# Ann Price Project 17-24

Pre-treatment Monitoring Report

2019/2020


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Santa Fe – Pojoaque Soil & Water Conservation District

# Contents

# Acronyms and Abbreviations

| Acronym, Abbreviation, or Term | Explanation or Definition as used by NMFWRI |
|---|---|
| BBIRD plots | Breeding Biology Research and Monitoring Database, larger circular plot types |
| BEMP plots | Bosque Ecosystem Monitoring Program, small rectangular plot types |
| FSA | Farm Service Agency, a department of the USDA |
| GIS | Geographic Information Systems |
| GRGWA | Greater Rio Grande Watershed Alliance |
| LIDAR | Light detecting and ranging, a remote sensing technique using light to gather elevation data |
| NAIP | National Agriculture Imagery Program (aerial imagery) |
| NDVI | Normalized Difference Vegetation Index; GIS term for a band ratio of the visible red and the near infrared spectral bands and is calculated using the following formula: (NIR – Red)/(NIR+Red) |
| NHNM | Natural Heritage New Mexico |
| NMDGF | New Mexico Department of Game and Fish |
| NMED SWQB | New Mexico Environment Department Surface Water Quality Bureau |
| NMFWRI | New Mexico Forest and Watershed Restoration Institute |
| NMHU | New Mexico Highlands University |
| NMRAM | New Mexico Rapid Assessment Method, version 2.0 |
| NRCS | Natural Resource Conservation Service |
| PC | Plot center |
| RGIS | Resource Geographic Information System |
| SWCD | Soil and Water Conservation District |
| TIFF | Tagged image file format |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| WQCC | Water Quality Control Commission |
| WSS | Web Soil Survey, a soils database of the NRCS |

# Purpose of Report

This report covers the low-intensity and high-intensity pre-treatment vegetation monitoring assessment performed on a non-native phreatophyte removal project submitted for Ann Price to the Greater Rio Grande Watershed Alliance in 2017, and again in 2019.

# Ann Price Project

This 2.7-acre project was proposed in 2017 and is sponsored by the Santa Fe-Pojoaque Soil and Water Conservation District. According to the 2019 Request for Proposals, the project is an initial treatment of pole-sized and mature Russian olive, salt cedar, and pole- and sapling-sized Siberian elms. Large Siberian elms (over 12 inch DBH) on site which will not be treated, nor will treatment occur on inoperable areas beyond toe of slope of an irrigation dam. The project goal is to restore irrigation water storage, complement nearby GRGWA treatments and restore a unique riparian area. Follow-up by landowner (seeding and noxious weed control) as well as by GRGWA (project maintenance likely via herbicide spray) is planned.

Pre-treatment monitoring was conducted on October 31, 2019 as part of a restoration project. Two monitoring plots were collected on-site during pre-treatment monitoring using the protocols outlined in Appendix IV. Plot coordinates and other project geospatial data can be found in Appendix I.

**2019 New Mexico Forest and Watershed Restoration Institute Personnel Involved in Fieldwork & Data Analysis:**

- Carmen Briones, Monitoring Specialist & Field Supervisor (fieldwork)
- Raymundo Melendez, Monitoring Specialist & Field Supervisor (fieldwork)
- Iman Chudnoff, Monitoring & Data Technician (fieldwork)
- Karlee Rogers, Monitoring & Data Technician (fieldwork)
- Kathryn R Mahan, Ecological Monitoring Specialist (data entry & analysis)
- Louis Rymalowicz, NMHU Intern (data entry)
- Dorian Miranda, NMHU Intern (data entry)

## Site Description

The site is located around 6000 ft elevation. Monitoring plots had an average of 6% slope with north and west aspects. The nearby city of Santa Fe receives an average of 14.21 inches of precipitation per year. The average high temperature is 86° F in July and the average low is 17° F in December and January. (U.S. Climate Data, 2017)

According to the NRCS Web Soil Survey, the project area is 100% Ojito-Koshare-Quarteles complex, 5 to 50 percent slopes. On-plot soil data classes the site as 62.5% Silt Loam, and 37.5% Loam. Rangeland ecological sites within this project include R035XA113NM Sandy, R036XB111NM Sandy Slopes, and R035XG122NM Sandstone Hills (USDA NRCS, 2020).

The Sandy ecological site typically supports plant communities composed of fourwing saltbush, winterfat, and sagebrush at the shrub layer, and at the herbaceous layer, Rocky Mountain beeplant, blue grama, western wheatgrass, threeawns, galleta, dropseed, Indian ricegrass, needle-and-thread, squirreltail, and New Mexico feathergrass. This may also support a shrub-dominated state (dominated by sagebrush, rabbitbrush with a blue-grama/threeawn/dropseed/muhly understory), as well as a juniper-dominated state (with a patchy grass understory of blue grama, dropseeds, galleta, Indian ricegrass and threeawn (USDA NRCS n.d.).

The Sandy Slopes ecological site typically supports a mixed-shrub grassland state dominated by sagebrush, fourwing saltbush, winterfat, rabbitbrush and sagewort in the shrub strata, and blue grama, galleta, dropseed, Indian ricegrass, and threeawn in the herbaceous strata. It can also be found in a piñon-juniper state (up to 15% cover by pinõn-juniper with patchy grass), a shrub state (sagebrush, saltbush and squirretail), and an eroded state (piñon-juniper, annual forbs/grasses, bare ground and reduced soil A-horizon) (USDA NRCS n.d.).

The Sandstone Hills ecological site type is typically a characterized by a mixture of warm and cool season grasses, shrubs, and scattered trees. Grasses include sideoats grama, blue grama, little bluestem, Indian ricegrass, New Mexico feathergrass, galleta, and sometimes black grama. Threeawns and hairy grama can also dominate. Shrubs found in this site type include skunkbrush sumac, oak, mountain mahogany, and winterfat; trees include piñon and juniper.  Piñon and juniper may encroach on this site, facilitated by a loss of grass cover due to water and wind erosion, as well as overgrazing and lack of fire. An eroded state is also possible if these processes continue, in which tree and shrubs dominate and grass is sparse; restoration efforts are difficult at point due to steep slopes, soil degradation and lack of precipitation (USDA NRCS n.d.).

