

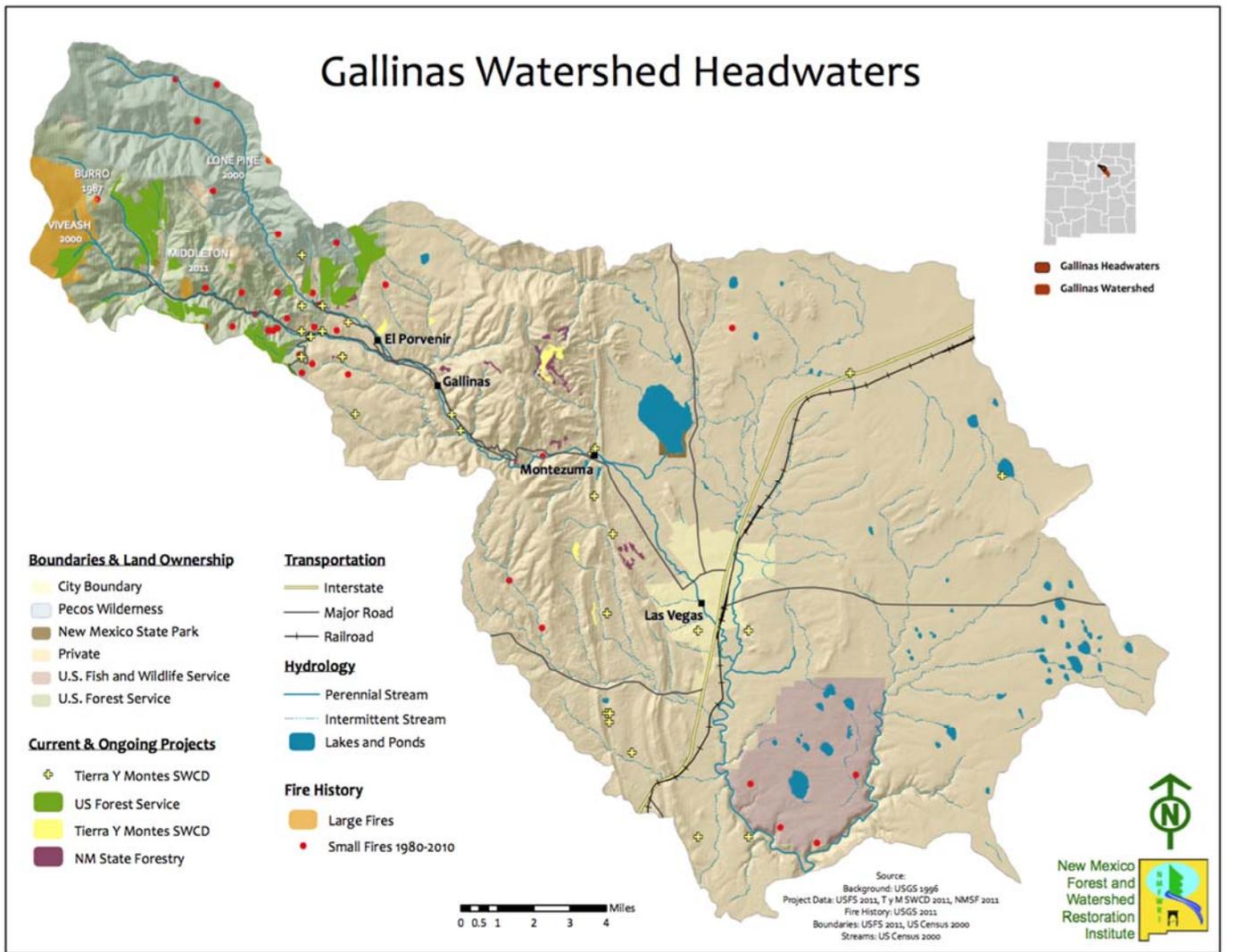
## NMWRRI Student Water Research Grant Final Report

- 1: Student Researcher: Grant Eyster  
Faculty Advisor: Edward Martinez, PhD (New Mexico Highlands University)
2. Project title: Aquatic and Morphological Assessment of the Gallinas River Within the Las Vegas, New Mexico, City Limits
3. Research problem and objectives

