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Department of Water Resources
Southern Region

September 7, 2004

Shelley Keen
Idaho Department of Water Resources
1301 North Orchard Street
Boise, ID 83706

Subject: Blaine County School District No. 61; Application for Permit/Woodside Elementary School (37-21177)

Dear Shelley:

Speck and Aanestad, PC (Ketchum, Idaho) have submitted an *Application for Permit* (37-21177) to appropriate water at the Woodside Elementary School on behalf of the Blaine County School District No. 61. The application requested an irrigation flow rate of 0.14 cfs from a ground water source for the irrigation of 7 acres. A mitigation plan was proposed to offset potential impacts on downstream water users from the proposed Woodside School withdrawals. A letter from James Stanton of the IDWR Southern Region office (dated July 15, 2004) indicated that the mitigation plan submitted for the Application for Permit was found to be unacceptable. The letter stated that "because river water could simply be used by other irrigators if left in the river, the plan does not protect water users near the proposed well from being negatively impacted by the new appropriation". This letter addresses concerns raised in the July 15, 2004 letter regarding the proposed mitigation plan.

The proposed plan for mitigating ground water production at the Woodside School well consists of leaving a portion of Big Wood River water right 37-21114 (currently diverted via the Hiawatha Canal) undiverted in the Big Wood River. We believe that this plan is appropriate because (1) the proposed mitigation plan contributes to channel water levels, thereby protecting downgradient and downstream ground and surface water users from any impacts caused by the proposed Woodside School ground water withdrawals, (2) it is unlikely that increased flows would be diverted by other users upstream of Bellevue, (3) drawdown in the vicinity of the proposed well will be minimal, (4) effects of proposed withdrawals on downgradient ground water users (e.g., in the Bellevue area) would be minimal (if any), and (5) alternative mitigation closer to the school site does not appear to be available.

1. Contribution to Big Wood River Channel

The purpose of the proposed mitigation for Woodside School withdrawals is to protect potential impacts to water users in the lower Wood River reaches. This is consistent with the goals of the Big Wood River Ground Water Management Area (BWRGWM). The BWRGWM was created in 1991 in response to the recognition that (1) surface and ground water in the Big Wood River drainage are interconnected, (2) "new ground water uses can deplete available supplies for other users and affect basin underflow which presently accumulates in the Magic Reservoir," and (3) injury could occur to prior surface and ground water rights including the storage right in Magic Reservoir if the flows of

streams, rivers, and ground water underflow in the Big Wood River Basin are intercepted by junior priority ground water diversions" (IDWR, 1991). The area was designated after "IDWR determined that junior ground water diversions were depleting senior surface water flows in the Big Wood River and Silver Creek" (Harrington and Bendixsen, 1999). The proposed mitigation plan for Application 37-21177 leaves an amount of water greater than the proposed Woodside School withdrawals in the Big Wood River to protect downstream senior surface water users.

2. Potential Diversion of Mitigation Water

There may also be a concern that mitigation water (i.e., 0.18 cfs from Snake River Basin Adjudication Claim 37-21114) left in the Big Wood River could be diverted by other users upstream of the Woodside School. The number of water rights allowing diversion of ground water from the Big Wood River between the Hiawatha Canal diversion and Bellevue (Figure 1) are listed in Table 1. A large portion of the water being diverted in Section 20of T3N R18E is probably diverted via the Hiawatha Canal.

It is our understanding that diversions from the Big Wood River are currently monitored by the local watermaster (Kevin Lakey), and that water is diverted on the basis of priority date based on flow at the Hailey gage. Mitigation water left in the Big Wood River would not result in increases in diversions by other users because diversions would still be allocated on the basis of available natural flow in the Big Wood River. Furthermore, withdrawals from the Woodside School would occur only at those times when water is available to fill the Snake River Basin Adjudication Claim 37-21114 (a portion of right 37-577), further protecting existing users.

One way in which other senior (and/or junior users) could possibly divert additional water resulting from the undiverted mitigation water is if the Big Wood River ran dry in the Hailey-Bellevue reach. However, the river does not run dry, as indicated by hydrographs for low-water years using Hailey gage data (Figure 2). Thus, pumping at the Woodside School would result in a depletion to river flow in the Hailey to Bellevue Reach, but those depletions would be fully mitigated by the 0.18 cfs portion of water right 37-21114 that would flow past the Hailey gage.

