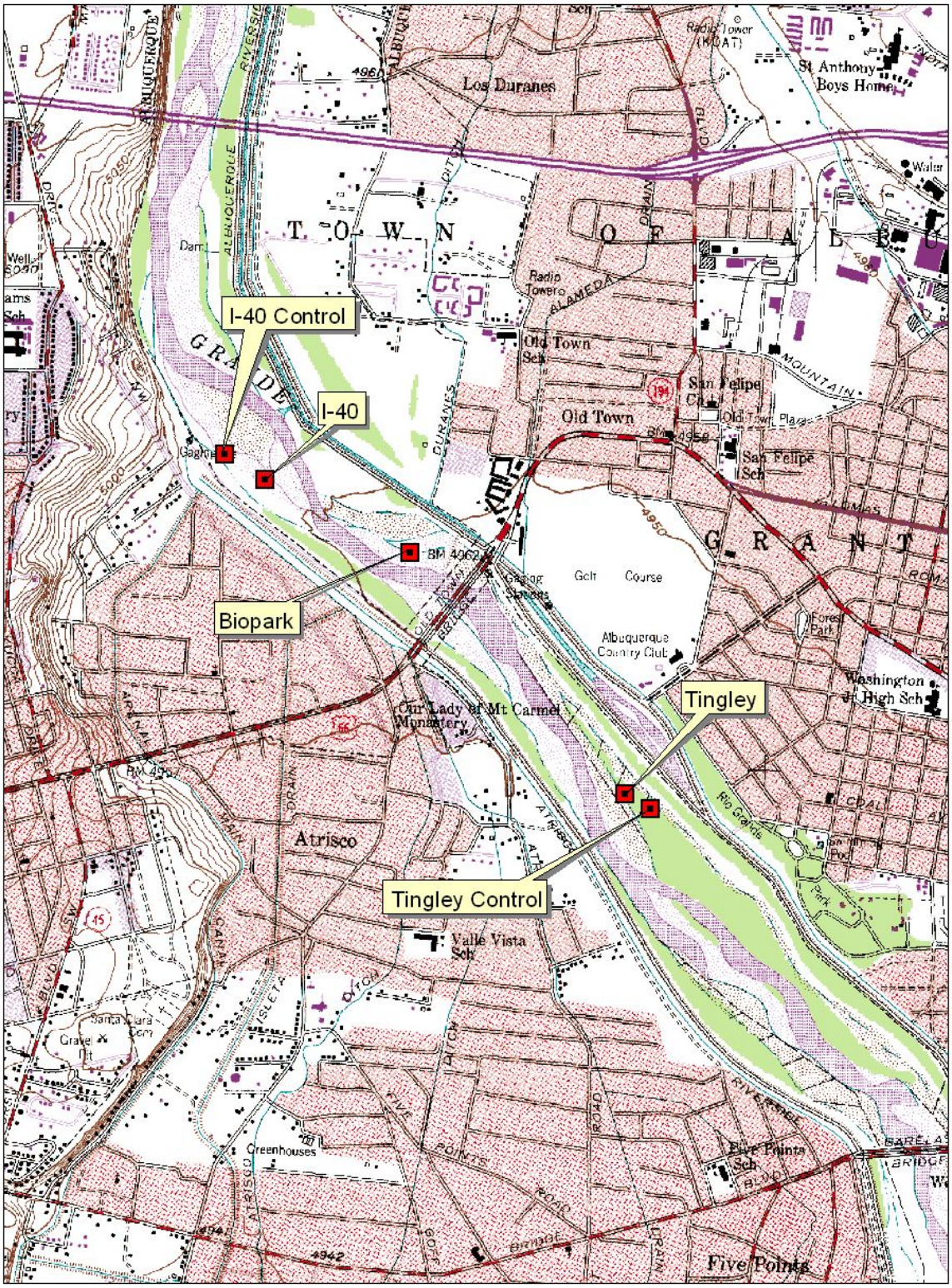

Figure 4: Map showing location of I-40, Biopark, and Tingley sites (Albuquerque West 7.5' quad)

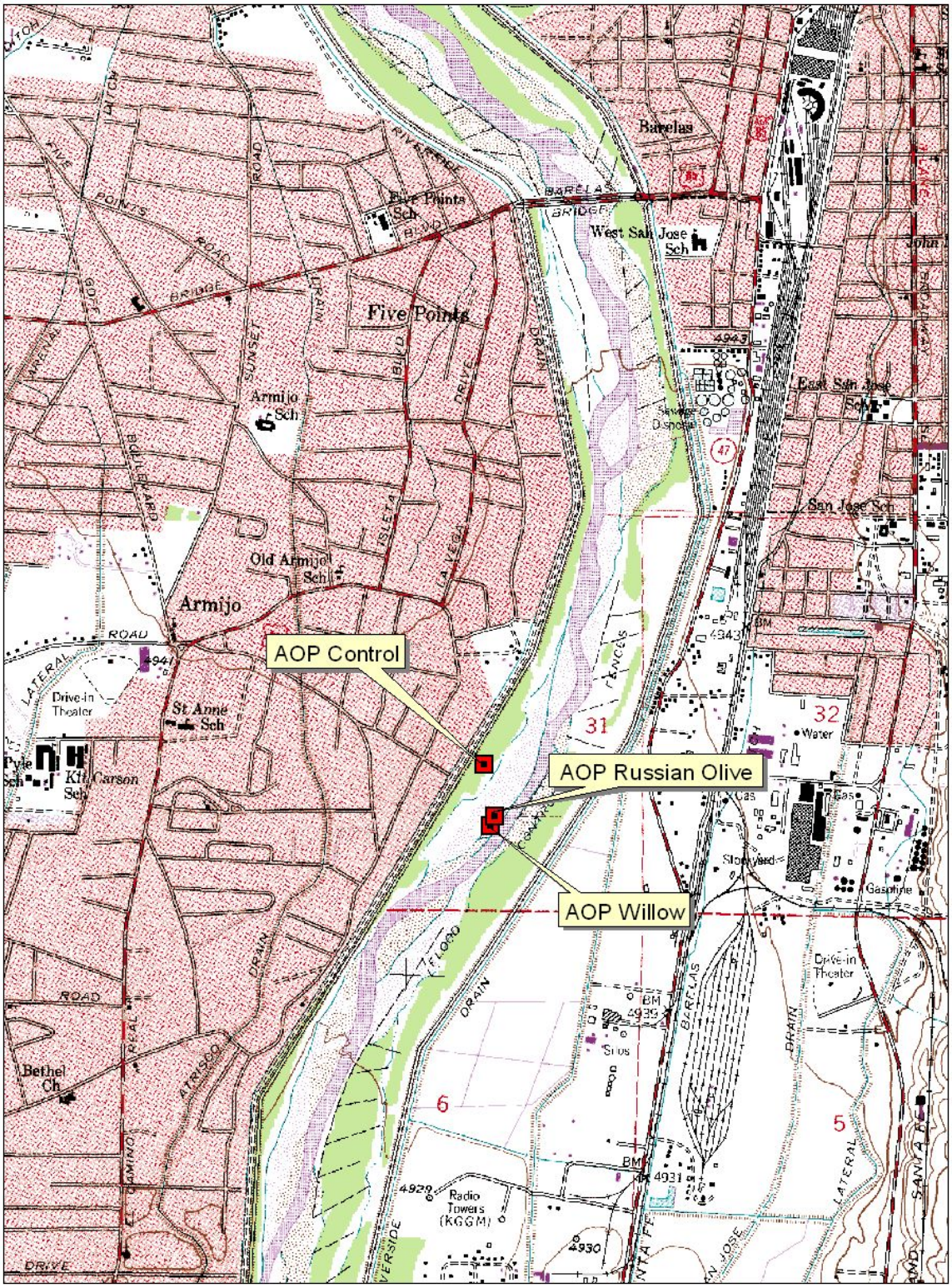

Figure 5: Map showing locations AOP sites (Albuquerque West 7.5' quad map)

