MEMO

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Department of Water Resources
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Date: April 14, 2010

To: Steve Lester

From: Craig Tesch and Sean Vincent CT SV

cc: Rick Raymondi

Subject: Technical Review of Groundwater Modeling in Support of Idaho Water Company Water Right Transfer #73811

Introduction

The purpose of this memorandum is to document our review of the December 28, 2009, groundwater modeling analysis that was prepared by Brockway Engineering, PLLC in support of Idaho Water Company (IWC) water right transfer #73811. In accordance with your request, this review has been conducted to answer the following questions:

1) Does the consultant information show an adequate, sustainable ground water supply at the proposed site?
2) What impacts would be expected to other wells in the area?
3) What impacts to Mountain Home Ground Water Management Area (GWMA) and Cinder Cone Critical Ground Water Area (CGWA) would be expected?
4) How does consultant information fit with other information previously provided to and analyzed by IDWR for the general area in question?

Summary

The subject transfer proposes to split six groundwater irrigation rights and create a new permissible place of use (POU) with a maximum diversion rate of 5.56 cubic feet per second (cfs) and an annual volume limitation of 1,476 acre-feet. The transfer involves moving rights from the current POU approximately seven miles southeast of the Cinder Cone CGWA to a proposed POU approximately 0.5 miles northwest of the Cinder Cone CGWA; both locations are within the larger Mountain Home GWMA. The existing points of diversion (PODs) are located southwest of Mountain Home and east of the

Mountain Home Air Force Base at T04S R06E Sections 17, 18, 19, and 20 in Elmore County. The proposed POD are approximately 0.5 miles south off the Simco Road exit of I-84, at T01S R04E Sections 14, 23, and 24 in Elmore County (Figure 1).

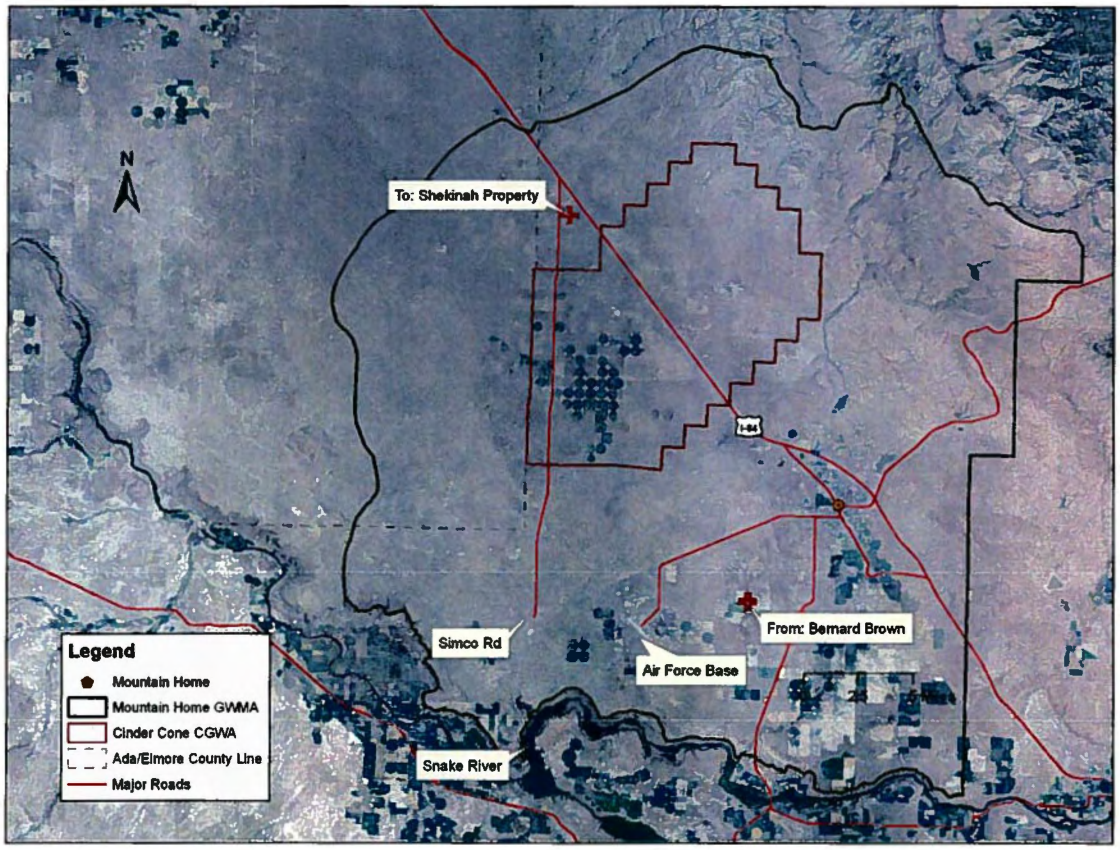

Figure 1. Map showing To (Shekinah Property) and From (Bernard Brown) POD locations for the proposed IWC transfer.