3. Drawdown and Effect of Drawdown in the Vicinity of the proposed well

Drawdown associated with pumping from the proposed Woodside School Well is expected to have a minimal effect on local ground water levels. This is demonstrated with two calculations using analytical solutions to ground water flow equations.

Numerous analytical solutions have been developed to estimate drawdown from a well. All of these solutions have limitations and assumptions that are frequently not met in actual conditions. Nonetheless, analytical solutions can yield approximate solutions for drawdown estimates. Two analytical solutions were used to estimate aquifer drawdown at a point ¼ mile from the proposed well following 197 days (e.g., from April 1 to October 15) of continuous pumping at the maximum requested diversion rate.

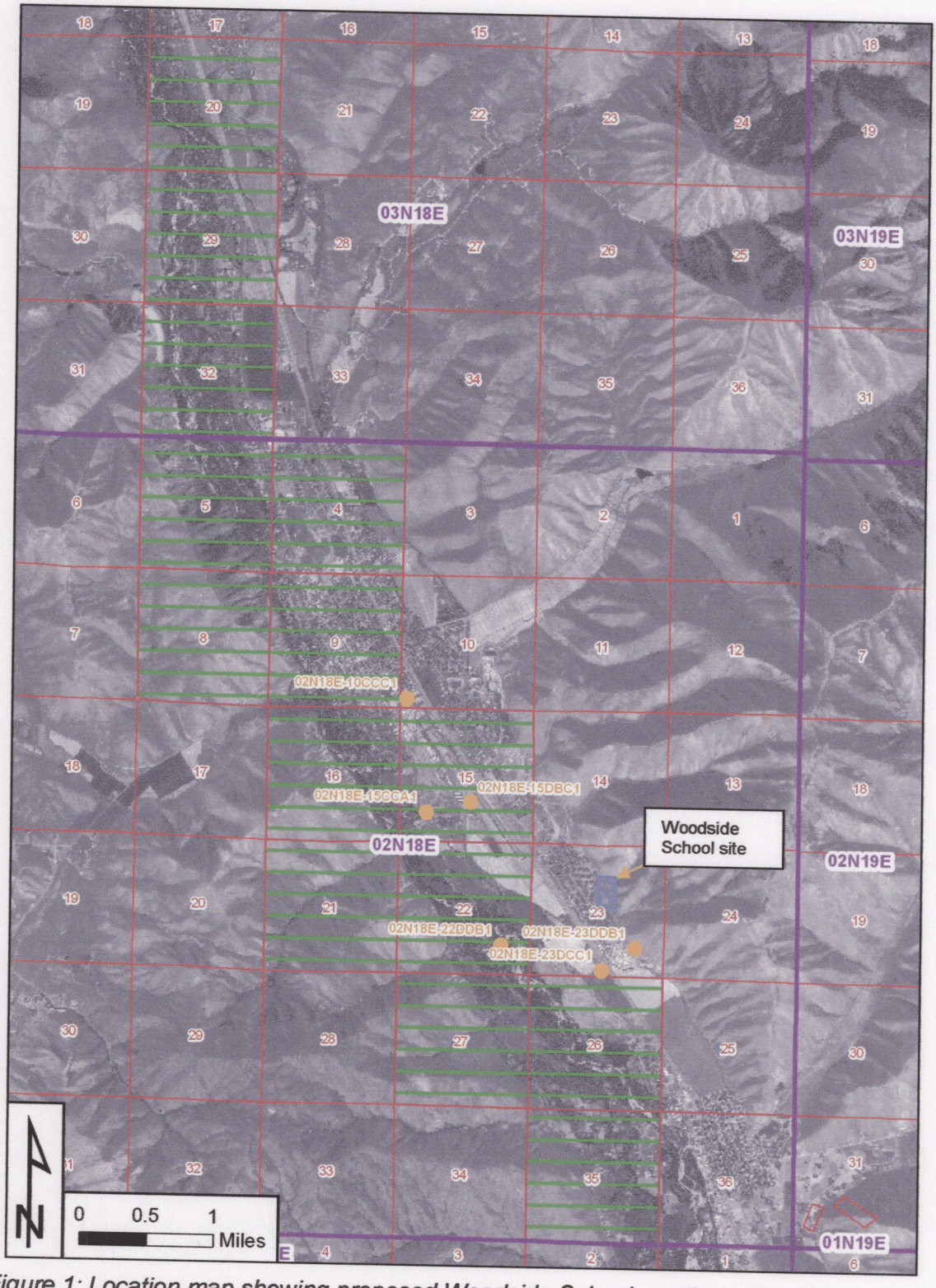


Figure 1: Location map showing proposed Woodside School, section referred to in Table 1, and hydrograph wells.

