Seboyeta Project 17-13a,b,c

Pre-treatment Monitoring Report

2019-2020

Prepared by
Kathryn R Mahan, Ecological Monitoring Specialist
New Mexico Forest and Watershed Restoration Institute
for the Greater Rio Grande Watershed Alliance

New Mexico Forest and Watershed Restoration Institute

conserving natural resources for our future

Lava 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 3 areas in Seboyeta (a, b, and c) to the Greater Rio Grande Watershed Alliance in 2017 and again in 2019.

Seboyeta 17-13a,b,c Project

The project was proposed in 2017 and is sponsored by the Lava Soil and Water Conservation District. According to the 2019 Request for Proposals, these three related project units are initial treatments. 17-13a Seboyeta Creek Upper Portion was proposed at 5.8 acres, 17-13b Seboyeta Creek was proposed at 65.9 acres, and 17-13c Seboyeta Creek – Michaels was proposed at 113 acres. The projects are in narrow and rocky drainages along the Seboyeta and Bibo Creek drainages. The project has mature and pole-sized salt cedar, Russian olives, and Siberian elms; large Siberian elms will not be treated. The project is accessible by private ranch roads and land grant property. 17-13a has a seep and spring. Drainages through the projects experience intermittent flow. Treatment will promote native vegetation, decrease nonnative competition, and complement irrigation. Control of re-sprouts (by 60% to 80%) will likely require multiple years of both herbicide and hand crew re-treatments.

Pre-treatment monitoring was conducted on November 19 and 20; December 9, 10, 11, 2019; and January 23, 2020. A total of eleven monitoring plots were collected on-site during pre-treatment monitoring using the protocols outlined in Appendix IV. Note that changes to project boundaries occurred between pre-treatment monitoring and conclusion of treatment (maps can be found on the following pages). 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 between 6000 to 6500 ft elevation. Monitoring plots had an average of 7% slope with predominately southern aspects. The average annual precipitation in the nearby city of Grants, NM is 10.5 inches. The average high temperature is 91° F in July and the average low is 15° F in December and January (U.S. Climate Data, 2017).

NRCS Web Soil Survey data is only available for an area including the project plus a 100 meter buffer because the project units are so long and narrow. This total area (project and buffer) is comprised of 49% Sparank sandy clay loam, saline, sodic, 1 to 3 percent slopes, 12% Sparank clay loam 1 to 3 percent slopes, 12% Poley-Pojoaque very cobbly loams, 5 to 30 percent, 9% San Mateo clay loam, 1 to 3 percent slopes, 8% San Mateo sandy clay loam, 1 to 3 percent slopes, and the remainder minor soil components and water. On-plot soil data classes the overall project as 18% Loam, 18% Sandy Clay Loam, 16% Loamy Sand, 16% Sandy Loam, 16% Silt Loam, 11% Silty Clay Loam, 2% Clay Loam, and 2% Clay. Rangeland ecological sites within the project plus buffer area include R035XA112NM Loamy, R035XA118NM Bottomland, R035XA119NM Clayey Bottomland, R035XA126NM Salt Flats, R035XG121NM Shallow Sandstone, R035XA115NM Deep Sand, R035XA113NM Sandy, R035XA131NM Foothills, R035XG129NM Limy, R035XG127NM Savanna, and R036XB015NM Shallow Savanna (USDA NRCS, 2020). Descriptions for the most common ecological sites are below.

The Loamy ecological site typically supports a grassland state dominated by blue grama, western wheatgrass, galleta, ring muhly, dropseeds, and/or threeawns. It can also be found in a piñon-juniper invaded state (dominated by piñon, juniper, and blue grama), a grass/succulent-mix state (dominated by blue grama, cholla and prickly pear), a shrub-dominated state (dominated by rabbitbrush or horsebrush and blue grama), as well as a bare state with sparse grass. (USDA NRCS n.d.).

Bottomland occurs most commonly in floodplain areas. It is typically a highly productive warm and cool-season grassland dominated by alkali sacaton and western wheatgrass; blue grama and galleta may be present. Rabbitbrush and saltbush occur as scattered shrubs. Loss of available soil moisture may result in a transition to a less-productive grassland, and extensive disturbance may lead to bare ground and/or a shrub-dominated state. (USDA NRCS, n.d.)

The Clayey Bottomland ecological site typically supports a grassland state dominated by western wheatgrass, blue grama, galleta, and alkali sacaton. Under stress, rabbitbrush, fourwing saltbush, galleta and other grasses may become dominate. In its most degraded state it may occur as mostly bare, with sparse annual vegetation (USDA NRCS n.d.).

The Foothills ecological site type occurs in rolling to steep hills, slopes of high mesas and foot slopes of mountains. It typically supports sideoats grama, blue grama, galleta, shrubs and piñon-juniper. Fire suppression may result in a transition to a piñon-juniper dominated community with sparse grass and large, bare interspaces. (USDA NRCS, n.d.)

