Results From Ongoing Water Quality Monitoring (Feb 2020-Present) of the Upper Pecos River

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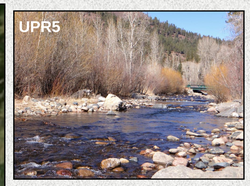
INTRODUCTION

The Upper Pecos watershed encompasses approximately 360,000 acres. It is part of the larger Rio Grande Basin and extends from the headwaters of the Pecos River in the Sangre de Cristo Mountains to the point where Interstate Highway 25 crosses the Pecos, below its confluences with Cow Creek and El Rito. There are natural and anthropogenic influences that contribute to the quality of the water in the Upper Pecos River. The natural occurrence of sulfide mineralization can lead to impairments of the water quality. Likewise, anthropogenic influences of recreation, tourism, agriculture, cattle grazing, and potential mining activities can also contribute to the impairments of river water quality. It is hypothesized that climate change and land usage are impacting the river quality over time. This study is monitoring the physical-chemical water quality parameters along a 25 km stretch of the Upper Pecos River to determine if it is meeting water quality thresholds and identify what, if any, impairments exist.

UPPER PECOS WATERSHED

- Elevation ranges >13,000' to ~ 6,000 feet.
- Lands include private holdings, land grants, US National Forest, the Pecos National Historical Park, the Village of Pecos.
- Vegetation includes spruce-fir, mixed conifer, and ponderosa forests, piñon-juniper, woodland savannah, grassland, and some sage.



CONCERNS

- The Pecos Canyon is a hot spot for tourism from Santa Fe, Albuquerque, and surrounding areas.
- High volume and high density usage at campgrounds and recreation areas result in trash, human waste, and river bank degradation.
- Exploratory mining permit (under review) threatens scarce water resource in culturally and environmentally sensitive catchment.

HYPOTHESES

•Ho: The Upper Pecos River water quality is consistent downstream along the 25 km study reach.

•H1: The Upper Pecos River water quality degrades downstream; anions, cations, and other naturally occurring elements increase downstream due to inflows from tributaries.

•H2: The Upper Pecos River water quality degrades downstream; phosphates and nitrates increase downstream due to liquid waste issuances at recreation sites and/or agricultural runoff.

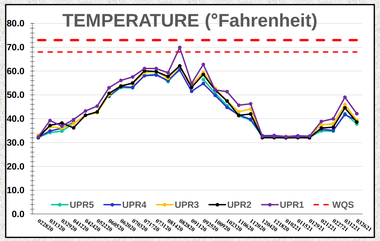
METHODS

Collection of Background Information:
- Gathered surveys of geologic, topographic, and vegetation maps.
- Identified 5 sampling sites along the Upper Pecos River.
- Obtained existing water quality reports for the Upper Pecos Watershed.

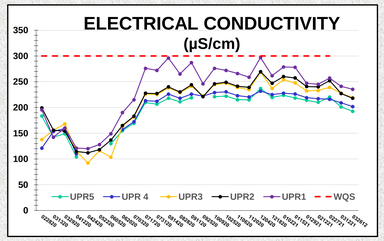
Field Work:
- Collecting in the field physical parameters (temperature, pH, conductivity, total dissolved solids, and dissolved oxygen using a YSI 556 MS on a biweekly basis starting February 2020 to present.

Laboratory Work:
- Measuring turbidity using Hach TL2300 Turbidimeter.
- Tabulating, graphing, and assessing water quality amounts and trends.
- Comparing data to New Mexico water quality standards for Upper Pecos River designated uses: domestic water supply, fish culture, high quality cold water aquatic life, irrigation, livestock watering, wildlife habitat and primary contact; and public water supply.

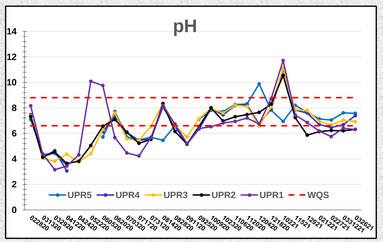
RESULTS



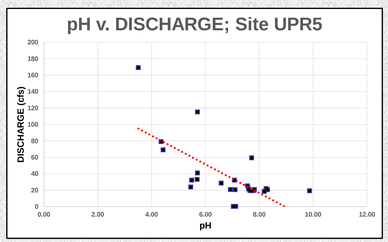
Temperature increased from upstream to downstream sites as well as during summer months with a high at the end of Aug and a drop in early September during a record early snowfall. Temperature values remained below the 23°C (73°F) water quality standard.

