GROUP A: PROJECT MANAGEMENT

## A.1 Title and Approval Sheet

# Quality Assurance Project Plan

Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM

Submitted by:

New Mexico Environment Department
***Surface Water Quality Bureau***

**APPROVAL SIGNATURES**

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## ACRONYMS

| | |
|---|---|
| BLM | Bureau of Land Management |
| CADD | Computer Aided Design and Drafting |
| DQO | Data Quality Objectives |
| *E. coli* | *Escherichia coli* |
| EPA | United States Environmental Protection Agency |
| ET | Evapotranspiration |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| HEC-RAS | Hydrologic Engineering Center - River Analysis System |
| Ksat | Saturated hydraulic conductivity rate |
| LEW | Low Erosivity Waiver |
| LPOS | Los Potreros Open Space |
| NMAC | New Mexico Administrative Code |
| NMED | New Mexico Environment Department |
| NM RAM | New Mexico Rapid Assessment Method (for Montane Riverine Wetlands) |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| SOP | Standard Operating Procedures |
| SWQB | Surface Water Quality Bureau |

| | |
|---|---|
| SWPPP | Stormwater Pollution Protection Plan |
| TMDL | Total Maximum Daily Load |
| WAP | Wetland Action Plan |

## A.3 Distribution List

Table 1. below contains the distribution list, project roles and responsibilities for this project. The QA Officer will ensure that copies of this QAPP and any subsequent revisions are distributed to members who have signature authority to approve this QAPP. The SWQB Project Officer will ensure that copies of the approved QAPP and any subsequent revisions are distributed to all other project personnel listed in Table 1. All members of the distribution list who do not have signature authority to approve this QAPP will review the QAPP and sign the Acknowledgment Statement prior to initiating any work for this project. The signed Acknowledgement Statements will be collected by the SWQB Project Officer and will be given to the QA Officer for filing with the original approved QAPP.

**Table 1. Distribution List, Project Roles, and Responsibilities**

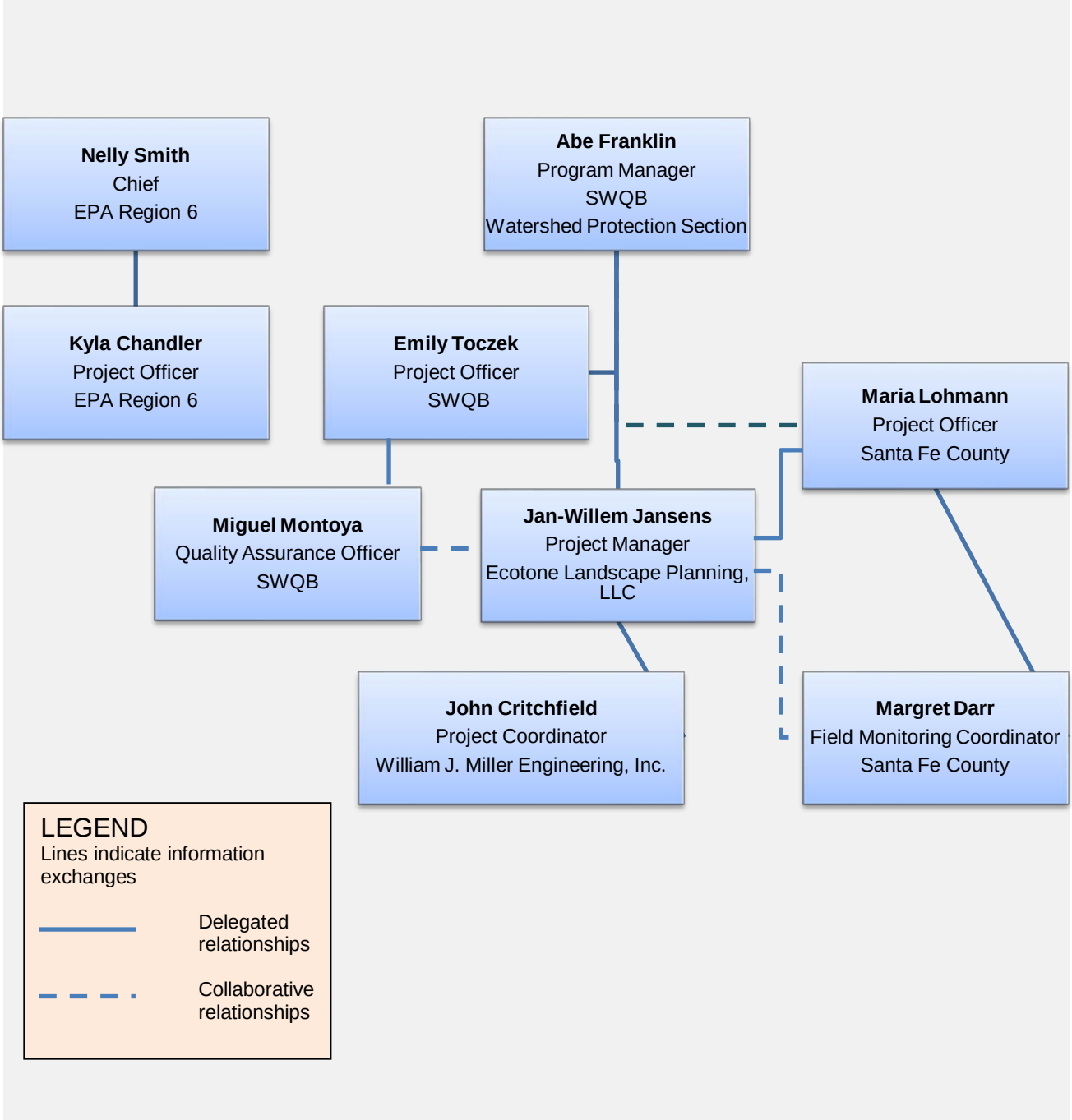
| Name | Organization | Title/Role | Responsibility | Contact Information |
|---|---|---|---|---|
| Abraham Franklin | SWQB | Program Manager | Reviewing and approving QAPP, managing project personnel and resources | (505) 827-2793 abraham.franklin@state.nm.us |
| Miguel Montoya | SWQB | QA Officer | Reviewing and approving QAPP | 505-819-9889 miguel.montoya@state.nm.us |
| Emily Toczek | SWQB | Project Officer | Preparing and revising QAPP, distribution of QAPP, project reporting, coordinating with contractors, oversight of data collection, and EPA reporting | (505) 819-8074 emily.toczek@state.nm.us |
| Jan-Willem Jansens | Ecotone Landscape Planning, LLC | Project Manager | Project oversight, data management, and submittal of quarterly reports, stakeholder outreach and education, data collection, surveys and assessments, regulatory requirements, post-restoration inspections and monitoring, adaptive management and follow-up, record keeping, and submitting reports | 505-470-2531 jwjansens@ecotonelandscapeplanning.com |
| John Critchfield | William J. Miller Engineers, Inc. | Project Coordinator | Project design and implementation, construction oversight | 505-983-7694 john@wjmillerengineers.com |
| Maria E. Lohmann | Santa Fe County | Project Officer Santa Fe, County | Contract management, field data collection | 505-995-2774 melohmann@santafecountynm.gov |
| Margaret "Peggy" Darr | Santa Fe County | Field Monitoring Coordinator | Development of field survey protocols, training field workers, field data collection, data analysis | 505-992-9825 mjdarr@santafecountynm.gov |
| Kyla Chandler | EPA | State & Tribal Grants Project | Reviewing and approving QAPP | (214) 665-2166 chandler.kyla@epa.gov |

| | | | | |
|---|---|---|---|---|
| | | Officer, Water Division, Region 6 | | |
| Nelly Smith | EPA | Chief, State and Tribal Programs Section Water Division, Region 6 | Reviewing and approving QAPP | (214) 665- 7109 smith.nelly@epa.gov |

## A.4 Project Organization

The SWQB Quality Management Plan (NMED/SWQB 2020) documents the independence of the Quality Assurance Officer (QAO) from this project. The QAO is responsible for maintaining the official approved QAPP. Figure 1 presents the organizational structure for the project Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM (Rio Quemado Wetland Restoration Project).

**Figure 1. Organization Chart**



## A.5 Problem Definition/Background

The purpose of this Quality Assurance Project Plan (QAPP) is to provide the quality assurance and control methodology for monitoring of work that aims to halt channel degradation, raise the channel elevation, improve channel morphology and functionality, restore riparian and wetland vegetation and aquatic and wildlife habitat, protect the restoration area from cattle trespassing, and create riparian buffers to improve water quality. This QAPP refers to the project as the "Rio Quemado Wetland Restoration Project." The Rio Quemado Wetland Restoration Project is being managed by Ecotone Landscape Planning, LLC in direct collaboration with Santa Fe County staff as a counterpart, representing Santa Fe County which is the landowner.

The reach of the Rio Quemado in the proposed project area waters riverine wetlands and a slope wetland on a large alluvial fan at the confluence with the Rio Santa Cruz. The reach of the Rio Quemado has been impacted by many years of upstream impacts, including irrigation related water diversion infrastructure, upstream wildfire impacts, and rural development. This has resulted in flash flooding and debris flows. The flash floods have created log jams and sediment accumulations that have impacted acequia inlets and caused channel headcuts and bank erosion. The wetland is currently impaired due to channel degradation (channel form resembles Rosgen G3-G4 and Rosgen F3-F4), caused most likely by cumulative land use and historical stressors, leading to declining overbank flow and possibly declining sub-irrigation of stream-side wetlands. In the project reach, an engineered channel related to water diversion for irrigation has also affected riverine wetland conditions. Between 2016 and 2018, four existing irrigation diversion dams were reconstructed on the lower end of the Rio Quemado using rock cross-vane grade control structures.

Riparian vegetation was locally removed due to channel modifications for irrigation structures. Old riparian vegetation died off due to drought and possibly channel degradation. Non-native species, such as Russian olive (*Eleagnus angustifolia*), Siberian elm (*Ulmus pumila*), tree of heaven (*Ailanthus altissima*), and diffuse knapweed (*Centaurea diffusa*) have invaded the riparian area. Dead woody debris is poorly distributed. Several log jams and heavy build-up of woody debris were removed in past years. Some leaning and fallen trees across the channel remain and cause channel morphology stressors, such as headcuts, bank erosion, and excessive debris and sediment build up.