The Salt Flats ecological site type is typically dominated by alkali sacaton along with western wheatgrass, blue grama, vinemesquite grass, galleta, inland saltgrass, and spike muhly. Dominance of grass species is determined by salt; salty sites are dominated by alkali sacaton while areas with less salt tend to have more blue grama and galleta. Shrubs include fourwing saltbush, shadscale, and greasewood and are typically scattered when grass is dominant. However, a shrub-dominated state is possible with overgrazing and/or drought. A gullied state is also possible as a site deteriorates and changes in cover lead to changes in hydrology. The changes in hydrology in turn result in an increase of surface salts and downcutting. In this state, shrubs and salt-tolerant forbs are dominant while grasses are absent (USDA NRCS n.d.).

17 - 13 Seboyeta

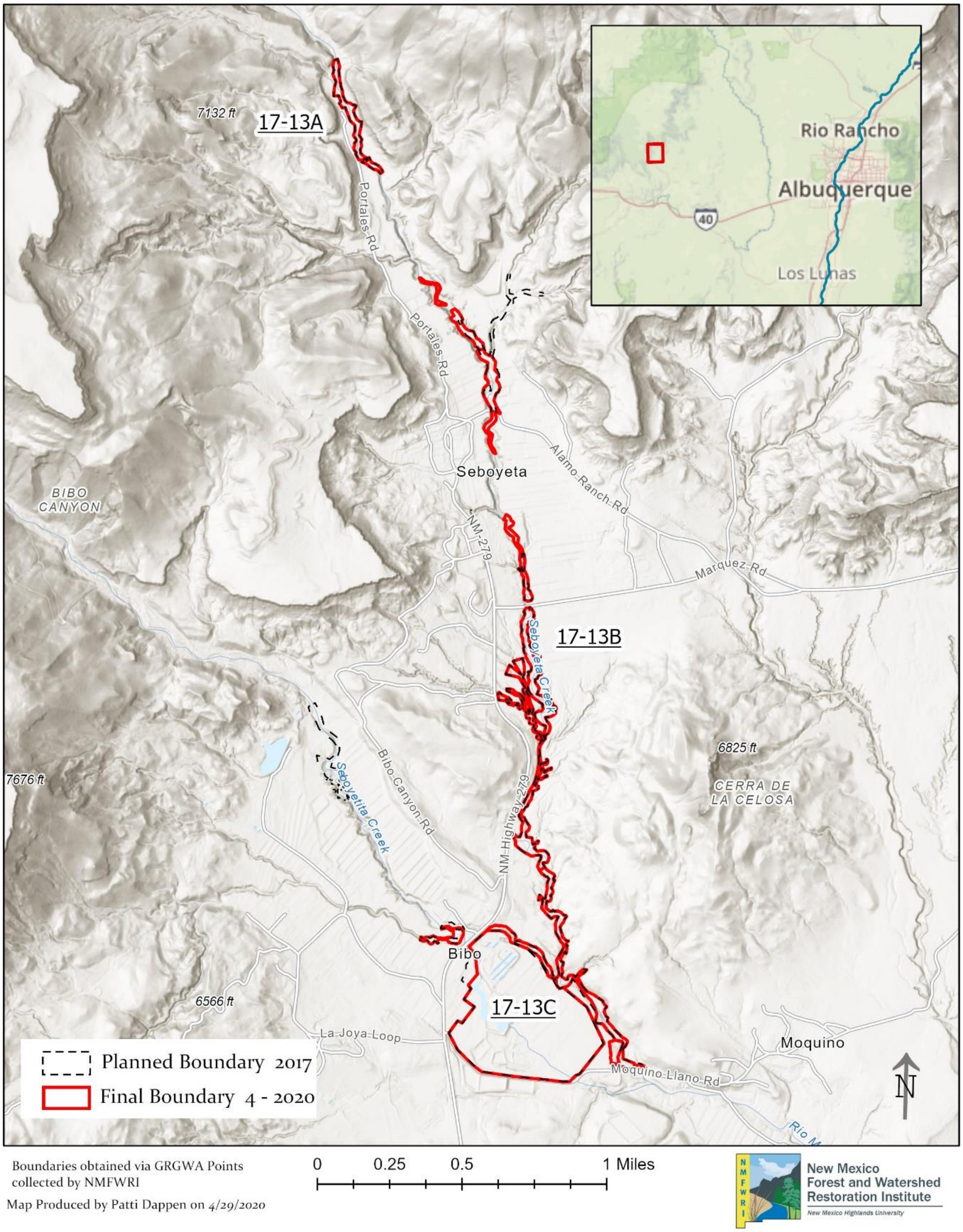

Figure 1. Project 17-13 planned and final project boundaries.