The original transfer application was submitted by IWC on behalf of Shekinah Industries to IDWR on December 7, 2006. IDWR issued a letter on November 5, 2008, requesting additional information related to potential hydrologic impacts, monitoring, and mitigation. Shekinah Industries retained Brockway Engineering to develop a numerical groundwater model (referred to herein as the Brockway Engineering model) to address IDWR questions. The report titled "Shekinah Industries Groundwater Model Development and Transfer Scenario Runs" (Powell, 2009) is the focus of this technical review and contains the following information:

- General area description
- Model development and calibration
- Aquifer characterization
- Water budget analysis

- Transfer evaluation
- Data deficiency and refinement

Hydrogeology

The western Snake River Plain (WSRP) is a deep structural depression that is filled with sedimentary and volcanic rocks of Tertiary and Quaternary age that is bounded by northwest trending faults (Newton, 1991). Mountains composed of granitic and volcanic rocks surround the plain on the northeast and southwest (Figure 2). Powell (2009) describes two aquifers beneath the study area: (1) a shallow, perched, alluvial aquifer with limited extent around the city of Mountain Home, and (2) a regional aquifer composed primarily of basalt layers of the Bruneau formation of the Idaho Group.

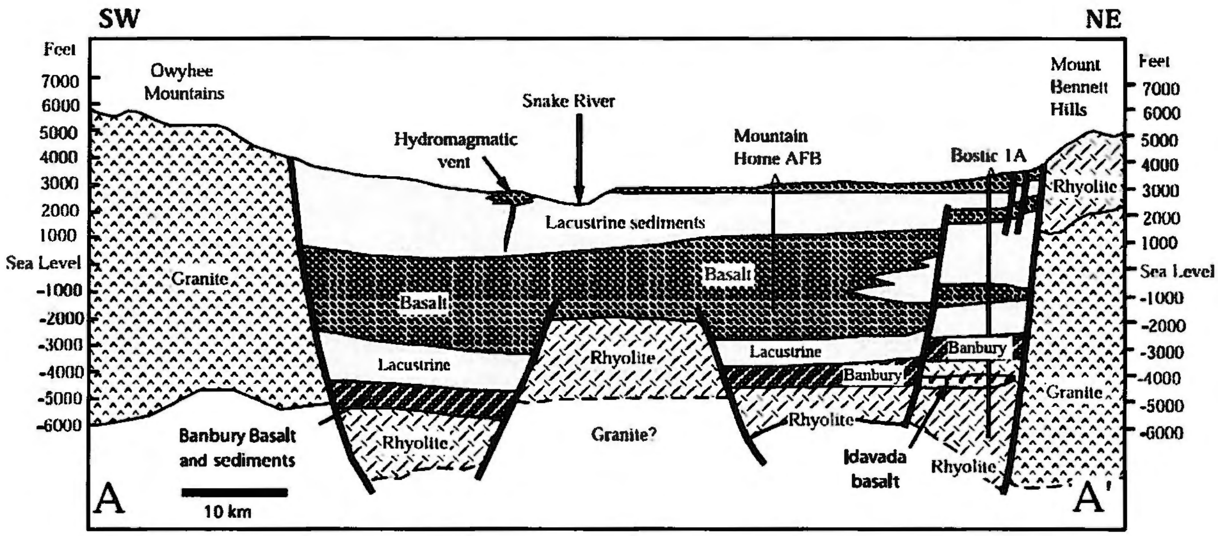

Figure 2. Geologic cross-section through the WSRP (Shervais, 2002).

According to the modeling consultant "Numerous well drilling reports indicated layers of alluvium material below rock layers throughout the model domain" (Powell, 2009, p. 13). While this description is indicative of the large-scale geology and formations of the Idaho Group, it is important to note that variability exists on a local scale. For example, well logs in T01S R04E Sections 22 and 23 (Eisman and Williams Pipeline wells) show several layers of volcanics intermixed and underlain by sediments; however, a well log in T01S R04E Section 15 (adjacent to Sections 14 and 22) shows 467 feet (ft) of sediments from land surface to completed depth with no volcanics present. Data deficiencies related to geology, hydrostratigraphy, groundwater elevations, and aquifer extent exist in this portion of the WSRP and are the focus of ongoing studies by IDWR.

A two-aquifer system (shallow perched and deep regional) is described in the Mountain Home area by Norton (1982). Location maps indicate that neither the current nor the proposed POD reside within the boundaries of the perched aquifer system mapped by Young (1977) near Mountain Home. However, a review of driller's logs for wells in and around the proposed POD (T01S R04E Section 23 and its eight adjacent sections) indicates other shallow groundwater systems can exist locally in the region. A driller's log for a well in T01S R04E Section 24 (Western Livestock well) reports 176 ft of sediments from land surface to completed depth with a static water level of 45 feet below ground surface (ft-bgs). The remaining driller's logs report regional aquifer static water levels ranging from approximately 300 to 500 ft-bgs.

Groundwater flow is generally south/southwest towards the Snake River based on contouring of spring 2000 water level data that were collected by IDWR (Figure 3). Although water levels have changed, the shape and spacing of the contours are similar to those presented in Figure 3 of Newton (1991), which is a groundwater contour map based on water levels collected in the spring of 1980. The contours from the Newton (1991) map were used as the calibration target for the steady-state Brockway Engineering model.

