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To: Mid-Region Council of Governments
From: Jesse Roach

Subject: Development of water availability metrics for the Central New Mexico Climate Change Scenario Planning Project

Water Availability:

This effort used native flows at Otowi and San Juan Chama allocations as an estimate of the change in renewable Rio Grande and imported surface water resources in the Rio Grande. Based on conversations with members of the Climate Change Adaptation committee, the decision was made to use simulated future native (non-imported) Rio Grande flows, and Albuquerque Bernalillo County Water Utility Authority (ABCWUA) San Juan – Chama (SJC) water flows (imported from the Colorado River Basin) at Otowi gauge (which is the first gauge on the Rio Grande north of the four county study area) as a metric representing renewable water availability.[1] However, an initial look at the ABCWUA-SJC data exposed a limitation to this data, specifically, that the ability of Albuquerque to utilize the full SJC allocation in these simulations is limited by diversion capacity in the summer and demand in the winter. Because winter demand is less than diversion capacity, diversion capacity is not sufficient to use the entire annual allocation of SJC water unless it is run at capacity all year, and a lack of local storage, Albuquerque is unable to use its full SJC allocation in these runs.[2] Thus the ABCWUA-SJC water at Otowi is infrastructure-constrained on the demand side and does not represent availability. Based on this realization, the SJC allocation is used instead as representative of the availability of imported water.

Simulations:

The hydrologic runs were made by the Upper Rio Grande Simulation Model (URGSiM) (Roach 2013b) using Hybrid Delta Ensemble inputs as described in the technical memo by Jesse Roach to City of Santa Fe (Roach 2013a). The runs are based on gridded (every 1/8th degree) observation-based datasets of precipitation and temperature from 1950 through 1999 (Maurer, et al. 2002) which were used to drive the Variable Infiltration Capacity (VIC) rainfall runoff model to get a historic baseline series of inflows

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[1] This metric does not include renewable groundwater recharge to the study area, which is an important source for urban use. However, the URGIA methodology upon which this study is based does not include changes to mountain front recharge.

[2] Albuquerque SJC allocation is 48,200 AF/yr, which with 2.35% transportation losses results in 47,067 AF/yr divertible at Albuquerque. The permitted diversion rate is 130 cubic feet per second (cfs), which for operational reasons is typically limited to 50% SJC, or 65 cfs, which equates to 47,090 AF. So not accounting for evaporative losses resulting from storage in Abiquiu Reservoir, the diversion would need to be run at essentially 100% capacity 24/7/365 to divert the entire SJC allocation. As a result, SJC allocation to the ABCWUA can decrease based on availability, but cannot increase.

to the URGSiM operations model.[3] Because of data processing from calendar year to water year and back to calendar year, the hydrographs available from VIC to drive URGSiM are from January 1, 1951 through December 1998, a 48-year run. It is worth noting that the simulated historic value is based on 2010 infrastructure – the San Juan-Chama Project was not completed until the 1970s – and municipal and agricultural demand in order to provide meaningful comparison to projected river flows.

VIC-URGSiM Simulated Historic Otowi Flows – 1951-1998 (Acre-feed per year – AF/yr):

- Total Flow at Otowi Gauge – 1,045,829 (AF/yr)
- Native Rio Grande Flow – 983,993 (AF/yr)
- San-Juan Chama Albuquerque Allocation – 38,893 (AF/yr)

Changes to temperature and precipitation based on five groupings of general circulation models (GCMs) for three 30-year future periods (2010-2039, 2040-2069, and 2070-2099) compared to 1950-1999 were added to the baseline temperature and precipitation, and the process repeated for each GCM grouping for each future period. The five GCM groupings are defined based on dividing what each model calculates as the average change in temperature and precipitation between the historic period and the future period. Thus, the total number of runs is 16: one historic and 15 future (five groups by three periods).

2040 Time Period:

Because the planning horizon for the MRCOG/Volpe effort is 2040, the results from the future periods of 2010-2039 and 2040-2069 are averaged to get the average for the 2010-2069 period, which is centered on 2040. These values are used as representative of 2040 conditions as defined by the different groupings of GCMs. It is worth mentioning that the GCM groupings changes from period to period, and thus that the 2040 average combines results from different GCM groupings. In my opinion this is not an important issue.

