Ojo Caliente Project 16.07

Post-treatment Monitoring Report

2021

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Acronyms and Abbreviations

Acronym, Abbreviation, or Term	Explanation or Definition as used by NMFWRI
AGL	above ground level; GIS term
BBIRD plots	Breeding Biology Research and Monitoring Database, larger circular plot types
BEMP plots	Bosque Ecosystem Monitoring Program, small rectangular plot types
FEAT	Fire Ecology Assessment Tool
FFI	FEAT/ FIREMON Integrated
FIREMON	Fire Effects Monitoring and Inventory System
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 pre-treatment vegetation monitoring assessment performed on a non-native phreatophyte removal project submitted for the Ojo Caliente River to the Greater Rio Grande Watershed Alliance in 2016. Following a discussion of the ecological context, and our monitoring methods, we present pertinent background, observations, and assessment results for the project.

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.

Monitoring and Field Methods

Low intensity Field Methods

Low intensity pre-treatment vegetation monitoring was done using an adapted version of the biotic portion of the New Mexico Rapid Assessment Method (NMRAM), v 2.1, updating recommendations made in the Field Manual for Greater Rio Grande Watershed Alliance (GRGWA) Riparian Restoration Effectiveness Monitoring and the GRGWA Monitoring Plan, developed by Lightfoot & Stropki of SWCA Environmental Consultants in 2012. (For a brief overview of both low and high intensity monitoring methods used by the NMFWRI on GRGWA projects, please see Appendix III.)

For those not familiar, NMRAM was developed by the New Mexico Environment Department Surface Water Quality Bureau Wetlands Program and Natural Heritage New Mexico as a "cost effective, yet consistent and meaningful tool" (Muldavin, 2011) for wetland ecological condition assessment in terms of anthropogenic disturbance as negatively correlated with quality and functionality. The portions of NMRAM we utilized are Level 2 "semi-quantitative" field measurements taken at less detail than plot level (Muldavin, 2011).

Measurements taken included relative native plant community composition, vegetation horizontal patch structure, vegetation vertical structure, native riparian tree regeneration, and invasive exotic plant species cover. The underlying method for these biotic assessments was a version of the 1984 Hink and Ohmart vertical structure classification system, modified for use in the NMRAM for Montane Riverine Wetlands version 2.0 (see Appendix IV). First, vegetation communities were mapped out by patch (polyon) according to the Hink and Ohmart system. Next, the presence of (state-listed) invasives, wetland species, and the two dominant species in each strata ("tree" >15 ft, "shrub" 4.5-15 ft, and "herbaceous" <4.5 ft) were recorded for each plant community. The native/exotic ratio in each of the patches was scored and weighted based on the percent of the project area each patch comprised. These scores were then combined with the additional biotic metrics of vertical and horizontal diversity, native tree regeneration, and overall (listed) invasive presence. The NMRAM rating system is based, on all levels, on a scale of 1 to 4, where 4 is considered excellent condition, 3 good, 2 fair, and 1 poor.

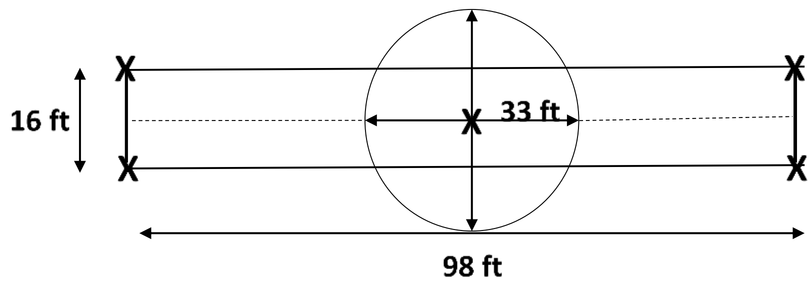
We also assessed soil surface condition, which is a metric typically included in the abiotic section of the NMRAM, as well as the presence of surface fuels, which is not part of the NMRAM. Unlike the other 6 metrics we used, surface fuels were recorded on a rating scale from 0 to 1.0 where 1.0 is a continuous fuel matrix.

