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11/15/2012

MEMORANDUM

DATE: November 15, 2012

TO: Gary Spackman, Director
Idaho Department of Water Resources

FROM: Christian R. Petrich, Ph.D., P.E., P.G.

RE: *Response to IDWR Staff Memo regarding the sufficiency of water supply for water right applications and transfers along the I-84 corridor*

A. Introduction

The Idaho Department of Water Resources (IDWR) combined various protested applications and transfers in the Interstate 84 (I-84) corridor in Eastern Ada County and western Elmore County[1] for a consolidated hearing. IDWR staff then prepared a memorandum[2] (referred to hereinafter as the "IDWR Staff Memo") to "suggest and justify a study boundary, present data and information within the boundary, and conclude, to the extent possible the sufficiency of water supply within the suggested boundary for existing and new uses."[3]

This document provides a response to the IDWR Staff Memo. This response was prepared on behalf of Mayfield Townsite LLC (Application 63-32499), Nevid LLC (Applications 61-12095 and 61-12096), and Mayfield Townsite/ARK Properties (Application 63-33344). Conclusions from this review are listed in the following section (Section B), followed by supporting findings and opinions (Section C).

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[1] January 24, 2012 Order Creating Contested Case and Consolidating Protested and unprotested Applications in the Matter of Application for Transfer 7381 (Shekinah Industries); Application for Transfer 73834 (Orchard Ranch); Application for Permit 63-32499 (Mayfield Townsite); Application for Permit 61-12095 (Nevid-Corder); Application for Permit 61-12096 (Nevid); Application for Permit 63-32703 (Orchard Ranch); Application for Permit 61-12256 (Intermountain Sewer and Water); Application for Permit 63-3344 (Ark Properties-Mayfield Townsite).

[2] Memorandum from Craig Tesch to Gary Spackman regarding Sufficiency of Water Supply for Water Right Applications and Transfers along the I-84 corridor, dated May 31, 2012.

[3] January 24, 2012 Order Creating Contested Case and Consolidating Protested and unprotested Applications, pg. 3.

B. Summary

IDWR used a standard methodology for estimating net average annual recharge volume (i.e., total aquifer recharge minus existing consumptive groundwater use), but any analysis of aquifer recharge in this area is constrained by lack of some water-budget data. Specific conclusions from this review include the following:

1. IDWR's estimate of average annual recharge (11,060 AFA) is likely conservative because it does not include existing upwelling of geothermal groundwater originating from outside of the study area (Welhan, 2012). A 5% contribution of geothermal groundwater from outside of the study area would represent an additional 550 AFA of recharge.
2. Actual consumptive-use volumes are likely lower than those estimated by IDWR because (a) not all stockwater, commercial, industrial, or domestic withdrawals are fully consumed and (b) some of the irrigation assumed by IDWR is on land without active water rights (and therefore likely is not irrigated). IDWR's estimate of net annual recharge might be approximately 180 AFA higher if existing-use estimates are limited to actual consumptive use.
3. IDWR's estimate of evapotranspiration has the greatest uncertainty of any water-budget parameter. Overestimating evapotranspiration by even a small amount could result in a substantial underestimation of areal infiltration and aquifer recharge.
4. The net average annual aquifer recharge, when accounting for possible geothermal recharge contributions from outside of the study area and lower consumptive uses, is 7,900 AFA (Table 1, page 14). The net average annual aquifer recharge would be even greater if evapotranspiration is less than the IDWR estimate or if recharge from areal infiltration is more than IDWR estimates.
5. Estimates of net average annual recharge will be larger if existing study-area permits are not fully developed. The undeveloped portions of these permits can be added to the estimated net annual recharge volume.
6. The IDWR Staff Memo states that "In combination with the maximum rate for recently approved water right permits (14.02 cfs), the proposed additional maximum appropriation of 84.76 cfs represents a 1,102% increase in the permissible, instantaneous withdrawal rate in the study area"[4] over the estimated net average annual recharge rate of 9.8 cfs. Maximum instantaneous withdrawal

[4] IDWR Staff Memo, page 17.

rates are a poor measure of aggregate aquifer impacts. The aggregate annual volume represented by all the applications and transfers in this consolidated case is approximately 14,200 AF, which is equivalent to a uniform flow rate of 19.6 cfs, and which is only two times IDWR's estimated uniform net annual recharge (9.8 cfs).

