RGDSS Memorandum

Phase 6 - State and Federal Wildlife Operations

Final

To: File
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Subject: RGDSS Groundwater Model - Phase 6: State and Federal Wildlife Operations
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1. Introduction

This memorandum represents enhancements to the pumping and recharge data for State and Federal wildlife operations that were incorporated in the non-irrigation well files as part of Phase 6 of the RGDSS groundwater modeling. The objective of this task was to:

1. *Estimate pumping associated with State and Federal wildlife well operations in the RGDSS groundwater model.*
2. *Estimate recharge associated with State and Federal wildlife well operations in the RGDSS groundwater model*

The RGDSS groundwater model incorporates operations for wells in the San Luis Valley. State and Federal agencies operate wildlife wells as part of hatchery and wildlife habitat enhancements. These operations are unique and can be significant volumetrically; thus requiring separate input and documentation.

2. Previous Efforts

Previous phases of the model incorporated State and Federal wildlife wells into irrigation, small flowing wells, and M&I pumping files and associated recharge components. Because of the availability of 2009 and 2010 annual pumping volumes, pumping and recharge data were re-evaluated and documented herein. In addition as part of Phase 6, the M&I well file was expanded to include explicitly modeled non-irrigation wells.

3. Approach and Results

A review and update of the State and Federal wildlife wells was conducted as part of Phase 6 of the Rio Grande Decision Support System (RGDSS) Groundwater Model (Model) as defined by Model Version 6P98. Three significant State and Federal wildlife well operators were identified:

- Colorado Division of Wildlife (CDOW),
- United States Bureau of Land Management (BLM), and
- United States Fish and Wildlife Service (USF&W).

Each of the major wildlife operations were analyzed individually. Details on the approach and results for each of the three operators are provided in the following subsections.

3.1. Colorado Division of Wildlife (CDOW) Wells

In the Rio Grande Valley, the following CDOW wildlife facilities make use of large-capacity wells:

- Native Aquatic Species Restoration Facility (NASRF)
- Monte Vista Hatchery
- Spicer Hatchery
- Russell Lakes State Wildlife Area
- Hot Pond Well

Each of these facilities and their associated groundwater use is described in detail in the following subsections. CDOW owns or operates additional wells in the valley for irrigation; these wells are incorporated in the irrigation wells list. Additionally, CDOW low-capacity stock wells completed in layer 2 or below, are incorporated into the small flowing wells list.

(During Phase 6, Colorado Division of Wildlife merged with Colorado State Parks to become Colorado Parks and Wildlife (CPW). The new naming convention after the merger has not been incorporated into the modeling datasets, which still reflect the older designation of CDOW.)

3.1.1. Native Aquatic Species Restoration Facility (NASRF)

Three NASRF wells are modeled as non-irrigation wells.

NASRF Wells			
WDID	Appropriation Date	Decree Use	Structure Name
2010773	12/5/1959	Fishery & Irrigation	W1456 WELL NO 01
2010774	12/31/1952	Fishery & Irrigation	W1456 WELL NO 02
2010775	12/31/1952	Irrigation	W1456 WELL NO 03

The water at this facility is applied for both fishery and irrigation uses. General operations at the facility require year around use for the raising of fish and wastewater is used to irrigate wetlands during the irrigation season. Typically more water is used in the hatchery operation than is needed for irrigation. This additional water is either returned to the drainage or recharges the shallow aquifer.