The riparian area is partly affected by an unimproved rural road/maintenance trail to the irrigation diversion structures. A low water crossing at the bottom end of the reach crosses the stream to a gate that gives access to the wetlands and wet meadows of Los Potreros at the confluence of the Rio Quemado and Rio Santa Cruz. The crossing also leads to a track along

which cattle are led to a pasture to the east of the wetland area. Occasionally cattle escape and trespass into the riparian areas and onto the County wetland and wet meadow areas. In addition to impacting the wetlands, cattle may also contribute *Escherichia coli (E. coli)* loading to the lower Rio Quemado and the nearby Rio Santa Cruz. Both are listed as impaired by *E. coli* and have TMDLs for *E. coli.*

Known relevant information:

- Rio Quemado Assessment Report of 9/9/2013, based on assessment data about channel morphological features measured between 2012 and 2013 for channel modifications and acequia inlet improvements completed in 2017.
- A Riparian Management Plan Los Potreros Open Space of January 2018, and a draft of this report that includes a separate assessment report with vegetation descriptions, sediment characterization in the channel, a cross section at the upper end of the project reach taken in November 2017 and a longitudinal profile from this cross section point going downstream over nearly 250 feet.
- Wetland plant characteristics identified in 2015-2016.
- Anuran inventories 2019-2020.
- Photo point monitoring (photo series) of wetland meadows adjacent to the upper part of the reach, a more limited photo point series for a central point along the stream, and site photographs of other points along the stream (2015-2020).
- Notes on the structural stability conditions of the in-stream irrigation structures
- A Wetlands Action Plan (WAP) of December 2012 with general information about the wetland conditions (Jansens 2012)

Unknown relevant information:

- Recent stream morphological data (longitudinal profile, cross sections); bankfull width and depth, flood prone width and depth at various locations; and any other site data relevant as input data for HEC-RAS modeling
- Overbank flow frequencies onto the wetlands and wet meadows
- Sub-irrigation capacity (e.g., Ksat) for the adjoining wetlands/wet meadows
- Recent stream flow regime data
- Recent pollutants and pollutant sources (e.g., *E. coli,* temperature, sediment)
- Stream channel canopy cover percentage and spatial variability and its role in shading and water temperature reduction
- Current cover of noxious weeds

- Quantitative volume, location and distribution data of coarse woody debris in and across the channel and on the flood plain
- Monitoring information as per the 2012 WAP (to be updated)
- Anticipated cattle movements and impact intensities for 2021 and future years in and across the project area
- Acequia maintenance regimes and other anticipated anthropogenic activities in the channel

**Background**

The Rio Quemado (Santa Cruz River to Rio Arriba County boundary), is known with Waterbody Identifier NM-2118.A_52 and NM Standards Segment 20.6.4.121, as part of the Upper Rio Grande Watershed (USGS HUC 13020101). In 2012, the NM Environment Department (NMED) Surface Water Quality Bureau (SWQB) included the 3.8-mile segment of the Rio Quemado (Santa Cruz River to Rio Arriba County boundary) in a TMDL report for the Upper Rio Grande Watershed (approved by EPA on September 13, 2012) with *E. coli* as the parameter of concern[1]. The TMDL report indicates that the affected use is "Primary Contact".

The Rio Quemado waterbody of concern has a watershed size of 42 square miles, originating from the Sangre de Cristo Mountains, east of Truchas, NM, in the Southern Rockies ecoregion (21d and 21b). The stream segment of concern is located in the Arizona/New Mexico Plateau ecoregion (22h – North Central New Mexico Valleys and Mesas) (Griffith et al. 2006). The watershed's land cover and land use consist of 79% forest, 14% grassland, 5% shrubland, 1% barren, and 1% pasture. Land management and ownership are identified as 62% US Forest Service, 34% private, 4% BLM, and <1% state[2]. The lower part of the project reach of the Rio Quemado, over a length of approximately 250 feet, is located in FEMA flood zone A associated with the flood zone of the Santa Cruz River (FEMA 2012).

The TMDL report for the Rio Quemado segment lists possible probable sources of pollution as: cattle/livestock, rangeland grazing, on-site treatment systems, inappropriate waste disposal, imperious surfaces, dumping garbage/litter, hiking trails, waste from pets, waterfowl, wildlife other than waterfowl, highway/road/bridge runoff, bridges, low water crossings, and

[1] https://www.env.nm.gov/surface-water-quality/wp-content/uploads/sites/25/2017/07/TMDL-master-list-with-links_111919.pdf
[2] https://www.env.nm.gov/surface-water-quality/wp-content/uploads/sites/25/2017/07/TMDL-master-list-with-links_111919.pdf

paved/gravel/dirt roads. The stream segment is identified as in IR Category 5/5A[3], and its priority ranking is classified as "High". The TMDL for *E. coli* is calculated as WLA + LA + MOS = TMDL, resulting in a TMDL of $2.39 \times 10^9$ cfu/day ($0 + 2.03 \times 10^9 + 3.59 \times 10^8$).

The Rio Quemado stream reach of concern is owned by Santa Fe County and is located in Los Potreros Open Space. The area is managed through Santa Fe County's Open Space and Trails Program, an interdepartmental program between the Planning Division of the Growth Management Department and the Projects Management and Maintenance Divisions of the Public Works Department.

In December 2012, the NMED SWQB Wetlands Program produced a Wetlands Action Plan (WAP) for Santa Fe County in collaboration with Ecotone as its contractor and Santa Fe County as one of the main project partners and beneficiaries (Jansens 2012). This WAP lists the "El Potrero wetland", referring to what is currently known as the wetlands of Los Potreros Open Space at the confluence of the Rio Quemado and the Santa Cruz River. The WAP described the estimated present and future threats and stressors of the wetland area as "increased temperature exposure and evapotranspiration (ET) losses" and "invasive plant encroachment". The WAP lists the El Potrero wetland as a priority area for restoration between 2013 and 2030, needing assessment, mapping, and restoration work. While the WAP provides general recommendations on management measures and monitoring for wetlands in Santa Fe County, it does not include any site-specific information on the conditions of the El Potrero wetlands or the Rio Quemado riverine ecosystem or any site-specific recommendations for management measures or monitoring.

In 2013, Santa Fe County commissioned an assessment of the 0.5-mile reach of the Rio Quemado between the crossing of the Martinez Arriba Ditch (a.k.a. Santa Cruz District Ditch) and the confluence with the Santa Cruz River (Santa Fe County 2013). This report addresses general hydrological, hydraulic, and ecological conditions of the lower Rio Quemado and the Santa Cruz River, such as stream geometry, soils, geomorphic conditions, ecological conditions, stream bank stability and erosion, off-site land use impacts, acequia diversions, hydrologic and hydraulic data, proposed solutions, and construction costs. The report mentions the incised

[3] IR Category 5/5A refers to streams that are "impaired for one or more designated or existing uses and a TMDL is underway or scheduled. Assessment Units (AU) are listed in this category if the AU is impaired for one or more designated uses by a pollutant. Where more than one pollutant is associated with the impairment of a single AU, the AU remains in IR category 5A until TMDLs for all pollutants have been completed and approved by USEPA. Source: NMED. 2018. Draft 2020 Integrated report CWA Section 303d-305b Integrated List. https://www.env.nm.gov/surface-water-quality/wp-content/uploads/sites/25/2018/03/DRAFT-2020-IR-CWA-303d_305b-Integrated-List.pdf

channel conditions of the Rio Quemado reach subject to this QAPP, and characterizes the channel type as Rosgen-F4b. The report also mentions seeps related to the rivers and the Martinez Arriba Ditch and the presence of non-native plant species. The report recommends a series of management measures, including the rehabilitation of acequia diversions and riparian buffer enhancements.

The 2013 report was amended in 2015 with an Addendum that provides assessment information and design details for the rehabilitation of existing diversion structures in the Rio Quemado and Santa Cruz River (Santa Fe County 2015). The addendum includes area maps and detailed schematic design images for the proposed diversion structures as well as cost estimates. Santa Fe County implemented the project in late 2017 with final completion in early 2018.

In 2016, Santa Fe County developed and adopted a Management Plan for Los Potreros Open Space (LPOS) under a contract with Ecotone Landscape Planning, LLC (Ecotone LP) and with considerable community input (Santa Fe County 2016). The management plan states that based on the plan's vision statement, the central management goal for the open space area is: "Santa Fe County and the community of Chimayo collaboratively maintain and enhance the natural qualities and beauty of the uplands, acequias, wetlands, pastures, and riparian zones of LPOS to reflect the historical use and aesthetic of the place through landscape conservation and traditional uses, such as grazing, haying, wildlife habitat maintenance, and periodic rest periods, with a view toward local enjoyment and education. Traditional uses should be organized in such a way that they are equitable, low-impact, supportive of the qualities of the land, and transparently managed."

Conservation is the de facto land use of the open space area with agriculture and passive recreational use as minor seasonal land uses. Agricultural activities include three acequia diversions in the Rio Quemado and seasonal cattle grazing in nearby pastures for which cattle has to cross the Rio Quemado at the lower end of the project reach. Passive recreation includes the use of a trail on river right along the Rio Quemado and visitation of the edges of the area for views across the area and for occasional artistic uses, such as photography and landscape painting. The open space area is the scenic backdrop of the Santuario de Chimayo, a pilgrimage destination of national importance, which draws more than 300,000 visitors a year. The area is considered of significant spiritual importance among Catholics, and local lore has it that the area is the site of a miracle observed in the 1800s.

The management plan calls for a number of management measures, such as fence improvements, planting of riparian buffers, pasture management, irrigation and drainage improvements, replacing of old, weak, dead and fallen trees, as well as the development of a

monitoring plan. Santa Fe County followed up on the management plan by developing a riparian management plan among various other implementation oriented planning initiatives (Santa Fe County 2018). The riparian management plan (January 2018) includes a rapid appraisal of riparian conditions and lists several concerns and maintenance needs. Key recommendations include (1) the improvement of riparian vegetation including revegetation, and removal of non-native and noxious plants, (2) the widening of the riparian forest buffers along the Rio Quemado and Santa Cruz River, (3) the improvement of river health by reducing channel erosion and instability and restoring floodplain access of annual flows, and (4) clearing of dead and down riparian vegetation that can cause flooding and wildfire, among other recommendations. The plan also includes a conceptual implementation proposal for riparian buffer planting and fencing, which has become part of the scope of work of the project subject to this QAPP.