The Gallinas River, a tributary of the Pecos River originating in the Santa Fe National Forest northwest of Las Vegas, New Mexico, is the primary source of drinking water for the city of Las Vegas. In addition, the City of Las Vegas views the river as a potential economic source if restored to an ecologically functioning state and developed into a parkway/river walk. Various studies have been conducted determining the health of the Gallinas in the upper watershed and below the City. However, the health of the system within the City limits (most urbanized section) is unknown. The goal of the proposed project is to conduct a baseline stream health study of a reach of the Gallinas within the City limits, using chemical, biological and physical measures. To accomplish this goal the following objectives will be completed:

1. Conduct a bioassessment using aquatic macroinvertebrates;
2. Conduct a water quality assessment using physiochemical and nutrient concentrations;
3. Conduct a morphological assessment to determine morphological impacts such as incision and channelization;
4. Conduct a riparian vegetation assessment; and
5. Investigate and recommend suitable potential restoration techniques that could be utilized by the City of Las Vegas and its contracted design and construction employees

The Gallinas River provides more than 90% of potable water for the City of Las Vegas, the largest municipality in northeastern New Mexico. Residents not only are dependent on the watershed for drinkable water, but for a variety of other natural resources, including timber, fish and wildlife as a food source, recreational activities, and agricultural areas. Currently the reach of the Gallinas within the city is classified as a marginal cold water stream, with designated uses for livestock watering, wildlife habitat, irrigation, primary contact and marginal coldwater aquatic life. However, the health of watershed is in a poor state and is not effectively producing resources that are needed for the ensured vitality of the community. The data collected through this project will be utilized by the City of Las Vegas, the Hermit's Peak Watershed Alliance, and other stakeholders to establish the current state of degradation and plan for upcoming restoration work.



Map of the Gallinas Watershed from its headwaters through its course in Las Vegas, New Mexico. Map credit is to the New Mexico Forest and Watershed Restoration Institute (NMFWRRI)

Centuries of heavy use and years of consistent drought have taken their toll, and the Gallinas Watershed is in dire need of restoration work. Measurements taken in conjunction with New Mexico Highlands University as a part of this project in the fall of 2015 found that the sinuosity of the Gallinas River within the study area was 1.05. Since the sinuosity value for the project area reach is close to one, this means that the Gallinas River does not meander, which in turn means that it is prone to increased erosion and further entrenchment, continuing the process of disconnecting the Gallinas from its floodplain. These factors have resulted in the drastic decline of trout habitat and other riparian dependent species, entrenched and straightened stream channels with little in-stream structural diversity, desiccated floodplains isolated from stream flows, degraded riparian vegetation, and a loss of wetlands. Issues of decreased water quality over the past fifteen years have also been documented by NMED and studies conducted by New Mexico Highlands University and the University of New Mexico. During the 2010 Gallinas River

Assessment conducted by NMED found 1046 CFU of E. Coli in the same assessment area as the proposed project area, which violated the 410 CFU limit for a single sample. Furthermore, studies published by New Mexico Highlands University determined that E. Coli was found in the same stretch of river, with MPN's in excess of 4100 colonies.

