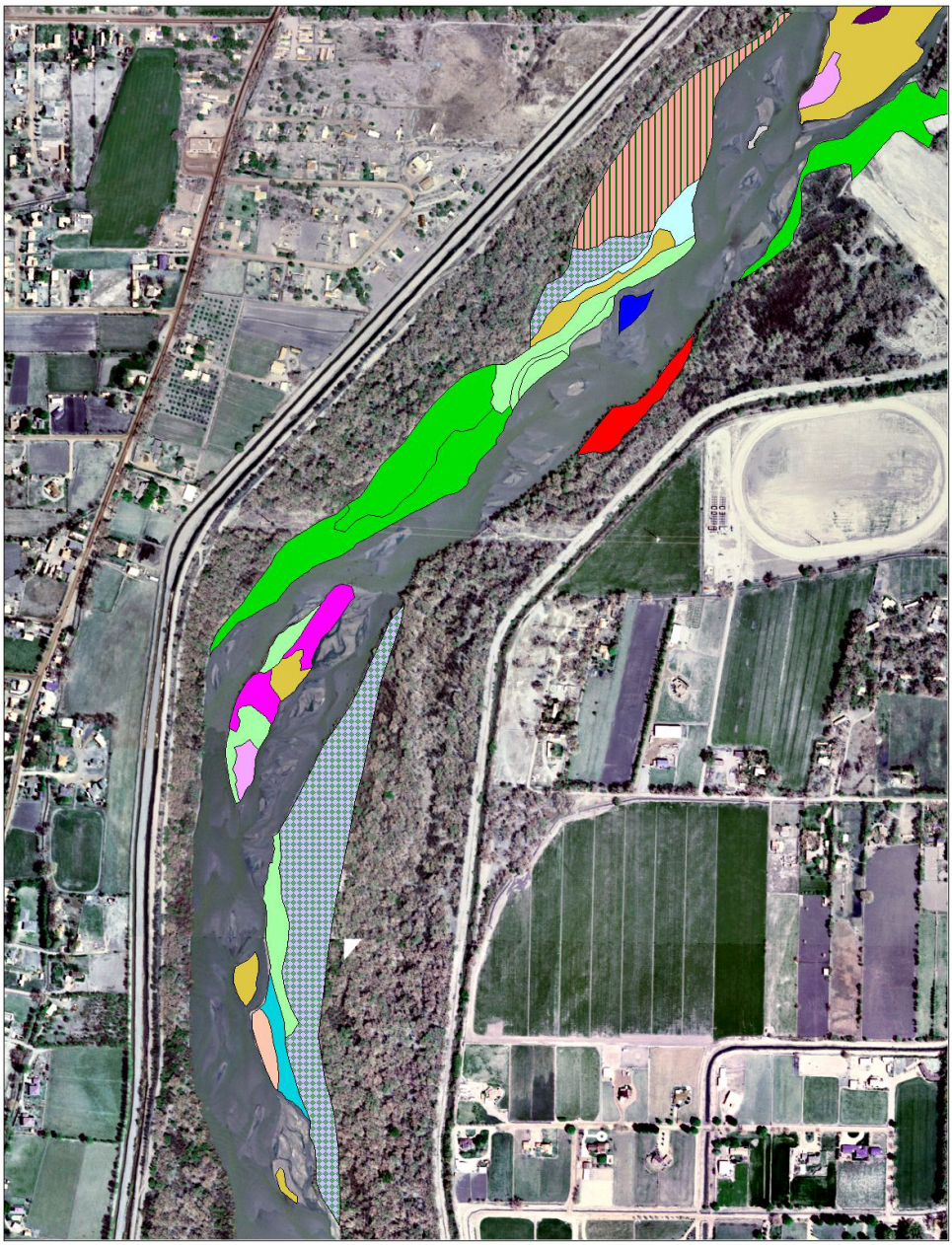
Middle Rio Grande River Bar Vegetation Map

The Albuquerque Reach



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The University of New Mexico

New Mexico Natural Heritage Program
NMNHP

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Introduction

A vegetation map of the river bars of the Albuquerque reach of the Middle Rio Grande was developed to support riparian ecosystem management and restoration per the guidelines of the Bosque Biological Management Plan (Crawford et al. 1993). Of particular interest are the plan's recommendations 16 and 17 on enhancing existing and creating new native cottonwood communities along the river while containing the expansion of exotic trees and shrubs. Because river bars are nurseries for native trees and shrubs, they are key elements in the restoration effort. River bars also provide habitat for wetland herbaceous species, have greater overall biological diversity than established terrace forests (see Wood et al. 1999, Milford et al. 2000, Milford and Muldavin 2001), and contribute to habitat heterogeneity within the river corridor, thus providing unique and important habitat for wildlife.

To integrate river bars into the restoration planning process, we felt it was important to know the actual extent of the bars and their composition, plus their stability through time, e.g., how many and what kind of bars are there in the Middle Rio Grande, what are their sizes, and to what degree are they dominated by exotics. Furthermore, are these island and sidebars (alternate bars) constant in their position and shape (that is quasi-stable as a function of recent river flow regulation, and channel stabilization), or are they dynamic in location and composition despite modifications to the river.

Given the importance of vegetated river bars with respect to biodiversity in the bosque ecosystem and the need to understand their spatial extent and configuration, we have been conducting a three-year project (2001-03) that focuses on mapping the bar vegetation in the Albuquerque reach (Figure 1). In the first year, we assembled available aerial digital ortho-photography, satellite or air-borne sensor imagery from the reach into a geographic information system (GIS) for spatial analysis. In the second year, we visually interpreted the imagery, built a map for the reach between the Alameda and I-25 bridges (Bernalillo County), and "ground-truthed" it. The third year will be devoted to completing the mapping northward to Santa Ana Pueblo and southward through Belen. Our goal is to have a sufficient length of reach mapped in

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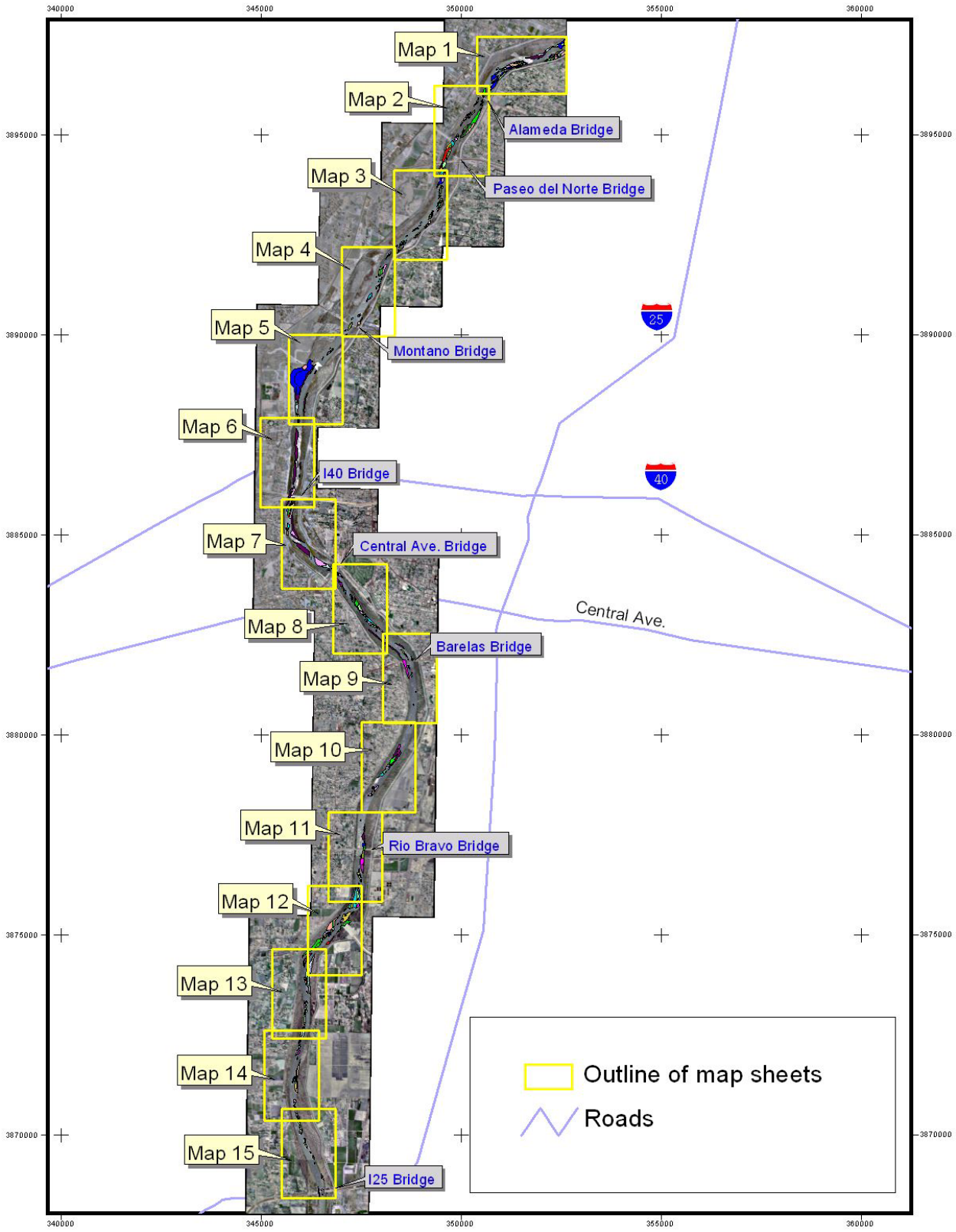


Figure 1. Overview of the reach mapped showing the bridges and the locations of the map sheets contained in Appendix B.

high detail that will enable us to analyze the current composition, extent, and configuration of the bars relative to their historical setting. Our objectives are to evaluate the effects of regulation and channelization on bar stability, morphology, and composition, and to assess the overall changes in distribution as a guide for future restoration efforts.