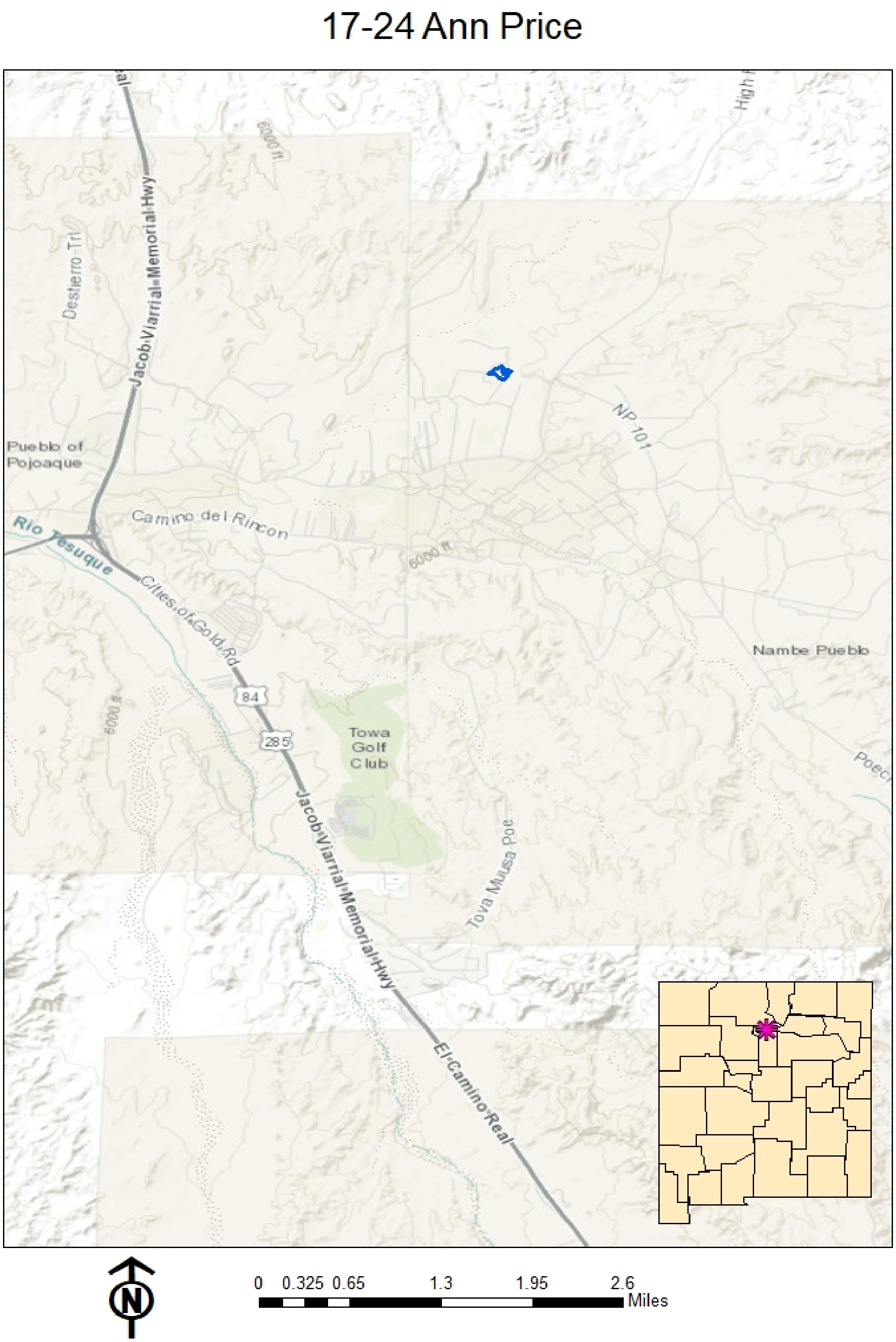


*Figure 1. Project 17-24 in geographic context.*

17-24 AnnPrice

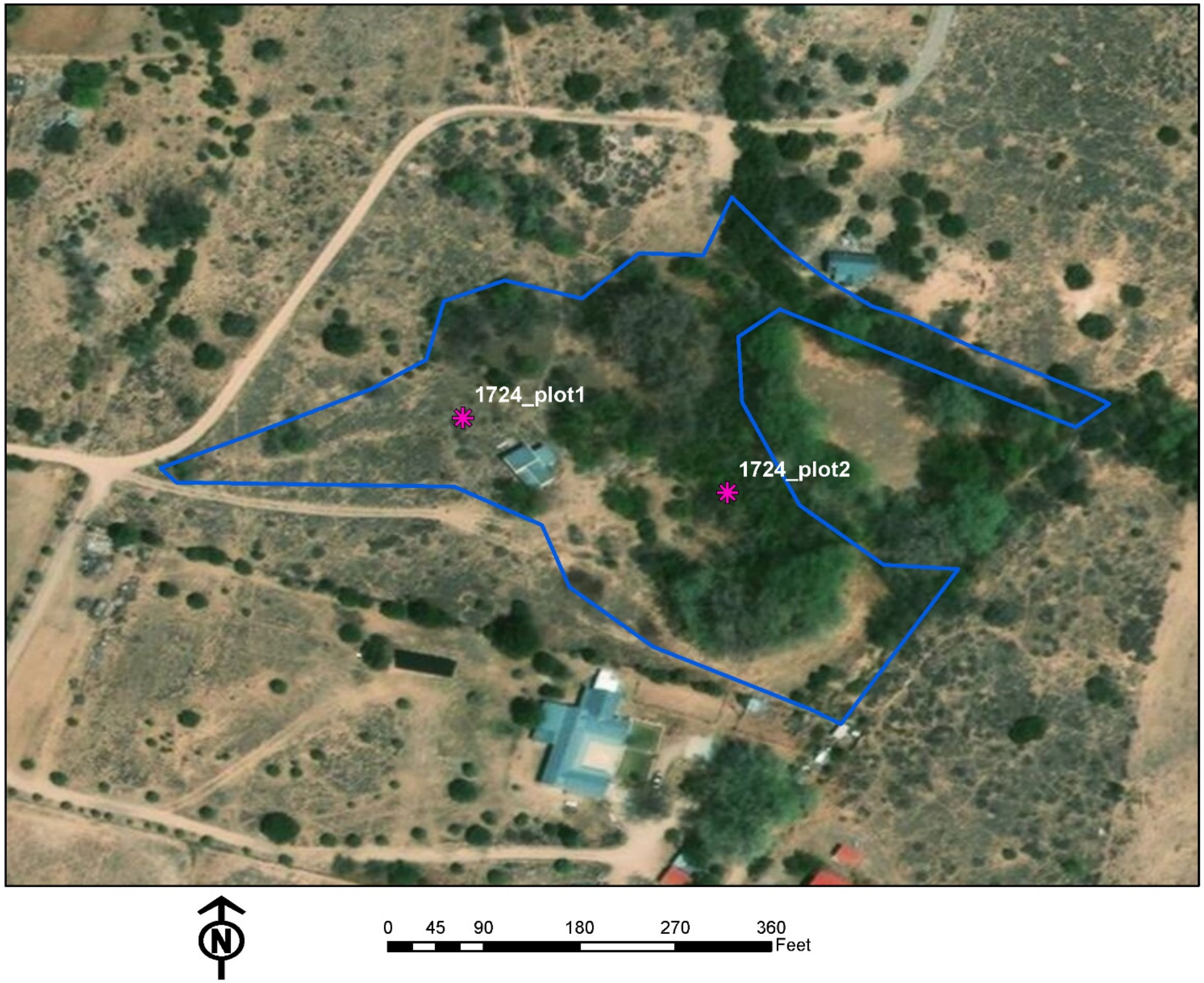


*Figure 2. 17-24 Ann Price project outline.*

## Pre-Treatment Monitoring

### Tree Component

The plots on site were characterized as Hink and Ohmart Type 3 and Type 6 (modified types 1 and 6S). This indicates a vegetative vertical structure of overstory and understory, as well as tall shrubs.

The site had an average of 50% overstory canopy cover collected by densiometer. There were 45 trees (over 5 inches at DBH) per acre. These trees were 84% Siberian elm (30 trees per acre), 14% oneseed juniper (5 trees per acre), and 3% Russian olive (1 tree per acre).  