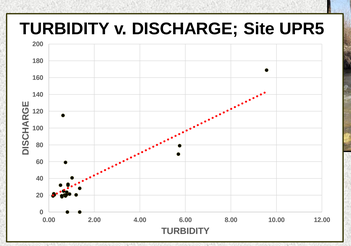


Electrical conductivity values fell below the 300 µS/cm water quality standard throughout the monitoring period. Electrical conductivity values were relatively low (<150 µS/cm) during the spring runoff (April-May) and relatively high (>200 µS/cm) during low flows.

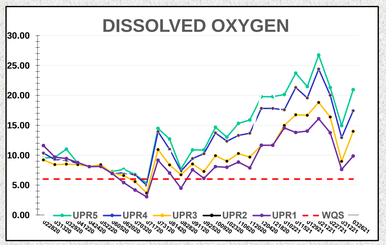


Measured pH values were highly variable during the monitoring period and out of the 6.6-8.4 water quality standard range. On most days, pH increased downstream, becoming more alkaline.

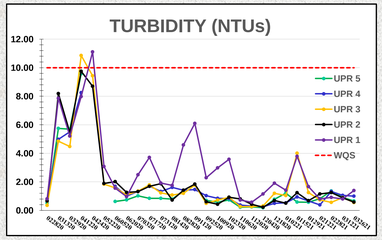




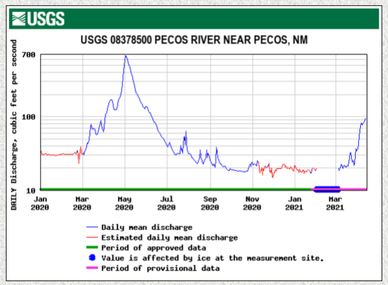
To test whether or not the variation in pH and turbidity values were related to river discharge, we calculated Pearson's product moment correlation coefficients (r-values) for all 5 monitoring sites. The r-values for pH versus discharge ranged between -0.70416 (UPR5) -0.57604 (UPR1) demonstrating a moderate to weak negative correlation. The r-values for turbidity versus discharge ranged between 0.6412 and 0.8346 demonstrating a moderate positive correlation.



Dissolved oxygen (DO) values generally decreased downstream and generally decreased from February through July mimicking warming trends. DO steadily increased during fall and winter months. DO values were ≥ 6.00 mg/L in accordance with water quality standards for most sites throughout the sampling period.



The majority (133/135) of turbidity values fell below the 10 NTU water quality standard threshold, with the exception of two exceedances in March 2020 having turbidity values of 10.85 and 11.10 NTUs.

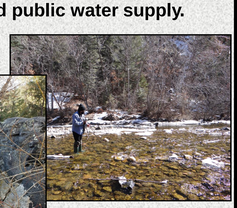


- Average daily discharge during monitoring period = 62.99 cfs.
- Minimum flow = ice / 15.00 cfs (11/30/20).
- Maximum average flow = 678.00 cfs (05/02/20).

DISCUSSION

Recorded temperature, electrical conductivity, dissolved oxygen, and turbidity values were mostly within the Upper Pecos River designated use threshold (73°F, <150 µS/cm, ≤10 NTU, and ≥ 6.0 mg/L respectively). The measured pH values were highly variable and not correlated with location or season. The project is continuing bi-weekly monitoring and conducting a variety of statistical analyses to assess the relationship between discharge and measured parameters and evaluate the variability in water quality metrics throughout the year.

The New Mexico Environment Department's (NMED) Water Quality Control Division identified temperature, specific conductance, and turbidity as impairments in several Upper Pecos assessment units in its 2020-2022 State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report. The data from this study will be shared with the NMED, as well as the Upper Pecos Watershed Association, to assist with identifying water quality problems and developing solutions to address them.



Principle student researchers Megan Begay (left) and Letisha Mailboy (right) using the YSI Sonde and measuring water quality along the Upper Pecos River.

CONCLUSIONS

Data collected during this on-going 14+ month water quality monitoring program suggest that the Upper Pecos River is in good health. The measured water quality parameters are within range for the majority of the year and meet the Upper Pecos River's domestic water supply, fish culture, high-quality cold-water aquatic life, and other designated uses.

ACKNOWLEDGEMENTS

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