Photopoints were established to capture images where vegetation shifts were observed and/or at representative locations throughout the site. Waypoints were marked with a Garmin GPS unit and named sequentially by site. Photos were taken facing north, east, south and west at each point.

Prior to entering the field, we created a map with the project boundaries as provided by GRGWA. We combined these polygons with recent aerial imagery and identified relevant roads and other landscape features. Once on the ground, the vegetation community polygons (as determined by the modified Hink and Ohmart classification system) were hand-drawn onto this map and served as the basis for other biotic metric assessments. Upon return to the office, this polygon map and the photopoints were digitized by the monitoring technician and/or specialist.

High-intensity Field Methods

High-intensity monitoring was also done, in part, on this site. We used an adapted Bosque Ecosystem Monitoring Program (BEMP) style plot. These are 16 x 98-foot rectangles, placed approximately parallel to the river. Within these plots, we measure canopy and species, and vegetation and ground cover. We also used Brown's transects to measure surface fuels.



Personnel Involved

2021 New Mexico Forest and Watershed Restoration Institute Monitoring Team:

- Kathryn R Mahan, Ecological Monitoring Specialist
- Carmen Briones, Crew Logistics Support/ Assistant Manager
- Raymundo Melendez, Ecological Monitoring Technician
- Alex Makowicki, Ecological Monitoring Technician

2021 New Mexico Forest and Watershed Restoration Institute GIS Team:

- Patti Dappen, GIS Specialist
- Katie Withnall, GIS Specialist

Other persons contacted:

- Fred Rossbach, Field Coordinator, Greater Rio Grande Watershed Alliance
- Marcos Valdez, East Rio Arriba Soil and Watershed Conservation District

Ojo Caliente Project

Project 16.07 is located Rio Arriba County in Ojo Caliente, N.M, along the Rio Ojo Caliente and in fenced pastures west of US 285. It is approximately 24 miles north of Española.

The average precipitation for the nearby city of Española is 11.41 inches per year. The average high temperature is 90° F in July and the average low is 15° F in December and January (U.S. Climate Data, 2017). According to the NRCS Web Soil Survey, the project area is comprised of 83% Abiquiu-Peralta complex, 0 to 2 percent slopes, 14% Pinavetes loamy sand, 3 to 12 percent slopes, 1.0% Parida-Palacid very gravelly sandy loams, 10 to 40 percent slopes, 0.5% Pinavetes loamy sand, 0 to 3 percent slopes, 0.5% Florita-Rock outcrop complex, 15 to 45 percent slopes, and 0.5% Walrees-Abiquiu complex, 0 to 2 percent slopes. Rangeland ecological sites within this project include R035XA112NM Loamy, R035XA113NM Sandy, R035XA115NM Deep Sand, R035XG114NM Gravelly, R036XB010 Salty Bottomland, R036XB111NM Sandy Slopes, and R036XB132NM Gravelly Hills. Forestland ecological site types within this project include F035XG135NM Steep Gravelly Woodland, F036XA005NM Riverine Riparian, and F036XB133NM Pinyon Juniper/Skunkbush Sumac Shallow Sandy (USDA NRCS, 2016).

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.).

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 bee plant, 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 Deep Sand ecological site typically supports a grassland state dominated by Indian ricegrass, Blue grama, dropseeds and threeawns, but also can be found in a shrub-dominated state dominated by sand sagebrush and in a juniper-dominated state (USDA NRCS n.d.).

The Gravelly ecological site type typically supports grassland with minor shrub and piñon-juniper components. Common dominant grass species include blue, black and sideoats grama, little bluestem, spike muhly, Western wheatgrass, New Mexico feathergrass, Indian ricegrass, and squirreltail. Common shrubs include fourwing saltbush, winterfat, Apache plume, rabbitbrush, soapweed yucca, sagebrush and broom snakeweed. The site can also be found in a shrub-encroached state dominated by rabbitbrush and blue grama; erosion is more common in this state (USDA NRCS n.d.).