The quadratic mean diameter (QMD) for all trees was 8.2 inches, and average basal area per acre was 17 square feet. Average overall tree height was 34 feet, and average live crown base height was 8.4 feet. There were no recorded snags per acre.

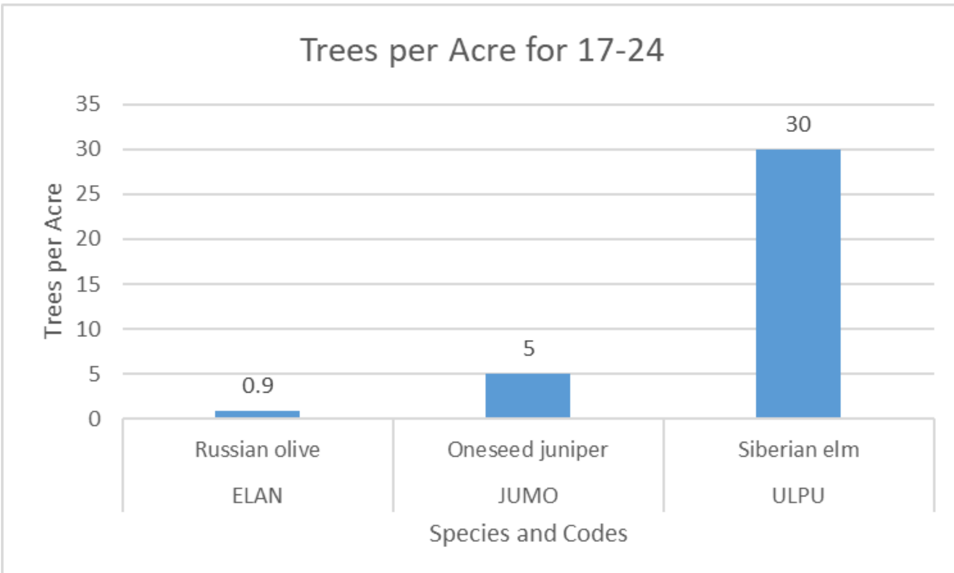


*Figure 3. Trees per Acre.*

Live tree seedlings were recorded at 200 individuals per acre, all of which were Siberian elm (no chart created). No dead tree seedlings were found. Fourwing saltbush, broom snakeweed and prickly pear were recorded as shrubs (detail in chart, below).