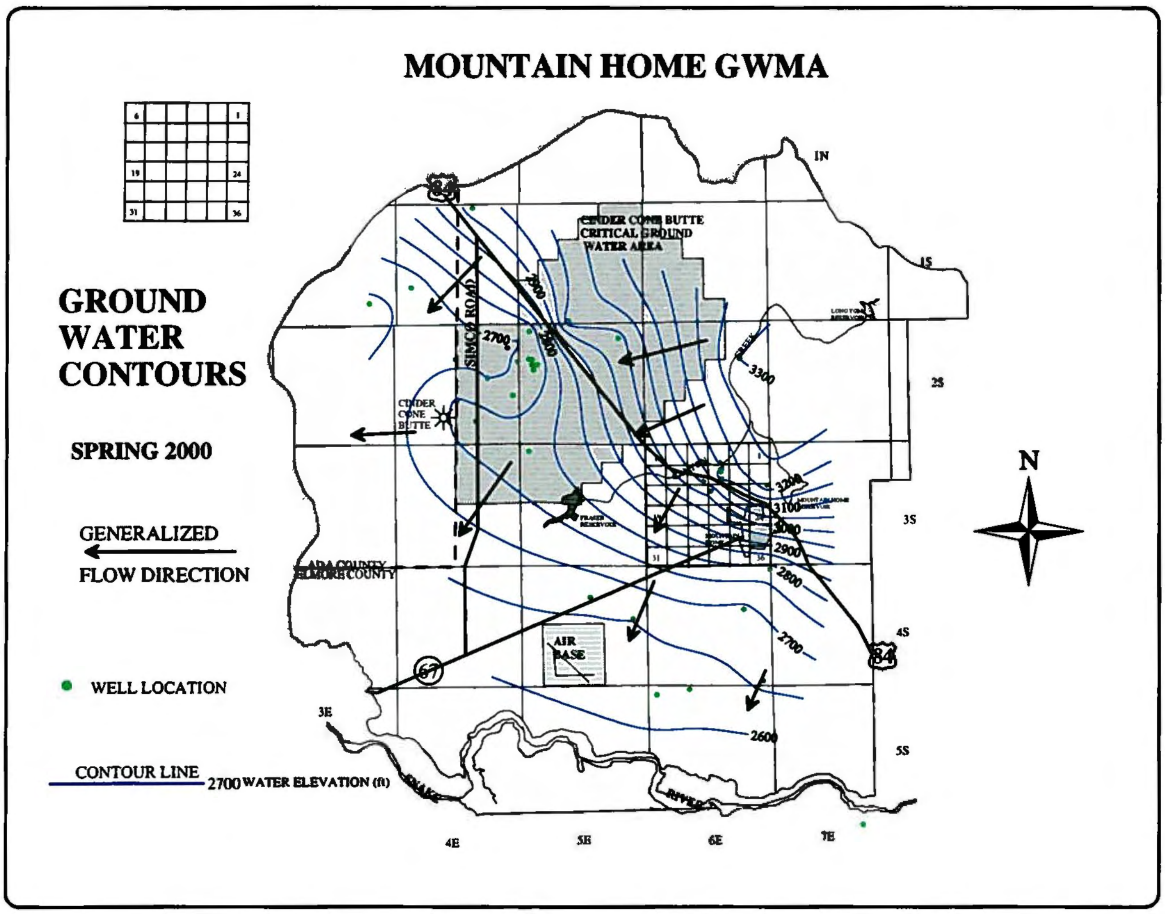

Figure 3. Spring 2000 water level contours for the Mountain Home groundwater monitoring network (Harrington, 2001).

IDWR has maintained a groundwater level monitoring network on the Mountain Home Plateau since 1960. The network includes wells that are located within both the Mountain Home GWMA and the Cinder Cone CGWA. Water level declines since that time resulted in the establishment of the Cinder Cone CGWA on May 7, 1981, and the Mountain Home GWMA on November 9, 1982. According to Powell (2009), "steady aquifer declines have been recorded in the Mountain Home area for about 35 years" (p. 6).

Water levels measurements taken in 19 wells during the spring between 1983 and 2009 were analyzed by IDWR to determine differences between historic and current water levels (Figure 4). Thirteen of the 19 wells (68%) had lower water levels in the spring of 2009 than were measured in the spring of 1983. The water level declines in those wells range from approximately 0 to 80 feet. Declines greater than 50 feet were observed in five wells located in the southwest portion of the Cinder Cone CGWA.