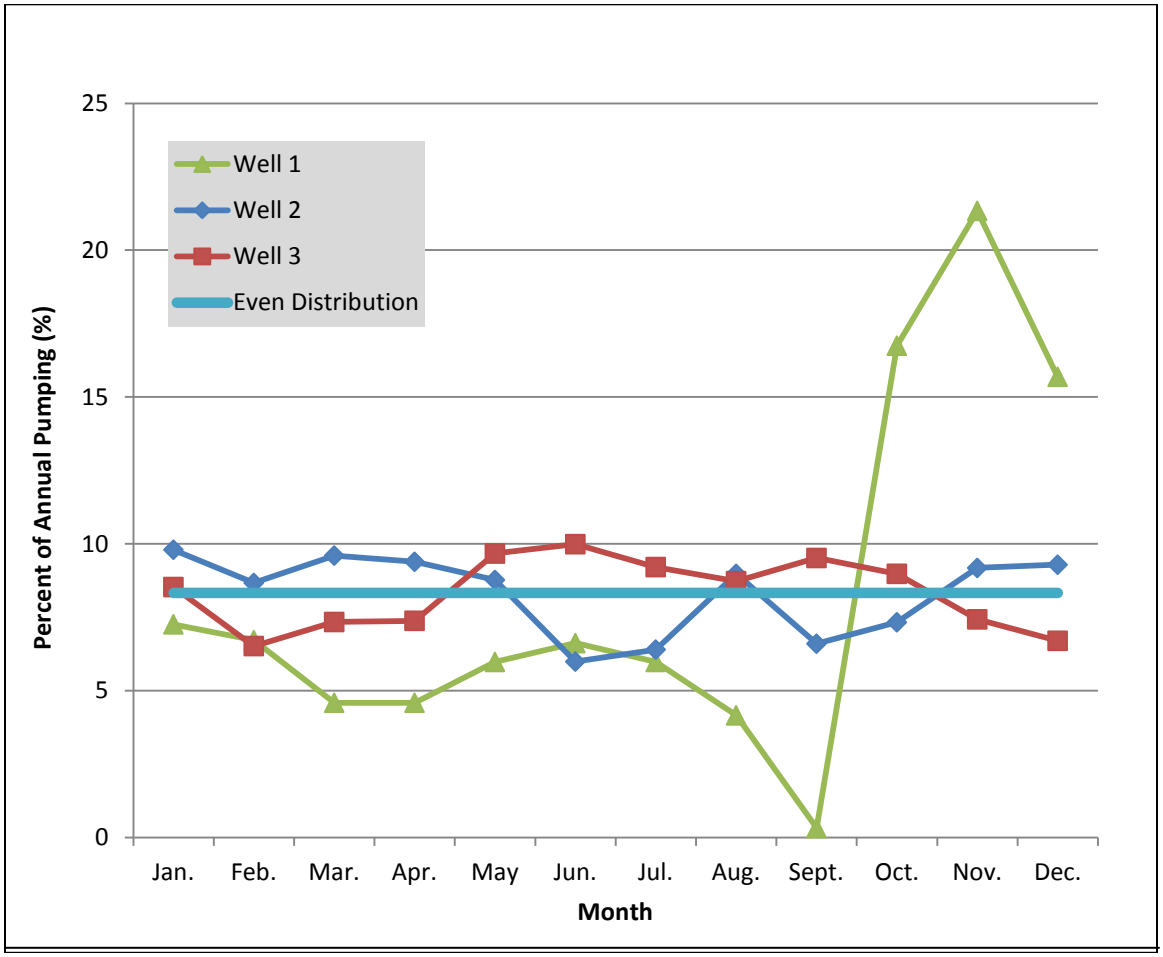
For the NASRF, two wells are decreed for commercial and irrigation; while one well is decreed only for irrigation. However, the three wells are permitted as Alternate Points of Diversion to each other and the wells operate as a well field.

Pumping Data:

Annual pumping data for 2009 and 2010 were obtained from HydroBase for each well. For 2009 and 2010, the HydroBase annual pumping volumes were distributed evenly each month. For 1960 through 2008, the average annual pumping volumes were distributed evenly each month. The average annual pumping volumes were calculated as the average of the 2009 and 2010 annual pumping data. For a given year in the study period of 1950-2010, only those wells that had active appropriation dates were allowed to pump at their average annual volume.

The decision to evenly distribute the annual pumping was based on monthly pumping data for 2009 provided by CDOW (Vail, 2011). **Figure 1** shows the monthly distribution for the three wells at the NASRF for 2009. Visual inspection of **Figure 1** indicates that the monthly pumping for Wells 2 and 3 are distributed relatively evenly throughout the year. According to CDOW, Well 1 had some operational issues and was pumped at greater rates in October, November and December to remove sand and debris. Because of these operational issues the 2009 monthly distribution for this well was not used and an even monthly distribution was assumed.

Figure 1 – Monthly Distribution of NASRF Pumping for 2009



Recharge Data:

Wastewater from the hatchery operation was assumed to recharge the alluvial aquifer. This recharge was estimated as:

Recharge = Pumping - Consumptive Use.

Consumptive use was divided into two categories; 1) evaporation from surface water ponds at the facility, and 2) evapotranspiration of water from irrigation of the wetland area.

