

Republican River Basin-Wide Plan Reduction Run Results

The following handout is intended to provide information on the effect that reductions in groundwater pumping have on streamflow depletions in the Republican River Basin relative to the 1998-2002 baseline, which is represented by 0% throughout this handout. 1998-2002 is the baseline from which each NRD agreed to reduce pumping levels by 20% in their IMP. The model runs use the Republican River Compact model. 2007-2015 pumping data were repeated 3 times past 2015, for a model year range of 2007-2036. The model runs repeated conditions of landuse and precipitation cycles experienced during 2007-2015. For each model run, the pumping rate from 1998-2002 was reduced by a range of percentages (0%, 20%, 25%, 30%, and 40%) beginning in 2016 and these reduced pumping scenarios were compared, along with the 2007-2015 level of pumping, to provide a series of stream depletion scenarios.

Although the tables provide specific values in acre-feet, these values are modeled and are not necessarily what will occur. Thus, caution should be used when relying on or interpreting those values. The trends that occur among NRDs, between pumping reductions, and across time can be used to determine the relative gains expected when reducing groundwater pumping.

Reduction Runs Handout

Figure 1. Modeled annual depletions to streamflow under five scenarios of pumping relative to the 1998-2002 baseline (0%).

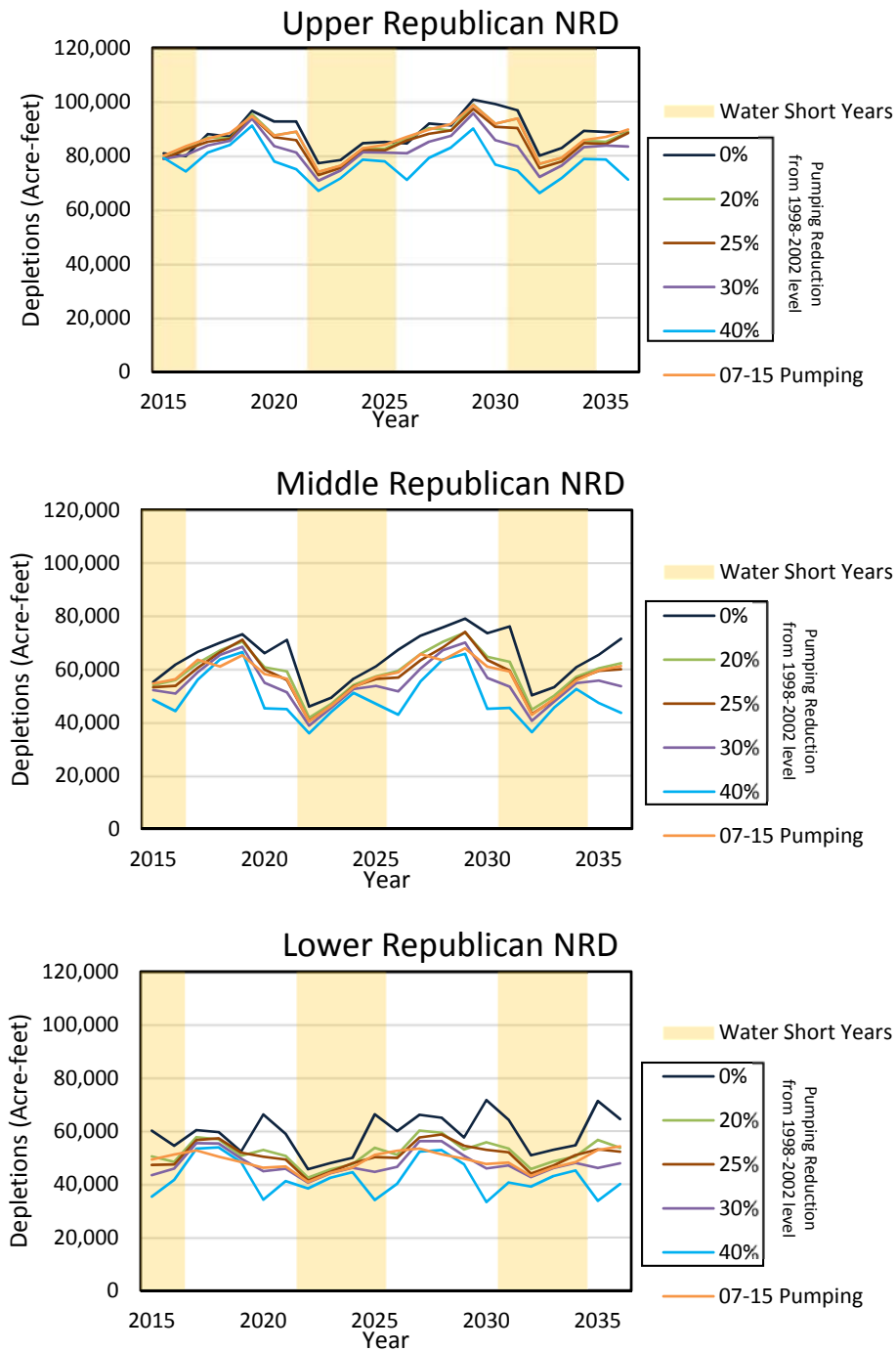


Table 1. Modeled cumulative depletions (acre-feet) to streamflow at different pumping reductions from 2007-2036 rounded to the nearest 100.

NRD	98-02 Pumping	20%	25%	30%	40%	07-15 Pumping
Upper Republican	2,583,400	2,534,400	2,503,800	2,458,500	2,345,400	2,544,500
Middle Republican	1,859,900	1,738,600	1,693,200	1,642,000	1,528,300	1,694,300
Lower Republican	1,679,800	1,524,300	1,480,100	1,428,600	1,314,500	1,453,700

Reduction Runs Handout

Figure 2. Five-year rolling average of modeled depletions to streamflow under five scenarios of pumping relative to the 1998-2002 baseline (0%).

