APPENDIX A: Climate Change

Farmers Mutual Ditch Rehabilitation
Farmington, NM

August 2020

US Army Corps
of Engineers ®
Albuquerque District

APPENDIX A: Climate Change

Farmers Mutual Ditch Rehabilitation
Farmington, New Mexico

Contents

List of Figures

Introduction

The Farmers Mutual Ditch is located near Farmington in San Juan County, NM. The ditch diverts water from the Animas River, and runs generally west along the north bank of the San Juan River, through a siphon under the La Plata River (a small tributary of the San Juan), and continues west beyond the city limits towards the community of Kirtland. The project area begins just blow the La Plata siphon, immediately outside the Farmington city limits, and continues west until the first fields of Kirtland are encountered. The purpose of this project is to replace the current open ditch with piping throughout most of the project area to improve water transmission and reduce water losses from evaporation and seepage.

The project area is located in the northwestern corner of NM within the Colorado Plateau physiographic province. Located almost a mile above sea level, it has a temperate desert climate characterized by cool summers (mean maximum temperatures below 90°F), mild winters (average temperature of the coldest month is 30.5°F) and mean annual precipitation of 8.6 inches (NCDC 1981-2010 Monthly Normals for the Farmington Agricultural Science Center Cooperative Observer site (https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm3142)). During the July-October wet season, monthly precipitation averages about one inch, typically falling during localized convective storms; winter precipitation is generally sparse. Stream flow in the Animas, San Juan, and La Plata rivers originates as snowmelt runoff in the San Juan Mountains to the north-northeast of Farmington. Navajo Reservoir, east of Farmington, provides flood risk management for the city and water storage functions as part of the larger seven-state Colorado River Compact Agreement area.

Observed and Projected Changes in Climate

Temperatures in the San Juan Basin have risen over 1°C (1.8°F) between 1910 and 2009, mostly occurring after 1993, consistent with trends across the Western U.S. (Nydick et al. 2012). Warming is greater in the spring and summer months, and is more robust for the minimum temperature than the maximum (Nydick et al. 2012). Projected increases in temperature occur in all seasons, with increases in daytime high temperatures of approximately 6°F in summer daytime high temperatures projected for mid 21st Century, and a similar magnitude rise in winter nighttime minimum temperatures. Precipitation has showed no trend, and projected changes diverge among models (Bennett et al. 2019).

Warmer winter and spring temperatures (Nydick et al. 2012), and increases in late-spring dust on snow (Painter et al. 2007) have contributed to a 40% reductions in

snowpack snow water equivalence (SWE) in the San Juan Mountains from 1995 to 2005. The timing of snowmelt and peak spring runoff has shifted earlier into the spring by two weeks (Clow 2010, Nydick et al. 2012). Analysis of the Animas River at Farmington, NM stream gage shows long term declines in annual peak stream flow (-27.0051* water year+59450.4, pvalue = 0.0094891, Rsq. = 0.065) on the Animas near the Farmers Mutual diversion (Figure 1). The USACE Nonstationarity Detection Tool shows a change in mean peak flows in the late 1950s. No significant water storage or flood risk infrastructure development occurred at this time.

