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REPORT REGARDING ANNUAL DIVERSION VOLUME FOR IRRIGATION

In Re SRBA
Twin Falls County Civil Case No. 39576
Sub-Case No.: 36-08649

Report to the SRBA District Court

Prepared by the Idaho Department of Water Resources
Karl J. Dreher, Director
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August 1, 1996

REPORT REGARDING ANNUAL DIVERSION VOLUME

The Director of the Idaho Department of Water Resources (IDWR) submits this report regarding annual diversion volume for irrigation in response to the request of the special master, pursuant to Idaho Code §42-1412(4) and the court's Order Requiring Report on Annual Diversion Volume. The following persons assisted in the preparation of the following portions of this report:

David R. Tuthill Jr., Acting Adjudication Bureau Chief, reviewed and verified this Report Regarding Annual Diversion Volume for Irrigation. Mr. Tuthill also reviewed IDWR's Report Regarding Development of Standards for Annual Volume of Irrigation Requirements at the Field Headgate, described below.

Jeff Peppersack, Adjudication Engineer, prepared and verified IDWR's Report Regarding Development of Standards for Annual Volume of Irrigation Requirements at the Field Headgate, which is incorporated by reference herein.

A. DIVERSION RATE VS. DIVERSION VOLUME

The difference between diversion rate and diversion volume is perhaps best conceptualized by the images of a faucet and a bucket. Assume that you turned your garden faucet half open, let it run for one minute, and filled one ten-gallon bucket with water. The diversion rate, or the measure of the flow of water from the faucet, is ten gallons per minute. The diversion volume is the amount of water in the bucket, which is ten gallons. If you wanted twenty gallons of water, you could double the diversion rate, by turning the faucet wide open, and produce the twenty gallons in the same time of one minute. Or, you could keep the same diversion rate, by leaving the faucet turned half open, and double the time you leave the faucet running, producing the twenty gallons in two minutes.

IDWR, as well as the corresponding agencies from other states, use the terms "cubic feet per second" (cfs) and/or "acre feet per year" (afy) to quantify water rights.¹ CFS represents diversion rate, also known as "instantaneous diversion rate." AFY represents annual diversion volume, sometimes simply referred to as "diversion volume" or just "volume."

Both cfs and afy are measurements of the amount of water diverted. They are similar in the sense that both are a unit of volume (cubic foot and acre foot) per unit of time (second and year). Since both are based on a unit of volume, they could both

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See Idaho Code §§ 42-102, 42-1409(1)(c), 42-1411(2)(c).

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be considered volume measurements;² since both are based on a unit of time, they could both be considered measurements of a rate of flow. Measurement in cfs is nonetheless generally considered a measurement of diversion rate, and measurement in afy is nonetheless generally considered a measurement of diversion volume. There are differences in these measures that are significant for both the quantification of water rights and the distribution of water pursuant to those water rights.

Historically, water rights have been quantified in terms of diversion rate (cfs) because, historically, water right development occurred primarily from streams, and water right administration occurred primarily to resolve conflicts over the distribution of water from streams. Since the flow of water in the stream will likely change the next month, week, or day, the flow of water must be divided among the water users based on what is available "at that instant." Although a second is not "instantaneous" for some purposes, it is a sufficiently short period of time to be considered instantaneous for purposes of distribution of water from a public source.

Historically, most water rights have not been quantified in terms of annual diversion volume, because historically, quantification by diversion rate has been sufficient to resolve most conflicts over the distribution of water. Since measurement of annual diversion volume requires measurement over a substantial period of time, effective measurement can generally be accomplished only with the use of continuous recording meters, which require significant financial investment.³ As long as quantification by diversion rate was sufficient to resolve conflicts over the distribution of water, there was no incentive for the investment in the cost and effort required to quantify water rights and distribute water by annual diversion volume.

Annual diversion volume can nonetheless be an important measurement, for several reasons. First, water supply in Idaho is dependent on an annual cycle, in which winter precipitation provides a large share of both surface water flows and ground water recharge. Water demand is also dependent on an annual cycle, since irrigation is the largest consumptive use of water resources.

The need for quantification of water rights by annual diversion volume occurred initially with the development of surface water storage. Generally, surface water

² One acre foot is the volume of water necessary to cover 1 acre of land to a depth of one foot, and equals 43,560 cubic feet.

³ Measurement can be made less effectively with repeated "instantaneous" measurements, which are labor intensive and require assumptions as to the diversion rate between measurements. There are also some methods to estimate annual diversion volume instead of measuring it.



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storage development sought to address the divergence between the annual water supply cycle and the annual water demand cycle. Since water supply was highest in the spring, but demand was highest in mid to late summer, surface water storage allowed the excess spring flows to be held for use later in the year. Quantification by diversion volume was needed to administer storage rights, since the amount of water stored is a volume, like the bucket in the illustration above. Quantification by annual diversion volume is needed since storage of water and its subsequent use is generally based on an annual cycle.