In this report, we present the map for the Albuquerque/Bernalillo County reach along with an annotated map legend and a preliminary map analysis of vegetation composition and extent. The map units focus on vegetation structure and density, dominant species composition, and level of exotic encroachment. They are based on our vegetation work from our previous bar studies, direct ground sampling along the reach, and the wetland/riparian classification of Muldavin et al. (2000). Paper versions of the map with a generalized legend were produced at a 1:6,000 scale. In addition, the map with comprehensive annotation on composition, density, and site characteristics is available to all interested parties as an ArcView 3.2 GIS shapefile.

Methods

The mapping process consisted of a number of stages: preliminary map unit classification and mapping, ground truthing and data collection, final map production, final map unit classification, and quality control. The map is based on a natural-color digital orthophotograph at one-foot pixel resolution of Bernalillo County created by Bohannan Huston, Inc. for the United States Army Corp Engineers, Albuquerque District. The original photo scale was 1:12,000 and the photography was flown in April 1999. The New Mexico Natural Heritage Program (NMNHP) was given access to the imagery by the County of Bernalillo.

The map was developed in an ArcView environment, and consists of a polygon shapefile and associated data table. The map was developed using the Universal Transverse Mercator (UTM) coordinate system for the North American Datum 1927 (NAD27) Zone 13. The image was initially visually interpreted and polygons screen digitized and classified into provisional map units based on available ground data (primarily NMNHP's river bar monitoring sites (Milford et al. 2000)). A preliminary map was completed by March 2002, and in May and June 2002 fieldwork was conducted to verify and refine the map.

The field validation was conducted either on foot along the river edge or by boat where water levels permitted. The areas checked included a combination of randomly selected polygons and areas that had been particularly difficult to classify because of questionable imagery or because they appeared to represent unusual vegetation. There were 71 ground control plots establish with locations determined to within 15m using field values from a Garmin GPS 12. For each plot, site characteristics such as height above the river, location relative to the bank, the degree of bare ground, and substrate texture were noted. The percent aerial cover of the dominant plants was recorded by species and strata (tree (>3 m), shrub (0.5-3 m), sub-shrub (<0.5 m), and herbaceous layers). In addition, there were 14 observation points taken with brief qualitative plant community descriptions and GPS locations. Because of logistical constraints, a number of polygon map units were verified at a distance and charted on the field maps without a GPS position. Although mapping all of the mature terraces was outside of the project scope, terrace forests (bosque) were evaluated opportunistically during the fieldwork and added to the

map. Plant voucher specimens were collected as necessary, identified by the NMNHP botanist, and deposited at the University of New Mexico Herbarium.

The information from these plots along with the 12 long-term NMNHP river bar monitoring plots was used to create the vegetation classification and map unit descriptions. Map units were organized by strata (woodlands, shrublands, and herbaceous types) and primarily defined by the dominant species and level of exotic invasion. There are also a series of modifiers and attributes associated with each mapped polygon that include vegetation cover classes, bar morphology and location, hydrological conditions, and cottonwood reproduction, among others (see Appendix A).

The map was revised based on the updated legend and the various modifiers, and a streamlined GIS then developed for users (see CD in back pocket). Appendix A is the table of attributes associated with the ArcView shapefile of the map and includes the definitions of all fields (this is also part of a readme file on the CD). Paper map sheets were also generated at 1:6,000 scale and organized from north to south along the river (Figure 1). The maps are presented in Appendix B with a legend based on the map units (Table 1) and labled with the cover class codes (Table 2).

Results

River bar distribution

There were 4,157 acres (1,682 ha) of total floodplain (levee to levee) in the Albuquerque/Bernalillo County reach mapped in 2002. Of this, river bars - both island and sidebars - accounted for 13% or 541 acres (219 ha), while upper terraces comprised 59% (2,450 acres; 992 ha) and active channel 28% (1,179 acres; 477 ha). The majority of the bars - 71% - were sidebars lying between the active channel and the upper, forested terraces (383 acres; 155 ha), and they ranged in size from small, narrow strips along the river to large point bars as much as 180m wide and greater than a kilometer in length. In contrast, island bars made up only 158 acres (64 ha). There were a few very large islands over 100m wide and one that was 650m in length, but typically islands were less than 80m wide and 350m long.

Bars were not equally distributed along the river. More island bars occurred in the upper reach from Alameda to Montano and again south of the Rio Bravo to I-25. The large, higher sidebars were more prevalent in the central reach from I-40 bridge to south of the Central, and again south of Rio Bravo. In contrast, there were very few bars of any type between the Barelas and Rio Bravo.

River bar vegetation composition

There were 19 primary map units defined for the reach (Table 1) that fall into four major structural groups: Woodlands, Shrublands, Herbaceous, and Other miscellaneous types. The woodlands are represented by five units defined by the presence of mature, overstory cottonwoods with various understory compositions (Cottonwood/Native, Cottonwood/Mixed and Cottonwood/Saltcedar) or the presence of mature or advanced regeneration Siberian elms

Table 1. Middle Rio Grande River Bar vegetation map units.

Map Unit Code	Map Unit Name	Scientific Name
Mature Cottonwood Woodlands		
Cw/N	Cottonwood/Native	*Populus deltoides* /Native
Cw/M	Cottonwood/Mixed	*Populus deltoides* /Mixed
Cw/Sc	Cottonwood/Saltcedar	*Populus deltoides* /*Tamarix ramosissima*
Siberian Elm Woodlands		
Em/M	Siberian Elm/Mixed	*Ulmus pumila* /Mixed
Em/Ro	Siberian Elm/Russian Olive	*Ulmus pumila* /*Elaeagnus angustifolia*
Coyote Willow Shrublands		
Wi/Cw	Coyote Willow/Cottonwood	*Salix exigua* /*Populus deltoides*
Wi/N	Coyote Willow/Native	*Salix exigua* /Native
Wi/Ro	Coyote Willow/Russian Olive	*Salix exigua* /*Elaeagnus angustifolia*
Wi/Sc	Coyote Willow/Saltcedar	*Salix exigua* /*Tamarix ramosissima*
Russian Olive Shrublands		
Ro/Wi	Russian Olive/Coyote Willow	*Elaeagnus angustifolia* /*Salix exigua*
Ro/E	Russian Olive/Exotic	*Elaeagnus angustifolia* /Exotic
Saltcedar Shrublands		
Sc/Wi	Saltcedar/Coyote Willow	*Tamarix ramosissima* /*Salix exigua*
Sc/M	Saltcedar/Mixed	*Tamarix ramosissima* /Mixed
Herbaceous types		
HW	Herbaceous Wetland	Herbaceous Wetland
HM	Herbaceous Mesic	Herbaceous Mesic
HU	Herbaceous Upland	Herbaceous Upland
HC	Herbaceous - Common Reed	Herbaceous - *Phragmites australis*
Other types		
Ot	Other	Other
Br	Bare	Bare

Table 2. Middle Rio Grande River Bar vegetation map unit cover class modifiers.

Cover Map Unit Code	Cover Map Unit Name	Overstory Cover	Understory Cover
Woodlands and Shrublands			
h/h	high/high	high	high
h/m	high/moderate	high	moderate
h/s	high/sparse	high	sparse
m/h	moderate/high	moderate	high
m/m	moderate/moderate	moderate	moderate
m/s	moderate/sparse	moderate	sparse
s/h	sparse/high	sparse	high
s/m	sparse/moderate	sparse	moderate
s/s	sparse/sparse	sparse	sparse
Herbaceous types			
h	high	high	N/A
m	moderate	moderate	N/A
s	sparse	sparse	N/A
Barren			
b	bare	bare	bare

(Siberian Elm/Mixed and Siberian Elm/Russian Olive). The overstory canopies must be at least 10% in cover to qualify as woodlands, but the understory layers can be considerably higher. These types occur on the high sidebars (as opposed to the forests of the upper, older terraces) or very rarely on high islands, and account for only 79 acres (32 ha) or 15% of the bar area within the reach (Table 3).

Shrublands are the most prevalent vegetation on the bars making up 293 acres (119 ha) or 54% of the total bar area. The shrublands are represented by eight map units grouped by native versus exotic shrub components. Native shrublands are dominated by coyote willow (Coyote Willow/Cottonwood, Coyote Willow/Native, Coyote Willow/Russian Olive and Coyote Willow/Saltcedar). Although these types may contain exotic species, coyote willow always accounts for more than 50% of the total woody cover. In contrast, there are four exotic shrubland map units that were defined by the dominance of either Russian olive (Russian Olive/Coyote Willow and Russian Olive/Exotic), or saltcedar (Saltcedar/Coyote Willow and Saltcedar/Mixed). Native species account for less than 49% of the total woody cover. Native-dominated bars account for 142 acres (57 ha) or 48% of the shrublands, while exotics prevail over the remaining 151 acres (61 ha) or 52%.

There are four map units defined by herbaceous vegetation (Herbaceous Wetland, Herbaceous Mesic, Herbaceous Upland and Herbaceous – Common Reed). These are broadly categorized by general vegetation and species complexes rather than by single dominants. The exception is the Herbaceous – Common Reed map unit, which is always dominated by common reed. The other herbaceous types may contain a number of species both native and exotic. There were 147 acres (60 ha) mapped for these units or 27% of the bar vegetation.

There are two miscellaneous map units: Bare, which includes all polygons that have less than 10% total vegetative cover, and Other, for those polygons dominated by upland species or exotics that are only incidental within the riparian corridor.