Location	No. of Surface Water Rights	Total Diversions (cfs)	Number of Water Rights Senior to March 24, 1883	Total Diversions under Senior Rights (cfs)	Remarks
T3N R18E 20	124	112.591	5	4.098	(A large portion of these rights are probably diverted via the Hiawatha Canal)
T3N R18E 29	16	11.16	2	3.76	
T3N R18E 32	8	18.53			
T2N R18E 4	0	0			Only ground water rights found
T2N R18E 5	9	11.34			
T2N R18E 8	0	0			No rights found
T2N R18E 9	1	2			
T2N R18E 15	0	0			Only ground water and spring rights found
T2N R18E 16	31	36.32	2	3.32	
T2N R18E 21	0	0			Only spring right found
T2N R18E 22	21	41.616	3	3.40	
T2N R18E 26	13	5.88	1	0.02	
T2N R18E 27	2	3.87	1	0.38	
T2N R18E 35	37	19.52	6	7.25	
Total	**262**	**262.827**	**20**	**22.228**	

Table 1: Number of surface water rights in sections between (and including) the Hiawatha Canal diversion and Bellevue.

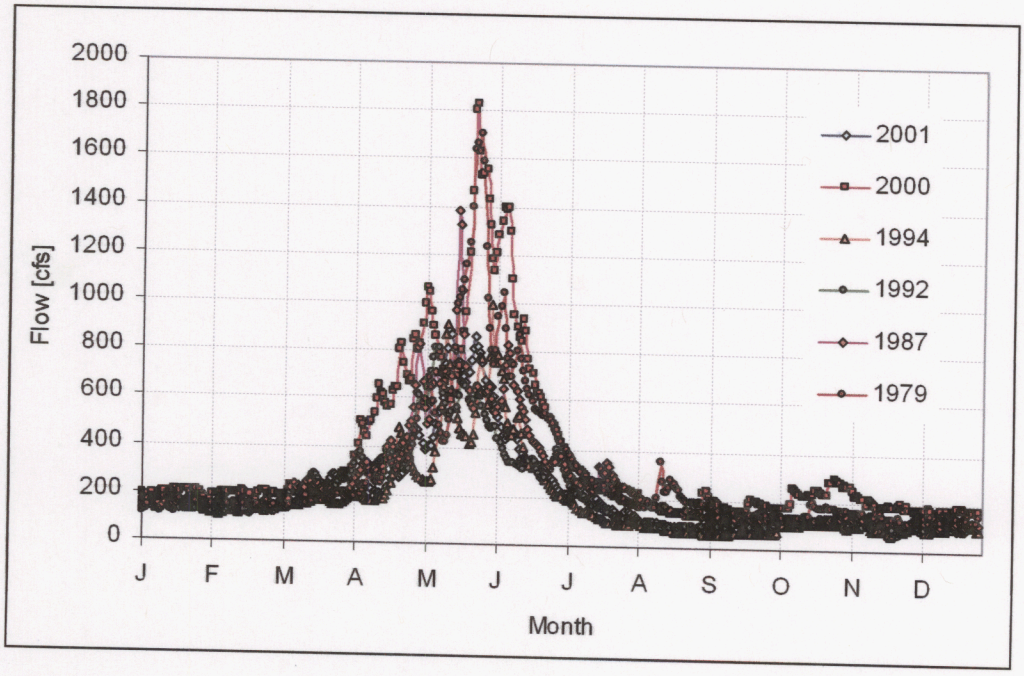


Figure 2: Big Wood hydrographs for low flow years (Hailey gage).

First, a Theis analysis was conducted to determine potential drawdown in the vicinity of the proposed Woodside School well. The solution to an equation for radial flow to a well (Theis, 1935) can be given by

$$s = \frac{Q}{4\pi T} W(u)$$

where s is drawdown, Q is discharge rate, T is transmissivity, and $W(u)$ is the well function defined as

$$W(u) = \int_u^\infty \left(\frac{e^{-u}}{u} \right) du \qquad u = \frac{r^2 S}{4Tt}$$

and where r is the radial distance from the pumping well to an observation well, S is aquifer storativity, and t is time. Values of W(u) are tabulated in Dawson and Istok (1991).