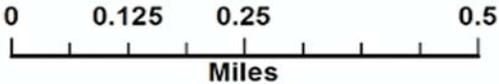
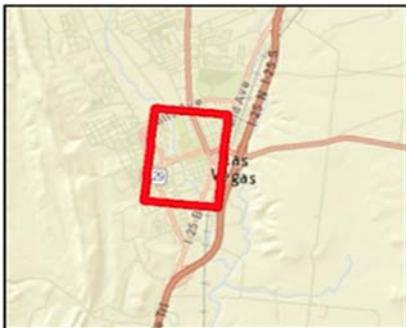
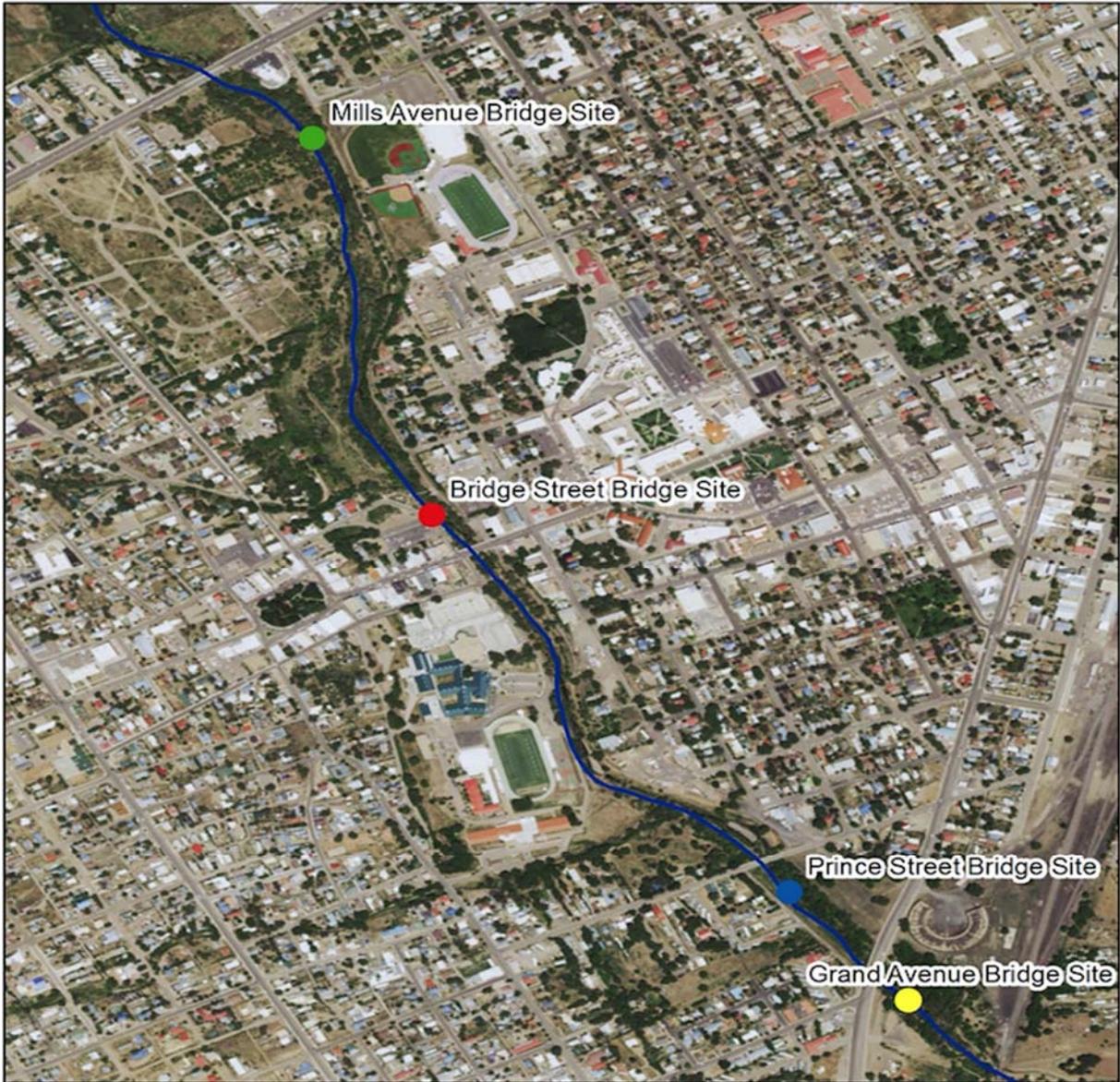
The City of Las Vegas also has inadequate and aging storm water drainage systems, so the probability of toxins making their way into the river is likely. The University of New Mexico found that chlorides, sulfates and total dissolved solids were all above allowable values in a study done on the Gallinas River within the assessment unit, in 2004. It is also expected that storm water runoff from impervious surfaces increases water temperature and increases petroleum by-products and other toxins in the Gallinas River. The goal of this project is to provide a broad assessment of the morphology of the river and its aquatic health prior to restoration work both to establish the current state of the river and also as a basis for comparison once restoration techniques have been fully applied.