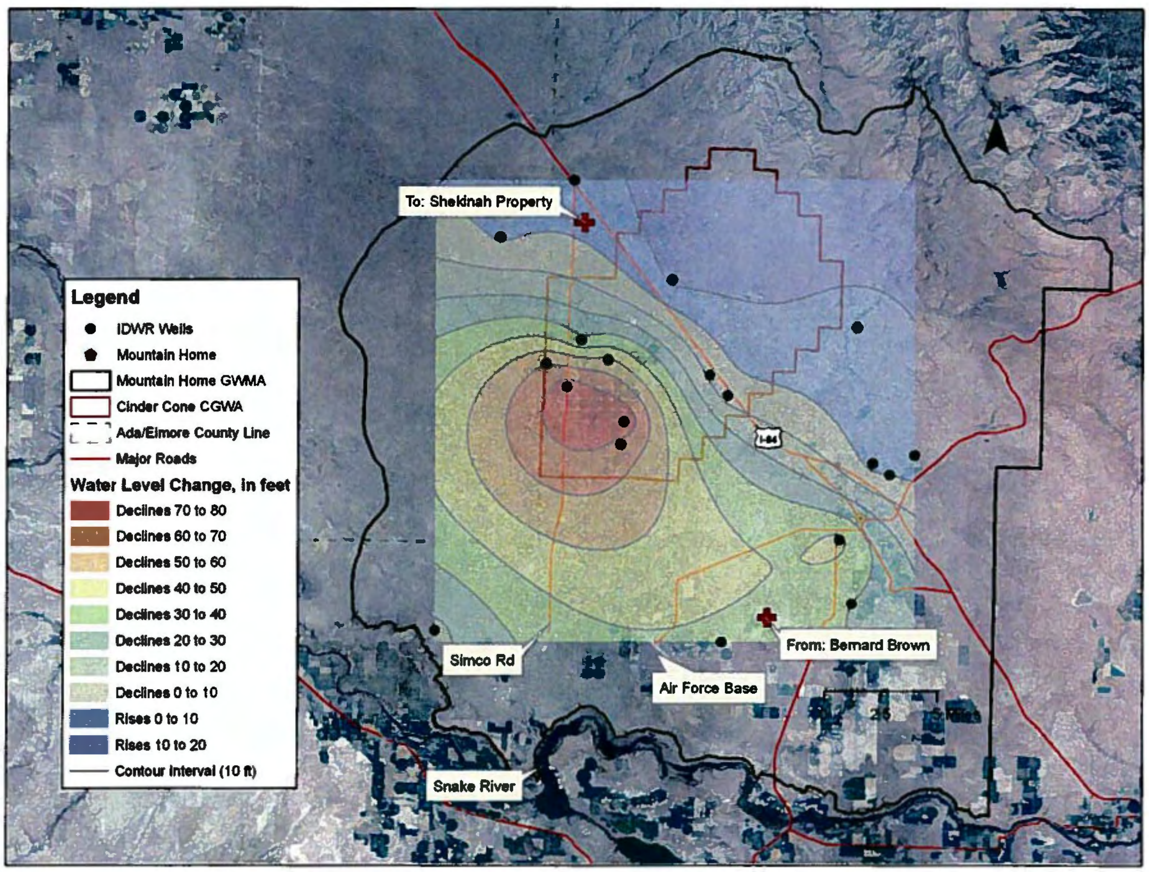

Figure 4. Groundwater level change from spring 1983 to spring 2009 within the IDWR Mountain Home monitoring network.

Five of the six wells in which water level increases were observed are located northeast of interstate I-84. The current PODs are located in an area with declines of 30 to 40 ft over the last 26 years, while the proposed PODs are in an area in which the water level has risen from 0 to 10 ft. The cause of differing trends is currently unknown; there is significant uncertainty about aquifer behavior in this area due to a general lack of hydrogeologic data.

Northwest-trending faults mapped in the area (Bond, 1978) may serve as partial barriers to flow and contribute to the difference in trends between wells north/northeast of I-84 and those south/southwest of I-84. Additionally, irrigation development near Simco Road in the southwestern portion of the CGWA likely is affecting the distribution of water level declines. Studies performed as part of the IDWR Treasure Valley Comprehensive Aquifer Management Planning (CAMP) program will provide hydrologic information to facilitate a more rigorous evaluation of the factors affecting water levels in the GWMA and CGWA.

Groundwater Model

Overview

As mentioned earlier, Shekinah Industries retained Brockway Engineering to develop a numerical groundwater flow model for the area. The Brockway Engineering model is based loosely on the Newton (1991) model created for the Regional Aquifer-System Analysis (RASA) Program of the U.S. Geological Survey (USGS). Subarea boundaries of the Newton model were used as guides and the resulting grid consisted of 152 columns by 116 rows with 15,710 active cells and a uniform cell size of ¼ mile by ¼ mile (Powell, 2009, Figure 8). The Brockway Engineering model was developed as a steady-state model with one layer, similar to Newton's layer 1, with a bottom elevation 500 feet below the water table. Calibrated hydraulic conductivities are similar to those used in the Newton model and range from 4 ft/day to 53 ft/day (Powell, 2009, Figure 14).

A specified flux boundary was defined on the northeast edge of the model domain and the flux was estimated using Darcy's law. Head-dependent river cells were used to represent the Snake River along the southwest boundary of the model. Constant heads were assigned to the southeast and northwest model boundaries based on 1980 groundwater elevation contours from Newton (1991) and then converted to specified flow boundaries after calibration. Another set of groundwater contours was developed by Brockway Engineering based on more recent water level data from USGS observation wells and IDWR well logs; however, it was determined that the new data were unreliable and the contours from Newton (1991) were used instead.

While it is reasonable to use a published USGS potentiometric surface map for assignment of constant head boundaries, the water table has declined in a majority of the Mountain Home GWMA since the 1980 contours were developed. As identified by Allan Wylie in his review of the model (Attachment A), assuming steady-state conditions while acknowledging the system has been declining in many areas of the model domain for decades is difficult to justify and causes large predictive uncertainty.

It is unclear why contours were used for calibration instead of the water levels from which they were developed. More commonly, groundwater models are calibrated to actual water levels and goodness of fit is calculated by comparing simulated heads to measured water levels. The statement in the modeling report that "no current published groundwater contours were available for the region" (Powell, 2009, p. 23) does not explain the rationale for deciding to not use recent water level data for model calibration. In fact, a groundwater contour map could have been created from the 2000 water level data (see Figure 3) or from the 2009 data.

Water Balance

A review of Brockway Engineering's water balance (Table 1) for the calibrated, steady-state model was conducted as part of this request. However, because the model is based on the assumption of equilibrium, the model water budget is not very useful for evaluating adequacy and sustainability issues in an area that has experienced large water level declines over time. On the other hand, the aquifer does supply the annual volume to the current water right, and the transfer request involves moving the POD rather than increasing the rate of extraction.