Ground water development has furthered the need to quantify water rights by annual diversion volume. Since ground water exhibits some of the properties of both surface streams (flow) and reservoirs (storage/volume), the modern trend throughout the western states is to quantify ground water rights by both diversion rate (cfs) and annual diversion volume (afy). In addition, increasing competition for water and improvements in the technology available to measure or estimate diversion volume has created greater incentive for the quantification and administration of water rights in terms of annual diversion volume as well as diversion rate.

Diversion rates can be "converted" to diversion volumes by using simple formulas. For example, one cfs of water will produce about 1.984 acre feet of water in 24 hours. Generally, however, the recommended diversion volume for a water right is less than the full volume that can be produced by continuous diversion of the recommended diversion rate throughout the recommended season of use, because most systems are not operated at full capacity all of the time.

For example, household plumbing is designed with a diversion rate sufficiently high that showers, washing machines, sinks, etc. can be used at the same time with reasonable water pressure. Domestic uses, however, do not require the full diversion volume that the domestic diversion rate can produce, because people do not run all their showers, washing machines, sinks, etc. for 24 hours every day. As another example, a lawn sprinkler system is generally designed with a diversion rate sufficient to irrigate the entire lawn in a few hours. If such a system were operated 24 hours a day every day, it would produce a volume far greater than required to adequately water the lawn.

Representative numbers can be used to further illustrate these examples. A typical domestic well is designed to produce a diversion rate of about 18 gallons per minute, or 0.04 cfs. Continuous diversion would produce about 25,920 gallons per day, or about 28.97 af per year. But the average diversion volume required for a typical single-family domestic use (not including lawn and garden) is about 500 gallons per day, or about 0.6 afy. Similarly, continuous diversion of the standard diversion rate of 0.02 cfs per acre for irrigation will produce 9.76 acre feet over an irrigation

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season of March 15 to November 15, while the annual diversion volume generally required for a moderately efficient irrigation system in the warmest and most arid portions of the state is 4.5 afy.⁴

B. QUANTIFICATION OF DIVERSION RATE FOR IRRIGATION

IDWR's recommendation of each right includes a diversion rate in cfs for each purpose of use as well as a total diversion rate, except for certain types of storage, which are quantified only by annual diversion volume in afy.

Water rights acquired under state law are limited to the amount of water beneficially used.⁵ Generally, the diversion rate for a water right is determined by either measuring the actual diversion rate, or by applying standards as to the diversion rate required for a particular type of use, or some combination of both.

A standard maximum diversion rate of 0.02 cfs per acre for irrigation has been set by statute.⁶ Where more than 0.02 cfs per acre is claimed, IDWR will examine conveyance losses between the point of diversion and place of use, the method of irrigation, field conditions, or other factors to determine if a greater amount is actually used and reasonably necessary due to those conditions.⁷

C. QUANTIFICATION OF DIVERSION VOLUME FOR IRRIGATION

As noted above, water rights are limited to the amount of water beneficially used. Generally, the diversion volume for a water right is determined by either measuring the actual diversion volume, or by applying standards as to the diversion volume required for a particular type of use, or some combination of both. As noted above, however, measurement of diversion volume is more difficult than measurement of diversion rate. Generally, there are few water rights (other than storage rights) for which historic diversion volume measurement data are available.

⁴ IDWR's standards for annual diversion volume are further discussed below.

⁵ Idaho Code §§ 42-104, §42-1402.

⁶ Idaho Code §§ 42-202, 42-220.

⁷ Analysis of claims to a diversion rate greater than 0.02 cfs per acre is described in IDWR's Report Regarding Evaluation of Irrigation Diversion Rates, previously filed in Subcase No. 36-00003A and 23 other subcases in Basin 36. IDWR may also recommend less than 0.02 cfs per acre in appropriate circumstances.

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IDWR has developed standards for annual diversion volume for irrigation for the various regions throughout the state based on climatic and other data, which are expressed in afy per acre. To determine the annual diversion volume for a water right or a portion of a water right used for irrigation, the total number of irrigated acres is multiplied by the standard. Where a diversion volume greater than the standard is claimed (or where a diversion rate greater than the 0.02 cfs per acre is recommended) IDWR will examine conveyance losses between the point of diversion and place of use, the method of irrigation, and field conditions to determine if a greater amount is actually used and reasonably necessary due to those conditions.

Described in the most basic terms, IDWR developed its standards for annual volume for irrigation by:

1. Determining the annual volume of water required by the crop in addition to precipitation (consumptive irrigation requirement);
2. Determining the annual volume of water that must be delivered at the place of use (the field headgate requirement) to provide the annual volume of water consumed by the crop (the consumptive irrigation requirement); and
3. Determining the volume of water that must be diverted at the point of diversion (the annual volume of diversion) to deliver the volume required at the place of use (the field headgate requirement).

