PRINCIPIA

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RE: Application of a Trim Line to the Snake River Farm Call and the applicability of the proposed mitigation alternatives to satisfying the water flow shortfalls at Snake River Farms

Dear Mr Simpson

I was requested by Clear Springs Foods, Inc to assess the application of the Idaho Department of Water Resources (IDWR) declared trim-line to identifying and mitigating injury to water rights and in particular the water rights associated with Snake River Farms. The report containing my conclusions is attached. Please do not hesitate to contact us if you have any questions.

Yours Sincerely
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Application of a Trim Line to the Snake River Farm Call and the applicability of the proposed mitigation alternatives to satisfying the water flow shortfalls at Snake River Farms

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Introduction

I was requested by Clear Springs Foods, Inc to assess the application of the Idaho Department of Water Resources (IDWR) declared trim-line to identifying and mitigating injury to water rights and in particular the water rights associated with Snake River Farms. The use of a so-called trim line applied by the IDWR in the context of excluding some junior water right holders from curtailment for the benefit of senior spring users is inappropriate at several levels. The implications of such action, is that pumping by these excluded junior right holders does not impact the spring flows. The Eastern Snake Plain Groundwater Model and basic hydrology prove otherwise. While the concept of a zone of exclusion is not novel, the application of a trim-line in this instance is inappropriate as the justification is invalid.

First, the uncertainty in the ability of the model to predict the impact of a particular well on a particular spring is very weakly correlated with the accepted 10% accuracy of stream gages. The actual model uncertainty in this quantity can only be determined through a laborious uncertainty analysis. This has not been done and therefore the actual model uncertainty is not known.

Second, even if the model uncertainty were known, it is inappropriate to simply a priori exclude all junior appropriators that have impacts less than the uncertainty on a percentage basis. The uncertainty does not reflect ***whether*** the junior appropriator is impacting the senior, but ***by how much***. Furthermore, if the uncertainty were known to be 10%, and the model predicts that the impact of a particular junior appropriator is 5%, that means that the impact is between 4.5% and 5.5%, and ***not*** that the impact is between -5% and 15%.

Third, it is simple to construct a scenario where a large junior water right or group of junior water rights can completely eliminate a senior water right yet be excluded under this approach. For example, a senior water right may be 10 cfs, and a group of junior water rights is 200 cfs. If the junior water rights impact the senior by 5%, and they are the only impact on the senior right, then their collective impact on the senior water right is 10 cfs, in other words the senior water right goes to zero. However, if the trim line is established at the 10% level, then the senior has no recourse under this approach.

The Concept of a Zone of Non-Influence

The concept of a zone of influence and its complement, a zone that does not influence a particular flow is not a new idea. For example, the State of Colorado defines tributary and non-tributary zones in an aquifer with respect to streams. It is presumed that, for example, well pumping in a non-tributary zone in the aquifer will have a minimal impact on stream flows, and therefore not be injurious to senior water rights.

In order to be classified as non-tributary in Colorado, the impact of a well cannot exceed one tenth of one percent of the amount of production within one hundred years. Therefore, for example, a well producing 200 acre-feet per year cannot cause a reduction of more that 0.2 acre-feet per year (about 0.00028 cfs) total on surface streams. This standard is stringent, however, it was likely adopted because of the recognition that, even though the impact from a single well is relatively insignificant, the cumulative impact on a surface stream from multiple wells is significant.

When a basin is fully appropriated during the majority of the period of use, the impact of a new well is readily established since any reduction in stream flow will be injurious to some senior surface water right. However, in order to allow for the practical administration of water rights as well as maximum utilization of the natural resources, it is typical for states to establish a minimum impact requirement such as the Colorado non-tributary test. Any new withdrawal of water will have a non-zero impact on streams. Simple mathematical tools such as the Glover Equation[1] have been applied for many decades to determine the impact of wells on streams. When, for example, the Glover Equation is applied to a well located hundreds of miles from a stream, the mathematical solution may indicate that after 100 years a well producing 200 acre-feet per year has an impact on the stream of say a gallon per day, or about a millionth of a cfs. In principle, that well is injuring a senior water right, but under the Colorado definition, the well would be considered non-tributary because the impact is so small.