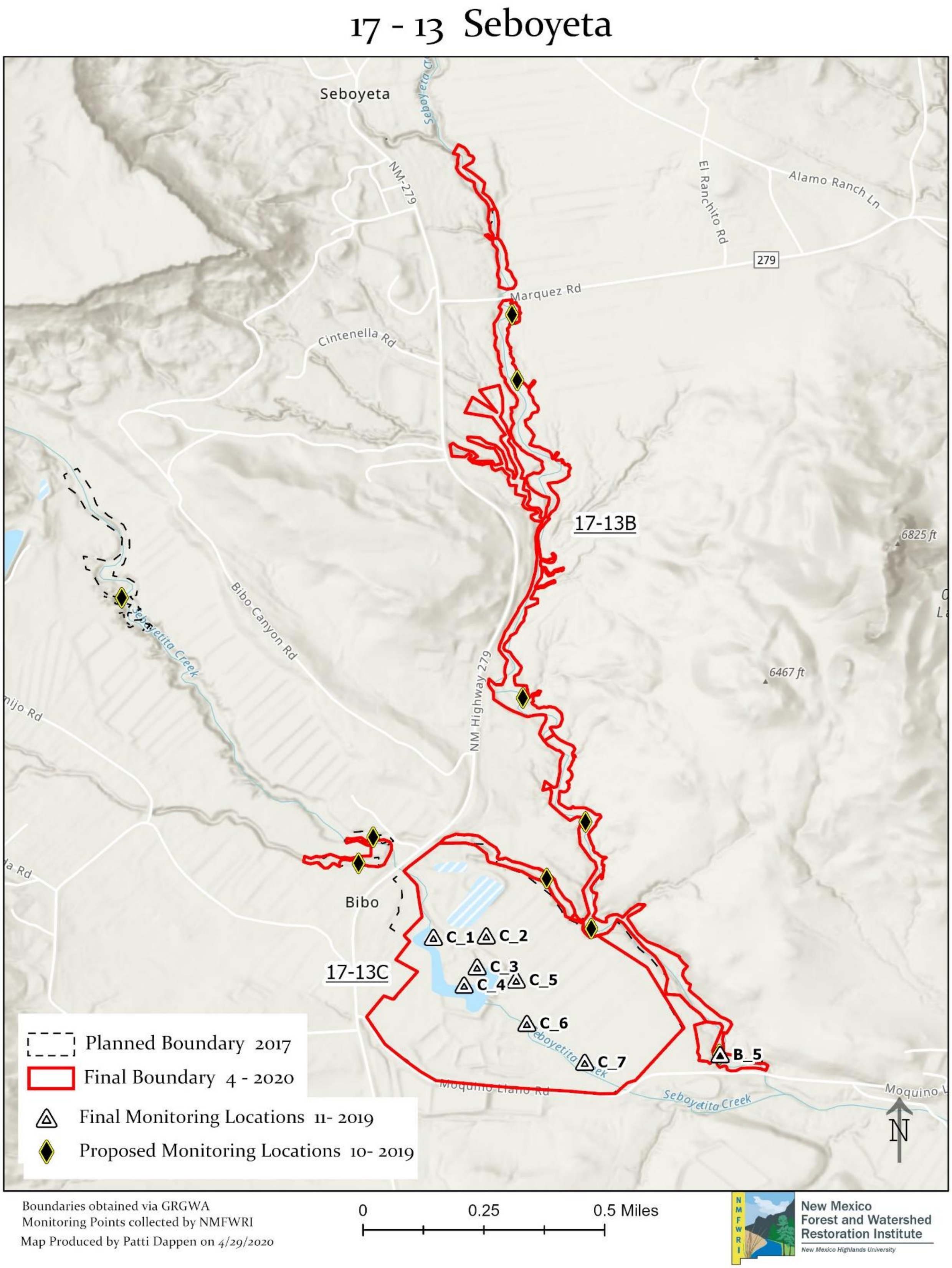

Figure 2. 17-13 monitoring locations, southern portion.

17 - 13 Seboyeta

Figure 3. 17-13 monitoring locations, northern portion.

Pre-Treatment Monitoring

Tree Component

The plots on site were characterized as Hink and Ohmart Type 1, 5, and 6 (modified types 5, 2 and 9). This indicates a vegetative vertical structure of overstory and understory, with an abundance of tall shrubs.

The site had an average of 39% overstory canopy cover collected by densiometer. There were 65 trees (over 5 inches at DBH) per acre. These trees were 84% salt cedar (55 trees per acre), and 8% oneseed juniper (6 trees per acre). The quadratic mean diameter (QMD) for all trees was 10.2 inches, and average basal area per acre was 35 square feet. Average overall tree height was 24 feet, and average live crown base height was 2.3 feet. There were also 3 snags per acre, 67% Rocky Mountain maple and 33% oneseed juniper.

