GROUP A. PROJECT MANAGEMENT AND INFORMATION/DATA QUALITY OBJECTIVES

A1. Title Page

Quality Assurance Project Plan

Watershed Project Implementation for Wolf Creek Watershed – Phase I
Revision 0

Funding Source:
Grant No. C9-99610121 (FY24)

Effective period: Three years from date of final approval

Submitted by:
New Mexico Environment Department
Surface Water Quality Bureau

12/18/2025

A2. Approval Page

Approval Signatures

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A3. Table of Contents

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List of Tables and Figures

Acronyms

AU	Assessment Unit
DQO	Data Quality Objective
DQI	Data Quality Indicators
EPA	United States Environmental Protection Agency
GAINS	Geospatial Applications In Natural Science Lab at NMHU
HPWA	Hermit's Peak Watershed Alliance
NMED	New Mexico Environment Department
NMRAM	New Mexico Rapid Assessment Method
NDVI	Normalized Difference Vegetation Index
LIDAR	Light Detection and Ranging
MRWBP	Mora River Watershed Based Plan
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QAO	Quality Assurance Officer
SOP	Standard Operating Procedures
SWQB	SWQB Surface Water Quality Bureau
TBD	To Be Determined
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
WBP	Watershed Based Plan
WCWBP	Wolf Creek Watershed Based Plan
WQPD	Water Quality Protection Division

A4. Project Purpose, Problem Definition, Background

Project Purpose and Problem Definition

The purpose of this Quality Assurance Project Plan (QAPP) is to ensure valid and defensible data is used in the *Watershed Project Implementation for Wolf Creek Watershed – Phase I*. This QAPP will speak to data collection, data compilation, watershed modeling and analysis of hydrologic trends in Wolf Creek Watershed resulting from Management Measure implementation, as well as help inform future Management Measures needed.

According to the 2024 - 2026 State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report and Appendix A, Wolf Creek does not support its designated use for Marginal Coldwater Aquatic Life with a cause of impairment listed as Flow Regime Modification. A TMDL has not been developed because its impairment is not caused by a pollutant but rather low flow. This type of designation in the Integrated Report is referred to as an IR Category 4C, defined as "impaired for one or more designated uses, but does not require development of a TMDL because impairment is not caused by a pollutant" (NMED SWQB 2024). Unlike a water quality pollutant issue where a load reduction is needed, in this case a study of the flow regime is needed instead.

Watershed Project Implementation for Wolf Creek Watershed – Phase I will help better understand the potential flow regime of Wolf Creek and help determine improvements by implementing restoration treatments. This QAPP refers to the project as the *Watershed Project Implementation for Wolf Creek Watershed – Phase I (*aka Wolf Creek Phase I).

Wolf Creek Phase I is being managed by the Hermit's Peak Watershed Alliance (HPWA). HPWA will utilize satellite imagery and Light Detection and Ranging (LiDAR) data to locate wet and dry stream reaches and identify visible improvements in surface and ground water using vegetation as the indicator of wetness. HPWA will identify sources of moisture using the monitoring approach outlined below. We will use these data, assemble baseline information, and work together with NMED to develop attainable flow goals relating flow regime to the beneficial uses that can be realistically supported. Wolf Creek Phase I will help the long-term progress toward restoring flow to this and other similar 4C streams in New Mexico.

The data collection and monitoring components of the Wolf Creek Phase I intend to answer the following questions:

1) Will the wetness data gathered as part of Wolf Creek Phase I help inform the current flow regime of Wolf Creek and determine whether it can support the designation of Marginal Coldwater Aquatic Life?

2) What type and location of management and restoration measures could improve subsurface recharge and surface flow conditions in the Wolf Creek watershed to address the current impairment caused by flow regime modification?

The monitoring data gathered will be used to help answer the questions listed above. Normalized Difference Vegetation Index (NDVI) remote sensing and photo documentation will help inform both the potential Wolf Creek flow regime as well as Management Measures to improve subsurface recharge and surface flows in the Wolf Creek Watershed. More information on the type, quantity, and quality of information needed for its intended use (including performance and acceptance criteria) is discussed in section A6.

Background

The temporal and spatial dynamics of streamflow presence and absence are considered vital information to many hydrological and ecological studies (Kaplan, 2019). In the 2024 - 2026 State of New Mexico Clean Water Act 303(d)/§305(b) Integrated Report, Wolf Creek was still listed as Not Supporting because of Low Flow Alterations. Despite being considered a Perennial Stream, the Integrated Report Appendix A notes, "According to the manager of the Black Willow Ranch, Wolf Cr. used to be perennial, but then the well serving the facility at Valmora was deepened or otherwise improved and pumping has increased. Now Wolf Cr. goes dry (AU Comment)." HPWA will examine all conditions that have led to reduced flow and hence will identify the sources of Wolf Creek flow impairment with the goal of restoring perennial flow to Wolf Creek or improving base flows where the potential exists.

The Wolf Creek Watershed Based Plan (HPWA, 2023) laid out a monitoring approach for implementation projects by using NVDI remote sensing to show wetness in the project area as well as help inform recommendations for future Management and Restoration Measures needed. In developing the WCWBP, no baseline data was found to indicate groundwater withdrawals as a source of flow impairment – contributing sources of the flow impairment include rangeland grazing, roads, habitat modification, baseflow modification due to drought and climate change, channelization, impoundments, and water diversions. The WCWBP also recommended future studies to better understand surface and subsurface hydrologic conditions to clarify the cause of the flow regime impairment. The use of existing aerial and satellite photos of Wolf Creek were used to determine both baseline and current channel locations of wetted conditions. HPWA will again utilize satellite imagery to locate wet and dry sections, arroyos draining alluvial fans, wetlands, and identify visible on-the-ground flow modifications during this Wolf Creek Phase I project. Photo documentation monitoring throughout this implementation project will also act as a clear, accessible tool for tracking changes, demonstrating the effects of watershed restoration treatments, and ensuring that these efforts are moving toward their intended goals.