This analysis is appropriate for homogeneous aquifers bounded from above and below by aquicludes, layers are horizontal and of infinite areal extent, the pre-pumping piezometric surface is horizontal and extends infinitely in a radial direction, and the aquifer is homogeneous and isotropic. The aquifer underlying the Woodside School is almost certainly heterogeneous on a small scale, but might be considered as homogenous on a larger scale. The aquifer is probably unconfined or partially confined. The Theis solution is appropriate for use in unconfined aquifers if the drawdown values are small relative to aquifer thickness. In addition, the Theis solution is based on the assumption of infinite areal aquifer extent. However, the well is located near the alluvial basin margins, which probably represents a negative hydrologic boundary. Effective flow to the well would occur from approximately one half of the normal well radius. Estimated drawdown values using the Theis equation were therefore doubled to account for the reduced radial flow area.

Hydraulic conductivity of aquifer sediments at the proposed well site have not been measured. Aquifer materials in the vicinity of the Woodside School consist of unconsolidated, coarse-grained, highly permeable fluvioglacial, alluvial, and colluvial sediments (please see our letter to James Stanton, May 8, 2004). Frenzel (1989) estimated hydraulic conductivity values for this general area ranging from 150 ft/day to 300 ft/day. Moreland (1977) reported transmissivity estimates in the range of 30,000 to 70,000 ft^2/day near Bellevue based on specific capacity data, or 200 to 470 ft/day (Frenzel, 1989). In this analysis we assumed a hydraulic conductivity value of 200 ft/day, an aquifer thickness of 200 feet (yielding a transmissivity value of 40,000 ft^2/day), and a flow rate of 12,096 ft^3/day (based on a requested diversion rate of 0.14 cfs in the Application for Permit). Using these parameter values, the estimated drawdown at 1,320 feet (¼ mile) from the proposed well would be approximately 0.10 feet after 197 days of continuous pumping. Doubling the drawdown estimate to account for a 50% reduction in hydraulic radius (because of negative boundary effects) would yield a drawdown estimate of 0.20 feet ¼ mile from the pumping well after 197 days of pumping.

A second estimate was made using the Neuman solution (Neuman, 1972; Neuman, 1974; Neuman, 1975; Neuman, 1987) to radial flow to a well in an unconfined aquifer (as presented in Fetter, 1994). Radial flow is described by

$$Kr\frac{\partial^2 h}{\partial r^2}+\frac{K_r\partial h}{r\partial r}+K_v\frac{\partial^2 h}{\partial z^2}=S_s\frac{\partial h}{\partial t}$$

where h is the saturated thickness of the aquifer, r is the radial distance from the pumping well, z is the elevation above the base of the aquifer, S_s is the specific storage, K_r is the radial hydraulic conductivity, K_v is vertical hydraulic conductivity, and t is time. Neuman's solution is

$$h_0 - h = \frac{Q}{4\pi T}W(u_A, u_B, \Gamma)$$

where

$$u_A = \frac{r^2 S}{4Tt} \text{ (for early drawdown data)}$$

$$u_B = \frac{r^2 S_y}{4Tt} \text{ (for late drawdown data)}$$

$$\Gamma = \frac{r^2 K_v}{b^2 K_h}$$

and where $(h_0 - h)$ is the drawdown, Q is the pumping rate, T is the transmissivity, r is the radial distance from the pumping well, S is storativity, S_y is the specific yield, t is the time, K_h is the horizontal hydraulic conductivity, K_v is the vertical hydraulic conductivity, and b is the saturated thickness of the aquifer. Values of $W(u_A, u_B, \Gamma)$ are tabulated in Fetter (1994).

This solution is appropriate for unconfined, homogeneous aquifers in which the vadose zone has no influence on drawdown, initial withdrawals come from instantaneous release of water from elastic storage, long-term drawdown comes from gravity drainage from interconnected pores, the drawdown is negligible compared to elastic storativity, and the specific yield is at least 10 times the elastic storativity. Again, these assumptions are not met entirely, rendering the drawdown estimate an approximation.