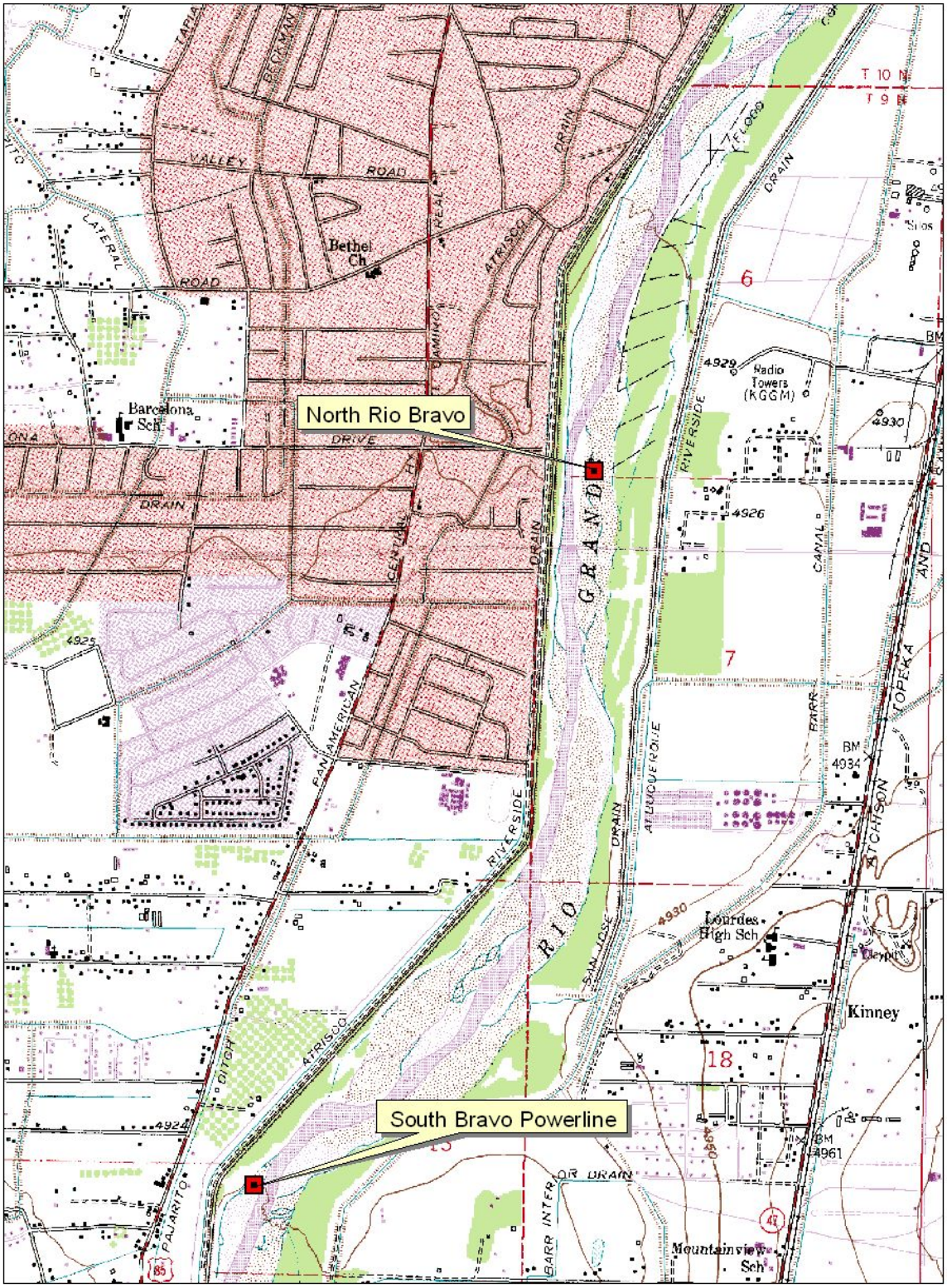

Figure 6: Map showing locations of North Rio Bravo and South Bravo Powerline sites (Albuquerque West 7.5' quad map)

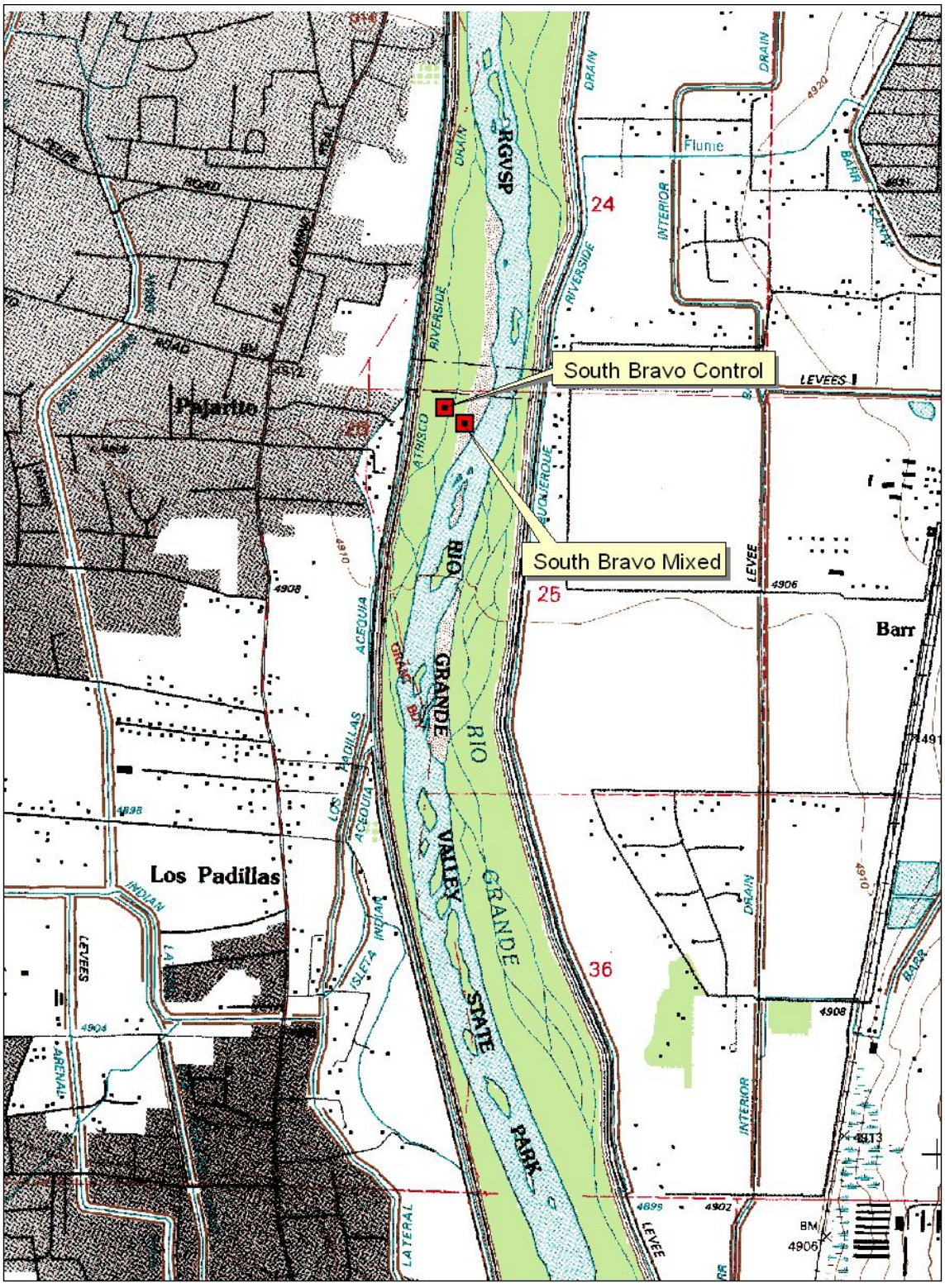

Figure 7: Map showing locations of South Bravo Bosque and Mixed sites (Isleta 7.5' quad map)