7. The ultimate decrease in discharge to the Snake River as a result of diverting IDWR's estimated net annual recharge volume (7,100 AFA) will be no more than 9.8 cfs. This amount is approximately 0.25% of the summertime minimum Snake River flow at the Murphy Gage (3,900 cfs) and an even smaller percentage of larger, typical Snake River flows. Based on water-level observations in the Cinder Cone Butte Critical Ground Water Area (CGWA), it will take decades for such a decrease in study-area discharge resulting from new groundwater pumping to occur.
8. The IDWR Staff Memo uses the historical response to groundwater pumping in the Cinder Cone Butte CGWA as an indication of potential impacts to new withdrawals within the consolidated cases study area. However, in making this comparison it is important to note the following:
    a. IDWR estimated that annual groundwater withdrawals in the CGWA are approximately 14,300 AFA, which is approximately three times IDWR's 4,900-AFA recharge estimate for the Cinder Cone study area.
    b. By comparison, the IDWR estimate of average annual aquifer recharge in the consolidated cases study area (approximately 11,000 AFA) is substantially greater than IDWR's estimate of existing withdrawals (3,900 AFA). By definition, withdrawing a volume of groundwater from within the study area equivalent to IDWR's estimate of net average annual recharge (7,100 AFA) would not induce the prolonged water-level declines seen in the Cinder Cone Butte CGWA.
9. Most of the recharge within the consolidated cases study area enters the subsurface north and east of I-84. Thus, wells located along the I-84 corridor should well-positioned to capture a large portion of the net study-area recharge.
10. Production rates from individual wells will reflect local aquifer characteristics. Some local groundwater-level declines may occur as production is developed (some drawdown is necessary to induce sufficient flow to a well), especially in the basin margin sediments north of I-84.
11. Continued groundwater production and water-level monitoring is recommended. Data from such efforts will provide additional insight into available groundwater supply within the study area.
12. Development of better evapotranspiration data within the study area are needed to refine estimates of aquifer recharge and sustainable groundwater supply.

C. Findings and Opinions

This section lists findings and opinions based on the review of the IDWR Staff Memo. The findings and opinions are organized under the same headings used in the IDWR Staff Memo, i.e., Item 1 (Study Area), Item 2 (Data and Information), and Item 3 (Sufficiency of Water Supply).

Item 1: Study Area

1. The IDWR Staff Memo established a study boundary[5] consisting of an "11-mile wide swath oriented parallel to the southwesterly direction of regional groundwater flow." This is a reasonable study area in that it encompasses (a) all of the proposed Points of Diversion (PODs) of pending transfers, (b) recharge areas up-gradient of and surrounding the PODs, and (c) the regional discharge area along the Snake River.
2. IDWR staff also identified an adjacent Cinder Cone study area with similar hydrogeologic characteristics to that of the consolidated cases study area. The Cinder Cone study area encompasses the Cinder Cone Butte CGWA. The effects of ground water development over the past several decades in the Cinder Cone study area were used to provide context for potential hydrologic impacts of the proposed applications[6]. Although the Cinder Cone study area has similar hydrogeologic characteristics to the consolidated cases study area, aggregate groundwater production substantially exceeds the estimated aquifer recharge in the Cinder Cone study area (see below).

Item 2: Data and Information

3. The IDWR Staff Memo[7] notes that the hydraulic gradient decreases from northeast to southwest in the vicinity of I-84. The IDWR Staff Memo suggests that various mechanisms, including faulting, aquifer recharge, or reductions in aquifer transmissivity could explain the decrease in hydraulic gradient.

   A decrease in hydraulic gradient from areas north of I-84 to areas south of I-84 could also be explained by different hydraulic properties of inter-fingered basin-margin sediments north of I-84 (see cross-section A-A' in the IDWR Staff Memo).

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[5] IDWR Staff Memo, Figure 2, page 3.

[6] IDWR Staff Memo, page 3.

[7] IDWR Staff Memo, page 6.