Implicit in the concept of a zone of exclusion is the principle that new water rights can be granted in that zone, and that the collective impact of all these new water rights would be negligible on senior water rights. This in essence means that such a zone would be sufficiently isolated from any streams where senior rights exist that the collective impact of all new rights granted in that zone will not impact senior water rights anywhere else.

The trim line concept, as applied by the IDWR, differs from the non-tributary concept described above in two important aspects. First, the percentage of impact to production applied was not based on an argument that the collective impact of these producers on the senior water rights were minimal. Second, the impacts were limited to specific senior water rights, instead of considering potential injury to all senior water rights as would be required by the Prior Appropriation doctrine. The ESPA ground water curtailment scenario addresses the cumulative or collective effect on all spring flows and thus on all senior water rights.

Therefore, while in concept a zone of exclusion might be appropriate, the application of an exclusionary zone in the form of a trim-line in this instance by IDWR is inappropriate for the reasons described below.

Model Uncertainty and a Trim Line

The trim line established by IDWR was based on an argument that East Snake Plain Aquifer Model (ESPAM) predictions are only accurate to within 10% because the model is calibrated in part to stream

[1] The Glover Equation is an analytical method for determining the impact of wells on streams developed by Robert Glover of the United States Geologic Survey and first published in Water Supply Paper 1583 *Ground Water in Fountain and Jimmy Camp Valleys, El Paso County, Colorado* by Edward D. Jenkins and Robert E. Glover, 1964. For a detailed discussion of the method see *Transient Ground Water Hydraulics* by Robert E Glover, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado, 1974.

gages that are only accurate to 10%. This argument fails for several reasons.

First, consider a model that can be rigorously determined to have an uncertainty in the prediction of spring flow of 10%. Now consider a well which is demonstrated by applying the model to have an impact on that spring of 8% of the pumping in that well. Since the model has an inherent uncertainty of 10%, the uncertainty associated with the determination of 8% impact uncertain by 10%, so the impact falls in the range of 7.2% to 8.8%. So if the well pumped 1,000 acre-feet per year, an 8% depletion would be 0.11 cfs. The uncertainty associated with that prediction, however is 10%, so the true depletion is between 0.10 cfs and 0.12 cfs.

The 10% clip line established by the IDWR would argue that since the model uncertainty is 10% and the impact of this well is 8%, that the model cannot determine the impact of the well. That is incorrect. The correct view is simply that instead of being 8%, the depletion from that well is between 7.2% and 8.8%. However, there is no escaping the conclusion that this well does have an impact on that senior water right.

Consider the example where the model can be demonstrated to be accurate to only 50%. Following the IDWR logic, a well could be injuring a senior water right by up to 50% of its production yet be excluded from being required to mitigate that injury. So a well pumping 1,000 acre-feet per year can deplete that senior right by 0.69 cfs with impunity. In reality, we may simply know that the senior right is injured by between 0.35 and 1.0, however it is incorrect that since we can only determine the rate of depletion to within 50% that all impacts less than 50% are automatically excluded.

Second, the IDWR trim line uses the accuracy of stream gages to arrive at the 10% value associated with the model uncertainty. This is incorrect for several reasons. First, the model is calibrated to water levels measured in the aquifer, stream gains and spring flows. Stream gains were derived from differences between gages, where gage errors can accumulate or cancel in ways that have little to do with the inherent absolute gage error. Therefore, asserting that the model is accurate to within 10% because gages are accurate to within 10% is a giant and unsubstantiated leap and cannot be justified. The ESPAM model was calibrated to several different targets and not just reach-gains. Ground water levels, which have a likely accuracy of 1% or 2% were also used as targets for calibration.

The true accuracy of the model is difficult to quantify. Doing so based on the accuracy of measurements used to calibrate the model would require translating accuracy in water level measurements and similar calibration data into the accuracy in model prediction. The model also does not calibrate perfectly, and additional uncertainty is introduced by mismatches between model predictions and observations. Furthermore, the ability of the model to predict the absolute flow at a specific location, does not necessarily equate to an ability to predict the change in flow at that location given the application of a new stress.

The accuracy of the model is also not uniform. The model may be accurate to 1% in one location and only accurate to 50% in another location. Similarly, the model may be able to predict flows with great accuracy but water levels less so. At issue here is specifically the ability of the model to predict spring flows, and more specifically changes to spring flows as a result of well pumping, which is poorly informed by the accuracy of the stream gages. The relative responsibility of any one well on the depletions in spring flows at any one spring at a particular time cannot be predicted with the relative certainty being offered by the mitigation plan. What one can conclude is that the junior wells in the ESPA do in fact contribute to the depletions and hence injury to the springs at Snake River Farms.