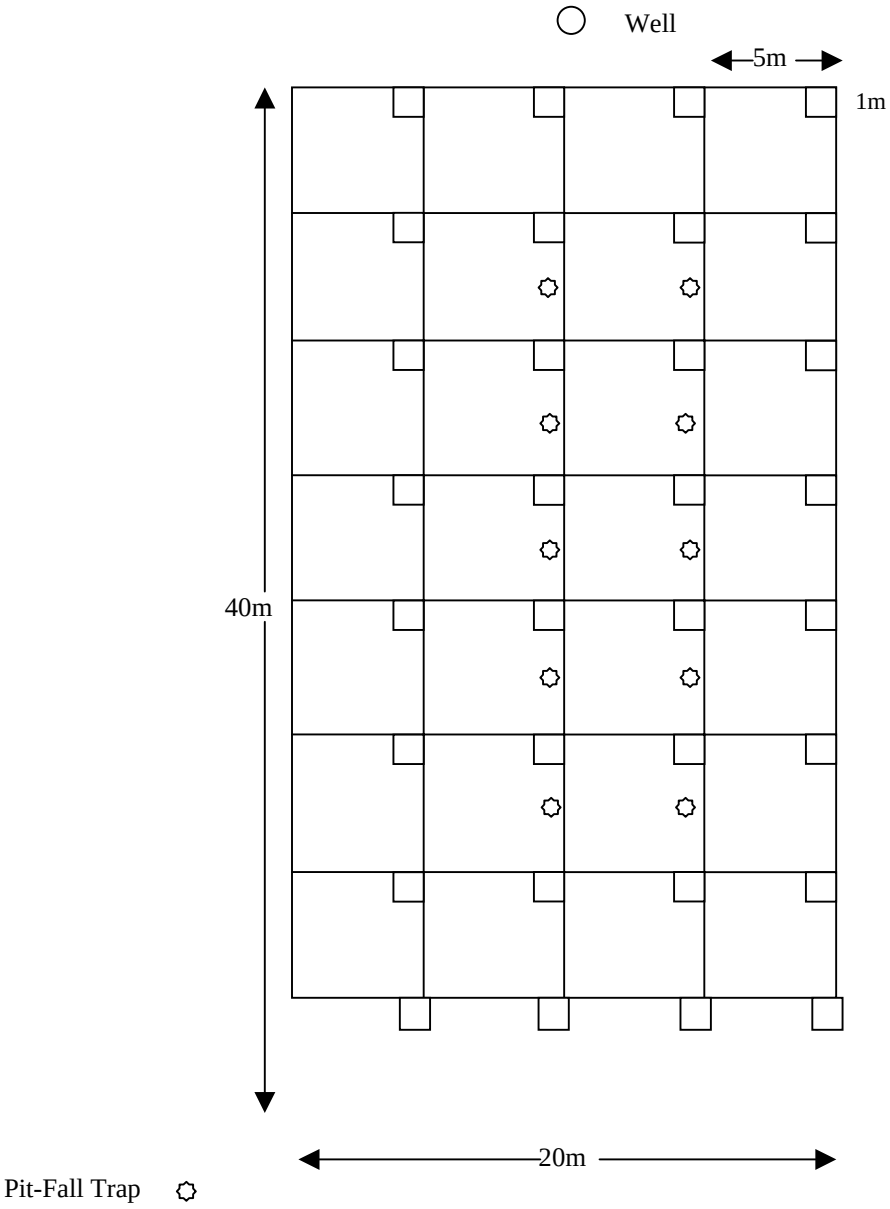

Figure 8: Layout of standard study site.

Results

Vegetation Species Diversity and Cover We found a total of 100 different species over two years of vegetation monitoring, but there were differences from year to year. An additional 34 species were observed in 1999 that had not been found on the sites in 1998, and 15 species observed in 1998 were not seen in 1999 (Table 2). There are indications of significant differences in species diversity among the habitat types (Tables 2 & 3). Species richness was highest at the willow sites, and higher overall at the bar sites than in the bosque. Willow sites also had the highest number of unique species found only in that habitat type, with over three times as many as the mixed or bosque types (Table 2).

Table 2: Number of plant species observed by year and habitat type.

Habitat Type	Total # Species obs		# Species obs in only		Total # Species all years	# Unique Species over all years
	1998	1999	1998	1999		
Mixed	39	46	8	15	54	10
Willow	58	69	12	23	81	37
Bosque		27		27	27	7
All sites combined	68	86	15	34	100	54

The majority of species on bar sites are herbaceous, whereas woody and herbaceous species are about equally represented in the bosque. Although trees and shrubs combined have the highest cover values within all habitats, for the bar sites they represent less than a fifth of the total number of species (Tables 3 & 4). On the bars herbaceous species make up 84-88% of the recorded species, which distinguishes the bars from the mature forest of the bosque, where herbs make up 52% and trees and shrubs make up 48% of the total number of species present.

Table 3: Species richness by lifeform for habitat types, both years combined.

Lifeform	Bosque Habitat Type		Mixed Habitat Type		Willow Habitat Type	
	# of spp.	% of total #	# of spp.	% of total #	# of spp.	% of total #
Trees	6	22%	4	7%	5	6%
Shrubs	7	26%	5	9%	5	6%
Forbs	9	33%	26	48%	38	47%
Graminoids	5	19%	19	35%	33	41%
Total:	27	100%	54	100%	81	100%

Cover by lifeform type differed greatly between the three habitat types. Not surprisingly, trees were dominant in the bosque sites, with an average canopy and sub-canopy cover combined exceeding 100% (Table 4). Although mixed sites have 41-45% tree cover, this is primarily composed of low statured Russian olive. On the willow sites shrub cover, predominantly composed of coyote willow on both bar types, is considerably higher. With respect to herbaceous cover there were striking differences. Total herbaceous cover was lower in the bosque habitat by an order of magnitude compared to the bar sites. The bar sites were nearly equal in total herbaceous cover, however, the composition of the herbaceous layer differed between the willow and mixed habitat types. Although, the mixed sites had lower graminoid species richness than the willow sites, they have higher graminoid cover. The higher graminoid cover at the mixed sites is due to a few high-cover dominant species, such as alkali muhly, alkali sacaton and vine mesquite. Willow sites, in contrast, have relatively sparse, scattered grass cover, composed of a variety of species. In addition, willow sites had high forb cover, nearly double that of mixed sites.

Appendix A summarizes plant cover and occurrence frequency for all species grouped by year and habitat type and ordered alphabetically within lifeform.

Table 4: Combined average covers by lifeform for habitat type and year.

	1998		1999			1998/99 Average	
	Mixed	Willow	Bosque	Mixed	Willow	Mixed	Willow
Trees	45.4	4.7	109.6	41.6	5.4	43.5	5.1
Shrubs	17.8	53.3	10.1	16.2	44.0	17.0	48.7
Total Herbaceous	37.6	36.7	4.8	45.9	46.6	41.8	41.6
Graminoids	21.3	7.6	3.5	29.2	12.5	25.2	10.0
Forbs	16.4	29.1	1.2	16.8	34.1	16.6	31.6

Wetland Status as a Measure of Hydrological Connectivity One of the primary questions in this study is to what degree the vegetation of river bars is hydrologically connected to the surface and subsurface ground water flows. And, in turn, what are the associated implications from this connectivity, or lack there of, for water and sediment management and vegetation maintenance. The degree of connectivity should be reflected in the number and kind of wetland indicator species present: bars that are more closely linked to the river hydrologically should have a greater number of obligate and facultative wetland species.

We used the national wetland indicator status, as defined by Reed (1997), to evaluate differences among bars. Based on numerous studies, wetland status is broken down into five groups that represent the spectrum of plant affinity for wet to dry habitats:

Obligate wetland plants (OBL) - occur almost always (estimated probability of >99%) in wetlands
Facultative wetland plants (FACW) – usually occur in wetlands (estimated probability of 67 to 99%)
Facultative plants (FAC) - share an equal likelihood (estimated probability 33 to 67%) of occurring in either wetlands or non-wetlands
Facultative upland plants (FACU) – usually occur in non-wetlands (estimate probability 67 to 99%)
Obligate upland plants (UPL) – occur almost always (estimate probability >99%) in non-wetlands
Non-indicators (NI) – not indicative or not yet evaluated

Positive (+) or negative signs (-) are used to more specifically characterize the wetland status of facultative indicator species (e.g., FACW+ or FACU-). The positive sign indicates that the species occurs more frequently in wetlands while the negative sign indicates that a species occurs less frequently in wetlands. Data from our own watershed studies in the southwestern United States do not always support the current national indicator status for several species (Muldavin et al. 2000). However, for consistency we have used the current national rankings in our analysis. The Rio Grande Cottonwood (*Populus deltoides* ssp. w*islizenii*) is a good example of the discrepancies in the national classification for southwestern species. Reed classifies it as a facultative wetland species, but most studies (e.g., Fenner et al. 1984, 1985) show it to be an obligate wetland species. Similar problems are encountered with the wetland status of some of the other species occurring in the Southwest. This should be kept in mind when looking at the summary data presented here on the wetland status of species we observed on the bars. Plants encountered during our study, which have no national wetland status, have been lumped with the

FACU, UPL and NI plants into the category "Other" in figures 9 through 11. With further review of their distribution in the Southwest, some of these plants may eventually be reclassified as obligate or facultative wetland species.