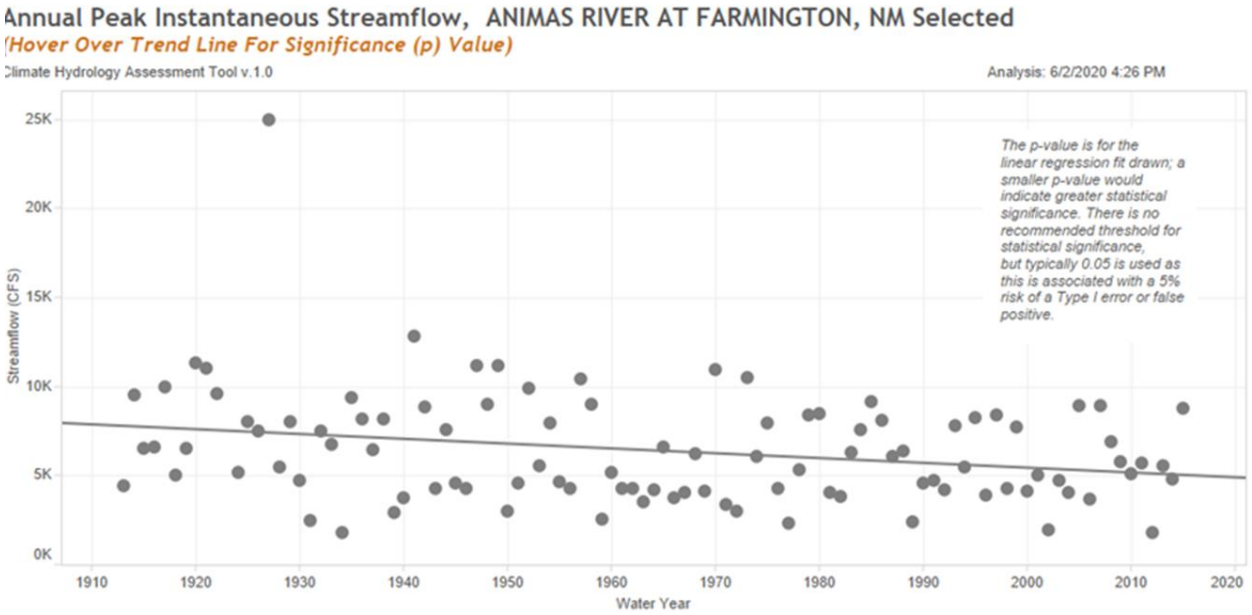

Figure 1: Observed change in annual peak instantaneous stream flow, USGS gage Animas River at Farmington, NM.

This trend is anticipated to continue, with projected future spring melt occurring two weeks to one month earlier (peaking in May) and reductions in projected annual flow volumes of 14% below the historical mean (Bennett et al. 2019). Winter half-year flows may increase, reflecting more precipitation as rain and earlier snowmelt at lower elevations (Bennett et al. 2019). Taking into account future full use of water rights not currently being fully utilized, future flows in the San Juan may be 33% lower than historical values; water shortages intensify across the basin, water deliveries to municipalities, electric power plants, and agriculture may decline by 25% to 50% (Bennett et al. 2019).

Changes to flood risk, and therefore flood damage to acequia intake structures, may occur in the future but are highly uncertain because the causal mechanisms (changes to summer convective precipitation, changes to eastern Pacific hurricane characteristics) are parameterized in climate models. However, these impacts are likely to be felt most

keenly at the ditch intake, located some miles to the east of the project area. These events could result in disruption of water to the proposed piped portions of the ditch, but are unlikely to physically impact the project area.

Project Area Vulnerability

The USACE Civil Works Vulnerability Assessment Tool was used to further investigate projected climate change impacts to the project area (Figure 2). The data indicate that flood magnification (the increase in flood size compared to present) is the leading risk related to future flooding, both locally (flash flooding due to direct precipitation) and regionally to be the biggest concern for the San Juan basin as a whole.

However, given the project area is several miles from the diversion on the Animas River, damage to the project from flooding is unlikely to be significant. Reductions in water supply over time due to climate change is likely to be the dominant concern.