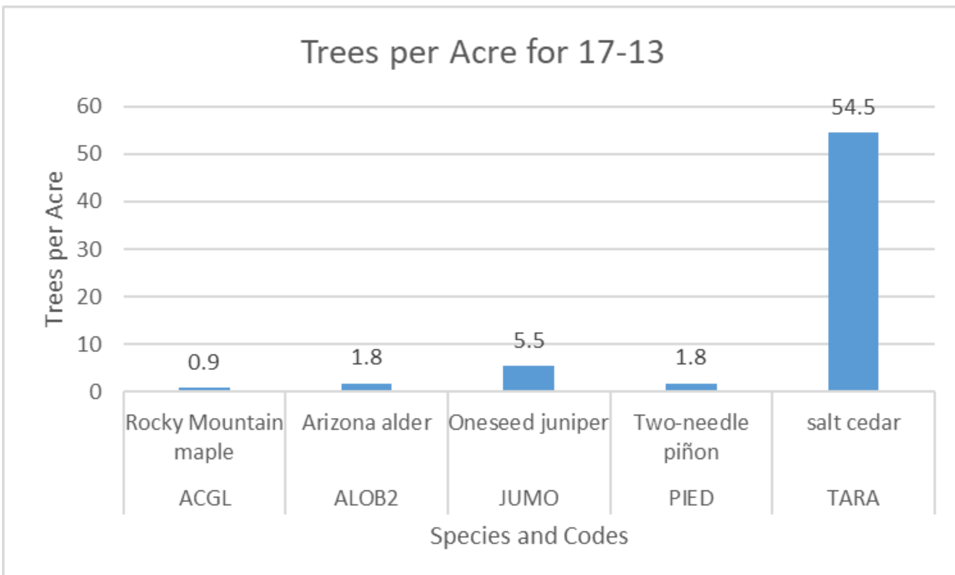

Figure 4. Trees per Acre.

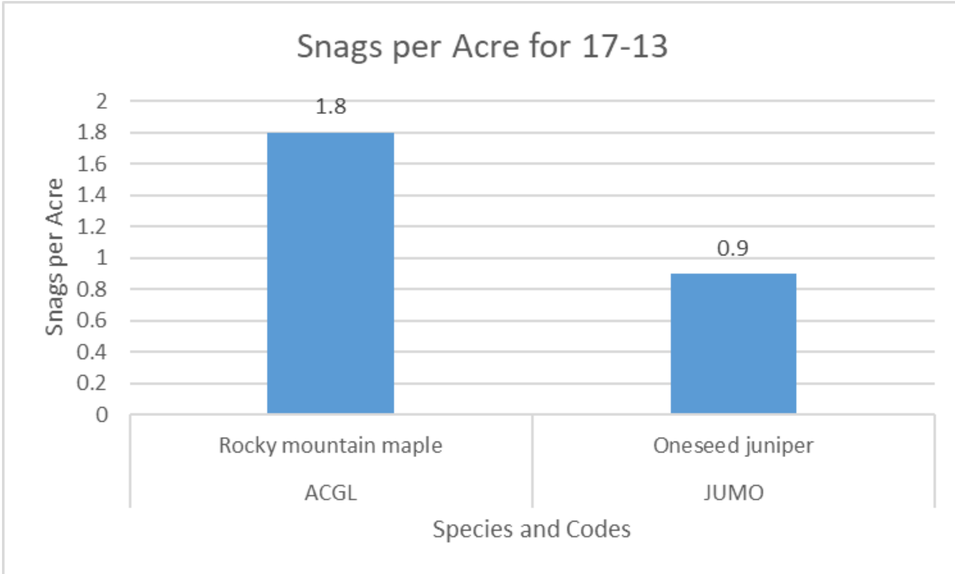

Figure 5. Snags per Acre

Live tree seedlings were recorded at 1150 individuals per acre, of which 98% (2270 seedlings) were salt cedar and 2% (36 seedlings) were oneseed juniper. There were 82 dead salt cedar seedlings per acre.

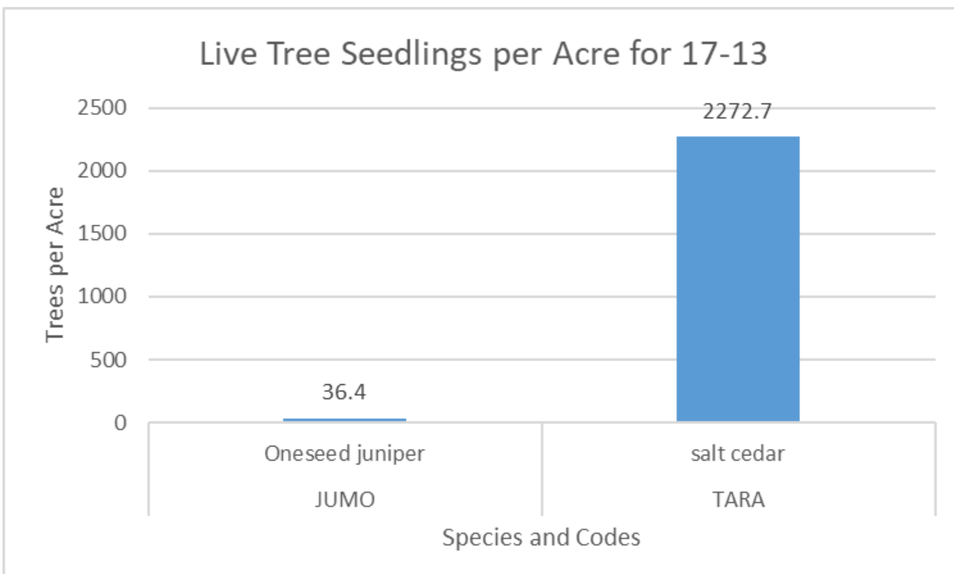

Figure 6. Live tree seedlings per acre

There were 1960 live tree saplings per acre: 99% salt cedar (1946 per acre), 0.5% oneseed juniper (9 per acre), and 0.5% two-needle piñon (9 per acre). No dead saplings were recorded on plots.

