

MEMORANDUM

To: Garth Taylor
Fr: Bryce Contor
Date: 7 September 2005

Re: Approximate magnitude of externalities

The following estimates of the magnitudes of hydrologic externalities are for illustration purposes. They are prepared as input for your report on economic principles that relate to ground-water banking in the Eastern Snake River Plain Aquifer. They are based on the USGS Regional Aquifer-system Analysis (RASA) reports completed in the 1980s and 1990s for the Snake Plain aquifer, and upon USGS gauging-station records downloaded from the Internet.

The externalities considered are:

1. Negative surface-water externality imposed on Snake River ecosystems from diversion of surface water.
2. Positive externality provided to the aquifer from recharge incidental to surface-water irrigation.
3. Positive externality provided to the aquifer by operation of managed recharge projects.
4. Negative externality imposed on the aquifer by ground-water pumping.
5. Positive externality provided to the aquifer by excess mitigation generated as part of water-right permit or transfer mitigation plans.

Other impacts associated with water use are not considered to be externalities and are not estimated here. For instance, water that is delivered to a senior right is not available for use by a junior right. This is not treated here as an externality but simply as a consequence of the method used to allocate scarce resources.

The five externalities listed are discussed in more detail below:

1. Negative surface-water externality imposed on Snake River ecosystems from diversion of surface water.

Because of significant recycling of return flows and imprecision in return-flow estimates, this is estimated using natural inflows to the Snake River above Milner and discharges past Milner, with net diversions assumed to be the residual. Natural inflows (except as influenced by out-of-basin upstream consumptive use) to the Snake River above Milner are listed in Table 1.

Table 1
 Surface-water Inflows, Snake River above Milner
 1980 - 2000 annual average from
 USGS gauging-station records

Location	Average KAF/yr (thousand acre feet per year)
Heise (Snake River)	5,400
Ashton (Henry's Fork)	1,300
St. Anthony (Teton)	670
Near Blackfoot (Blackfoot R. and Bypass)	200
Near Tyhee (Portneuf)	310
Chester (Falls River)	590
Total Supply	8,400

To these surface water inflows is added an estimate of 1,500 KAF/year of "natural" gains above Milner¹, for a total supply of 9,900 KAF/year. The average discharge past Milner for the same period was 2,700 thousand acre feet per year. The net extraction from the river above Milner, then, is approximately 7,200 acre feet per year (9,900 minus 2,700). This net extraction from the river is an ecological externality to the Snake River.

I have not considered this an externality to non-ecological water uses because functioning mechanisms allow traditional water users to compete for this water, through the rental pool or outright purchase and transfer. Their demand therefore is internalized as part of the opportunity cost considered by right holders in making diversion and water-use decisions.

2. Positive externality provided to the aquifer from recharge incidental to surface-water irrigation.

The potential fates of diverted surface water are:

- a) Consumptive use (evapotranspiration).
- b) Return flows above Milner.
- c) Return flows below Milner.
- d) Recharge to the aquifer.

¹ The value reported here is an estimate of the "natural" or pre-development net gains. Current net gains and losses above Milner are a combination of the natural net gains and losses that would occur, plus additional gains due to surface-water irrigation, less additional losses due to ground-water pumping. Values used in this estimate are summarized in Table A1 at the end of the document.

Consumptive use is estimated from water-use data in RASA 1408-E. Return flows above Milner are implicitly included in the calculation of net extraction from the river discussed above. Return flows below Milner are obtained from RASA 1408-F Appendix A. Recharge to the aquifer is calculated as a residual, as summarized in Table 2.

Table 2
Summary of Recharge Incidental to
Surface-water Irrigation

Water-budget Component	Data Source	Quantity (KAF/yr)
Available supply (net extraction from river)	(this memo)	+7,200
Consumptive Use	RASA 1408-F ²	-1,800
Returns above Milner	(see text)	0
Returns below Milner	RASA 1408-F ³	-710
Net recharge to aquifer (residual, rounded)		4,700

3. Positive externality provided to the aquifer from managed recharge projects.

Current managed recharge activity is nearly non-existent. The potential annual volume of managed recharge can be as much as 1,300 KAF in a good year (John Keyes, comments before Idaho legislative committee, 2004) and can average 170 KAF per year over time (Contor and others, Eastern Snake Plain Aquifer Recharge Scenario, 2005).

4. Negative externality imposed on the aquifer by ground-water pumping.

The RASA 1408-F estimate of net ground-water pumpage (Table 15, page F29) is 1,140 KAF/YR.

5. Positive externality provided to the aquifer by excess mitigation generated as part of water-right permit or transfer mitigation plans.

This externality has not been quantified yet. It is expected that the total volume of water involved will be very small relative to other aquifer budget components. The significance of this externality is that it represents an increase in transaction cost for potential permit or transfer applicants.

² Acreage and ET depths from Table 5, Snake-River only, based on Figure 7.

³ From Appendix A

Summary

The estimated annual volume of these externalities is summarized in Table 3.

Table 3
Summary of Hydrologic Externalities
in the Eastern Snake River Plain

Externality	Positive/Negative	Impact To:	Approximate Magnitude (KAF/year)
Snake-river diversions (net)	Negative	Snake River	7,200
Recharge incidental to surface-water irrigation	Positive	Aquifer	4,700
Managed recharge	Positive	Aquifer	170 ⁴
Excess mitigation	Positive	Aquifer	(small)
Ground-water pumping	Negative	Aquifer	1,140

⁴ This is potential, rather than actual, annual average volume

Table A1
 Estimates of Pre-development
 Snake River Reach Gains
 from RASA 1408-C

Reach	Reference in RASA 1408-C for historical value	Date	Historical Gain(+) or Loss(-), KAF/yr	Current Gain (+) or Loss (-), KAF/yr (RASA 1408-C page C13)
Ashton- Rexburg ⁵	(omitted)		- ?	+ ?
Heise-Shelley	Figure 7	1932-1936	-370	-60
Shelley-Near Blackfoot	page C15	1915-1927	-200	-110
Near Blackfoot- Neeley	Figure 16	1912	+2,000	+1,900
Neeley- Minidoka	page C23	Before American Falls reservoir	+29 to +36	+200
Minidoka- Milner	Figure 26	1910	+50	-110
Sum			< + 1,500	> +1,820

⁵ This reach was not reported in the RASA data. Stearns and Bryan (USGS Water-supply Paper 560, 1925 and Water-supply paper 818, 1939) suggest that water levels in that area were elevated significantly by surface-water irrigation at the turn of the last century. The Ashton-Rexburg reach may have been a loosing reach historically and is assumed to currently be a gaining reach.