Basin-margin sediments with differing hydraulic properties (e.g., vertical and horizontal hydraulic conductivity), and therefore with varying patterns and rates of downward movement and/or degrees of confinement, could explain the apparent observed difference in water levels (and hydraulic gradient) north and south of I-84.

4. There clearly have been groundwater-level declines within the Cinder Cone Butte CGWA, but the degree to which water level declines within the CGWA have extended outside of the CGWA is unclear. Groundwater-level contours shown Figure 5 of the IDWR Staff Memo[8] show substantial declines extending west and southwest (i.e., outside) of the CGWA in the consolidated cases study area, but these depictions of the study-area groundwater-level declines represent a software interpolation unsupported by actual groundwater-level data.
5. Hydrographs[9] in the southwestern portion of the Cinder Cone Butte CGWA show a consistent downward trend in groundwater levels. It appears that drillers' reports are available for only 6 of the 11 wells used in this analysis[10]. Some of the wells for which drillers' reports are available have very broad completion intervals (e.g., Well 02S05E-06ACC1 has an open interval of over 1,000 feet). It is not clear whether the observed water-level declines represent aquifer conditions throughout these open intervals or in individual aquifer zones.
6. The IDWR Staff Memo refers to water levels in one of the Mountain Home Plateau wells (Well 01S04E-30AAC1) as having risen from 1967 to 2000 and decreasing since that time. As a point of clarification, this well is located in the consolidated cases study area (and outside of the Cinder Cone Butte CGWA). Groundwater levels in this well rose approximately 7 feet from 1967 to 2000 (approximately 2.5 inches per year). Groundwater levels have fallen approximately 2 feet in the last 12 years (approximately 2 inches per year).
7. Groundwater levels in the Cinder Cone Butte CGWA Well 02S04E-09DDD2, which is the closest well within the CGWA to the well referenced in the previous finding (Well 01S04E-30AAC1) have risen approximately 10 feet since 1993. It is unclear whether this rise reflects regional or local conditions.
8. The Staff Memo[11] presents hydrographs for the Cinder Cone Butte CGWA. A number of the hydrographs indicate similar downward trends. However, when re-

[8] IDWR Staff Memo, page 7.

[9] IDWR Staff Memo, Appendix B.

[10] Based on the drillers' reports provided by IDWR in its discovery response.
[11] IDWR Staff Memo, Appendix B, Plate 1.

plotted with consistent y-scales the hydrographs show that the area of greatest declines is limited to the southern portion of the CGWA (Figure 1, page 15).

9. The availability of groundwater-level and streamflow data from study-area wells and streams has improved substantially as a result of increased IDWR, USGS, and private measurement and monitoring efforts over the past three years.

10. The IDWR Staff Memo notes that there are not currently enough data to establish long-term groundwater-level trends in all but two of the consolidated cases study area wells (01S04E-10DAD1 and 01S04E-30AAC1). However, most of the hydrographs presented in Appendix C of the IDWR Staff Memo are based on multiple water level measurements collected since 2009 or 2010, and these hydrographs indicate relatively stable groundwater levels[12].

Item 3: Sufficiency of Water Supply

11. IDWR's water-budget approach for evaluating aquifer recharge represents standard methodology and is based on sound hydrologic principles.

12. The largest study-area water-budget component is precipitation. Precipitation estimates were based on PRISM climate-elevation regressions for digital elevation model grid cells that are approximately 0.5 mile in size (Daly et al., 2008). PRISM data are commonly accepted for interpolating precipitation values over a large area.

13. The second largest study-area water-budget component is evapotranspiration (ET). ET estimates were based on (a) ET Idaho[13] values using Mountain Home weather station data and (b) previous estimates made for a water budget covering the entire western Snake River Plain (Newton, 1991). ET data represent the most uncertain component of the study-area water budget. Additional ET data based on actual study-area measurements would improve study-area ET estimates.

14. The IDWR Staff Memo states[14] that "Using ET Idaho values from the Mountain Home station for sagebrush and range grasses in the study area likely result in underestimation because actual ET is limited by the amount of precipitation." While this may be true for growing-season months, precipitation substantially exceeds ET

[12] Some local groundwater-level declines are anticipated in the study area as withdrawals increase under new appropriations. However, groundwater levels should stabilize as long as recharge volumes exceeds withdrawals.