Table 1. Water balance for the steady-state Brockway Engineering model.

	IN (ft^3/day)	OUT (ft^3/day)	TOTAL (ft^3/day)
Northeast Underflow	9,165,000	0	9,165,000
Constant Head	5,142,000	-12,102,000	-6,960,000
Snake River	73,000	-20,489,000	-20,416,000
Transfer Well	0	-176,000	-176,000
ET – Sagebrush	0	-69,060,000	-69,060,000
Irrigation	21,395,000	0	21,395,000
Precipitation	83,500,000	0	83,500,000
Ground Water Extraction	0	-16,880,000	-16,880,000
Municipal Extraction	0	-568,000	-568,000
Total	119,275,000	-119,275,000	0

According to the modeling report, the volumetric precipitation rate in Table 1 (83,500,000 ft^3/day) represents the average annual value for the period 1971-2000. This rate is equivalent to 13.4 in/yr if evenly distributed over the area that is represented by the 15,710 active cells in the model. Since we were not provided with a shapefile of the model boundaries, it is not possible to verify the computed precipitation rate, but it is higher than the average annual value cited on page 4 of the modeling report (9.98 inches). It is possible that the 3.4 in/yr discrepancy can be accounted for based on location differences and/or the use of different periods of record.

The ET value in Table 1 represents an area-adjusted average annual value that was developed using ET data from the University of Idaho Kimberly Research and Extension Center (http://www.kimberly.uidaho.edu/ETIdaho). The ET value for alfalfa was assumed for areas of agricultural land use, and the ET value for sagebrush was assumed for rangeland areas. It's worth noting that the rate of precipitation exceeds the rate of evapotranspiration by 14,440,000 ft^3/day. This differential is equivalent to 167 ft^3/sec (cfs) and represents 2.3 in/yr of recharge if uniformly distributed over the active model area. This recharge rate as a fraction of the total precipitation is 17%, which is an order of magnitude higher than the estimate for the western Snake Plain as a whole (2%) that was developed for the USGS model (Newton, 1991, p. G16).

The modeled Snake River contributions in Table 1 were compared to reach gain estimates based on stream gage data for the Snake River. In 2008, the USGS measured an average annual rate of 6,561 cfs at the gage below CJ Strike Reservoir and 6,788 cfs at the downstream Murphy gage; this represents a river gain of 227 cfs compared to 236 cfs in the water balance for the model. While the two numbers compare favorably, the water balance estimate (236 cfs) represents Snake River contributions from the north side of the river only. This suggests that the modeled discharge to the Snake River is overestimated by the amount of water contributed from the south side; however, the contribution from the south side of the river is unknown.

Recharge from irrigated acreage (Powell, 2009, Figure 12) was obtained by analyzing IDWR water right shape files and aerial photography, and assuming a uniform crop and irrigation efficiency. Alfalfa was chosen as the crop, and an irrigation efficiency of 75% was assumed, both of which are reasonable. The result in Table 1 is inclusive of surface water and groundwater irrigation sources and is a reasonable approach to calculating the irrigation recharge component of the water balance.

Groundwater extraction estimates for irrigated lands were calculated by dividing the precipitation deficit amount by an irrigation efficiency of 75%, and then applying them to irrigated acreage according to IDWR water right files (Powell, 2009, Figure 13).

Municipal extractions were determined by obtaining records directly from water system managers. Domestic well extractions were not included in the model as Brockway Engineering assumed nearly all water was returned to the aquifer through septic systems.

The transfer well discharge value of 176,000 ft^3/day in Table 1 represents the requested annual volume limitation of 1,476 acre-feet. The maximum diversion rate of 5.56 cfs is 3.52 cfs (304,351 ft^3/day) greater than the average rate based on the annual volume limit (2.04 cfs). Greater drawdown than predicted in the Brockway Engineering analysis could be expected from using the maximum rate of withdrawal instead of the average rate.

Brockway Engineering reports two underflow values, a hand calculated rate and a model calibrated rate, the latter of which is reported in Table 1. The hand calculated external flux, or underflow, was determined using Darcy's law and water table gradients from the 1980 contours published by Newton (1991). Brockway Engineering calculated an underflow rate of 9,224,090 ft^3/day using a gradient of 0.0085, hydraulic conductivity of 12 ft/day, aquifer thickness of 500 ft, and length of 34.31 miles. This value is equivalent to 2,250 acre-ft/yr/mile. The model calibrated underflow was reported as 9,165,000 ft^3/day.

Brockway Engineering compares their hand calculated underflow to previous values of 800 acre-ft/yr/mile and 270 acre-ft/yr/mile calculated by SPF Consulting and IDWR, respectively, for the review of a previous water right application for groundwater development in the area (IDWR, 2009a). Powell (2009) states the underflow value estimated by IDWR is "substantially low when compared to the published aquifer properties" (p. 17). Brockway Engineering's calculated underflow rate exceeds the SPF estimate of 800 af/yr/mile, which was developed by assuming 100% of the difference between precipitation and evapotranspiration is recharge. The IDWR underflow estimate that was developed as part of the evaluation of the Nevid water right application (270 acre-ft/yr/mile) is also based upon water budget calculations that were developed using precipitation data, measurements of surface channel seepage, and estimates of evapotranspiration (IDWR, 2009a, Finding of Fact #23).