According to the Assessment Rationale Record of Decision (NMED 2022-2024), Wolf Creek (Mora River to headwaters) was dry on 6/17/2015 when visited by NMED during the 2015-2016 Canadian/Dry Cimarron survey). Another source of information that will be drawn upon for this Wolf Creek Phase I, is a restoration report developed for one-third of the Fort Union Ranch which includes a large part of Wolf Creek, by Bill Zeedyk during the 2017 - 2020 for *On-the-Ground Improvement Projects for the Mora River- Upper Canadian Plateau Phase IA*, which is discussed in further detail in the Wolf Creek WBP (HPWA, 2023).

A5. Project Task Description

Description

The State of New Mexico has found Wolf Creek to not support its designated Marginal Coldwater Aquatic Life use because of flow regime modification. The Wolf Creek Phase I will continue watershed monitoring recommended in the WCWBP to detect changes in surface flow as a result of implementing Management Measures. Monitoring strives to improve understanding of locations of surface and groundwater and how changes can be affected by Management Measures. By filling in the missing information about surface water flow in Wolf Creek, the project can identify the sources of flow changes and propose Management Measures to help restore year-round flow or improve base flows where possible. The project monitoring consists of NDVI remote sensing comparison, once at the end of this Phase I Project and pre/post treatment photos to be taken to produce a better understanding of the impacts of Management Measures on ground and surface water and watershed condition.

Schedule

The project start date was September 2023 with a planned project end date of December 2026. No monitoring occurred before this QAPP was approved.

Table 1. Project Task, products, responsible party, timeline

Task	Product	Responsible Party	Approximate Start Date	Approximate Completion Date
Administrative	Procurement for contract	Lea Knutson, HPWA	September 2023	December 2026
Planning	Field site visit (no data collection)	Renee Hernandez, HPWA	September 2023	December 2026
Quality Assurance Project Plan	Approved QAPP	Renee Hernandez, HPWA	January 2025	October 2025

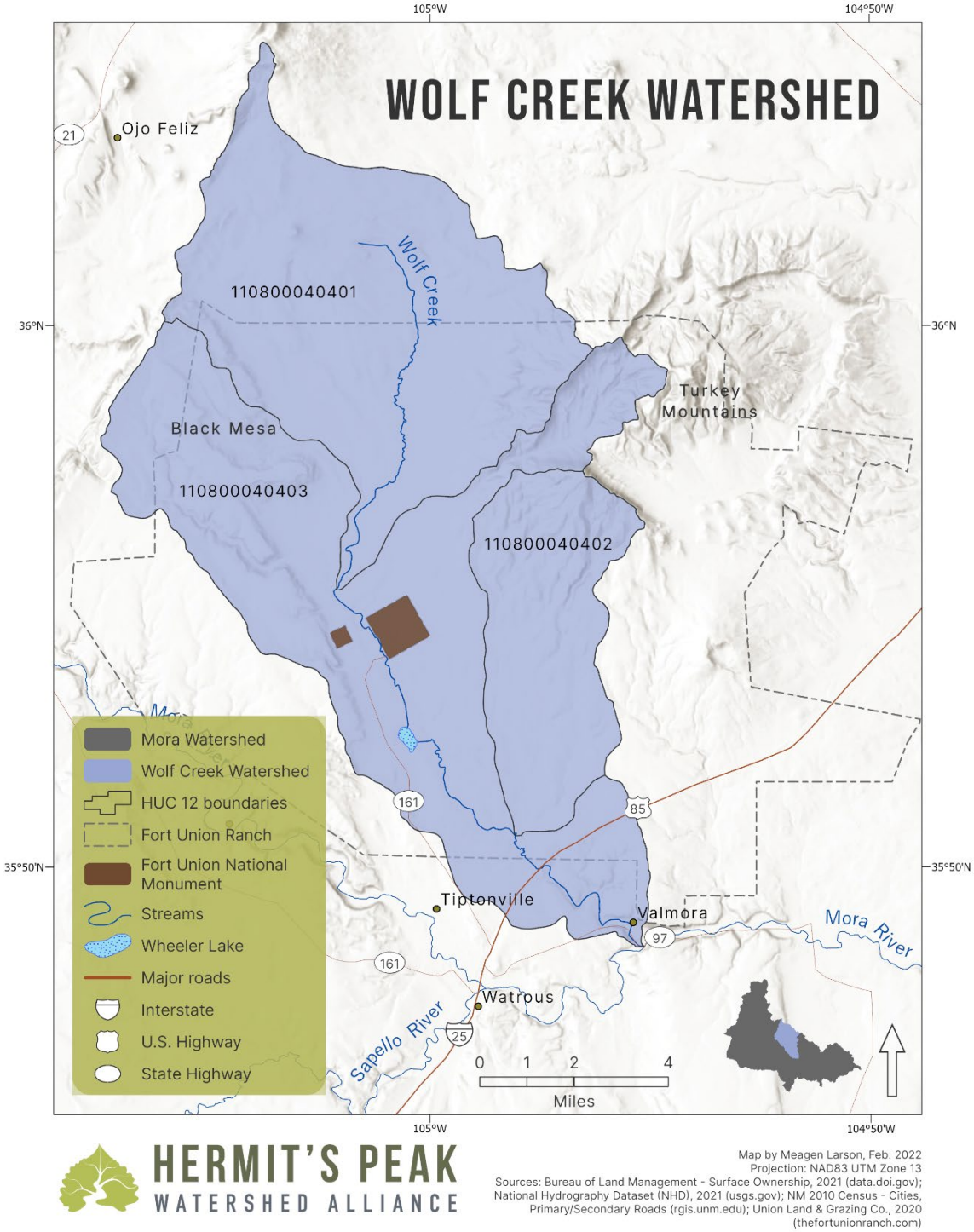
Task	Product	Responsible Party	Approximate Start Date	Approximate Completion Date
Pretreatment Wet Dry Mapping - Baseline done during WBP	Used satellite imagery to locate wet and dry sections, arroyos draining alluvial fans, wetlands, and identify visible wetness developed in the WCWBP to establish a baseline.	Joe Zebrowski, NMHU	July 2020	January 2021
Pre Treatment Photo Points	Project site photo points of Wolf Cr. instream work in accordance with 404 permit monitoring plan.	Renee Hernandez, HPWA	October 2025	October 2025
Pre Treatment Photo Points	Project site photo points alluvial fan	Renee Hernandez, HPWA	July 2024	July 2024
Pre Treatment Photo Points	Project site photo point Arroyo Needham	Renee Hernandez, HPWA	April 2024	April 2024
Develop restoration design	Restoration Design for Arroyo Needham and Wolf Cr.	Renee Hernandez, HPWA	April 2024	May 2025
Implementation of restoration design	Instream Restoration implementation in Wolf Cr.	Renee Hernandez, HPWA	September 2025	October 2026
Implementation of restoration design	Alluvial Fan Restoration implementation	Renee Hernandez, HPWA	July 2024	July 2024
Implementation of restoration design	Arroyo Needham Restoration implementation	Renee Hernandez, HPWA	April 2024	May 2025

