Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

February 27, 2009

Mr. Jim Ruby
Executive Secretary
Wyoming Environmental Quality Council
Herschler Bldg. – 2W
Cheyenne, WY 82002

RE: Questions from Consultants

Dear Mr. Ruby:

The purpose of this letter is to respond to the questions that you forwarded to the Water Quality Division from Jan Hendrickx. I would appreciate it if you would convey a copy of this letter to Mr. Hendrickx along with our offer to answer any additional questions that he might have.

General Background

The water quality standard for the protection of irrigation uses in Wyoming is to maintain water quality in surface waters to the degree that there will be no decrease in crop production. This standard is not in question in the current rule making. The intent of the proposed rule is to provide the process for establishing effluent limits on permitted discharges that will achieve that standard.

There are a few important concepts that need to be stated in order to understand the procedures that have been developed:

- A "surface water" is not necessarily a flowing stream but is rather any defined drainage with perennial, intermittent or ephemeral flows. In most cases in Wyoming, discharges are to non-perennial streams;
- The irrigation standard of "no measureable decrease in crop production" implies that there is a pre-existing irrigation use. It is a standard that applies to decreases in production that may be attributed to water quality.
- The "no measurable decrease" standard applies to the in-stream water quality. The proposed procedure applies to the end-of-pipe discharge quality. These do not need to be the same because water quality changes from where it is discharged to where it is applied for irrigation.
- The intent of the proposed rule is to develop effluent limits for EC and SAR on discharges that will reach and potentially affect:

A. Artificially irrigated lands – lands that have been conventionally irrigated, i.e. where there is a water right and a point of diversion for that water right (canals, ditches, pumps sprinklers, spreader dikes etc.); and

B. Naturally irrigated lands – naturally occurring floodplains and bottomlands along stream channels where there exists a significant amount of enhanced forage production that may be negatively affected by the produced water discharges even though there may not be an irrigation water right or point of diversion.

Questions:

1. Assume that you know exactly the EC and SAR value of the historical water in the drainages, how is Tier II implemented using these numbers?

Historic water quality information on intermittent and ephemeral drainages is not usually available and the great majority of our permit applications are for discharges to such non-perennial drainages. When data on such waters are available, they are extremely variable due to the "flashy" nature of the flow events. For example, water quality at the beginning of a flow event is much different from water quality at the end of the event.

It is because we do not have reliable in-stream water quality data for our non-perennial waters that we have developed the approach described in the proposed rule. It is our position that using soil quality information from the lands to be impacted by the discharges allows us to judge the historic situation for those soils. With that information we can then set permit effluent limits for discharge waters which could be applied to those soils.

On discharges to perennial waters where we are more likely to have decent historical water quality data, the idea is to match the effluent water EC with the historic background EC. In all circumstances, background water quality will be variable and we would set effluent limits based upon the average EC. The SAR limits would not be based upon background SAR but would be calculated to a level that would result in no reduction in infiltration. This calculation would use the background EC to derive an appropriate SAR based upon the EC/SAR relationship developed by Ayers and Westcott and referred to in the proposed rule as the "Hanson Diagram"

2. Assume that you also know exactly the temporal variability of the EC and SAR values of the historical water in the drainages, how is Tier II implemented? Will the threshold value be the average, the minimum, or the maximum of these values?

Again, since the great majority of permitting circumstances occur in ephemeral drainages, historical water data is not available and it is not possible to quantify the variability of infrequent storm flows. Also, in answering this question, we have interpreted "temporal variability" to mean seasonal variability rather than day-to-day or hour-to-hour variability.

In the less common circumstances where a discharge is to a perennial stream that is diverted in a conventional sense for irrigation, the effluent limits may be derived using irrigation-season background values and applied during the growing season. The EC effluent limit in the discharge permit would be derived from the average historic EC of the irrigation water within the drainage using a straight mean of the available EC data (generally from USGS stations).

