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WORK EXPERIENCE:

Civil Engineer

Date Employed: 10/2001-Present

Civil Engineer

Program and project management including project feasibility, planning, and implementation. Program oversight of facilities, wastewater systems, water systems, and dams. Work includes oversight of approximately 50 water systems including approximately 20 public water systems. Proficient in preparation of drawings and specifications for solicitation documents. I have been involved in directing and overseeing well yield testing and construction of approximately 10 new wells.

EDUCATION:

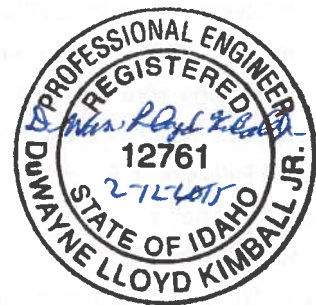
University of Idaho
Moscow, ID 83844
B.S., 1998
134 credit hours
Major: Agricultural Engineering
GPA: 3.96 out of 4.00
Honors: Summa cum laude

Castleford High School
Castleford, ID 83321
1994 graduate
GPA: 3.97 out of 4.00
Honors: Valedictorian

JOB-RELATED CERTIFICATES AND LICENSES:

Licensed as a Professional Engineer (PE) 12761
Licensed as a Certified Energy Manager (CEM) 20048
Licensed as a Water Operator DWDVSW-10911
Licensed as a Wastewater Operator WWC1-14128

Water Budget



By: DuWayne Kimball
Date: January 26, 2015

I was asked to provide an opinion on the effects to the aquifer in the vicinity of the transfer's proposed point of diversions from a water budget perspective. The starting point for this analysis is the Research Technical Completion Report titled *Geohydrology and Development of a Steady State Ground-Water Model for the Twin Falls, Idaho Area* from the Idaho Water Resources Research Institute in December of 1997. The water budget is developed in chapter 3 of this report with a study area water budget found in Table 1 and a groundwater budget found in table 5. The study area for this report goes from Murtaugh to Buhl and is depicted in Figure 1 of the report.

A water budget is an area that is defined by a set boundary and one balances the water coming in and out of the boundary. Sometimes this a bathtub or bucket analogy is used to describe this. One can set the boundaries to include all water (surface and groundwater) or set the boundaries to just include surface or groundwater.

The first analysis was to attempt to replicate the total (surface and groundwater) water budget found in Table 1. The report was replicated with the exception that there appears to be a small addition error in the original report where the Salmon Falls Creek inflow of 5,800 acre-feet per year was not included into the total inflow into the unit. This 1997 report is the basis for the other assumptions that will be made to show different scenarios that may occur in the future. In my opinion the 1997 report appears to make logical assumptions from the data that is available and is a good starting point for a water budget for the area. It is possible that there have been more recent attempts on a water balance for the area but a quick internet search did not indicate more recent information. I initially looked at the total water budget with two assumptions being no irrigation and 100% high efficiency sprinkler conversion, and then at the groundwater budget with no irrigation and 100% high efficiency sprinkler conversion.

No Irrigation Scenario for Water Budget

The first scenario (second column in water budget table) is if irrigation ceased on the Twin Falls and Salmon Falls tracts. The scenario assumes the Twin Falls and Salmon Falls tract irrigation go to zero acre-feet in the water budget. This causes a reduction of the existing 1,631,800 acre feet of inflow to 510,800 acre-feet of inflow in the water balance. This scenario assumes that Murtaugh Lake and Salmons Falls Creek Reservoir would both exist in their current form. If either were to be removed the underflow inflows from Murtaugh Area and Salmon Falls would both be less. The assumptions on the outflow include irrigation returns going to zero acre feet and the evapotranspiration (ET) rate being the same as the precipitation in the study of 307,000 acre feet. One of the assumptions in the initial 1997 report was that in non-irrigated areas evapotranspiration equals precipitation. This scenario is also similar to a case where agricultural land is converted to urban development but this report will not investigate further.

The scenario effects on the water budget are quite drastic. A negative number is not possible for spring returns to the Snake River but will leave that number in the table because it is easy to see the end effects. One possible scenario is the 312,200 acre-feet of un-measured surface and sub-surface flow goes to zero. Most of this quantity appears to return to the Snake River which means this water would

not be available and is not too big of a deal unless the water has been appropriated further downstream. The assumption of no spring return to the Snake River still does not balance the water budget though as it is still 266,800 acre feet to the negative side. One way this could be balanced is to dry up Rock Creek, Salmons Falls Creek, and half of Deep Creek exit flows. The effects likely would not be that these creeks would completely dry up but is a more visual representation of the quantity of water. In short, the water balance in this scenario is a reduction of 579,000 acre feet per year and if annualized to an even flow basis of 800 cfs. The 800 cfs is approximately 20% of the Swan Falls agreement minimum flow of 3,900 cfs. It is important to note that much of the above discussion is meant as an attempt to quantify the amount of water. The tributaries in the study area to the Snake River would likely see flow reductions but the total amount of water to the Snake River would increase significantly as the water would not be removed from the Snake River for irrigation.