Spatially, the various types were not evenly distributed among bar types (Table 3). The majority of woodland sites occurred on sidebars, with cottonwood-dominated woodlands occurring only on sidebars. The native cottonwood regenerative type (Coyote Willow/Cottonwood) also occurred most frequently on sidebars. However, the most strongly exotic-dominated shrubland types occurred almost exclusively on sidebars as well (Russian Olive/Exotic and Saltcedar/Mixed). In contrast, with the exception of the Coyote Willow/Cottonwood type, the island bars contained the majority and the most luxuriant of the native-dominated shrubland communities (Table 3).

Table 3. Area per Map Unit for island and sidebars with percentage of area for that Map Unit by bar type plus total area and percentage per Map Unit for both bar types combined.

	Island Bars		Sidebars		Total Bars	
Map Unit	**Acres (Ha)**	**%**	**Acres (Ha)**	**%**	**Acres (Ha)**	**%**
Woodlands						
Cottonwood/Native			5.5 (2.2)	100%	5.5 (2.2)	1.0%
Cottonwood/Mixed			28.3 (11.5)	100%	28.3 (11.5)	5.2%
Cottonwood/Saltcedar			17.2 (6.9)	100%	17.2 (6.9)	3.2%
Siberian Elm/Russian Olive	5.8 (2.4)	24%	18.1 (7.3)	76%	23.9 (9.7)	4.4%
Siberian Elm/Mixed	1.4 (0.6)	33%	2.9 (1.2)	67%	4.3 (1.7)	0.8%
Total Woodlands	**7.2 (2.9)**	**9%**	**71.9 (29.1)**	**91%**	**79.1 (32.0)**	**14.6%**
Shrublands						
Coyote Willow/Cottonwood	5.1 (2.1)	13%	35.1 (14.2)	87%	40.1 (16.2)	7.4%
Coyote Willow/Native	22.1 (8.9)	49%	23.3 (9.4)	51%	45.4 (18.4)	8.4%
Coyote Willow/Russian Olive	25.6 (10.4)	80%	6.4 (2.6)	20%	32.0 (13.0)	5.9%
Coyote Willow/Saltcedar	15.6 (6.3)	64%	8.7 (3.5)	36%	24.2 (9.8)	4.5%
Russian Olive/Coyote Willow	27.5 (11.1)	59%	19.0 (7.7)	41%	46.5 (18.8)	8.6%
Russian Olive/Exotic	1.5 (0.6)	2%	76.7 (31.0)	98%	78.2 (31.7)	14.4%
Saltcedar/Coyote Willow	3.3 (1.3)	21%	12.4 (5.0)	79%	15.7 (6.3)	2.9%
Saltcedar/Mixed			11.0 (4.4)	100%	11.0 (4.4)	2.0%
Total Shrublands	**100.7 (40.7)**	**34%**	**192.5 (77.9)**	**66%**	**293.1 (118.6)**	**54.1%**
Herbaceous						
Herbaceous Wetland	18.4 (7.4)	22%	63.7 (25.8)	78%	82.0 (33.2)	15.2%
Herbaceous Mesic	21.6 (8.7)	44%	27.1 (10.9)	56%	48.6 (19.7)	9.0%
Herbaceous Upland			14.9 (6.0)	100%	14.9 (6.0)	2.8%
Herbaceous - Common reed	0.9 (0.4)	54%	0.8 (0.3)	46%	1.6 (0.7)	0.3%
Total Herbaceous	**40.8 (16.5)**	**28%**	**106.4 (43.1)**	**72%**	**147.2 (59.6)**	**27.2%**
Other						
Other			2.6 (1.0)	100%	2.6 (1.0)	0.5%
Bare	9.2 (3.7)	48%	10.0 (4.1)	52%	19.2 (7.8)	3.6%
Total All Types	**157.9 (63.9)**	**29%**	**383.4 (155.2)**	**71%**	**541.3 (219.1)**	**100.0%**

Map Unit Descriptions

Rio Grande Cottonwood (Populus deltoides var. wislezenii) *Woodlands:*

Cottonwood/Native

Woodlands dominated by mature and/or advanced regeneration cottonwoods without major exotic invasion. The woody understory, when present, is dominated by natives such as coyote willow and New Mexico olive. Exotic woody species may be present, but are clearly not dominant or sub-dominant (comprising less than 24% of the total woody cover). This unit includes dense (>50% woody cover) to sparse (10-25% woody cover) forest types and occurs either on high sidebars or terraces that are seldom flooded. Depending on moisture regime and soil type the herbaceous understory can vary from sparse upland grasses and forbs to lush riparian grasses (Figure 2).

Cottonwood/Mixed

Woodlands dominated by mature and/or advanced regeneration cottonwoods with significant exotic woody species invasion in the sub-canopy and shrub layer. The understory is either dominated or co-dominated by exotic Russian olive, Siberian elm, or saltcedar, but may still include significant amounts of native understory species such as coyote willow and New Mexico olive. Although the understory is usually exotic dominated, 50% to 75% of the total woody species cover is comprised of native species. This unit includes dense (>50% woody cover) to sparse (10-25% woody cover) forest types and occurs on high sidebars and terraces. The herbaceous understory in this type is usually sparse (Figure 3).

Cottonwood/Saltcedar

Woodlands dominated by mature cottonwoods in the overstory and saltcedar in the sub-canopy and shrub layer. Saltcedar often comprises greater than 50% of the total woody cover. Other exotic woody species such as Russian olive and Siberian elm may also be common to abundant. Cottonwoods tend to be remnant older individuals. Occasionally these stands are a mixture of sparse advanced regeneration cottonwoods and sparse saltcedar. Most of these stands are dense (>50% woody cover) forest types and occur on terraces and high sidebars. The herbaceous cover is sparse or absent (Figure 4).

Siberian Elm (Ulmus pumila) Woodlands

Siberian Elm/Mixed

Shrublands dominated by Siberian elm with native woody species, such as coyote willow or young cottonwoods, as co-dominants or sub-dominant (25-49% of total woody cover). Other exotic woody species may be present, but are not dominant or sub-dominant. Stands tend to be dense (>50% woody cover) to moderately dense (25-50% woody cover) and usually occur on high sidebars. The herbaceous understory in these stands is usually sparse (Figure 5).

Figure 2. Example of the Cottonwood/Native map unit.

Figure 3. Example of the Cottonwood/Mixed map unit.

Figure 4. Example of the Cottonwood/Saltcedar map unit.

Figure 5. Example of the Siberian Elm/Mixed map unit.

Siberian Elm/Russian Olive

Woodlands dominated by Siberian elm with Russian olive as a sub-dominant. Russian olive can have greater total cover than Siberian elm, but in most stands both are well represented. Native woody species may be present, but usually comprise less than 25% of total woody cover. Other exotic woody species, particularly white mulberry, may also be present. The herbaceous understory is usually luxuriant and graminoid-dominated. Stands tend to be dense (>50% woody cover) and usually occur on high sidebars and islands.

Coyote Willow (Salix exigua) Shrublands:

Coyote Willow/Cottonwood

Shrublands dominated by coyote willow with young cottonwoods a significant sub-dominant. Native species comprise at least 75% of the woody cover, but exotic species may be present in low numbers. Stands tend to be dense or dense in patches. Stands usually occur on sandy bars with moderately dense graminoid-dominated to sparse forb-dominated herbaceous understories. This type occurs on low to high islands and sidebars. Stands modified by restoration work with pole planted cottonwoods are included in this type (Figure 6).

Coyote Willow/Native

Shrublands dominated by coyote willow (>75% total woody cover). Exotic species may be present but make up less than 24% of the total woody cover. Unlike Willow/Cottonwood, young cottonwoods are not a significant component. Stands can be dense or sparse, depending on moisture availability. The herbaceous understory also varies with soil moisture, from luxuriant graminoid-dominated to sparse forb-dominated. This type occurs on low to high islands and sidebars (Figure 7).

Coyote Willow/Russian Olive

Shrublands dominated by coyote willow with Russian olive sub-dominant. Willows comprise 50% to 74% of the total woody cover, while Russian olive and other exotic woody species account for 25% to 49%. Russian olive is the most significant exotic woody component, but saltcedar, Siberian elm, white mulberry, and southern catalpa may be present. These sites often have a luxuriant grassy understory, particularly on low islands. A sparser variant occurs on high sidebars and islands with a correspondingly sparse herbaceous understory (Figure 8).

Coyote Willow/Saltcedar

Shrublands dominated by coyote willow with saltcedar sub-dominant. Willows comprise 50% to 74% of the total woody cover, with saltcedar and other exotic woody species accounting for 25% to 49% of woody cover. Saltcedar is the most significant exotic component, but other exotic woody species, particularly Siberian elm, may be present. These stands tend to be on high islands and sidebars and are usually moderately dense (25-50% woody cover) to sparse (10-25% woody cover). The herbaceous understory varies from dense (>50%) to moderately dense (25-50%) grass and forb cover (Figure 9).

Figure 6. Example of the Coyote Willow/Cottonwood map unit.

Figure 7. Example of the Coyote Willow/Native map unit.

Figure 8. Example of the Coyote Willow/Russian Olive map unit.

Figure 9. Example of the Coyote Willow/Saltcedar map unit.

Russian Olive (Elaeagnus angustifolia) Shrublands:

Russian Olive/Coyote Willow

Shrublands dominated by Russian olive with coyote willow a sub-dominant (25-49% of woody cover). The herbaceous understory is often abundant to luxuriant and graminoid-dominated. These stands are generally mesic and occur on low to high islands and sidebars. Stands tend to be dense (>50% woody cover), though there is also a sparse variant that occurs on high dry sidebars (Figure 10).

Russian Olive/Exotic

Shrublands dominated by Russian olive or Russian olive and a mixture of other exotic woody species, particularly saltcedar. Together exotic species comprise more than 75% of the total woody cover. Native woody species maybe present but are clearly subordinate. The herbaceous understory can vary from luxuriant and graminoid-dominated to very sparse. Sites range from low islands and sidebars to terraces. Generally, the denser stands occur on more mesic low islands and sidebars, while sparse stands are found on drier high sidebars and terraces (Figure 11).