[13] http://www.kimberly.uidaho.edu/ETIdaho/online.php

[14] IDWR Staff Memo, page 13.

during non-growing season months, especially during or following high-intensity precipitation and snowmelt events.

15. IDWR's estimate of infiltration in the "non-recharge" area was based on western Snake River Plain subareas used in Newton's (1991) regional aquifer analysis. Infiltration estimates for these regional sub areas do not fully describe variations in study-area recharge patterns.

    For example, the northeastern portion of the consolidated cases study area's "non-recharge" area likely has a greater amount of shallow course-grain alluvial sediments (because of proximity to the foothills) than most portions of the western Snake River Plain, and may have a greater infiltration capacity than other rangeland portions of the western Snake River Plain having duripan and/or caliche layers. It is precisely such sediment properties (i.e. greater infiltration capacity) that allow for seepage of the entire streamflow from Indian and Bowns creeks in most years.

    Swales and channels in the study area, especially in the area north of I-84, occasionally experience overland flow during high-precipitation and/or snowmelt events. Most of these channels do not convey water over a great distance because of seepage to the subsurface. A portion of such infiltration will become aquifer recharge.

16. IDWR's estimated average annual recharge amount (11,063 AFA) did not include recharge from geothermal sources. Welhan (2012) notes that two-thirds of the East wells are in the 66 to 71°F temperature range, with the lowest temperatures observed in shallow wells. Based on these temperature observations, Welhan (2012) concludes that "Given the range of observed [groundwater] temperatures, it is likely that East Ada aquifers are recharged by a mixture of cold, shallow ground water originating in nearby highlands and geothermally heated water that originates from greater depths and geographic distances."[15]

    Welhan's conceptual model[16] (adapted from Waag and Wood, 1987) illustrates regional-scale recharge via deep circulation through the Idaho Batholith from areas that may be outside of the defined study area. Most of the geothermal upwelling likely occurs via faults along the Danskin front. Many of the diversions proposed under applications and transfers would draw water from deeper wells located along

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16 Welhan (2012), page 28.

the I-84 corridor in proximity to (or hydraulically down-gradient from) inferred faulting shown in Phillips et al. (2012).

17. Welhan concluded that "the fraction of geothermal recharge to parts of the deep East Ada aquifer may exceed 20%"[17] based on observed well temperatures. A portion of this upwelling of geothermal groundwater likely originated from outside of the study area. Geothermal recharge from outside of the study area might represent an additional 5% or 10% to IDWR's cold-water recharge estimate of 11,000 AFA (or an additional 550 or 1,100 AFA) along the Danskin front.

18. IDWR's estimate of existing withdrawals appears to be high, yielding a conservative (i.e., low) estimate of net annual recharge.

    a. Some of the crops identified by IDWR using the 2011 NASS Cropland Data layer, such as approximately 400 acres of winter wheat for which a consumptive irrigation requirement (CIR) of approximately 730 AFA was estimated, are on land without active water rights (and therefore should not count as existing aquifer use). However, the IDWR aggregate CIR assessment also excluded some land in the Indian Creek drainage currently irrigated under valid water rights. In aggregate, it appears that the irrigated acreage (462 acres) in the IDWR assessment of the "non-recharge area" is approximately 50 acres more than that which is actually authorized under existing water rights (413 acres), and the CIR based on water right POUs (825 afa) is about 60 AFA less than the IDWR estimate of 884 AFA[18]. Overestimation of existing withdrawals has the effect of reducing the estimated net recharge volume available for appropriation.

    b. The IDWR Staff Memo estimated consumptive domestic and stockwater use to be 493 AFA[19] based on active water rights within the study area[20]. It appears that IDWR staff took care to eliminate duplicate and/or overlapping rights[21].

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[17] Welhan (2012), page 2.

[18] The difference in CIR based the NASS Cropland Data Layer and water right POUs is not proportional to the difference in acres because some of the land not included in the IDWR estimate is likely irrigated with greater volumes than land that IDWR incorrectly included based on NASS data.