If it is a passive type of irrigation diversion such as a spreader dike in an ephemeral drainage, the effluent limits would be applied year-round since the water would be applied to the land whenever it was discharged, not just during an irrigation season. These are the most common circumstances encountered in Wyoming and measured surface water quality data is always scarce or unavailable. In these situations, soil sampling may then be employed within the drainage in order to estimate the historic EC of the applied water. In soil sampling, we also look for an average EC, but because there is an added spatial variable in the sampling, WDEQ tests the straight mean of the sample set with a 95% confidence interval. The lower bound of that 95% confidence interval is the value that is then divided by 1.5, to yield a final EC effluent limit for the discharge.

> Example: Tier 2 EC effluent limit calculated from soil samples collected within an ephemeral irrigated drainage (Bitter Creek; Campbell County, WY); Data Attached.
>
> Total Soil Samples Analyzed (n): 28
>
> Observed Average EC of Sample Set (straight average): 5397 µmhos/cm
>
> 95% Confidence Interval of the Observed Average: 1019 µmhos/cm
>
> Adjusted Average (Observed Average minus 95% Confidence Interval): 4378 µmhos/cm
>
> Discharge Effluent Limit (Adjusted Average ÷ 1.5): 2919 µmhos/cm

Therefore, average values are used whether we have established limits based upon measured water data (perennial streams) or estimated from soil sampling (ephemeral streams) when implementing the Tier 2 procedure.

3. *If one cannot determine the EC and SAR value of the historical water in the drainages, what will happen? Go to Tier III?*

No, by default we calculate the effluent limits using Tier 1. If the discharger does not believe he can meet the Tier 1 limits with his raw untreated effluent, he can choose to provide whatever water treatment is necessary to meet the Tier 1 standards, or he can choose to proceed with a Tier 2 analysis. Tier 3 may also be an option but it is more site-specific and requires an agreement between the discharger and each irrigator that may be affected by the discharge.

4. *Is Tier I as simple as: (1) Check if SAR is less than 10, if yes proceed without restriction. If no, go to (2) Check if EC and SAR are below the Hanson line. If yes, proceed without restrictions. If no, go to Tier II.*

No. Tier 1 uses published soil salinity threshold values for the affected crops to establish the effluent EC limit. The soil salinity threshold (EC_e) is divided by 1.5 to get the EC water value (EC_w) that would be used as the effluent limit. The only information that is needed to establish the Tier 1 limit is an identification of where the irrigation is occurring *(natural or artificial)* and the species of crop. Tier 1 would limit the EC to be no greater than the 100% yield threshold value for the most salt sensitive crop and would limit the SAR to be below the Hanson line up to a maximum of 10.

For example, if alfalfa is the most salt sensitive crop grown in a drainage, the Tier 1 limits effluent for EC and SAR would be calculated as follows:

> The USDA threshold value for alfalfa (EC_e) = 2000 µmhos/cm
> The calculated effluent limit (EC_w) would be 2000/1.5 = 1333 µmhos/cm (1.333 dS/M)
> The maximum SAR would be (1.333 dS/M X 6.67)-3.33 = 5.6 *(rounded to 6)*

In the simplest application of a direct discharge of produced water to this drainage, the discharger would be limited to a maximum EC of 1330 μmhos/cm and an SAR of 6.

It is also important to note that the derived SAR value is based upon the actual EC of the discharge rather than the maximum allowed value. Produced water that is better than the threshold EC plant value would have a more stringent SAR limit.

If the actual quality of the produced water was 1000 μmhos/cm, the SAR limit would be calculated using 1.0 dS/M resulting in an SAR limit of 3.

At this point the discharger must decide whether to install whatever treatment is necessary to meet the Tier 1 limits or proceed on with a Tier 2 study which usually results in less stringent effluent limits.

5. When is Tier III invoked? Is it the default for Tier II only? Or, can any producer and land owner come to a mutual agreement that is worked out in a Tier III procedure?