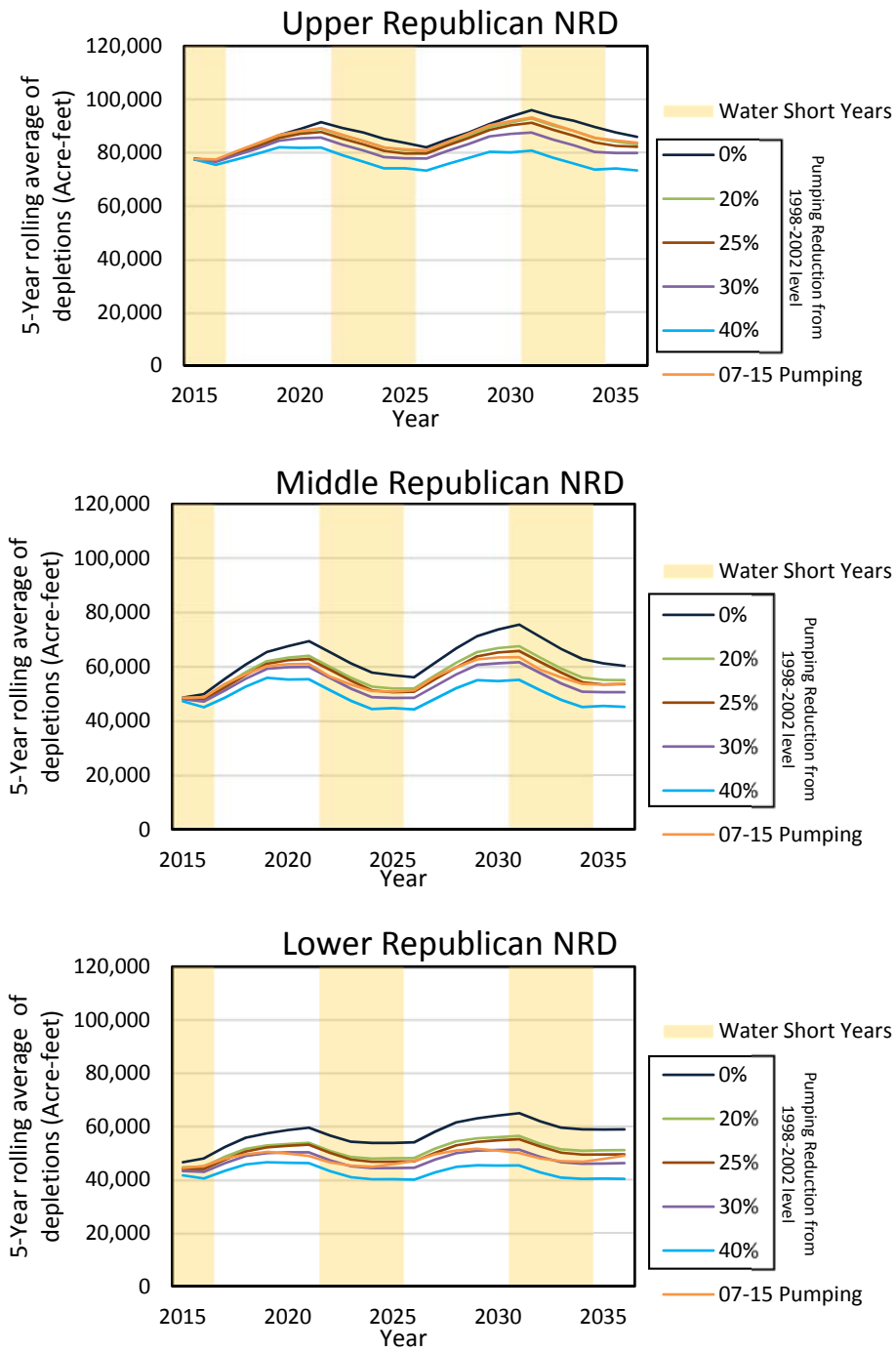


Figure 3. Five scenarios of pumping relative to the 1998-2002 baseline (0%). Gray points represent 2015-2036 annual depletions to streamflow. The colored point represents the average.