Saltcedar (Tamarix ramosissima) Shrublands:

Saltcedar/Coyote Willow

Shrublands dominated by young to moderate aged saltcedar (<3.5m tall) with coyote willow a sub-dominant. Natives, either coyote willow or coyote willow and cottonwood comprise 25-49% of the woody cover. Siberian elm is often present, particularly on higher islands and sidebars. The herbaceous understory varies from dense graminoids to very sparse forbs, depending on the site's moisture regime. Stands occur on all types of bars, from ephemeral to high sidebars. The denser stands tend to occur on lower, more moist bars (Figure 12).

Saltcedar/Mixed

Shrublands dominated either by saltcedar exclusively or by saltcedar with a mixture of exotic and native woody sub-dominants (usually Russian olive or cottonwood, and occasionally other species). These stands are usually composed of young to moderate aged saltcedars. Stands tend to be dense or dense in patches. Exotics comprise over 50% of the woody cover. The herbaceous understory is usually sparse and forb-dominated. Stands occur on a variety of bar types (Figure 13).

Figure 10. Example of the Russian Olive/Coyote Willow map unit.

Figure 11. Example of the Russian Olive/Exotic map unit.

Figure 12. Example of the Saltcedar/Coyote Willow map unit.

Figure 13. Example of the Saltcedar/Mixed map unit.

Herbaceous Types:

Herbaceous Wetland

Stands dominated by obligate wetland herbaceous species such as spikerushes, sedges, cattails, and bulrushes. Seedling trees and shrubs, both native and exotic, are common components but do not dominate. Herbaceous species diversity can be high. Stands are typically found on ephemeral islands and sidebars or occasionally on higher sites adjacent to perennial water sources. Stands tend to be dense but small or scattered dense patches over larger polygons (Figure 14).

Herbaceous Mesic

Stands dominated by mesic often weedy herbaceous facultative or obligate wetland species, such as Canadian horseweed, rough cocklebur and alfalfa. Scattered seedling and young trees and shrubs are often present. Species diversity is lower in these stands than in Herbaceous Wetlands, and is limited to forbs and grasses capable of withstanding periods of drought as well as occasional inundation. Many species are opportunistic annuals. Stands are usually found on low or ephemeral islands and sidebars. Ground cover can increase significantly after inundation (late spring to early summer) then becomes sparser later in the year as water levels drop and annuals senesce (Figure 15).

Herbaceous Uplands

Stands dominated by upland herbaceous species, either forbs or graminoids. Species in these stands tend to be perennials and may include upland or facultative wetland species, but rarely obligate wetland species. Native or exotic woody species may be present in low numbers (<10% woody cover). Sites tend to occur on higher more stable islands and bars as well as terraces. Stands can be either dense or sparse depending on moisture regime (Figure 16).

Herbaceous - Common Reed

These are stands dominated by common reed without any significant woody species. Typically these are very dense patches with a sparse grassy understory. This type is found near the edges of sidebars and on low to moderately low islands (Figure 17).

Other Types:

Other

Stands dominated by upland species or exotics that are only incidental within the riparian corridor. Examples include sand sagebrush and ravennagrass.

Barren

These are polygons that have less than 10% total vegetative cover. Typically, low, semi-stable sandy sidebars or islands. Occasionally includes sandy areas within higher sidebars or islands such as abandoned channels. Does not include ephemeral sandy shoals, which are considered part of the active channel.

Figure 14. Example of the Herbaceous Wetland map unit.

Figure 15. Example of the Herbaceous Mesic map unit.

Figure 16. Example of the Herbaceous Upland map unit.

Figure 17. Example of the Herbaceous - Common Reed map unit.

Discussion

Although islands and sidebars are less than 15% of the total river floodplain, these areas provide crucial wetland habitat for plants and animals that is not available elsewhere in the floodplain. Plant species diversity is higher on the bars than in the adjacent mature cottonwood bosque. In our data from 1998-1999 native-dominated bars had a total of 81 plants species, while 54 species were observed on exotic-dominated bars and only 27 species were found in the mature cottonwood bosque (Milford et al. 2000). Many of these species were unique to the bar habitat. Native-dominated bars also had the highest number of wetland indicator species. The higher plant species diversity on native-dominated bars is echoed by a higher diversity of ground active beetles on bars as compared with the mature bosque (Milford and Muldavin 2001). In addition, the bars are typically the only area in the river floodplain where natural reproduction of native woody species occurs. This all points to the bars' role as an essential ingredient in both wildlife habitat and the overall health of the Middle Rio Grande ecosystem. It is also evident that this area needs to be carefully considered during restoration and conservation planning.

Given recent accelerated efforts in forest and bar restoration in the Middle Rio Grande, a map of the current vegetation is needed for targeting and prioritizing restoration sites. In addition, current-condition maps will provide a benchmark for measuring change as restoration proceeds. A challenge for future management of the river is to maintain the reproduction of native species on the bars while trying to discourage the exotic species. Since bars are key in native species reproduction, knowledge about their current extent, distribution, and species composition is a crucial first step to managing exotics and encouraging native species. Especially important in the management of the river for native species is looking at how bars have changed in extent and placement in the river channel over the last century. This will aid in determining what sorts of bars (and under what conditions) become sidebars and terraces dominated by native woodlands rather than exotics. We suspect that the amount of both islands and sidebars has been reduced with the channelization of the middle Rio Grande within the levies and the installation of jetty jacks to stabilize the banks. By continuing the mapping process, looking at a greater area of the river, as well as mapping the historical extent of the bars, we hope to provide knowledge that can be used to manage the river and restoration efforts for greater success of native species into the future.

Literature Cited

Crawford, C., A. Cully, R. Leutheuser, M. Sifuentes, L White, and J. Wilber. 1993. Middle Rio Grande Ecosystem: Bosque Biological Management Plan. Middle Rio Grande Biological Interagency Team, U.S. Fish and Wildlife Service.

Milford, E., S. Wood, E. Muldavin, B. Jenkins, and K. Wild. 2000. River Bars of the Middle Rio Grande, Progress Report Year II. Unpublished report submitted to: Middle Rio Grande Bosque Initiative, Bosque Improvement Group, NM Ecological Services Field Office, U.S. Fish and Wildlife Service.

Milford, E. and E. Muldavin. 2001. River Bars of the Middle Rio Grande, Progress Report Year III. Unpublished report submitted to: Middle Rio Grande Bosque Initiative, Bosque Improvement Group, NM Ecological Services Field Office, U.S. Fish and Wildlife Service.

Muldavin, E., P. Durkin, M. Bradley, M. Stuever, and P. Mehlhop. 2000. Handbook of wetland vegetation communities of New Mexico: Volume I: Classification and community descriptions. New Mexico Natural Heritage Program for the New Mexico Environment Department and the U.S. Environmental Protection Agency.

Wood, S., E. Muldavin, E. Milford, and B. Jenkins. 1999. River Bars of the Middle Rio Grande, Progress Report. Unpublished report submitted to: Middle Rio Grande Bosque Initiative, Bosque Improvement Group, NM Ecological Services Field Office, U.S. Fish and Wildlife Service.

Appendix A – Bar Map Classification Table

Field Names and definitions for the attribute table for the ArcView GIS shapefile map of the river bars of the Middle Rio Grande, Albuquerque/Bernalillo County reach 2002. This appendix lists all the fields in the attribute table with their definitions. It also provides lists of the discrete value codes and their definitions for applicable fields. Boldface type indicates field titles present in the table. Boldface type in parenthesis indicates codes used in the table for discrete variables.

1. **PolyNum** – Unique identifier for each polygon

2. **GenLoc** – Descriptive general location of polygon along river

3. **Barlocname** – More specific descriptive location of bar on which polygon is located

4. **BarNum** – Unique identifier for each sidebar or island

5. **BarLoc** – General landform type for the polygon:
    A. Terrace (**Tr**)
    B. Sidebar (**Sb**) (Alternate bar) adjacent to active channel
    C. Island (**Is**)

6. **BarType** – More specific landform type:
    A. Terrace (**tr**) well above the channel (>4'), probably not inundated even at extreme high flows
    B. High Sidebar (**hs**) well above the channel (2-4'), inundated never or only at extreme high flows
    C. Low Sidebar (**ls**) above the usual channel height (1-2'), possibly inundated at high flows
    D. High Island (**hi**) well above the channel (>2'), inundated never or only at extreme high flows
    E. Low Island (**li**) above the usual channel height (1-2'), possibly inundated at high flows
    F. Ephemeral (**ep**) (island or sidebar that is barely above the active channel – this class does not include shoals, only more stable low sandbars that are often vegetated but easily inundated at moderate to high flows)
    G. Bar Channel (**bc**) (occasionally or previously active channel through island or sidebar)
    H. Terrace Channel (**tc**) (old channel through terrace –not active or only active at extreme high flows)

7. **Hydrotype** – Hydrological type or flooding potential of polygon:
    A. Saturated (**1**) (Frequently flooded with ground water near the surface)
    B. Mesic (**2**) (Potential for flooding during high river flows; ground water estimated between 0.5 and 1.5m of the surface)
    C. Dry (**3**) (No flooding potential under current river management conditions; ground water estimated at greater than 1.5m below the surface)
    D. Unknown (**9**)

8. **DomVegClass** – Dominant vegetation strata class:
    A. Woodland/Forest (**F**) = trees over > 5m make up > 10% canopy cover
    B. Shrubland (**S**) = shrubs (< 5m) dominate with at least 10% cover.
    C. Herbaceous (**H**) = other classes not present or less than 10% total cover.
    D. Bare (**B**) = less than 10% total cover.