Water consumed by pond evaporation was calculated as the pond area times an evaporation rate of 4 feet per year. The evaporation rate is based on an average evaporation from shallow open

water bodies in the San Luis Valley (Sanderson, 5/5/2011). Pond area was estimated using 2005 aerial photographs as 35 acres. This resulted in a pond consumptive use of 140 acre-feet/year. This annual average value was distributed monthly using the values provided in the attachment to Colorado Division of Water Resources Policy 2003-2, general guidelines for Substitute Water Supply Plans for gross evaporation above 6,500 feet above mean sea level (CDWR, 2003):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1%	3%	6%	9%	13%	16%	16%	13%	11%	8%	4%	2%	1

Water consumed by irrigation was calculated as the irrigated area times the historical average potential evapotranspiration (PET) for grass pasture of 2.904 feet/year. This PET value is based on data from the Alamosa Station using Rio Grande calibrated coefficients (1950-2006). Irrigated area was estimated using 2005 aerial photographs. The irrigated area was estimated at 37 acres which results in an annual irrigation consumptive use of 107 acre-feet. This annual irrigation consumptive use was distributed by month using the average monthly distribution obtained from historical analysis for grass pasture at the Alamosa Station using Rio Grande calibrated coefficients (1950-2006).

3.1.2. Monte Vista Hatchery

Five Monte Vista wells are modeled as non-irrigation wells.

Monte Vista Hatchery Wells			
WDID	Appropriation Date	Aquifer	Structure Name
2008695	4/30/1957	Confined	W0247 WELL NO 02
2009201	8/28/1966	Unconfined	W0507 WELL NO 01
2009202	9/30/1965	Unconfined	W0507 WELL NO 02
2014075	9/30/1965	Unconfined	2005CW017 WELL NO 2S
2014076	8/28/1966	Unconfined	2005CW017 WELL NO 1S

Pumping Data:

Annual pumping data for 2009 and 2010 were obtained from HydroBase. Annual pumping was distributed monthly using the following relationship (Vail, 2011b):

- Sixty percent of the annual pumping is distributed evenly between January and May.
- Forty percent of the annual pumping is distributed evenly between June and December.

For 2009 and 2010, the HydroBase annual pumping volumes were distributed as outlined above. For 1966 through 2008, the average annual pumping volumes were also distributed as outlined above. The average annual pumping volumes were calculated as the average of the 2009 and 2010 annual pumping data. For a given year in the study period of 1950-2010, only those wells that had active appropriation dates were allowed to pump at their average annual volume. Wells were assumed to start pumping the first full month after the appropriation date.

Recharge Data:

Wastewater from the hatchery discharges to the Parma Drain. This recharge was estimated as:

Recharge = Pumping - Consumptive Use.

Consumptive use was divided into two categories; 1) evaporation from surface water ponds at the facility, and 2) evapotranspiration of water from irrigation of the wetland area.

Water consumed by pond evaporation was calculated as the pond area times an evaporation rate of 4 feet per year. The evaporation rate was based on an average evaporation from shallow open water bodies in the San Luis Valley (Sanderson, 5/5/2011). Pond area was estimated using 2005 aerial photographs as 0.52 acres. This resulted in a pond consumptive use of 2.08 acre-feet/year. This annual average value was distributed monthly using the values provided in the attachment to Colorado Division of Water Resources Policy 2003-2, general guidelines for Substitute Water Supply Plans for gross evaporation above 6,500 feet above mean sea level (CDWR, 2003):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1%	3%	6%	9%	13%	16%	16%	13%	11%	8%	4%	2%	1

Water consumed by irrigation was estimated as irrigated area times the historical average PET for alfalfa of 2.775 acre-feet per year based on the Monte Vista Station using Rio Grande calibrated coefficients (1950-2006). Irrigated area was estimated at 112 acres using 2005 aerial photographs. This annual irrigation consumptive use was distributed by month using the average monthly distribution obtained from historical analysis for alfalfa at the Monte Vista Station using Rio Grande calibrated coefficients (1950-2006).

3.1.3. Spicer Hatchery

The Spicer Hatchery is a series of eight circular fish tanks that were added to an existing irrigation operation. CDOW started this hatchery operation in 2003. The well used is WDID 2105383, which has an appropriation date of 4/14/1962. Three years from the irrigated lands GIS coverages were reviewed for the pumping and recharge analysis:

Year	Irrigated Acres	Crop
2005	133.12	Alfalfa
2002	98.18	Grass Pasture
1998	54.70	Grass Pasture

Pumping Data:

Annual pumping data for 2009 and 2010 were obtained from HydroBase. For 2009 and 2010, the HydroBase annual pumping volumes were distributed evenly each month. For the remainder of the hatchery operation period (2003 through 2008), the average annual pumping volume was distributed evenly each month. The average annual pumping volume was calculated as the average of the 2009 and 2010 annual pumping data.

For water years prior to 2003, pumping was estimated using a similar methodology as was used for irrigation wells. The monthly pumping volume was calculated as 1.2 times the potential evapotranspiration for the identified crop from the Manassa station using Rio Grande calibrated crop coefficients. The multiplier of 1.2 represents the efficiency for sprinkler irrigation. This 20% was then returned to the aquifer as recharge.