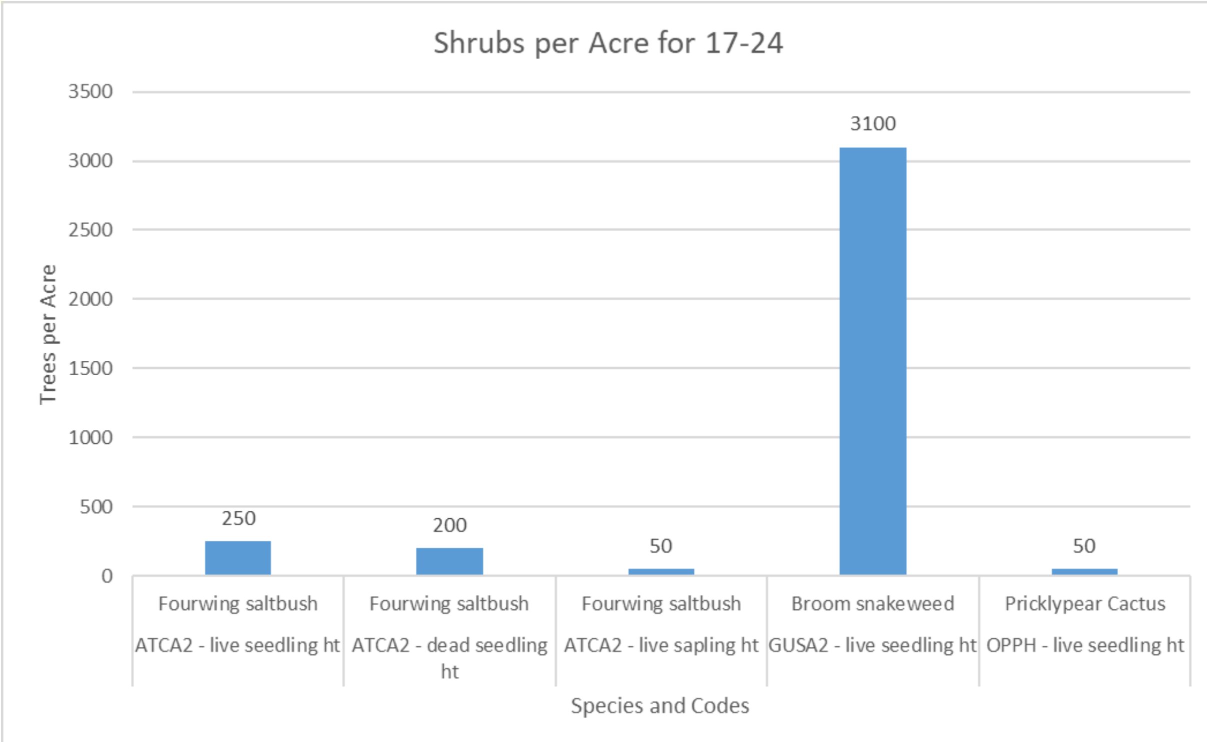


*Figure 4. Shrubs per acre by species for 17-24.*

There were 750 live tree saplings per acre; these were 87% Siberian elm, 7% oneseed juniper, and 7% Russian olive.

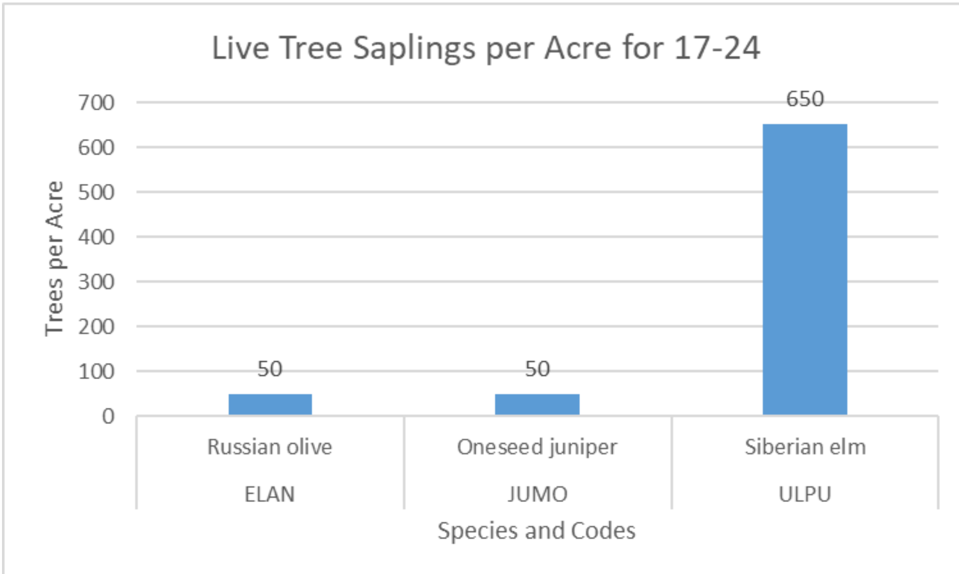


*Figure 5. Live saplings per acre.*

## Understory and Ground Cover

Overall aerial cover by vegetative lifeform averaged 46% tree, 42% shrub, 24% forb/herb, 75% graminoid, and 3.5% cactus. Tree species recorded on plots were oneseed juniper (*Juniperus monosperma)*, Russian olive (*Elaeagnua angustifolia)*, and Siberian elm (*Ulmus pumila*). Shrub species included broom snakeweed (*Gutierrezia sarothrae*), and fourwing saltbush (*Atriplex canescens*). Forb/herb species included two asters (*Aster sp*.), kochia (*Bassia scoparia*), upright prairie coneflower (*Ratibida columnifera*), Russian thistle (*Salsola tragus*), common dandelion (*Taraxacum officinale*), and alfalfa (*Medicago sp.)*. Graminoid species included purple threeawn (*Aristida purpurea*), *squirreltail* (*Elymus elymoides*), Canada wildrye (*Elymus canadensis*), switchgrass (*Panicum virgatum*), sand dropseed (*Sporobolus cryptandrus*), and unidentified grasses. Cactus species included pricklypear (*Opuntia phaeacantha*).

| Aerial cover for entire 1/10th acre plot | | | | | |
|---|---|---|---|---|---|
| **Tree** | **Shrub** | **Forb/Herb** | **Gramanoid** | **Cactus** | **Other (bryophyte, saprophyte)** |
| 46% | 42% | 24% | 75% | 3.5% | 0.0% |

Ground cover on plots was an average of 45% plant basal cover, 29% litter, 13% bole, 13% bare soil, and 1% gravel.

| Ground cover for entire 1/10th acre plot | | | | | | |
|---|---|---|---|---|---|---|
| **Plant Basal** | **Bole** | **Litter** | **Bare Soil** | **Rock** | **Gravel** | **Water/ Wet Soil** |
| 45% | 13% | 29% | 13% | 0.0% | 1.0% | 0.0% |

## Surface Fuels

Surface fuels on site averaged 0.34 tons of total wood fuels per acre, and a fuelbed depth of 1.25 inches.

| 17-24 Pre-Treatment | |
|---|---|
| **Fuel** | **Tons/Ac** |
| 1-Hour | 0.09 |
| 10-Hour | 0.15 |
| 100-Hour | 0.1 |
| 1000-Hour | 0 |
| Duff | 1.56 |
| Litter | 5.46 |
| TOTAL FINE WOOD FUELS | 0.34 |
| TOTAL WOOD FUELS | 0.34 |
| TOTAL SURFACE FUELS | 7.36 |
| | |
| **Fuelbed Component** | **Depth (inches)** |
| Duff | 0.16 |
| Litter | 1.09 |

## Comments and field crew observations

Site has an acequia with cottonwoods and invasives but also areas without trees that are grassy and shrubby. There is cryptobiotic soil and houses and telephone poles visible.