Salty Bottomland is typically dominated by alkali sacaton with subdominant western wheatgrass. Other grasses can include bottlebrush squirreltail, galleta, blue grama, and Indian ricegrass. Inland saltgrass is often found in patches. Fourwing saltbush is the dominant shrub. Other shrubs commonly found may include greasewood, big sagebrush, and other saltbush species. Continuous heavy grazing typically results in a decrease in grasses such as western wheatgrass, Indian ricegrass, and bottlebrush squirreltail (USDA NRCS n.d.).

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

The Gravelly Hills ecological site typical plant community consists of sideoats and black grama grasses. Shrubs include Bigelow sagebrush, broom snakeweed, longleaf ephedra, feather dalea and yucca. Sparse strands of piñon-juniper may be widely scattered across the site. Overgrazing may cause loss of grass cover allowing piñon and juniper seedlings to establish and possibly facilitate the transition to piñon/juniper encroachment (USDA NRCS n.d.).

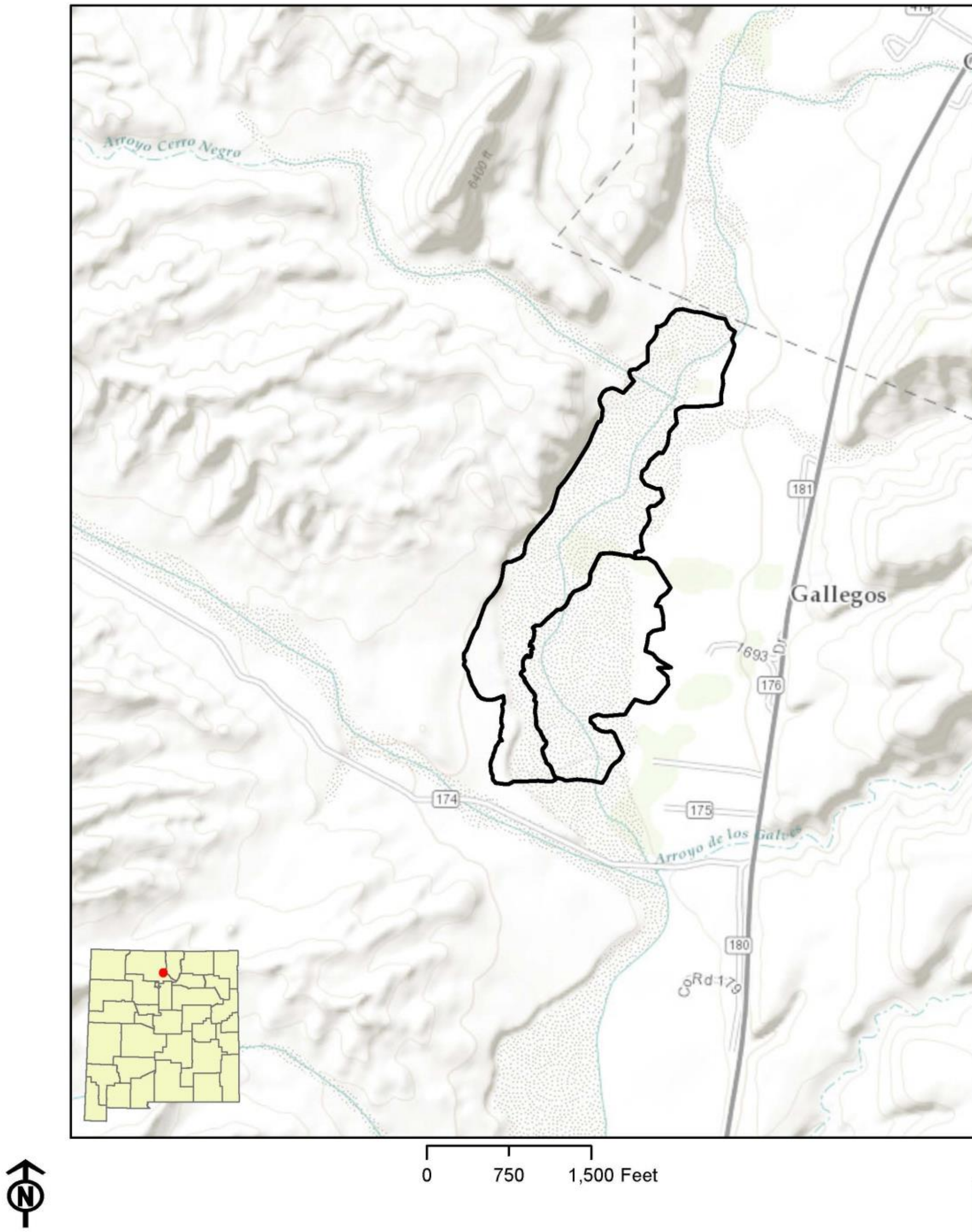
The Steep Gravelly – Woodland ecological site type is commonly dominated by piñon/juniper, mountain mahogany, rubber rabbitbush, and blue grama vegetation. Other information about this site type is not currently available. (USDA NRCS, n.d.)