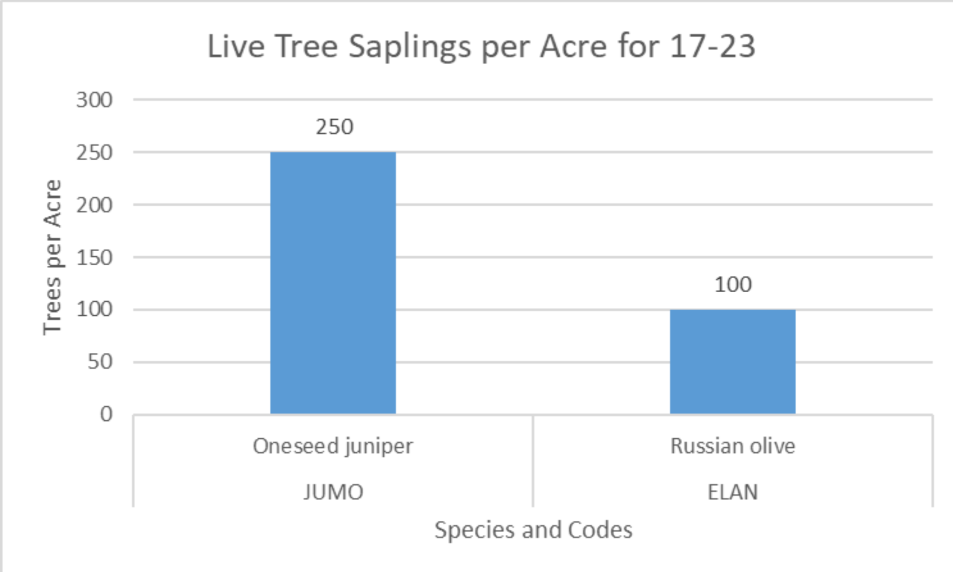

Figure 7. Live saplings per acre.

In addition, a variety of shrub species were recorded in both seedling and sapling classes (see chart for full details).

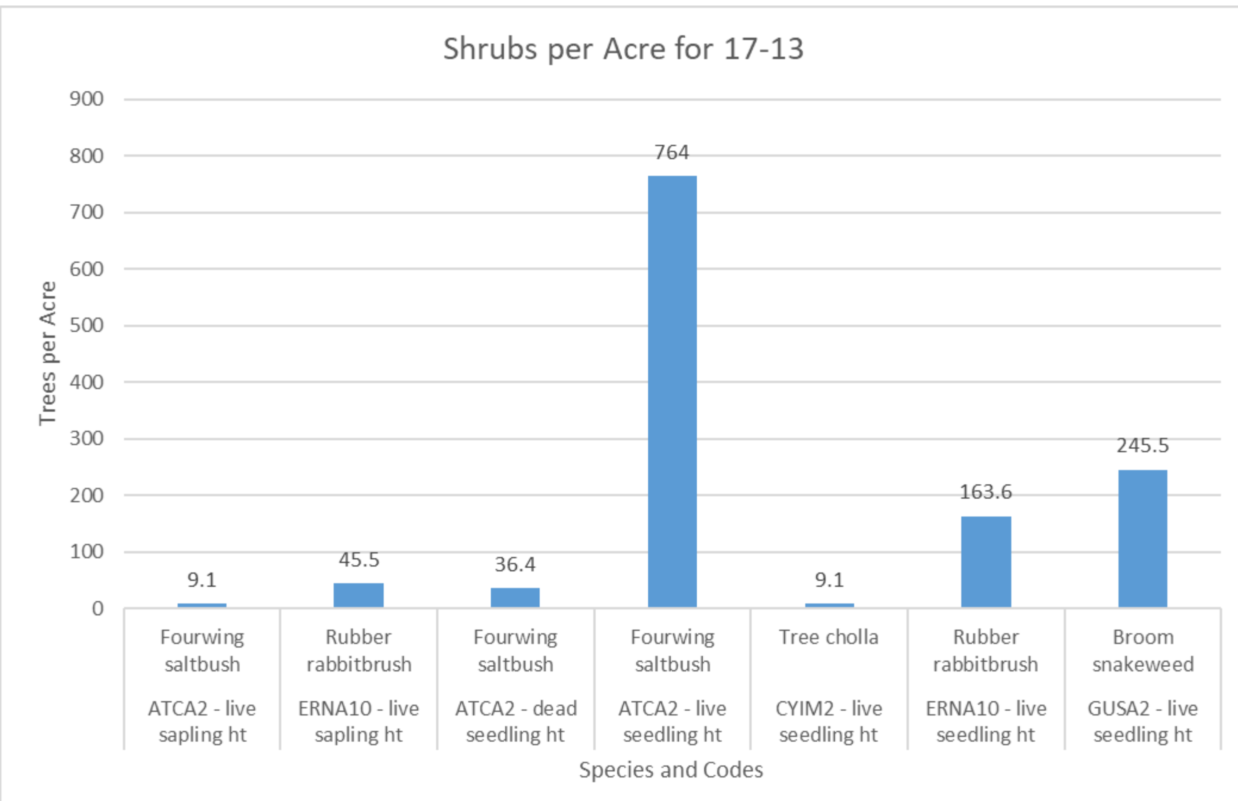

Figure 8. Shrubs per acre.