Task	Product	Responsible Party	Approximate Start Date	Approximate Completion Date
Post Treatment Photo Points	Project site photo points, Wolf Cr. instream. In accordance with 404	Renee Hernandez, HPWA	September 2026	October 2026
Post Treatment Photo Points	Project site photo points alluvial fan.	Renee Hernandez, HPWA	July 2024	July 2024
Post- treatment Wet/Dry Mapping	Use satellite imagery to locate wet and dry sections, arroyos draining alluvial fans, wetlands, and identify visible on-the-ground flow modifications	TBD (NMHU or HPWA staff)	July 2026	November 2026
Reporting to SWQB Project Officer	Quarterly Reports, Final Report	Lea Knutson, HPWA	September 2023	December 2026
Reporting to EPA	Quarterly and Final Reports to EPA	Eliza Martinez, SWQB	Quarterly starting Jan. 2024	December 2026

Project Area

This project is in Mora County, New Mexico (see Figure 1). The NMED Assessment Unit is Wolf Creek (Mora River to headwaters) NM-2305.3.A_10. To inform Wolf Creek Phase I, improvements in surface and groundwater will be monitored and assessed by using vegetation as an indicator of wetness. These data will help identify the sources of flow regime modifications contributing to the current stream impairment and the effects of treatments. These data will drive goals and strategies to improve water flow within the Wolf Creek Watershed (USGS HUCs 110800040401, 110800040402, and 110800040403). The Project Area is a total of 77,500 acres or 121 square miles.

Figure 1. Project Area Map



Monitoring Location Selection Criteria

Monitoring will occur across the entire watershed, without specific designated monitoring sites, using the Normalized Difference Vegetation Index (NDVI). HPWA will capture project site photo points both before and after treatment in Arroyo Needham, Wolf Creek and near their confluence. These photo points will be used to track and evaluate the project's impact over time.

Figure 2. Project Area with Monitoring Locations

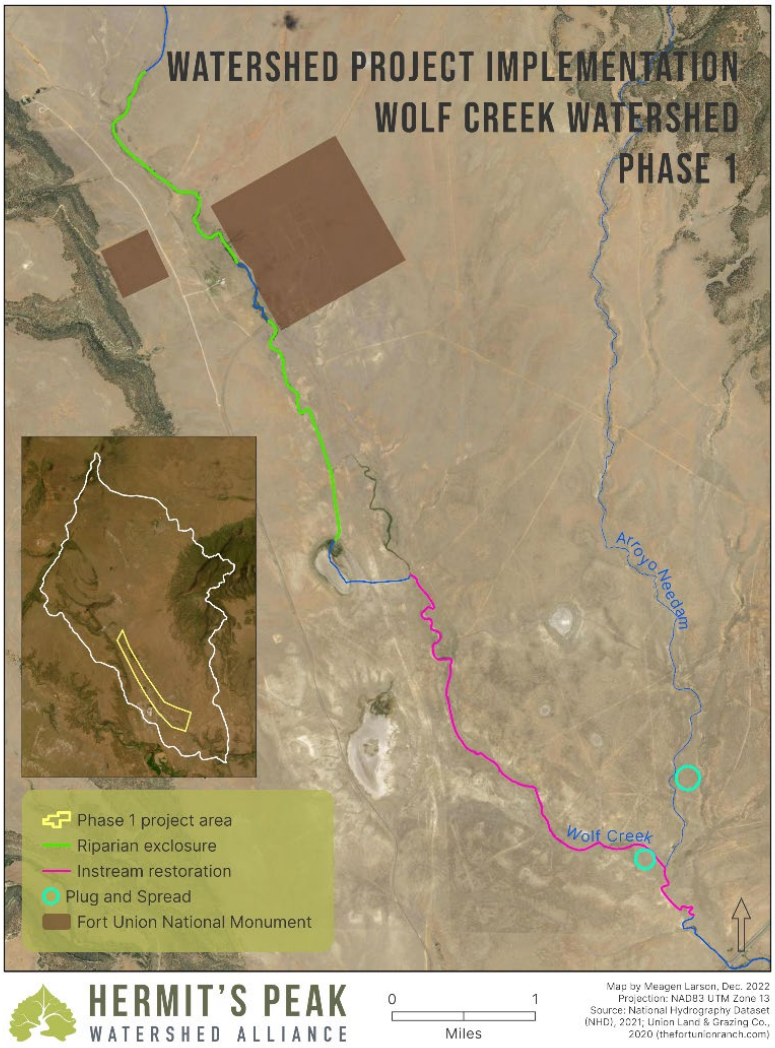


Table 2. Waterbody Attributes for the Project

Monitoring Station ID	WQS Citation Number	Assessment Unit ID	12-Digit HUC
N/A - Watershed Wide Monitoring	20.6.4.307	NM-2305.3.A_10	110800040401

N/A - Watershed Wide Monitoring	20.6.4.307	NM-2305.3.A_10	110800040402
N/A - Watershed Wide Monitoring	20.6.4.307	NM-2305.3.A_10	110800040403

Restoration Activities

The Wolf Creek Phase I restoration activities will include instream restoration in Wolf Creek, instream restoration of Arroyo Needham, reconnection of alluvial fans in Arroyo Needham and Wolf Creek, riparian vegetation enhancement along Wolf Creek, and riparian fencing to improve livestock management of riparian areas.