[3] See http://www.hydro.washington.edu/Lettenmaier/Models/VIC/ for more information on Variable Infiltration Capacity models.

Results:

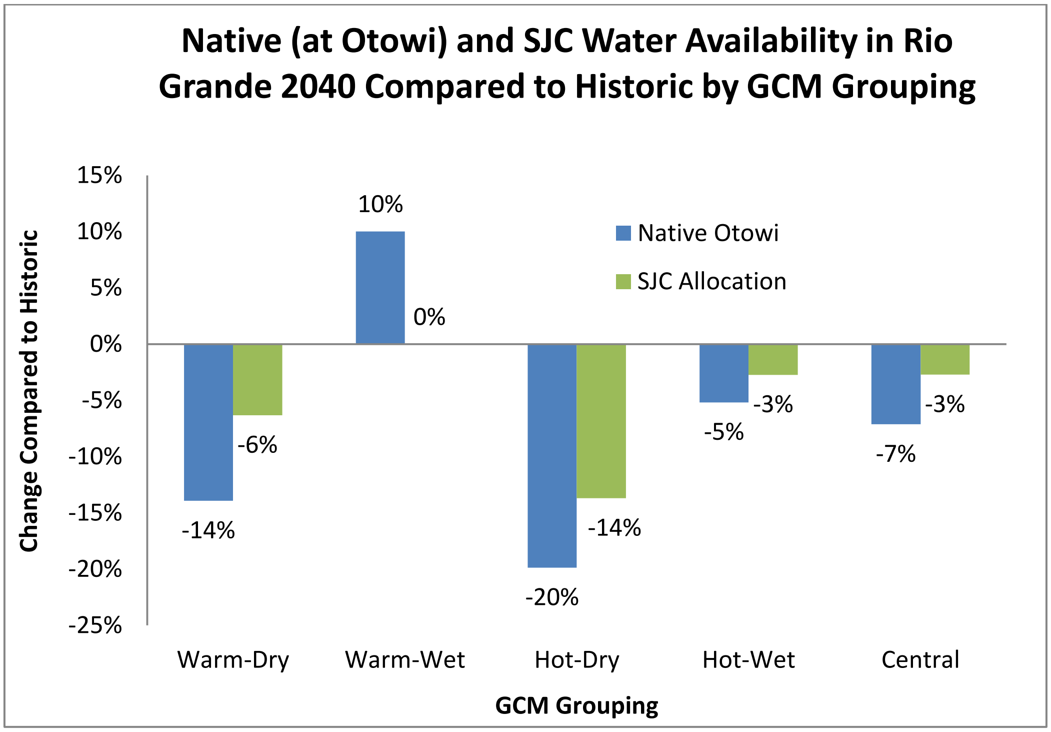

Figure 1: Changes to water availability metrics by 2040 compared to historic for the five GCM groupings.

As seen in Figure 1, this analysis suggests that native Rio Grande resources are likely to be more impacted by climate change than San Juan – Chama resources. This result is consistent with results seen in the Upper Rio Grande Impacts Assessment, and is due to SJC infrastructure's ability to cushion the blow of climate change on one hand, and the structure of the Rio Grande Compact on the other which allows a disproportionate portion of flow reductions in the Colorado headwaters to be passed downstream (Llewellyn, et al. 2013). Native flows at Otowi change from +10% to -20% depending on the GCM grouping, with all GCM groupings resulting in reductions in flow except the warm wet grouping. SJC allocations on the other hand cannot increase due to physical constraints in the infrastructure, but are less impacted by climate change than native resources in all cases where the latter experience some reduction.

Works Cited

Llewellyn, Dagmar, Ariane Pinson, Jesse Roach, David King, Subhrendu Gangopadhyay, and Seshu Vaddey 2013. *Upper Rio Grande Impacts Assessment; An Activity of the West Wide Climate Risk Assessment.* Albuquerque: U.S. Bureau of Reclamation. http://www.usbr.gov/WaterSMART/wcra/reports/urgia.html

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