In this case the same aquifer parameter values were assumed as for the Theis solution above, and lacking information to the contrary, it was assumed that K_v was the same as K_h. Drawdown after one year at a distance of ¼ mile from the pumping well was estimated to be approximately 0.22 feet (this estimate is double the calculated estimate to account for radial flow from approximately ½ of the full well radius).

Both calculations using the Theis and Neuman solutions yielded very approximate but nearly identical drawdown estimates for the aquifer underlying the Woodside School. The calculations do not account for recharge or stream-aquifer interaction, which would substantially reduce the amount of estimated local drawdown. As such, the very low estimated drawdown values suggest minimal (if any) impacts to other well users in the vicinity of the Woodside School.

The Permit to Appropriate Water for the Woodside School well would have a current priority date, even though the mitigation for downstream users would have an 1883 priority date. Thus, any injury associated with local well interference caused by

withdrawals from the Woodside School well could result in curtailment of Woodside School well withdrawals.

We are unaware of any broad, long-term water level declines in the area between Hailey and Bellevue. IDWR maintains water level data for selected wells in the Wood River Basin in the Well_Log database. Data from wells in the general vicinity of the Woodside School were provided by Shane Bendixsen (IDWR). Wells for which there were two or more water levels spread over a multi-year timeframe and which included data more recent than the mid 1980's are shown in Figure 1. No recent data were available for any of the wells, and no data were available for wells between Hailey and Bellevue. However, the hydrographs that were available (Figure 3) show variation from year to year (which reflects pumping levels in some of the wells), but do not appear to indicate broad long-term downward or upward trends. Thus, there is no indication that any water level trends in the vicinity of Woodside School would be exacerbated by withdrawals from the proposed school well.

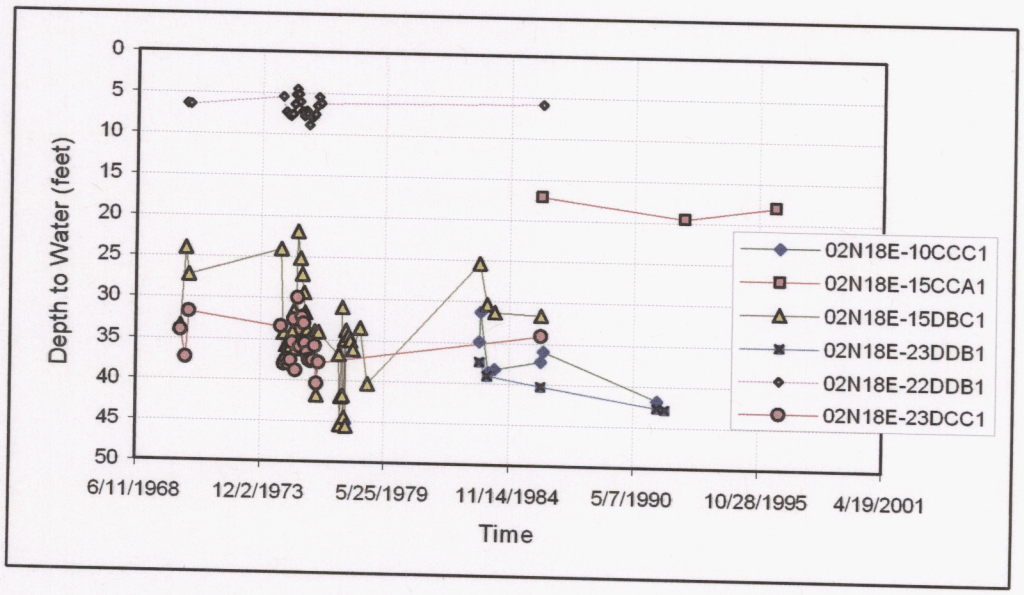


Figure 3: Hydrographs from selected wells in vicinity of Woodside School (see text).

4. Impact on Ground Water Users Downgradient of Proposed Well

Ground water flow during most of the year is likely in a down-valley direction with some component of flow toward the river. To the extent that ground water flow is down-valley, ground water flowlines likely extend from the Woodside School area in a southwesterly direction toward Bellevue. One concern that has been expressed regarding the proposed Application for Permit is that increased ground water withdrawals could impact ground water users downgradient of the proposed well (e.g., in the Bellevue area).