## Conclusions & Plans going forward

The same plots should be re-measured five years post-treatment to monitor the success of treatment in effecting long-term change. It is our intention and expectation that the data collected in these intervals will reflect any significant changes in disturbance and ecological function of the site. The water on site will likely support heavy re-sprouts, and treatment maintenance will be key.

## Personnel Involved

**2019 New Mexico Forest and Watershed Restoration Institute Personnel:**

- Carmen Briones, Monitoring Specialist & Field Supervisor (fieldwork)
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- Kathryn R Mahan, Ecological Monitoring Specialist (data entry & analysis)
- Louis Rymalowicz, NMHU Intern (data entry)
- Dorian Miranda, NMHU Intern (data entry)
- Joe Zebrowski, GRGWA Technical Committee Chair (technical support)
- Patti Dappen, GIS Specialist (technical support)

**Other persons contacted:**

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Alfredo Roybal, Local Landowner

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# Appendix I – Photopoint and Plot Coordinate Table

| Name | Latitude | Longitude |
|---|---|---|
| **17.24_1_NESW** | 35.90753171 | -105.98159643 |
| **17.24_2_NESW** | 35.90753171 | -105.98095026 |

## Appendix II – Photos


Ann Price
17.24_1_N

Ann Price
17.24_1_E



Ann Price
17.24_1_S

Ann price
17.24_1_W



Ann Price 17.24_1_BR_356°
taken 75’ from Plot Center
looking toward Plot Center

Ann Price 17.24_1_BR_138°
taken 75’ from Plot Center
looking toward Plot Center


Ann Price 17.24_1_C taken 75’ North from Plot Center looking toward Plot Center

Ann Price 17.24_2_N


Ann Price 17.24_2_E

Ann Price
17.24_2_S



Ann price
17.24_2_W

Ann Price 17.24_2_BR_250°
taken 75’ from Plot Center
looking toward Plot Center


Ann price 17.24_2_BR_110°
taken 75’ from Plot Center
looking toward Plot Center

Ann Piece 17.24_2_C taken
75’ North from Plot Center
looking toward Plot Center

## Appendix III – Ecological Context of Bosque Restoration

Neither the challenges nor the importance of working in the bosque and other riparian areas in New Mexico today should be underestimated. According to the New Mexico Department of Game and Fish Conservation Division, wetlands and riparian areas comprise approximately 0.6 percent of all land in New Mexico (2012). Despite this small percentage, estimates of New Mexican vertebrate species depending on wetland and riparian habitat for their survival ranges from 55% (New Mexico Department of Game and Fish Conservation Services Division, 2012) to 80% (Audubon New Mexico, 2013). These areas also provide flood mitigation, filtration of sediment and pollutants, and water for a variety of purposes including groundwater recharge (Audubon New Mexico, 2013). In addition, native vegetation such as cottonwoods have cultural significance to many communities.

As much as these areas are disproportionately important to ecosystems and human communities, they are equally disproportionately impacted by disturbance. Anthropogenic impacts with major consequences for our riparian areas include dams, reservoirs, levees, channelization, acequias and ditches, jetty jacks, riprap and Gabion baskets, urbanization, removal of native phreatophytes, grazing by domestic livestock, excessive grazing pressure by native ungulate populations absent natural predation cycles, beaver removal, logging, mining, recreation, transportation, introduction and spread of invasive exotic species, groundwater extraction, altered fire and flood regimes drought and climate change (Committee on Riparian Zone Functioning and Strategies for Management, et al., 2002). Statewide, it is estimated that as much as 90% of New Mexico’s historical riparian areas have been lost (Audubon New Mexico, 2013), and approximately 39% of our remaining perennial stream miles are impaired (New Mexico Department of Game and Fish Conservation Services Division, 2012).

New Mexico *is* fortunate enough to have the Middle Rio Grande Bosque, the largest remaining bosque in the Southwest (USDA USFS, 1996). However, over the past two decades, the number of fires in the bosque has been increasing. Historically, the primary disturbance regime in the bosque has been flooding, not fire, which means the system is not fire-adapted. In fact, native species like cottonwood resprout from their roots after floods and need wet soils to germinate from seed. Flooding also promotes decomposition of organic material and keeps the soil moist which reduces the likelihood of fire. Today, overbank flow is uncommon in many areas of the Rio Grande due to the heavy alteration of the channel and flow regimes (two obvious examples are the structures defining the upper and lower extent of the Middle Rio Grande: Cochiti Dam and Elephant Butte Reservoir). This has led to low fuel moisture content and high fuel loads, as well as increased human presence in the riparian area. As a result, bosque fires are more common and more severe: they kill cottonwoods and other native species, creating spaces which are filled by non-native species such as salt cedar, Russian olive, Siberian elm, and Tree-of-Heaven. We are constantly learning more about how these species can exploit and encourage a riparian fire regime, in addition to many other changes they bring to ecosystems.

Efforts geared toward the removal of these nonnative species can help to reduce fire risk, preserve native vegetation, and be part of a larger effort to restore the bosque and the watershed as a whole to a more natural and functional ecosystem. The Greater Rio Grande Watershed Alliance (GRGWA) has been working on these issues with a variety of collaborating organizations and agencies within the Rio Grande basin for several years. Since 2013, the New Mexico Forest and Watershed Restoration Institute (NMFWRI) has been working with GRGWA and the Claunch-Pinto Soil and Water Conservation District (SWCD) to begin construction of a geodatabase for all of GRGWA’s non-native phreatophyte removal projects as well as to perform the formal pre- and post-treatment monitoring, utilizing the field methods explained below as well as LIDAR analysis where appropriate and available.

# Appendix IV - Monitoring and Field Methods

## NMFWRI Riparian CSE-Based Plot Sample Protocols

These monitoring protocols were instituted in 2019 as standard for all GRGWA projects. These are based on the 2011 Guidelines and Protocols for Monitoring Riparian Forest Restoration Projects (Bonfantine, et al.) and the Common Stand Exam-based protocols used by NMFWRI for CFRP projects. For questions or comments, contact Kathryn R Mahan, Ecological Monitoring Specialist, NMFWRI.

### *Crews, Navigation & Plot Setup*

Plots are most efficiently accomplished with a **3-person crew** but can also be taken with 2 people. More detailed plots, presented here as options, are most efficient with a 4- to 5-person crew. All crews need basic knowledge of monitoring methods and rationale, equipment, plant species and common tree pests and diseases.