[19] IDWR Staff Memo, page 14.

[20] See "Consumptive Use Estimates.xlsx", provided in Item 16 of IDWR's discovery response.

[21] Duplicates are indicated in the above-listed spreadsheet with red font.

However, the remaining diversions appear to authorize year-round watering for over 8,000 cattle. Familiarity with the study area suggests that this number is in excess of actual stock numbers.

Furthermore, some of the domestic, commercial, and industrial rights are not consumptively used. For example, water right 63-11524 (having an annual volume limit of 42.8 AFA and owned by the State of Idaho Department of Transportation) is used for restrooms but also heating and cooling via a water-to-air heat pump (and is therefore mostly not consumptively used). Commercial use under water right 63-7571 (4 AFA, Boise Stage Stop) is for showers, restrooms, retail, and repair facilities, and is likely returned to the subsurface via septic system.

Table 2 (page 16) provides estimates of consumptive and not fully-consumed volumes for the water rights listed in IDWR's consumptive use spreadsheet. Of IDWR's estimated 493 AFA for stock water, domestic, commercial, and industrial rights, approximately 200 AFA may not be consumptively used.

19. This reviewer has more confidence in the IDWR net annual recharge estimate than those of Welhan (2012). Welhan used Darcy's Law and assumed aquifer transmissivity values to estimate recharge. If Darcy's Law is to be used to estimate discharge through an entire aquifer thickness, then the transmissivity term (or hydraulic conductivity and cross-sectional area) should also encompass the entire aquifer thickness.

    Welhan assumed an average transmissivity value 7,300 gpd/foot based on a pumping test conducted in the 763-foot deep Ken Agenbroad Well (SPF, 2007). The Agenbroad Well is located approximately 1.5 miles southwest of the Mayfield Townsite property and has an aggregate screened thickness of 130 feet. Transmissivity values based on this 130-foot open interval cannot reflect conditions throughout the entire aquifer thickness. Other pumping tests in this area have yielded higher transmissivity estimates. A pumping test in the nearby 627-foot deep ARK Properties Mayfield Irrigation Well No. 1 yielded a transmissivity estimate of 25,000 gpd/foot (SPF, 2007). Aquifer transmissivity based on a 4-day pumping test in the Elk Creek Canyon Production Well No. 1 was estimated to be approximately 27,000 gpd/foot (SPF, 2011). Both of these wells are screened in only a portion of the aquifer thickness. The aggregate transmissivity for the entire aquifer thickness is likely greater than even these estimates.

    The fact that a simple Darcy model cannot be used to evaluate recharge is not a surprise. The basin-margin aquifers in this area include perched, unconfined, partially-confined, and confined aquifers, which, in aggregate, do not lend themselves well to this simple Darcy analysis.

20. The amount of water available for appropriation will be greater if current permits aren't fully developed. The undeveloped portions of these permits can be added to

the net annual recharge volume. The two largest active permits are 63-32225 (with a volume limit of 1,815 acre-feet) and 61-12090 (with a volume limit of 345 acre-feet).

21. The IDWR Staff Memo suggests that groundwater-level declines similar to those experienced in the Cinder Cone Butte CGWA could occur as new consumptive uses *approach* the current net recharge rate[22] (emphasis added). However, while some groundwater-level decline may occur (and would, in fact, be necessary to induce sufficient flow to wells), groundwater levels would not experience continued declines such as those seen in the Cinder Cone Butte CGWA unless consumptive withdrawals *exceed* the net annual recharge.

22. The IDWR Staff Memo states that "In combination with the maximum rate for recently approved water right permits (14.02 cfs), the proposed additional maximum appropriation of 84.76 cfs represents a 1,102% increase in the permissible, instantaneous withdrawal rate in the study area"[23] over the estimated net average annual recharge rate of 9.8 cfs. However, maximum authorized instantaneous diversion rates are a poor indicator of long-term diversion volumes (and therefore a poor indicator of long-term aquifer impacts). The IDWR Staff Memo recognized this: "the fraction of the maximum total appropriation that would be consumptively used depends, not on the rate limits, but rather on ... the amounts withdrawn, information that is lacking for this analysis."[24]

