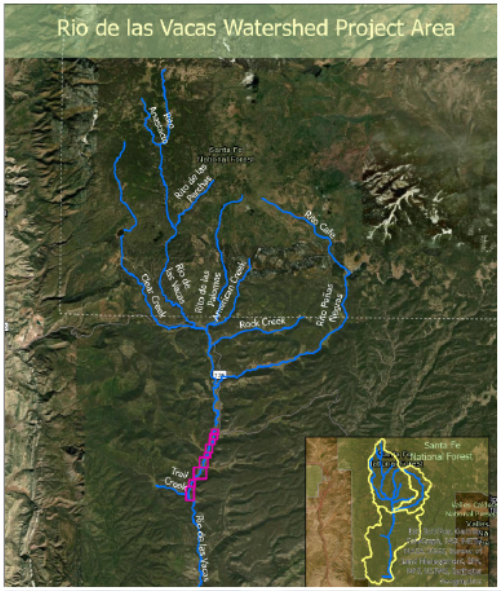
Rio de las Vacas Riparian Restoration



- Streams and riparian areas on lands managed by the U.S. Forest Service in the Rio de las Vacas watershed are highly degraded due to historic and current land use impacts such as cattle grazing, removal of beaver dams and woody debris, high density of poorly maintained roads, and recreational activities.
- Many miles of streams are incised and disconnected from their historic floodplains and are lacking in riparian vegetation, woody structure, and beaver populations needed to create healthy, complex, and self-sustaining habitats for fish and wildlife.
- We received input that this watershed would be of interest to look at restoration projects from the perspective of some of the CAC members in 2021. We have worked together (USFS and NMDGF) to develop a comprehensive strategy and approach to restore the Rio de las Vacas Watershed.

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- NMDGF, in collaboration with the USFS will contract the restoration activities.
- Process-based restoration methods are needed to reverse historic and current land use impacts. This includes beaver dam analogs and post-assisted log structures. Structures will slow and deepen the water, induce overbank flows during high water events, and raise the local water table. Restoration activities would also include addition or expansion of ungulate exclosures and planting of willows and other riparian hardwoods.

Estimated Budget for HSP: $1,200,000

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Rio de Las Vacas Riparian Restoration

CHALLENGE?

Channel incision and stream disconnect from floodplain

GOAL?

Increase system resilience including fish and wildlife species abundance and diversity, riparian expansion, increase temporary water storage and flood attenuation.

Background Info

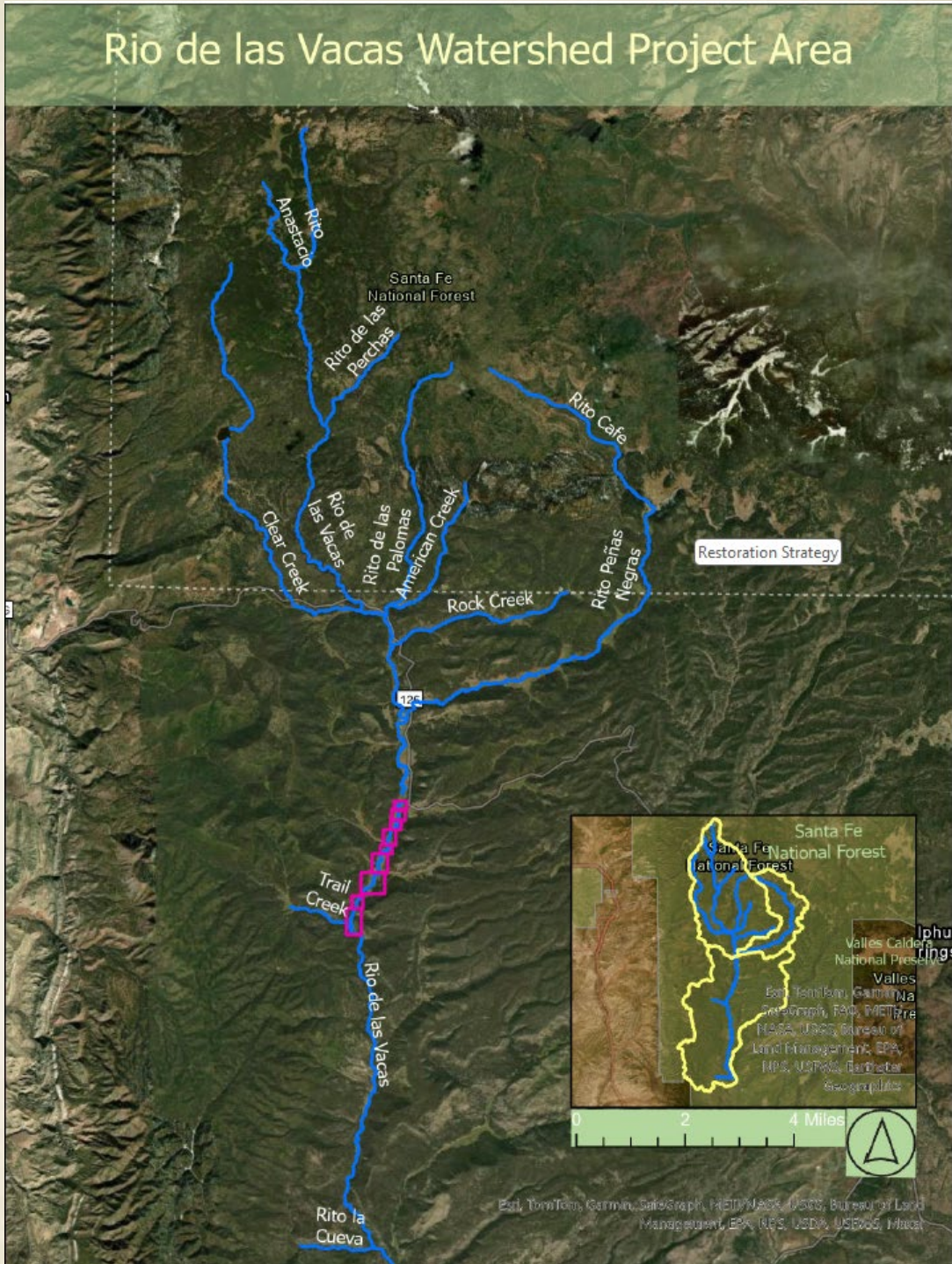
- Streams and riparian areas on lands managed by the U.S. Forest Service in the Rio de las Vacas watershed are highly degraded due to historic and current land use impacts such as cattle grazing, removal of beaver dams and woody debris, high density of poorly maintained roads, and recreational activities.
- Many miles of streams are incised and disconnected from their historic floodplains and are lacking in riparian vegetation, woody structure, and beaver populations needed to create healthy, complex, and self-sustaining habitats for fish and wildlife.
- We received input that this watershed would be of interest to look at restoration projects from the perspective of some of the CAC members in 2021. We have worked together (USFS and NMDGF) to develop a comprehensive strategy and approach to restore the Rio de las Vacas Watershed.

Limited Riparian Vegetation

Incised channels

Disconnected from floodplain

Restoration Overview



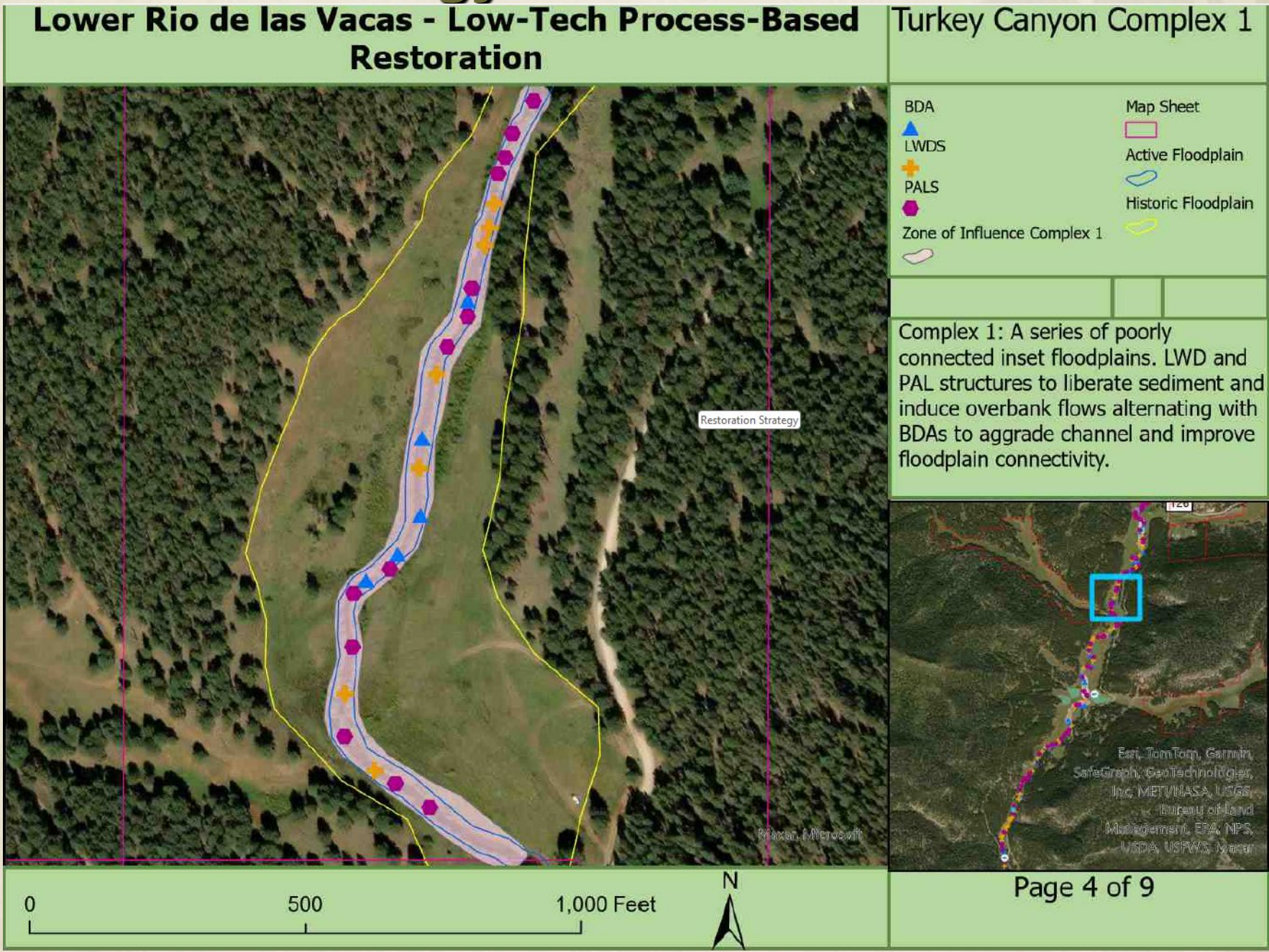
Restoration Strategy

- Process-based restoration methods are needed to reverse historic and current land use impacts. This includes beaver dam analogs and post-assisted log structures designed to reverse the process of channel incision and reconnect the stream with its historic floodplain. Structures will slow and deepen the water, induce overbank flows during high water events, and raise the local water table. This will facilitate the recovery of riparian vegetation and improve habitat for beaver to expand their populations and contribute to ecosystem recovery in the watershed. Restoration activities would also include addition or expansion of ungulate exclosures and planting of willows and other riparian hardwoods.
- Improved riparian and aquatic habitat quality including moderating water temperatures, increasing amount and quality of fish spawning and rearing habitats, and increasing the amount and quality of habitat for riparian-dependent species. The proposed project will also increase resilience to drought and mitigate impacts related to wildfire events.