9. **DomVegCov** – Dominant vegetation cover:
    A. High (**h**) > 50% total cover
    B. Moderate (**m**) = 25 to 50% cover
    C. Sparse (**s**) = 10 to 25% cover
    D. Bare (**b**) < 10% cover

10. **PerExotic** – (Percent Exotic) percent of woody layer dominated by exotic species:
    A. 0-24% - Native (**N**)
    B. 25-49% - Mixed, Native dominated (**Mn**)
    C. 50-74% - Mixed, Exotic dominated (**Me**)
    D. 75-100% - Exotic (**E**)

11. **DomSpecies** – Dominant species or species complex:
    A. Cottonwood (**Cw**) - *Populus deltoides* var. wislezenii
    B. Coyote Willow (**Wi**) - *Salix exigua*
    C. Russian olive (**Ro**) - *Elaeagnus angustifolia*
    D. Saltcedar (**Sc**) - *Tamarix ramosissima*
    E. Siberian Elm (**Em**) - *Ulmus pumila*
    F. Herbaceous Wetland (**HW**)
    G. Herbaceous Grassy Mesic (**HG**) – mesic, lush grasses with some forbs
    H. Herbaceous Forbs Mesic (**HFM**) – usually invasive annual forbs requiring a relatively mesic environment for establishment
    I. Herbaceous Forbs Upland (**HFU**) – dry, sparse upland grasses and forbs, annuals or perennials
    J. Common Reed (**Pr**) – herbaceous areas dominated by dense *Phragmites australis*
    K. Bare (**BR**) – Total vegetation cover less than 10%
    L. Other (**Ot**) – incidental dominants

12. **DomCert** – Dominant species certainty:
    A. Field Checked (physically visited) – (**A**)
    B. Field Observed (observed from distance in field) – (**B**)
    C. High photo interpretation confidence (not field checked: imagery good and typical for vegetation type) – (**C**)
    D. Poor photo interpretation confidence (not field checked: imagery confusing, not typical for type) – (**D**)
    E. Unclear class (not field checked: imagery very poor and/or extremely atypical) – (**F**)

13. **SubDomSp1** – (Sub-dominant Species 1) most common woody sub-dominant species:
    Same codes as DomSpecies with the additions of:
    A. Seepwillow (**Bc**) - *Baccharis salicina*
    B. New Mexico olive (**No**) – *Forestiera pubescens* var. pubescens
    C. Gooddings willow (**Sg**) – *Salix gooddingii*

14. **SubDomSp2** - Second most common woody sub-dominant species:
    Same codes as SubDomSp1

15. **OtherSigSp** – Other significant woody species present in the stand:
    Same codes as SubDomSp1

16. **SubDomCert** – Sub-dominant species certainty:
    Same codes as DomCert applied to sub-dominant species identification

17. **UnderHerb** – Understory herbaceous cover class for woodland and shrubland types:
    A. Abundant to luxurious cover (>50%), typically obligate or facultative wetland grasses and forbs – (**gm**)
    B. Abundant to moderately sparse cover (20-50%), typically upland grasses and forbs – (**gf**)
    C. Sparse, poorly-represented (<20%) or no herbaceous cover– (**vs**)

18. **Comments** – Brief description and comments about the polygon

19. **Inclusions** - Significant, but un-mapable inclusions at 1:6,000 scale; typically types that make up less than 10% of a polygon

20. **Cwrepro** – (Cottonwood reproduction) presence and type of cottonwood reproduction, used only for visited sites:
    A. A number of young trees or saplings (>0.5 m tall) present (**+ct**)
    B. A number of seedlings (<0.5 m tall) present (**+cs**)
    C. Little or no cottonwood reproductive observed (**-c**)

21. **MapDate** – Date on which polygon was last edited

22. **AreaMeters** – Area of polygon in meters

23. **PerimeterM** – Perimeter of the polygon in meters

24. **Acres** – Area of polygon in acres

25. **Hectares** – Area of polygon in hectares

26. **LegDomSpC** – (Legend Dominant Species Code) dominant species code for map unit type (usually, but not always the same as Domspecies):
    A. Cottonwood (**Cw**) - *Populus deltoides* var. wislezenii
    B. Coyote Willow (**Wi**) - *Salix exigua*
    C. Russian olive (**Ro**) - *Elaeagnus angustifolia*
    D. Saltcedar (**Sc**) - *Tamarix ramosissima*
    E. Siberian Elm (**Em**) - *Ulmus pumila*
    F. Herbaceous Wetland (**HW**)
    G. Herbaceous Mesic – (**HM**) usually invasive annual forbs requiring a relatively mesic environment for establishment
    H. Herbaceous Upland – (**HU**) upland grasses and forbs, annuals or perennials
    I. Herbaceous - Common Reed – (**HC**) herbaceous areas dominated by dense *Phragmites australis*
    J. Bare – (**BR**) Total vegetation cover less than 10%
    K. Other – (**Ot**) incidental dominants

27. **LegDomSpN** – (Legend Dominant Species Name) dominant species for map unit type
    Common names from LegDomSpC above rather than the codes

28. **LegCTcode** – (Legend Community Type Code) Map Unit code
    A. Cottonwood/Native (**Cw/N**) - *Populus deltoides*/Native
    B. Cottonwood/Mixed (**Cw/M**) - *Populus deltoides*/Mixed
    C. Cottonwood/Saltcedar (**Cw/Sc**) - *Populus deltoides*/*Tamarix ramosissima*
    D. Siberian Elm/Mixed (**Em/M**) - *Ulmus pumila*/Mixed
    E. Siberian Elm/Russian Olive (**Em/Ro**) - *Ulmus pumila*/*Elaeagnus angustifolia*
    F. Coyote Willow/Cottonwood (**Wi/Cw**) - *Salix exigua*/*Populus deltoides*
    G. Coyote Willow/Native (**Wi/N**) - *Salix exigua*/Native
    H. Coyote Willow/Russian Olive (**Wi/Ro**) - *Salix exigua*/*Elaeagnus angustifolia*
    I. Coyote Willow/Saltcedar (**Wi/Sc**) - *Salix exigua*/*Tamarix ramosissima*
    J. Russian Olive/Coyote Willow (**Ro/Wi**) - *Elaeagnus angustifolia*/*Salix exigua*
    K. Russian olive/Exotic (**Ro/E**) - *Elaeagnus angustifolia*/Exotic
    L. Saltcedar/Coyote Willow (**Sc/Wi**) - *Tamarix ramosissima*/*Salix exigua*
    M. Saltcedar/Mixed (**Sc/M**) - *Tamarix ramosissima*/Mixed
    N. Herbaceous Wetland (**HW**) - Herbaceous Wetland
    O. Herbaceous Mesic (**HM**) - Herbaceous Mesic
    P. Herbaceous Upland (**HU**) - Herbaceous Upland
    Q. Herbaceous - Common Reed (**HC**) - Herbaceous - *Phragmites australis*
    R. Other (**Ot**) - Other
    S. Bare (**Br**) - Bare

29. **LegCtname** – (Legend Community Type Name) Map Unit name
    Names from LegCTcode above

30. **LegCovCode** – (Legend Cover Code) Cover Map Unit code
    A. high/high (**h/h**) - overstory cover high, understory cover high
    B. high/moderate (**h/m**) - overstory cover high, understory cover moderate
    C. high/sparse (**h/s**) - overstory cover high, understory cover sparse
    D. moderate/high (**m/h**) - overstory cover moderate, understory cover high
    E. moderate/moderate (**m/m**) - overstory cover moderate, understory cover moderate
    F. moderate/sparse (**m/s**) - overstory cover moderate, understory cover sparse
    G. sparse/high (**s/h**) - overstory cover sparse, understory cover high
    H. sparse/moderate (**s/m**) - overstory cover sparse, understory cover moderate
    I. sparse/sparse (**s/s**) - overstory cover sparse, understory cover sparse
    J. bare (**b**) - overstory cover bare, understory cover bare
    K. high (**h**) - overstory cover high, understory cover N/A
    L. moderate (**m**) - overstory cover moderate, understory cover N/A
    M. sparse (**s**) - overstory cover sparse, understory cover N/A

31. **LegCovName** – (Legend Cover Name) Cover Map Unit name
    Names from LegCovCode above

Appendix B – 2002 Middle Rio Grande River Bar Vegetation Map Sheets

This appendix consists of an index map and fifteen bar vegetation map sheets for the reach of the Middle Rio Grande mapped in 2002. The index map shows the locations of the bridges and the arrangement of the individual map sheets. The map sheets are arranged from the area immediately north of Alameda bridge south to the I-25 bridge. The maps are at a 1:6,000 scale and are overlayed on a natural-color digital orthophotograph (see Methods). Polygons are color coded according to their map unit, and labeled by cover type (see Tables 1 & 2).