The Riverine Riparian ecological site is made up of sediments adjacent to perennial streams and vegetation is determined largely by local hydrology. Examples of typical species at different strata include Fremont cottonwood, sandbar willow, Western wheatgrass, and Nebraska sedge (USDA NRCS n.d.).

The Pinyon Juniper/Skunkbush Sumac Shallow Sandy ecological site type is typically found on flat landforms with soils ranging from shallow to very deep and well-drained. Soil textures include gravelly and cobbly sandy loams. Temperature and precipitation patterns determine the dominant vegetation communities, but the site is in general very susceptible to disturbance. For instance, in a fire-suppressed state, trees and shrubs shade out grasses and forbs leading to site dominance by sumac, piñon/juniper, and/or Gambel's oak with limited herbaceous forage. (USDA NRCS, n.d.)

Monitoring was conducted at this 107.9-acre site on October 21, 2016 as part of a restoration project targeting non-native phreatophytes scheduled for 2016-2017. Post-treatment monitoring was conducted on October 8, 2021. The project is located in Rio Arriba County in Ojo Caliente, NM, along the Rio Ojo Caliente and in fenced pastures west of US 285. Approximately 60acres are located in heavy density outside of the fence lines along the Rio Ojo Caliente corridor; 25 acres are in heavy density are on the west of the river. Multiple landowners fence the east side of the project. The East Rio Arriba Soil and Water Conservation District (ERASWCD) sponsored the project. This project is considered an initial treatment with Russian olive, Siberian elm and salt cedar (some of which have been affected by the Tamarisk leaf beetle) as the target species. Planned treatment includes extraction and mastication of target species while leaving 10% to 20% tree canopy cover along pasture fences and the river corridor. Restoration goals include returning the riparian area to a more natural state, promoting native plant species, minimizing impacts to native species and soils during treatment, enhancing an existing wildlife corridor, raising awareness of bosque restoration efforts and promoting overall watershed health.

16-07 Ojo Caliente



Project 16-07 Ojo Caliente, is located in Rio Arriba County in Ojo Caliente, N.M,along the Rio Ojo Caliente and in fenced pastures west ofUS 285 It is approximately 24 miles north of Española.The project is considered an initial treatmentwith Russian olive, Siberian elm and salt cedar (some of which have been affected by theTamarisk leaf beetle) as the target species.

Figure 1. Project 16-07 in geographic context.

Figure 2. 16.07 Ojo Caliente project outline.

The Rio Ojo Caliente, as visible in the image above, can take different paths depending on the amount of flow. The Rio Ojo Caliente flows from the Tusas and Vallecitos near Lamadera through the Ojo Caliente valley, to join the Rio Chama near Chili, south of Medenales and north of El Duende and Hernandez. The USGS gauge 08289000 measures the Rio Ojo Caliente at Lamadera.

The GRGWA site is located approximately 7 miles south of the gauge at an elevation around 6200 feet. Exotic species observed frequently included Russian olive and salt cedar. Native plants observed in abundance at the time of the site visit included Alkaline Sacatoon, Tall Sage and Rubber Rabbit Brush.