In step 1, IDWR developed standards for the consumptive irrigation requirement for the most water consumptive crop for the various climatic areas throughout the state. In step 2, IDWR multiplied the consumptive irrigation requirement by an efficiency factor of 70-75%, and rounded that figure to the nearest 0.50 AFY. This standard represents the annual volume of water that must be delivered at the field headgate (the place of use) to meet the consumptive requirement of the crop using a moderately efficient irrigation system. These two steps are more fully described in IDWR's Report Regarding Development of Standards for Annual Volume of Irrigation Requirements at the Field Headgate. In step 3, IDWR assumed that the volume of water diverted at the point of diversion is no greater than the volume of water required at the field headgate; in other words, it is assumed that the conveyance losses between the point of diversion and the place of use are insignificant and are adequately provided for by the 25-30% inefficiency already allowed by the field headgate requirement. Finally, it must again be emphasized, IDWR's standard for diversion volume is much like the statutory standard for diversion rate: it sets a standard that is reasonably attainable by most appropriators, but leaves the appropriator with the opportunity to demonstrate that a greater quantity has actually

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been used and is reasonably necessary due to conveyance losses, method of irrigation, or field conditions.⁸

D. Inclusion of Annual Diversion Volume in the Description of Water Rights

The director has concluded that the quantification of certain classes of water rights by diversion volume is appropriate and necessary to define and administer water rights. In reaching this conclusion, the director relied upon Idaho Code §42-1411(2), which provides for the director's report of water rights acquired under state law to include a determination of the quantity of water used, describing the rate of diversion in cfs and/or the annual volume of diversion in afy as the director deems appropriate to define and administer the water rights,⁹ and Idaho Code §42-102, which provides for the director to devise a simple, uniform system for the measurement and distribution of water.¹⁰

⁸ Analysis of claims to a diversion volume greater than the standard is similar to the analysis for claims to a diversion rate greater than the standard, which is further described in IDWR's Report Regarding Evaluation of Irrigation Diversion Rates, previously filed in Subcase No. 36-00003A and 23 other subcases in Basin 36.

⁹ Idaho Code §42-1411(2) provides: "The director shall determine the following elements, to the extent the director deems appropriate and proper, to define and administer the water rights acquired under state law: ... the quantity of water used describing the rate of water diversion or, in the case of an instream flow right, the rate of water flow in cubic feet per second or annual volume of diversion of water *for use or storage* in acre-feet per year as necessary for the proper administration of the water right;" *Compare* Idaho Code §42-1411(2), prior to the 1994 amendments, which provided: "The director shall determine the following elements with respect to all water rights acquired under state law: ... the quantity of water used in cubic feet per second or the quantity of water stored in acre-feet per year;" *Also compare* Idaho Code §42-1411(2), which provides that IDWR shall determine the quantity of water used to the extent the director deems *appropriate and proper* to define and administer water rights acquired under state law, and Idaho Code §42-1412(6), which provides that the decree shall contain or incorporate a statement of each element of a water right as stated in section 42-1411, as contrasted with language later in section 42-1412 providing for inclusion of general provisions to the extent *necessary* to define and administer water rights.

¹⁰ See also Idaho Code §42-237a(c), which authorizes IDWR to prescribe uniform scientific methods to determine water levels and calculate waters withdrawn from wells. Most sections of the relevant chapters of Title 42 refer to an "amount" or "quantity" of water without specifying how the water is to be quantified (either by diversion rate or annual diversion volume). Idaho Code §42-102 provides that "a cubic foot of water per second of time" shall be the legal standard for the measurement of water in this state"; that section is probably most properly read as establishing that CFS is the proper unit of measurement of diversion rate, as opposed to miner's inches. A miner's inch is a notoriously unreliable standard of measurement; it is deemed to be equivalent to 0.02 cfs in Idaho but is deemed equivalent to other amounts in other states. See TRELEASE, WATER LAW RESOURCE USE AND ENVIRONMENTAL PROTECTION 20-21 (1974)).

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As noted above, the trend in Idaho as well as other western states is to determine and administer water rights (particularly ground water rights) by diversion volume as well as diversion rate.¹¹ This greater specificity in the determination and administration of water rights is the result of a number of factors. First, as noted above, a reasonable diversion rate is capable of producing a diversion volume considerably greater than the diversion volume reasonably required, due to the need for a diversion rate that will produce the required diversion volume in a reasonable time. Thus, the lack of a diversion volume limit creates opportunity for unreasonable waste. Second, increasing development in the western states has produced increasing demands on public water resources, increasing litigation over the rights of competing appropriators, and increasing demand on public agencies and public funds for more stringent regulation of water use. Thus, the lack of a diversion volume limit creates opportunity for disputes as to this parameter of water use. Finally, improvements in technology, both as to the diversion and use of water and as to the measurement and control of water diversion, make the quantification of water rights and the distribution of water by diversion volume more feasible.