Willow sites, along with their greater species diversity, also have a greater of number of wetland indicator species. There were a total of 26 facultative wetland and obligate species found in willow sites, contrasted with 15 at mixed, and 9 species for bosque sites. More telling is the comparison of frequency of plants by lifeform within each wetland category. To gain an estimate unbiased by stature, comparisons for trees were made using only a count of individuals occurring within quads. The most facultative wetland trees occurred in the mixed sites, with about twice as many as in the willow sites, and nine times the number in the bosque sites (Figure 9). Russian olive is classified as a facultative wetland species, and accounts for most of the high number of facultative wetland trees observed at the mixed sites. Cottonwood is also classified as a facultative wetland species, and younger cottonwoods make up part of the number of facultative wetland trees in both the mixed and willow sites. The greatest number of upland and other status species occurred in the bosque. This is because the vast majority of seedlings and young trees observed in the bosque sites are introduced species without a national wetland status. The two most common of these species were Siberian elm (*Ulmus pumila*) with 61 individuals, and tree of heaven (*Ailanthus altissima*) with 29 individuals. This is probably a reflection of the increasing hydrological disconnectivity of the bosque terraces from the river.

Willow sites had the greatest occurrence of obligate wetland shrubs (Figure 10). This is a reflection of coyote willow (*Salix exigua*), which is an obligate wetland plant and the dominant cover type at willow sites. Among herbaceous species willow sites had the highest frequency of obligate and facultative wetland species (Figure 11).

Geographic Origin Another important ecological issue to be addressed is the number and kind of exotic species. Exotic species can readily out compete or displace native flora, without filling the functional niche of the original flora (Forcella and Harvey 1983). Large-scale invasions of a particular species can affect basic system processes, such as fire frequency and seasonality, water discharge or erosion rates, which in turn have a cascading effect on the system as a whole (Vitousek 1990). Following Kartesz (1994) the geographic origin of all species was classified into two categories: those native to North America (N), and those not native to North America and introduced either deliberately or accidentally (I).

At willow sites native trees are more common than introduced species when compared using the total count of individuals occurring within quads (Figure 12). However, introduced tree species are much more common than native species in the bosque and mixed sites (Figure 12). These counts of individual trees show the high level of recruitment of introduced species at bosque and mixed sites (Figure 12). As was discussed under the wetland status, this is due largely to Siberian elm and tree of heaven in the bosque sites, and Russian olive in the mixed sites. Introduced shrubs and grasses are rare across all types (Table 5). At the bosque sites introduced and native forbs are about equally common (Table 5).

Groundwater Levels Distance to groundwater has been measured monthly at each site since November 1998 (Figure 13). Average depth to groundwater is consistently and significantly deeper at mixed sites than at willow sites (one-way ANOVA, $p < .01$). This difference is especially pronounced during April, May, June and July when the average difference between the two vegetation types climbed from about 10cm to 20+cm. The graph also reflects the heavy rains and snows in northeastern New Mexico during May 1999 which contributed to high flows during May and June.

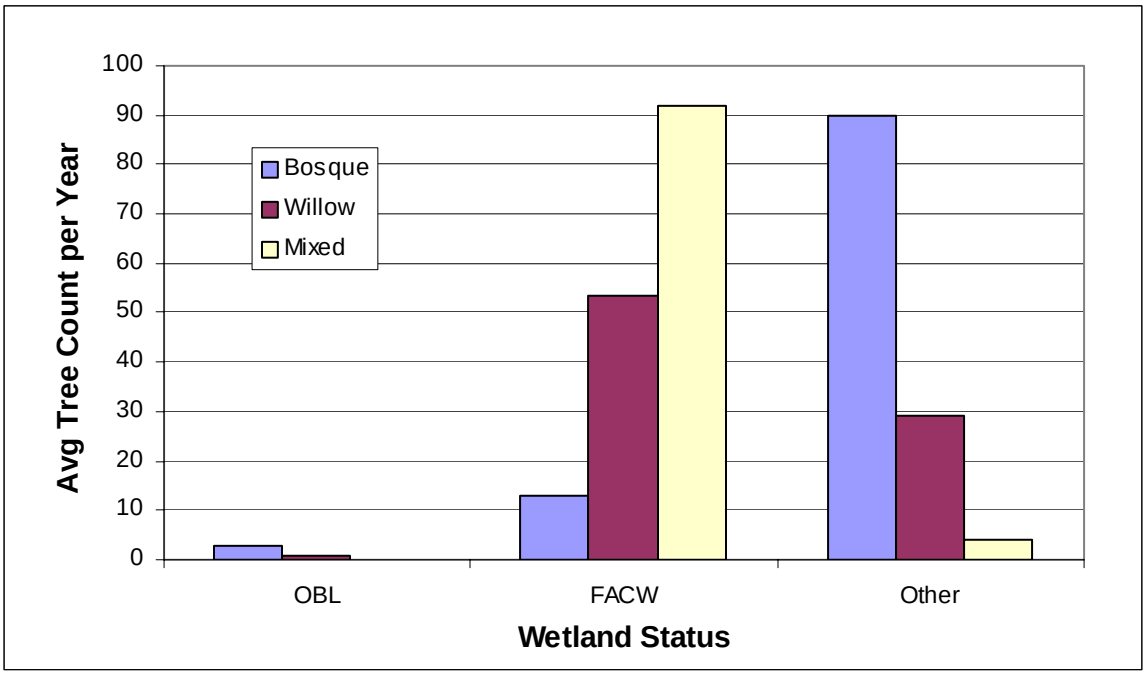

Figure 9: Average yearly number of trees per habitat type by wetland status.

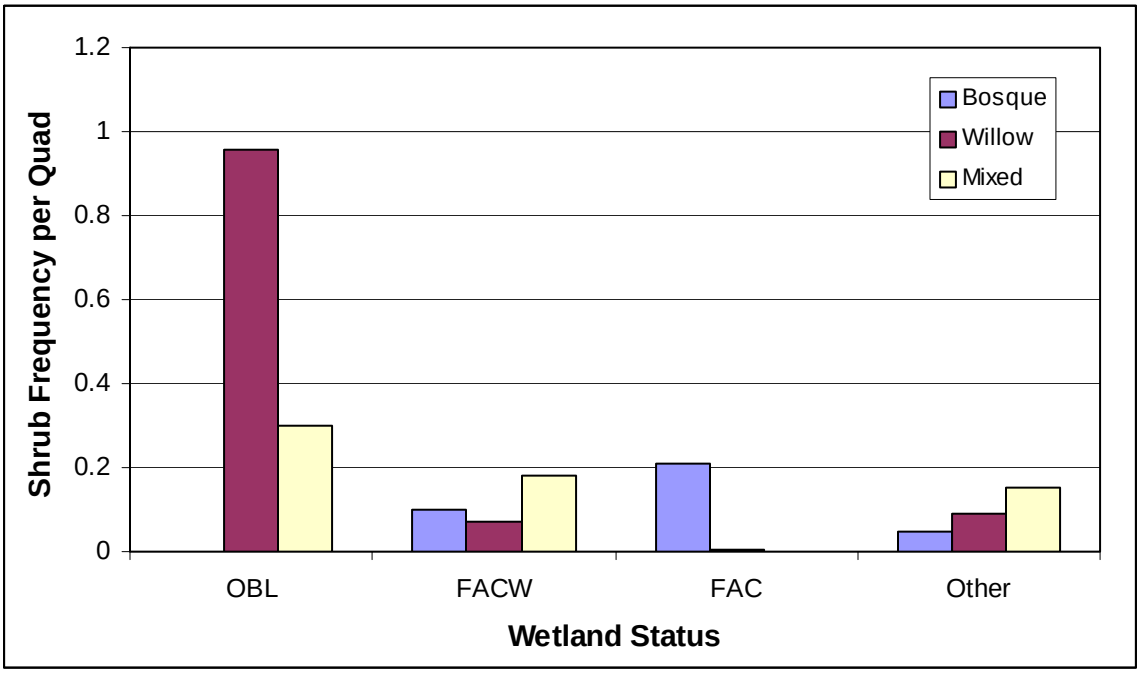

Figure 10: Average number of shrubs per quad by habitat type and wetland status.