Reduction Runs Handout

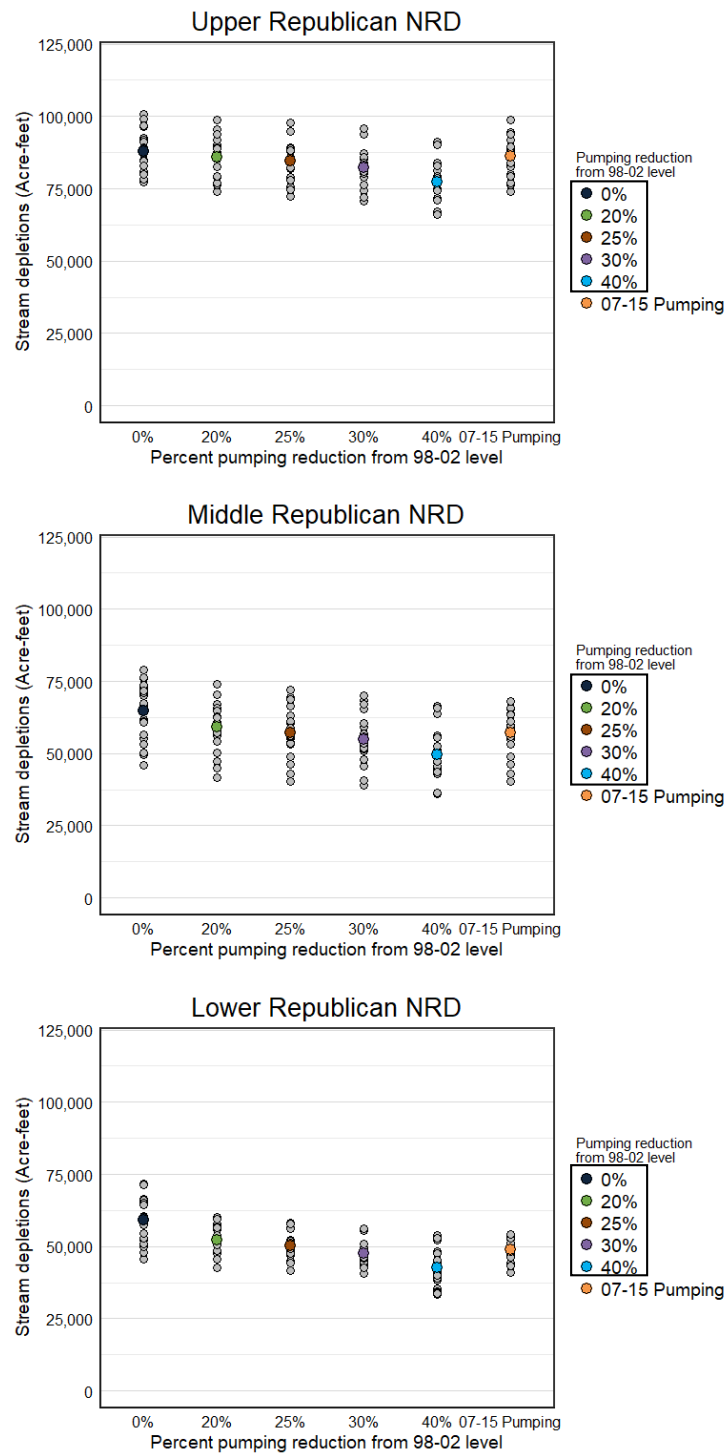


Table 2. 2015-2036 average acre-feet of annual streamflow depletion by pumping reduction rounded to the nearest 100.

NRD	98-02 Pumping	20%	25%	30%	40%	07-15 Pumping
Upper Republican	88,000	85,800	84,400	82,400	77,200	86,300
Middle Republican	64,700	59,200	57,200	54,800	49,700	57,200
Lower Republican	59,200	52,100	50,100	47,700	42,600	48,900

Figure 4. A five-year rolling average of the change in depletions to streamflow relative to no change in pumping reductions for five scenarios of pumping reductions relative to the 1998-2002 baseline (0%).