Understory and Ground Cover

Overall aerial cover by vegetative lifeform averaged 55% tree, 38% shrub, 56% forb/herb, 88% graminoid, and 1.3% cactus. Tree species recorded on plots were Rocky Mountain maple (*Acer glabrum*), Arizona alder (*Alnus oblongifolia*), *oneseed* juniper (*Juniperus monosperma)*, two-needle piñon (*Pinus edulis*), and salt cedar (*Tamarix ramosissima*). Shrub species included fourwing saltbush (*Atriplex canescens*), big sagebrush (*Artemisia tridentata*), rubber rabbitbrush (*Ericameria nauseosa*), broom snakeweed (*Gutierrezia sarothrae*), skunkbush sumac (*Rhus trilobata*), willow (*Salix sp.*). Forb/herb species included yerba mansa (*Anemopsis californica*), aster (*Aster sp.*), kochia (*Bassia prostrata*), yellow star-thistle (*Centaurea solstitialis*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), curlycup gumweed (*Grindelia squarrosa*), common dandelion (*Taraxacum officinale*), alfalfa (*Medicago sp.*), Russian thistle (*Salsola tragus*), silverleaf nightshade (*Solanum elaeagnifolium*), golden crownbeard (*Verbesina encelioides*), cocklebur (*Xanthium strumarium*), and unidentified forbs. Graminoid species included sideoats grama (*Bouteloua curtipendula*), blue grama (*Boutelous gracilis*), sedge (*Carex sp.*), rush (*Juncus sp.*), Canada wildrye (*Elymus canadensis*), squirreltail (*Elymus elymoides*), horsetail (*Equisetum sp.*), bristly wolfstail *(Lycurus setosus*), western wheatgrass (*Pascopyrum smithii*), switchgrass (*Panicum virgatum*), sand dropseed (*Sporobolus cryptandrus*), cattail (*Typha sp.*), and unidentified grasses. Cactus species included tree cholla (*Cylindropuntia imbricata*), barrel cactus (*Ferocactus*), and pricklypear (*Opuntia phaeacantha*).

Aerial cover averaged for all 17-13 plots					
Tree	**Shrub**	**Forb/Herb**	**Gramanoid**	**Cactus**	**Other (bryophyte, saprophyte)**
55%	38%	56%	46%	1.3%	0%

Ground cover on plots was an average of 33% plant basal, 17% bole, 17% litter, 10 % bare soil, 9% gravel, 8% rock, and 5% water.

Ground cover averaged for all 17-13 plots						
Plant Basal	**Bole**	**Litter**	**Bare Soil**	**Rock**	**Gravel**	**Water, Wet soil**
33%	17%	17%	10%	8.1%	9.4%	5.4%

Surface Fuels

Surface fuels on site averaged 1.4 tons of total wood fuels per acre, and a fuelbed depth of 0.4 inches.

17-13 Pre-Treatment	
Fuel	**Tons/Ac**
1-Hour	0.15
10-Hour	0.42
100-Hour	0.27
1000-Hour	0.55
Duff	0.4
Litter	1.94
TOTAL FINE WOOD FUELS	0.84
TOTAL WOOD FUELS	1.38
TOTAL SURFACE FUELS	3.72
Fuelbed Component	**Depth (inches)**
Duff	0.04
Litter	0.39

Comments and field crew observations

Project has livestock presence with cattle trails and in some areas, bare ground and herbaceous invasive species as well as phreatophytes. Some plots had notable amounts of trash and tires. Acequias, mesas, solar and wind power features, houses and entrances gates provided clear landmarks for photos.

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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- Iman Chudnoff, Monitoring & Data Technician (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

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Appendix I – Photopoint and Plot Coordinate Table

Name	Latitude	Longitude
17.13_A_1_NESW	35.21743695300	-107.39549454900
17.13_A_2_NESW	35.22101481700	-107.39671740500
17.13_B_5_NESW	35.17200505100	-107.37798753100
17.13_B_11_NESW	35.20359798900	-107.38715319200
17.13_C_1_NESW	35.17551108400	-107.38656512900
17.13_C_2_NESW	35.17555766500	-107.38498329100
17.13_C_3_NESW	35.17462668000	-107.38525751900
17.13_C_4_NESW	35.17408327000	-107.38564630800
17.13_C_5_NESW	35.17423453900	-107.38408754600
17.13_C_6_NESW	35.17293786000	-107.38376889900
17.13_C_7_NESW	35.17177511200	-107.38203809400

Appendix II – Photos

Seboyeta 17.13_A_1_N

Seboyeta 17.13_A_1_E

Seboyeta 17.13_A_1_S

Seboyeta 17.13_A_1_W

Seboyeta 17.13_A_1_BR_2°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_A_1_BR_162°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_A_1_C taken 75’ North from Plot Center looking toward Plot Center