Restoration Strategy

- Beaver Dam Analogs
- Post Assisted Log Structures
- Large Woody Debris Structures
- Willow, Cottonwood and Aspen Plantings
- Enclosure Fencing
- Targeted Pipe Rail Fencing

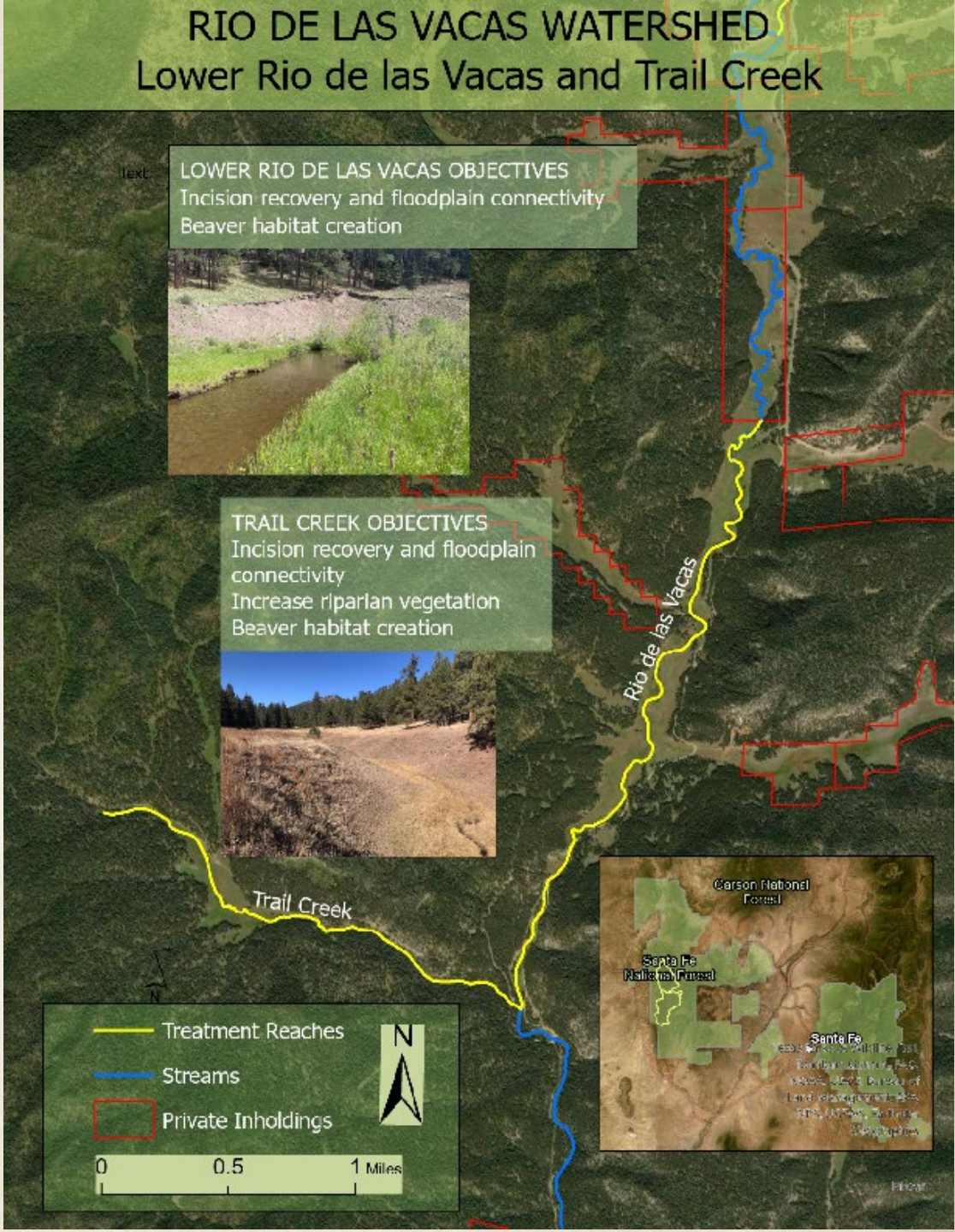
Restoration Strategy



Overview

This effort will be performed over the course of 4-5 years.

This initial proposal is focused on the first half, or 2.5 years of the effort.



Phased Restoration Approach

Habitat Stamp FY25

Desired Outcome

A beaver dam analog on San Antonio Creek that contributed to the expansion of riparian wetlands and aquatic habitat. Salmonid redds are often observed in the clean gravel downstream of the structure, and extensive off-channel rearing habitat for fry were created by the structure. Sightings of muskrat, waterfowl, and herps are also common. Upstream of this structure a beaver family has established a lodge and are maintaining several BDAs.

Summary of Project

- First Two Phases of this project will cost approximately $1,200,000
  - Work can begin this Fall
    - Enclosure Fencing - $250,000
    - Plantings - $250,000
    - In-Stream Structures - $700,000

Project Name: Rio De Las Vacas Restoration Project

Project relation to CAC advice or prioties:

This project benefits both fish and wildlife. It was requested in a public meeting that a restoration project in relation to Rio de las Vacas be developed for future consideration of Habitat Stamp Funding.

Project Specific Details:

This project is the first leg of a larger effort to improve watershed health in the Rio de las Vacas. Initial compliance requirements have been met and the project is shovel ready. A design packet is attached at the end of this document for additional details.

Historical Data:

The watershed was historically impaired by poor grazing management, which has since been altered to be more sustainable. The heritage impairments to the watershed will be systematically addressed in a phased restoration approach.

Itemized Use of Funds:

Enclosure Fencing: $250,000
Plantings: $250,000
Installation of In stream structures: $700,000

Comprehensive Project Analysis:

Please see the attached design packet and presentation for these details.

Monitoring Plan/ Strategy:

The watershed is monitored by the USFS staff, including Range, Wildlife, Fisheries, Hydrologists and other specialists.. As this phase of the project is the first stage of the restoration effort, the implementation will be monitored for success and best practices will be refined as the project moves forward.

Project Emphasis Species:

Trout, Beaver, Elk, Deer, Turkey

RIO GRANDE RETURN

REVITALIZING THE REGENERATIVE CAPACITY OF DAMAGED ECOSYSTEMS

Rio de las Vacas Design

&

Tributary Concept Design and Assessment

Cecil Rich and Reid Whittlesey, Rio Grande Return

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Rio de las Vacas Design and Concept Design Assessment of Tributaries

The section of the Rio de las Vacas between the FS 20 road crossing upstream to the private land boundary was assessed geospatially and surveyed on foot. An 80% design is included in this report for the section, which includes structure types and locations, recommended exclosure realignment, alluvial fan resets, and planting areas with complex objectives and anticipated zone of influence. The remainder of the tributaries and sections of the mainstem Rio de las Vacas were strictly assessed geospatially and verified through cross-checking with the Rio de las Vacas assessment report from 2021 (Whittlesey 2021), with the result being high-level concept designs.

The restoration design for the Phase 1 project reach was based on field assessments that used the Survey123 app (ESRI 2024) to collect and organize PBR project information that is based on a scale-dependent spatial hierarchy as described in Wheaton et al. 2019. The spatial organization framework within a project consists of:

REACHES include segments of the stream network identified to form the primary unit of management within a restoration project. A single reach includes a valley segment that has similar characteristics (i.e., level of incision, valley bottom width, gradient, ecosystem impacts) and restoration objectives. Reaches generally will contain multiple complexes of structures.
COMPLEXES include a group of restoration structures (i.e., wood structures and/or beaver dam analogs) designed to work together to mimic specific processes.
STRUCTURES refer to structural elements introduced to the stream system with the objective of mimicking the form and function of beaver dams and woody debris accumulations.

Figure 1. A Beaver Dam Analog (BDA) on San Antonio Creek

Treatment types

In-stream structure types are generally categorized into three types of structures: beaver dam analogs (BDAs), Post Assisted or Assisted Log Structures (PALS/ALS), and Large Woody Debris Structures (LWDS). The objective of BDAs is largely to raise the water table, facilitate aggradation of the channel and floodplain reconnection, and to develop pool habitat to improve fish habitat and create refugia for beaver. PALS and ALS can be built in several different forms, from channel-spanning, center-channel mounted, or bank attached depending on the objective of the structure. Bank attached PALS and ALS are frequently used to liberate sediment while widening the entrenched channel and development of inset floodplains, whereas center-channel mounted structures are intended to cause island development and braiding of the

Figure 2. A Large Woody Debris Structure (LWDS) following spring snowmelt floods in 2023. Note extensive racking of small diameter debris. The structure helped to facilitate reconnection of the in-set floodplain.

channel. Channel-spanning PALS and ALS may be placed to reduce shear stress on upstream structures (predominantly BDAs), as well as reconnecting floodplains and channels during high-flow events. LWDS are coarser, larger stature structures that will provide in-stream habitat and engage at higher flow stages. LWDS may be built from whole trees (including the rootball) and mimic the natural process of wood recruitment into the channel.

All in-stream structure types will benefit the habitat condition of the channel, which is currently in a highly uniform state, with a low pool to riffle ratio, poor sorting of in-channel sediments and a deficiency in woody debris, a metric which the PALS/ALS and LWDS will directly address. BDAs and channel-spanning PALS will positively affect the pool-riffle ratio and help entrain fine silts, sands, and clays, whereas other structure types will promote fluvial-geomorphic processes to develop clean gravel pointbars, scour pools, and backwater channels, among other features.

Additionally, several alluvial fan re-sets are identified within the design plan. The targeted fans have incised, reducing the water holding capacity of the feature. Re-setting the fan entails reconnecting the current channel to the pre-incision elevation, accomplished by a series of earthen plugs paired with lead-outs to promote aggradation of the incision trench and restoration of dispersed sheet flow across the feature.

Figure 3. A Post-Assisted Log Structure (PALS) on the Rio Cebolla, Jemez Mountains

Low-Tech Process-Based Restoration Reasoning for a Phased Approach

Streams in the upper Rio de las Vacas watershed have been significantly altered from historical conditions due to the extirpation of beaver and land uses including timber removal, road building, livestock grazing, and fire suppression. These activities removed the structural elements such as beaver dams and woody debris that are critical for creating functioning aquatic habitats leading to extensively degraded conditions over the course of the last 300+ years.

The restoration goal for stream systems in the Rio de las Vacas watershed is to restore the hydro-geomorphic processes that maintain complex

Figure 4. A whole-tree LWDS on San Antonio Creek that caused scour pool development and deposited clean, sorted gravels. Extensive redds were observed at this site.

aquatic and riparian habitat, channel-floodplain connectivity, and high groundwater tables and water storage. This is accomplished through an iterative process of adding structural elements such as beaver dams or beaver dam analogs, and woody debris to streams to facilitate the development of a multi-threaded channel network across the entire available floodplain. Because process-based restoration relies on periods of high streamflow such as large spring runoff or summer monsoon events to do the hydrogeomorphic work of restoration rather than large earth-moving equipment, this occurs over a period of years and can involve multiple interventions as part of an iterative restoration treatment.

In some sections of the valley where there is little to no channel incision, restoration goals may be achieved in a single process-based restoration treatment, while in other areas where the channel is more deeply incised, multiple treatments may be needed. Where the stream channel is significantly incised, the objective of the first treatment phase may be to widen and aggrade the channel within an in-set floodplain. Aggradation in this first phase of treatment will likely be limited to the current channel width. Objectives for subsequent treatments could include increasing lateral connectivity and the development of a multi-threaded channel to increase the proportion of the valley bottom engaged. Correspondingly, the zone of influence (ZOI) of each complex will change over the course of subsequent treatments. Each additional treatment will expand the anticipated ZOI with the eventual goal of having the ZOI encompass the entire historic floodplain.

Figure 5. An entrenched reach within the Rio de las Vacas project area. Note the inset floodplain and limited riparian wetland width. In-channel complexity is limited.

Planned Phasing

Two areas within the project boundary on the Rio de las Vacas are recommended to be implemented in later project phases. The first is the Trail Creek Complex. Extensive recreational use of the floodplain and stream banks should be addressed prior to an in-stream treatment. The second is the reach from FS 20 downstream to the Girl Scout Camp boundary. Currently there is recreational use that restricts the restoration potential of the reach. Additionally, as floodplains are reconnected within the unconfined reaches, the peak hydrograph will lessen, allowing for increased resilience of structures within the downstream, moderately confined or confined reaches.

Deciduous Riparian Plantings

Number of plantings includes 36,000 willow, 300 cottonwood, and 200 aspen. The material will be planted across the historic floodplain in areas where the groundwater is within 6' of the soil surface. Planting densities will mimic the groupings of natural willow breaks and cottonwood stands, with groves of aspens interspersed. The goal is to create a mosaic habitat, with a high degree of variability between average canopy height, stem density, and spacing between groupings. The objective of the plantings is to provide overwinter forage and building material for beaver, a source of wood recruitment into the channel and floodplain, wildlife habitat, and increased stream shading. Plantings will be composed of site-appropriate species (including *Populus angustifolia, Salix bebbiana, S. amygdaloides, S. exigua, S. ligulifolia,* and *S. scouleri*). Source sites will be of an appropriate elevation with similar temperature regimes.

Figure 6. Planted deciduous riparian species are seen on the left side of the photo within the elk exclosure. Under the restoration plan, the plantings will be extended across the historic floodplain.