**Objective**

The project addresses three main stressors and has three associated goals:

(1) **Stressors:** Channel degradation and occasional excessive sediment and organic (woody) debris deposition. **Goal:** Building onto the recently installed grade control system, it is a goal of the project to minimize channel degradation (by creating Rosgen C and/or Rosgen B channel types), raise the channel invert elevation by approximately 1 foot, and induce at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain. It's also an objective to lower part of the terrace on river left by approximately 1 foot to improve stream connectivity with the alluvial fan wetland area and riparian vegetation on this side. Successful execution of the project will serve as the foundation for future upstream restoration work to improve channel morphology and wetland functions upstream on private land to the benefit of the entire Los Potreros wetland area.

(2) **Stressors:** Drought, riparian vegetation removal, trash, excessive pile up of woody debris, invasive plant species, and poor vegetation management. **Goal:** It is a goal to restore native riparian and wetland vegetation and its associated aquatic and wildlife habitat. The objectives are to reposition dead or leaning logs that impair stream morphological functions, to remove invasive plants (Russian olive, Siberian elm, tree of heaven, and knapweed), to redistribute dead wood material across the flood plain, to plant approximately 1,000 riparian buffer plants on river left and native riparian plants in openings on the floodplain, and improve habitat conditions in the riverine wetland area for

existing amphibian species, such as boreal chorus frog (a NM Department of Game and Fish Species of Greatest Conservation Need) and Woodhouse's toad.

(3) **Stressors:** *E. coli* contamination in the Santa Cruz River. **Goal:** It is a goal of the project to protect the riparian areas, riverine wetland, and alluvial fan (slope) wetland areas from cattle trespassing. It is also an objective to create buffers between pathways and cattle grazing areas and the wetlands, improve shading on the stream, and reduce potential *E. coli* inflows into the streams. These improvements would protect and improve the water quality of the streams and amphibian habitat conditions and reduce the impacts of the stressors on general wetland health.

## A.6 Project/Task Description

**Description**

The Project will:

1. Build onto the recently installed grade control system to minimize channel degradation, by raising the channel invert elevation by approximately 1 foot. This will induce at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain. The project will also lower part of the terrace on river left by approximately 1 foot to improve stream connectivity with the alluvial wetland and riparian vegetation on this side.
    a. A one-dimensional hydraulic modeling software (HEC-RAS) will be used to simulate water surface profiles for design and permitting purposes
    b. Baseline information on channel morphology based on a longitudinal profile and up to 6 cross sections will be used to formulate the design dimensions of the in-stream structures and bank modifications
    c. These activities and pieces of information pertain to Goal 1.

2. Restore native riparian and wetland vegetation and its associated aquatic and wildlife habitat, reposition dead or leaning logs that impair stream morphological functions, remove invasive plants (Russian olive, Siberian elm, tree of heaven, and knapweed), redistribute dead wood material across the flood plain, plant approximately 1,000 riparian buffer plants on river left and native riparian plants in openings on the floodplain, and improve habitat conditions in the riverine wetland area for existing amphibian species, such as boreal chorus frog (a NM Department of Game and Fish Species of Greatest Conservation Need) and Woodhouse's toad.

a. This will require documentation of presently existing and newly developing vegetation

b. It will also require baseline information and post-restoration information on anuran densities

c. These activities and pieces of information pertain to Goal 2.

3. By creating fenced riparian buffers between pathways and cattle grazing areas and the wetlands, protecting the riparian areas, riverine wetland, and alluvial fan (slope) wetland areas from cattle trespassing, improving shading on the stream, and reducing potential *E.coli* inflows into the streams.
    a. This will require baseline information on riparian buffer width and vegetation cover and structural integrity and effectiveness of fencing, and follow up information about the same
    b. These activities and pieces of information pertain to Goal 3.

The study/project consists of the following data gathering and monitoring activities:

a. Measure a longitudinal profile and cross-sections to verify stream morphological change from Rosgen F3-F4 toward Rosgen C3-C4 and from Rosgen G3 to Rosgen B3 channel types with a channel bottom raise of 12-18 inches

b. Conduct HEC-RAS modeling for channel design and permitting requirements

c. Conduct implementation monitoring of successful installation of grade control structures

These activities and pieces of information (in a-c) pertain to Goal 1.

d. Using the monitoring protocols of the New Mexico Rapid Assessment Method (NM RAM) for Montane Riverine Wetlands (www.env.nm.gov/surface-water-quality/wetlands-rapid-assessment-methods/), monitor the presence of vigorous riparian buffers of native plants of desired width and stream shading effect (canopy cover with stream shading capacity) and floodplain vegetation of native plants (measured using visual inspection and photo documentation), and the measurable, relatively even distribution of organic and woody debris across the floodplain

These activities and pieces of information (in d) pertain to Goal 2.

e. Identify the absence of unmanaged livestock and human access and impacts on the riparian and wetland areas (targets are 0 occurrences and 0 sq. ft affected; we will tally occurrences and area affected)

f. Conduct implementation monitoring of the realization of improved amphibian habitat as per design specifications (all measured using visual inspection and photo documentation).

These activities and pieces of information (in e-f) pertain to Goal 3.

Information from previous studies, as identified in previous sections, will be used as historical baseline information for the project-based pre-treatment and post-treatment measurements.

This will be elaborated in more detail in Data Generation and Acquisition section B1.

**Schedule**

The project will start in early October 2020 and be completed by December 31, 2023, and can be subdivided in four phases: (1) an administrative start-up phase (October-December 2020); (2) a permit preparation, assessment and planning phase (January-September 2021); (3) a permit-approved final design and implementation phase (September 2021-March 2022); and (4) a post-restoration phase (March 2022-December 2023).

No data collection will take place in phase 1. In phase 2 (January-September 2021), the project will collect baseline data by conducting baseline monitoring of abovementioned monitoring activities, including the HEC-RAS modeling assessment and any other specific data to satisfy permitting requirements. Santa Fe County will provide the cultural resource data and biological data for the area. In phase 3 (September 2021 – March 2022), the project will collect implementation (progress accomplishment) data and photographic evidence for purposes of implementation monitoring. In phase 4 (March 2022 – December 2023), the project will collect post-treatment monitoring data and photographic evidence according to the abovementioned monitoring activities. Project reporting is following a quarterly schedule, with due dates on January 31, April 30, July 31, and October 31 for the preceding quarters in each of the project years. See Table 2 for more details.

**Table 2. Project tasks, products, responsible party, timeline**

| Phase/Task | Product | Responsible Party | Approximate Start Date | Approximate Completion Date |
|---|---|---|---|---|
| (1) Administrative | [no data collection] Approved QAPP; MoU NMED and SF County; Hiring of contractors; Stakeholder outreach and education activities | NMED, SF County, Ecotone LP, LLC | 10/1/20 | 12/31/20 |
| (2) Planning | Surveys and assessment reports; Floodplain Modeling report; NMED approved conceptual design; permit applications | William J. Miller Engineers; Ecotone LP, LLC | 1/1/21 | 9/30/21 |
| (3) Implementation | NMED approved, completed construction designs; contract with contractor(s); staking, flagging, trash and debris removal; River terrace grading; Fence construction; Removal of invasive plants; Construction of in-stream structures; Tree planting; Detailed site completion | William J. Miller Engineers; Ecotone LP, LLC; San Isidro Permaculture | 9/1/21 | 3/15/22 |
| (4) Post-restoration activities | Post-restoration inspections and monitoring; Adaptive management and follow-up; WAP Update; Reporting | Ecotone LP, LLC; William Miller Engineering, SF County | 3/15/22 | 12/31/23 |

**Project Area**

The project is located along approximately 1,335 feet (0.25 miles) of the lowest reach of the Rio Quemado above the confluence with the Santa Cruz River in the village of Chimayo, New Mexico (Figure 2). The upper end of the reach is located at 35°59’36.37” N, 105°55’45.27” W, and the lower end of the reach at 35°59’28.64” N, 105°55’57.61” W. The project area comprises approximately 7 acres of wetland, riparian area, terrace and wet meadow buffer area, of which 3.5 acres is riverine wetland and riparian area. The project area is accessible from Jesus Medina Road at a gate located just to the north of the bridge across the Santa Cruz River.