Underflow estimates for the various methods using a boundary length of 34.31 miles include:

- Brockway (2,250 af/yr/mile): 9,224,090 ft^3/day (77,290 af/yr or 106.8 cfs)
- SPF (800 af/yr/mile): 3,275,562 ft^3/day (27,448 af/yr or 37.9 cfs)
- IDWR I-84 memo[1] (393 af/yr/mi): 1,598,400 ft^3/day (13,394 af/yr or 18.5 cfs)
- IDWR Nevid (270 af/yr/mile): 1,105,502 ft^3/day (9,263 af/yr or 12.8 cfs)

[1]An underflow estimate of 55.4 cfs for a similar area of interest (subarea 4 of the Newton model) was derived by IDWR in a previous staff memo (IDWR, 2009b) for all three layers of the Newton model. Dividing by three results in an underflow value of 18.5 cfs (1,598,400 ft^3/day) for one layer.

Brockway Engineering's method to calculate underflow using Darcy's law differs from the water balance method used by SPF and IDWR to evaluate water right applications of other area developments (e.g., SPF 2009, IDWR 2009a, and IDWR 2009b). Uncertainty in the input parameters can lead to large variations in Darcy flow calculations (Table 2). The hand calculated hydraulic conductivity used by Brockway Engineering, 12 ft/day, represents an average specific capacity derived from 14 pump tests conducted in the flat-gradient portion of the area; however, the gradient itself appears to be calculated from steep contours at the basin boundary (Powell, 2009, Figure 8). The modeled hydraulic conductivity is 4 ft/day along a portion of the underflow boundary, and 10 ft/day along the remainder of the boundary (Powell, 2009, Figure 14). The use of a higher hydraulic conductivity (12 ft/day) to calculate underflow than was used to represent the aquifer next to the underflow model boundary will increase the underflow estimate. Although data are lacking, consistency in geographic locations should be maintained when calculating flow by using either (a) a gradient from the same flat-gradient portion as the pump tests or (b) using a hydraulic conductivity from the same steep contour area as the gradient.

A sensitivity analysis was performed where underflow was calculated using various hydraulic conductivity values from the Brockway Engineering model and hydraulic gradients from the 1980 water level contour map in Newton (1991). Modeled hydraulic conductivities of 4 ft/day and 10 ft/day at the underflow boundary of the Brockway Engineering model were analyzed along with the reported average of 12 ft/day used to estimate the external flux at the northeast boundary (Powell, p. 16). Gradients used ranged from 0.0085 representative of the steep contour area near the boundary to 0.0025 in the relatively flat portion near the center of the WSRP. Calculated underflow in Table 2 ranged from 223 af/yr/mi to 2,263 af/yr/mi, demonstrating the uncertainty in the estimation of underflow using Darcy's law.

Table 2. Underflow as a function of hydraulic conductivity and gradient. Total area = 34.31 miles * 500 foot aquifer thickness. Model underflow = 9,165,000 ft^3/day (2,238 af/yr/mi - Table 1, Powell, 2009).

Hydraulic Conductivity (ft/day)	Contours Used (ft)	Distance Between Contours (miles)	Gradient (ft/ft)	Darcy Flow (af/yr/mi)	Darcy Flow (ft^3/day)	Difference from Brockway Value (ft^3/day)
12	3300-2850	10	0.0085	2,263	9,263,700	-98,700
12	3200-2500	20	0.0066	1,760	7,205,100	1,959,900
12	2900-2700	15	0.0025	670	2,744,800	6,420,200
10	3300-2850	10	0.0085	1,885	7,719,750	1,445,250
10	3200-2500	20	0.0066	1,466	6,004,250	3,160,750
10	2900-2700	15	0.0025	559	2,287,333	6,877,667
4	3300-2850	10	0.0085	754	3,087,900	6,077,100
4	3200-2500	20	0.0066	587	2,401,700	6,763,300
4	2900-2700	15	0.0025	223	914,933	8,250,067

Technical Review Questions

Responses to each of the four questions posed in the introduction and included in the request for analysis are presented below.

Question 1

- Does the consultant information show an adequate, sustainable ground water supply at the proposed site?

The consultant provides little site-specific data to help evaluate whether the supply at the proposed location is adequate and sustainable. No drilling or aquifer testing was performed as part of this transfer application and the potential hydrologic impacts of nearby faults were not considered in the modeling analysis. Although driller's logs were presented in the modeling report (Powell, 2009, Appendix A), there was little geologic interpretation and no attempt was made to validate the conceptual model of a 500-foot thick aquifer. The modeling report does, however, present a summary table which presents hydraulic conductivity estimates that the consultant developed using specific capacity data from area wells (Powell, 2009, Appendix B).

Conclusions by the consultant about the sustainability of the water resource are instead based on the modeling simulation, the model water budget, and historical water level trends for area wells. As previously expressed, the value of the steady-state model and the significance of conclusions based upon the model water budget are diminished by the fact that the model is predicated on the assumptions that the aquifer system is, and has been, in equilibrium since the calibration dataset was collected in 1980. The equilibrium assumption is contrasted by the statement, "*Steady aquifer declines have been recorded in the Mountain Home area for about 35 years*" (Powell, 2009, p. 6).

The consultant is correct in noting that the proposed POU is in an area of more stable water levels than the current place of use (Powell, 2009, p. 6). Because the steady-state model can't be used to simulate historical water level declines, however, the model cannot be used to help to understand the non-uniform distribution of water level declines. The fact that the model is not capable of simulating historical water level declines that resulted in the creation of the Mountain Home GWMA and Cinder Cone CGWA makes model-based conclusions uncertain.