Plots are established using a random point location with project-specific boundaries e.g. stand boundaries, treatment areas, vegetation types, etc. In our office, maps and plot locations are generated with ArcGIS utilities and are loaded onto a Trimble and Garmin GPS units. **The sampling density scheme** for GRGWA projects is as follows:

Projects under 21 acres – 2 plots
21-50 – 1 plot per 10 acres
For projects 51+ acres:
51-70 ac --- 5 plots
71-90 ac --- 6 plots
91-110 ac --- 7 plots
111-200 ac --- 8-9 plots
201-400 ac --- 10 plots
400+ ac – discuss alternate sampling methods (e.g. LiDAR)

The plot minimum spacing is 300 ft on most projects, or 200 or 100 ft on projects where a 300 ft spacing will not allow the prescribed number of plots to fit within boundaries. Plots must be a minimum of 50 ft from project boundary. Plots will be moved in a random direction towards the inside of project if plot lands less than 50 ft of boundary using "Create Random Points" in ArcMap. **Note that within this framework, flexibility exists to add plots as needed to capture site diversity.**

Unit maps, driving maps and driving directions are created and sent with the field crew. Once in the project area, **navigation** to a plot is typically accomplished through paper maps and the Garmin GPS units. Paper maps can be easily marked with Sharpies to indicate sequence of plot collection, dates, and teams at work; this information can be stored with the datasheets and may help answer questions that arise later. We use Garmin GPS units because they are user-friendly and can run on AA batteries which are easily replaced in the field. We use the Trimble unit to more accurately determine plot location and collect updated plot location coordinates which can later be post-processed for greater location accuracy with GPS Pathfinder Software. Plots must be moved one chain (66 ft) at a random azimuth from their original, intended location if they are within 75 feet of a road.

A marker (we typically use a 1-foot piece of ½ inch rebar with a mushroom cap) is installed at plot center if the landowner/manager gives permission. Markers should be low to the ground and well flagged so that they are obvious to managers and treatment contractors. Where plots are being re-visited, a good metal detector may be of use to locate the center stake. Copies of the previous plot photos can also be useful.

Plots are set up using 8 pin flags in addition to the center stake. Crew members walk cardinal azimuths (N, E, S, W) from plot center and place pin flags at **11.78ft (11' 9") and 37.24ft (37' 3")** to give visual aids for the two plots (1/10$^{th}$ ac and 1/100$^{th}$ ac) whose purposes are described below.

### *Photographs, Witness Trees & Other Plot data*

Eight **photographs** are taken per plot. If more than the two standard Brown's transect is collected, additional photographs are taken in the same format. Typically, a white board with marker is used to tag each photo. The first photo taken at each plot is of the white board on the ground at plot center ("PC"). This ensures the data technicians are able to read the plot name and number and correctly identify the photos that follow. It is helpful if the camera used can record GPS coordinates.
Additional photos include:

- "C," taken from 75 feet along the North azimuth looking at a crew member holding the white board at plot center
- Brown's transect photo, "B_*degrees*" taken from the 75-foot mark of each fuels azimuth looking towards a crew member holding the white board at plot center
- "N," "E," "S," and "W" photos taken from plot center facing a crew member holding the white board 37.2' at each of the four cardinal azimuth flags. Additional photographs may be taken, but we recommend these be taken after the mandatory eight plot photos, and noted on the data sheets, so that there is no confusion for the data technicians.

All plot photos except "PC" and Brown's transect photos need to be documented in the **Photopoint Log**. The Photopoint Log provides places to document landmarks and other information about each photograph to make re-takes simpler.

**Photo order, hill slope, dominant aspect, coordinates, elevation, date**, and **time** are recorded for each plot. **Comment fields** are available on all datasheets and we encourage all observations, including species, land use impacts, fire history, challenges in taking plot, etc. to be documented here.

A **witness tree** or trees should be near plot center to assist with finding plot center and ideally should be expected to survive any future thinning, fire, or other disturbance. For example, mature yellow-bark pines near plot center are easy to find and not likely to be thinned. Any healthy tree will work. The tree should be flagged, noted in the overstory data, and described on the Plot Description datasheet.

### *Overstory*

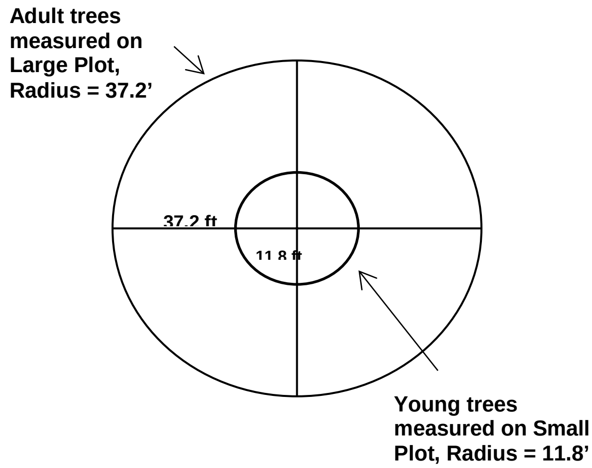
All **trees and snags** are measured within the 1/10$^{th}$ acre plot (37.24 ft. radius) circular, fixed area sample plot. We typically define a tree as ≥ 4.5 ft. and > 5 in DBH or DRC, although other cutoffs may be used depending on objectives. Species, condition, DBH or DRC, number of stems, total height, and live crown base height are recorded for each tree located within the plot. Most trees are measured at DBH with exception of *Quercus* spp., *Juniperus* spp. or *Pinus edulis* species with more than two stems at DBH. Be aware that other trees/large shrubs with multiple stems, such as saltcedar, Russian olive, mountain mahogany or chokecherry, cannot be processed if they are measured at DRC since their conversion formulas are unavailable. Depending upon the project, other information may be collected including damage and severity, scorch height, snag decay class, crown ratio, and crown class. Trees are recorded starting from the north azimuth line and moving clockwise, like spokes of a wheel from plot center. In dense stands, we find it helpful to flag the first tree measured to keep the crew oriented. If appropriate, this first tree may also serve as the **witness tree**. Do not forget to flag and record your witness tree.