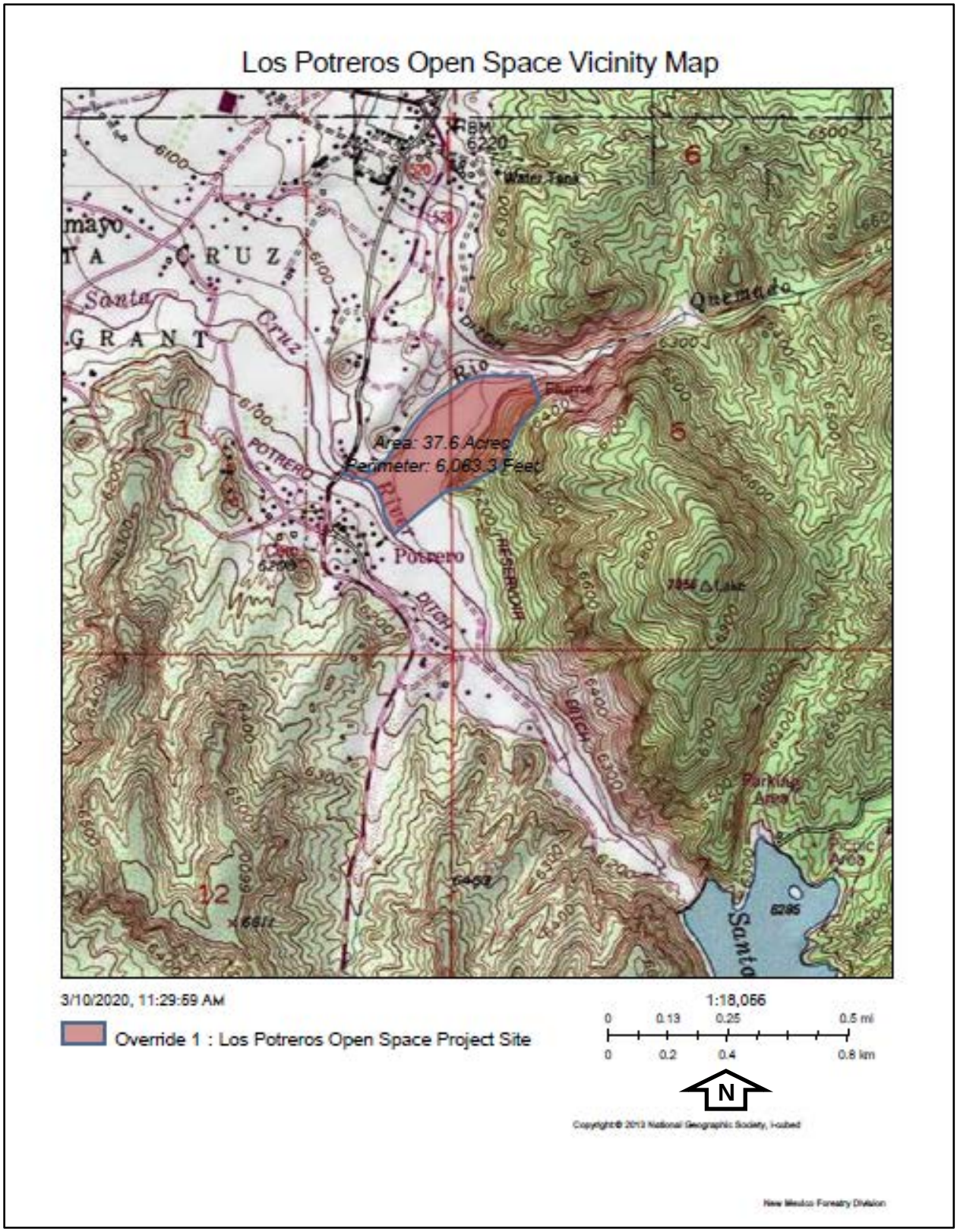



**Figure 2A. Project Area Map – Vicinity Overview**

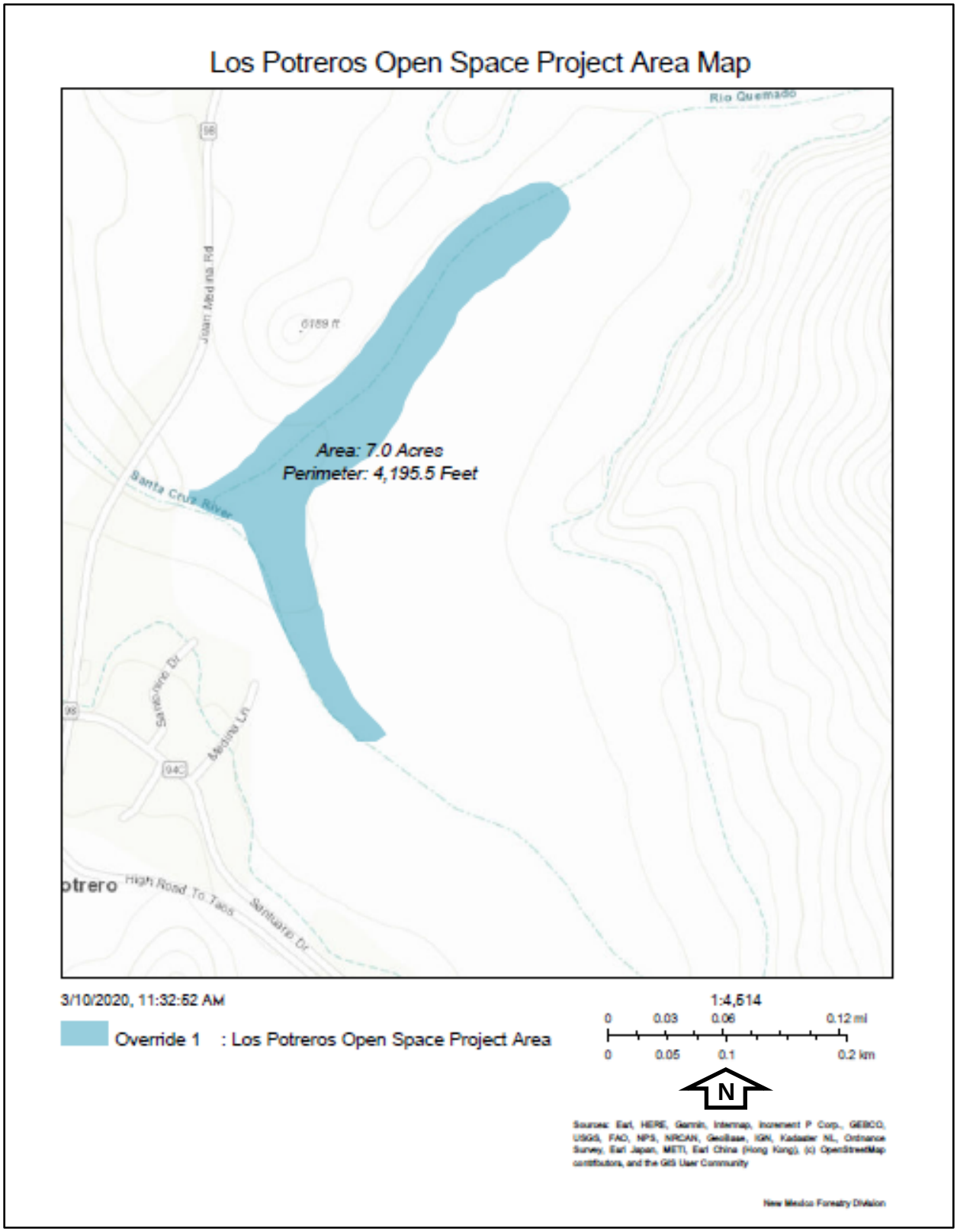



**Figure 2B. Project Area Map – Area Detail**

**Monitoring Location Selection Criteria**

The exact locations of monitoring sites will be determined in the course of the project, but general monitoring locations can be indicated at this time. These locations are chosen for the purpose of comparing stream morphological and riparian vegetation responses for each specific stream segment with new or existing grade control structures. Each of these segments also have specific morphological and ecological characteristics in terms of plant cover, channel dimensions, and riparian area widths. Furthermore, data gathering for HEC-RAS modeling and SWPPP or LEW planning, wetland monitoring associated with the NM RAM, implementation monitoring, woody debris monitoring, and amphibian habitat monitoring will take place across the entire 7-acre project area. The stream channel related monitoring activities include a longitudinal profile, which will take place along nearly all of the entire 1,335-foot stream reach, and up to six cross sections at the following approximate locations (Figure 3):

1. top of reach (0 ft)
2. below the first set of new structures (250 ft)
3. above 1st set of diversions (700 ft)
4. below 1st set of diversions (850 ft)
5. below 2nd set of diversions (1200 ft)
6. at bottom of reach (1300 ft)

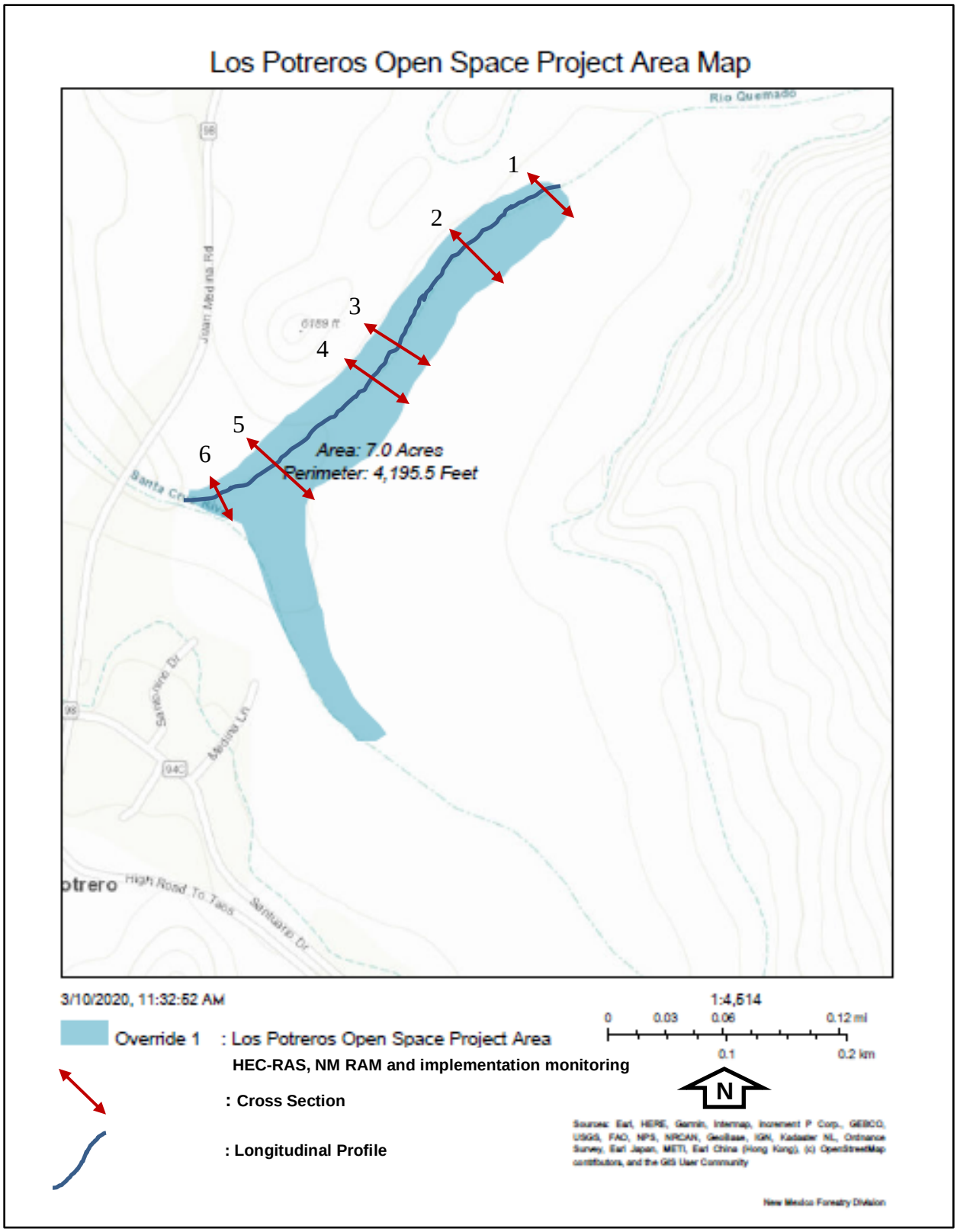



**Figure 3. Project Area with Monitoring Locations**

**Restoration Activities**

The project will complete the following restoration activities:

1. An initial cleanup of trash and some dead brush in the project reach (October 2021). Associated with goal #2: restoration of native riparian and wetland vegetation.
2. Some of the log jams, fallen or leaning logs across the stream and coarse woody debris piles will be relocated on the floodplain (October 2021). Associated with goal #2: restoration of native riparian and wetland vegetation.
3. Large woody debris will be repositioned for habitat improvement and stream morphology stabilization (October 2021). Associated with goal #2: restoration of native riparian and wetland vegetation.
4. The terrace on river left will be lowered by about 1 foot to enhance overbank flow capacity onto the new riparian buffer area (October-December 2021). Associated with goal #1: inducing at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency and improving stream connectivity with the alluvial wetland and riparian vegetation on this side.
5. A livestock fence will be constructed, which will most likely include 4-strand barbed wire on a combination of traditional wooden and modern steel T-posts and wooden stays to keep livestock out of the riparian area (November 2020-December 2021). Associated with goal #3: protecting the riparian areas, riverine wetland, and alluvial fan (slope) wetland areas from cattle trespassing and reducing *E. coli* inflows into the streams.
6. Invasive plant species will be removed, stumps will be treated in ways that are sensitive to aquatic life form, and slash will be hauled off site (October-December 2021). Associated with goal #2: restoration of native riparian and wetland vegetation.
7. The riparian area will be planted with local riparian species, with dominance of willow and cottonwood (January-March 2022). Associated with goal #2: restoration of native riparian and wetland vegetation; and goal #3: creating buffers between pathways and cattle grazing areas and the wetlands, improving shading on the stream, and reducing potential *E. coli* inflows into the streams.
8. At least three small grade control structures (boulder cross vanes, log vanes, and/or post vanes – depending on material availability and installation costs at the time of construction) will be built in the stream in the upper reach above the first acequia diversion structures (October-December 2021). Associated with goal #1: halting channel degradation, raising the channel invert elevation by approximately 1 foot, and inducing at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency.