#### 4. Methodology

Four sites have been identified within the city limit-reach of the Gallinas. At each site discharge and physiochemical (temperature, dissolved oxygen, turbidity, specific conductivity, and pH) concentrations will be determined and water samples will be collected weekly for one year starting in October 2015. Water samples will be analyzed in the lab for concentrations of coliforms, total suspended solids (TSS), alkalinity, nitrite, nitrate, and phosphate.

At each site basic morphological measurements such as cross-section and longitudinal profiles will be measured using a Total Station to determine morphological characteristics such as sinuosity, bank-full discharge, incision, channelization and width depth ratio. This information will subsequently be used to classify the river through the Rosgen Stream Classification System.

At each site a riparian health assessment will be conducted following the New Mexico Rapid Assessment Method (NMRAM). In addition, macroinvertebrates will be collected at each of the four sites following the EPA methods to conduct the bioassessment. Both the riparian and biological assessments will be completed three times within the year-long project.



Map of selected sample sites in Las Vegas, New Mexico, as indicated by the colored dots and adjoining text referring to the four individual sample sites. Map by NMHU student Jeff Falance.

The research period will consist of nine months of field and laboratory research for a preliminary understanding of the health of the system. The investigation will continue until October 2016 in order to complete sampling throughout four seasons. Below I have listed the various field and laboratory aspects of this project and their respective timelines for completion:

## Field Work

### Physiochemical measurements

- Physiochemical measurements are collected with a sonde weekly beginning in Fall 2015 and continuing through Fall 2016

### Water Samples

- Weekly collection for nutrient analysis and alkalinity from each of the 4 sites in Las Vegas began in September 2015 and will continue through Fall 2016

### Discharge

- Weekly collection of river discharge at each site also began in Fall 2015 and will continue through Fall 2016

### Fish Survey

- The fish survey conducted with electroshocking was completed in Fall 2015 and will not be repeated

### Macroinvertebrates

- The benthic macroinvertebrate survey was performed once in October 2015, and will be repeated around the same time in Fall 2016

### New Mexico Rapid Assessment Method

- The NMRAM was completed in October 2015 and will not be repeated, although I may seek to verify some of the results again in October 2016

### Longitudinal Profile

- A longitudinal profile of the river in the study reach was completed in Fall and Winter 2015-16 and will not be repeated

### River Cross-Sectional Profile

- Cross-sectional profiles of the river at each site and at other points in the river within Las Vegas will be completed in July and August 2016

### Rosgen Stream Classification

- The Rosgen classification of the river will utilize the data from the longitudinal profile, cross-sections, and other morphological measurements such as sinuosity, width-depth ratio, and entrenchment and will be completed in Summer and Fall 2016

## Laboratory Analysis

### Nutrient Analysis

- Nutrient analysis using the Dionex Ion Chromatography System is performed monthly to include the samples from several weeks of collection. This will be continued through Fall 2016 until all samples are analyzed

#### Alkalinity

- Alkalinity is calculated in the laboratory using titration, and is completed weekly after water samples are collected and will continue through the fall as samples are brought back to the lab

#### Turbidity

- Turbidity is collected with the sonde along with the other physiochemical measurements weekly

#### Coliform and *E. coli*

- Water samples are tested for the presence of coliform and *E. coli* bacteria every 2 weeks through Fall 2015-Fall 2016

#### Macroinvertebrates

- Macroinvertebrate samples collected in the field are sorted and identified to their respective taxonomic families, which will be repeated again in Fall 2016

### 5. Preliminary results

While this research project is ongoing, results from the Fall 2015 study season were analyzed and placed into a report meant to be shared with Las Vegas community leaders and other interested parties, and Las Vegas city employee Lorraine Garcia has been coordinating with me to utilize other aspects of my research data in grant proposals produced by the city and the Hermit's Peak Watershed Alliance. Some preliminary conclusions include:

- The discharge ranged from a minimum of 0.644 million gallons per day to a maximum of 3.3 million gallons per day. The low figure was likely a result from water diversion from the river within the City of Las Vegas, and the maximum figure can be attributed to a season of high precipitation with several large rain events. Discharge thus far in the study reached a low in late winter around February, and monsoon rains in Fall 2015 contributed to the maximum discharge.
- The physiochemical results indicate adequate water parameters as all measurements were within values that support fish and aquatic life.
- The nutrient analysis displayed levels of nutrients within standards and results are not notably high for any particular nutrient surveyed. Increases in nitrates, phosphates, and sulfates could be attributed to runoff into the Gallinas River.
- The high alkalinity (~250 mg/L CaCO<sub>3</sub>) demonstrates a large capacity of the Gallinas River to buffer against acidity.
- The New Mexico Rapid Assessment Method conducted indicated Fair wetland condition at 3 sites but also classified the Mills Avenue site as Good.
- The fish survey performed indicated low diversity but habitat suitable to support sensitive and economically/recreationally important fish like trout.
- The macroinvertebrate survey contained relatively low numbers of organisms but diversity and presence of intolerant species like EPT organisms indicates fair to good water quality.
- The presence of coliform bacteria and *E. coli* in all samples is indicative of animal/human

waste runoff into the river system, and could pose a danger to those in close interaction with the river.

## 6. Significance of research project and relevance to others

This study of the Gallinas River will serve as a baseline assessment of the physical, chemical, and biological health of the system within the City limits. Areas that are shown to be ecologically sound and productive may be identified for protection, and areas that are in poor aquatic health may be identified for improvement during the restoration efforts by the City. Results of the aquatic assessment will thus lead to steps taken by the city in order to lessen the urban impact on the river, and help transform the river into a source of pride and economic growth as well as a focal point of the city's urban planning going forward. This study could also serve as a starting point for local government entities and interested citizen groups in Las Vegas and greater San Miguel County, to collaborate in implementing best management practices within the Gallinas Watershed. Additionally, this study can also be used to determine the effectiveness of the restoration strategies implemented by the City while restoring and developing this stretch of the Gallinas. Ultimately, this study may serve as a model to other small- to medium-sized cities working to study and improve water and ecosystem health in culturally and scientifically important water systems, thus having a greater impact outside the area of Northern New Mexico.

The Gallinas River in Las Vegas is currently under-utilized and degraded from its natural state. The local municipal government and other organizations such as Hermit's Peak Watershed Alliance are currently in the process of applying for grants that would fund restoration work. The Hermit's Peak Watershed Alliance submitted a proposal entitled "Rewinding the Gallinas River in the City of Las Vegas" on March 2, 2016, aiming to restore some of the natural conditions of the river, while the City of Las Vegas applied in December 2015 for a \$600,000 Brownfields Community-Wide Coalition Assessment Grant in order to assess current conditions and lead restoration in brownfields adjacent to the Gallinas River. The long-term vision of revitalizing the Gallinas River Park with river restoration as the centerpiece was included in the City of Las Vegas Comprehensive Master Plan. That plan identifies the poor condition of the existing park and lists redevelopment of the Gallinas River Park as the first priority in their Infrastructure Capital Improvements Plan (ICIP). The plan addresses inadequate management of storm-water to include water quality concerns and a lack of water harvesting infrastructure as issues requiring attention. Improved drainage into the Gallinas River is also listed in the City's ICIP. Also included in the Master Plan are the goals of improving the ecological health of the Gallinas River and its Watershed and improving fish habitat and fishing opportunities in all areas of the Gallinas River. In spite of the City's inclusion of the Gallinas River and River Park in their plan, no specific work has occurred on that front since the plans development in 2011. The City and the Hermit's Peak Watershed Alliance are working to coordinate their efforts and expertise to ensure that restoration on the Gallinas River Park and the river itself is conducted in an ecologically-minded manner.

The data collected through the research of this year-long study of the Gallinas River will be used by local entities led by the City of Las Vegas and the Hermit's Peak Watershed Alliance to establish and understand the current state of degradation in the river and further apply for additional grants and other aid in completing the long-term restoration goals. While various

stakeholders ranging from the city government to neighbors and users of the Gallinas River may all hold different perspectives on how the Gallinas River should look and function, it is hoped that restoration work to the river park and the river itself will contribute to increased ecological health. Some of the specific aims of the restoration include:

1. **Improve general urban water quality** - more specifically, reduce concentrations of E. coli, total dissolved solids, chloride and sulfate with the following enhancements.
  - a. Treat storm-water with storm-water infiltrators, bio-retention basins and rain gardens in West Las Vegas School parking lots and where storm-water enters the river from Moreno and Bridge Streets. Treatment will include catchment, filtration, and degradation of petroleum products, heavy metals, and other pollutants prior to allowing storm-water to flow or infiltrate towards the river.
  - b. Enhance riparian and wetland vegetation with native herbaceous and woody plants and by creating wetter areas that will sustain them thereby improving sequestration and filtration of sediments and pollutants, improving temperature regulation and protecting streambanks from erosion and subsequent sedimentation.
2. **Enhance Stream Habitat** by installing instream and streambank structures (e.g. grade control, floodplain benches, bank stabilization, cross-vanes, j-hooks, baffles) that mimic natural structures and functions to do the following.
  - a. Recover marginal coldwater fish and aquatic organism habitat with instream habitat features that restore pool and riffle complexes, woody debris structures, and riparian vegetation.
  - b. Create high quality coldwater fish habitat by creating pools and refugia that would remain under 20° C. Stream temperature data collected by NMED in the summer of 2009 on the Gallinas River at Mills Ave. resulted in an average temperature of 15.97° C and a maximum temperature of 22.61° C. While this assessment unit is classified as a marginal coldwater stream it is possible to create habitat for high quality coldwater aquatic life that would remain under 20° C.
  - c. Increase vertical structural diversity (e.g. falls, pools, and riffles).
  - d. Arrest streambank erosion.
  - e. Restore suitable stream geomorphology (e.g. width:depth ratio).
  - f. Improve floodplain connectivity.
  - g. Improve horizontal diversity (sinuosity).
3. **Enhance wildlife habitat** and travel corridor features through this urban setting. Adding riparian vegetation will be especially beneficial for resident and migratory birds and beaver (recent occupants). Pollinator habitat will also be a focus of plants used around bio-retention basins.
4. **Attenuate floods** in this urban stream by: enhancing floodplain connectivity, creating floodplain benches, improving streambank and floodplain water storage, and by improving instream and riparian obstacles to slow water flow.

Specific non-ecosystem, societal goals and objectives are to:

1. Launch work to create a Gallinas River Park with a healthy river as its centerpiece;
2. Ensure that water quality and river health are adequately addressed in future work to revitalize the Gallinas River Park, including Brownfields related projects;

3. Create a highly visible demonstration site of river and floodplain restoration; and
4. Engage local stakeholders (e.g. City of Las Vegas, West Las Vegas Schools and NM Highlands University) in this work thru educational opportunities (e.g. interpretive signs) and hands-on experiences (e.g. building bio-retention basins and planting vegetation).

The data collected through this project will help to serve as just one of the first steps in the understanding of the current state of the Gallinas River and eventual restoration work that is a long-term goal of the local government and citizen groups.

#### 7. Grant funds allocation

I would like to again thank the NMWRRI for generously providing me with the Student Water Research Grant. This grant has allowed me to continue my research over the course of this summer, which likely would not have been possible otherwise.

#### 8. Presentations made related to the project

I presented the plan of research at the NMWRRI 60<sup>th</sup> Annual New Mexico Water Conference on October 9, 2015, in Taos, New Mexico. I am also exploring the possibility of presenting my completed project in Summer 2017 at relevant conferences either in New Mexico or around the nation, as well as participating in the NMWRRI conference this year.

9. List publications or reports, if any, that you are preparing. Remember to acknowledge the NMWRRI funding in any presentation or report that you prepare.

My research will be published in the form of my graduate thesis in Spring 2017, but no other publication or report is planned. If possible, however, I would like to submit my research to a relevant scientific journal in the hopes of it being published on a professional scientific level.

10. List any other students or faculty members who have assisted you with your project.

I have received assistance from my advisor, Dr. Edward Martinez, and the students of the New Mexico Highlands University Forestry 418/518 Aquatic Ecology course during the Fall 2015 semester. In Summer 2016 I have been aided by intern Diego Trujillo, an undergraduate NMHU student. I have also been assisted by City of Las Vegas Watershed Specialist Lorraine Garcia, and will continue to work alongside her in making this research as relevant and helpful to the city as possible.