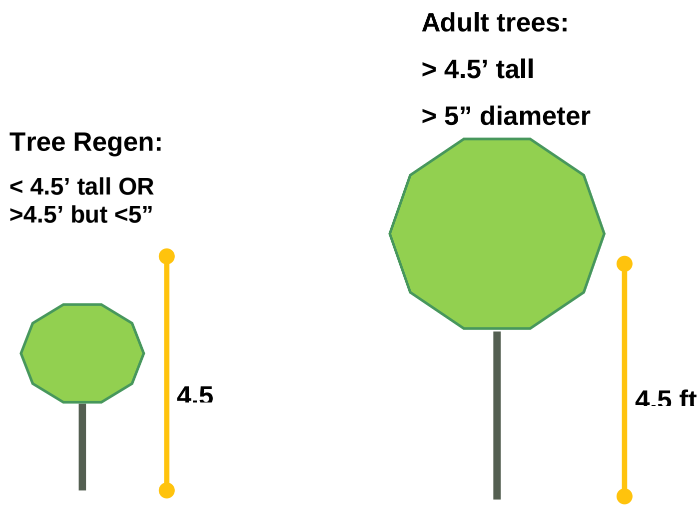
**Tree regeneration** is measured on the nested 1/100$^{th}$ acre circular plot (11.78 ft. radius) and species, condition, and height class (>0-0.5 ft; >0.5-1.5ft; >1.5-2.5ft; >2.5-3.5ft.; >3.5-4.5ft) are recorded for each **seedling** or sprout. **Saplings** (>4.5ft but <1.0in DBH/DRC) are also recorded in this way. **Shrubs** are measured on the same nested subplot and species, condition and height/diameter class are recorded for each stem just as with tree species; we typically record cacti in this category as well. Other cutoffs may be used for height and diameter classes depending upon objectives.

Trees and shrubs are typically recorded using their **USDA PLANTS code**, which is commonly a four letter code defined by the first two letters of the genus and first two letters of the species name (e.g. PIPO, ABCO, PIFL, PIED, JUDE, JUSC, QUGA, etc). Note that upon entry into a database, it is common for these codes to be followed by various numbers in order to differentiate between other species whose names would create the same code. These symbols can be found on the USDA PLANTS website, https://plants.usda.gov/

**Canopy cover** (density) is an average of four measurements from a spherical densiometer. These four measurements are taken facing out at the four small-plot pin flags along the perimeter of the nested subplot. In this way, each reading is spaced 90 degrees apart. Each of the four measurement is recorded separately on the datasheet. The crew should be sure to count dots, not squares, and always record the area covered, not open.

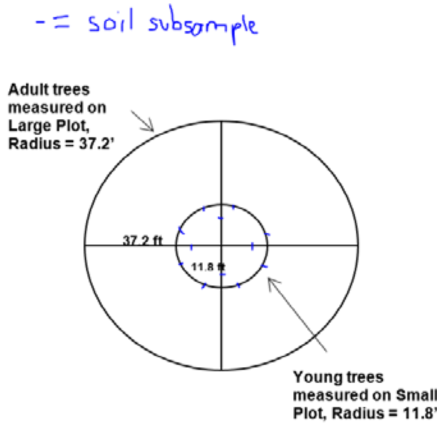
**Vegetative Community Structure** type is a classification system developed by Hink and Ohmart to describe patterns of vegetation specifically along the Middle Rio Grande. The **"original" Hink and Ohmart** scheme uses vegetation height and presence of understory vegetation to assign a structure type between 1 and 6. In addition, the New Mexico Environment Department developed a **"modified" Hink and Ohmart** system that assigns a value of 1, 2, 5, 6S, 6W, 6H or 7. We recommend the field crews take copies of the keys for both original and modified schemes and apply them to the entire 1/10$^{th}$ acre plot.


Adult trees
measured on
Large Plot,
Radius = 37.2’
37.2 ft
11.8 ft
Young trees
measured on Small
Plot, Radius = 11.8’


Adult trees:
> 4.5’ tall
> 5” diameter
Tree Regen:
< 4.5’ tall OR
>4.5’ but <5”
4.5
4.5 ft

*Soils*

At this time, **soil texture** is collected in four locations. At each of the four 1/100th acre cardinal direction flags, collect 3 subsamples of soil using a shovel or soil corer to a depth of 6 inches. Standing over the flag as if taking canopy cover, i.e. facing away from plot center in the cardinal direction of the flag, you will collect soil subsamples 2 feet to the left, right and immediately behind you as illustrated below.



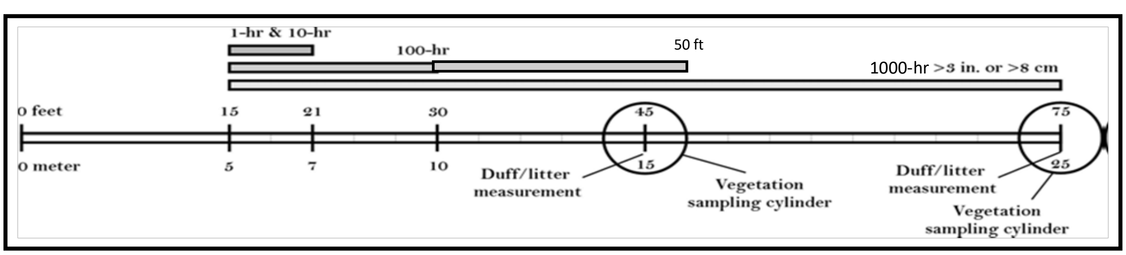

Combine each set of three subsamples into one sample by mixing thoroughly in a bag or tub. Remove any large organic debris such as plants or wood chips. Follow the soil texture flow chart to determine soil texture for each combined sample at each measurement point. Record this on the datasheet for a total of four soil textures per plot. Return soil to all holes when sampling is complete.

*Fuels (Brown's)*

**Dead woody biomass** and forest floor depth are measured using two planar Brown's transects. These are at random azimuths. To select a random azimuth, one crew member spins a compass and another decides when to stop. Typically in our protocol, a fiberglass tape is run from the plot center stake out 75 feet and fuels are measured from 15 to 75 feet to account for the expected foot traffic disturbance around plot center. Parameters measured include **1, 10, 100, and 1,000 hour fuels** ("time-lag fuels"). See diagram below for standard lengths of various transects.