Instream restoration in Wolf Creek will consist of construction of approximately 40 various rock structures to include one rock dams and baffles. The installation of these structures will help reinstate historic pools and increase pool depth. This work will improve in-channel characteristics in Wolf Creek as well as support increases in wetted areas, improve water retention, water distribution, and improve riparian vegetation.

The reconnection of alluvial fans in Arroyo Needham and Wolf Creek will consist of installation of a variety of erosion control structures which include Plug and Spreads to divert water onto alluvial fan surfaces and Zuni bowls or rock lay backs to arrest head cuts. Plug and Spread structures are designed to re-wet an area that has been abandoned by the down cutting of an ephemeral stream channel. This work will result in improved groundwater recharge and increased native vegetation growth.

The riparian vegetation enhancement along Wolf Creek will consist of planting cottonwood galleries with diverse and locally appropriate shrubs in areas with good moisture and topography. These galleries will be caged with livestock, and ungulate proof caging. This riparian vegetation enhancement will not only improve habitat diversity but also anchor stream banks and beds to prevent future incision.

The riparian fencing to better manage livestock will consist of the construction of riparian exclosures to protect instream restoration efforts from livestock, elk and pronghorn herbivory. This fencing also helps reduce soil erosion by preventing livestock and elk from trampling the banks, which can degrade water quality and habitat. This riparian fencing will promote the recovery of native vegetation, allowing riparian ecosystems to regenerate and improve biodiversity in the area.

A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

The watershed-wide monitoring planned for Wolf Creek Phase I, uses GIS analysis to detect changes in surface and subsurface water flow and storage and to guide the type and location of Management Measure implementation. Conditions at the end of implementing Phase I treatments will be compared to baseline conditions established during development of the Wolf Creek Watershed Based Plan.

A Wolf Creek Riparian NDVI analysis was developed as part of the Watershed Based Plan by delineating HUC 12 watershed boundaries and defining assessment areas from the USFWS National Wetlands Inventory. These areas were buffered, merged with the 2020 NM Riparian Habitat Map, and clipped to the HUC 12 boundaries for further geoprocessing.

NDVI data from June 2022 NAIP CIR imagery (0.6-m resolution) was processed in ArcGIS Pro, subset to the project boundaries, and analyzed with zonal statistics, yielding values ranging from (-0.87037) to (0.747368), with a mean of (-0.31735) and a range of (1.617739).

Visual analysis of NDVI and CIR imagery indicated that values above 0 represented active vegetation, with values above 0.4 corresponding to mature deciduous canopy. Reclassified into four categories, 75.6% of the 18,913-acre study area was dormant vegetation, bare ground, or water; 5.8% was emerging vegetation; 18.1% was active vegetation; and 0.5% was broadleaf canopy.

Further detail is included in section B2.

Data Quality Objective (DQO)

The Data Quality Objectives (DQOs) ensured that all geospatial data used for the watershed assessment were accurate and reliable. High-resolution NAIP imagery and supporting datasets were used, all meeting strict positional standards. Data processing, including NDVI analysis and mapping tasks, was completed efficiently across the study area. Spatial alignment had to meet a minimum 95% match rate, with any large offsets corrected. Maps were digitized carefully to avoid gaps or overlaps, maintain accurate attributes, and use consistent vegetation categories. QA/QC checks, including visual inspections, confirmed that the data and vegetation classifications were trustworthy

Data Quality Indicators

Resolution and Accuracy of Input Data Sources will include all geospatial input data and shall meet the resolution and positional accuracy required to assess riparian and watershed-scale conditions. For Wolf Creek Phase I, 2022 NAIP Color Infrared (CIR) imagery at 0.6-meter resolution was used to assess vegetation vigor and canopy cover. Watershed boundaries were delineated using HUC 12 units from Esri's Watershed Boundary dataset, consistent with national standards. Wetland and riparian datasets (USFWS NWI and NM CUP Riparian Habitat Map v1.1, 2020) were constrained to HUC 12 boundaries to ensure hydrologic consistency and carry an inherent mapping accuracy of ±10 meters.

Application Processing Speed Requirements will include geospatial processing and shall be completed using tools such as ArcGIS Pro under efficiency benchmarks that ensure timely data analysis. Raster-based NDVI tasks, including sub setting, reclassification, and zonal statistics, shall be carried out efficiently across the 18,913-acre study area. Vector-based operations, including buffering, merging, and clipping of HUC 12 boundaries, NWI, and CUP datasets, shall support consistent watershed-scale analysis.

Geo-referencing Accuracy for Aerial and Satellite Imagery will include all aerial and satellite imagery and shall be geo-referenced to meet a horizontal positional accuracy of ≤1 meter. The 2022 NAIP CIR imagery is terrain-corrected and provided with sub-meter accuracy, which meets this requirement.

Minimum Match Rate, Spatial Offset Tolerances, and Corrections will include spatial matching of imagery, wetlands, and riparian datasets to HUC 12 boundaries and shall achieve a minimum 95% match

rate. Any spatial offsets greater than 10 meters shall be corrected or flagged, and adjustments shall be documented in metadata.

Map Digitizing Quality Indicators will include topology standards and shall prohibit polygon overlaps or unintended gaps greater than 1 meter. Line features shall connect at intersections; dangling nodes or overshoots shall be corrected. Attribute accuracy shall meet a minimum of 95% consistency with source metadata, and vegetation class codes shall align with NDVI reclassification. Features (dormant, emerging, active vegetation, broadleaf canopy) shall be labeled consistently with valid domain values. QA/QC checks shall include visual inspection of NDVI overlays to confirm alignment with field or reference expectations.

A7. Distribution List

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 the Project Manager. The Project Manager will distribute to all other project personnel listed below. All members of the distribution list who do not have signature authority to approve this QAPP will review the QAPP and sign the Acknowledgement 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.