23. SPF estimated that the aggregate volume that would be withdrawn under the pending study-area applications and transfers (Table 3, page 17) is approximately 14,200 AFA. This estimate is based on the following assumptions (see also Table 4, page 18):

    a. Urban or semi-urban developments would be constructed with the number of equivalent dwelling units (EDUs), or numbers of homes and equivalent commercial uses, listed in individual applications;

    b. Residential developments will be constructed at an average density of 4 EDUs per acre;

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[22] IDWR Staff Memo, page 15-16: "The net recharge for the study area (7120 AFA) is positive, indicating that existing consumptive uses, including those for water rights that are not yet fully developed, are less than the rate of recharge... Additional consumptive use is approaching the amount of the difference [i.e., 7120 AFA] would be expected to result in water level declines similar to those observed in the Cinder Cone CGWA..."

[23] IDWR Staff Memo, page 17.

[24] IDWR Staff Memo, page 16.

c. The average irrigated land irrigated per EDU will be approximately 4,900 ft^2 (or approximately 0.11 irrigated acres per EDU);

d. The average irrigation volume for residential irrigated areas will be 4.0 AF/acre/year;

e. Used in-home domestic water will be recycled (and will be used to meet irrigation demand);

f. Institutional and common-space irrigation under municipal applications will require an additional 20% of water over the consumptive use projected for listed EDUs;

g. The average irrigation volume for agricultural lands will be 3.0 AF/acre/year[25]

These assumptions are based on professional judgment. The amount of water use represented by the consolidated applications and transfers will depend on the actual number of homes constructed, businesses built, actual housing density, acres irrigated, and water-conservation strategies incorporated.

24. The annual consumptive use represented by the consolidated applications and transfers (14,200 AF) is approximately two times IDWR's estimate of net annual recharge (7,100 AF).

25. The 14,200 AFA estimated aggregate volume represented by the applications/transfers is equivalent to a constant pumping rate of 19.6 cfs. This constant flow rate is approximately two times IDWR's projected net annual recharge rate of 9.8 cfs.

26. IDWR states that pumping within the study area will not lead to induced flow from the aquifer system adjacent to the study area, i.e., "lowering of the water table in the study area will not substantively increase the amount of water available for appropriation."[26] Supporting IDWR's assertion is that pumping in the southwestern portion of the Cinder Cone Butte CGWA in excess of net recharge over approximately four decades has not led to groundwater-level declines in the portion of the study area in which appropriations are sought.

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[25] The average consumptive use by agricultural crops will likely be less than residential turf. Also, the agricultural irrigation efficiency will likely be more efficient than residential irrigation because of greater irrigation-system control and greater sensitivity to pumping costs.

[26] IDWR Staff Memo, page 16.

27. The IDWR Staff Memo states that "Additional groundwater extraction would ... decrease aquifer storage, particularly in the short term..."[27] Some drawdown within the study area is hydraulically necessary to induce sufficient flow toward wells and effectively capture aquifer recharge within the study area.

28. IDWR also notes the additional groundwater extraction would decrease aquifer storage, and therefore decrease discharge to the Snake River.[28] There is a substantial distance between pumping proposed in the consolidated applications/transfers and the Snake River, and, based on the extent of declines within the Cinder Cone Butte CGWA over the last approximately four decades, it would take decades for the effects of the proposed pumping to be realized at the Snake River. The ultimate decrease in study-area discharge to the Snake River as a result of authorizing the appropriation 7,100 AFA would be no more than 9.8 cfs. It is highly unlikely there would be much seasonal variation in this discharge because of the distance between the proposed points of diversion and the Snake River (approximately 20 miles or more).

29. IDWR staff did not evaluate hydrologic impacts associated with the proposed ground water development, using instead data from the Cinder Cone Butte CGWA to provide an indication of potential impacts. The IDWR Staff Memo then concludes that "the data suggest an inverse relationship between the amount of ground water development and water levels in the regional aquifer."[29] It is important to note, however, that the groundwater-level declines observed in the Cinder Cone Butte CGWA reflect estimated withdrawals (14,300 AFA) that are almost three times more than estimated recharge (4,900 AFA)[30] in the CGWA area. The prolonged declines experienced in the Cinder Cone Butte CGWA are not expected within the study area if the amount appropriated does not exceed the net annual recharge.