The well was assumed to start pumping the first full month after the appropriation date. The irrigated acreage decreased linearly from 1998 to 1961. Thus, the irrigated acreage equaled 54.70 acres in 1998 and 0.00 acres in 1961.

Recharge Data:

Wastewater from the hatchery was assumed to recharge the alluvial aquifer. This recharge was estimated as:

Recharge = Pumping - Consumptive Use.

The total volume of water consumed by pond evaporation was calculated, using the method described above for NASRF, as 0.052 acre-feet/year which is considered too small to distribute monthly. Therefore, at this facility consumptive use consists exclusively of crop irrigation.

For the hatchery years (2003-2010), monthly recharge values for those months in the irrigation season (April through October) were calculated as:

- The pumping less consumptive use. Where consumptive use was estimated as area irrigated times the monthly PET. PET was calculated using the filled mean monthly data from the Manassa Station for 1950 to 2008 and was calculated using Rio Grande calibrated coefficients for alfalfa.
- If in any month, the calculated percent recharged was less than 20% of the amount pumped. The recharge was increased to 20% to ensure that the irrigation operations were not operating more efficiently than 80%, which is the maximum efficiency for sprinkler irrigation in the RGDSS modeling.
- Recharge for 2009 and 2010 were calculated using the average historical return flow pattern.

For years prior to 2003, when the pumping was used for irrigation, recharge was calculated to be 20% of the volume pumped. Recharge in the winter months was calculated as 100% of the pumping volume.

3.1.4. Russell Lakes State Wildlife Area (SWA)

There are numerous wells at Russell Lakes, several of which are small flowing wells. Many are owned by the Bureau of Reclamation and operate as components of the Closed Basin project, providing mitigation to keep the project in compliance (San Luis Valley Wetlands Focus Area Committee, 2000). Efforts to sort out the various permits and WDIDs are ongoing and no definitive list is yet available from CDOW.

The large capacity (>=50 gpm) Russell Lakes wells were treated as irrigation wells and the numerous small capacity wells (<50 gpm) were treated as small flowing wells. No changes or modifications from existing procedures were needed to incorporate the Russell Lakes SWA wells

3.1.5. Hot Pond Well (WDID 2006690)

This well has an appropriation date of 12/10/1963 and is used to pump water into the nearby pond. This well was included in the non-irrigation well list.

Pumping Data:

Historical annual pumping data goes back to 1994 in HydroBase. Annual pumping from 1964 through 1994 was estimated as the 1994 through 2010 average of the annual pumping data. Because the majority of the pumped water goes to seepage and is not seasonally dependant; the annual rate was evenly distributed throughout the 12 months of the year. The well was assumed to start pumping the first full month after the appropriation date.

Recharge Data:

Seepage from the pond was assumed to recharge the alluvial aquifer. This recharge was estimated as:

Recharge = Pumping - Consumptive Use.

Consumptive use consists exclusively of evaporation from the surface water pond at the facility. Water consumed by pond evaporation was calculated as the pond area times an evaporation rate of 4 feet/year of evaporation based on an average shallow open water bodies in the San Luis Valley (Sanderson, 2011). Pond area was estimated using aerial photographs as 8.5 acres which results in a pond consumptive use of 34 acre-feet per year. This annual average value was distributed monthly using the values provided in the attachment to Colorado Division of Water Resources Policy 2003-2, general guidelines for Substitute Water Supply Plans for gross evaporation above 6,500 feet above mean sea level (CDWR, 2003):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1%	3%	6%	9%	13%	16%	16%	13%	11%	8%	4%	2%	1

3.2. United States Bureau of Land Management (BLM) Wells

The BLM operates the Blanca Wetlands project approximately ten miles northeast of Alamosa. BLM provided historical groundwater withdrawal data for their wells, as described below. They categorize their wells by two types:

- Pre-McCarran – data is yearly from 1974-2005
- Post-McCarran – data is monthly from 1990-2005

BLM did not provide a linkage between WDIDs and their numbering system. Using permit legal descriptions and GIS location information, it was possible to connect the BLM wells to WDIDs and subsequently BLM groundwater withdrawal data to WDIDs. In some instances groundwater withdrawal data existed for multiple BLM wells over time, which are represented by one WDID. This is due to some of the BLM wells being replaced and redrilled near the original well, therefore a new WDID was not created for the replacement well. Many of the BLM wells flow less than 50 gallons per minute; however, these wells are still modeled as non-irrigation wells due to their non-exempt classification.