New Mexico Environment Department Surface Water Quality Bureau
Project Officer: Eliza Martinez, (505) 819-8099
Program Manager: Kathryn Lacey-Younge, (505) 946-8863
Quality Assurance Officer: Emily Miller, (505) 660-3534

The Hermit's Peak Watershed Alliance
Executive Director Project Manager: Lea Knutson, (505) 617-1360, lknutson@hermitspeakwatersheds.org
Project Coordinator: Renee Hernandez, (505) 310-2612, rhernandez@hermitspeakwatersheds.org

U.S. Environmental Protection Agency Region 6
Chief: Nelly Smith, State and Tribal Programs Section, (214) 665-7109
Project Officer: Anthony Suttice, Water Division, (214) 665-8590

A8. Project Organization

The table below lists all staff involved in EIO and describes their roles and responsibilities. The Project Officers will ensure that any staff responsible for conducting work in accordance with this QAPP will be provided a copy to read and acknowledge the QAPP requirements by signing the Acknowledgement Statement.

Table 3. Project Roles and Responsibilities

Name	*Organization*	*Title/Role*	*Responsibility*	*Contact Information*
Kate Lacey-Younge	SWQB	Program Manager	Reviewing and approving QAPP, managing project personnel and resources	(505) 946-8863 kathryn.lacey@env.nm.gov
Emily Miller	SWQB	QA Officer	Reviewing and approving QAPP	(505) 660-3534 emily.miller@env.nm.gov
Eliza Martinez	SWQB	Project Officer	Preparing and revising QAPP, distribution of QAPP, project reporting, coordinating with contractors, oversight of data collection, and EPA reporting	(505) 819-8099 eliza.martinez@env.nm.gov
Michael Petronis	NMHU	Director of NMHU GAINS Lab	In charge of all collaborations and projects done in lab	(505) 454-3262 mspetro@nmhu.edu
Lea Knutson	HPWA	Senior Manager	Project oversight, data management, and submittal of quarterly reports	(505) 617-1360 lknutson@hermitspeakwatersheds.org
Renee Hernandez	HPWA	Project Operations Manager Field Team Supervisor #1	Project design and implementation, construction oversight Field training and supervision, monitoring, data collection, record keeping, and submitting reports	(505)310-2612 rhernandez@hermitspeakwatersheds.org
Patrick Gutierrez	HPWA	Field Team Supervisor #2	Field training and supervision	(505)429-8386 pgutierrez@hermitspeakwatersheds.org
Anthony Suttice	EPA	Project Officer WDAS, Region 6	Reviewing and approving QAPP	(214) 665-8590 suttice.anthony@epa.gov
Nelly Smith	EPA	Supervisor, State and Tribal Programs Section WDAS, Region 6	Reviewing and approving QAPP	(214) 665-7109 smith.nelly@epa.gov

A9. QAO Independence

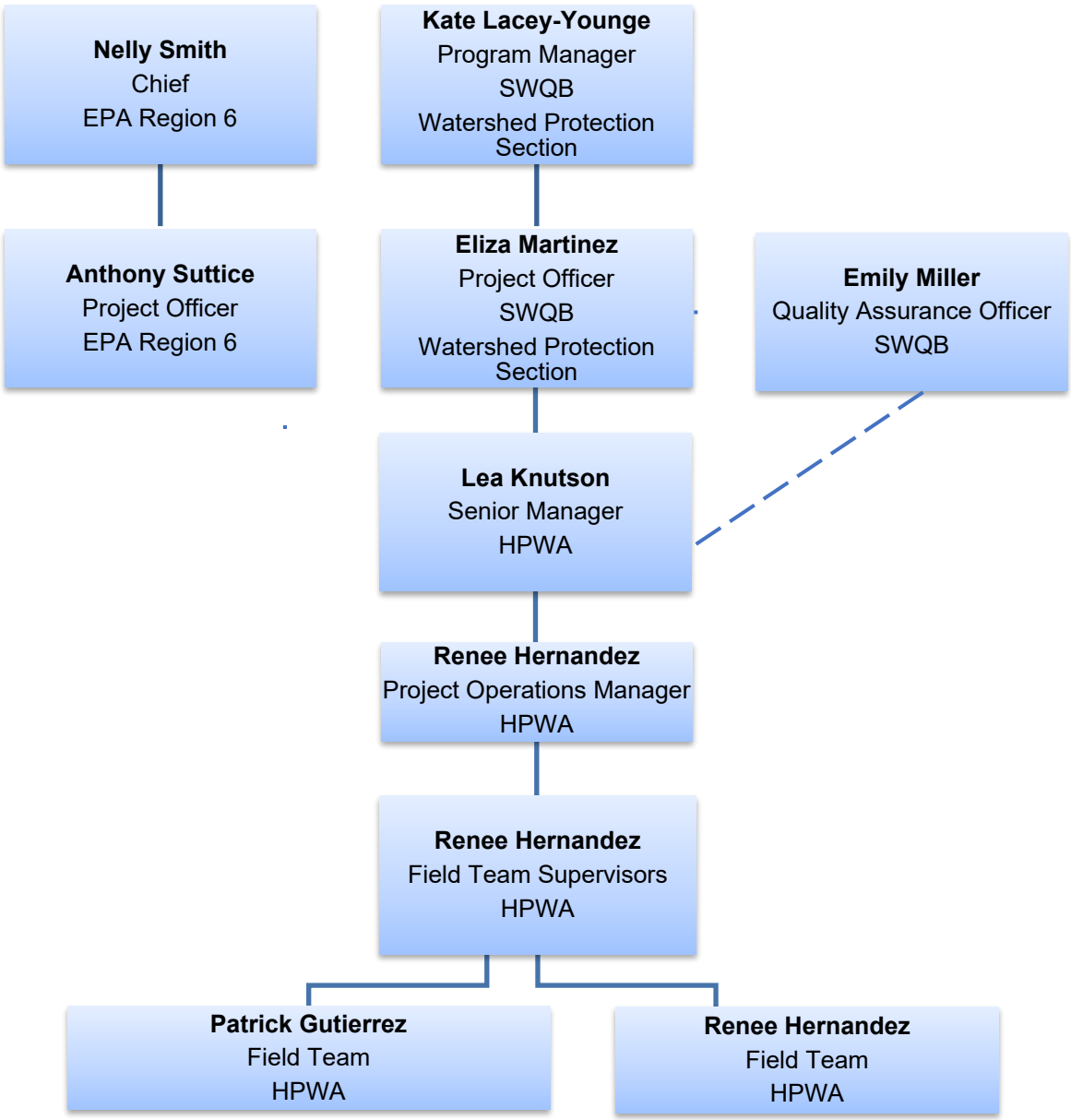
The QAO shall maintain independence in all QA matters and has the ability to directly and independently interact and initiate communication with technical staff and management. This direct access allows the QAO to independently elevate critical, quality-related issues to the attention of the Bureau Chief at their discretion without challenge or section approval. The QAO communicates with NMED senior management through the Bureau Chief and the Standards and Outreach Team Supervisor. The SWQB Quality Management Plan (NMED/SWQB 2025) further documents the independence of the Quality Assurance Officer (QAO) from this project. The QAO is responsible for maintaining the officially approved QAPP.