In short, the ability of the ESPAM model to predict the response in spring flows to well pumping has not been determined quantitatively, and the 10% value has no scientific justification. Therefore, the appropriate application of the model is to utilize the model results without any unjustified qualifier, such as the trim-line.

Trim Line and Remedy

Part of the justification of the trim line is based on the presumption that the only remedy for injury is curtailment. Therefore, if a well is injuring a spring flow by only 5% of the production of the well, then it is unfair to curtail that well for such a small benefit to the spring.

When, for example, groundwater produced from a well is determined to be tributary to a stream, production in that well is not automatically prohibited. Depletions from that well simply need to be mitigated in time, place and amount such that senior surface water rights are not being injured. If the stream is not fully appropriated, that is all senior rights are being fully filled and there is a so-called free river, then the well can pump in priority. If, on the other hand, there are insufficient surface flows to satisfy the senior rights, the well owner is only obligated to mitigate his depletions.

Based upon my working understanding of the prior appropriation doctrine, a new water right can be allowed as long as the new water right owner demonstrates that should there not be a free river, he can provide sufficient replacement flows to prevent injury to a senior water right. Absent such a demonstration, the water right could not be allowed. Furthermore, if the water right owner fails to meet his obligations to provide replacement water, he would be in violation of the conditions of his water right, and would therefore not be allowed to continue exercising that water right.

The trim line as established by the IDWR, on the other hand, excludes some water right owners from any obligations to senior water rights holders based on the premise that the only possible remedy is for those water rights owners to stop exercising their right. In reality, this is the ultimate sanction that should be imposed only if the water right holder fails to mitigate injury to senior rights. Curtailment, therefore, should not be the first consideration, but rather the ultimate sanction should the water rights holder fail to meet his obligations.

The determination of non-influence should therefore be set such that only those water rights which collectively will have an infinitesimal impact on senior rights are excluded from having any obligation towards the senior rights. Where junior water rights only have to provide a small amount of mitigation flows to senior water rights, the burden on individual junior rights is small, yet the collective impact on the senior may be quite significant if there are a large number of junior rights.

Estimating Impacts of Junior Wells on Springs

Given the task of estimating the impact of specific junior wells on springs, there are a number of options available. The simplest option is to use analytical methods such as the Glover method to estimate the impacts based on average aquifer transmissivity, specific yield and geometry. Alternatively, a more sophisticated method may be used, such as using the ESPAM model. Since the ESPAM Version 1.1 model is to all intents and purposes a linear model, the model can be used in superposition mode to estimate changes in spring flows as a result of changes in groundwater pumping. In fact, this is how IDWR applied the ESPAM model to determine the impacts of wells on springs.

In order to estimate the impacts, it is necessary to determine the time, place and amount of the impacts. The ESPAM as applied by the IDWR considers the impacts in steady state. This removes the temporal component and considers the impacts in a time-independent fashion. Furthermore, the ESPAM 1.1 model in superposition mode enforces conservation of mass through reach gains. This means that any change in well pumping must show up as a change in sprinDefaultg flow or change in stream flow somewhere on the Snake River. Therefore the amount of pumping will exactly equal the change in spring or stream flow.

The only remaining variable is the location. The ESPAM predicts changes in stream and spring flows at a scale of one mile grid cells. However, there is widespread agreement that the model predictions at that scale are not sufficiently accurate to be used for estimating well to spring impacts. Therefore, the model in its current form (ESPAM 1.1) can only be used to predict changes to spring reaches such as from Devils Washbowl to Buhl, or Buhl to Thousand Springs, etc. Some other technique must therefore be used translate these spring reach impacts to an individual spring.

It is important to note, however, that the accuracy of this specific application of the model has little correlation to the accuracy of stream gages on which the 10% trim line is based. Having eliminated time and amount from the equation, the model is simply being used to determine which spring or stream reach the wells are impacting. Given that the spring reaches are quite large, it is likely that the model is able to predict the relative impacts between spring reaches with considerably better accuracy than just 10%.

END