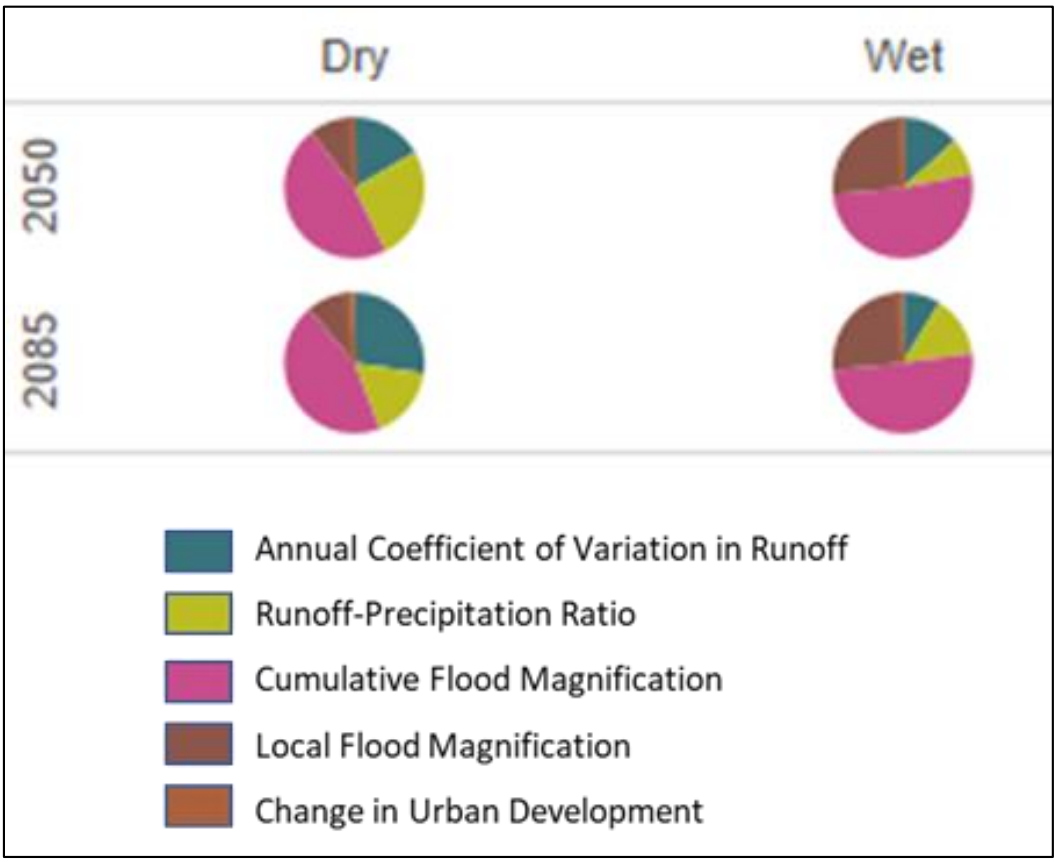

Figure 2: Hydrologic vulnerabilities related to flood risk in the project area.

Conclusion

Given projected reductions in water availability in the San Juan Basin, the proposed project will contribute significantly to regional economic resilience by minimizing water loss in the capture and transmission of water through the irrigation ditch to consumers.

List of Preparers

Name	Affiliate	Discipline/Role
Amanda Velasquez	USACE Project Management	Project Manager
Ariane Pinson	USACE Planning	Climate Science Specialist Lead Writer
Sarah Moore	USACE Planning	Plan Formulator Technical Writer

References

Bennett, K.E., V.C. Tidwell, D. Llewellyn, S. Behery, L. Barrett, M. Stansbury and R.S. Middleton. 2019. Threats to a Colorado river provisioning basin under coupled future climate and societal scenarios. Environmental Research Communications 1 095001. https://doi.org/10.1088/2515-7620/ab4028

Bennett, K. E., Bohn, T. J., Solander, K., McDowell, N. G., Xu, C., Vivoni, E., and Middleton, R. S. 2018. Climate-driven disturbances in the San Juan River sub-basin of the Colorado River, Hydrology and. Earth System Science 22:709–725., https://doi.org/10.5194/hess-22-709-2018.

Clow, D. W. (2010). Changes in the timing of snowmelt and streamflow in Colorado: a response to recent warming. Journal of Climate, 23(9), 2293-2306.

Nydick, K., Crawford, J., Bidwell, M., Livensperger, C., Rangwala, I., and Cozetto, K. 2012. Climate Change Assessment for the San Juan Mountain Regions, Southwestern Colorado, USA: A Review of Scientific Research. Prepared by Mountain Studies Institute in cooperation with USDA San Juan National Forest Service and USDOI Bureau of Land Management Tres Rios Field Office. Durango, CO.

Painter, T. H., Barrett, A. P., Landry, C. C., Neff, J. C., Cassidy, M. P., Lawrence, C. R., ... & Farmer, G. L. (2007). Impact of disturbed desert soils on duration of mountain snow cover. Geophysical Research Letters, 34(12).