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[27] *Ibid.*

[28] IDWR Staff Memo, page 16.

[29] IDWR Staff Memo, page 20.

[30] Based on Table 3 in IDWR Staff Memo, page 11.

D. References

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Welhan, J.A., 2012. Preliminary Hydrogeologic Analysis of the Mayfield Area, Ada and Elmore Counties, Idaho, staff report published by the Idaho Geological Survey, Moscow, Idaho.

Modifications to IDWR's Estimate of Study Area Net Average Annual Recharge				
Water Budget Component	IDWR Estimate (AFA)	SPF Estimate (AFA)	Difference (AFA)	Comment
Recharge	11,060	11,610	550	Geothermal contribution
DCMI uses	3,059	2,879	-180	Reduction in stockwater/wildlife consumptive use estimate
CU for irrigated lands	884	824	-60	Net CU reduction for lands without valid water rights
Net annual average recharge rate (rounded)	7,100	7,900	800	

Table 1. Modifications to IDWR's estimate of net average annual recharge.

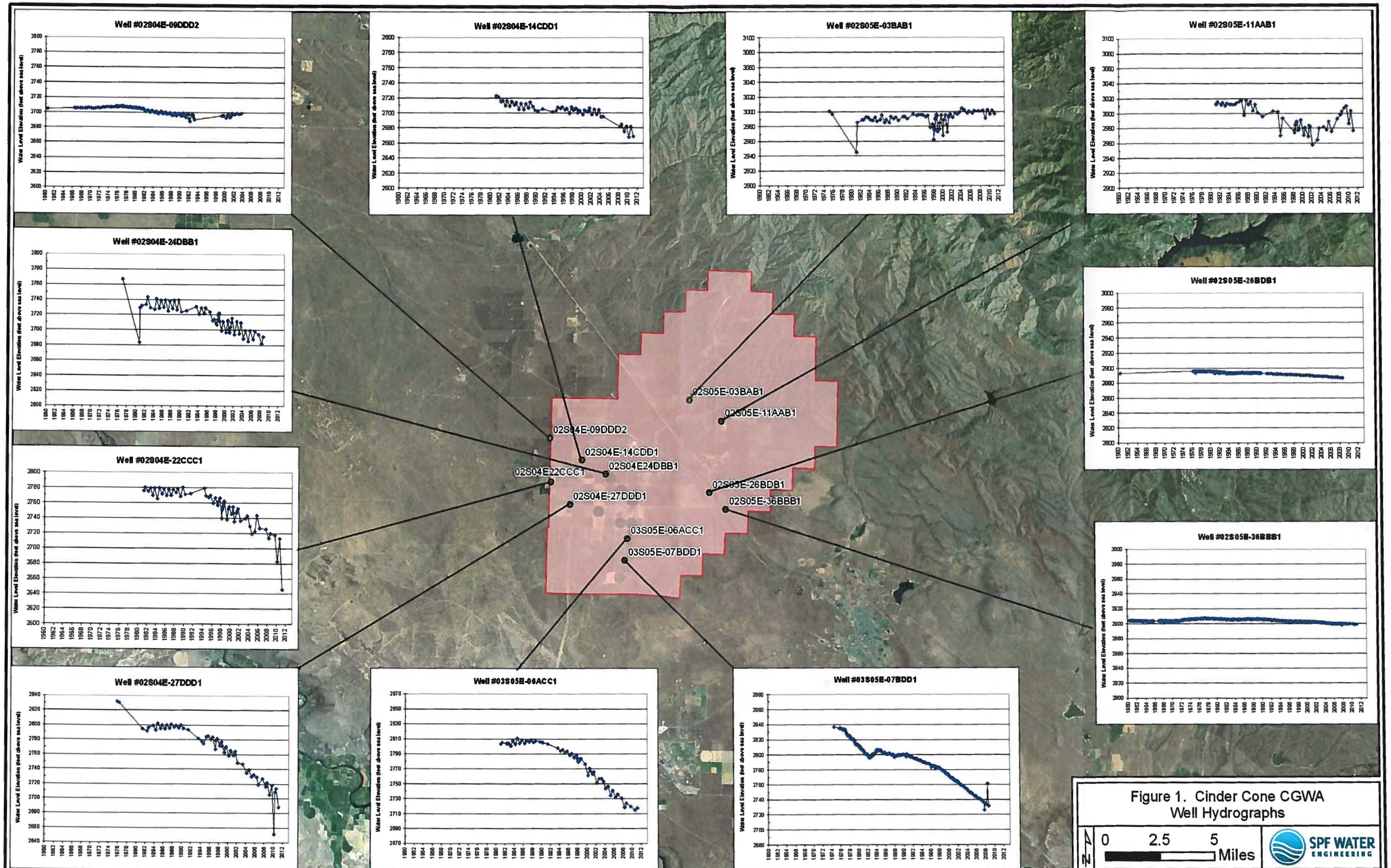

Figure 1. Cinder Cone CGWA Well Hydrographs

Consumptive Use Estimates							
Source	Ground-water	Surface Water	Springs	Total	Assumed Consumptive Use	Assumed not Fully Consumed	Note
Stockwater Calves and Cattle (count)	2,687	5,548	50	8,285			(1)
Stockwater Storage (AFA)	-	52	-	52	52	-	(2)
Stockwater/wildlife Volume (AFA)	84	118	6	209	42	167	(3)
Commercial/ Industrial Volume (AFA)	27	-	-	27	13	13	(4)
Domestic Volume (AFA)	206	-	-	206	206	-	(5)
	317	170	6	493	313	180	

Notes
(1) Based on IDWR spreadsheet.
(2) Assume most storage ponds are completely filled each year and go dry during summer (i.e., 100% consumptively used).
(3) Assume 10% is consumptively used on a year-round basis.
(4) Assume 50% is consumptively used.
(5) Assume 80% consumptively used.

Table 2. Consumptive use estimates.