For full protocol details, see Brown 1974 and subsequent guidelines or the NMFWRI training manual. Quick reminders: Note that in our protocol, a piece of coarse woody debris (CWD) must be >3" in diameter and at least 3 feet long to count as a 1000-hour fuel; if it is >3" in diameter, but under 3 feet long, we count it as a 100-hour fuel. Decay class (1 to 5) and sometimes length is collected for each 1000-hour fuel. The comment field on the datasheets is often used to record species and how the log came to be on the ground, when discernable. The sampling plane goes up to 6 ft above the transect. Rooted vegetation does not count unless it has a lean over 45 degrees.

Litter and duff depth measurements are taken at 45 feet and 75 feet on each transect.



### *Understory Cover*

Vegetation and ground cover are estimated across the entire 1/10th acre plot. Vegetation measurements include **aerial percent cover** of seedling/saplings, shrubs (including cacti), graminoids, and forbs, and may not necessarily total 100%. Aerial percent should be further stratified by individual species greater than 1% cover. USDA PLANTS codes are preferred. The status of each group of vegetation (live, dead, sick) as well as the nativity (Native, Exotic, Both, or Unknown) should be recorded. Any unknown plants should described in comments, photographed (after plot photos!) and samples collected in a field press for subsequent identification. We strongly recommend the inclusion of sticky notes with each pressed sample describing the collection location and conditions, including the plot.

**Ground cover measurements** include percent cover of plant basal area (including cacti), boles, litter, bare soil, rock, gravel, and water/wet soil and must total 100%.

### *Data processing and reporting*

At this time, we use **FFI software**, as well as Excel spreadsheets, to enter and analyze our data. FFI is able to export to FVS and FuelCalc. FFI software and User Guides are available for download here: https://www.frames.gov/partner-sites/ffi/software-and-manuals/

In order to process individual piñons, junipers and oaks with more than 2 stems or whose branch structure made access difficult and were therefore measured at root collar (DRC) instead of breast height (DBH), we use the **equations developed by Chojnacky and Roger** (1999).

All our results are typically reported to two significant digits, with exceptions for those metrics we know were measured with either more or less precision.

**Sample reports** can be found on our website: http://nmfwri.org/resources/restoration-information/cfrp/cfrp-long-term-monitoring/cfrp-long-term-monitoring

And

https://www.nmfwri.org/collaboration/greater-rio-grande-watershed-alliance

## Appendix V - Modified Hink and Ohmart categories, from NMRAM

*The following is pages 39-41 in Muldavin et al.'s 2014 NMRAM for Montane Riverine Wetlands v 2.0 Manual (draft, not yet published)*

# Vegetation Vertical Structure Type Definitions for NMRAM

Multiple-Story Communities (Woodlands/Forests)

**Type 1 – High Structure Forest with a well-developed understory.**

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon)and understory layer (0-5 m [0-15 feet]) covering >25% of the area of the community (polygon). Substantial foliage is in all height layers. (This type incorporates Hink and Ohmart structure types 1 and 3.) Photograph on Gila River by Y. Chauvin, 2012.

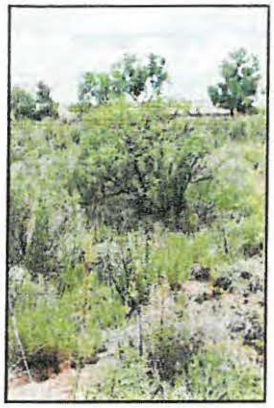
**Type 2 - Low Structure Forest with little or no understory.**

Tall mature to intermediate-aged trees (>5 m [>15 feet]) with canopy covering >25% of the area of the community (polygon) and understory layer (1-5 m [3-15 feet]) covering <25% of the area of the community (polygon). Majority of foliage is over 5 m (15 feet) above the ground. (This type incorporates Hink and Ohmart structure types 2 and 4.) Photograph on Diamond Creek by Y. Chauvin, 2012.

Single-story Communities (Shrublands, Herbaceous and Bare Ground)

**Type 5 - Tall Shrub Stands.**

Young tree and shrub layer only (15-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

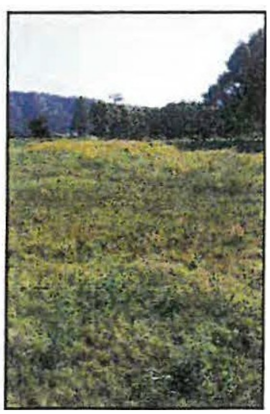


**Type 6S-Short Shrub Stands.**

Short stature shrubs or very young shrubs and trees (up to 1.5 m [up to 4.5 feet]) covering >10% of the area of the community (polygon). Stands dominated by short woody vegetation, may include herbaceous vegetation underneath the woody vegetation. Photograph on Lower Pecos River by E. Lindahl, 2008.

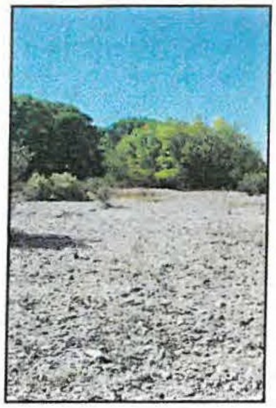
**Type 6W-Herbaceous Wetland.**

Herbaceous wetland vegetation covering >10% of the area of the community (polygon). Stands dominated by obligate wetland herbaceous species. Woody species absent, or <10% cover. Photograph of *Carex nebrascensis* meadow on upper Rio Santa Barbara by Y. Chauvin, 2009.



**Type 6H-Herbaceous.**

Herbaceous vegetation covering >10% of the area of the community (polygon). Stands dominated by herbaceous vegetation of any type except obligate wetland species. Woody species absent or <10% cover. Photograph on Diamond Creek by Y. Chauvin, 2012.



**Type 7–Sparse Vegetation/Bare Ground.**

Bare ground, may include sparse woody or herbaceous vegetation, but total vegetation cover <10%. May be natural in origin (cobble bars) or anthropogenic in origin (graded or plowed earth) Photograph on Lower Gila River by Y. Chauvin, 2012.