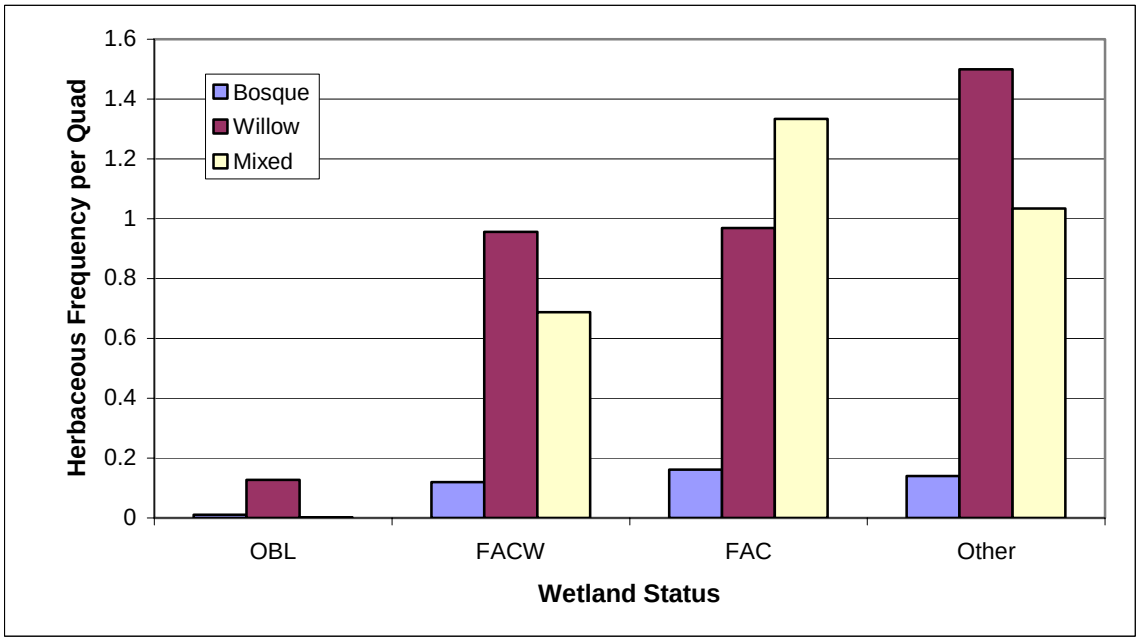

Figure 11: Average number herbaceous species per quad by wetland status and vegetation type.

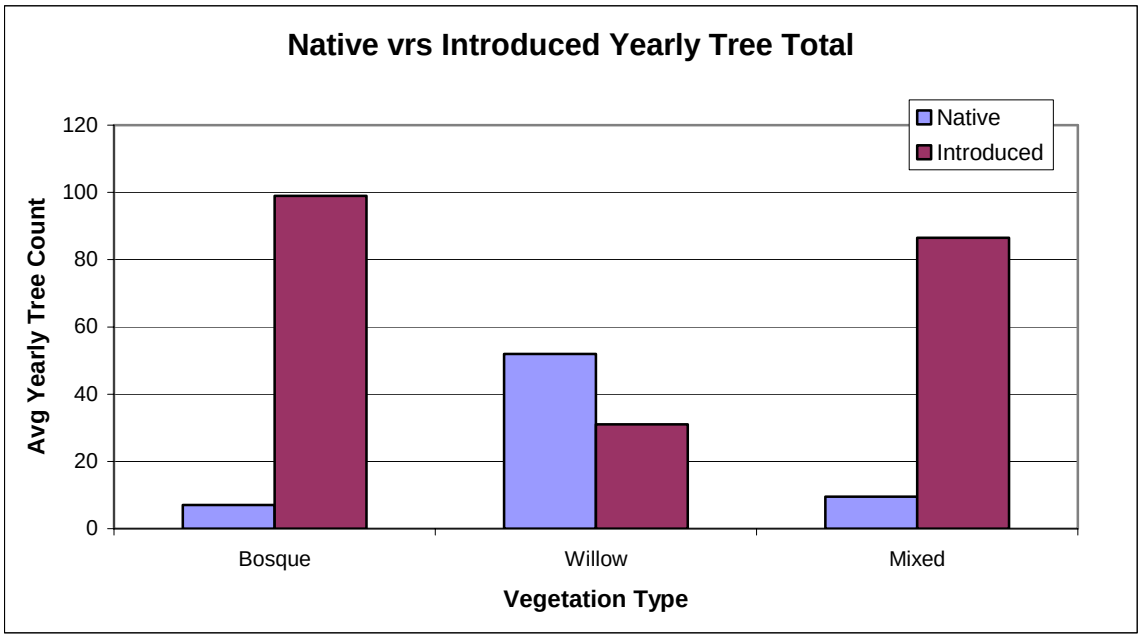

Figure 12: Native versus introduced total yearly tree count by vegetation type.

Table 5: Number of native and introduced species by habitat type and lifeform.						
	Bosque		**Willow**		**Mixed**	
Lifeform	**Native**	**Introduced**	**Native**	**Introduced**	**Native**	**Introduced**
Trees	2	4	2	3	1	3
Shrubs	6	1	4	1	4	1
Graminoids	5		23	6	15	1
Forbs	5	4	27	6	16	4

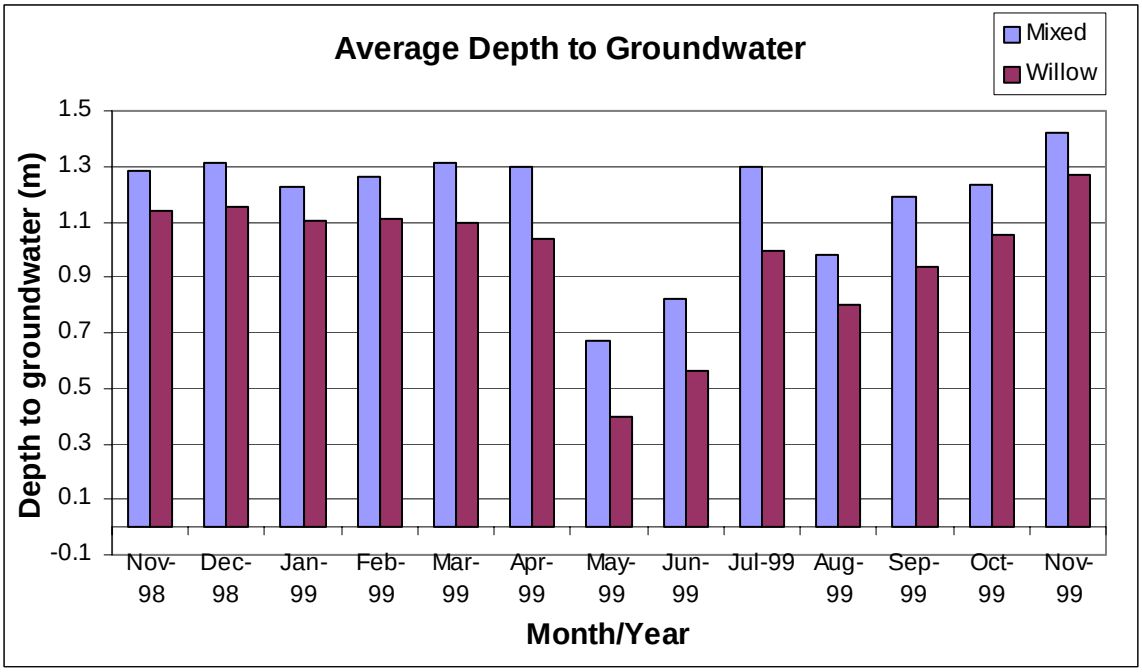

Figure 13: Average depth to groundwater by month and vegetation type.

Beetle Species Diversity A total of 49 beetle species among 14 families were collected across all sites. Total number of species was nearly equal among the three vegetation types, but there were differences in species distribution across families. The bosque sites showed the greatest diversity of beetle families while the mixed and willow sites had somewhat lower diversity (Table 6). The bosque sites also had the greatest number of unique species, twice the number of unique species of the willow and mixed sites (Table 7).