Proposed Consolidated Hearing Transfers and Applications									
Name	Number	Received	Priority	Water Use	Maximum Instantaneous Diversion (cfs)	EDUs	Agricultural Irrigation Acres	Estimated Annual Volume (AF)	Comment
Mayfield Townsite	63-32499	7/28/2006	7/28/2006	Municipal	10	8000		4,320	Assume 0.54 AF/unit
Shekinah Industries (transfer)	73811	12/4/2006	1963+	Irrigation	5.56		369	1,107	Assume 3.0 AF/acre
Nevid	61-12095	4/3/2007	4/3/2007	Municipal	5	750		405	Assume 0.54 AF/unit
Nevid	61-12096	4/3/2007	4/3/2007	Municipal & Fire Protection	20.48	4603		2,486	
Orchard Ranch (transfer)	73834	6/21/2007	1976	Irrigation (municipal)	11.36		631	1,893	Decreed volume is 2,975 (or 4.71 AFA); assume average use of 3.0 AFA
Orchard Ranch	63-32703	6/21/2007	6/21/2007	Irrigation (was municipal)	9.6		480	1,440	Assume 3.0 AF/acre
Inter-mountain Sewer & Water	61-12256	1/17/2008	1/17/2008	Municipal	13.76	2000		1,080	Assume 0.54 AF/unit
Ark Properties / Mayfield Townsite	63-33344	3/1/2010	3/1/2010	Irrigation in planned community (63-32499)	9		475	1,440	Assume 3.0 AF/acre
Total					84.76	15,353	1,955	14,171	

Table 3. Consolidated applications and transfers.

Calculation of Annual Residential Water Requirements		
Component	**Value**	**Units**
Assumed number of EDUs/acre	4	
Land area/EDU	10,890	ft^2
Percentage irrigated area in residential areas	45%	percentage
Irrigated area per EDU	4,901	ft^2
Irrigated area per EDU	0.11	acre
Assumed irrigation application rate per net residential irrigated acre	4.0	AF/acre/year
Annual volume/EDU	0.45	AF/acre/year
Additional volume per EDU for common space, etc.	20%	percentage
Estimated average annual water volume per EDU	0.54	AF/acre/year
Note: assumes treatment and storage of domestic wastewater		

Table 4. Calculation of residential water requirements.