Table 1. NMRAM Scores for 16.07.

Metrics for 16.07 (October 28, 2021)	**2021 Score**	**2016 Score**
Relative Native Plant Community Composition	1	1
Vegetation Horizontal Patch Structure	3	4
Vegetation Vertical Structure	2	4
Native Riparian Tree Regeneration	2	2
Exotic Invasive Plant Species Cover	1	1
Project Biotic Score (based on above ratings)	1.7	2.3
Project Biotic Rating	D/Poor	C/Fair
Soil Surface Condition	4	3
Surface Fuels	0.26	.50

Overall, the site scored lower than in 2016 and this can be attributed to the increase in Invasive Exotic Species Cover. Low scores came in Relative Native Plant Community Composition and Invasive Exotic Plant Species Cover. Relative Native Plant Community Composition score dropped from 2016 due to a loss of cottonwood making up most of the tall woody stratum. In 2021, Russian Olive was observed to be the dominant plant in the tall woody stratum. Invasive Exotic Species Cover increased 10% from 2016 and, as well, fewer native species were observed. The site scored a “D” or “Poor”. Other contributions to this site’s low score include cattle disturbance, burn piles and trash.

In 2021 the monitoring team was unable to take Brown’s transects and a BEMP plot due to time constraints.

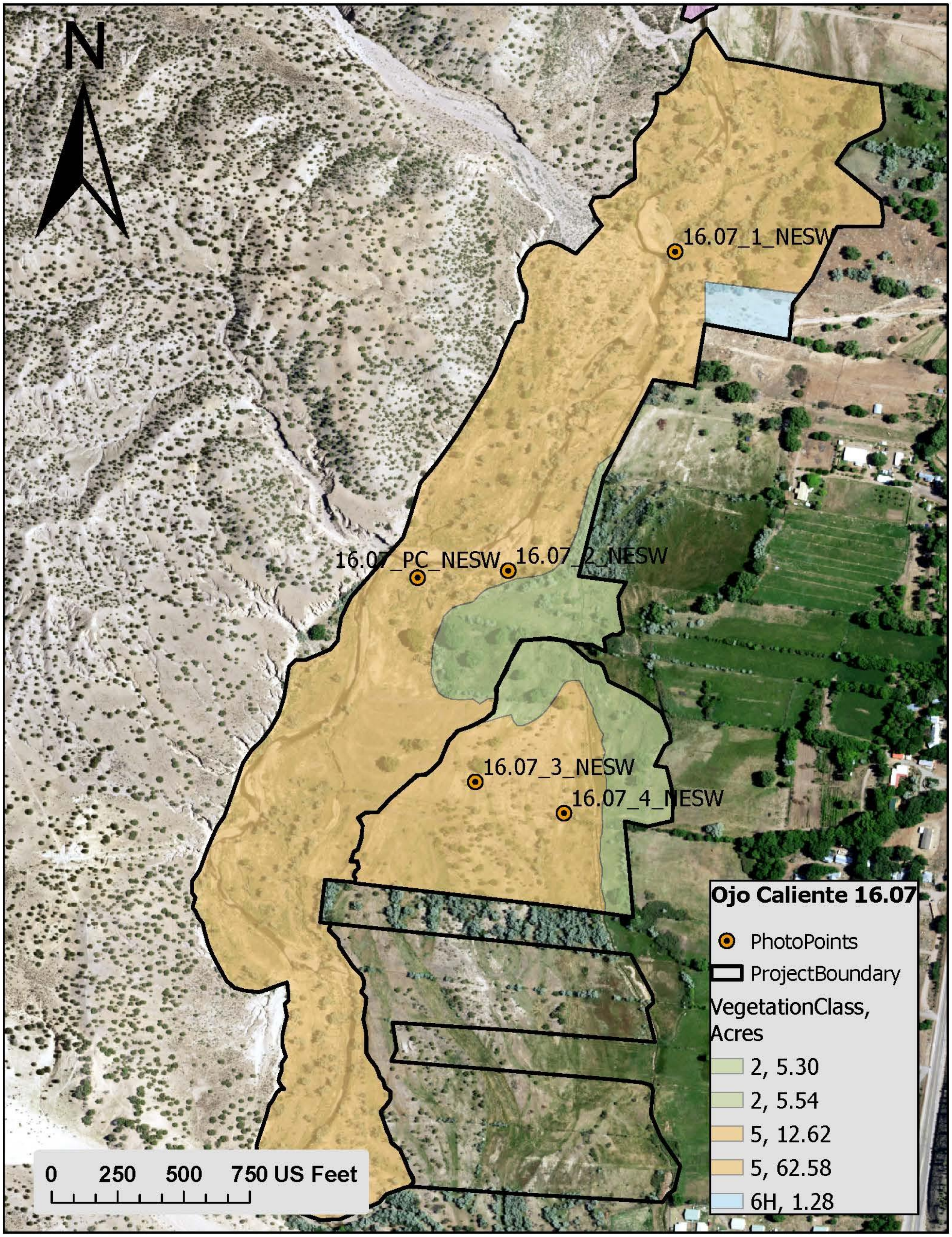


Figure 3. 16.07 Ojo Caliente project vegetation polyons

Discussion

We would like to clarify that we are adapting these NMRAM metrics for our own purposes. That is, we are using them both inside and outside their intended site ranges, including on larger sites (NMRAM is designed to handle a site around 100 x 200 meters), sites further from the river (NMRAM is currently in use primarily for assessing riverine wetlands), and sites defined by exotic vegetation presence rather than hydrologic boundaries and upland vegetation indicators/apparent wetland extent. Site delineation and size is likely to be variable for a number of other reasons, including landowner participation, available funds, proposals received from contractors, etc – many of which cannot be directly correlated to site disturbance or ecological function. For this reason, we do not use the entire NMRAM assessment, or place confidence in the weighted score roll-ups that are typically part of an NMRAM report. Should one be interested, rationale for the weighting in the NMRAM score roll-up can be found in the yet-to-be-published field manual for version 2.1. For more information, contact Maryann McGraw of the NMED or NMFWRI.