Middle Rio Grande River Bar Vegetation Map 2002 - Map Index

base: 1999 digital orthophotograph

NMNHP

N

4 Kilometers

2 0 2

Central Ave

Alameda Bridge

Paseo del Norte Bridge

Montano Bridge

Barelas Bridge

Rio Bravo Bridge

Central Ave. Bridge

I-40 Bridge

I-25 Bridge

Map 1

Map 2

Map 3

Map 4

Map 5

Map 6

Map 7

Map 8

Map 9

Map 10

Map 11

Map 12

Map 13

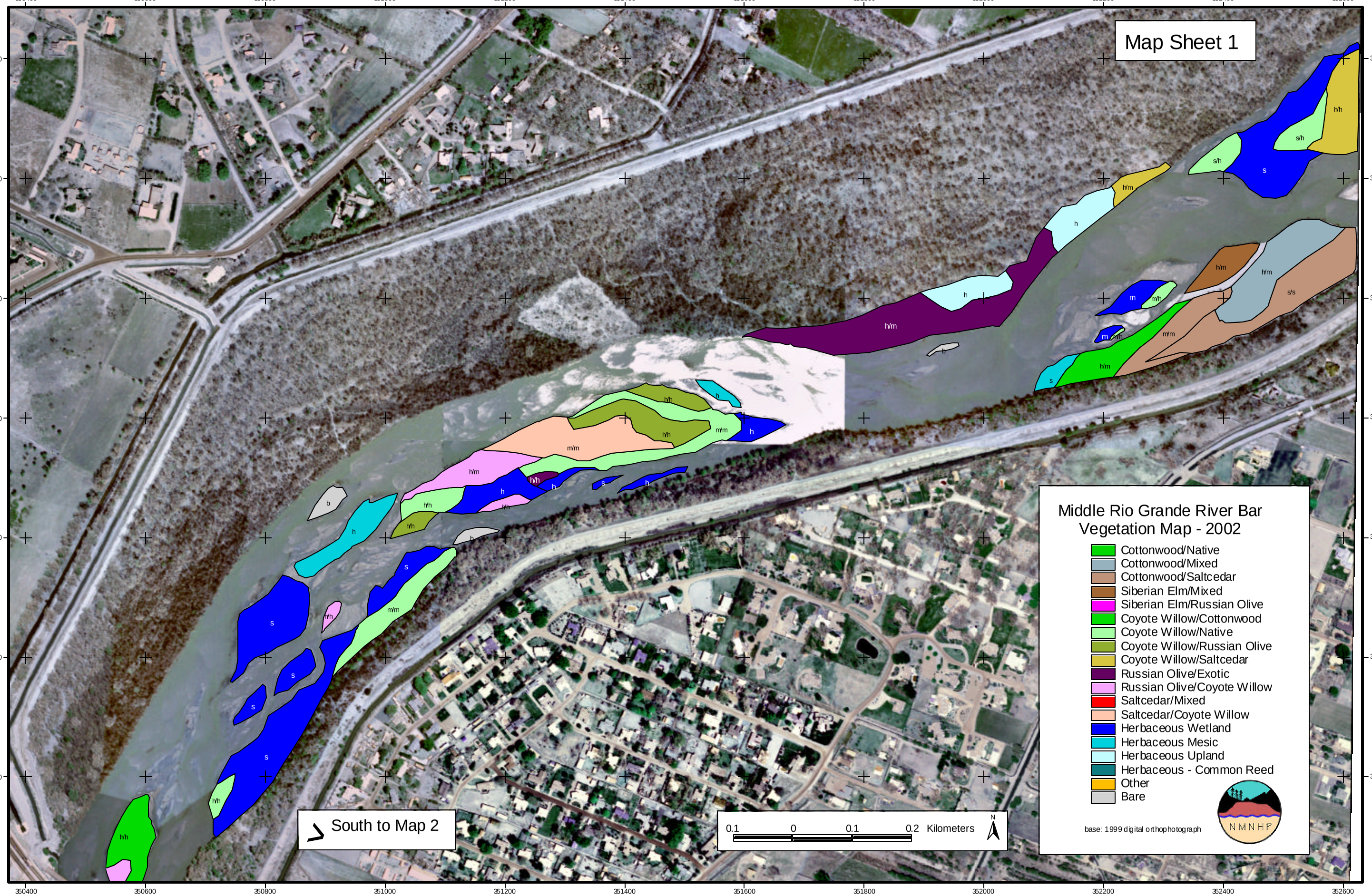
Map 14

Map 15

3896000 3894000 3892000 3890000 3888000 3886000 3884000 3882000 3880000 3878000 3876000 3874000 3872000 3870000

356000 354000 352000 350000 348000 346000 344000 342000 340000

Map Sheet 1

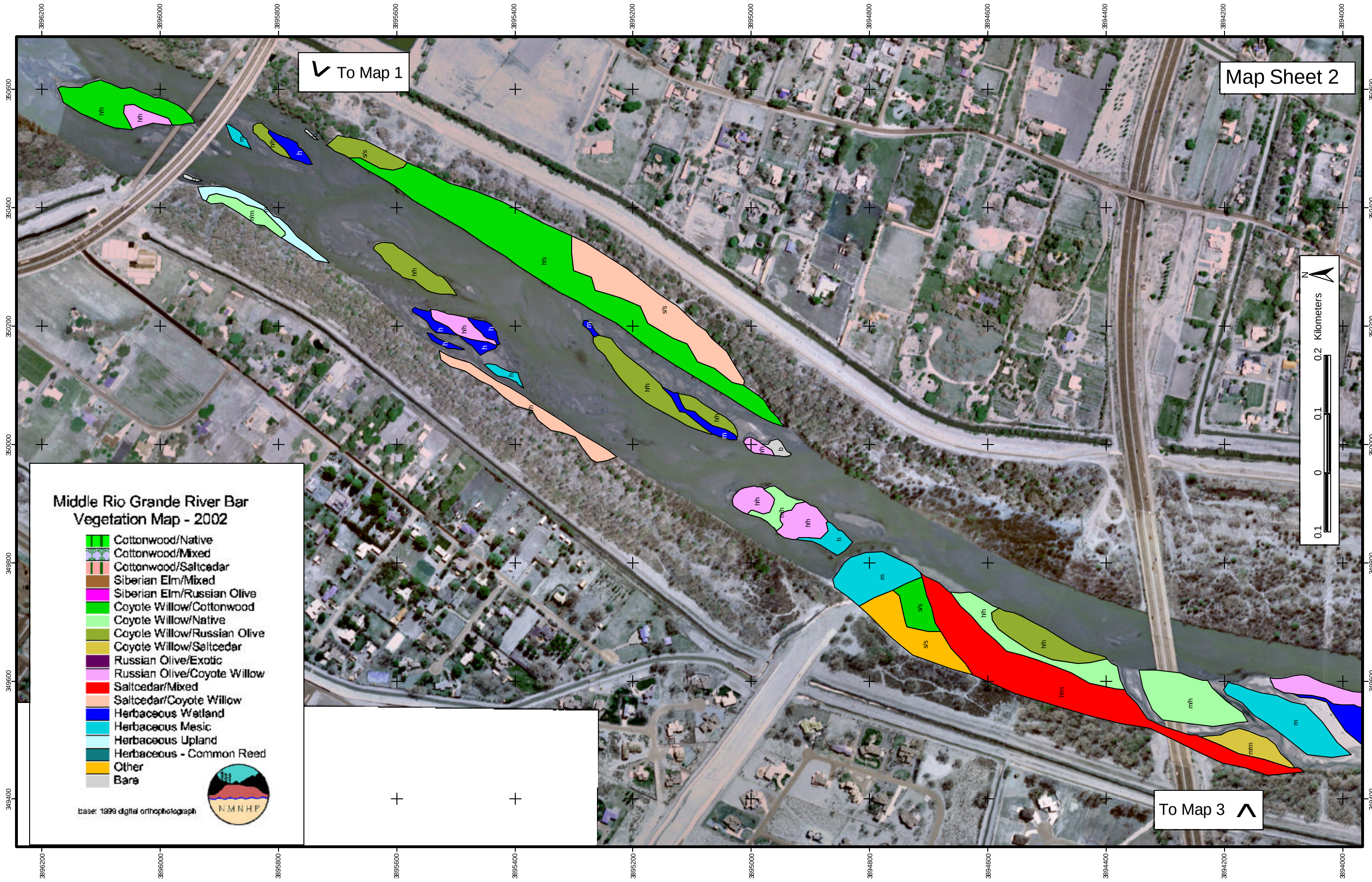


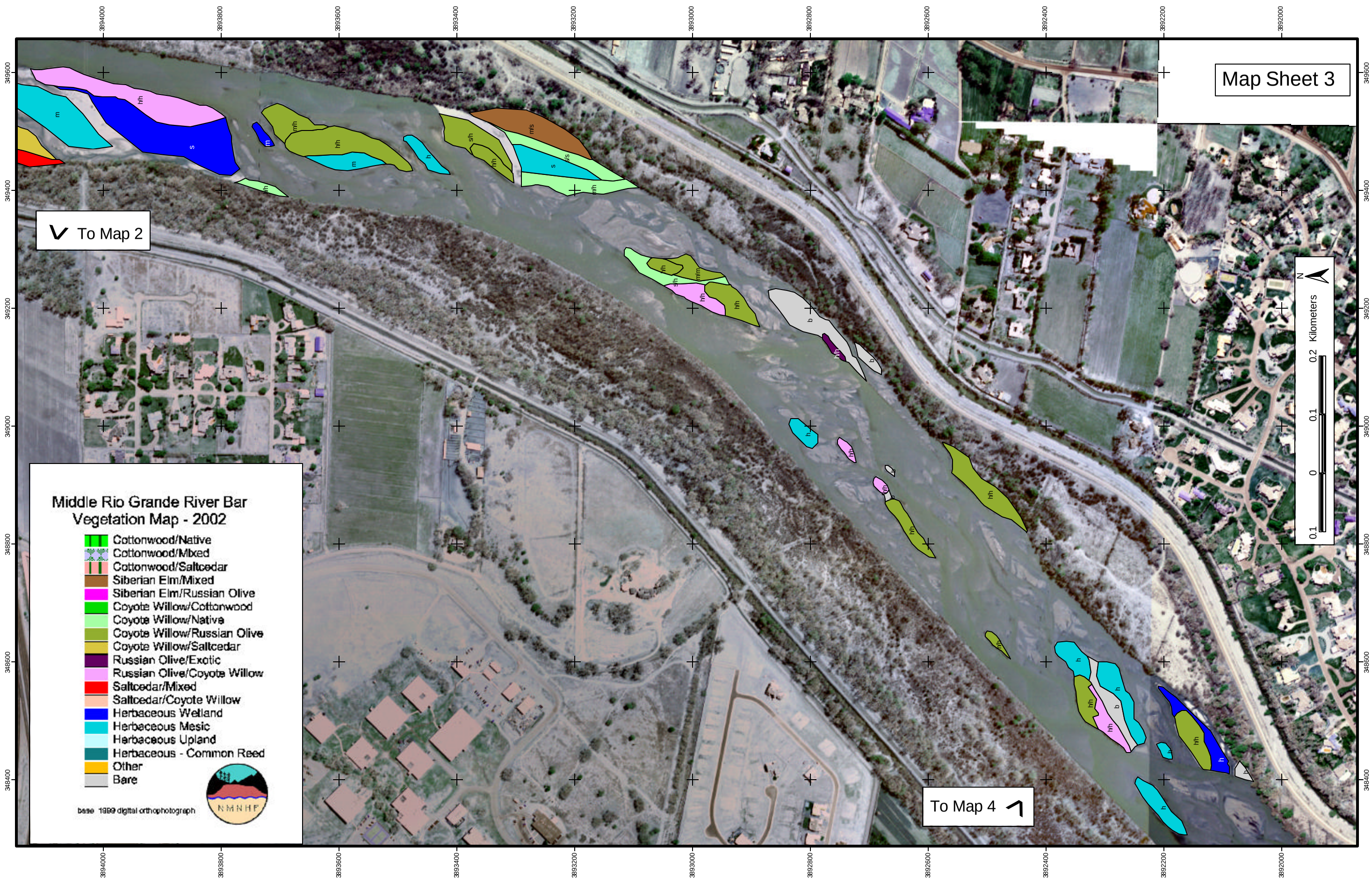
Middle Rio Grande River Bar Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base: 1999 digital orthophotograph