Seboyeta 17.13_A_2_N

Seboyeta 17.13_A_2_E

Seboyeta 17.13_A_2_S

Seboyeta 17.13_A_2_W

Seboyeta 17.13_A_2_BR_320°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_A_2_BR_116°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_A_2_C
taken 75' North from Plot
Center looking toward Plot
Center

Seboyeta 17.13_B_5_N

Seboyeta 17.13_B_5_E

Seboyeta 17.13_B_5_S

Seboyeta 17.13_B_5_S

Seboyeta 17.13_B_5_W

Seboyeta 17.13_B_5_BR_224°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_B_5_BR_284°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_B_5_C taken 75’ North from Plot Center looking toward Plot Center

Seboyeta 17.13_B_11_N

Seboyeta 17.13_B_11_E

Seboyeta 17.13_B_11_W

Seboyeta 17.13_B_11_BR_12°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_B_11_BR_134°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_B_11_C taken 75’ North from Plot Center looking toward Plot Center

Seboyeta 17.13_C_1_N

Seboyeta 17.13_C_1_E

Seboyeta 17.13_C_1_S

Seboyeta 17.13_C_1_W

Seboyeta 17.13_C_1_BR_194°
taken 75’ from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_1_BR_156°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_1_C
taken 75' North from Plot
Center looking toward Plot
Center

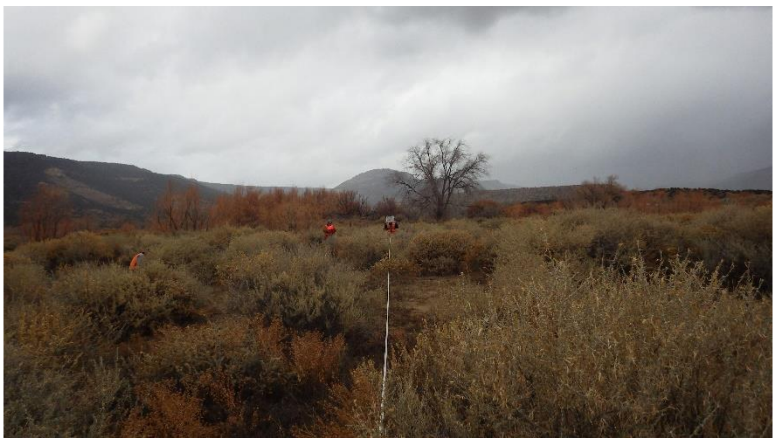
Seboyeta 17.13_C_2_N

Seboyeta 17.13_C_2_E

Seboyeta 17.13_C_2_S

Seboyeta 17.13_C_2_W

Seboyeta 17.13_C_2_BR_160°
taken 75’ from Plot Center
looking toward Plot Center



Seboyeta 17.13_C_2_BR_136°
taken 75’ from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_1_C
taken 75’ North from Plot
Center looking toward Plot
Center

Seboyeta 17.13_C_3_N

Seboyeta 17.13_C_3_E

Seboyeta 17.13_C_3_S

Seboyeta 17.13_C_3_W

Seboyeta 17.13_C_3_BR_268°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_3_BR_294°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_3_C taken 75' North from Plot Center looking toward Plot Center

Seboyeta 17.13_C_4_N

Seboyeta 17.13_C_4_E

Seboyeta 17.13_C_4_S

Seboyeta 17.13_C_4_W

Seboyeta 17.13_C_4_BR_290°
taken 75’ from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_4_BR_340°
taken 75’ from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_4_C
taken 75’ North from Plot Center looking toward Plot Center

Seboyeta 17.13_C_5_N

Seboyeta 17.13_C_5_E

Seboyeta 17.13_C_5_S

Seboyeta 17.13_C_5_W

Seboyeta 17.13_C_5_BR_58°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_5_BR_200°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_5_C
taken 75' North from Plot Center looking toward Plot Center

Seboyeta 17.13_C_6_N

Seboyeta 17.13_C_6_E

Seboyeta 17.13_C_6_S

Seboyeta 17.13_C_6_W

Seboyeta 17.13_C_6_BR_88° taken 75’ from Plot Center looking toward Plot Center

Seboyeta 17.13_C_6_BR_260° taken 75’ from Plot Center looking toward Plot Center

Seboyeta 17.13_C_6_C taken 75’ North from Plot Center looking toward Plot Center

Seboyeta 17.13_C_7_N

Seboyeta 17.13_C_7_E

Seboyeta 17.13_C_7_S

Seboyeta 17.13_C_7_W

Seboyeta 17.13_C_7_BR_328°
taken 75' from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_7_BR_110°
taken 75’ from Plot Center
looking toward Plot Center

Seboyeta 17.13_C_7_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 (1/10th ac and 1/100th 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