While we provide a biotic site score and rating for your reference, we recommend comparisons be done with individual metrics from pre-treatment and post-treatment assessment from the same site, rather than across multiple sites. Also of note is that statistical analysis is not appropriate for NMRAM, or other low intensity, rapid field methods.

Please note that should the project area change significantly from what was originally proposed and monitored, all metrics will lose some amount of confidence on comparison as it is impractical to re-examine the original site assessment scores using new boundaries. This is an issue of concern of which GRGWA should be aware. We recommend that GRGWA attempt to minimize alterations in project boundaries once pre-treatment monitoring data has been approved for collection. Another, somewhat alternative, recommendation is that the initial monitoring regime include high-intensity modified BEMP-type plots which could be repeated in their exact initial locations, allowing collection of comparable data regardless of boundary change. We recognize that this is not always practical: boundaries change for a number of reasons and time and cost constraints can necessitate the sole use of a rapid assessment method for monitoring. We have reason to hope our outlined assessment method will still be a satisfactory indicator for site function improvement or degradation primarily because metrics in rapid assessment methods such as this are set up to have relatively low sensitivities (i.e. for a change to be reflected in the metrics, either positive or negative, disturbance on site has to be significantly altered).

From here on out, the goal of the GRGWA/ NMFWRI is that all sites will be revisited for post-treatment monitoring in 5-year intervals. 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.