While the equilibrium assumption decreases the significance of model-based conclusions, modeling is not required to assess regional impacts because the aquifer system already supplies the transfer volume to the current water right. Assuming the water is produced from hydraulically connected portions of the same flow system, there should be no impacts to the overall water budget at a regional scale. Localized impacts are described in our responses to Questions 2 and 3 below.

<u>Question 2</u>

- What impacts would be expected to other wells in the area?

Drawdown impacts were predicted with the Brockway Engineering model assuming a steady rate of extraction equal to the volume limit (1,476 af/yr). A contour map of the pumping-induced drawdown (Figure 18, Powell, 2009) indicates approximately four to five feet of drawdown at a distance of one mile and approximately two feet at a distance of five miles (the map does not have a scale so distances necessarily are approximate).

Based on their steady-state simulation, the consultant concludes "The model results in a maximum aquifer decline of over 11 feet at the proposed diversion." (Powell, 2009, p. 27). Even if the model is representative of the physical system at a regional scale, the prediction of the localized water level impact cannot be taken at face value since an individual model cell is much larger (¼ mile by ¼ mile) than a well and all of the discharge was assumed to be pumped from a single well in the simulation. Using the methodology described in Prickett and Lonnquist (1971, p. 61), the additional drawdown that could be expected at the well is 29.5 feet (assuming a well diameter of 12 inches, pumping rate of 1,476 acre-ft/yr (914 gal/min), saturated aquifer thickness of 500 feet, and a hydraulic conductivity in the vicinity of the well of 12 ft/day).

The total drawdown would be approximately 40 feet (11 feet of modeled drawdown plus 29.5 feet to correct for the model grid) if the well were fully penetrating and 100% efficient. For comparison, the drawdown at the conclusion of a 70-hour aquifer test that was performed on the Dale Payne well was 90 feet after pumping at a constant rate of 1,700 gal/min with a similar hydraulic conductivity estimate (17.6 ft/day) and a somewhat greater saturated interval (770 feet). The model results should not be used alone as an indicator of near-pumping well impacts without acknowledging the impacts of grid cell size.

Since recharge from precipitation is part of the water budget it is assumed the aquifer system was modeled using the unconfined layer option (LAYCON = 1) in Modflow. However, if the confined layer option (LAYCON = 0) was used instead, there would theoretically be more drawdown than was predicted because pumping would cause a decrease in the saturated thickness. This possibility cannot be evaluated because the model documentation does not describe which layer option was selected.

Greater drawdown would be predicted using the maximum diversion rate instead of the volume limit resulting in greater impacts than what is currently reported. Additionally, the model does not simulate the fault zone that Bond (1978) mapped as roughly paralleling Interstate 84. Fault zones potentially serve as partial flow barriers resulting in increased drawdown from pumping and limiting hydraulic communication with the recharge area to the north.

<u>Question 3</u>

- What impacts to Mountain Home Ground Water Management Area and Cinder Cone Critical Ground Water Area would be expected?

After reviewing historical water level declines (Figure 4) and drawdown contours developed by the Brockway Engineering model, IDWR has no reason to disagree with the following statements in the Powell (2009) report:

<u>Mountain Home GWMA</u>

"The proposed transfer will have a positive effect in the Mountain Home groundwater management area near the city of Mountain Home." (p. 29)

"Considering that the proposed transfer involves valid water rights, these water rights currently have impacts on the groundwater management area and the critical groundwater area." (p.25)

"Since the existing water right already has an impact on the groundwater management area and critical ground water area (Figure 19), we are relocating that impact to portions of the critical ground water area that have seen stable or increasing groundwater levels (Figure 6) and reducing the demand in the Mountain Home region where the groundwater elevations have been steadily declining (Figure 4).

Cinder Cone Butte CGWA

"The proposed transfer will also have a negative impact on the Cinder Cone Butte Critical Groundwater Area." (p. 29)

"Groundwater elevations in the vicinity of the proposed point of diversion will be negatively affected by the transfer...Groundwater elevations were shown to decrease within the Cinder Cone Butte Critical Groundwater Area." (p. 25)

The aquifer does supply the annual volume to the current water right, but it is important to note that the current POU is approximately seven miles from the Cinder Cone CGWA while the boundary of the proposed POU is less than a mile from the Cinder Cone CGWA. As noted by Brockway Engineering, water table impacts are being transferred closer to the CGWA. Figures 18 and 19 in the Brockway Engineering model report also suggest a larger and deeper cone of depression resulting from the proposed transfer when compared to the current cone of depression.

Large differences in groundwater level trends exist between the locations of the current and proposed POU (Figure 4). As Brockway Engineering states, "The groundwater elevations near the northwest portion of the Cinder Cone Butte Critical Groundwater Area have been experiencing a slight increase in elevation over the last few years, while the area near the southeastern portion of the critical groundwater area have seen steady declines" (Powell, 2009, p. 25). The extent to which stable or increasing trends in the vicinity of the proposed PODs could offset any pumping effects is unknown.

The source for differing trends is also currently unknown. Irrigation development near Simco Road in the southwestern portion of the CGWA is potentially a major contributor to water level trends in the area; however, northwest-trending faults mapped in the area (Bond, 1978) may serve as partial barriers to flow and contribute to the difference in trends between wells north/northeast of I-84 and those south/southwest of I-84. Faults that serve as flow barriers would be expected to cause greater drawdown than predicted by the consultant model near and within the CGWA as the result of pumping.