A10. Project Organization

The communication flow for the *Watershed Project Implementation Wolf Creek Watershed Phase I* is as follows: HPWA staff will provide feedback, concerns, or progress reports to the SWQB project officer.

The Project Officer will then relay this information to the SWQB program manager, who will communicate with the EPA Project Officer as necessary. All communication will occur through phone and/or email.

Figure 3 presents the organizational structure for the Watershed Project Implementation for Wolf Creek Watershed Phase I referred to in this document as the "Project."



A11. Personnel Training/Certification

This project will be primarily implemented by the HPWA, who will be trained as needed by the SWQB Project Officer in accordance with procedures identified in SOPs referenced in this QAPP.

Patrick Gutierrez possesses a background in conservation management, ecological research, and habitat restoration. He holds a Bachelor of Science in Conservation Management with a minor in Forest Management and a certificate in Geographic Information Systems (GIS). Renee Hernandez holds a Bachelor of Science in Conservation Management with a minor in Forest Management. Annie Topal holds a Master of Science in Natural Sciences and a certificate in Geographic Information Systems (GIS). Patrick and Annie will do NDVI analysis and seek assistance from the NMHU GIS lab, also known as the Geospatial Applications In Natural Science (GAINS) lab as needed.

Data collection and monitoring for this project will be implemented by the HPWA with technical assistance from the SWQB Project Officer as needed. Volunteers will not be collecting any data in the field. Any individual conducting monitoring work for the project will review this QAPP and sign the acknowledgment statement prior to initiating any monitoring for this project. The signed Acknowledgement Statements will be collected by the SWQB Project Officer and will be given to the QAO for filing with the original approved QAPP.

A12. Documents and Records

The SWQB Project Officer will make copies of this approved QAPP and any subsequent revisions available to the Project Manager. The Project Manager will distribute to all individuals on the distribution list who do not have signature authority for approving the QAPP. 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, recorded field data, records of analytical data in hard copy or in electronic form, and QC records. 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 a HPWA computer or an external hard drive at the end of each day. 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 a HPWA's Google Drive and on a separate external backup hard drive at the HPWA office. Hard copy project documents will be kept in a project folder in a filing cabinet at the HPWA office. All hard copy documents will be digitized and stored on a HPWA Google Drive and backup hard drive (see Table 4). Copies of the data will be distributed by HPWA to NMED SWQB Project Officer after each field season, typically at the end of November. The resulting data will be uploaded to WQX. More detail on the management of project information is covered in B7. Environmental Information Management.

Table 4. Data Records for the Project

Document	Type of Form	Storage Location	Field Sheet Used
QAPP	Electronic (doc) & Hard Copy	Google Drive	Quality Assurance Project Plan Standard. CIO 2105-S-02.1. Located at: https://www.epa.gov/system/files/documents/2024-04/quality_assurance_project_plan_standard.pdf
NDVI Remote Sensing	Electronic (doc)	Google Drive	NA
Photos	Electronic (.jpg)	Google Drive	Photo Documentation Field Form
Interim and Final Reports	Electronic (doc) & Hard Copy	Google Drive, HPWA office	NA

GROUP B. IMPLEMENTING ENVIRONMENTAL INFORMATION OPERATIONS

This QAPP was developed following the Quality Assurance Project Plan Standard and QAPP Standard Checklist (EPA, 2023).

B1. Identification of Project Environmental Information Operations

Normalized Difference Vegetation Index (NDVI) remote sensing will be conducted watershed wide by HPWA and NMHU GAINS lab director used to assess the health and density of vegetation by analyzing data from satellite imagery, allowing HPWA to quantify the amount of green vegetation in a given area. Wetted area NDVI remote sensing analysis will be done in 2026 after all on-the-ground work is completed using data from the same time of year as the baseline and the most recent satellite imagery available to detect changes. Based on past work in the area, it is suspected that the HPWA's Wolf Creek Phase I may provide information to suggest a need to reclassify the upper stream reach of Wolf Creek as it is generally considered to be ephemeral with perennial pools. The data collected under this QAPP may be used to provide information to support the development of a more rigorous Use Attainability Analysis, although that is not part of this effort. NDVI remote sensing is a powerful tool for identifying wetted areas. By detecting changes in vegetation health and moisture content, it provides valuable insights into the progress of restoration activities and helps prioritize areas for further action.

All photo points of instream restoration and plug and spread structures will be taken by HPWA. Photo points will be used to visually document and monitor changes in the area treated. Photo documentation is an accessible and efficient tool for gathering data. It will be used to provide a clear visual record of the project's progress and support adaptive management.