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Appendix I - Photopoint Table

Name	Latitude	Longitude
16.07_1_NESW	36.2934	-106.0550
16.07_2_NESW	36.2901	-106.0570
16.07_3_NESW	36.2879	-106.0570
16.07_4_NESW	36.2875	-106.0560
16.07_PC_NESW	36.2900	-106.0580

		100-0223			N	Russian olive @5' @0º/360º	Tamarisk @33' @0º/360º				Cocklebur, rrues, rochy, russian olive, loose sandy hill.
		100-0224			E	Russian olive @3' @90º	Russian olive @10' @90º				Russian olive, cocklebur, later tamarisk
		100-0225			S	Russian olive @7' @180º	Cottonwood @217' @180º				Russian olive (1), tamarix, cocklebur
16.07_PC_NESW	10/28/2021 1:15PM	100-0226	36.28998292	-106.0581337	W	Russian olive @10' @270º	Tamarisk @15' @270º				Hill hidden behind tamarisk, coclebur, russian olive.
		100-0231			N	Russian olive @17' @347º	Russian olive @87' @0º/360º				Stream bank, russian olive, cocklebur, tamarix, grade channel
		100-0232			E	Russian olive @37' @90º	Tamarix @127' @90º				Russian olive, NM olive, tamarix, cocklebur
		100-0233			S	NM olive @16' @180º	Russian olive @58' @180º				Russian olive, NM olive, stream bank
16.07_1_NESW	10/28/2021 2:10pm	100-0234	36.29338285	-106.0548559	W	Rio Ojo Caliente @45' @268º	R. Rabbit brush @175' @270º				R.Rabbit brush, tamarix, JUMO hill, Rio Ojo Caliente
16.07_2_NESW	10/28/2021 1:42pm	100-0227	36.29008021	-106.0569526	N	Stream/cocklebur @44' @0º/360º	Cottonwood @342' @0º/360º	-	Olympus red	CB, AM	Stream bed, mullein, cocklebur, russian olive, DWD

		100-0228			E	Cocklebur/ R.O. @11' @90º	Russian olive @82' @90º				Cocklebur, russian olive, stream bank, tamarisk
		100-0229			S	Tamarisk @35' @180º	Cottonwood @253' @182º				Stream bank, thistle, cocklebur, DWD, tamarix, russian olive, fence, cottonwood.
		100-0230			W	Cocklebur/ riverbed @31' @270º	Russian olive @137' @270º				Stream bank, tamarix, cocklebur, russian olive, stream, JUMO on hill.
		100-0219			N	NM olive @10' @24º	Cottonwood @71' @0º				Stream, litter, NM olive, grassy, JUMO, Russ. Olive, cottonweeds
		100-0220			E	Stream @1-15' @90º	JUMO @104' @90º				Stream, cacti, Rubber Rabbit brush, JUMO, cottonwood, JUMO, hill.
		100-0221			S	DWD/stream @1-20' @180º	JUMO @99' @180º				Stream, cacti, fence, DWD, JUMO
16.07_3_NESW	10/28/2021 12:41pm	100-0222	36.28787086	-106.0573439	W	JUMO @40' @263º	Cottonwood @307' @276º				Bank of stream, grassy, JUMO, open space, cottonwood, russian olive, JUMO hill
		100-0215			N	JUMO @16' @24º	Cottonwood @410' @360º				Dead cholla, Russian olive, JUMO, grassland, cottonwood.
		100-0216			E	Yerba mansa/ Russian olive @26-58' @110º	Cottonwood @1131' @90º				Wetland, Russian olive, yerba mansa, building, road, JUMO hill.
16.07_4_NESW	10/28/2021 11:43am	100-0217	36.28754601	-106.0562192	S	Cholla/fence @20' @180º	Russian olive @344' @180º				Shrubby big sage, cholla, fence, field of Russian olive.

		100-0218			W	JUMO @44' @270°	Cottonwood @650' @285°				Cattle trail, JUMO, cholla, rocky, cottonwood, JUMO hill.

Appendix II - Photos

2016: Ojo Caliente 16.07_1_N View facing north inside of polygon 2.

2021: 16.07_1_N

2016: 16.07_1_E View facing east inside of polygon 2.

2021: 16.07_1_E

2016: 16.07_1_S View facing south inside of polygon 2.

2021: 16.07_1_S

2016: 16.07_1_W View facing west inside of

2021: 16.07_1_W

2016: 16.07_2_N View facing north inside of

2021: 16.07_2_N

2016: 16.07_2_E. View facing east inside of polygon 2.