9. Two cross vane structures for grade control will be (re)built for improved sediment flows, including a rock cross vane associated with an acequia diversion and a cross vane at the bottom end of the project reach to replace a rock sill structure (October-December 2021). Associated with goal #1: minimizing channel degradation, raising the channel invert elevation by approximately 1 foot, and inducing at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency.
10. Using coarse woody debris and creating and leaving shallow pools and depression in the floodplain, the project will enhance anuran habitat (January-March 2022). Associated with goal #2: restoration of native riparian and wetland vegetation and improving habitat conditions in the riverine wetland area for existing anuran species, such as the boreal chorus frog and Woodhouse's toad.

## A.7 Quality Objectives and Criteria for Measurement Data

**Question/Decision**

The baseline data collection and monitoring components of the Rio Quemado Wetland Restoration Project are intended to answer the following questions:

1. Did we halt channel degradation (by creating Rosgen C3 and Rosgen B3 channel types), raise the channel invert elevation by approximately 1 foot, and induce at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain? (Goal #1).

    - ✓ Cross-sectional elevation data (geometric data) from the cross sections in combination with elevation data from the longitudinal profile will be used to model stream morphology using the HEC-RAS modeling software[4].
    - ✓ Based on the input date, the modeling software computes a streamflow analysis, which can be expressed in bankfull width and depth, floodplain width and depth, width:depth ratios, channel roughness and floodplain roughness, to generate output in the form of flow volume and velocity and flow height to characterize the hydraulic efficiency of the channel.
    - ✓ The output data are then imported into CADD for stream modification design. The data output is presented in graphics of stream cross sections and a stream

[4] https://www.hec.usace.army.mil/software/hec-ras/documentation/HEC-RAS%205.0%20Users%20Manual.pdf

area map. Future follow-up monitoring allows for comparison of before and after implementation data to ascertain whether the results meet the intended goals.

- ✓ Specifically, the results will help the project team understand whether goal #1 is reached in terms of halting channel degradation (by creating Rosgen C3 and Rosgen B3 channel types), raising the channel invert elevation by approximately 1 foot, and inducing at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain.

2. Did we halt channel degradation (by creating Rosgen C3 and Rosgen B3 channel types), raise the channel invert elevation by approximately 1 foot, and induce at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain? (Goal #1).

    - ✓ Implementation monitoring of successful installation of grade control structures will involve the visual inspection of structures, elevational verification with a laser level, total station, or RTK GPS equipment, and photography of the structures from across and from in the channel above and below each of the structures. Each structure represents its own photo point.
    - ✓ The results will help the project team understand whether goal #1 is reached in terms of realizing the structures needed to halt channel degradation, raise the channel invert elevation by approximately 1 foot, and induce at least once-annual overbank flows and sub-irrigation of streamside wetlands, while increasing the river's efficiency of moving sediment and ability of spreading woody debris across the flood plain.

3. Did we restore native riparian and wetland vegetation and its associated aquatic and wildlife habitat?

    - ✓ The monitoring protocols of the NM RAM for Montane Riverine Wetlands[5] will help the project team collect data to complete the specific rubrics of the RAM. This will require a limited amount of field assessment work as well as map (or Google Earth imagery) analysis, relative to each element of the RAM protocol.

[5] https://www.env.nm.gov/wp-content/uploads/sites/25/2018/01/NMRAM_Montaine-Riverine-Wetlands.pdf

- ✓ The results will help the project team ascertain whether goal #2 is reached regarding the presence of vigorous riparian buffers of native plants of desired width and stream shading effect (canopy cover with stream shading capacity) and floodplain vegetation of native plants (measured using visual inspection and photo documentation), and the measurable, relatively even distribution (cover percentage and variability in avg. distance between debris objects) of organic and woody debris across the floodplain

4. Did we protect the riparian areas, riverine wetland, and alluvial fan wetland areas from cattle trespassing, create buffers between pathways and cattle grazing areas and the wetlands, improve shading on the stream, and reduce potential *E. coli* inflows into the streams, in order to improve the water quality of the streams and amphibian habitat conditions and reduce the impacts of the stressors on general wetland health?

    - ✓ The project team will track the absence of unmanaged livestock and human access and impacts on the riparian and wetland areas (targets are 0 occurrences and 0 sq. ft affected; we will tally occurrences and area affected) through regular site visits by County staff and project team members. Observations will be logged on a documentation form accompanied with photography at established photo points, using the picture post method[6], as well as random points when and where unmanaged access occurs.
    - ✓ Implementation monitoring of the successful realization of improved anuran habitat as per design specifications will involve visual inspection and photo documentation of terrain conditions; as well as estimation of anuran larvae density using total counts on randomly-placed sample plots in the restoration area, as well as an upstream control site, contingent upon landowner approval (Garton et al. 2005). The size and number of plots will be determined in the Spring of 2021, after pilot data collection and a statistical power analysis.
    - ✓ The results will help the project team ascertain whether goal #3 is reached regarding the protection of the riparian areas, riverine wetland, and alluvial fan (slope) wetland areas from cattle trespassing, as well as the creation of buffers between pathways and cattle grazing areas and the wetlands, improvement of shading on the stream, and reduction of potential *E. coli* inflows into the streams, so that water quality of the streams and anuran habitat conditions are

[6] https://picturepost.ou.edu/index.jsp

improved and the impacts of the stressors on general wetland health are reduced.

**Data Quality Objective (DQO)**

The quality of the data will be adequate to provide a high level of confidence in determining stream channel stability and functionality, wetland integrity, buffer integrity, and ecological diversity and resilience the Rio Quemado Wetland Restoration Project.

**Data Quality Indicators**

The measurement quality objectives will be sufficient to achieve the Data Quality Objective (DQO) and will be in conformance with those listed in the SWQB's QMP. The Data Quality Indicators (DQI) listed in the SWQB's QAPP and applicable to the data collected for this project are accuracy, precision, completeness, and sensitivity. Stream type classification will be performed using the Rosgen (Level II) morphological description, which outlines the stream type based on entrenchment ratio, width:depth ratio, sinuosity, gradient, and particle substrate (Rosgen 1994). Following methods in Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994), cross section and longitudinal profile data for the stream channel will be collected using level and rod, total station instrument, and/or RTK GPS equipment. Data collection equipment will be verified or calibrated in accordance with manufacturer's recommendations prior to field work activity. For cross sections and longitudinal profiles, the manufacturer's directions for the laser level and rod, total station, and/or RTK GPS equipment and their instrument calibration checks, and the NM RAM protocol, Ecotone LP, Santa Fe County, and William J. Miller Engineers, Inc. will ensure that the collected data meet the needs for the DQOs. When weather conditions or flow rates are hazardous, work will be postponed to times when conditions are beneficial to meet safe working conditions and data that are representative and comparable between data sets.

| DQI | Determination Methodologies |
|---|---|
| Precision | For cross-sections and longitudinal profile: measuring at exactly the same locations, referenced with GPS coordinates, rebar stakes, and stable reference benchmarks, using the same data point intervals of 1 m along the cross section;<br><br>For photo points: taking pictures following the same protocol at each location |

| | |
|---|---|
| | For the NM RAM: following the same version of the NM RAM protocol each year and assessing the same area each year<br><br>For anuran monitoring: complete counts of anuran larvae at the same sampling plots, using the same methods, each year; and sampling at enough plots to ensure a statistically significant analysis of larvae densities |
| Bias | For cross-sections and longitudinal profile: using high quality instrumentation that is calibrated and properly referenced to known elevation reference point (if applicable)<br><br>For photo points: using a high-resolution camera with color imagery; each time at exactly the same locations, the same directions, angles, and image frames, referenced by GPS coordinates and rebar stakes or picture posts<br><br>For the NM RAM: ensuring that the RAM assessment is conducted by the same person(s), at approximately the same time of year and under the same terrain conditions<br><br>For anuran monitoring: using a random plot design when surveying larvae and, if possible, surveying in control plots located upstream from the project area (contingent upon landowner permission) |
| Accuracy | For all indicators: pursuing high precision and low bias; where necessary adding meta data descriptions of monitoring choices made that clarify precision and bias deviations |
| Representative | For cross-sections and longitudinal profile: choosing non-anomalous locations for the cross-sections; and always following the thalweg for the long pro<br><br>For photo points: ensuring that photographs are taken on approximately the same day(s) each year, with the same lighting and weather, and stream flow regimes, and that the imagery depicts non-anomalous conditions<br><br>For the NM RAM: ensuring that RAM is executed on approximately the same day(s) each year, with the same terrain conditions are non-anomalous |

| | |
|---|---|
| | For anuran monitoring: ensuring monitoring is conducted numerous times during the breeding season, on the same dates, at the same times, and during similar weather conditions |
| Comparability | For cross-sections and longitudinal profile: ensuring that each cross section and long pro is always placed in the same way and same location, and that references for laser or total station settings are the same<br><br>For photo points: ensuring that photographs are taken with the same camera, same camera settings, and scale (zoom settings)<br><br>For the NM RAM: ensuring that RAM is executed the same way each time<br><br>For anuran monitoring: ensuring consistency in methods by extensively training field personnel, and conducting data quality reviews |
| Completeness | For cross-sections and longitudinal profile: ensuring that all cross sections and all data points on each cross section and on the long pro are always taken and included in the analysis<br><br>For photo points: ensuring that all photographs in the protocols are taken and analyzed<br><br>For the NM RAM: ensuring that RAM is executed the same way each time<br><br>For anuran monitoring: ensuring consistency in methods by extensively training field personnel, and conducting data quality reviews |
| Sensitivity | For cross-sections and longitudinal profile: with an acceptable accuracy of 5% error, we want to measure at a scale of elevation intervals =<5% of 1 foot =< 0.05ft (1.5 cm or smaller)<br><br>For photo points: we want to document that structures are built according to design and at the correct locations<br><br>For the NM RAM: as per RAM protocol<br><br>For anuran monitoring: our goal is to compare anuran larvae densities before and after restoration, as well as at an upstream control site (contingent upon landowner permission) |