NMNHP


To Map 1
Map Sheet 2
To Map 3
3896200
3896000
3895800
3895600
3895400
3895200
3895000
3894800
3894600
3894400
3894200
3894000
350600
350400
350200
350000
349800
349600
349400
N
0.2 Kilometers
0.1
0
0.1
hh
hm
m
hs
s/s
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base: 1999 digital orthophotograph
NMNHP


Map Sheet 3
To Map 2
To Map 4
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base 1999 digital orthophotograph
NMNHP
N
0 0.1 0 0.2 Kilometers
3894000
3893800
3893600
3893400
3893200
3893000
3892800
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3892400
3892200
3892000
349600
349400
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349000
348800
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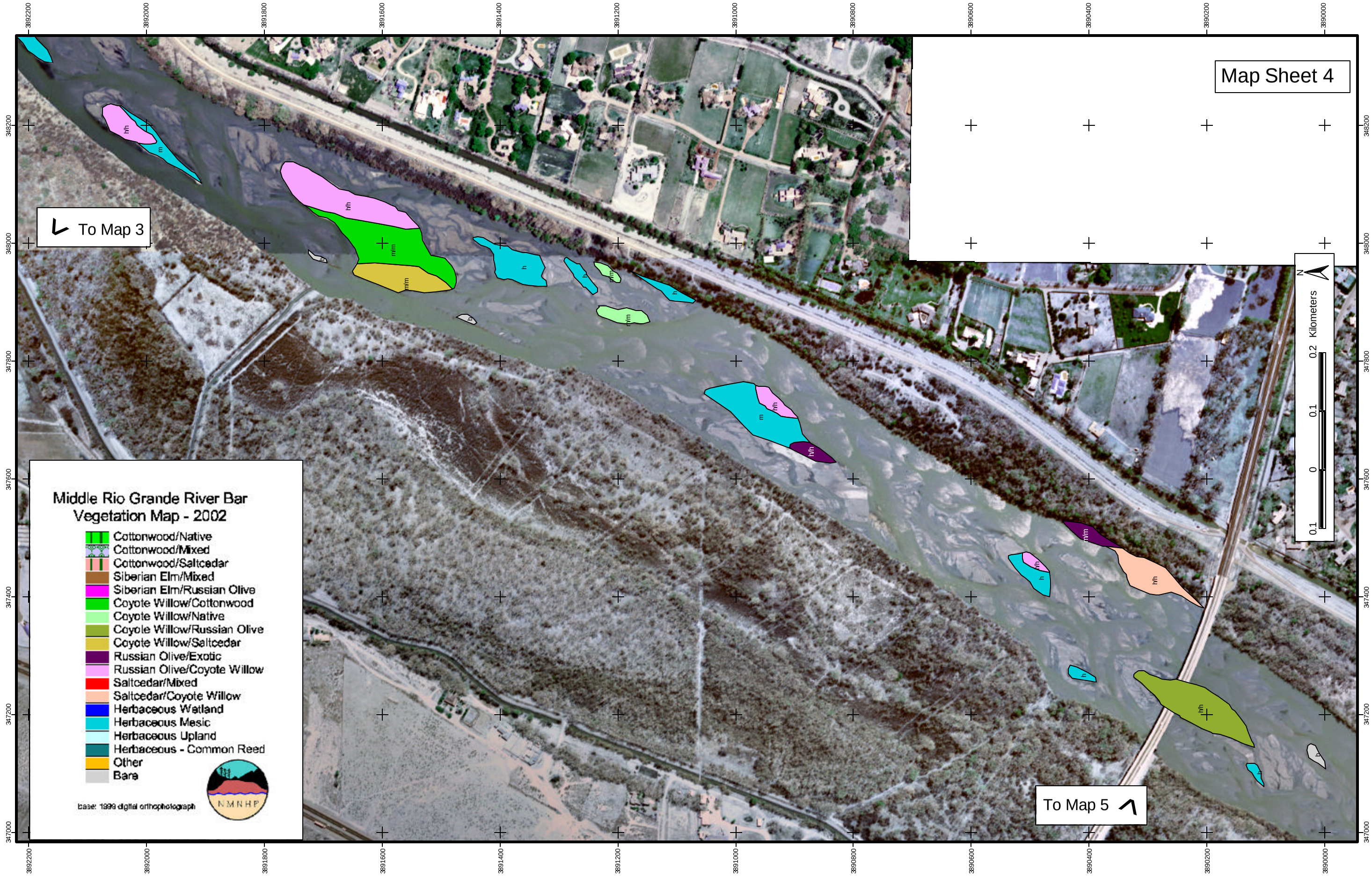
348400


Map Sheet 4
To Map 3
To Map 5
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base: 1999 digital orthophotograph
NMNHP
N
0.2 Kilometers
0.1
0
0.1
3892200
3892000
3891800
3891600
3891400
3891200
3891000
3890800
3890600
3890400
3890200
3890000
348200
348000
347800
347600
347400
347200
347000

Map Sheet 5

To Map 4

To Map 6

Middle Rio Grande River Bar
Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1999 digital orthophotograph

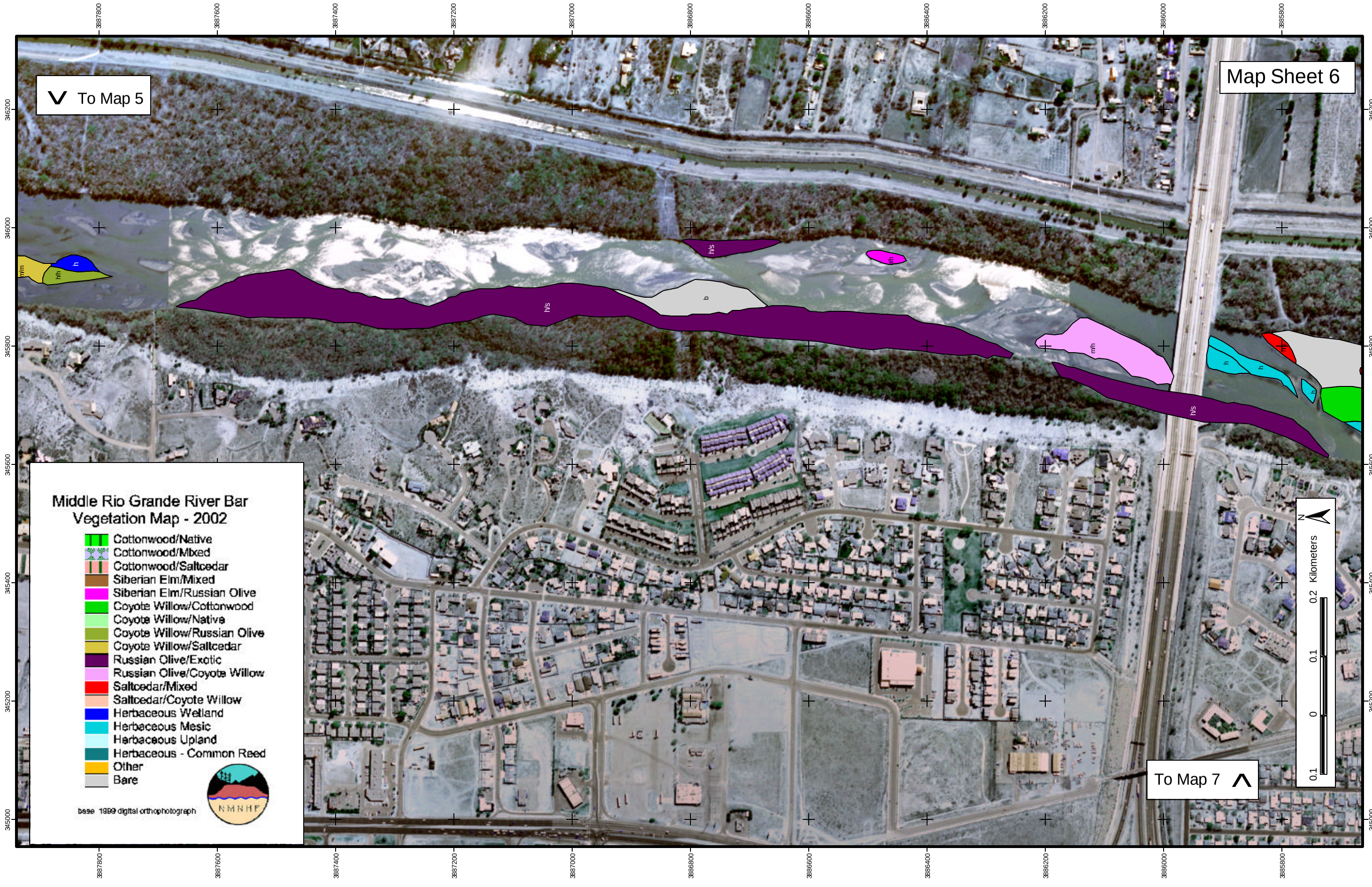
NMNHP

N

0 0.1 0 0.1 0.2 Kilometers

3890000 3889800 3889600 3889400 3889200 3889000 3888800 3888600 3888400 3888200 3888000 3887800