Conversion to 100% High Efficiency Sprinkler Pivot Irrigation for Water Budget

I would like to first discuss the probability of the scenario. Over the last 10 years there has been a significant movement of agricultural producers converting from more labor intensive irrigation such as furrow irrigation, wheel lines, and movable handlines to less labor intensive irrigation methods such as center pivots and solid set handlines. Some farmers have chosen not to irrigate pivot corners. The irrigation improvements are significant capital expenditures and higher crop prices the last five or so years have provided the capital for these improvements. It is unknown going forward if the conversion will continue at the same rate or at a lesser or greater degree. The variables affecting implementation likely being crop prices, production costs, and the cost of electricity which is used to power the pivots.

The second scenario (third column in water budget table) is if irrigation is converted 100% to pivot irrigation with solid set handlines in the pivot corners. The existing irrigation efficiency in the reports can be estimated to be $741,000 \text{ (ET)} / (307,000 \text{ precipitation} + 1,090,000) = 53\%$. This would be a reasonable number for predominantly furrow irrigation. In the case of center pivot irrigation the efficiency could reach 85% but will need to include a 10% seepage loss by canals so assume a maximum efficiency of 75%. This equates to $741,000 \text{ (ET)} / (307,000 \text{ precipitation} + x) = 75\%$ where x is 681,000 acre feet. The Salmon Falls irrigation component is so small that it will be ignored. The difference to the study area is 409,000 acre feet per year.

No Irrigation Scenario for Groundwater Budget

Initially the groundwater budget in Table 5 of the 1997 report was replicated after which the assumed scenario (second column in the spreadsheet) of no irrigation diversions, surface returns, and canal seepage equated to a reduction of 489,000 acre-feet. The effect to the aquifer would likely be reduced to possibly eliminated spring flow to the Snake River and the tributaries to the Snake River listed in the water budget. There would also be water level reductions in the aquifer until the aquifer stabilized at a new equilibrium where spring discharges equal the underflow entering the study area.

Conversion to 100% High-Efficiency Sprinkler Irrigation Groundwater Budget

The third column in the groundwater budget spreadsheet uses the same assumption in the initial report that canal seepage is 10% of the diversion amount and an assumption was made that increased efficiency reduced the surface returns to 50% of the 1997 report conditions. These assumptions equate to 98,000/acre-feet per year reduction to the Snake River which is not possible so it likely means reduced discharges to the tributaries in the study area and reduction in groundwater elevation levels.

Conclusion

As farmers convert to higher efficiency sprinkler irrigation systems, there will be reduced discharges to the Snake River and the tributaries to the Snake River listed in the study area. There will also be increasing depths to groundwater until aquifer stabilization occurs. I will not attempt to estimate what the groundwater elevational changes but the 1997's report figure 16 estimates a groundwater elevational drop of 65 feet with an 80% conversion to sprinkler irrigation in the approximate area of the proposed transfer point of diversion. The prediction of the proposed transfer's impacts to neighboring wells is difficult in a steady state aquifer condition but is even more difficult to predict in a changing aquifer.


DuWayne Kimball, PE

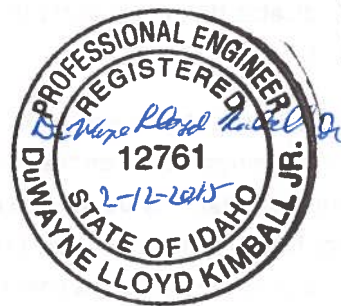
Water Budget

Inflow			Brockway Report Rate Acre-ft/yr	No Irrigation Acre-ft/yr	Conversion To Sprinkler Acre-ft/yr
		Municipal water imported from Blue Lakes	9,000	9,000	9,000
		Precipitation	307,000	307,000	307,000
	Creek Inflows				
		Dry Creek	2,800	2,800	2,800
		Rock Creek	25,000	25,000	25,000
		Epheremal Stream	10,200	10,200	10,200
		Salmon Falls Creek	5,800	5,800	5,800
	Underflow				
		Rock Creek/Dry Creek	21,000	21,000	21,000
		Salmon Falls	115,000	115,000	115,000
		Murtaugh Area	15,000	15,000	15,000
	Irrigation				
		Twin Falls Canal Diversion	1,090,000		681,000
		Salmon Falls Irrigation	31,000		31,000
		TOTAL	1,631,800	510,800	1,222,800
Outflow					
	Creek Outflows				
		Salmon Falls	103,500	103,500	103,500
		Deep	46,000	46,000	46,000
		Mud	62,000	62,000	62,000
		Cedar Draw	69,000	69,000	69,000
		Rock	139,000	139,000	139,000
	Pumpage to West of Study Area				
		Salmon Falls Creek Consumption	44,100	44,100	44,100
	Irrigation Returns to Snake River				
		Measured Drains	70,000	0	70,000
		Estimated Drains	38,000	0	38,000
		Sewage Treatment Outflow	7,000	7,000	7,000
	Evapotranspiration				
		ET	741,000	307,000	741,000
		TOTAL	1,319,600	777,600	1,319,600
	Un-measured surface and sub-surface outflow		312,200	-266,800	-96,800