Table 5. Project Monitoring Specifics

Responsible Party	Monitoring	Location	Frequency
HPWA	NDVI Remote Sensing	Watershed Wide	Pre-treatment was done 2020 during WBP. Post Project Implementation will be done 2026
HPWA	Photo Documentation	Each Specific Project	Pre/Post Project Implementation

NDVI remote sensing and photo documentation play an essential role in achieving the project's objectives by offering valuable data that captures both a broad, watershed-wide overview as well as detailed insights into specific restoration treatments. This dual perspective allows for a comprehensive assessment of the project's impact across various scales, ensuring that both large-scale trends and individual treatment outcomes are effectively evaluated. The integration of remote sensing technology and photographic records ensures that the restoration efforts are monitored with precision, providing an objective basis for tracking progress and identifying areas for improvement. These data collection methods contribute to a more informed, evidence-based approach to watershed restoration.

The data collected for this project will meet the DQO and DQI's identified in section A4 and A6 by following the QA/QC specifications and procedures therein.

B2. Methods for Environmental Information Acquisition

Field Activities Environmental Measurements
To ensure consistent and repeatable photo monitoring, photo point locations will be carefully documented (including geographic coordinates) and monumented so they can be precisely reestablished during repeat photographic events. Each photo point will be selected to provide the best possible vantage for observing and tracking anticipated changes over the duration of the project. Including a portion of the horizon in each photograph helps orient the view and allows for quicker, more accurate comparison between images taken at different times. When conducting repeat photography, the original image will be referenced to match framing and composition as closely as possible, ensuring the scene is consistently captured. To minimize variation caused by seasonal lighting changes, photo sequences will be scheduled at the same time and on the same day of the year as the initial photo, reducing differences due to sun angle and shadow length. Improving the reliability of visual change detection over time. Photo points will be recorded using the Photo Documentation Field Form.

Laboratory Analyses
Because there are no plans to collect samples, no analytical methods are needed.

Existing Information
Baseline NDVI remote sensing data collected in 2022 (as part of the WCWBP) will be used to assess post-treatment vegetation health and density by comparing it to 2026 satellite imagery. The NVDI analysis method is described in Appendix A of this QAPP. NDVI remote sensing includes a repeatable process to ensure data accuracy and reliability. This process involves checking for accuracy and conducting field

verification to compare remote data with actual conditions. It also addresses any anomalies, like cloud cover, to maintain consistent and reliable data for wetted monitoring and flow restoration.

Joe Zebrowski conducted the baseline Wolf Creek Riparian NDVI analysis using geospatial methods. The first step involved selecting HUC 12 watersheds for the Wolf Creek drainage area, using the ArcGIS Environmental Systems Research Institute's (Esri) Watershed Boundary dataset. The assessment areas were then derived from Esri's USA Wetland Layer, with a 100-meter buffer applied using the pairwise buffer tool in ArcGIS Pro. This dataset was sourced from the USFWS National Wetlands Inventory (NWI). Afterwards the buffered area was merged with the NM Riparian Habitat Map Canadian and Pecos (CUP) Riparian Habitat Map 1.1 from 2020 using the ArcGIS merge tool. In both cases, only the features that intersected the HUC 12 boundaries were selected before further geoprocessing.

The NDVI data, derived from 2022 with a 0.6-meter resolution, was sourced from the Color Infrared (CIR) National Agriculture Imagery Program (NAIP) data, downloaded from the USDA Geospatial Data Gateway NAIP Direct Data Download site. This data subset was processed using ArcGIS Pro, with the image date being June 13, 2022. The NDVI was further subset to the boundary areas, and zonal statistics were calculated to determine key values, including the minimum (-0.87037), maximum (0.747368), mean (-0.31735), and range (1.617739).

A visual inspection of both the NDVI and CIR images indicated that NDVI values greater than 0 represented actively growing vegetation, with values greater than 0.4 indicating mostly mature deciduous canopy. The NDVI data was then reclassified into four categories: dormant vegetation, emerging or less vigorous vegetation, active vegetation, and broadleaf canopy. The reclassification revealed the following: 75.61% of the area (14,300 acres) was classified as dormant vegetation, bare ground, or water; 5.75% (1,087 acres) was categorized as emerging or less vigorous vegetation; 18.13% (3,428 acres) was active vegetation; and 0.52% (98 acres) was broadleaf canopy. In total, the study area covered 18,913 acres (76,538,987.64 square meters).

B3. Integrity of Environmental Information

Data generated for this project will only be in electronic form and therefore there are no chain of custody or handling requirements.

B4. Quality Control

The Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) guide the collection, processing, and validation of geospatial and environmental data for the Wolf Creek watershed to ensure accuracy, consistency, and reliability. High-resolution NAIP imagery and supporting datasets were used, with geo-referencing maintained at ≤1 meter. Quality control (QC) activities—including GPS field data collection, standardized map digitizing, ground-truthing, and visual inspection of NDVI overlays—are performed routinely throughout the project to verify data precision and reliability. Each QC activity is done on a regular schedule, and any errors or inconsistencies are quickly corrected and recorded in the metadata. Corrective actions are determined based on the nature and magnitude of discrepancy and are recorded to ensure transparency and traceability. All QC procedures, frequency schedules, corrective actions, and documentation follow the Quality Objectives and Criteria for Measurement Data, the SWQB Standard Operating Procedures (SOPs), and the photo-documentation procedures outlined in this QAPP. These

practices reduce variability, improve data quality, and ensure dependable vegetation classification and watershed assessment results.

B5. Instrument/Equipment Calibration, Testing, Inspection, and Maintenance

Calibration and Frequency

Equipment requiring maintenance, testing and inspection is the GPS device. These will be tested during calibration for accuracy and function according to requirements and procedures are specified in the SWQB SOPs. The GPS unit will be visually inspected for damage before and after each use and if any maintenance is necessary, it will be completed prior to the next monitoring trip. Photo points will be taken on tablet or cell phone and will be visually inspected for damage before and after each use and if any maintenance is necessary, it will be completed prior to the next monitoring trip No calibration is required for tablet or cell phone.

Testing, Inspection, and Maintenance

None of the equipment or systems used in this project requires inspection, testing, or regular maintenance, so testing, inspection, and maintenance are not needed.