Reduction Runs Handout

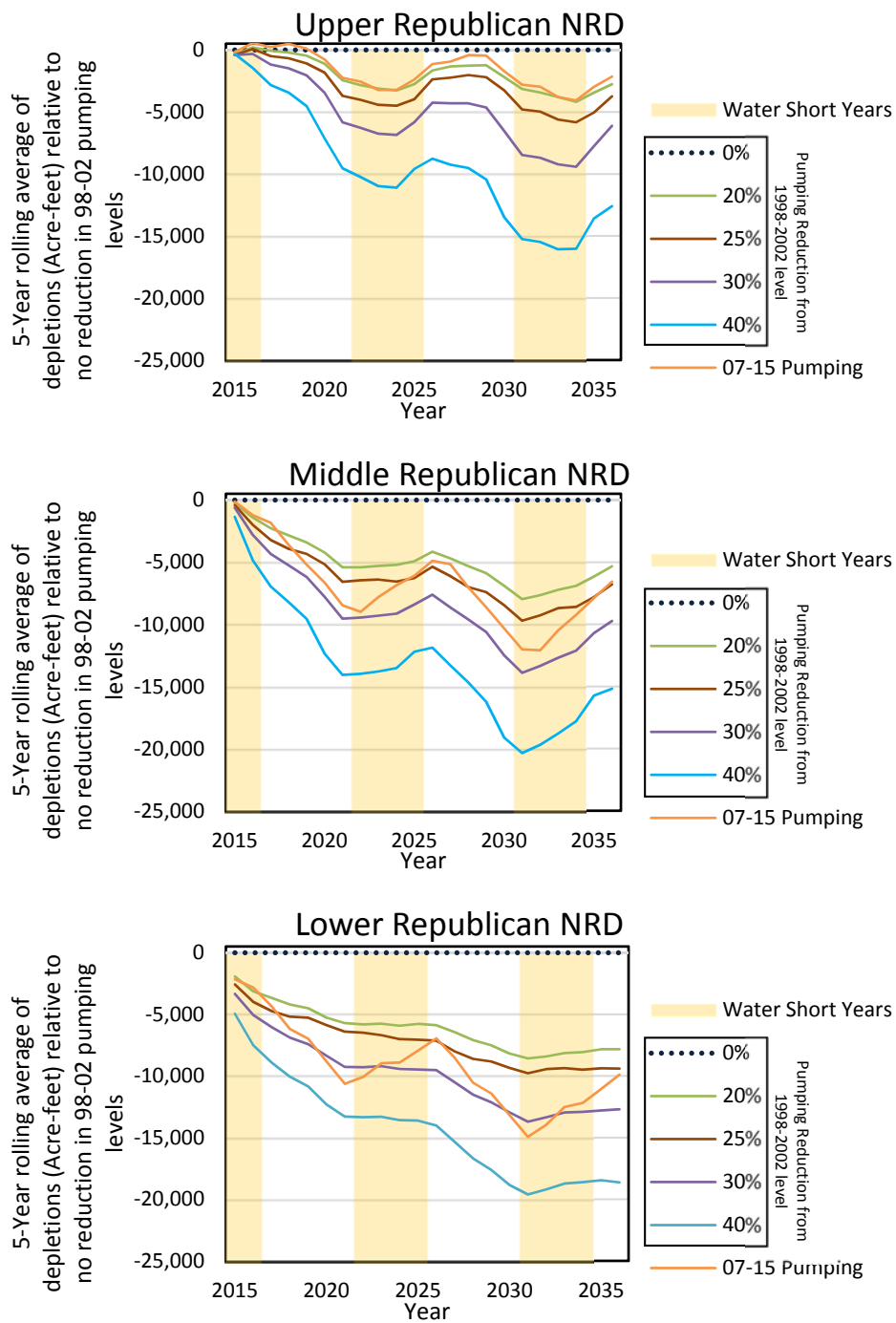
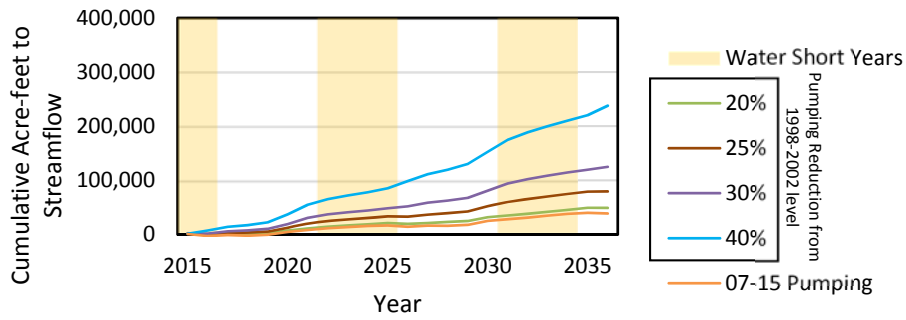
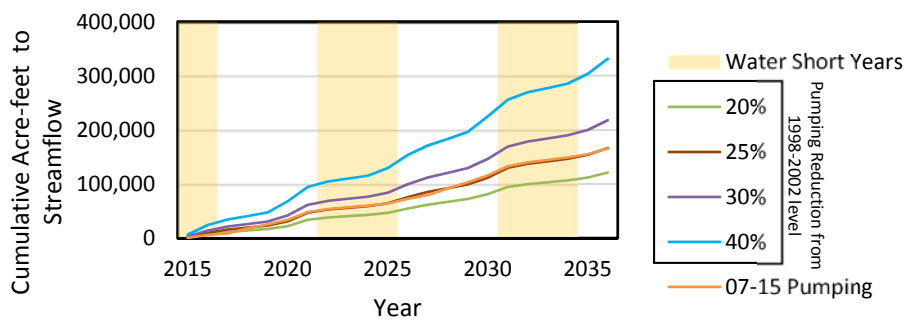


Figure 5. Cumulative streamflow depletion reductions by decreasing pumping from 1998-2002 baseline.