Cottonwood and willow will be harvested and planted as cuttings. The aspen will be planted as rooted stock that was started either from local seed or collections of rhizomes. Cottonwood and willow will be harvested and planted within the same season, whereas the aspen will require a grow out period of up to 2 years. If seed or rhizome grow-out is infeasible, other commercial purchasing options will be assessed.

Cattle/Elk Fencing

Exclosures will be needed to re-establish riparian woody vegetation across the historic floodplain, which serves a crucial role in the restoration of ecological processes and function to the riverscape. Proposed locations are intended to be just that: proposals. It is anticipated that the final locations will require significant stakeholder input and feedback from USFS district staff, permittees, and other stakeholders such as conservation and fishing groups.

Elk exclosures are recommended due to evidence of high browse pressure within areas excluded from cattle. In the absence of wolves, elk browse pressure can exceed the tolerance of willow, either leading to long-term stunting or local extirpation. Willow outside of elk exclosures but within livestock exclusionary fences were observed to be experiencing sufficient levels of elk browse to inhibit growth to a mature, within the Red Top and Telephone Canyon reaches.

Figure 7. Elk-browsed willow plantings.

Exclosures are intended to be temporary and to be removed when set parameters are reached, with the goal being achievement of a mid-seral stature of planted willow stands. This duration can vary from 10-20 years depending on elevation, landform, hydrograph, occurrences of fence cutting or damage from wildlife or livestock, water table elevation and fluctuation, and source material viability. Four-strand, wildlife friendly fence may be substituted for elk fence in areas that are more geologically confined with less concentrated elk pressure yet persistent cattle pressure, however it is not recommended that the substitution be made ubiquitously as it will prevent or delay the project goals from being met.

Currently there are 11 elk exclosures within the project area between 1-4 acres in size. Few of them incluide the entire historic floodplain. The recommended course of action is to remove the existing exclosures and realign them to span the historic floodplain, reducing the total number of exclosures but increasing the size. Larger exclosures are less of an impediment to wildlife and recreational access and are visually less disruptive to the viewshed. Exclosures will be built with gates and/or walkthroughs to allow for access and can be fitted with one-way wildlife gates to prevent injury to livestock of wildlife that manages to get inside the exclosures.

Overview of Current Conditions in Project Area

Many of the headwater streams in the Jemez Mountains are significantly altered from their historical condition. The Rio de las Vacas and tributaries are no exception. Most stream reaches within the project and concept assessment area have incised, reducing floodplain access, and riparian wetland width, causing a diminishment of associated ecosystem services and wildlife habitat value. Paleo channels on isolated, historic floodplains depict historically meandering and braided systems, with greater floodplain access. Streams are now largely single-threaded, deficient in LWD, and with low channel complexity. The riparian wetland width is minimal, with willow, alder, and cottonwood coverage low. Riparian wetland extent is reduced to a narrow band on an often recessed and instable floodplain terrace that is often as much as 1/10th the width of the pre-disturbance wetland extent.

In-channel complexity is low in many reaches. Streams are dominated by riffle complexes, with few pools. Hoof shear on banks has contributed to laid-back bank development, with few sites with overhanging banks and narrow, deep, channel dimensions. Generally, channels are overly widened, shallow, and experiencing high solar loading rates with pool to riffle ratios much less than the historic norm. Due to the historic channelization, the water storage capacity represented in these watersheds is much less than prior to degradation or after a concerted, multi-phase restoration treatment regime following the recommended prescriptions. During flood events, due to the poor overall floodplain connectivity and channel complexity, compounded by a reduction in riparian vegetation, there is a reduced level of infiltration and peak hydrograph attenuation associated with overbank events.

Figure 8. An overly simplified and linear stretch of the Rio de Las Vacas

Several tributaries in more remote locations of the watershed that have steeper gradient, more confined geography, are in better condition overall. The proximity of hillslopes in a confined channel allows for more LWD recruitment into the stream, leading to more pooling, more readily accessible floodplain access, and improved aquatic habitat. At least two tributaries in this category were found to retain a beaver dominated condition and exhibited robust riparian wetlands, perched water tables, and very high value habitat as well as a much greater water storage capacity.

Beavers are present in the watershed but only in a very small remnant population on the main stem of the Rio de las Vacas (June 2024). Landowners and permittees in the area expressed support of beaver populations (personal conversation with R. Whittlesey) and believed that the beavers have been depredated by hunters or recreationalists without proper permitting. The extent of beaver activity has been noticeably reduced in the last twenty years, from activity occurring on the Rito Café, Rito Peñas Negras, Rito Luterio, Rio de las Vacas, and an unnamed tributary of Trail Creek into the mid-2000's (2002 USFS Rio de las Vacas Stream Assessment).

Figure 9. A new active beaver dam on the Rio de las Vacas.

Historic sign of beaver dams is ubiquitous across all tributaries, with dams occurring from headwater springs to the main stem Rio de las Vacas. Some of the dams are up to eight feet tall and span over 200 yards, reaching from the toe of the hillslope on both sides of the valley. Relic dams that are unmaintained are still supporting increased wetland conditions and perennial flow. For example, segments of American Creek were found to be flowing downstream of relict complexes when most of the reach was dry during 2020 and 2021 assessments. Under this historic beaver dominated condition, the water storage capacity, riparian wetland area, and resilience to droughts, floods, and wildfire, were much greater than the current condition.

Springs within the Rio de las Vacas are generally in a degraded condition. Wetland vegetation coverage is much reduced, and soils are locally destabilized due to browse, hoof shear, and wallowing by livestock and ungulates. Semi-intact springs were discovered in remote, densely forested locations that prevented concentrated use due to extensive windfall inhibiting access.

The Rio de las Vacas is habitat to three sensitive fish species, including Rio Grande chub, Rio Grande sucker, and Rio Grande cutthroat. The New Mexico Meadow Jumping Mouse and Mexican Spotted Owl are also located within the watershed.

Rio de las Vacas Lower Reach – Private Land Boundary to FS Rd 20:
Stream section where 80% Design was produced

In this reach of the Vacas, which is entirely within USFS jurisdiction, the stream condition is less degraded than the upstream, private land dominated reach. Numerous past projects have had positive influence on the reach aiding in holding the channel grade and revegetating the reach with woody riparian species. It is the only site within the project boundary that had an active beaver population during the time of survey. Willow and cottonwood are abundant within the reach, both of natural and planted origin, with much greater concentrations within the elk exclosures or riparian pasture fences that were constructed during past restoration projects. Alders are also abundant and recovering through natural recruitment following the reduction of browse pressure facilitated by the exclosures.

While the woody component is present, it is all in early to mid-seral age class, particularly the cottonwood which will account for the bulk of large diameter LWD recruitment in time. The stream is largely single-thread, isolated from its historic floodplain due to being incised, is riffle dominated, has high solar loading, and is lacking habitat complexity. Several limited and non-contiguous sections of the stream have multi-threaded channels caused directly by beaver dams.

Figure 10. A representative photo of the Telephone Canyon Reach on the Rio de las Vacas within the project area. The stream is lacking habitat complexity and is largely disengaged from the historic floodplain, with a reduced riparian wetland and limited willow.

Several segments of the reach have a narrow floodplain that is caused by valley wall constrictions. These segments often exhibit a higher density of alder and willow, contributing to stream shading, bank stability, and a higher degree of channel complexity. Three segments (separated by more confined segments) have a wider historic floodplain available, yet overbanking only occurs during large, greater than a 5-year average flood events due to the incision of the channel. Relict channels are evident on the floodplain, illustrating a more meandering, braided stream with much greater floodplain connectivity.

Two springs are found in the reach, both originating from hillslopes adjacent to the floodplain. One spring enters from river left towards the upstream end of this designated reach. It is outside of an existing exclosure, and correspondingly is experiencing heavy browse pressure. The second spring is midway down the reach and enters from river right near an old homestead ruin. This spring is more prolific and contributes to off-channel wetlands. Browse pressure is impacting the vegetation composition at this location as well. Both springs were likely fen complexes prior to degradation.

Tributaries assessed geospatially and verified through past field-based surveys for concept design treatments.

Clear Creek

Clear Creek from San Gregorio Reservoir to the Rio de las Vacas Boundary is 5.37 miles long and is listed as being impaired for E. coli, nutrients, and temperature. The stream varies in condition from having characteristics indicative of a highly functioning stream, to locally degraded, deficient in LWD, pools, and complexity, with acute pollutant loading from campers and cattle. The high degree in variance between segments can partially be explained by accessibility and proximity to access roads and windfall density along the stream corridor. Cattle fences are in disrepair throughout the area.

Figure 11. A functionally intact reach of Clear Creek. A geologically confined condition has limited excessive browse pressure from elk and livestock.

FS Rd 70 parallels the stream channel as it nears the San Pedro Parks boundary, which provides easy access to the stream by campers. Sites with extensive vehicle access had human waste, trash, OHV related erosion, campfire rings that locally eliminated groundcover, and poor bank stability. Analysis to determine the source of E. coli is recommended.

Non-system roads are actively contributing fine sediments into the stream. The heavily degraded areas are not continuous along extensive segments of streams. Geologic changes in the landform that inhibit access as well as trail divergence away from the stream or increasing downed and dead density can shift the stream from a heavily impacted, poor condition to relatively healthy.

Above the confluence with the Rio de las Vacas, Clear Creek has incised from its historic floodplain, and has a reduced meandering pattern and channel complexity. Once it crosses Hwy 126 and enters a geologically confined canyon, the cattle, elk, and recreational traffic lessens substantially, allowing alder and willow to flourish. Many natural LWD complexes are found in this reach, and channel complexity is high. Once FS Rd 70 gains proximity, local degradation occurs in sites, and cattle access, where available, contributes to bank erosion, pressure on willows and alders reducing their stature and shading capacity, and directly impacting water quality through waste introductions.

Rio de las Vacas – Clear Creek to San Pedro Parks Wilderness Boundary

Upstream of the confluence with Clear Creek, the Rio de las Vacas extends 5.8 miles to its headwaters in San Pedro Parks. The Rito Perchas joins the Rio de las Vacas and is a small, first order tributary largely

within the San Pedro Parks Wilderness. The Rio de las Vacas headwater reach is impaired for sediment/siltation, and turbidity. It is a pure strain Rio Grande Cutthroat stream, with a fish passage barrier upstream of the Rio de las Vacas campground.

Overall, the Rio de las Vacas from Clear Creek to the wilderness boundary is in good condition. It is a remote stretch, with relatively steep hillslopes on either side, which has inhibited the valley bottom from being used extensively for trailing. Dense alder, willow, and mixed conifer from the slopes make it an impenetrable thicket in places. Bedrock controlled cascades are relatively disrupted from their historic condition. LWD components in the reach are high, with active recruitment still occurring.

Figure 12. A woody debris jam creating pooling habitat on the upper Rio de las Vacas. Extensive hoof shear and browse are reducing function.

There was no sign of beaver in the reach, although many segments provide habitat. Dam building material is plentiful in this reach. Pools, and pool depth, may be a limiting factor by not providing sufficient refugia to support a beaver during colonization efforts prior to dam construction.

Segments of the stream in this reach would benefit from increased pooling, floodplain connectivity (where floodplains are found in the confined channel), and increased channel complexity, particularly in side-channel development and anabranching.

Rito de las Palomas – Headwaters to American Creek Confluence

Rito de las Palomas extends 5.8 miles from the confluence with the Rio de las Vacas. It is predominantly a high gradient, confined stream, with occasional segments with small floodplains. It is listed as impaired for exceeding TMDLs for sediment/siltation and turbidity. The upstream extent is near the intersection of FS Rd 70. At that point the stream was intermittent and losing riparian vegetation composition. Above the

Figure 13. Cattle and elk trailing causing erosion and contributing to sediment inputs to Rito de las Palomas

crossing, while depicted on maps as being a perennial stream, it was dry and dominated by upland associated species.

Rito de las Palomas is remote, with much of the reach inaccessible by vehicle or machine. Both valley walls are relatively steep – averaging about 14 degrees. Forest coverage is dense, continuing to the valley floor. Mature willow and alders are present, with recruitment occurring in some areas on depositional bars and inset floodplains. Cattle and elk impacts are moderate, with hoof shear and trailing impacting banks and acting as a source for sediment input into the stream. Antler rub is found on many willows and alder, however not to a detrimental degree. Conifers extend to the stream banks in areas, providing further shading.

Stand densities are high on both sides of the channel. Old stumps of aspen felled by beaver suggest that the forest composition historically was much different than the current state, with aspen stands more common, and conifer densities lower. Due to the hillslope on either side of the channel, sediment inputs even in largely undisturbed conditions will continue. In the event of wildfire, Rito de las Palomas is at a great risk of experiencing debris flows, and downstream flooding.