B6. Inspection/Acceptance of Supplies and Services

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

B7. Environmental Information Management

HPWA will be responsible for data management. All data including GPS and photo documentation will be converted to electronic format, stored and backed up by HPWA project coordinator. Google Drive and computer hard drives are backed up at the end of every season or will be backed up on external hard drives, respectively. The resulting data will be uploaded to WQX. Hard copies of field sheets will be maintained in a project binder organized by assessment and date and stored in a key protected filing cabinet in the office of HPWA.

Data will be sent to the SWQB Project Officer by the end of each field season by HPWA, typically by the end of November. Upon receiving data, the SWQB Project will store data on SWQB network drive. The SWQB 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 New Mexico Administrative Code (NMAC) and Retention and Disposition of Public Records regulations, codified at 1.21.2 NMAC.

GROUP C. ASSESSMENT, RESPONSE ACTIONS, AND OVERSIGHT

C1. Assessment and Response Actions

The Project Officer will provide project oversight by periodically assisting with and/or reviewing data collection efforts as needed. A review of the baseline data collection and monitoring efforts by the SWQB Project Officer will take place at the end of the project. 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.

C2. Oversight and Reports to Management

Annual reports will be submitted by the HPWA to the SWQB Project Officer and will include project progress 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 December 2026. The SWQB Project Officer will be responsible for submitting the final project deliverables to EPA through their Grants Reporting Tracking System.

GROUP D. ENVIRONMENTAL INFORMATION REVIEW AND USABILITY DETERMINATION

D1. Environmental Information Review

Data will be reviewed by the Field Team Supervisor 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 are followed and the data is within acceptable range limits as defined under this QAPP in sections A6, B4, and in Appendix A. 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 not be used in analysis and implementation of activities listed under this QAPP unless the data can be recollected and assessed for usability.

Validation and Verification Methods

The HPWA will ensure that valid and representative data are acquired. Verification of field sampling and analytical results will be performed by the HPWA in accordance with the SWQB SOP 15.0 for *Data Verification and Validation Procedures* (NMED/SWQB 2023). Verification and validation (V&V) of data will occur after every field season using the attached V&V worksheets. In the event questionable data is found, the SWQB Project Officer will be notified and will consult appropriate personnel to determine the validity of the data. Results of the verification and validation process will be included in the final reports.

D2. Usability Determination

Data will be reviewed by the Field Team Supervisor for errors in data, incomplete data and transcription errors prior to demobilization from the field site. Data will be considered usable if the requirements of this QAPP are followed and the data is within acceptable range limits as defined under this QAPP. HPWA will ensure that valid and representative data are acquired. Verification of field sampling and analytical results will be performed by HPWA in accordance with the SWQB SOP 15.0 for Data Verification and Validation. Verification and validation (V&V) of data will occur after every field season using the

attached V&V worksheets. In the event questionable data are found, the SWQB Project Officer will be notified and will consult appropriate personnel to determine the validity of the data. Results of the verification and validation process will be included in the final reports.

If the project's results do not meet this requirement, then 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.

References

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Appendix A. NDVI Methods

Wolf Creek Riparian NDVI Analysis Methods used by Joe Zebrowski

1. Selected HUC 12 Watersheds for Wolf Creek drainage area from ArcGIS Environmental Systems Research Institute's (Esri) Watershed Boundary data set

2. Assessment areas were derived from Esri's USA Wetland Layer and applied a 100m buffer using the pairwise buffer tool in ArcGIS Pro. That dataset was derived from the USFWS National Wetlands Inventory (NWI). The buffered area was then merged with NM Riparian Habitat Map Canadian and Pecos (CUP) Riparian Habitat Map 1.1, 2020 using ArcGIS merge tool. In both cases, the features intersecting the HUC 12s were selected before further geoprocessing.

3. NDVI derived from 2022 with 0.6 resolution, Color infrared (CIR) National Agriculture Imagery Program (NAIP) data downloaded from USDA Geospatial Data Gateway NAIP Direct Data Download site, which is a subset to the study area and processed using ArcGIS Pro. Image date: 6/13/22

4. NDVI further subset to boundary areas. Zonal statistics to determine the minimum (-0.87037), maximum (0.747368), mean (-0.31735), and range (1.617739)

5. Visual inspection of the NDVI image and the CIR image indicated the NDVI values greater than 0 being actively growing vegetation and values greater than .4 being mostly mature deciduous canopy. Subset NDVI reclassified into four sets:

Class	Description	Sq. Meters	Acres	Percent
1	Dormant vegetation bare ground or water	57,868,815.96	14,300	75.61%
2	Emerging or less vigorous vegetation	4,399,059.96	1,087	5.75%
3	Active Vegetation	13,872,674.52	3,428	18.13%
4	Broadleaf Canopy	398,437.2	98	0.52%
Total		76,538,987.64	18,913	

Joe Zebrowski conducted a Wolf Creek Riparian NDVI analysis using several geospatial methods. The first step involved selecting HUC 12 watersheds for the Wolf Creek drainage area, using the ArcGIS Environmental Systems Research Institute's (Esri) Watershed Boundary dataset. The assessment areas were then derived from Esri's USA Wetland Layer, with a 100-meter buffer applied using the pairwise buffer tool in ArcGIS Pro. This dataset was sourced from the USFWS National Wetlands Inventory (NWI). Afterwards the buffered area was merged with the NM

Riparian Habitat Map Canadian and Pecos (CUP) Riparian Habitat Map 1.1 from 2020 using the ArcGIS merge tool. In both cases, only the features that intersected the HUC 12 boundaries were selected before further geoprocessing.

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- Acknowledgement Statement

New Mexico Environment Department Surface Water Quality Bureau

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Watershed Project Implementation for Wolf Creek Watershed Phase I
Quality Assurance Project Plan Acknowledgement Statement

This is to acknowledge that I have received a copy (in hard copy or electronic format) of the "Watershed Project Implementation for Wolf Creek Watershed Phase I" 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 or Electronic Signature (e-certified accepted)

_____
Name (Please Print)

_____
Date
Return to SWQB QAO Emily Miller