DIVER	R	OWNER	PRIOR	CFS	ABOVE	BELOW	TRIB	MITIG	TOTAL	NEW TOT
6	D	LOSS TO SYSTEM	01 / 01 / 1880	10.00	10.00			0.00	10.00	10.00
12	E	KATHLEEN ROSEKRANS	04 / 01 / 1880	10.00		10.00			20.00	20.00
3	D	RALPH GIRTON	07 / 01 / 1880	10.00	20.00			0.00	30.00	30.00
8	E	ECCLE'S WINDOW ROCK RANCH LLC	10 / 01 / 1880	10.00		20.00		0.00	40.00	40.00
2	D	ROBERT GARDNER	01 / 01 / 1885	10.00	30.00			10.00	50.00	60.00
5	D	E HADLEY STUART	04 / 01 / 1885	10.00	40.00			10.00	60.00	70.00
9	E	SUN VALLEY INC	07 / 01 / 1885	10.00		30.00		10.00	70.00	80.00
11	E	E HADLEY STUART	10 / 01 / 1885	10.00		40.00		0.00	80.00	80.00
1	D	SUN VALLEY INC	01 / 01 / 1890	10.00	50.00				90.00	90.00
4	D	MYER BERLOW	04 / 01 / 1890	10.00	60.00			10.00	100.00	110.00
10	E	VALLEY CLUB INC	07 / 01 / 1890	10.00		50.00		10.00	110.00	120.00
14	E	ROBERT W. PULLEN	10 / 01 / 1890	10.00		60.00			120.00	120.00
0	F	JOHN MCGONIGAL	01 / 01 / 1895	10.00			10.00		130.00	130.00
7	D	COTTONWOOD INVESTMENT	04 / 01 / 1895	10.00	70.00			10.00	140.00	150.00
13	E	J D SPRING CREEK RANCH	07 / 01 / 1895	10.00		70.00			150.00	150.00

2=MITIGATION START POINT

10=MITIGATION END POINT

D Decreed water rights above magic above Hailey gage

E Decreed water rights above magic below Hailey gage

F Decreed rights above Magic delivered from tributaries

FIGURING GAGE

PRIORITY > 1885 Q-10

PRIORITY < 1885 Q

WATER SHALL BE LEFT IN RIVER FOR USE AS MITIGATION AVAILABLE NATURAL FLOW
AND INCLUDED AS NATURAL RIVER FLOW BELOW STATION
DIVER NO. 36/37. — CFS SHALL NOT BE
CREDITTED TO NATURAL FLOW BELOW DIV # 22.
AND ABOVE # 36/37


BIG WOOD RIVER AT HAILEY ID
DIVERSION DITCH AT HAILEY ID
BIG WOOD SLOUGH AT HAILEY ID
COMBINATION BIG WOOD R/SLOUGH AT HAILEY ID
CROY CREEK NR HAILEY ID
DIV. NO. 34-A FROM ROCKWELL BYPASS CL NR HAILEY ID
DIV. NO. 34-B FRM ROCKWELL BP CL NR BELLEVUE ID
BRADFORD SLOUGH NR BELLEVUE ID
ROCKWELL BYPASS CL AT OUTLET NR BELLEVUE ID
DIV. 36 FROM BRADFORD SLOUGH NR BELLEVUE ID
BIG WOOD R AT U XING ON BRADFORD RD NR HAILEY ID
Hailey
Bradford.

The aquifer is hydraulically connected to the Big Wood River in the reach between Hailey and Bellevue. Transmissive sediments and a high degree of hydraulic connection between ground and surface water would ensure a rapid response between changes in ground water levels.

Drawdown associated with radial flow toward a well would be superimposed on the existing flow system. Even though ground water in the vicinity of the proposed well might flow down-valley, the head response to extraction at the proposed well would radiate outward from the well toward the river. The proposed Woodside School well is approximately 3,800 feet from the river (0.71 miles). Thus, any head changes caused by withdrawals from the Woodside School Well would likely result in changes in flow between the aquifer and the river in the vicinity of Woodside School, and would not propagate large distances down-valley. Thus (1) water users down-valley of the proposed well (e.g., those withdrawing water in or south of the Bellevue area) would be unaffected by the Woodside School withdrawals, and (2) the mitigation plan to leave water undiverted in the Big Wood River is appropriate to mitigate against downstream surface water impacts.