Upper Republican NRD



Middle Republican NRD



Lower Republican NRD

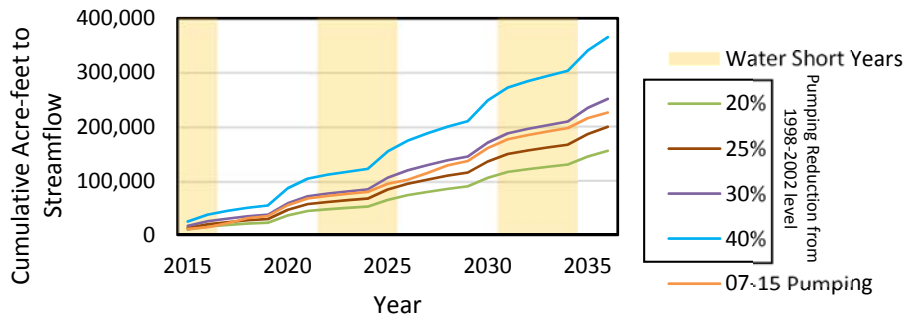


Table 3. 2015-2036 cumulative acre-feet of streamflow depletions **reduced** as compared to the 1998-2002 pumping level rounded to the nearest 100.

NRD	20%	25%	30%	40%	07-15 Pumping
Upper Republican	49,000	75,600	124,900	238,000	38,900