LWD densities are high and contribute to complex channel morphology throughout. Multiple stream segments are bedrock controlled, with cascading step pools and dense accumulation of LWD. Relic beaver dams are found throughout the reach, some appearing to have been to impound flow from lateral springs on the hillslope. None of the dams that are visible are still intact, although it is likely that historic beaver activity has contributed to elevating the surface area of some of the springs.

Figure 14. Woody debris racking on Rito de las Palomas. Note minimal coverage of willow suggestive of high cattle and elk browse pressure.

Numerous springs enter from both sides of the valley throughout the reach. These are particularly impacted by cattle and elk, with hoof shear and browse negatively impacting soil stability and plant coverage. Trailing to the springs is contributing to channelization of flow. Some springs are still supporting small fens, however the size and number are likely much reduced from the historical extent.

Figure 15. A heavily degraded perennial spring on Rito de las Palomas

Near the confluence with American Creek, the condition of the Rito de las Palomas shifts to a lower gradient, meandering, Rosgen type E channel. Like the lower reach of American creek, it is more incised, with historic channels evident located on the elevated, and now abandoned floodplain. Some willow is present, but it is more impacted than within the confined stream segments with browse pressure impacting the lower shoots that is also limiting natural recruitment and the ability of some stands to exceed a minimal height.

American Creek

Abandoned channels are evident across the valley bottom and stands of willow are prevalent. The current channel is straightened, with poor complexity, limited pooling, and low bank stability. The abandoned channels depict a much more meandering stream that traversed the entire floodplain. The channel is restricted to one side of the valley bottom and scour/deposition processes are limited. The reach appears to be a transport reach, with bank stability decreasing with increased livestock and elk pressure due to drought, and OHV uses accessing the reach via non-system roads. During survey in 2021 the reach was intermittently dry, with very low volume of flow in the wetted areas.

Figure 16. An eroding road crossing contributing sediment into American Creek. Throughout much of the lower reach a non-system user created road parallels the channel.

Relic beaver dams are in the reach, some that appear to have spanned the entire valley bottom. Much of this reach has a non-system two-track running parallel to the channel within the floodplain. It crosses the stream channel numerous times and is eroding in multiple locations, transporting sediment into the channel during runoff events. While it will provide truck and machine access for project implementation, it should be closed to reduce further degradation to the reach. The road appears to originate from within the downstream private land boundary yet is appearing to collect more recreational traffic from other OHV roads that join it. Fuel wood collection was evident within the floodplain, further denuding the already LWD deficient reach.

Downstream of American Park, the stream enters a steep walled, confined canyon. Extensive relict beaver dams are found in this reach, as are willow and alder. While most of the dams are breached, the stream complexity is higher in this reach and LWD is sufficient. Areas are bedrock controlled, with steep cascading pools and good shading that is provided both by vegetation coverage as well as the steep canyon walls. Cattle and elk are largely absent from isolated areas because of large boulders and step pools, allowing other riparian vegetation to flourish.

While it is one of the least disturbed lengths of stream and displays relatively high function, and structurally is nearly a reference reach, it still has reduced connectivity, riparian wetland width, and water storage capacity. Where cattle and elk have access, trailing, browse, and antler rub are contributing to sediment inputs into the stream, channelization, and reduced willow recruitment and growth rates. The reach is much less impacted than other tributary reaches of the Rio de las Vacas.

American park is likely a historic wet-meadow complex at the intersection of an unnamed canyon and American Creek. It is now incised, with low channel complexity, poor floodplain access, and no woody riparian vegetation through the "American Park" meadow. Heavy cattle and elk pressure has denuded the reach of woody riparian vegetation. Bank stability is compromised in areas, with extensive cattle and elk trailing.

Upstream of American Park to the headwaters, the stream is within a relatively confined, low/moderate grade channel, with conifers frequent in the valley bottom. The water table has receded due to channelization caused by cattle and elk related erosion, breaching of historic beaver dams, and the reduction in LWD recruitment. Periodic relic beaver complexes are still affecting the stream condition and are supporting complex flow patterns, elevated water tables, wetland vegetation, and large woody debris at higher frequencies than in other areas. Some of the relic dams are still intact but are beginning to disintegrate.

Figure 16. Hoof shear impacting bank stability and browse pressure reducing shading and woody riparian vegetation on the Rito Café.

Livestock fences are in disrepair in the reach. Cattle use, particularly in American Park, is very high. Elk sign is also prevalent throughout the reach, with browse and antler rub contributing to diminished willow population densities and structure.

Rito Café Headwaters to Rito Peñas Negras

The Rito Café is a relatively remote tributary of Rito Peñas Negras. At 4.49 miles, it is almost as long as Rito de las Palomas and American Creek. Its headwaters are in the Southeastern extent of San Pedro Parks. It has no CWA impairments. It may have a fish passage barrier installed mid-way up. The Rito Café is dominantly a single thread channel, with high levels of shading due to dense forests and narrow, relatively steep-walled valley shape. Numerous relict beaver dams are present, with few continuing to impound water and contribute to

stream complexity. LWD is adequate, with recruitment high from the dense forest contributing through windfall. Stands of willow are continuous throughout, however the age class is uniformly old, and all are impacted by browse and rub from elk and cattle. Grasses and forbs are also heavily browsed. Riparian vegetation is limited to a narrow band along the stream channel except for where springs or relict beaver dams have perched the water table and facilitated greater riparian wetland width.

Extensive windfall in some lengths of the stream contribute to high vegetation coverage and bank stability. Floodplain access is moderately high, with extensive roughness from dead and downed LWD. Where windfall is moderate to low, elk and cattle pressure remains high. Bank stability diminishes in these reaches (most of the stream length), with few overhanging banks, extensive trailing across the stream channel, and heavily browsed vegetation.

Rito Luterio

The stream is largely perennial, aside from several short reaches where the flow is subsurface (though enough to support facultative wetland vegetation), and numerous other springs feed into it downstream of the primary Luterio Spring. The Rito Luterio is also only one of two tributaries found during this survey that remain in a beaver dominated condition, although beaver are currently absent. While there is no current maintenance of dams the extensive infrastructure built by beavers remains largely intact and is allowing the stream to exhibit a markedly different state than most of the streams in the watershed.

Figure 17. Upstream of the beaver dominated reach on the Rito Luterio, the stream becomes more degraded. An active headcut is seen here, downcutting through a spring-fed slope wetland.

Water flow patterns are extremely complex, with surface water often dispersed as sheet flow rather than in a confined channel. The valley bottom consistently exhibits a convex form, with relict beaver dams causing the water to flow from one side of the valley wall to the other. The water table is perched, with surface saturation through much of the length of the stream.

The largest of the dams, visible from FS Rd 70, is similar in size and position to a stock pond. It is still promoting standing water that is attracting use from wildlife and cattle. The dam stands almost eight feet tall and is composed of approximately 7,200 cubic feet of material, with aspen being the most common component. While many of the dams are entirely intact, some, including this one, are suffering from erosion caused by cattle and elk trailing. Without maintenance from beaver, the dams will begin to fail over time. Willow stands are present, some growing from dams, but recruitment is limited due to browse, rub, and hoof shear.

Figure 18. Near Luterio Spring and the Valle Luterio, the channel is actively eroding. A historic slope wetland, or wet meadow is becoming an ephemeral, single threaded channel. Hoof shear and browse pressure are reducing bank stability and vegetation coverage.

Upstream of the FS 70 Rd crossing, the stream becomes more degraded, only intermittently controlled by relic dams, between which it is single thread, with significant trailing and browse. The flow goes subsurface at multiple locations, and appears to dry up, only to repeatedly reemerge in surface flow. Multiple springs contribute; however the headwaters are located at Luterio Spring. The spring itself is heavily degraded, with browse pressure and wallowing diminishing ground cover and inhibiting the establishment of any woody riparian species and reducing stubble height and ground cover. The area immediately around the spring is heavily eroded.

A fence was constructed around the spring and the small Valle that it feeds into within the last couple decades, however, like most of the fences in the district, it is in disrepair and no longer functions to restrict cattle access from the site.

Rito Penas Negras - Upper Reach From FS 103 to Headwaters

Stream channel complexity is low, with high levels of solar loading, bank erosion, and minimal floodplain connectivity due to incision rates. A stock pond is located near the Forest Service boundary that retains water year-round. Downstream of the private land, numerous elk exclosures were constructed by WildEarth Guardians in 2011-2013 and the banks were heavily planted with willow, some narrowleaf cottonwood, and aspen. Three exclosures were constructed. The vegetation inside is thriving, however the fence has been cut repeatedly over the years allowing cattle and elk inside, having a deleterious impact to the riparian vegetation, especially the planted willow and existing alder. The stream is single thread, with low complexity through this reach. Bank stability is high, allowing the formation of stable undercut banks. The areas within the exclosures are in a condition to benefit from in-stream treatments.

Rito Peñas Negras FS Rd 103/70 to FS Rd 527

The reach between FS Rd 103 and FS Rd 527 is confined, with greater stream shading, a reduced floodplain, and extensive relict beaver dams. At numerous locations the stream is bedrock controlled, with rocky cascades, floodplain access, and complex flow patterns. Natural windfall and a past jack-falling project have led to high levels of large woody recruitment into the stream and onto the floodplain. Cattle and elk access is also somewhat impeded, causing the reach to be less degraded than the open valleys located downstream.

None of the relict beaver dams are still functioning, but complexes are evident throughout the reach, ranging in age from historic (soil development and mature willows growing on the dam) to within the last two decades. In the 2003 USFS stream survey, one of the complexes was still active. It has since been breached

and none of the dams are maintained. No active beaver sign was observed in the area. Numerous Bebb's willow are present in the reach, however there is no recruitment.

Figure 19. Cattle browse in a bedrock-controlled section of Rito Peñas Negras. Bebb's willow are found in this reach, but there is no natural recruitment.

All the fences in this reach (both that run parallel to the stream and that cross it) are unmaintained and permeable. An old fence had been replaced, but the old material had not been removed and was still partially intact. The newer fence was also damaged by windfall and is permeable to cattle at regular intervals. Bank instability is high in areas that are not directly protected by windfall or jackfelling. Several springs are present in the reach, with fen-like wetlands. These sites are especially impacted by browse and wallowing.

FS Rd 527 downstream to beginning of Sawmill Canyon

This is the upstream terminus of the current NFF/RGR project. It extends downstream to HWY 126. Over 200 in-stream structures have been built including BDAs, ALS, and LWDS. More willow planting has occurred, with further efforts planned for 2024/2025. A 25 acre elk exclosure was constructed in 2023 with an additional three exclosures planned to be constructed in 2024/25.

This reach contains the upper-most low gradient, open valley. Several private parcels are in the reach. At the uppermost bounds of the reach (just downstream of the FS Rd 527 crossing) a large relict beaver dam complex is present. It has breached and is not maintained. Willow stands that supported the beaver complex are much reduced due to cattle and elk browse. Stream cover is minimal, with woody riparian vegetation absent. The stream is channelized, single thread, and with a reduced riparian wetland extent.

Numerous springs identified on maps in the reach are largely dried up and would fail to meet ACOE Wetland Status through not exhibiting wetland hydrology and/or vegetation. Ben Spring, a named spring on USGS maps, is no longer discernible. A tributary drainage has a larger slope wetland complex that is significantly impacted by cattle.

Stream channel complexity is minimal outside of treatment areas. LWD is absent and potential recruitment is limited to what can pass through the FS Rd 527 culvert. The culvert is becoming damaged and should be replaced. It is functioning as a fish passage barrier, whether intentionally or not.

Sawmill Canyon Reach (Corral and House Site Tributary)

This is the main valley in Rito Penas Negras. Extensive manipulation of the landscape has occurred in this reach in the past, including contouring berms, seeding of smooth brome, timber harvest, and logging road crossings. The reach is currently very degraded, with active bank erosion, upland erosion, and no woody riparian species recruitment outside of the elk exclosures. Non-point surface erosion is high, due to highly erosive soils and extreme cattle pressure during drought years. Historic beaver dams have been found in the reach that extended upwards of 300' and spanned the valley floor. Paleochannels are evident on aerial imagery showing a much more braided and meandering stream, with an associated broad riparian wetland.

Figure 20. An active headcut migrating upslope in Sawmill Canyon, Rito Peñas Negras. High erosion rates are due in part to soil composition as well as extremely high cattle pressure reducing groundcover and disrupting soils.