Among the ground beetles (Carabidae) there was greater species diversity at the mixed and willow sites than in the bosque (Table 6). However, the bosque sites had the greatest number of individuals among the carabids (Figure 14). Species diversity and abundance for weevils (Curculionidae) was highest in the bosque. Click beetles (Elateridae) were most common in the mixed sites. Rove beetles (Staphylinidae) had similar diversity at bosque and willow sites, but were most numerous at the willow sites, and more numerous overall on the bar sites. Darkling beetles (Tenebrionidae) appear to be more common at willow and bosque sites, and species diversity was highest at the willow sites.

Other Arthropods At the time of this report all beetle species from all samples have been counted and identified; for other taxa we have only sorted through the pitfalls from June 1999 and are working on identification of the ants below the family level. In the data from the June pitfall sample, pill bugs (*Armadillidium vulgare*), an introduced detritivore, were three times more common at the bosque sites than at the willow sites, and three times more common at willow sites than at mixed sites (Table 8). Crickets, a native detritivore, were rare at all sites, but more were found at the bosque and willow sites than at the mixed sites. Spiders were about twice as common in the bosque than in the bars.

Table 6: Number of beetle species per family by habitat type.

Family	Common Name	Bosque	Mixed	Willow
Anthicidae	Antlike flower beetles			1
Carabidae	Ground beetles	6	11	10
Cryptophagidae	Silken fungus beetles		1	2
Curculionidae	Weevils	5	2	
Elateridae	Click beetles	3	3	2
Histeridae	Clown beetles	1		
Laemaphloeidae	Flat bark beetles	1		
Melyridae	Soft-winged flower beetles	1		
Scarabaeidae	Scarab beetles	2	3	2
Scraptiidae	False darkling beetles	1		
Silphidae	Carrion beetles		1	1
Staphylinidae	Rove beetles	4	2	3
Tenebrionidae	Darkling beetles	4	5	6
Trogidae	Skin beetles	2	1	
Total # families:		11	9	8
Total # of species:		30	29	27

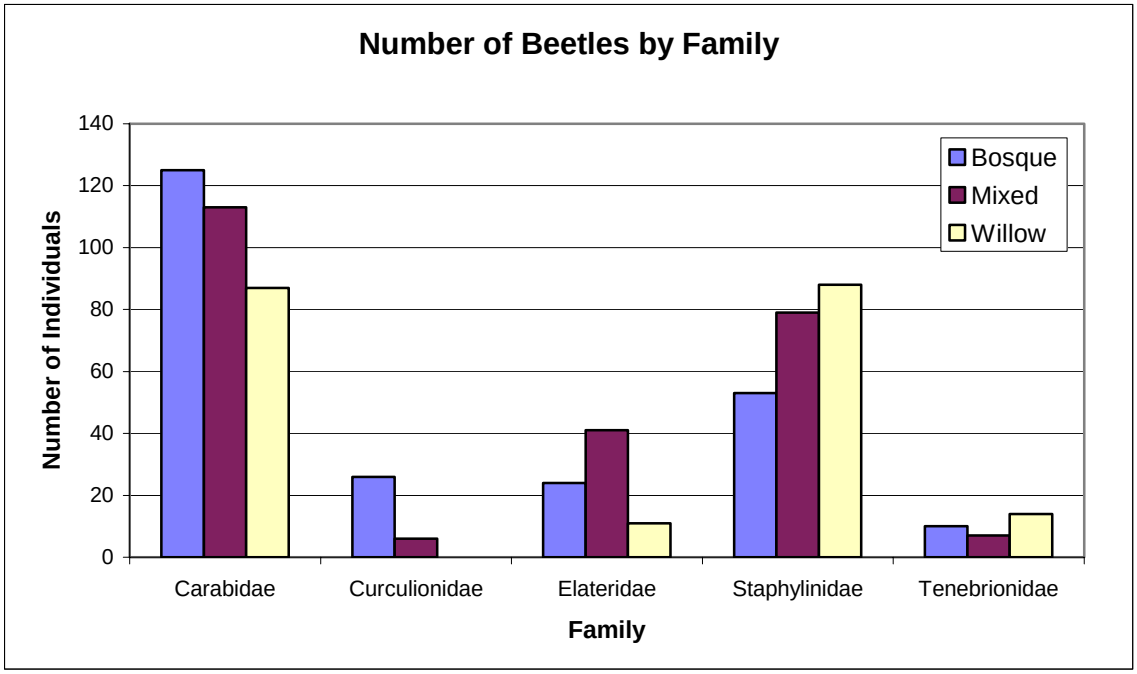

Figure 14: Total number of beetles by family for vegetation types.

Table 7: Total of all beetles collected by family, species, and habitat type.					
			Total number of Inds.		
Family	**Species name**	**Common name**	**Bosque**	**Mixed**	**Willow**
Anthicidae	*Anthicus* sp.*	Antlike flower beetle			1
Carabidae	*Amara farcta**	Ground beetle		1	
	Amara quenseli	Ground beetle	1	2	4
	Amara thoracica	Ground beetle		4	4
	Calathus opaculus	Ground beetle	95	52	52
	*Cicindela punctulata**	Tiger beetle			5
	Cyclotrachelus constrictus	Ground beetle	7	26	6
	Galerita janus	Ground beetle		1	1
	*Harpalus caliginosus**	Ground beetle		1	
	*Harpalus fuscipalpus**	Ground beetle	1		
	Harpalus pennsylvanicus	Ground beetle	20	22	11
	*Lebia bivittata**	Ground beetle		1	
	*Omophron americanus**	Hunch-backed beetle			2
	Pasimachus californicus	Ground beetle	1	2	
	Scarites subterraneus	Ground beetle		1	1
	Tachys sp.*	Ground beetle			1
Cryptophagidae	*Cryptophagus discedens*	Cryptophagid beetle		4	1
	*Cryptophagus tuberculosus**	Cryptophagid beetle			1
Curculionidae	*Cimbocera conspersa**	Weevil	1		
	Ophryastes sulcirostris	Weevil	1	2	
	Otiorhynchus ovatus	Strawberry root weevil	21	4	
	*Otiorhynchus rugostriatus**	Weevil	2		
	*neomexicanus**	New Mexico billbug	1		
Elateridae	*Aeolus livens*	Click beetle	20	38	10
	Agrypnus rectangularis	Click beetle	1	1	
	Lanelator schotti	Click beetle	3	2	1
Histeridae	*Xerosaprinus* sp.*	Hister beetle	2		
Laemaphloeidae	*Laemaphloeus biguttatus**		1		
Melyridae	*Collops bipunctatus**	Softwinged flower beetle	1		
Scarabaeidae	*Euoniticellus intermedius*	Dung beetle	2	1	1
	*Euphoria inda**	Bumble flower beetle		1	
	Onthophagus hecate	Dung beetle	3	1	2
Scraptiidae	*Anaspis rufa**		1		
Silphidae	*Heterosilpha ramosa*	Carrion beetle		4	3
Staphylinidae	*Aleochara* sp.	Rove beetle	1	1	3
	Creophilus maxillosus	Rove beetle	1		1
	*Dropephylla cacti**	Rove beetle	1		
	Platydracus sepulchralis	Rove beetle	50	78	84
Tenebrionidae	*Blapstinus fortis*	Darkling beetle	1	1	5
	Blapstinus pimalis	Darkling beetle		1	5
	*Eleodes extricatus**	Skunk beetle			1
	Eleodes longicollis	Skunk beetle	2		1
	Eleodes suturalis	Skunk beetle	3	2	
	Embaphion contusum	Darkling beetle	4		1
	Eusattus reticulatus	Darkling beetle		1	1
	*Lobometopon fusiformes**	Darkling beetle		2	
Trogidae	*Trox punctatus**	Skin beetle		1	
	Trox sp.*	Skin beetle	1		
	*Trox tessellatus**	Skin beetle	1		
Num. of spp. unique to veg. type:			11	6	6

Table 8: Non-Beetle summaries for June sample only

Order	Family	Species name	Common name	Total number of Inds. Bosque	Mixed	Willow
Araneae		Unidentified Spider	Spider	405	211	235
Isopoda	Armadillidiidae	Armadillidium vulgare	Pill bug	3712	326	1114
Orthoptera	Gryllidae	Unidentified Cricket	Cricket	9	3	9

Discussion

These data from the first two years show definite trends in differences between willow, mixed, and bosque sites. Willow sites have high water tables, higher species diversity, a lower number of exotics, and a greater frequency of wetland indicator species. This suggests that willow bars may be more hydrologically connected to the river.