Groundwater Budget

Inflow			Brockway Report Rate Acre-ft/yr	No Irrigation Acre-ft/yr	Conversion To Sprinkler Acre-ft/yr
	Areally Distributed Recharge				
		Precipitation	307,000	307,000	307,000
		Irrigation Diversions- Canal Seepage	982,000	0	581,000
		ET	-741,000	-307,000	-741,000
		Surface Returns	-168,000	0	-84,000
	Canal Seepage				
		Canal Seepage	109,000	0	68,000
	Underflow				
		Rock Creek/Dry Creek	21,000	21,000	21,000
		Salmon Falls	115,000	115,000	115,000
		Murtaugh Area	15,000	15,000	15,000
		TOTAL	640,000	151,000	282,000
Outflow					
	Springs/Drains				
		SF Creek	102,000	102,000	102,000
		Rock Creek	96,000	96,000	96,000
		Cedar Draw	55,000	55,000	55,000
		Mud Creek	59,000	59,000	59,000
		Deep Creek	42,000	42,000	42,000
		Snake Measured	26,000	26,000	26,000
	Estimated Springs Snake River				
		Snake River (Est.)	260,000	-229,000	-98,000

Groundwater Flow Direction for Originating Point
of Diversion in Township 16S, Range 16E, Section 20.



By: DuWayne Kimball
Date: January 26, 2015

Groundwater flow direction maps are often developed through the use of spring locations, surface water stream gages, existing wells, and at times the addition of monitoring wells. In almost all cases assumptions are made as there are not enough data points to fully describe all conditions. There are more costly and time extensive methods and equipment that may be used to further clarify groundwater flow directions and these may include such methods as tracer dye tests, water chemistry analysis, and geo seismic reflection surveys. Prior to initiating a groundwater flow direction model one should perform research to see if existing models may have already been developed describing the aquifer characteristics.

I have been asked to provide a professional opinion on the groundwater flow direction for the originating transfer application point of diversion in Township 16S, Range 16E, Section 20 NWSWSW quarter/quarter/quarter, or in other terms a location approximately 14.5 miles south and 1 mile west of Rogerson, Idaho, or in other terms a location approximately 1.5 miles north of the Idaho/Nevada border.

The first step taken was to perform a review of previous aquifer information. The city of Jackpot's wellhead protection plan was obtained in an attempt to see if they have done some groundwater modeling. They have performed modeling but it appears the cone of depression generated by the water withdrawal creates a groundwater depression in the area as their model shows water coming from the north, south, east, and west. The other source that was investigated was the Water Resources – Reconnaissance Series Report 48 titled *Water-Resource Appraisal of the Snake River Basin in Nevada* published in July 1968 by the Geological Survey and the Department of Interior. This report states the following on page 23 of the document:

“Ground water commonly is at or near land surface in the axes of the valleys along the flood plains of the principal streams. The water table slopes upward toward the adjacent mountains but ordinarily with a somewhat lower gradient than the overlying land surface.”

This indicates that in general the groundwater will have a tendency to follow the gradient of the land surface.

The second step taken was to look at the data available near the point of diversion. The data available includes springs shown on the topographic map, springs indicated by the surface water rights, and well information that may be used to estimate the groundwater flow direction. The presence of multiple springs in the area in the Mule Creek hydrologic drainage as well as neighboring drainages to Mule Creek indicate that the geology is conducive to transporting water from the north to the south. The well logs show the groundwater elevations lower to the south than the north indicating a hydraulic gradient in the same direction. One should note that there are not a lot of data points in the drainage (two wells) but the determination is based on the best available data present. The water elevations are taken by using the well locations in the Idaho Department of Water Resources (IDWR) interactive mapping site, taking the static water level indicated on the well logs, and then acquiring elevation information from Google Earth. It should be noted that the IDWR well locations are often the center of quarter quarters

which means the well is likely in the same quarter quarter but may not be at the exact location shown on the map. The large differences in groundwater elevation differences override any errors due to small elevation differences in a respective quarter quarter. Please see attached map showing the calculated well and spring locations.

It is interesting to note that the north well indicates a confined aquifer or artesian well as the water level in the well is higher than the water level that was first encountered in the drilling operations. The south well appears to be an unconfined aquifer. It is also interesting to note that the water was initially encountered for both wells at the interface between the above clay layer and the below sandstone layer.

With the information that is present it is my professional opinion that there is a very high likelihood that the groundwater at the transfer's existing point of diversion travels from the north to the south and into the State of Nevada. This then presents a legal discussion on whether the State of Idaho has control over that water until, which time, it may make its way back into the State of Idaho.



DuWayne Kimball, P.E.

POD - Water Rights ☐ PLS - Section ☐

Counties

PLS - Township/Range

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1.63.143

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