Active headcuts are prevalent throughout the reach and contribute to nutrient and sediment loading. Most of the headcuts originated from poor road construction, with some caused by the berms that were built on contour throughout the valley, presumably as a means of increasing water retention rates. At multiple points, the berms have breached and with the concentrated flow accelerating to meet the diminished channel grade, a headcut has formed and migrated up the valley.

Figure 21. RGR Crews building in-stream structures in Sawmill Canyon. June 2024

A prairie dog colony is present mid-way up the valley and is seemingly contributing to increased sheet erosion. Inside the colony, however, the plant diversity is much higher than the smooth brome monoculture found outside of the colony, and impacts to micro-topography are creating non-linear flow patterns with increased infiltration.

Within the reach there are three spring fed slope wetland tributaries. The largest complex is on valley right, near the upstream extent of Sawmill Canyon. Multiple springs are contributing to the wetland complex, and several old Bebb's willow are at the head of the spring, near an old cabin and corral. The second spring is on river right and is a single spring

Figure 22. A spring-fed wetland complex in Rito Penas Negras, Sawmill Canyon. The wetland area is extremely degraded by cattle browse and hoof shear. Elk wallows are also present in the area.

that feeds a smaller historic wetland located within the tree band. All three wetlands are degraded, with heavy pressure from cattle and elk diminishing vegetative groundcover, channelizing flow, and causing erosion.

Extensive LTPBR restoration work is occurring within this reach, with over 200 BDAs and ALS installed from 2021-2024. Four existing exclosures were removed and replaced by a single, 25 acre elk exclosure, and more plantings were added during the spring of 2023. Treatments extend up and downstream from HWY 126 to FS 527.

Red Fern Canyon to HWY 126

Figure 23. Extensive bank erosion on Rito Penas Negras outside of cattle and elk exclosures.

In the reach from the Red Fern Canyon tributary (at the downstream extent of Sawmill Canyon) to State HWY 126, the condition of the stream varies. At the upstream end the valley narrows, to a steeper walled canyon. The WEG exclosures extend into this area, and a riparian pasture fence and willow plantings were conducted by USFS in the 1990's. The willow planting has created a dense coyote willow stand. The riparian pasture fence was in disrepair until it was rebuilt by RGR in fall of 2021.

At the upstream end of the reach, a large alluvial fan from Red Fern Canyon has contributed to the floodplain narrowing prior to the geologic confines of the canyon walls downstream and has caused the upstream length of stream extending into the greater Sawmill Canyon to be very low gradient, even with the significant channelization that has occurred. Several headcuts caused by cattle trailing and road drainage are migrating up the alluvial fan and were treated with erosion control structures in June of 2024.

Figure 24. A BDA on Rito Penas Negras contributing to floodplain connection and riparian wetland development.

Continuing downstream, multiple historic beaver dam complexes are still semi-intact, yet all of them are fully breached. Willow (mostly coyote willow) stands are intermittent. There are some sites of natural recruitment of willow, however the browse pressure – likely by cattle – is high and inhibits proper stand formation or stream shading. The relict dams continue to near the Hwy 126 intersection.

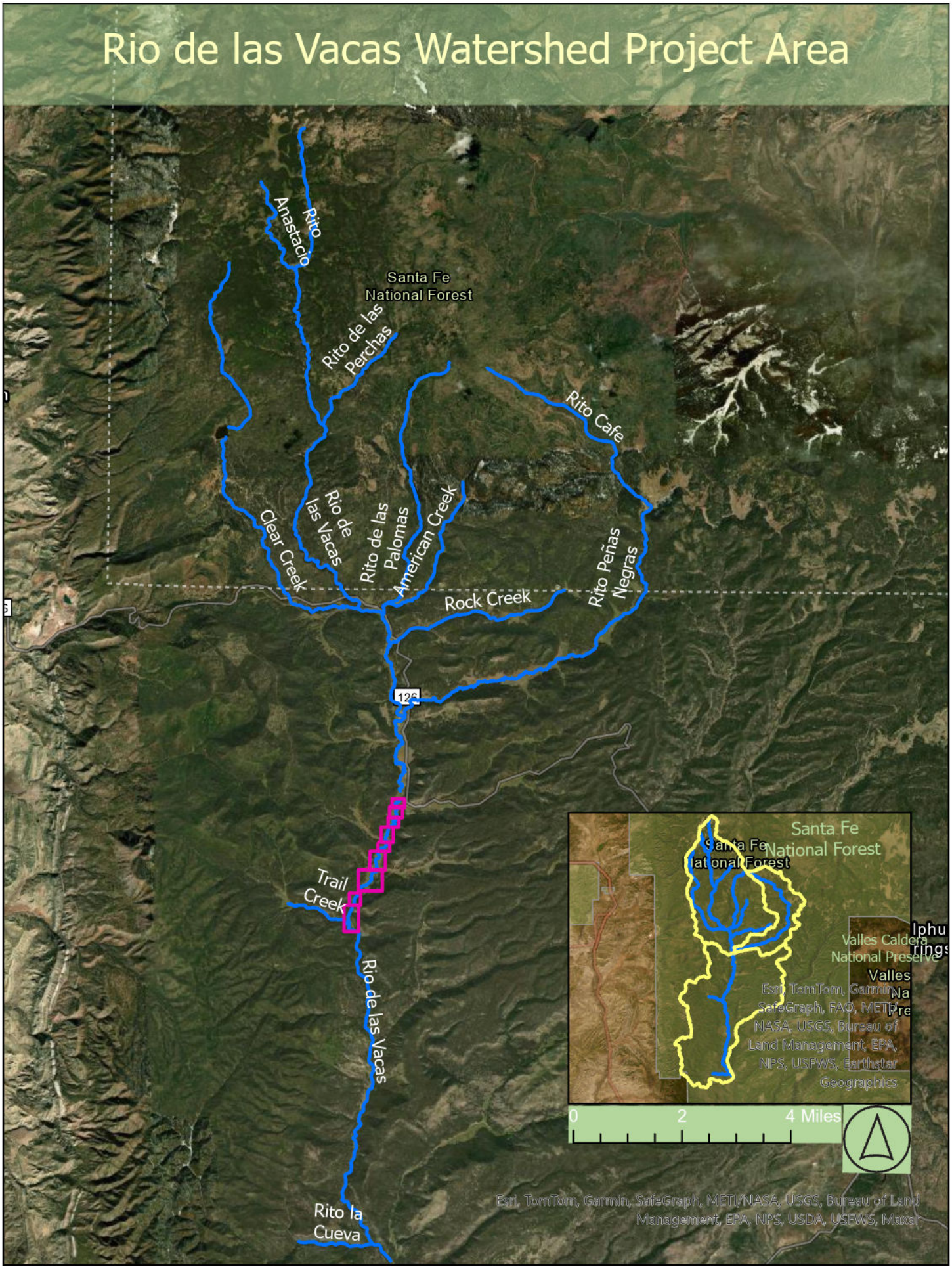
A spring is located on the hillslope of valley right midway down the reach. Surface flow was evident, and a slope wetland was located downslope from the source. Multiple events over time have caused channels to form in the wetland, diminishing the size of the wetland and reducing the water table. It is currently very impacted by cattle and would benefit from exclusionary fencing.

Rock Creek

Rock creek is a four mile long, semi-perennial stream that runs parallel to FS Rd 103 for much of its length. It is not listed as being impaired. The flow originates from multiple springs, most notably a prolific semi-developed spring .8 mi from the confluence with the Rio de las Vacas. This spring has a pipe installed to allow filling water vessels. It is surrounded by a decrepit buck and pole fence that is no longer functioning to exclude cattle from the site. Upstream of this spring, multiple other seeps contribute to a small but perennial base flow that extends approximately 1.5mi. Upstream of this site, it becomes intermittent, with pockets of wetland vegetation around and downstream of seeps. A 90-acre inholding is located along Rock Creek.

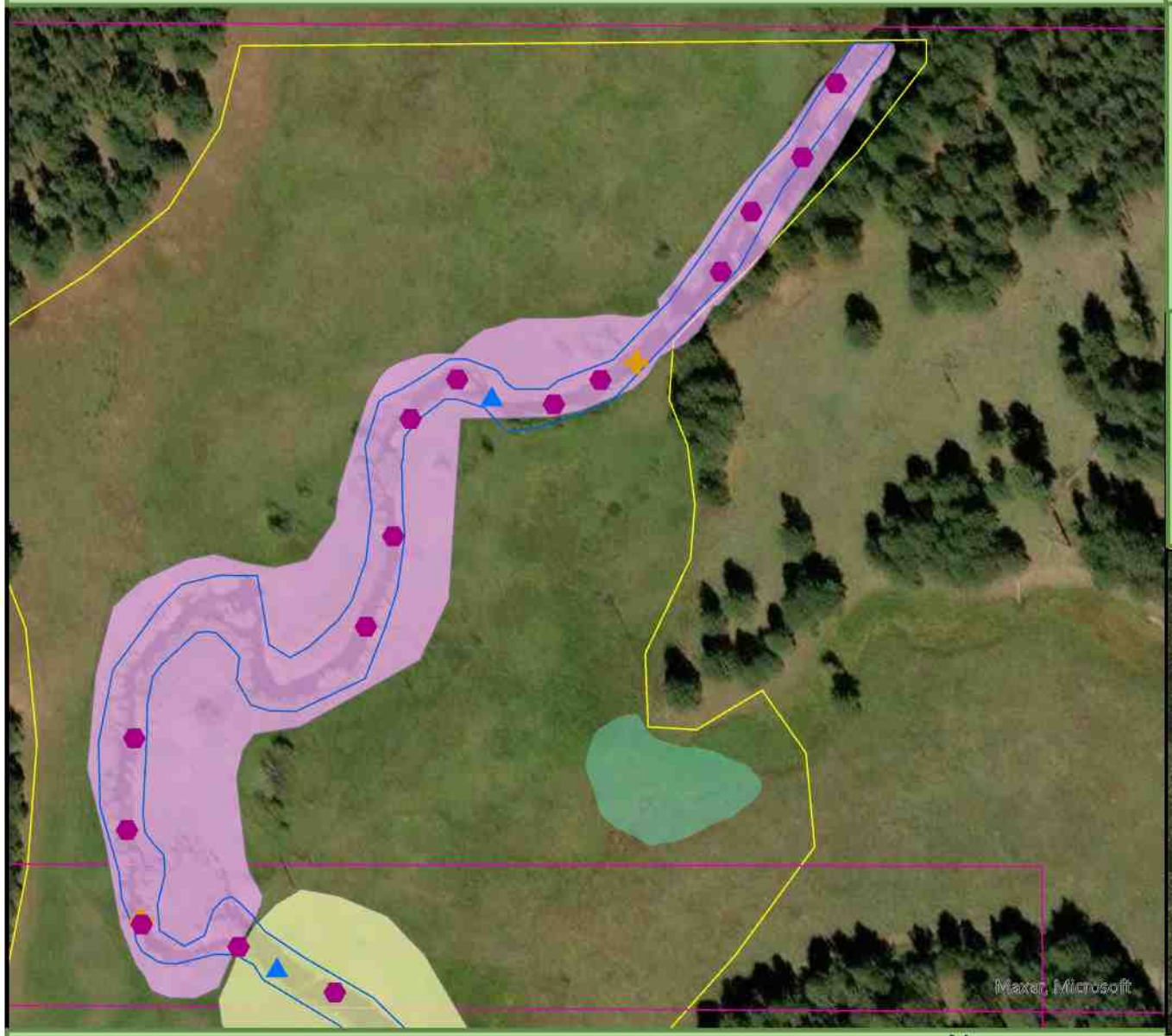
Numerous road drainage issues are located along the length of Rock Creek, including malfunctioning culverts, sediment transporting runoff from poorly drained roads, improperly or non-decommissioned relict logging roads, and user-created non-system roads that have been enhanced through elevated UTV use in the last several years. Sediment inputs from roads are degrading the stream function and impacting wetland vegetation. Culverts in the channel are creating headcuts and scour in locations. FS Rd 103 has several culverts that are clogged, causing ponding and further sediment transport. Recreational use within this area is high and will require recreational management actions to prevent further resource degradation from occuring.

Cattle are having a pronounced deleterious impact on Rock Creek, particularly in the springs, seeps, and perennial reaches of the stream. By the most prolific spring system, the stream has incised nearly eight feet in places. Cattle browse and hoof sheer are inhibiting riparian vegetation growth and are destabilizing the soil through extensive hoof shear. Willow and alder are present but are heavily browsed. Limited natural recruitment is occurring. Throughout much of the perennial length, the stream is incised from its historic floodplain. It is actively degrading in some locations and continues to be impacted through cattle and road drainage issues.