2021: 16.07_2_E

2016: 16.07_2_S View facing south inside of polygon 2.

2021: 16.07_2_S

2016: 16.07_2_W View facing west inside of polygon 2.

2021: 16.07_2_W

2016: 16.07_3_N View facing north inside of polygon 7.

2021: 16.07_3_N

2016: 16.07_3_E View facing east inside of polygon 7.

2021: 16.07_3_E

2016: 16.07_3_S
View facing south inside of polygon 7.

2021: 16.07_3_S

2016: 16.07_3_W View facing west inside of polygon 7.

2021: 16.07_3_W

2016: 16.07_4_N
View facing north inside of polygon 8.

2021: 16.07_4_N

2016:
16.07_4_E
View facing east inside of polygon 8.

2021:
16.07_4_E

2016: 16.07_4_S View facing south inside of polygon 8.

2021: 16.07_4_S

2016:
16.07_4_W
View facing west from inside of polygon. 8.

2021:
16.07_4_W

16.07 Plot Photos 2016

N from PC

E from PC

S from PC

W from PC

PC

16.07 Plot Photos 2021

N from PC

E from PC

S From PC

W From PC

PC

Appendix III – Current monitoring methods available

Low-intensity methods

- Where: happens on all sites with GRGWA projects
- Method name: NMRAM (New Mexico Rapid Assessment Method v 2.1)
- Time required: 3 hours – half day/ site
- Repeat: done once pre-treatment and in 4-5 year intervals post-treatment
- Basics: mapping vegetation communities (by vertical and horizontal structure), recording dominant vegetation in each strata (trees, shrubs, herbaceous), assessing fuel load, noting soil surface condition and native/exotic ratio at all vegetation levels, photo points
- Any on-site impacts or materials: none

High-intensity methods

- Where: happens on select sites, in addition to low-intensity monitoring

Submethod name 1: BBIRD or BEMP vegetation plots (depends on treatment area size)

- Time required: approx. 2 hours/site
- Repeat: both pre-treatment and in 4-5 yr intervals post-treatment
- Basics: larger plots and transects documenting vegetation, photo points
- On-site impacts or materials: rebar and cap

Submethod name 2: Brown's transects

- Time required: 1-1.5 hours/site
- Repeat: both pre-treatment and in 4-5 yr intervals post-treatment
- Basics: transects to calculate fuel loading and fire behavior, photo points
- On-site impacts or materials: rebar and cap

Submethod name 3: BEMP-adapted Groundwater Well Monitoring

- Time required:
    - Initial installation: 1-2 hours/ well (ideally 2+ wells/site)
        - Repeat: maintenance as needed, should be minimal
    - Data offloading: 10-20 minutes/well
        - Repeat: at least annually (this is when we anticipate datalogger will be full and batteries will need to be changed)
- Basics: install a well with a sensor which records groundwater level and temperature once an hour year round; this will reflect changes due to seasonal variation, vegetation growth, irrigation, etc.
- On-site impacts or materials: shallow monitoring well (consists of capped PVC pipe extending into the ground about 3 feet below the water table and above ground approx. 2 feet (can be painted earth tones); well contains a datalogger (pressure transducer) suspended on a cable into the water); well should be protected from cattle grazing (so may require rebar around pvc visible above ground)

Appendix IV - 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.

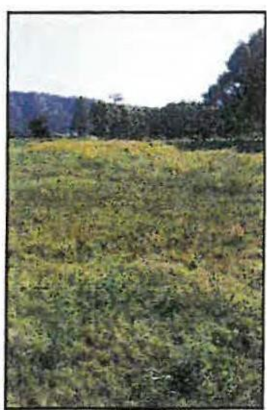
Young tree and shrub layer only (15-5 m [4.5-15 feet]) covering >25% of the area of the community (polygon). Stands dominated by tall shrubs and young trees, may include herbaceous vegetation underneath the woody vegetation. Photograph on San Francisco River by Y. Chauvin, 2012.

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.