Question 4

- How does consultant information fit with other information previously provided to and analyzed by IDWR for the general area in question?

Data utilized to construct the Brockway Engineering model is generally consistent with information used or received by IDWR in recent hydrologic reports, with the exception of underflow. Information available from IDWR used in the model and previous reports includes: precipitation, irrigation, groundwater extraction, water levels, and well driller reports. Other methodologies implemented by Brockway Engineering that have been used by IDWR and others include the use of a published USGS WSRP model (Newton, 1991) and average annual ET values taken directly from ET Idaho (Allen, 2009).

Brockway Engineering's method to calculate underflow using Darcy's Law differs from the IDWR and SPF water balance methods used in the Nevid case, and the proportional method used in an IDWR staff memo of dividing USGS underflow equally across constant flux cells (IDWR, 2009b). Underflow rates calculated per method include:

- Brockway (IWC - Darcy): 2,250 af/yr/mi
- SPF (Nevid - Water balance): 800 af/yr/mi
- IDWR (I-84 memo - Proportional): 393 af/yr/mi
- IDWR (Nevid - Water balance): 270 af/yr/mi

A lack of data in the area has lead to a high degree of uncertainty in underflow estimation and values above vary by an order of magnitude. Because the modeling report author states that "the most sensitive input to the model was the aquifer underflow" (Powell, 2009, p. 31), high uncertainty in the underflow estimate makes model-derived predictions tenuous. Unfortunately, the modeling report does not provide documentation of the sensitivity of model predictions to variations in the rate of underflow.

Based on our review, data for quantifying underflow into the WSRP Aquifer with confidence are still lacking. A report documenting a model of groundwater flow in the Treasure Valley, for example, concludes "*The rate and spatial and vertical distribution of underflow into the valley and into the model domain is highly uncertain*" (Petrich, 2004, p. 107).

We agree with the consultant's determination that "significant data deficiencies remain and it is recommended that a data collection effort be immediately instigated by the State of Idaho to improve accuracy of the model inputs and provide a better basis for model calibration" (Powell, 2009, p. 30). A hydrogeologic characterization project is currently underway for East Ada County as part of the Treasure Valley CAMP. A future study of the Mountain Home Plateau was also proposed as part of the CAMP but the project is contingent on reinstatement of project funding by the legislature.

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Attachment

February 18, 2010, IDWR Memo
from A. Wylie to C. Tesch

MEMO

State of Idaho
Department of Water Resources
322 E Front Street, P.O. Box 83720, Boise, Idaho 83720-0098
Phone: (208) 287-4800 Fax: (208) 287-6700

Date:	18 February 2010
To:	Craig Tesch
From:	Allan Wylie AW
cc:	Rick Raymondi, Sean Vincent
Subject:	Review of Shekinah Model

Craig

For the most part, the model was constructed reasonably given the available data; however, given the limited data, model predictive uncertainty (i.e. the ability to match the same filed observations with another model equally as well and get significantly different predictions) is likely quite high. Generally the better constrained the water budget, the lower the predictive uncertainty. The unfortunate truth here is that there are no constraints on underflow and as a result, no constraints on the total water budget. This means that one could change underflow and flux from the constant head boundaries and probably still calibrate the model, and these changes would probably affect the predicted impact of the transfer.

Please find my detailed comments below.

Pg 11 D.3. – Time domain definition: Steady state model; translation - not enough information, or budget, or both to do a transient model. With an acknowledged declining water table, I think it is hard to justify a steady state model. This assumption has the potential to impact the prediction.

Pg 12 D.5.1 – "Almost no data were available on the amount of underflow into the model domain (Newton, 1991)." Brockway Eng. calculated underflow using Darcy's law. Although probably the only option available, this results in a highly uncertain estimate.

Pg 12 D.5.2 – Specified head boundaries converted to specified flux. This is better than keeping the specified head boundaries, but it essentially means that the flux from these boundaries is a calibration parameter, probably with no constraints. The result is that predictive uncertainty will be high.

Pg 15 E.4. – Why estimate storativity for a steady state model?

Pg 15 E.5. – Why use the contours as calibration targets, why not use the observed heads?

Pg 17 G. Figure 11 arrow on right side of the figure should be "Inflow".

Pg 20 H. Model calibration: I am not buying that assuming steady state when you have an acknowledged declining water table and calibrating to a 1980 contour map is "most defensible". If the water table is continuing to decline, actual steady state heads will be lower, perhaps much lower, than the 1980 observations.

Pg 21 H.2. Model Calibration – Underflow: It appears that underflow along the northeast boundary is a calibration parameter, not a calibration target, further demonstrating that the water budget is not well constrained, and that predictive uncertainty is high.

Pg 23-30 I. Model Evaluation of Shekinah Industries Transfer: They predict head impacts from the transfer. This model will tend to under predict local impacts from pumping because 1) MODFLOW does not account for well efficiency, 2) although the GUI may allow the user to input the well diameter, the actual math in MODFLOW will show that in the model the well is the same size as the cell it is in, thus, in this case the well is 1320' X 1320' X 500'. 3) the model is steady state and during the irrigation season declines will be more than predicted and conversely, less during the non-irrigation season.

Allan Wylie