Middle Republican	121,300	166,700	217,900	331,600	165,700
Lower Republican	155,500	199,700	251,200	365,300	226,100

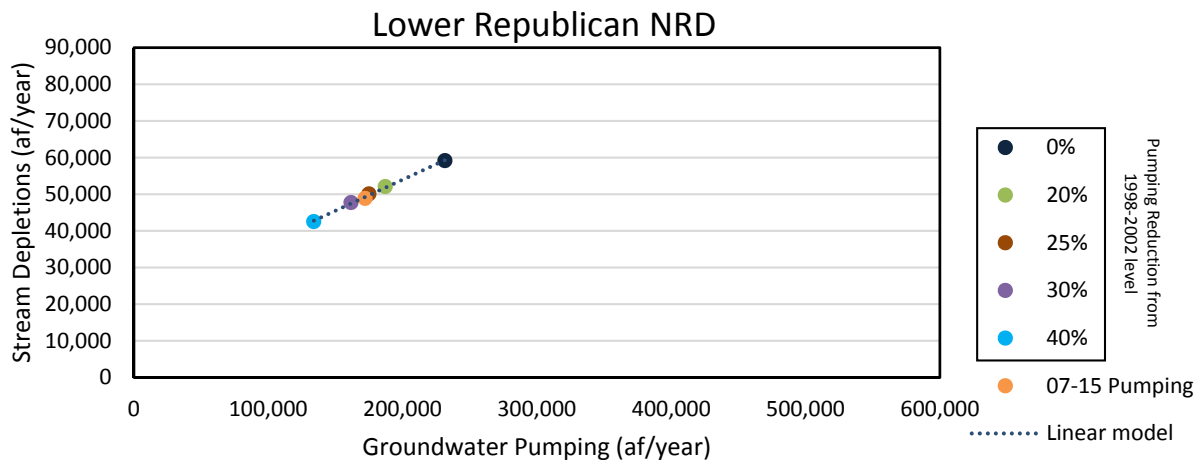
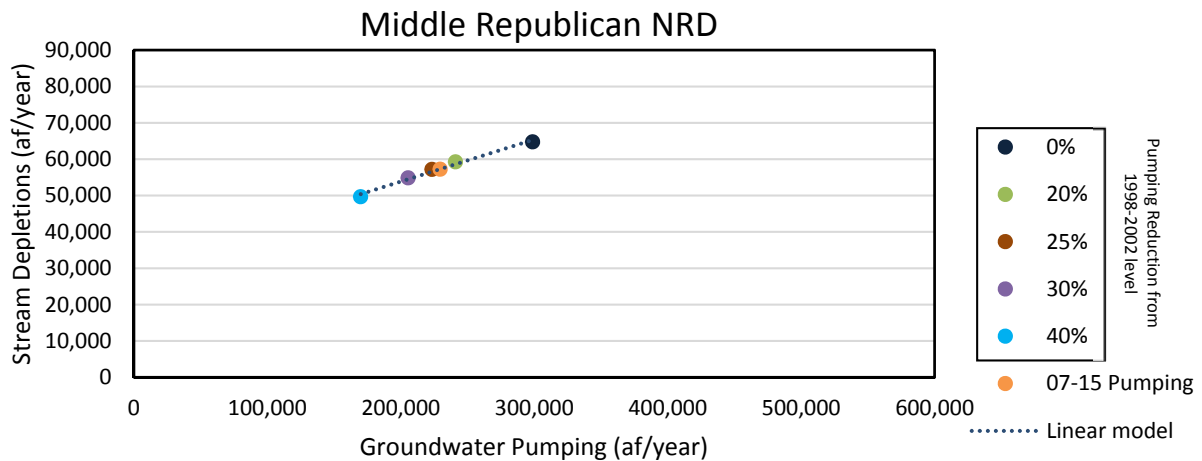
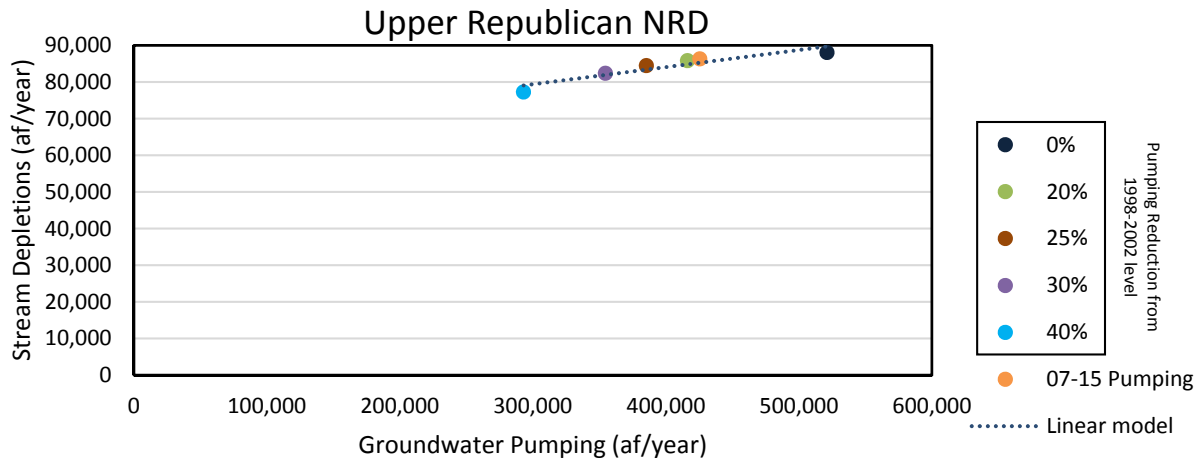
Table 4. 2015-2036 average annual acre-feet of streamflow depletions **reduced** as compared to the 1998-2002 pumping level rounded to the nearest 100.