The following provides a summary of the BLM wells:

- 42 wells have WDIDs, and
- 8 WDIDs are associated with more than one BLM groundwater withdrawal record.

The only circumstance when more than one BLM pumping record was associated to one WDID was when there was no recent pumping data for the BLM record. Thus non-current pumping well data was merged with a nearby active WDID well. For a complete list of the BLM wells, see **Table 1**.

Table 1 – Blanca Wildlife Area Well WDIDs

WDID		WDID		WDID		WDID		WDID		WDID
2013973		3505355		3505597		3505622		3505726		3505739
2014113		3505358		3505598		3505623		3505733		3505740
2014114		3505582		3505599		3505624		3505734		3505741
2014115		3505589		3505600		3505625		3505735		3505742
2014469		3505591		3505601		3505626		3505736		3505743
2014470		3505595		3505602		3505633		3505737		3505745
3505099		3505596		3505605		3505725		3505738		3505746

Yearly groundwater withdrawal data was provided by the BLM for the wells from 1974 through 2005. In addition, HydroBase provides diversion records for the wells in 2009 and 2010. Missing data was filled for the years 2006 through 2008 using the average groundwater withdrawal from 1974 through 2005. A few wells do not have diversion records in 2009 and 2010; therefore, data for these wells were filled for the years 2006 through 2010 using the average groundwater withdrawals from 1974 through 2005.

Monthly groundwater withdrawal information is available for 15 Post-McCarran Wells. The monthly volumes for each well were close to evenly distributed over a given year and do not show significant seasonal variations. For the last 3 years of data (2003-2005) the monthly data was an even distribution of the annual volume for each month throughout the year. The Blanca wells are flowing wells without pumps so the even distribution is a reasonable monthly distribution. Based on the available monthly data, wells that only have annual groundwater withdrawal data, the annual data was distributed evenly throughout the year.

Two decreed wells (3505355 and 3505358) were purchased by BLM in 1986, for which they did not collect pumping data. For these wells, HydroBase is the only source of pumping information, and data is available starting in 2009. Roy Smith (BLM) stated that the production from those wells is fairly consistent; thus the 2009 pumping data was used to extrapolate from 1986 to 2005 and a historical average was used to fill in years 2006 through 2008.

Division 3 staff stated that due to the salinity and sedimentation in the ponds, an approximate recharge rate of 10% would be reasonable (conversations held summer of 2011). A simple water balance was used to confirm this recharge estimate. **Table 2** shows that approximately 11% of the pumped water is recharged to the aquifer. This water balance is very simple and is based on data for only one year. To reflect the broad nature of the water balance calculation an even 10% recharge rate was used in calculating input to the groundwater model.

Table 2 – Blanca Wildlife Area Generalized Water Balance

Parameter	Estimated Pond Acreage
Year	2009
Pond Acres, acres (measured from aerial photos)	917
Net ET rate (ET less precipitation), ft/year (assumed)	3.41
Water Evaporated from Ponds, af/year (Pond Acres x ET rate)	3130
Closed Basin water, af	1050
2009 Pumping, af	2473
Total Water Available (Closed Basin + Pumping), af	3523
Water Available -Water Evaporated, af	393
% Recharge	11%

3.3. United States Fish and Wildlife Service (USF&W) Wells

USF&W operates or manages the Alamosa, Monte Vista and Baca National Wildlife Refuges. Wells on these facilities are incorporated in the model in the same manner as the other irrigation and small flowing wells in the basin. The refuge wells permitted for less than 50 gpm and completed in or below layer 2 are modeled as small flowing wells.

4. Comments and Concerns

Listed below are the comments and concerns regarding State and Federal Wildlife well operations included in the RGDSS groundwater model:

- Although the pumping and recharge data presented herein are reasonable and based on the best data available, the somewhat limited historical pumping data and the generalized consumptive use calculations presented herein could be improved with a detailed complex site by site analysis. Should the State and Federal entities decide to pursue this path and undertake their own analysis, this data could be revised at a later date.

5. References

Colorado Division of Water Resources, 2003, Policy 2003-2: Implementation of Section 37-92-308, C.R.S. (2003) Regarding Substitute Water Supply Plans.

San Luis Valley Wetlands Focus Area Committee, September 2009, The San Luis Valley Community Wetlands Strategy, funded by EPA 104-B-3 Wetlands Grants Program Region VIII in cooperation with the Colorado Natural Heritage Program.

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Vail, Richard, 2011, Email correspondence from Richard Vail (Colorado Division of Wildlife) to Mary Halstead (Colorado Division of Water Resources) dated 7/15/2011 titled SLV Fish Hatchery.

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