Rio de las Vacas Watershed Project Area
Rito Anastacio
Santa Fe National Forest
Rito de las Perchas
Rito Cafe
Clear Creek
Rio de las Vacas
Rito de las Palomas
American Creek
Rito Peñas Negras
Rock Creek
126
Trail Creek
Rio de las Vacas
Rito la Cueva
Santa Fe National Forest
Valles Caldera National Preserve
0
2
4 Miles
Esri, TomTom, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS, Maxar

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Telephone Canyon Complex 1



BDA

LWDS

PALS

Zone of Influence Complex 1

Zone of Influence Complex 2

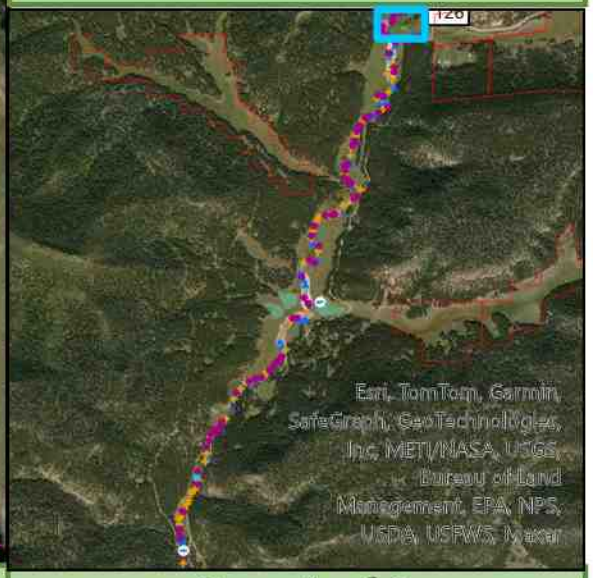
Map Sheet

Alluvial Fan Reset

Active Floodplain

Historic Floodplain

Complex 1: Incised channel with narrow inset floodplain, lacks woody structure. Beaver dam blow out and partly rebuilt. PALS used to source sediment, widen, aggrade, and induce connection with floodplain.



0 325 650 Feet

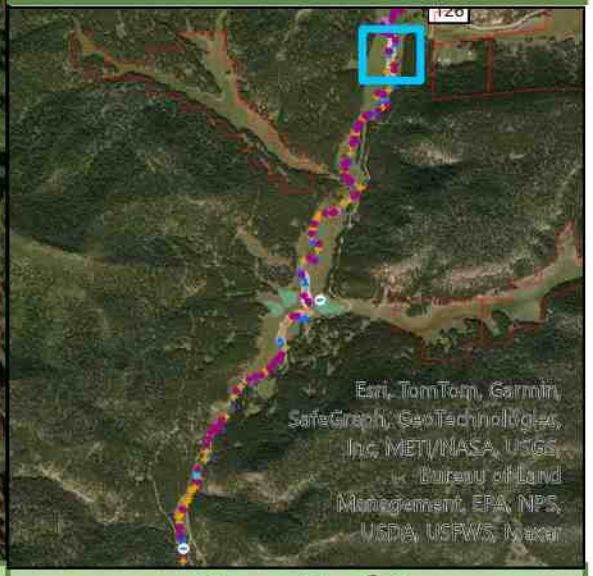
N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Telephone Canyon Complex 2

BDA
LWDS
PALS
Zone of Influence Complex 1
Zone of Influence Complex 2
Zone of Influence Complex 3
Map Sheet
Active Floodplain
Historic Floodplain

Complex 2: Blown out beaver dam and current dam building activity. BDAs to improve habitat for beaver and PALS alternating with BDAs to source sediment, aggrade channel, and improve floodplain connectivity.



0 400 800 Feet

N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Telephone Canyon Complex 3

BDA
LWDS
PALS
Zone of Influence Complex 2
Zone of Influence Complex 3
Map Sheet
Active Floodplain
Historic Floodplain

Complex 3: Channel incised with narrow inset floodplain and lacks woody structure. LWD and PAL structures to liberate sediment and indiuce overbank flows alternating with BDAs to aggrade channel and improve floodplain connectivity.

0 345 690 Feet

N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Turkey Canyon Complex 1

BDA

LWDS

PALS

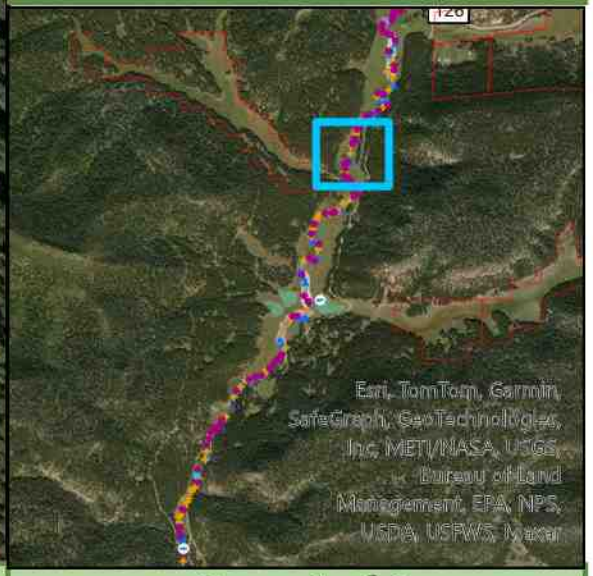
Zone of Influence Complex 1

Map Sheet

Active Floodplain

Historic Floodplain

Complex 1: A series of poorly connected inset floodplains. LWD and PAL structures to liberate sediment and induce overbank flows alternating with BDAs to aggrade channel and improve floodplain connectivity.

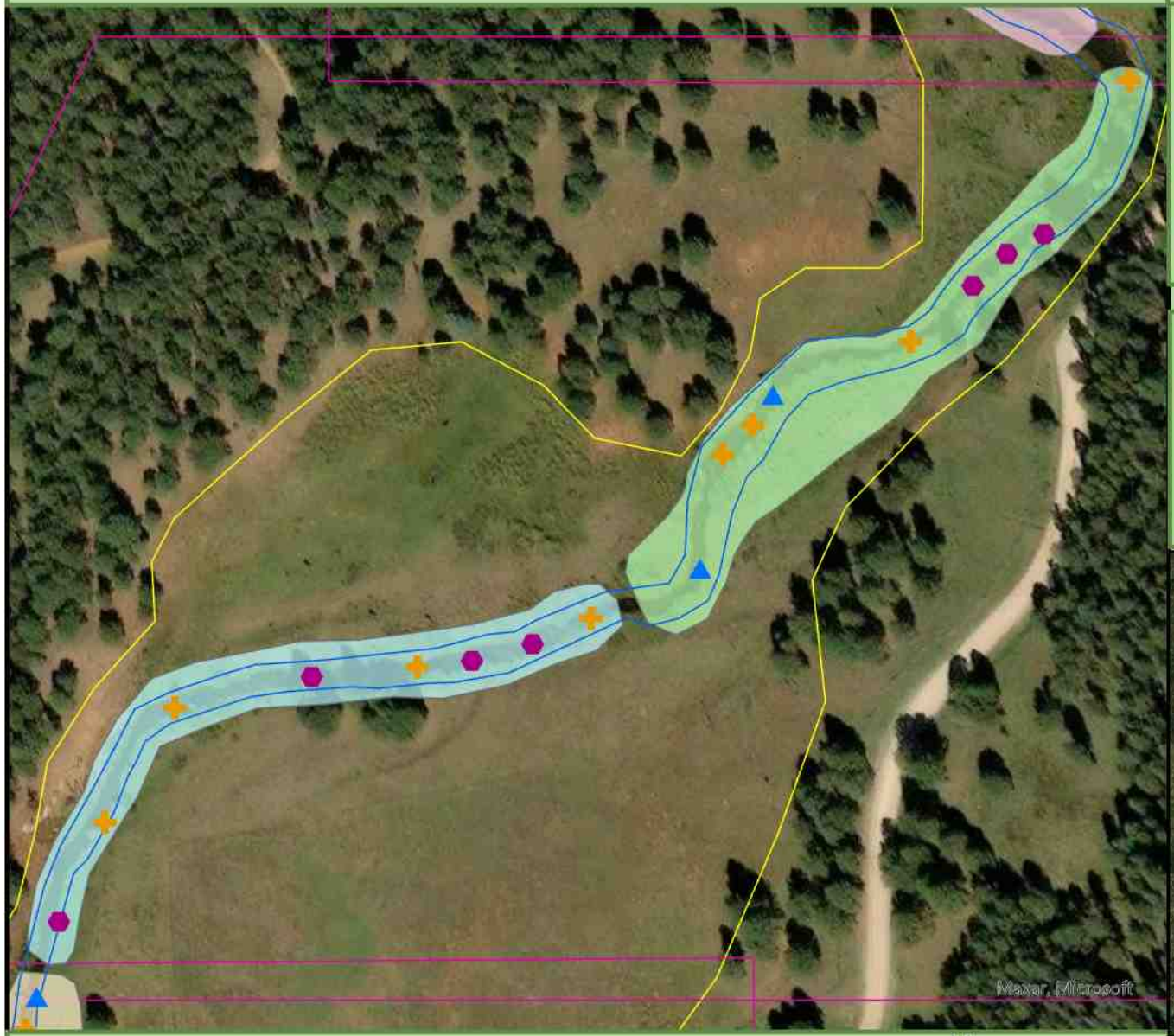


0 500 1,000 Feet

N

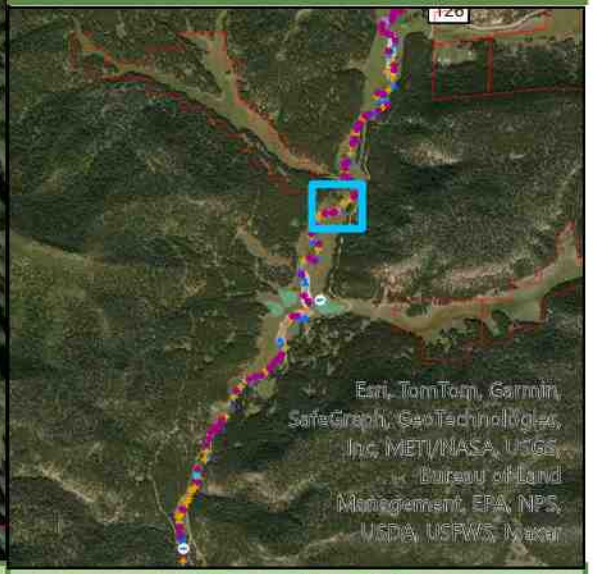
Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Red Top Complex 1-2



BDA
LWDS
PALS
Zone of Influence Complex 1
Zone of Influence Complex 1
Zone of Influence Complex 2
Zone of Influence Complex 3
Map Sheet
Active Floodplain
Historic Floodplain

Complex 1-2: Channel is incised and lacks habitat complexity and woody structure. PAL and LWD structures to widen and aggrade channel, liberate sediments and improve floodplain connectivity at downstream BDAs.



0 345 690 Feet

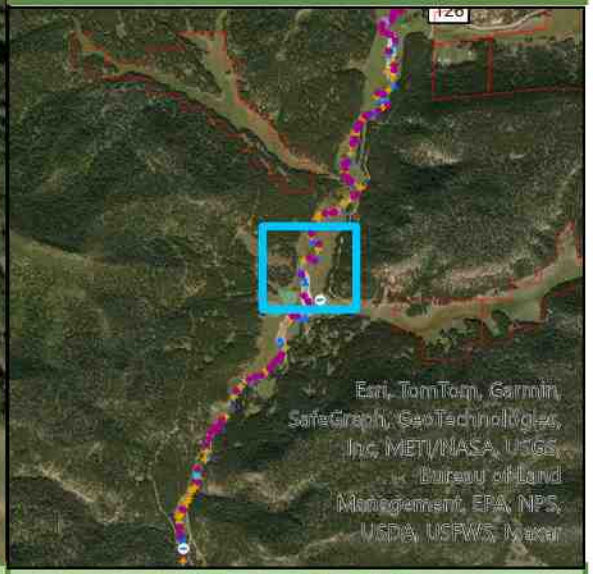
N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Red Top Complex 3

BDA
LWDS
PALS
Water Spreading Structure
Zone of Influence Complex 3
Zone of Influence Complex 4
Map Sheet
Alluvial Fan Reset
Active Floodplain
Historic Floodplain

Complex 3: Channel is incised and has a narrow inset floodplain. PAL and LWD structures alternating with BDAs to source sediments to aggrade channel and reconnect floodplain.