347000 346800 346600 346400 346200 346000 345800


Map Sheet 6
To Map 5
To Map 7
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base 1999 digital orthophotograph
NMNHP
N
0.2 Kilometers
0.1
0
0.1
3887800
3887600
3887400
3887200
3887000
3886800
3886600
3886400
3886200
3886000
3885800
346200
346000
345800
345600
345400
345200
345000

Middle Rio Grande River Bar Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1989 digital orthophotograph

NMNHP

To Map 8

Map Sheet 7

To Map 6

N

0.2 0 0.2 Kilometers

385800 385600 385400 385200 385000 384800 384600 384400 384200 384000 383800

346800 346600 346400 346200 346000 345800 345600

Middle Rio Grande River Bar Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1999 digital orthophotograph

NMNHP

To Map 9

Map Sheet 8

To Map 7

N

0 0.1 0.2 Kilometers

3884200 3884000 3883800 3883600 3883400 3883200 3883000 3882800 3882600 3882400 3882200 3882000

348000 347800 347600 347400 347200 347000 346800

Middle Rio Grande River Bar Vegetation Map - 2002

Map Sheet 9

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base: 1999 digital orthophotograph

NMNHP

To Map 8

To Map 10

N

0 0.1 0.2 Kilometers

3882400 3882200 3882000 3881800 3881600 3881400 3881200 3881000 3880800 3880600 3880400

349200 349000 348800 348600 348400 348200

Map Sheet 10

To Map 9

To Map 11

Middle Rio Grande River Bar
Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1989 digital orthophotograph

NMNHP

N

0 0.1 0.2 Kilometers

3880200 3880000 3879800 3879600 3879400 3879200 3879000 3878800 3878600 3878400 3878200

348800 348600 348400 348200 348000 347800 347600

3878000 3877800 3877600 3877400 3877200 3877000 3876800 3876600 3876400 3876200 3876000

348000 347800 347600 347400 347200 347000 346800

Map Sheet 11

To Map 10

To Map 12

Middle Rio Grande River Bar
Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1999 digital orthophotograph

NMNHP

N

0.1 0 0.1 0.2 Kilometers

3878000 3877800 3877600 3877400 3877200 3877000 3876800 3876600 3876400 3876200 3876000

Map Sheet 12

To Map 11

To Map 13

Middle Rio Grande River Bar
Vegetation Map - 2002

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1989 digital orthophotograph

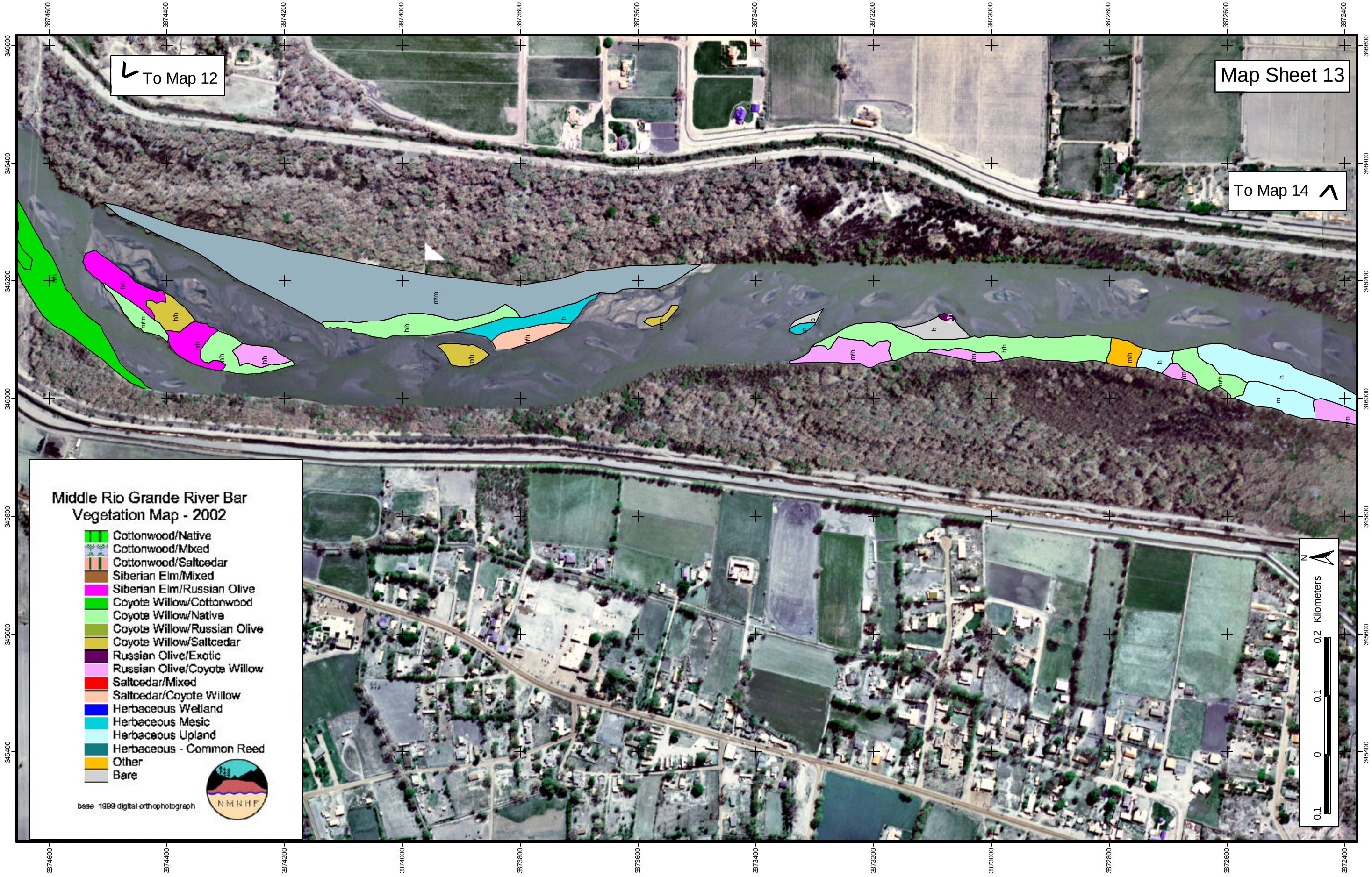
NMNHP

N

0.2 0 0.2 Kilometers

3876200 3876000 3875800 3875600 3875400 3875200 3875000 3874800 3874600 3874400 3874200 3874000

347400 347200 347000 346800 346600 346400 346200


To Map 12
Map Sheet 13
To Map 14
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base 1999 digital orthophotograph
NMNHP
N
Kilometers
0.2
0.1
0
0.1
3874600
3874400
3874200
3874000
3873800
3873600
3873400
3873200
3873000
3872800
3872600
3872400
346600
346400
346200
346000
345800
345600
345400


Map Sheet 14
To Map 13
To Map 15
Middle Rio Grande River Bar
Vegetation Map - 2002
Cottonwood/Native
Cottonwood/Mixed
Cottonwood/Saltcedar
Siberian Elm/Mixed
Siberian Elm/Russian Olive
Coyote Willow/Cottonwood
Coyote Willow/Native
Coyote Willow/Russian Olive
Coyote Willow/Saltcedar
Russian Olive/Exotic
Russian Olive/Coyote Willow
Saltcedar/Mixed
Saltcedar/Coyote Willow
Herbaceous Wetland
Herbaceous Mesic
Herbaceous Upland
Herbaceous - Common Reed
Other
Bare
base 1999 digital orthophotograph
NMNHP
N
0.2 Kilometers
0.1
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0.1
3872600
3872400
3872200
3872000
3871800
3871600
3871400
3871200
3871000
3870800
3870600
3870400
346400
346200
346000
345800
345600
345400
345200

Middle Rio Grande River Bar Vegetation Map - 2002

Map Sheet 15

- Cottonwood/Native
- Cottonwood/Mixed
- Cottonwood/Saltcedar
- Siberian Elm/Mixed
- Siberian Elm/Russian Olive
- Coyote Willow/Cottonwood
- Coyote Willow/Native
- Coyote Willow/Russian Olive
- Coyote Willow/Saltcedar
- Russian Olive/Exotic
- Russian Olive/Coyote Willow
- Saltcedar/Mixed
- Saltcedar/Coyote Willow
- Herbaceous Wetland
- Herbaceous Mesic
- Herbaceous Upland
- Herbaceous - Common Reed
- Other
- Bare

base 1999 digital orthophotograph

NMNHP

To Map 14

N

0.1 0 0.1 0.2 Kilometers

3870600 3870400 3870200 3870000 3869800 3869600 3869400 3869200 3869000 3868800 3868600 3868400

346800 346600 346400 346200 346000 345800 345600