In this second year of vegetation sampling we observed 34 species not observed in 1998. With another year's data it is likely that we will continue to expand the total species list, and further define species composition for each type of site.

This year's arthropod data clearly show that the bars differ greatly from the bosque in beetle species diversity and composition. The data also show some differences between the two bar habitats in beetle species composition, and with another year of collection these patterns should become clearer. Two notable species that occurred only in the willow sites are the tiger beetle (*Cicindela punctulata*) and the hunch-backed beetle (*Omophoron americanus*). Both are species that inhabit moist, open sandy areas, usually near water, and are often associated with active river channels.

The vegetation and wells will continue to be monitored in the final year, and we will then conduct multivariate and multiyear comparisons and provide a detailed picture of vegetation composition and dynamics in relation to water table levels on the bars. These vegetation and hydrological analyses will serve as the foundation for additional comparative work on arthropods and soil characteristics. The arthropod pitfalls established in 1999 will be used to sample ground active arthropods in April, June, August and October of 2000. In the coming year we will dig soil pits at each site and describe the profiles in detail. The elevation of the wells and the sites relative to the river channel is also important to interpret or predict groundwater fluctuation and overland flows, and we hope to be able to survey our sites with respect to the river channel this year.

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Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1998

Species Name	Common Name	Native/ Introduced	Wetland Status	Willow Freq (% cover)	Mixed Freq (% cover)
Trees					
Elaeagnus angustifolia	Russian olive	I	FACW-	7 (1.67%)	126 (40.79%)
Morus alba	white mulberry	I	NI	3 (0.33%)	1 (0.38%)
Populus deltoides ssp. wislizenii	Rio Grande cottonwood	N	FACW-	21 (1.19%)	16 (3.63%)
Salix gooddingii	Goodding's willow	N	OBL	2 (0.23%)	
Ulmus pumila	Siberian elm	I	NI	12 (1.31%)	3 (0.61%)
Shrubs					
Baccharis salicifolia	seepwillow	N	FACW	3 (0.74%)	26 (6.03%)
Salix exigua	coyote willow	N	OBL	185 (51.15%)	58 (8.14%)
Solidago sp.	goldenrod	N		16 (0.73%)	28 (1.78%)
Tamarix ramosissima	saltcedar	I	FACW	9 (0.74%)	10 (1.85%)
Graminoids					
Agrostis gigantea	redtop	I	FACW	12 (0.99%)	
Bothriochloa laguroides ssp. torreyana	silver beardgrass	N	NI		3 (0.48%)
Bromus spp.	brome				1 (0%)
Cynodon dactylon	bermudagrass	I	FACU	2 (0.03%)	1 (0.04%)
Distichlis spicata	inland saltgrass	N	FACW	2 (0.17%)	4 (0.19%)
Echinochloa crus-galli	barnyardgrass	I	FACW-	2 (0.03%)	
Elymus canadensis	Canada wildrye	N	FAC	8 (0.14%)	2 (0.05%)
Elymus elymoides	bottlebrush squirreltail	N	UPL	8 (0.07%)	
Hordeum jubatum	foxtail barley	N	FACW-	3 (0.02%)	
Juncus balticus	Baltic rush	N	OBL	1 (0.11%)	
Juncus spp.	Rush	N		1 (0%)	
Muhlenbergia asperifolia	alkali muhly	N	FACW	25 (0.97%)	43 (2.19%)
Muhlenbergia racemosa	marsh muhly	N	FACW	4 (0.2%)	2 (0.47%)
Panicum capillare	witchgrass	N	FAC	4 (0.02%)	
Panicum hirticaule	Mexican panicgrass	N		1 (0.01%)	

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1998 (cont.)

Species Name	Common Name	Native/ Introduced	Wetland Status	Willow Freq (% cover)	Mixed Freq (% cover)
Panicum obtusum	vine mesquite	N	FAC	1 (0.01%)	21 (5.6%)
Phragmites australis	common reed	N	FACW+		5 (0.32%)
Poa pratensis	Kentucky bluegrass	I	FACU	8 (0.75%)	
Polypogon monspeliensis	annual rabbitsfoot grass	I	FACW+	8 (0.09%)	
Schoenoplectus tabernaemontani	softstem bulrush	N	OBL	4 (0.18%)	
sedge				9 (0.15%)	
Sorghastrum nutans	Indiangrass	N	UPL	33 (3.1%)	31 (3.68%)
Sphenopholis obtusata	prairie wedgescale	N	FAC	2 (0.12%)	
Sporobolus airoides	alkali sacaton	N	FAC		41 (5.4%)
Sporobolus compositus var. compositus	tall dropseed	N	UPL	1 (0.02%)	18 (2.71%)
Sporobolus cryptandrus	sand dropseed	N	FACU-	15 (0.41%)	7 (0.13%)
Unidentified grass		N			1 (0.04%)
Forbs					
Ambrosia psilostachya	Cuman ragweed	N	FAC	86 (7.66%)	166 (11.59%)
Ambrosia spp.	ragweed.			1 (0.01%)	
Apocynum cannabinum	Indianhemp	N	FAC+	33 (7.39%)	6 (0.34%)
Asclepias spp.	milkweed	N		1 (0.03%)	
Asclepias subverticillata	whorled milkweed	N	FACU	1 (0.01%)	7 (0.52%)
Aster ericoides	heath aster	N	FACU	27 (1.03%)	39 (2.17%)
Bidens pilosa	Spanish needles	N	FACW	3 (0.05%)	
Chamaesyce spp.	spurge			2 (0.01%)	
Chloracantha spinosa	spiny chloracantha		FACW		3 (0.15%)
Convolvulus arvensis	field bindweed	I	NI	2 (0.01%)	2 (0.02%)
Conyza canadensis	Canadian horseweed	N	FACU	57 (2.15%)	4 (0.04%)
Equisetum laevigatum	smooth horsetail	N	FACW	19 (0.05%)	46 (0.15%)
Euthamia occidentalis	western goldenrod	N	FACW	59 (4.94%)	7 (0.24%)
Gaura parviflora	velvetweed	N	UPL		4 (0.07%)

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1998 (cont.)

Species Name	Common Name	Native/ Introduced	Wetland Status	Willow Freq (% cover)	Mixed Freq (% cover)
Gnaphalium stramineum	cottonbatting cudweed	N	FAC	14 (0.48%)	
Grindelia squarrosa	curlycup gumweed	N	FACU	12 (0.24%)	
Helianthus annuus	common sunflower	N	FAC-	12 (0.32%)	23 (0.37%)
Heterotheca villosa	hairy goldenaster	N	NI	1 (0%)	
Lactuca serriola	prickly lettuce	I	FAC	3 (0.03%)	4 (0.09%)
Linum lewisii	prairie flax	N	NI		1 (0.01%)
Lycopus americanus	American bugleweed	N	OBL	8 (0.29%)	
Machaeranthera canescens	hoary aster	N	UPL	1 (0.03%)	
Machaeranthera spp.	tansyaster	N		1 (0.01%)	
Melilotus officinalis	yellow sweetclover	I	FACU+	13 (0.71%)	13 (0.28%)
Mentha arvensis	wild mint	N	FACW	2 (0.19%)	
Oenothera elata ssp. hirsutissima	Hooker's eveningprimrose	N	FACW	28 (1.93%)	1 (0.01%)
Plantago major	common plantain	I	FACW	2 (0.05%)	
Senecio flaccidus	threadleaf ragwort	N	NI	1 (0%)	
Sphaerophysa salsula	alkali swainsonpea		FACU		1 (0.05%)
Trifolium spp.	clover			46 (1.4%)	16 (0.27%)
Xanthium strumarium	rough cocklebur	N	FAC	9 (0.09%)	