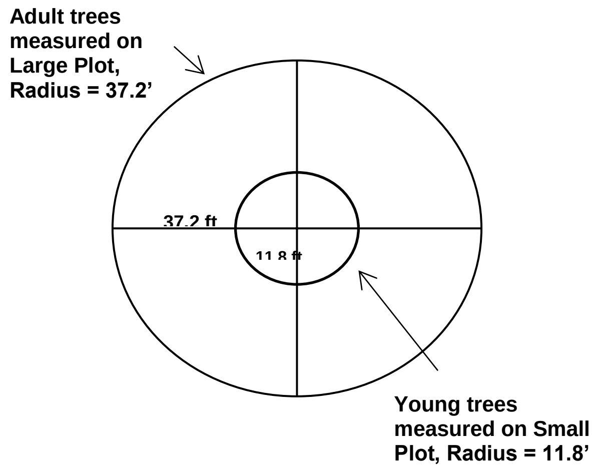
All **trees and snags** are measured within the 1/10th acre plot (37.24 ft. radius) circular, fixed area sample plot. We typically define a tree as ≥ 4.5 ft. and > 5 in DBH or DRC, although other cutoffs may be used depending on objectives. Species, condition, DBH or DRC, number of stems, total height, 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.

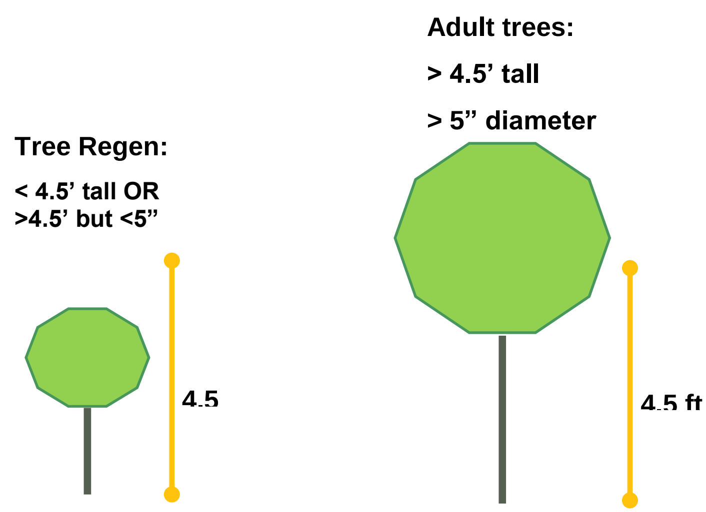
Tree regeneration is measured on the nested 1/100th acre circular plot (11.78 ft. radius) and species, condition, and height class (>0-0.5 ft; >0.5-1.5ft; >1.5-2.5ft; >2.5-3.5ft.; >3.5-4.5ft) are recorded for each **seedling** or sprout. **Saplings** (>4.5ft but <1.0in DBH/DRC) are also recorded in this 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.

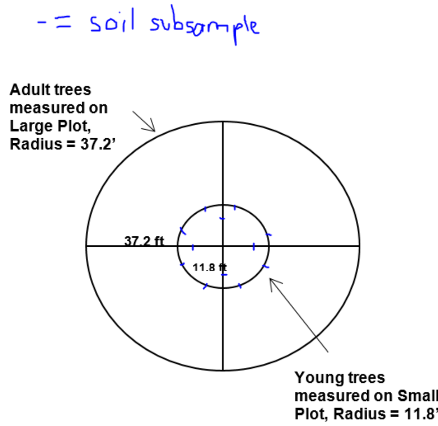
Vegetative Community Structure type is a classification system developed by Hink and Ohmart to describe patterns of vegetation specifically along the Middle Rio Grande. The **"original" Hink and Ohmart** scheme uses vegetation height and presence of understory vegetation to assign a structure type between 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 1/10th 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.



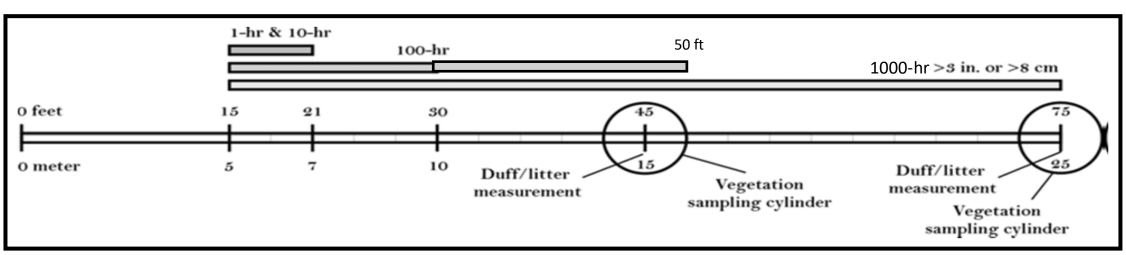
Combine each set of three subsamples into one sample by mixing thoroughly in a bag or tub. Remove any large organic debris such as plants or wood chips. Follow the soil texture flow chart to determine soil texture for each combined sample at each measurement point. Record this on the datasheet for a 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.

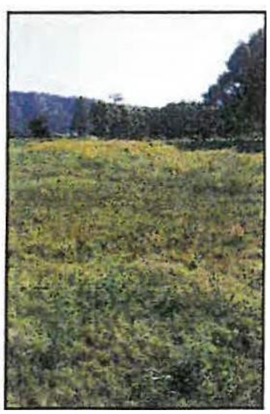
Young tree and shrub layer only (1.5-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

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.