## A.8 Special Training/Certification

Elevation data using cross sections and a longitudinal profile will be collected by John Critchfield of William J. Miller Engineers, Inc. and Jan-Willem Jansens of Ecotone Landscape Planning, LLC (Ecotone LP), with help from an Ecotone LP intern or associate and/or volunteers. Implementation monitoring, photo monitoring and NM RAM assessments will be conducted by Jan-Willem Jansens of Ecotone LP with help from an Ecotone LP intern or associate and/or volunteers. Livestock impacts and herpetological monitoring will be conducted by Santa Fe County staff and volunteers. SWQB will provide technical assistance and oversight. Volunteers will be trained and supervised by either Ecotone or by Santa Fe County staff, as appropriate for the type of monitoring. Ecotone LP team members plan to participate in a workshop on volunteer monitoring and data sharing and a NM RAM workshop in early 2021.

**John Critchfield (PE, CFM)** serves as project coordinator for this project. He is a Project Engineer for William J. Miller Engineers, Inc., located in Santa Fe, NM. Mr. Critchfield earned his Bachelor of Science degree in Civil Engineering with an emphasis on Water Resources from Virginia Tech in 2004. Between 2005 and 2010, he worked for a natural resources consulting firm on wetland and stream restoration projects, during which he also attended Levels I-IV of Dave Rosgen's trainings on fluvial geomorphology. Since 2011, Mr. Critchfield has worked on a variety of surface water resources related projects in northern NM. Mr. Critchfield is a Professional Engineer (NM License No. 21128) and Certified Floodplain Manager (NM-18-00429).

**Jan-Willem Jansens** serves as the project manager for this project. He is the owner and Principal of Ecotone Landscape Planning, LLC, located in Santa Fe, NM. Mr. Jansens holds a master of Agricultural Sciences degree from the Wageningen Agricultural University in The Netherlands in 1987, with a specialization in Landscape Architecture, Forestry, and Agricultural Engineering. After an international development career on ecological planning and restoration with extended work periods in several African countries, he moved to New Mexico in 1993. He has initiated and managed a number of stream and wetland restoration and watershed management projects throughout northern New Mexico and conducted several Open Space Management plans for Santa Fe County.

**Margaret (Peggy) Darr** serves as the project monitoring coordinator for Santa Fe County. Peggy is a Wildlife Biologist with a Master's Degree, and approximately 17 years of field experience. She will train all field personnel, conduct data quality reviews, and analyze data.

This project will be primarily implemented by project team members and Santa Fe County staff, with assistance from volunteers. Data collection and monitoring for this project will be implemented by project team members and Santa Fe County staff, with assistance from volunteers with technical assistance and oversight from the SWQB Project Officer. Volunteers will be trained by project team members and Santa Fe County staff and supervised at all times by project team members and Santa Fe County staff in the field during data collection efforts. Any individual collecting data for the project will be informed of proper data collection procedures prior to initiating data collection by either Jan-Willem Jansens of Ecotone LP or Santa Fe County Staff identified in Table 1. All members of the distribution list (Table 1) who do not have signature authority to approve this QAPP will review the QAPP and sign the Acknowledgment Statement prior to authorizing data collection by others (e.g., volunteers, etc.) for this project.

Monitoring training information will be kept by Ecotone LP in a computer, in an online digital file, and in a paper copy filing system for project team members. Jan-Willem Jansens of Ecotone LP is responsible for ensuring that these data storage guidelines are met, and that qualified personnel are available to perform the work.

## A.9 Documents and Records

The SWQB Project Officer will make copies of this approved QAPP and any subsequent revisions available to all individuals on the distribution list who do not have signature authority for approving the QAPP. Ecotone LP will distribute relevant documentation to other team members as appropriate. The SWQB WPS will retain project documents in accordance with applicable sections of New Mexico's Disposition of Public Records and Non-Records regulation, codified at 1.13.30 Administrative Code (NMAC) and Retention and Disposition of Public Records regulations, codified at 1.21.2 NMAC.

When changes affect the scope, implementation, or assessment of the outcome, this QAPP will be revised to keep project information current. The SWQB Project Officer, with the assistance of the QAO, will determine the effects of any changes to the scope, implementation, or assessment of the outcome on the technical and quality objectives of the project. This Project Plan will be reviewed annually by the SWQB Project Officer to determine the need for revision.

Project documents include this QAPP, field notebooks, calibration records, validation and verification records, and recorded field data in hard copy or in electronic form. Also included are project interim and final reports. Data captured on a global positioning system (GPS), camera, smart phone, tablet, or laptop will be downloaded to an Ecotone LP computer at the end of each week. Copies will be made of all data and stored separately from the original data.

All digital project data will be kept in a project file on the project manager's (JW Jansens) computer and on a separate external backup hard drive at the Ecotone LP office. Hard copy project documents will be kept in a project folder in a filing cabinet at the Ecotone LP office. All hard copy documents will be digitized and stored on an Ecotone LP computer and an online backup drive (see Table 5). Copies of the data will be distributed by Ecotone to NMED SWQB Project Officer at the end of the spring season beginning 2021.

**Table 4. Data Records for the Project**

| Document | Type of Form | Storage Location | Field Sheet Used |
|---|---|---|---|
| **QAPP** | Electronic (.doc) & Hard Copy | SWQB, SF County, and Ecotone LP | EPA Requirements for Quality Assurance Project Plan. EPA QA/R-5 |
| **Calibration Records** | Electronic (.doc) & Hard Copy | Wm Miller Engineers and Ecotone LP | NA |
| **Field sheets (cross-section, longitudinal profile)** | Electronic (.xls) & Hard Copy | Wm Miller Engineers and Ecotone LP | Field datasheet designed specifically for this project |
| **Photos** | Electronic (.jpg) | Ecotone LP | Permanent Phot Point Record. Appendix I *"Let the Water do the Work"* |
| **NM RAM** | Electronic & Hard Copy | SWQB and Ecotone LP | The forms from the latest version of the NM RAM Field Guide |
| **Implementation monitoring reports** | Electronic & Hard Copy | SWQB, Santa Fe County and Ecotone LP | Field datasheet designed specifically for this project |
| **Anuran data** | Electronic & Hard Copy | SF County and Ecotone LP | Field datasheet designed specifically for this project |
| **Interim and Final Reports** | Electronic (.doc) & Hard Copy | SWQB, SF County, and Ecotone LP | NA |

# GROUP B: DATA GENERATION AND ACQUISITION

## B.1 Sampling Design

The project's monitoring component consists of gathering and analyzing data for (a) stream morphology verification, (b) implementation verification, (c) wetland conditions, (d) cattle impact reduction verification, and (e) anuran population conditions.

a. Stream morphology verification

The purpose of this monitoring element is to determine whether the induced stream morphology changes support the desired wetland and stream hydrology. Using cross sections and longitudinal profile data collected during the initial survey of existing conditions, the initial channel Rosgen Stream Type(s) will be verified for the study reach of the Rio Quemado channel, by characterizing the stream channel's entrenchment ratio, width:depth ratio, sinuosity, and average channel slope. The initial Rosgen Stream Type(s) will serve as a baseline from which the desired channel conditions can be achieved.

Relevant hydrologic and hydraulic data will be compiled and reviewed as part of the design process in order to provide a reasonable estimate for bankfull discharge. A flood frequency curve for the Rio Quemado watershed near the confluence with the Santa Cruz River will be constructed from Northern mountain-valley flood region frequency equations using generalized least-squares regression (Waltemeyer 2008). Preparation of the flood frequency curve will be facilitated by using the USGS StreamStats Online Tool. Studies suggest that bankfull discharge is between the 1 and 1.8-year recurrence interval flood events for the arid southwest (Moody et. al, 2003). Bankfull parameters measured during the Spring 2021 field survey, including cross sectional area, width, mean depth, and discharge, will be plotted on the Eastern Arizona/New Mexico Regional Curves (Moody et. al, 2003). Plotting field-measured parameters onto the Regional Curves will provide a check that the data collected is within the normal range of scatter points observed in data collected from streams in Eastern Arizona and New Mexico (Moody, et. al, 2003). Upon completion of the hydrologic and hydraulic analyses described above, a design discharge will be selected that meets project objectives for desired overbank flooding frequency.

The design discharge will be used to size proposed riffle channel cross section(s) using an iterative process of hydraulic computations based on the Manning's Equation. The proposed channel cross section(s) will be drawn using AutoCAD Civil 3d for preparation of the stream modification design. Cross sections depicting the finish grade relative to the existing grade and a Project area site map will be prepared to identify structure locations. Construction details will be prepared to provide clarification on the extents and dimensions of the grade control structures to be constructed using wood and/or boulders and native plantings.

The project team will use up to six cross sections at critical locations that delineate stream segments and a longitudinal profile of the channel thalweg to measure elevations at breaks in grade (or minimum 3-foot intervals) and at the locations of future grade control structures. Comparison of baseline data with post-treatment monitoring data will indicate the extent of elevational change toward desired conditions.

The data for the six modified cross sections will be imported into the Hydrologic Engineering Center's River Analysis System (HEC-RAS) in order to create a 1-D simulation of the water surface profile. The purpose of creating a HEC-RAS Model is for: 1) simulation of the design discharge to verify the water surface profile can inundate overbank areas at the desired locations, and 2) verification that proposed channel and floodplain improvements will meet FEMA Floodplain requirements. Preliminary Steady Flow inputs into the HEC-RAS Model will consist of the annual Peak Discharge values for the 2-year and 100-year stream flows obtained from the USGS StreamStats Online Tool, which utilizes regression equations for estimation of instantaneous peak stream flows (Waltemeyer 2008).