The idea behind Tier 3 is that under proper management (i.e. flood event timing, duration, volume; fields selected for application; the application of soil amendments: gypsum, sulfur) it is possible to use water that is of a lower quality than background for irrigation and not suffer a loss of productivity. It is not a default for Tier 2. It can be invoked whenever a landowner chooses to accept the increased risks associated with irrigating with water that is a lower quality than background and we are assured there will be no damage to adjacent or downstream water users.

6. Is there no state oversight for Tier III? In other words, could a land owner follow Tier III to sacrifice his land quality to make it available for release of low quality produced waters?

The proposed rules apply only if the discharger releases water to the drainage. If an operator applies wastewater directly from his operation onto the land, that becomes a "Land Application Disposal Facility" and is regulated by the agency through another set of rules. In that situation we are primarily concerned with the protection of groundwater and assuring that there is no runoff to adjacent property.

If the water is released into the drainage and a downstream landowner wants to use the water under Tier III, there is oversight of the limits that would be approved as Tier III limits. Some judgment has to be exercised by the DEQ in establishing Tier III limits on a discharge permit. A primary consideration would be whether the water would be actually applied for a beneficial agronomic purpose or whether, as the question asks, is it simply a means of water disposal? There would be a burden placed upon the permit applicant to demonstrate that the circumstances of the use of the lower quality water would not cause harm to ground water or adjacent or downstream landowners.

7. When a producer has Tier I water quality, can the landowner refuse release of this water in the landowner's drainage?

No, landowner concurrence is only required when water quality is worse than Tier 1 or Tier 2.

8. Is there any mention of the quantity of produced water that can be released in a drainage? Maybe the discharge of produced water (cubic feet per second) is always less than the discharge of the drainage. But what on an annual basis (cubic feet per year)?

There are provisions in the permitting program that address the quantity of water that can be discharged but quantity is not a subject of this part of the regulation. This section is concerned only with establishing water quality limits. Water quantity is addressed by an "Assimilative Capacity" program that limits the total load of pollutant that can be added to a particular river system. The quantity and rate of discharge is also limited to an amount that would not result in unacceptable erosion.

With regard to the request for any additional guidelines for Tier 1, 2, and 3 and how the state works through them, it should be noted that the current rule being proposed consists of what has been our implementation policy for many years. This policy is now being considered for adoption as a rule. Essentially there are no additional guidance documents outside this implementation policy which is now being proposed as a rule.

Sincerely,

John F. Wagner
Administrator

JFW/rm/9-0160

cc: John Corra, DEQ Director
David Waterstreet, WQD Cheyenne
Bill DiRienzo, WQD Cheyenne
Jason Thomas, WQD Cheyenne

Attachment 1:

Bitter Creek Soils Data:

		Soil Depth (inches)		
Sampler / Date	Sample Location	Upper	Lower	EC (µmhos/cm)
SWCA / August 2007	Odekoven Flood-Irrigated	0	12	488
		12	24	446
		24	36	1664
		36	48	1940
		48	60	1902
		60	72	1936
SWCA / August 2007	Odekoven Sub-Irrigated	0	12	390
		12	24	3000
		24	36	8010
		36	48	7060
		48	60	6090
		60	72	6540
SWCA / June 2007	Crockett Section 36 (Field 3, Zone 1)	0	12	3050
		12	24	5630
		24	36	4780
		36	48	5300
KC Harvey / Dec 2007	Crockett Section 26 (Field 7)	0	12	1350
		12	24	6380
		24	36	8920
		36	48	8870
		48	60	7820
		60	72	7510
KC Harvey / Dec 2007	Crockett Sections 23 + 26 (Field 6)	0	12	7540
		12	24	11800
		24	36	10700
		36	48	7600
		48	60	8300
		60	72	6110

Observed Average	**5397**
AVEDEV	**2752**

Effluent Limit Calcs

0.05	=1 - 0.95
2752	AveDev
28	Sample Pop (n)
1019	95% Conf Int

4378 Adjusted Avg: (Observed Average minus conf interval)

2919 Calculated EC Limit: (Adjusted average / 1.5)