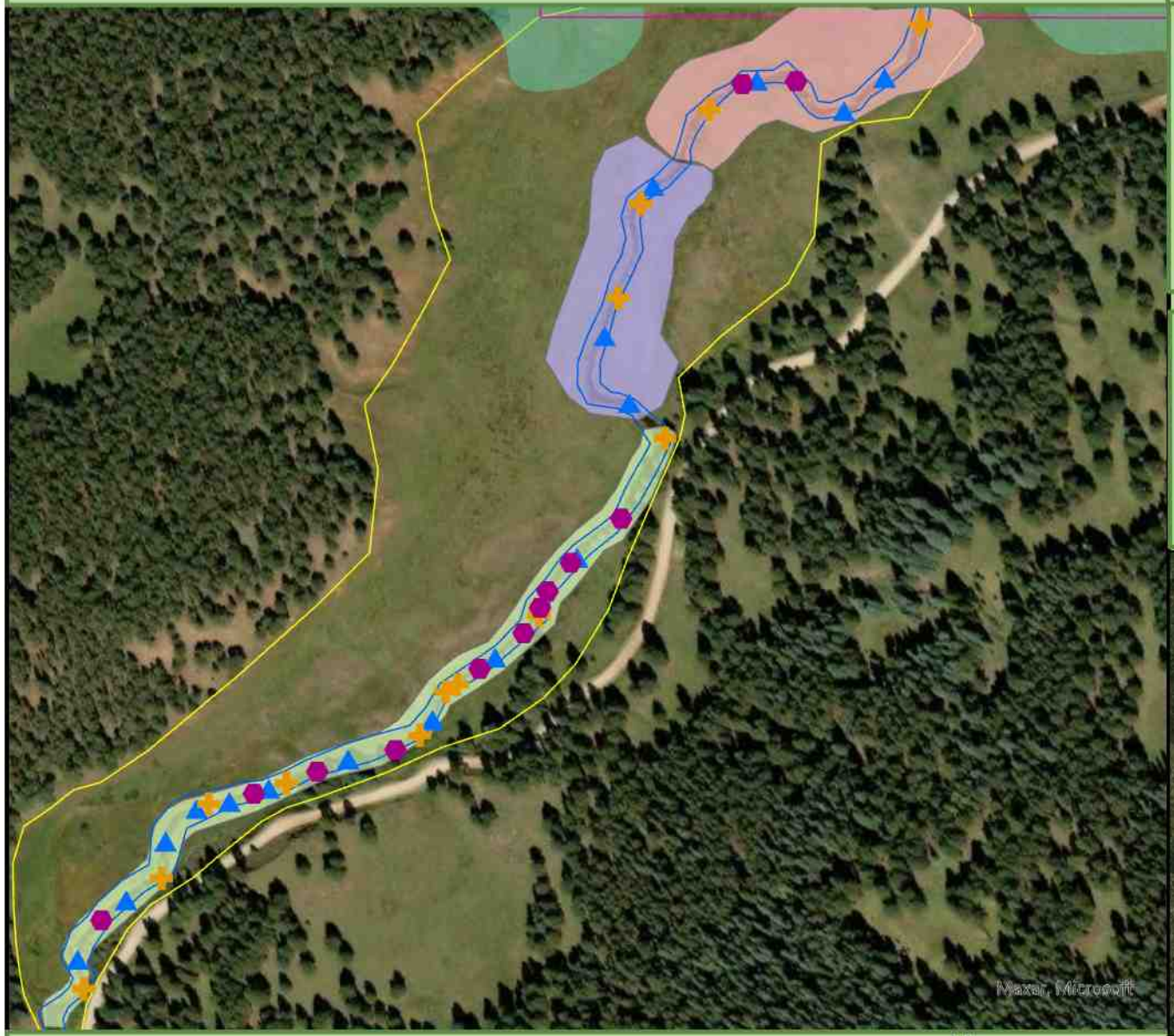


0 500 1,000 Feet

N

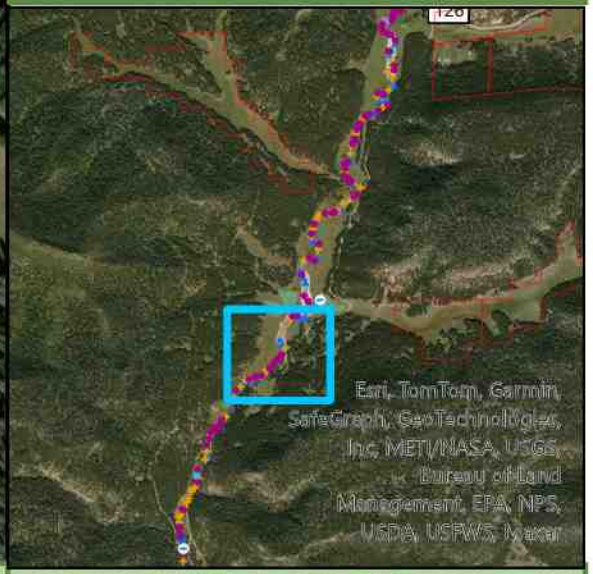
Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Red Top Complex 4-6



BDA
LWDS
PALS
Zone of Influence Complex 4
Zone of Influence Complex 5
Zone of Influence Complex 6
Map Sheet
Alluvial Fan Reset
Active Floodplain
Historic Floodplain

Complex 4-5: PAL and LWD structures to source sediments and aggrade channel at downstream BDAs.
Complex 6: Channel is incised and lacks sinuosity and woody structure.

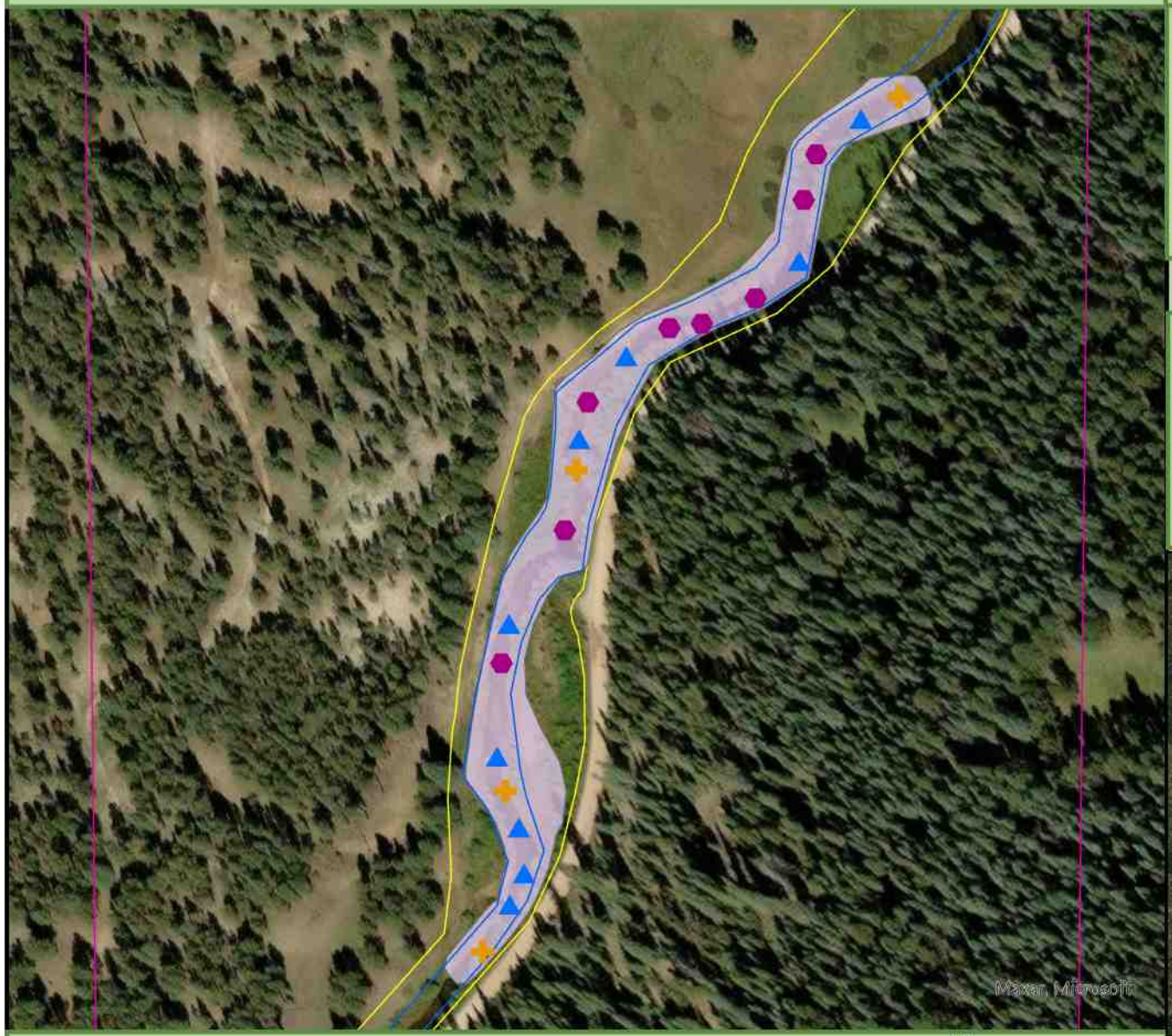


0 500 1,000 Feet

N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Ojo de la Vaca Complex 1



BDA

LWDS

PALS

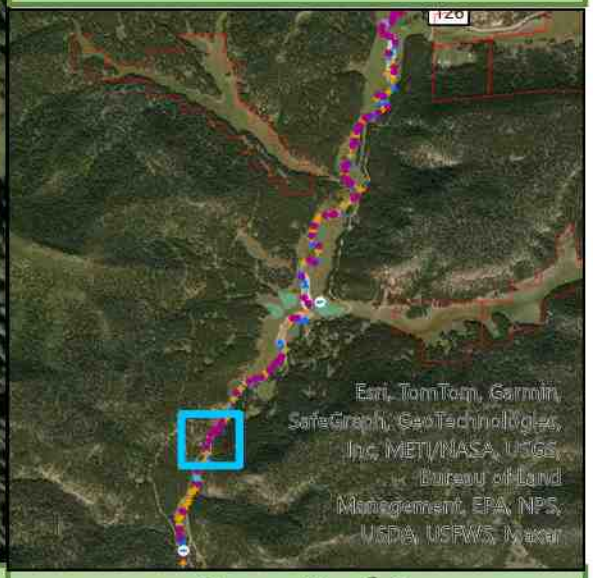
Zone of Influence Complex 1

Map Sheet

Active Floodplain

Historic Floodplain

Complex 1: PAL and LWD structures alternating with BDAs to aggrade channel and increase habitat complexity and floodplain connectivity.