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1999

Species Name	Common Name	Native/ Introduced	Wetland Status	Bosque Freq (% cover)	Willow Freq (% cover)	Mixed Freq (% cover)
Trees						
Ailanthus altissima	tree of heaven	I	FACU	33 (11.24%)		
Elaeagnus angustifolia	Russian olive	I	FACW-	69 (22.24%)	11 (1.75%)	127 (36.82%)
Morus alba	white mulberry	I	NI	15 (2.83%)	11 (0.42%)	1 (0.42%)
Populus deltoides ssp. wislizenii	Rio Grande cottonwood	N	FACW-	164 (61.95%)	20 (1.36%)	19 (3.44%)
Salix gooddingii	Goodding's willow	N	OBL	8 (1.67%)		
Ulmus pumila	Siberian elm	I	NI	44 (9.61%)	18 (1.85%)	7 (0.94%)
Shrubs						
Amorpha fruticosa	desert indigobush	N	FACW+	3 (0.11%)		3 (0.3%)
Baccharis salicifolia	seepwillow	N	FACW	1 (0.16%)	4 (0.93%)	20 (3.92%)
Clematis ligusticifolia	western white clematis	N	FAC	13 (2.08%)		
Forestiera pubescens	New Mexico olive	N	FACU	7 (1.22%)		
Parthenocissus quinquefolia var. quinquefolia	Virginia creeper	N	FAC	27 (4.34%)	2 (0.01%)	
Rhus trilobata	skunkbush sumac	N	UPL	2 (0.35%)		
Salix exigua	coyote willow	N	OBL		185 (41.40%)	58 (7.22%)
Solidago sp.	goldenrod	N			19 (1.15%)	31 (2.56%)
Tamarix ramosissima	saltcedar	I	FACW	15 (1.82%)	11 (0.51%)	10 (2.18%)
Graminoids						
Bothriochloa laguroides ssp. torreyana	silver beardgrass	N	NI			5 (0.73%)
Bromus tectorum	cheatgrass	I	NI		4 (0.03%)	
Carex spp.	sedge	N			12 (1.34%)	
Distichlis spicata	inland saltgrass	N	FACW		9 (0.87%)	
Echinochloa crus-galli	barnyardgrass	I	FACW-		3 (0.01%)	
Elymus canadensis	Canada wildrye	N	FAC	7 (0.1%)	21 (0.45%)	15 (1%)
Elymus elymoides	bottlebrush squirreltail	N	UPL	3 (0.04%)	19 (0.78%)	
Elymus spp.	wildrye				1 (0.02%)	1 (0.01%)
Juncus balticus	Baltic rush	N	OBL	2 (0.11%)	1 (0.04%)	1 (0.01%)

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1999 (cont.)

Species Name	Common Name	Native/ Introduced	Wetland Status	Bosque Freq (% cover)	Willow Freq (% cover)	Mixed Freq (% cover)
Juncus spp.	rush	N			1 (0%)	
Juncus torreyi	Torrey's rush	N	FACW		1 (0%)	
Muhlenbergia asperifolia	alkali muhly	N	FACW	22 (3.13%)	36 (2.17%)	96 (10.07%)
Muhlenbergia racemosa	marsh muhly	N	FACW		1 (0.01%)	
Panicum capillare	witchgrass	N	FAC		7 (0.06%)	
Panicum obtusum	vine mesquite	N	FAC		3 (0.01%)	4 (0.15%)
Panicum spp.	panicgrass	N			1 (0%)	
Pascopyrum smithii	western wheatgrass	N	FAC-		1 (0.01%)	3 (0.08%)
Phragmites australis	common reed	N	FACW+		1 (0.03%)	5 (0.32%)
Poa pratensis	Kentucky bluegrass	I	FACU		12 (1.83%)	
Polypogon monspeliensis	annual rabbitsfoot grass	I	FACW+		5 (0.18%)	
Schoenoplectus americanus	American bulrush	N	OBL		5 (0.02%)	
Scirpus spp.	bulrush				2 (0.02%)	
sedge						11 (1.65%)
Setaria spp.	bristlegrass	N/I			1 (0%)	
Sorghastrum nutans	Indiangrass	N	UPL		37 (3.99%)	31 (5.03%)
Sporobolus airoides	alkali sacaton	N	FAC	3 (0.16%)		34 (5.38%)
Sporobolus compositus var. compositus	tall dropseed	N	UPL		18 (0.50%)	10 (1.15%)
Sporobolus contractus	spike dropseed	N	NI		2 (0.11%)	28 (3.49%)
Sporobolus cryptandrus	sand dropseed	N	FACU-		1 (0.01%)	2 (0.1%)
Forbs						
Ambrosia psilostachya	Cuman ragweed	N	FAC	7 (0.39%)	96 (8.66%)	139 (6.76%)
Ambrosia spp.	ragweed				6 (0.31%)	
Anemopsis californica	yerba mansa	N	OBL		2 (0.03%)	
Apocynum cannabinum	Indianhemp	N	FAC+		31 (1.77%)	7 (0.17%)
Asclepias latifolia	broadleaf milkweed	N			5 (0.07%)	
Asclepias spp.	milkweed	N			1 (0.02%)	8 (0.32%)

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1999 (cont.)

Species Name	Common Name	Native/ Introduced	Wetland Status	Bosque Freq (% cover)	Willow Freq (% cover)	Mixed Freq (% cover)
Asclepias subverticillata	whorled milkweed	N	FACU		1 (0.02%)	3 (0.09%)
Asparagus officinalis	garden asparagus	I	FACU	1 (0.08%)		
Aster ericoides	heath aster	N	FACU		39 (1.47%)	64 (2.8%)
Bidens pilosa	Spanish needles	N	FACW		2 (0.01%)	
Cenchrus longispinus	longspine sandbur	N			2 (0.01%)	
Chamaesyce spp.	spurge				15 (0.17%)	2 (0.03%)
Chenopodium album	lambsquarters	N	FAC-			2 (0.03%)
Chloracantha spinosa	spiny chloracantha		FACW			3 (0.22%)
Convolvulus arvensis	field bindweed	I	NI	12 (0.13%)	1 (0.02%)	7 (0.16%)
Conyza canadensis	Canadian horseweed	N	FACU		64 (2.47%)	6 (0.04%)
Dalea spp.	prairieclover				2 (0%)	
Equisetum laevigatum	smooth horsetail	N	FACW	1 (0.01%)	18 (0.05%)	25 (0.03%)
Erigeron flagellaris	trailing fleabane	N	FAC-		5 (0.03%)	1 (0%)
Euphorbia spp.	spurge					1 (0.01%)
Euthamia occidentalis	western goldenrod	N	FACW		78 (8.60%)	9 (0.26%)
Gaura spp.	beeblossom					1 (0.01%)
Gaura villosa	wolly gaura	N				1 (0%)
Gnaphalium stramineum	cottonbatting cudweed	N	FAC		2 (0.01%)	
Grindelia squarrosa	curlycup gumweed	N	FACU		14 (0.38%)	
Helianthus annuus	common sunflower	N	FAC-	1 (0.01%)	12 (0.12%)	41 (0.98%)
Lactuca serriola	prickly lettuce	I	FAC	13 (0.36%)	8 (0.06%)	3 (0.02%)
Lycopus americanus	American bugleweed	N	OBL		28 (1.05%)	
Machaeranthera spp.	tansyaster	N			3 (0.06%)	
Melilotus officinalis	yellow sweetclover	I	FACU+	4 (0.08%)	61 (5.34%)	59 (4.42%)
Mentha arvensis	wild mint	N	FACW		1 (0.1%)	
Oenothera elata ssp. hirsutissima	Hooker's eveningprimrose	N	FACW		45 (2.54%)	15 (0.28%)
Ratibida tagetes	green prairie coneflower	N	NI		1 (0%)	

Appendix A: Summary of Vegetation Frequency and Cover by Habitat Type for 1999 (cont.)

Species Name	Common Name	Native/ Introduced	Wetland Status	Bosque Freq (% cover)	Willow Freq (% cover)	Mixed Freq (% cover)
Salsola kali	prickly Russian thistle	I	FACU		1 (0.04%)	5 (0.09%)
Senecio spp.	groundsel	N		2 (0.07%)		
Solanum spp.	nightshade				3 (0.41%)	
Sphaeralcea spp.	globemallow	N		5 (0.09%)		
Taraxacum officinale	common dandelion	N	FACU		1 (0.01%)	1 (0.01%)
Thelesperma megapotamicum	Hopi tea greenthread	N	NI		1 (0%)	
Trifolium spp.	clover				1 (0.01%)	2 (0.04%)
Verbascum thapsus	common mullein	I	NI		2 (0.02%)	
Xanthium strumarium	rough cocklebur	N	FAC		16 (0.23%)	