Stream morphology verification will take place in the early spring of each year, which will enable timely adaptive management of stream conditions before the start of the wetland and riparian growing season and the onset of the acequia irrigation season. Elevational changes in the Rio Quemado result from channel erosion and sedimentation under the influence of spring runoff and monsoonal summer and fall storms. It is expected that in future years, spring runoff will occur earlier in the season and in more concentrated flows (Tolley et al. 2015), and that summer storms will become more erratic and more extreme, including periods and years with excessive drought. As a result, stream flow energy may lead to erosion and sedimentation in both the spring and the summer-fall seasons, and flows may carry – as they have in the past – large amounts of coarse woody debris.

Stream channel erosion and sedimentation directly impact channel functionality related to overbank flow frequencies that benefit the streamside wetlands and water availability for the three acequia diversions in the lower reach of the channel. Adaptive management of channel conditions will be essential in the spring, during and immediately after the spring runoff season to ensure that overbank flow frequencies benefit the wetland ecology during the new growing season and that acequia diversions are adequately accessible for water at the onset of the irrigation season in April-May. It is important at that time that any channel cleaning by the acequia associations is conducted appropriately for not only acequia diversion needs but also for the purposes of ecological and hydrological channel functionality in support of the wetland ecology and amphibian habitat. Therefore, early spring monitoring is more effective toward timely adaptive management than fall monitoring. Baseline data for stream morphology

verification will be collected in the early spring of 2021, leading to baseline data that are comparable with the post-treatment conditions because annually they will be collected in the same season.

Wm. J. Miller Engineers will be responsible for collecting cross section and longitudinal profile data, with support from Ecotone LP staff. This team will gather stream morphological data at the locations indicated in Figure 3. As explained above, these locations are chosen for the purpose of comparing stream morphological and riparian vegetation responses for each specific stream segment with new or existing grade control structures. Each of these segments also have specific morphological and ecological characteristics in terms of plant cover, channel width and depth, and riparian area widths.

The cross-sectional monitoring locations will be accessible on foot only, and any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, or bank failure may render any of the cross-section locations temporarily or indefinitely inaccessible or invisible. If necessary, the project team will evaluate terrain conditions at the time after such events to develop an alternative data gathering approach.

b. Implementation verification

The purpose of this monitoring element is to establish whether the channel, bank, and riparian buffer management measures and their structural integrity have been realized according to the design specifications. Implementation monitoring of successful installation of grade control structures and stream bank excavation will involve the visual inspection of structures and bank locations, elevational verification with a laser level or total station, and photography of each of the structures from across and from in the channel above and below each of the structures. Each structure and the upstream and downstream limits of the excavated stream bank each represent discrete photo points. Implementation verification also applies to the installation of fencing and the planting and protection of riparian vegetation, as well as the distribution of woody debris and the planting of vegetation on the floodplain.

This monitoring element will take place immediately after project implementation in early 2022, and will be repeated annually in the early spring in conjunction with the stream morphological monitoring for purposes of efficiency (equipment on site and relationship between stream functions and structural integrity of implemented structures).

Ecotone staff will be responsible for this monitoring element with assistance from Santa Fe County staff and William J. Miller Engineers, Inc. The monitoring activity will take place at the location of each built structure or modified terrain feature and be part of an overall walk through of the project area.

Conducting this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, bank failure, or other events may render any of the structures temporarily or indefinitely inaccessible or invisible. The project team will evaluate terrain conditions at the time after such events to develop an alternative data gathering approach.

c. Wetland conditions

The purpose of this monitoring element is to establish whether wetland conditions and buffer conditions have improved. Monitoring will in particular focus on ascertaining the presence of vigorous riparian buffers of native plants of desired width and stream shading effect (canopy cover with stream shading capacity) and floodplain vegetation of native plants (measured using visual inspection and photo documentation), and the measurable, relatively even distribution of organic and woody debris across the floodplain.

The project team will conduct the NM Rapid Assessment Method for Montane Wetlands (NM RAM) in the spring of 2021 and in the spring of 2023 to develop output data that can be compared to evaluate quantitative and qualitative improvements as a result of the project. Additionally, the project team will sample and document woody debris distribution, and particularly whether log jams, debris piles, and wrack lines have formed that reduce stream functionality, increase flood risks of trails, infrastructure and nearby private property, cause severe channel degradation and/or bank erosion, or hamper acequia diversion capacity.

Ecotone LP staff will be responsible for this monitoring element with assistance from Santa Fe County staff. Field work for this monitoring activity will take place across the entire project area. Data analysis, including analysis of Google Earth imagery, will take place in the Ecotone LP office.

Conducting the field monitoring for this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding and bank failure may render the wetlands area temporarily or indefinitely inaccessible to foot traffic. An alternative approach may involve walking around the perimeter of the project area, in so far accessible, to collect information, and complete further assessment work in the office.

d. Cattle impact reduction verification

The purpose of this monitoring element is to establish whether unmanaged livestock and human access has impacted the riparian and wetland areas. The project team will tally, describe (including location specifications), and photograph impacts that require adaptive management.

The monitoring activity will require an overall walk through of the project area during which observations are documented and photographed. Santa Fe County staff will be responsible to organize the inspections. Inspections will include regular site visits by County staff and project

team members. This monitoring element will take place at least quarterly, and if necessary monthly (e.g., during the growing season).

Conducting this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, bank failure, or other events may render the project area temporarily or indefinitely inaccessible or invisible. The project team will evaluate terrain conditions at the time after such calamities to develop an alternative data gathering approach.

e. Anuran habitat and population conditions

The purpose of this monitoring element is to establish whether anuran habitat has been improved as per design specifications. Monitoring will involve visual inspection and photo documentation of terrain conditions, as well as anuran larvae density monitoring before and after restoration.

The monitoring activity will require an overall walk through of the project area during which observations are documented and photographed, and anuran larvae are counted. Santa Fe County staff will be responsible to organize the surveys. Surveys will include regular site visits by County staff and project team members. Visual inspections and photo documentation will take place at lease quarterly, and anuran larvae surveys will be conducted monthly from April to August.

Conducting this monitoring element can only occur on foot. Any equipment will have to be carried into the field. Snow cover, ice, catastrophic flooding, bank failure, or other events may render the project area temporarily or indefinitely inaccessible or invisible. The project team will evaluate terrain conditions at the time after such calamities to develop an alternative data gathering approach.

**Table 5. Project Monitoring Specifics**

| Responsible Party | Monitoring | Location | Frequency |
|---|---|---|---|
| Wm. J. Miller Engineers, Inc. and Ecotone LP | Cross sections and longitudinal profile | 6 locations in project reach of Rio Quemado – (Figure 3) | Annually (March) |
| Ecotone LP | Photo points | At each of the structures and other treatments | Biannually (Spring and fall) |
| Ecotone LP | Implementation monitoring | At each of the structures and other treatments | Biannually (Spring and fall) |
| Ecotone LP | NM RAM | Entire area and buffers | Annually (March) |
| SF County | Livestock impact verification | Project area perimeter, riparian buffers, and fences | Monthly (during grazing season) |
| SF County | Anuran monitoring | Flood plain | Monthly (April to August) |

## B.2 Sampling Methods

Sampling methods consist of cross-sections in association with a longitudinal profile, the NM RAM for Montane Riverine Wetlands, terrain observation and photo documentation, and larvae counts for anuran monitoring. The methods for each include:

Cross-sections and Longitudinal Profile methods: Cross-section surveys will each measure a single vertical plane across the stream channel between reference end points that have been monumented by the installation of ½" diameter steel rebar, flush with the ground surface. Cross section surveys are the basis for delineating channel form and will be used to compute channel discharge. A longitudinal profile measures points upstream and downstream of cross section locations and is used to measure the water surface slope and elevations of channel thalweg, floodplain, and terraces along the study reach. Cross Section and Longitudinal Profiles will be measured in accordance with Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994).

NM RAM methods: We will be using the most up to date NM RAM protocols and field sheets. The SWQB Wetlands Coordinator will be contacted for the latest version of the Montane Riverine Wetlands Manual, Field Guide, and Field Sheets prior to data collection.

Terrain observations and photographic documentation methods: We will use the protocols identified in *Let the Water Do the Work* (Zeedyk et al., 2009) Appendix I, Outline for Photographic Monitoring Plan. Photo points will be recorded using Permanent Photo Point-

Record-Initial Take (Form 1). Additionally, some existing photo points of Santa Fe County that are using the Picture Post method will follow the protocols for Picture Post photography (https://picturepost.ou.edu/index.jsp).

Anuran sampling methods: the method for anuran monitoring consists of estimating anuran larvae densities before and after restoration, as well as at an upstream control site (contingent upon landowner approval).

Complete counts of anuran larvae will be conducted in randomly-selected plots along the Rio Quemado (Garton et al. 2005). The number and size of plots will be determined after collection of pilot data, and a power analysis, in the spring 2021. Plots will be the same size, and will be surveyed monthly from April to August. Plots will be surveyed at approximately the same time of day, and time of year. In the case of inclement weather, plots will not be surveyed.

Our hypothesis is that anuran larvae densities will increase after restoration activities. The null hypothesis is that densities will remain the same. Our goal is to survey enough plots to detect a difference in anuran larvae densities, with a p-value of 0.05.

## B.3 Sample Handling and Custody

Because there are no plans to collect samples for laboratory analysis, there are no handling requirements.

## B.4 Analytical Methods

Because there are no plans to collect samples, laboratory analytical methods are not required. Analysis of anuran larvae densities before and after restoration is, however, required. For this analysis, appropriate statistical methods will be used.

## B.5 Quality Control

Quality control (QC) activities are technical activities performed on a routine basis to quantify the variability that is inherent to any environmental data measurement activity. The purpose for conducting QC activities is to understand and incorporate the effects the variability may have in the decision-making process. Quality Control mechanisms are implemented as described under the Quality Objectives and Criteria for Measurement Data as well as the sampling methodologies identified under this QAPP. Additional Quality Control includes the professional expertise of the personnel working under this project. If data do not meet the QC criteria as stated in Quality Objectives and Criteria for Measurement Data as well as in the sampling methodologies identified under this QAPP, the data will not be utilized for modeling, development of a design or in environmental decision making.