5. Alternative Mitigation

There has been a question regarding whether alternative mitigation might be available closer to the proposed school site. The planning representative for the Blaine County School district (John Gaeddert, Corporation for Land Planning and Engineering) indicates that it would not be feasible to bring surface water for mitigation to a location near the Woodside School site. Even if it were possible, the proposed mitigation (leaving water undiverted in the Big Wood River) would be more effective for maintaining water levels in the Big Wood River than artificial recharge in the Woodside School area.

Summary

In summary, the Woodside School is located in a relatively narrow valley overlying a shallow, unconfined aquifer present in highly-permeable, coarse-grained sediments. The aquifer is hydraulically connected to the Big Wood River; the aquifer discharges to the Big Wood River (i.e., the Big Wood River is a gaining reach) in the section between Hailey and Bellevue (Castelin and Chapman, 1972). Transmissive sediments and a high degree of hydraulic connection between the Big Wood River and underlying aquifers is the basis for the proposed mitigation of ground water use in the school vicinity area. The proposed mitigation (consisting of leaving 0.18 cfs from Snake River Basin Adjudication Claim 37-21114 undiverted in the Big Wood River) will offset any possible adverse effects from proposed Woodside School withdrawals on ground and surface water users downstream of the Bellevue area. This ensures that downstream senior water users are not impacted by Woodside School withdrawals. Analyses of potential drawdown associated with the proposed Woodside School withdrawals suggest minimal, if any, local impact.

The Blaine County School District recognizes that the proposed mitigation water has been cut in the past, and may be cut again in the future. The District proposes to limit irrigation at the Woodside School using well water to those times that water is available to fill Snake River Basin Adjudication Claim 37-21114.

For the reasons outlined above, we believe that the proposed mitigation plan is appropriate. We therefore respectfully request reconsideration of the Application for Permit for the Woodside School and the associated mitigation plan.

In advance, thank you for your review of this matter. Please call me if you have any questions about this letter, or would like additional information.

Sincerely,



Christian R. Petrich, Ph.D., P.E.
Principal Engineer/Hydrologist

CC: Jim Speck, Speck & Aanestad, PC
James E. Stanton, IDWR

References

Castelin, P. and Chapman, S., 1972. Water Resources of the Big Wood River - Silver Creek Area, Blaine County, Idaho, Idaho Department of Water Administration, Water Information Bulletin No. 28.

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Harrington, H. and Bendixsen, S., 1999. Ground Water Management Areas in Idaho - Overview as of 1998, Idaho Department of Water Resources, Boise, ID.

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Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of a well using ground-water storage. Transactions, American Geophysical Union, 16: 519-524.

Project: Woodside School **Date:** 8/29/2004

Purpose: Estimate drawdown at 1/4 mile from proposed diversion increase

Theis Solution for radial flow to a well in a confined system

$$s = \frac{Q}{4\pi T} W(u) \qquad W(u) = \int_u^\infty \left(\frac{e^{-u}}{u} \right) du \qquad u = \frac{r^2 S}{4Tt}$$

Use lookup table for W(u) (e.g., p 93 Aquifer Testing - Istock)

Equation		
K =	200	(ft/day)
b =	200	ft
Q =	12096	cu ft/day
r =	1320	feet
S =	0.15	
t =	197	days
T =	40000	
u =	8.29E-03	
W(u) =	4.29	
s =	0.10	feet

Project: Woodside School **Date:** 8/30/2004

Purpose: Estimate drawdown at 1/4 mile from proposed diversion increase

Radial Flow, equilibrium conditions, unconfined aquifer

$$Kr\frac{\partial^2 h}{\partial r^2}+\frac{K_r\partial h}{r\partial r}+K_v\frac{\partial^2 h}{\partial z^2}=S_s\frac{\partial h}{\partial t}$$

Neuman Solution for radial flow to a well in a confined system

$$h_0-h=\frac{Q}{4\pi T}(u_A,u_B,\Gamma) \qquad u_B=\frac{r^2S_y}{4Tt} \qquad \Gamma=\frac{r^2K_v}{b^2K_h}$$

Use lookup table for W(u) (e.g., Appendix 6, Fetter)

Equation

K_h =	200	(ft/day)
K_v =	200	(ft/day)
b =	200	ft
Q =	12096	cu ft/day
r =	1320	feet
S =	0.15	
t =	197	days
T =	40000	
u_B =	0.008292	
	120.5999	
Tau =	43.56	
$W(u_B, Tau)$ =	4.37E+00	(late time data; use max value of 6.0)
s =	0.11	feet