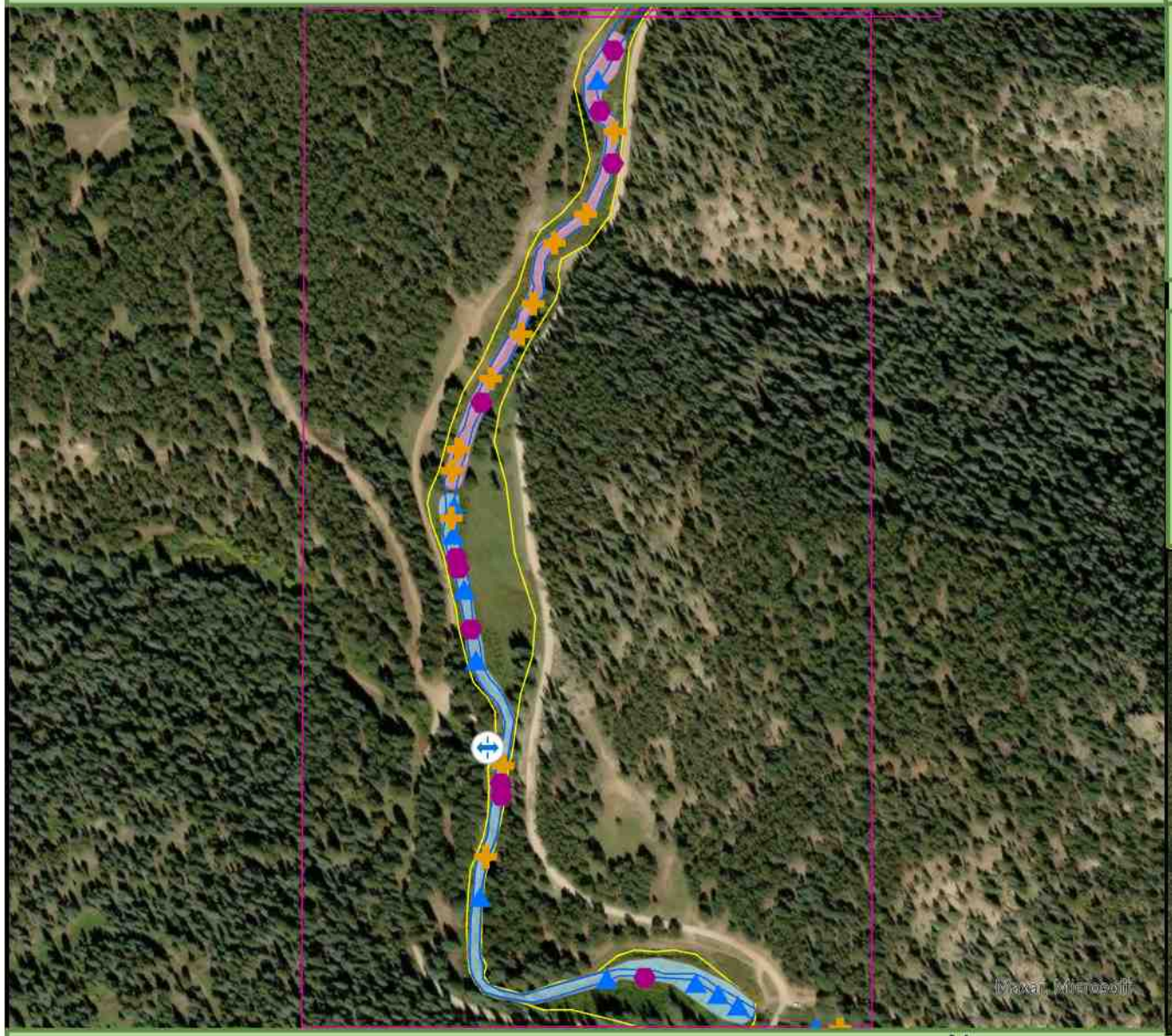


0 400 800 Feet

N

Lower Rio de las Vacas - Low-Tech Process-Based Restoration

Trail Creek Complex 1-2

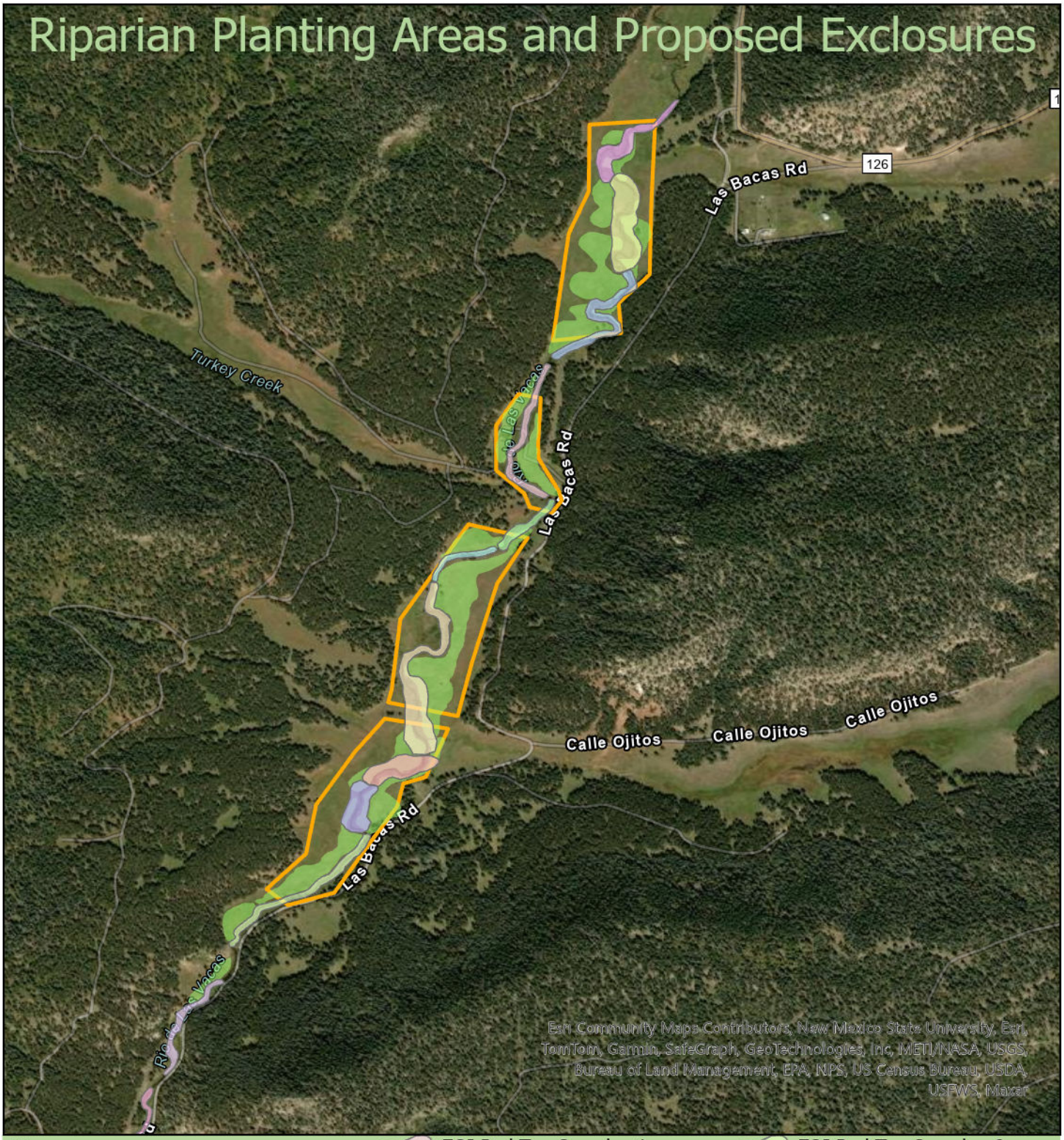


BDA
LWDS
PALS
Water Spreading Structure
Zone of Influence Complex 1
Zone of Influence Complex 2
Map Sheet
Active Floodplain
Historic Floodplain

Complex 1-2: Narrow partly confined valley segment lacking in woody structure and connection to floodplain. PAL and LWD structures to widen and aggrade floodplain, improve connectivity and create habitat for fish and beaver.

0 500 1,000 Feet

N


Riparian Planting Areas and Proposed Exclosures
Las Bacas Rd
126
Turkey Creek
Las Bacas Rd
Calle Ojitos
Calle Ojitos
Calle Ojitos
Las Bacas Rd
Esri Community Maps Contributors, New Mexico State University, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS, Maxar
Name
ZOI Telephone Complex 1
ZOI Telephone Complex 2
ZOI Telephone Complex 3
ZOI Telephone Complex 4
ZOI Red Top Complex 1
ZOI Red Top Complex 1
ZOI Red Top Complex 2
ZOI Red Top Complex 3
ZOI Red Top Complex 4
ZOI Red Top Complex 5
ZOI Red Top Complex 6
ZOI Ojo de la Vaca Complex 1
ZOI Trail Creek Complex 1
ZOI Trail Creek Complex 2
Riparian Planting Areas
Proposed Exclosure Alignment
0
0.9
1.8Miles

RIO DE LAS VACAS WATERSHED
Rito Penas Negras, Rito Cafe, and Rock Creek

Santa Fe National Forest

Rito de las Perchas

Rito Cafe

RITO CAFE OBJECTIVES
Incision recovery and floodplain connectivity
Improve beaver habitat

ROCK CREEK OBJECTIVES
Incision recovery and floodplain connectivity
Increase riparian vegetation

Rito de las Palomas

RITO PENAS NEGRAS OBJECTIVES
Incision recovery and floodplain connectivity
Beaver habitat creation

Rito Peñas Negras

Rock Creek

126

Rito Peñas Negras

Rio de las Vacas

Treatment Reaches
Streams
Private Inholding

N

0 1 2 Miles

RIO DE LAS VACAS WATERSHED
Upper Rio de las Vacas and Clear Creek

Wilderness San Pedro Parks

Rio de las Vacas

Rito Anastacio

San Pedro Parks Wilderness

Vega Redonda

RIO DE LAS VACAS OBJECTIVES
Increase habitat complexity
Improve riparian vegetation

Clear Creek

CLEAR CREEK OBJECTIVES
Incision recovery and floodplain connectivity
Beaver habitat creation

San Gregorio Reservoir

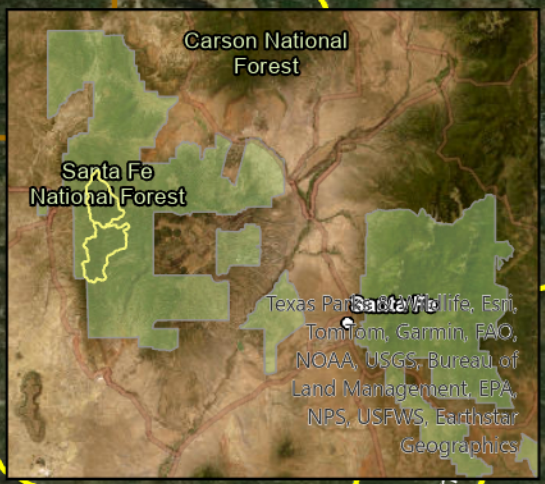
Rito de las Perchas

Rito de las Perchas

Rito de las Palomas

Rio de las Vacas

Clear Creek



Treatment Reaches
Streams
Wilderness
Private Inholding

N

Deer Lake

0 1 2 Miles

126

Rock Creek

126

Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA, USFWS, Maxar

RIO DE LAS VACAS WATERSHED
Lower Rio de las Vacas and Trail Creek

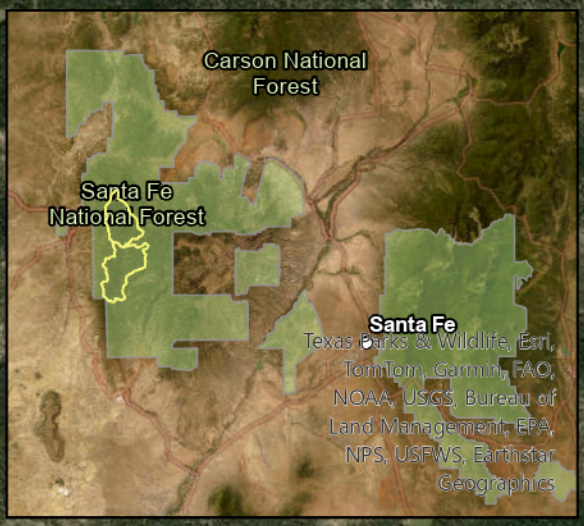
Text

LOWER RIO DE LAS VACAS OBJECTIVES
Incision recovery and floodplain connectivity
Beaver habitat creation

TRAIL CREEK OBJECTIVES
Incision recovery and floodplain connectivity
Increase riparian vegetation
Beaver habitat creation

Rio de las Vacas

Trail Creek



N

Treatment Reaches
Streams
Private Inholdings

N

0 0.5 1 Miles

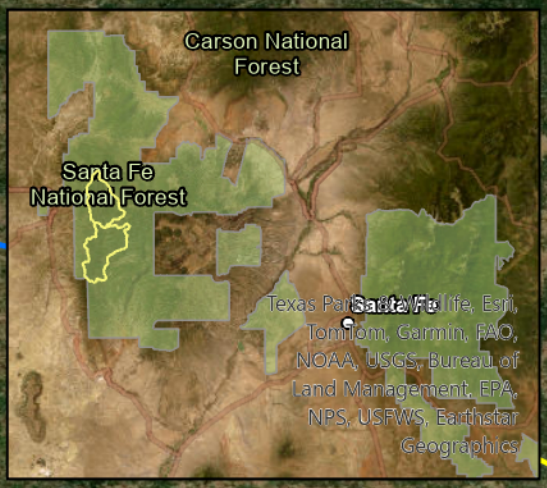
RIO DE LAS VACAS WATERSHED
Rito de las Palomas and American Creek

Santa Fe National Forest

Rito de las Perchas

San Pedro Parks Wilderness

Rito de las Palomas



RITO DE LAS PALOMAS OBJECTIVES
Increase habitat complexity
Increase floodplain connectivity

AMERICAN CREEK OBJECTIVES
Beaver habitat creation
Improve riparian vegetation

Rito de las Palomas

American Creek

Rock Creek

Treatment Reaches
Streams
Wilderness
Private Inholding

N

Rito Peñas Negras