NRD	20%	25%	30%	40%	07-15 Pumping
Upper Republican	2,200	3,400	5,700	10,200	1,800
Middle Republican	5,500	7,600	9,900	15,100	7,500
Lower Republican	7,000	9,000	11,400	16,600	10,300

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Figure 6. Modeled relationship between groundwater pumping and stream depletions. Within 0-40% range of pumping reductions each NRD had a nearly linear relationship between groundwater pumping reduction and stream depletion. Points represent the 2015-2036 average stream depletion per groundwater pumping level.

Modeled Relationship between Groundwater Pumping and Stream Depletions



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Within the range of groundwater pumping for each NRD (Table 5), and taking the **average well stream depletion factor** within the NRD, a 1000 acre-foot reduction in groundwater pumping creates **approximately**:

50 acre-feet of streamflow for Upper Republican NRD in that year

115 acre-feet of streamflow for Middle Republican NRD in that year

170 acre-feet of streamflow for Lower Republican NRD in that year

At groundwater pumping rates outside the range in Figure 6, changes in groundwater pumping may have a different effect on streamflow. **These values are based on a stream depletion factor that is the average value based on the current spread of wells within the NRD. Streamflow depletions from an individual well within the NRD may vary significantly from the values listed above.** These values were estimated by using a linear regression on modeled data that are known to be non-linear and should be interpreted with caution. Reducing groundwater pumping by the amounts listed above will not result in credits equal to the amounts shown above.