## B.6 Instrument/Equipment Testing, Inspection and Maintenance

All field equipment will be inspected prior to commencing data collection. The person(s) conducting the work is responsible for ensuring that equipment is inspected, and that proper maintenance has been completed before data collection has commenced. All instruments and equipment will be tested, inspected and maintained in accordance with the manufacturer's specifications as included in their associated instrument/equipment manual. Field equipment suspected to be faulty will not be used for data collection, until required maintenance is performed, or equipment is replaced (Table 6).

**Table 6. Field equipment that is anticipated to be used in the project.**

| Type of Equipment | Make/Model | Details |
|---|---|---|
| Advanced GNSS Rover System | Trimble R10-2 GNSS System | Rental |
| 35W Radio System Kit | Trimble TSC3 Data Collector and TDL 450 Radio | Rental |
| Electronic Total station | Topcon GTS-212 | |
| Tripod, prism, pole, and SMi Data Collector | Classic SMi 8.0j by Eagle Point | As backup for other survey equipment |
| Automatic level | Leica NA728 | As backup for other survey equipment |
| Tripod, rod | N/A (various, including CST/Berger) | As backup for other survey equipment |
| Laser level and rod | CST/Berger laser RL25h and receiver RD5 | As back up equipment |
| 300' Steel Tape | Stanley or other brand | |
| 100' 200' and 300' Fiberglass Tape | Lufkin and/or Stanley | |
| GPS Camera | iPhone7 | |
| GPS | Garmin 64s | |
| Photo (with GPS) camera | Sony, DSC-HX400V | Standard lens |

## B.7 Instrument/Equipment Calibration and Frequency

The calibration of the laser level, total station, and/or RTK GPS equipment will be verified according to the manufacturer's specifications. If a total station and/or RTK GPS equipment is used the equipment will be calibrated against the nearest US Geodetic Survey marker with the base station set to the same reference elevation as the survey marker. Documentation of calibration and verification will be maintained by John Critchfield (Wm J. Miller Engineers, Inc.).

## B.8 Inspection Inspection/Acceptance for Supplies and Consumables

There are no supplies or consumables that could affect the quality of data related to this project.

## B.9 Non-direct Measurements

No non-direct measurements used during the course of this project will affect the quality of data related to this project. The non-direct measurement data sources will include:

a. Google Earth remote sensing imagery (the latest imagery and historical data layers for purposes of comparison to understand changes over time).

Imagery will be selected based on visibility of critical landscape elements, terrain texture and color, and image resolution in relation to the specific purposes for which this data source is used.

b. Input data for HEC-RAS modeling will be based on field collected cross-section data and a longitudinal profile. Monuments (1/2" diameter steel rebar driven flush with the floodplain surface) to define each cross section and for elevation control along the longitudinal profile. Cross section and longitudinal profile data will be collected using a level, rod and tape. Supplemental floodplain data (for modeling purposes) and the XYZ of all monuments will be collected using a Trimble RTK GNSS (R-10-2) System. If supplemental floodplain data is required for floodplain modeling purposes, the most-current available LiDAR data for Santa Fe County would be used for this purpose. Santa Fe County's 2014 LiDAR Shaded Relief was collected between March 12 and August 11, 2014, and has been used to create a Digital Elevation Model (DEM) dataset through a joint effort between Santa Fe County, the US Geological Survey, Bohannan Huston Inc., and Aero-Graphics, Inc. The DEM dataset is referenced to horizontal datum NAD 1983 State Plane NM Central (Feet) and North American Vertical Datum (NAVD) 1988.

We will use the most up-to-date digital elevation model (map layers) available. At this time this is the 2014 LiDAR based data set. This information will be used as a backup dataset in case the in-field instrument measurements prove inadequate at a later date and/or to extend the cross section information beyond what is collected in the field. The key criterion for determining whether data is acceptable is the common standard in New Mexico of an acceptable variability of 0.1 foot or less.

c. Peer-reviewed scientific literature regarding anuran life history.

This information will be based on the following methodology and references.

Anuran life history, distribution, and identification for the Los Potreros Open Space will be determined using the references outlined below, written by the top herpetologists in New Mexico. Together, these documents provide the best available information on herpetological natural history, taxonomy, and distribution in New Mexico:

*Degenhardt, W.G., C.W. Painter, and A.H. Prince. 1996. Amphibians and reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico*

*Painter, C.W., J.N. Stewart, J.T. Giermakowski. 2017. Checklist of the amphibians and reptiles of New Mexico, USA, with notes on taxonomy, status, and distribution. Western Wildlife 4:29-60.*

Survey methods will be determined using the reference below, published by the Wildlife Society (this book is widely considered the most comprehensive wildlife management and research reference available), as well as the expertise of the Santa Fe County Open Space Resource Management Specialist, Margaret Darr. Given the small size of the Los Potreros Open Space restoration site, heavy consideration will be given to increasing sample sizes, and thus increasing our chances of detecting a statistically significant change in anuran densities and/or occupancy. To evaluate anuran response to habitat management, surveys can be conducted for adult frogs or for frog larvae. Given that larvae numbers are usually higher than adult frog numbers, to achieve the highest sample size possible, surveys for larvae will be selected as the most appropriate way to determine if we achieved our goal of improved anuran habitat at the Los Potreros Open Space.

*Braun, C.E., editor. 2005. Techniques for Wildlife Investigations and Management. Sixth edition. The Wildlife Society, Bethesda, Maryland, USA.*

## B.10 Data Management

Jan-Willem Jansens of Ecotone Landscape Planning and Margaret “Peggy” Darr of Santa Fe County will be responsible for data management. All data will be converted to electronic format, stored and backed up by Jan-Willem Jansens and Peggy Darr, and sent to SWQB Project Officer. Computer hard drives are backed up weekly or will be backed up on external hard drives, respectively. Hard copies of field sheets will be maintained in a project binder organized by assessment and date and stored in a filing cabinet in the office of Ecotone, Santa Fe County, and SWQB.

Upon receiving data, the SWQB Project Officer will store data on SWQB network drive. The SWQB network drive is backed up daily and maintained by the NMED Office of Information Technology. Project documents will be stored on the SWQB network drive in accordance with 1.21.2 NMAC, *Retention and Disposition of Public Records.*

# GROUP C: ASSESSMENT AND OVERSIGHT

## C.1 Assessment and Response Actions

The SWQB Project Officer will provide project oversight by periodically assisting with and/or reviewing data collection efforts. A review of the baseline data collection and monitoring efforts by the SWQB Project Officer will take place at the end of each monitoring season. The SWQB Project Officer will assess project progress to ensure the QAPP is being implemented, including periodic audits by the QAO, as needed. Any problems encountered during the course of this project will be immediately reported to the SWQB Project Officer who will consult with appropriate individuals to determine appropriate action. Should the corrective action impact the project or data quality, the SWQB Project Officer will alert the QAO. If it is discovered that monitoring methodologies must deviate from the approved QAPP, a revised QAPP must be approved before work can be continued. All problems and adjustments to the project plan will be documented in the project file and included in the final report.

## C.2 Reports to Management

Quarterly reports will be submitted by Jan-Willem Jansens (Ecotone LP), to the SWQB Project Officer and will include progress of project and any available data. Printouts, status reports or special reports for SWQB or EPA will be prepared upon request. The final report will be submitted to the SWQB Project Officer by Jan-Willem Jansens (Ecotone LP) by December 31, 2023. The SWQB Project Officer will be responsible for submitting the final project deliverables to EPA through their Grants Reporting Tracking System.

# GROUP D: DATA VALIDATION AND USABILITY

## D.1 Data Review, Verification and Validation

Data will be reviewed by Project Manager Jan-Willem Jansens (Ecotone LP) and SF County staff for erroneous data, incomplete data and transcription errors prior to demobilization from the field site. Data will be considered usable if the requirements of this QAPP were followed and the data is within acceptable range limits as defined under this QAPP. Data that appears incomplete or questionable for the parameter will be flagged for review. Flagged data will be discussed with the SWQB Project Officer to determine the potential cause and usability. If a reasonable justification for use of the data cannot be attained, those data will be not used in analysis and implementation of activities listed under this QAPP unless the data can be recollected and assessed for usability.

## D.2 Verification and Validation Methods

The Project Manager Jan-Willem Jansens (Ecotone LP) with assistance from Santa Fe County staff will ensure that valid and representative data are acquired through the actions stated in Section D1 of this QAPP. Data will be validated by the Watershed Protection Section of the Surface Water Quality Bureau prior to using the data for wetlands protection, policy, or public uses.

NM RAM data collected under this QAPP will be verified by the Surveyor (i.e., the data collector for NM RAM data) and Project Manager. The Surveyor and Project Manager will provide their initials where indicated on the Field Guide Worksheets for Montane Riverine Wetlands after ensuring there are no erroneous data, incomplete data and transcription errors. Results of the verification process for NM RAM data will be documented in the completed Field Guide Worksheets for each sampling area in Los Potreros Open Space Project area.

Cross-section and longitudinal profile data and data used for the HEC-RAS modeling collected under this QAPP will be verified by the Surveyor (i.e., the project engineer or associates) and Project Manager. The Surveyor and Project Manager will both initial any field data sheet related to these monitoring techniques after ensuring there are no erroneous data, incomplete data and transcription errors.

Similarly, implementation monitoring data, anuran monitoring data, and photo monitoring meta data collected under this QAPP will be verified by the Surveyor (i.e., the project engineer, Santa Fe County staff, or associates) and Project Manager. The Surveyor and Project Manager will both initial any field data sheet related to these monitoring techniques after ensuring there are no erroneous data, incomplete data and transcription errors.

## D.3 Reconciliation with User Requirements

The user requirement is a restatement of the data quality objective. The quality of the data will be adequate to provide a high level of confidence in determining whether the Rio Quemado Wetland Restoration Project is meeting the project goals, as stated in the approved scope of work.

If the project's results do not meet this requirement additional monitoring may be necessary to fill in data, which may include an extension of the monitoring period to measure effects that were not apparent during the project period. Additional funding from NMED may be required to accomplish the additional monitoring.

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## Acknowledgement Statement

New Mexico Environment Department Surface Water Quality

**Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM**
**Quality Assurance Project Plan Acknowledgement Statement**

This is to acknowledge that I have received a copy (in hard copy or electronic format) of the "Restoring the Rio Quemado" Quality Assurance Project Plan.

As indicated by my signature below, I understand and acknowledge that it is my responsibility to read, understand, become familiar with and comply with the information provided in the document to the best of my ability.

_____
Signature

_____
Name (Please Print)

_____
Date

***Return to SWQB QAO Miguel Montoya***

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