At the same time, however, neither Idaho nor the other western states have made a wholesale shift to the determination and administration of water rights based on annual diversion volume. The reason is simple - such a huge task is not justifiable, or even feasible, in the current economic and political environment. Therefore, the effort to quantify water rights and distribute water by diversion volume has been targeted to meet the most immediate needs and to most efficiently use the available resources (both water resources and financial resources).

IDWR's recommendations of water rights appropriated under state law in the SRBA therefore include diversion volumes for the following types of water rights.

1. Storage

Diversion volume *is* generally stated for rights that include storage. As noted in section A above, quantification of diversion volume is appropriate and necessary to define and administer storage rights, since the amount of water stored is a volume, like the bucket in the illustration at the beginning of section A.¹²

¹¹ Indeed, a trend appears to be developing in the western states toward administration of ground water based primarily on annual diversion volume.

¹² There are a few sections in Title 42 which contain specific references to quantification of storage in acre feet, including Idaho Code §42-1411(2) (content of director's reports in adjudications), 42-202 (applications for permits), and 42-220 (fees for applications).

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2. Ground water, other than small D&S

Diversion volume *is* generally stated for rights to groundwater, subject to one exception further described below. As noted in section A above, quantification of diversion volume is appropriate and necessary to define and administer rights to ground water, because ground water exhibits some of the properties of both surface streams (flow) and reservoirs (storage/volume). Irrigation is by far the dominant use of ground water; and most ground water irrigation rights are diverted and applied through moderately efficient closed pipe and sprinkler systems. Quantification of diversion volume for these rights can therefore be fairly readily accomplished through the adoption of standards as previously described, and measurement or estimation of actual volume of diversion for purposes of distribution of water can also be more readily accomplished.

The exception is that diversion volume is generally *not* stated for small domestic and stockwater rights *unless* the diversion volume was previously determined in a decree, license, or administrative order approving a change in use. IDWR generally does not determine diversion volumes on small D&S rights where diversion volume has not been previously determined in an administrative or judicial proceeding because it is not reasonably necessary for the distribution of water in accordance with water rights. Since the individual and cumulative impact of such water rights is minimal in comparison to the total water supply, the limited resources available for the regulation of water rights is appropriately spent on the water rights that place substantial demands on the public waters of the state or give rise to disputes among water users.¹³

3. Not surface water, with some exceptions

Diversion volume is generally *not* stated for rights to water from surface sources, *unless* a) the use is for storage, as noted above, b) diversion volume was previously determined by a decree, license, or order approving an application for change in use, or c) a diversion volume limit is necessary to prevent injury from an accomplished transfer.

¹³ IDWR's recommendations of small domestic and stockwater rights does include a further description of the use, including type and number of head for stock and number of households for domestic, as a more cost-effective alternative to determining diversion volume. Basin Wide Issue 12, as to the elements of small stockwater rights, is currently pending before Special Master Haemmerle. The likely outcome of Basin Wide Issue 12 is that this further description of the use will be omitted and the right will include a "cap" on diversion volume of 13,000 gallons per day.

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Diversion volume is generally not stated for rights to water from surface sources, except in those instances noted above. Due to the greater variation in surface water diversion and application methods, the quantification and administration of all surface water rights based on diversion volume is more difficult and costly than for ground water rights. The determination of diversion volume for all surface water rights is therefore not sufficiently cost-effective to be appropriate or necessary at this time. Determination of diversion volume for surface water rights is therefore limited to those exceptions, noted above, where determination of diversion volume is appropriate and necessary.

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State of Idaho)
) ss.
County of ADA)

David R. Tuthill, Jr., being first duly sworn, upon oath, deposes and says:

That I am the Acting Adjudication Bureau Chief for IDWR, and that I have read the foregoing report, know its contents, and that the statements contained therein are true to the best of my knowledge and belief.


DAVID R. TUTHILL, JR.
Adjudication Bureau Chief

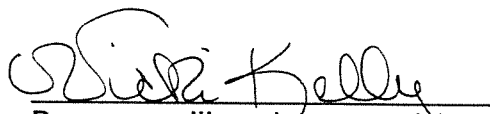
Subscribed and sworn to before me this 1st day of August, 1996.


Notary Public for Idaho
Residing at:
My commission expires:

Certificate of Mailing

I certify that on the 1st day of August, 1996, I mailed copies of the foregoing document, including all attachments, with sufficient first class postage, to the following:

Ray and Alice McCord
Route 1
Wendell, ID 83355


Person mailing document(s)